

FOREWORD

Association of Agricultural Technology in Southeast Asia (AATSEA) has been organized International Conference on Integration of Science and Technology for Sustainable Development (ICIST) since 2011 which starting from Thailand to Laos, Vietnam, Myanmar, Philippines and this time is being in Indonesia. The ICIST 2018 Organizing Committee welcome all participants to the seventh International Conference on Integration of Science and Technology for Sustainable Development 2018 (7th ICIST 2018) held at The Patra Bali Resort and Villas, Bali, Indonesia during November 26-29, 2018. AATSEA will provide the opportunity to discuss the recent advances and progress development in science and technology with the theme “Water conservation, Biological Diversity, Food Safety and Agriculture”. The theme of the conference is aptly chosen to address the current needs for academic, research and farm demands for further development and improvement.

The integration of various topics in science and technology in agriculture is needed to build up the sustainable development of human being. As being a resource of knowledge, AATSEA realizes that it is responsibility to serve the community by providing education, research and development in science and technology, particularly in the multi-disciplinary aspects. Accordingly, this conference is targeted to initiate an international network among academic members, researchers, scientists and interesting peoples in science and technology. It is aimed to a venue for knowledge exchange and discussion among those seeking for new vision and insight in all topics related. For the technical point of view, the conference will explore various topics as following oral sessions: Organic Agriculture and Related Fields, Plant and Food Technology, Microbial Biotechnology, Biodiversity, Taxonomy, Biological Activity, Animal and Fishery Sciences, Environmental Science, Soil and Water Conservation, Socio Economic, Community Development and Agricultural Development. Poster Sessions will be demonstrated as follows:- Plant Sciences and Soil Management, Microbial Biotechnology and Plant Protection, Animal, Fishery Science and Entomology, Environment, Toxicology, Socio Economic, Community Development and Agricultural Development

This year, there will be 12 plenary speakers, 159 oral and 60 poster presentations and attendants all together is about 300 participants who coming from 21 countries. ICIST 2018 are organized by Association of Agricultural Technology in Southeast Asia (AATSEA), Bengkulu University (Indonesia), King Mongkut's Institute of Technology Ladkrabang (KMUTL, Thailand), Rajamangala University of Technology Tawan-ok (RMUTTO), Chantaburi Campus, (Thailand), Rambhai Barni Rajabhat University (RBRU, Thailand), ATQ, Tuem, Hanoi (Vietnam), CGC organic coffee, Pakse, Champasack (Laos), Society of Applied Biotechnology (India), Foundation of Environmental Education (Thailand), Mahasarakam University, Thailand, CAS Asian Agricultural Bio Engineering Co. Ltd (China), University of Warmadewa, (Indonesia), Inofarming, (Myanmar)

Academicians, researchers, policy makers as well as extension experts contributed their expertise, experiences and research results to this conference. May the book of abstracts of this conference provide useful information and serve as references for those who are interested in the specific discipline. The selected full texts will be peer reviewed by Editorial board of International Journal of Agricultural Technology (IJAT) and external reviewers which will be online published in special issue of scopus indexed IJAT, December 2018, website: www.ijat-aatsea.com

Editors

OPENING REMARKS

- I am honoured, on behalf of all of us, to thank the whole Organizing Committee for providing us the great opportunity to have this meeting in this amazingly beautiful country - a dream place of any tourist.
- Special thanks belong to Prof. Kasem Soytung for his long-term unique efforts. Thanks for his endless energy.
- NEXT I would like to contemplate briefly about the position of the ICIST conferences in this world.

Human mankind, meaning all of us, is in a very new situation or phase; it never existed in the history:

- People are globally close to each other through communication systems and even physically (I flew here in one day from 15 thousand kms)
- Average standard of living is higher than ever (most people afford to have TV, internet, smart phones etc.)
- Our knowledge has penetrated into depths which were not even imaginable yet, say, only 20-30 years ago.
- BUT these positive facts are strongly opposed by many well-recognized threats for the future. We all know them even too well, and they are not necessary to be repeated

THAT MEANS: We have new capacities and resources but also extremely demanding challenges.

- Scientists have found out almost impossible facts about the universe during 2-300 years. We have placed our small planet in the universum and are even dreaming going to other planets.
- However, more importantly, we should also position ourselves into our factual surrounding, to our own ecological box in this planet. It is extremely complex and manysided task. It will require our all capabilities. Seems that there are no other tools than scientific ones to find out right ways to manage.
- Science is not a religion, it is critical method how to test what is probably true or not. Sometimes it is very effective, sometimes it does not bend to the question (like paradoxes).

All seriously thinking people understand the danger what lies in our future. Wise people try to act. All are confused.

- Following of the world news have made people to lose their trust to politicians. Unfortunately, they are also only humans - possibly not even in the first rank. We desire that politicians (or president, king, dictator) could solve our problems. But the international News to every single home let us think that they may not solve even their own problems.
- It follows that some individuals try to take their own power to decide what is right and wrong. Seeing the inequality and other bitter world realities causes frustrations and aggressions.
- Violence is poor reaction to all that - as confirmed by examples from various countries.

How this all is related to ICIST conferences?

- The main theme in the ICIST conferences has been saving our planet by promoting sustainable approaches in agriculture and other spheres.
- It is possible to see here in this part of the world high motivation to make sustainable decisions.

- In spite of different cultures and religions, here, in many different countries, cooperation is possible without strong confrontations. You may thank for that for your old cultural history

An individual person may have a feeling that it is impossible to change the world.

- It is evident that in practise a person can ONLY make his/her best believing that every sincere good deed or even a thought is a small step forward to a better world.
- In fact, this way of living is fantastic. It is advised in all religions: to make good not expecting price. Make good to all lifeforms and for the future.
- But if we have millions or even billions?
- I wish great success to this unique and import conference. It will bring us a little closer to a better world. THAN YOU!

Chairman of International Advisory Committee

Timo Korpela

OPENING REMARKS

The honorable Prof. Timo Korpela, the Chairman of International Advisory Committee

The honorable Prof. Kasem Soyong, The President of AATSEA

The honorable Dr. Ridwan Nurazi, Rector University of Bengkulu

The honorable Prof. Dewa Putu Widjana, Rector Warmadewa University

Respected Ladies and Gentleman 7th ICIST participants

Association of Agricultural Technology in Southeast Asia (AATSEA) has been organized International Conference on Integration of Science and Technology for Sustainable Development (ICIST) since 2011 which starting from Thailand to Laos, Vietnam, Myanmar, Philippines and this time is being in Indonesia. The ICIST 2018 Organizing Committee welcome all participants to the seventh International Conference on Integration of Science and Technology for Sustainable Development 2018 (7th ICIST 2018) held at The Patra Bali Resort and Villas, Bali, Indonesia during November 26-29, 2018. AATSEA will provide the opportunity to discuss the recent advances and progress development in science and technology with the theme “Water conservation, Biological Diversity, Food Safety and Agriculture”. The theme of the conference is aptly chosen to address the current needs for academic, research and farm demands for further development and improvisation. The integration of various topics in science and technology in agriculture is needed to build up the sustainable development of human being. As being a resource of knowledge, AATSEA realizes that it is responsibility to serve the community by providing education, research and development in science and technology, particularly in the multi-disciplinary aspects. Accordingly, this conference is targeted to initiate an international network among academic members, researchers, scientists and interesting peoples in science and technology. It is aimed to a venue for knowledge exchange and discussion among those seeking for new vision and insight in all topics related. For the technical point of view, the conference will explore various topics as following oral sessions: Organic Agriculture and Related Fields, Plant and Food Technology, Microbial Biotechnology, Biodiversity, Taxonomy, Biological Activity, Animal and Fishery Sciences, Environmental Science, Soil and Water Conservation, Socio Economic, Community Development and Agricultural Development. Poster Sessions will be demonstrated as follows:- Plant Sciences and Soil Management, Microbial Biotechnology and Plant Protection, Animal, Fishery Science and Entomology, Environment, Toxicology, Socio Economic, Community Development and Agricultural Development. This year, there will be 12 plenary speakers, 159 oral and 60 poster presentations and attendants who coming from 21 countries. ICIST 2018 are organized by Association of Agricultural Technology in Southeast Asia (AATSEA), Bengkulu University (Indonesia), King Mongkut’s Institute of Technology Ladkrabang (KMUTL, Thailand), Rajamangala University of Technology Tawan-ok (RMUTTO), Chantaburi Campus, (Thailand), Rambhai Barni Rajabhat University (RBRU ,Thailand), ATQ, Tuem, Hanoi (Vietnam), CGC Organic Coffee, Pakse, Champasack (Laos), Society of Applied Biotechnology (India), Foundation of Environmental Education (Thailand), Mahasarakam University, Thailand, CAS Asian Agricultural Bio Engineering Co. Ltd (China), University of Warmadewa, (Indonesia), Inofarming, (Myanmar). Academicians, researchers, policy makers and extension experts is welcome to contribut their expertise, experiences and research results to this conference. May the book of abstracts in this conference provides useful information and serves as references for those who are interested in the specific discipline. Last but not least, during our conference we also have tour around Bali. For the one who have not register, you may stop by in the booth in front of our meeting room to find the most interesting place you want to visit. ICIST Organizing Committee wishes you all to have fruitfull conference and enjoyable stay in Bali, Indonesia.

Organizing Committee

Prof. Nanik Setyowati

Presentation of AATSEA President

- AATSEA Awardees
- All country representatives
- All presenters and participants
- Chairs of organizing committees
- Distinguished guests
- International and local organizing committees
- Keynote and invited speakers
- AATSEA Committees and all Co-organizers
- Ladies and Gentleman

Good morning

Association of Agricultural Technology in Southeast Asia (AATSEA) is officially non-profitable organization which established in 9 March 2011 and officially approval on 7 April 2012. We are in the group of scientists from many countries.

We have the life members and yearly member of AATSEA.

May I take this opportunity to invite all of you to stand up for praying to Almarhum Prof. Dr. Riad Sadki (Egypt) who is one of our life member, an editorial board of IJAT and AATSEA awardee in 2015. He passed away in November 1, 2018 to RIP.

AATSEA has organized the International Journal of Agricultural Technology (IJAT) which indexed in Scopus, CABI, CAS, ACI and TCI since 2005.

AATSEA is active in a variety of training programs for sustainable development in agriculture especially organic agriculture.

AATSEA has organized the International Conference on Integration of Science and Technology for Sustainable Development (I-C-I-S-T) since 2012; as said 2012 and 2013 in Thailand, 2014 in Laos, 2015 in Vietnam, 2016 in Myanmar, 2017 in the Philippines and this year 2018 in Indonesia.

The ICIST 2018 Organizing Committee welcome all participants to the 7th International Conference on Integration of Science and Technology for Sustainable Development 2018 (7th ICIST 2018) held at The Patra Bali Resort and Villas, Bali, Indonesia.

ICIST 2018 are organized by Association of Agricultural Technology in Southeast Asia(AATSEA), Bengkulu University (Indonesia), King Mongkut's Institute of Technology Ladkrabang (KMUTL, Thailand), Rajamangala University of Technology Tawan-ok (RMUTTO), Chantaburi Campus, (Thailand), Rambhai Barni Rajabhat University (RBRU, Thailand), ATQ, Tuem, Hanoi (Vietnam), CGC organic coffee, Pakse, Champasack (Laos), Society of Applied Biotechnology (India), Foundation of Environmental Education (Thailand), Mahasarakam University, Thailand, CAS Asian Agricultural Bio Engineering Co. Ltd (China). University of Warmadewa, (Indonesia), Inno-farming, (Myanmar). I

I would be acknowledged and thanks to all committees, members, co-organizers and all participants to make our conference completely and special congratulates to all AATSEA Awardees to deserve individual who contribute their experience with sacrifice work to the society.

I deserve to thanks the AATSEA committee and members, advisory committee, International and local organizing committee, help to make this conference perfectly success.

26-29 November 2018

As I imagine to open an Institute/University which emphasizing in sustainable development especially in Organic Agriculture to educate the POOR and other interesting people. It is by our hearts and sacrifice to the society for the rest of life.

If there is anything inconveniences and mistake during the conference. I would like to highly apologize and responsible to all mistake. I will accept all comments, suggests and recommends to improve for the next conference.

Wishing all of you will have a wonderful time in Bali, Indonesia and safety back home after conference end.

Hope to meet you again in our future activities, collaboration and the next conference in Chi.

Thank you very much for your coming with sincerely heart and attention. I imagine our conference will completely success and hope you will join continue to joy us. THEN I WILL LOVE YOU MORE AND MORE.

May I welcome all of you to our conference and hope we will have precious memory with a song "IMAGINE".

Kasem Soytong

AATSEA President

The 7th ICIST 2018

Organized by

ATQ, Hanoi, Tuem, Vietnam; CAS Asian Agriculture Bio Engineering, China; CGC Organic Coffee, Champasack, Laos; Foundation of Environmental Education, Thailand; Innofarming, Myanmar; King Mongkut's Institute of Technology Ladkrabang, Thailand; Mahasarakham University; Rajamangala University of Technology Tawan-ok, Thailand; Rambhai Barni Rajabhat University, Thailand; Society of Applied Biotechnology, India; University of Bengkulu, Indonesia; University of Warmadewa, Indonesia.

International Advisory Committee

Chairman: Prof. Dr. Timo Korpela (Finland)

Vice Chairman:

Dr. Ridwan Nurazi, Rector/President, the University of Bengkulu (Indonesia)
Prof. Dr. Fucheng Lin, Zhejiang University (China)
Ms. Yi Zhao, CAS Asian Agriculture Bio Engineering (China)
Mr. Young Ah Choi, CGC (Republic of Korea)
Prof. Dr. Devarajan Thangaduri (India)
Prof. Dr. Akira Suzuki (Japan)
Prof. Dr. Teodoro C. Mendoza (Philippines)
Prof. Dr. Robert McGovern (USA)
Prof. Dr. Suchatvee Suwansawat, Rector, KMITL (Thailand)
Asst. Prof. Waigoon Tongaram, President of Rambhai Barni Rajabhat University (Thailand)
Asst. Prof. Dr. Prayon Wongchantra, Foundation of Environmental Education, MU, (Thailand)
Assoc. Prof. Dr. Somchai Prathomsiri, President, RMUTTO, (Thailand)
Nguyen The Quyet, ATQ (Vietnam)
Prof. Dr. Sampan Ritthidej, Mahasarakham University, MU (Thailand)
Prof. Dr. Cynthia C. Divina (Philippines)
Mr. Sineoky P. Sergei (Russia)
Dr. Somlit Vilavong (Laos)
Prof. Dr. Dewa Ngurah Suprpta, University of Warmadewa (Indonesia)

Committee

Asst. Prof. Dr. Chukeatirote, Ekachai (Thailand) BioScience	Assoc. Prof. Dr. Bhat, Rajeev (Malaysia) Food Technology
Assoc. Prof. Dr. Danesh, Y.R. (Iran) Plant Protection	Prof. Dr. Cisia Chkhubianishvili (Goregia) Biotechnology
Prof. Dr. Hiroyuki Konuma (Japan) Agriculture	Prof. Dr. Goltapeh, E. Mohammadi (Iran) Plant Pathology
Prof. Dr. Hyde, Kevin D. (UK) Mycology	Prof. Dr. Hong, Le Thi Ahn (Vietnam) Agricultural Genetics and Biotechnology
Prof. Dr. John C. Moreki (Botswana) Non-Ruminant Nutrition	Prof. Dr. Jayabalan, Narayanasamy (India) Plant Science
Prof. Dr. Kanokmedhakul Somdej (Thailand) Chemistry	Prof. Dr. Juokslahti Tapio (Finland) Biotechnology
Prof. Dr. Khaled Rashed (Egypt) Biotechnology	Dr. Kathirbelu Baker (India) Entomology
Prof. Dr. Kolombet Lyubov (Russia) Applied Microbiology	Assoc. Prof. Dr. Klajing, Vinai (Thailand) Agricultural Engineering
Prof. Dr. Qamaruddin Chachar (Pakistan) Cell Physiology	Prof. Dr. McKenzie Eric (New Zealand) Mycology
Assoc. Prof. Dr. Saha Aniruddha (India) Molecular Plant Pathology and Fungal Biotechnology	Prof. Dr. Riad Sedki Riad El-Mohamedy (Egypt) Plant Pathology
Dr. Huyly Tan (Cambodia) Plant Pathology	Prof. Dr. Sahayaraj Kitherian (India) Advanced Zoology and Biotechnology
Prof. Dr. Tarakanov (Russia) Plant Biotechnology	Prof. Dr. Sridhar Kandikere R. (India) Microbiology and Biotechnology
Dr. Phrattaporn Soyotong (Thailand) Environment	Assoc. Prof. Dr. Chaiwat To-anun (Thailand) Plant Pathology
Assoc. Prof. Dr. Vidhaya Trelo-ges (Thailand) Biology	

International Organizing Committee

Chair: Assoc. Prof. Dr. Kasem Soyong (Thailand)
Vice-chair: Prof. Dr. Fucheng Lin (China)
Prof. Dr. Suzuki, Akira (Japan)
Prof. Dr. Riad El-Mohamedy (Egypt)
Prof. Dr. Devarajan Thangaduri (India)
Dr. Samantha C. Karunaratna (Sri Lanka)
Asst. Prof. Dr. Preeyanan Sittijinda (Thailand)

Committee

Prof. Dr. Somdej Kanokmedhakul (Thailand)
Prof. Dr. John Moreki (Botswana)
Prof. Dr. T.S.S.K. Patro (India)
Assoc. Prof. Dr. Younes Rezaee Danesh (Iran)
Prof. Dr. Okigbo, Raphael (Nigeria)
Dr. Saithong Kaewchai (Thailand)
Mr. Chen Yi Sung (Taiwan)
Dr. Huyly Tann (Cambodia)
Dr. Jakrapan Wongpa (RBRU, Thailand)
Asst. Prof. Dr. Ajchara Bunroj (RBRU, Thailand)
Dr. Wikanya Prathumyot (RBRU, Thailand)
Asst. Prof. Dr. Sureemas Sukkasi (RBRU, Thailand)
Assoc. Prof. Dr. Pakkapong Pongsuk (Thailand)
Prof. Dr. Sampan Ritthidej, President, Mahasarakham University (Thailand)
Dr. Phattraporn Soyong (Burapha University, Thailand)
Asst. Dr. Lampan Khurnpoon (KMITL, Thailand)
Asst. Prof. Dr. Adisak Singsewo (Mahasarakham University, Thailand)
Dr. Wannasakpijitr Boonserm (Mahasarakham University, Thailand)
Asst. Prof. Dr. Virapol Jamsawat (Thailand)
Dr. Chongko Saetung (Thailand)
Dr. Bancha Wiangsamut (Thailand)
Mr. Jun Zhao, CAS (China)
Mr. Di Ma, CAS (China)
Dr. Laitha Ravikumar (India)
Dr. Somyot Detpiratmongkol (Thailand)
Dr. Sampan Promhom (Thailand)
Dr. Somporn Na-Nakorn (Thailand)
Dr. Chaiyasit Preecha (Thailand)
Dr. Auaree Suksommit (Suphanburi Collage of Agriculture, Thailand)
Asst. Prof. Dr. Kannikar Charoensuk (RMUTTO, Thailand)
Dr. Amornrat Suwanposri (RMUTTO, Thailand)
Dr. Boondarika Sumana (RMUTTO, Thailand)
Asst. Prof. Dr. Naruemon Mongkontanawat (RMUTTO, Thailand)
Dr. Wichai Supralucksana (KMITL, Thailand)
Dr. Wimonmat Boonme (KMITL, Thailand)
Dr. Sararat Monkhang (Silpakorn University, Thailand)
Dr. Narumon Tangthirasunun (KMITL, Thailand)

General Secretariats: Ms. Jiaojiao Song, Ms. Rujira Tongon

Vice-general Secretariat: Ms. Phannapa Sopchoke

Local Organizing Committee

Advisory Committee: Dr. Fahrurrozi

Chair: Prof. Dr. Nanik Setyowati

Co-Chair: Dr. Dwi Wahyuni Ganefianti, Ir. Dewa Nyoman Sadguna, M. Agb.

Vice Chair: Dr. Dwatmadji, Prof. Dr. Zainal Muktamar

Master of ceremonies

Indonesia staff: Dr. Heri Dwi Putranto, Ms. Juwita

AATSEA Staff: Dr. Jakrapan Wongpa (RBRU, Thailand)

Registration:

Indonesia Staff: Tatik Suteky, MSc., Ir. A A Putri Risa Andriani, MSi., Dr. Ir. Ni Made Ayu Gemuh Rasa Astiti, MP., Person Pesona Renta, MSc.

AATSEA Staff: Ms. Jiaojiao Song, Ms. Mongkutkarn Udompongsuk, Ms. Phannapa Sopchoke

Financial management

Indonesia Staff: Dr. Damres Uker, Ms. Trisnawati

AATSEA Staff: Ms. Rujira Tongon (Thailand), Ms. Jiaojiao, Song (China), Ms. Zhao, Yi (China), Mr. Sitichai Chuewboon, Thailand)

Ticket reservation and transportation

Indonesia Staff: Dr. Catur Herison, Ms. Lucy Anna, Mr. Nyoman Sudarma, SE., Ms. Eka Darmayanti, SE.

AATSEA Staff: Ms. Rungrat Vareeket

Food & Coffee break, reception and welcome dinner:

Indonesia Staff: Dr. Rustikawati, Ms. Lucy Anna, Ms. Mitha, Ms. Minah, Ms. Githa Saraswati, SE.

AATSEA Staff: Ms. Rujira Tongon, Ms. Rungrat Vareeket, Dr. Narumon Tangthirasunon

Documentation - Photograph & Video record:

Indonesia Staff: Mr. I Komang Supardika, Mr. Agus Juliantara, Mr. Made Takuma

AATSEA Staff: Mr. Sarayos Puangkrsaer, Mr. Akarat Jantub, Mr. Sommart Yoosukyingsataporn

Proceedings and souvenirs:

Indonesia Staff: Dr. M. Chozin, Ms. Juwita

AATSEA Staff: Asst. Prof. Dr. Supattra Poeaim, Ms. Rujira Tongon, Ms. Jiaojiao Song

Audiovisual aid and Sub-session Conveners

Indonesia Staff: Prof. Widodo, Mr. Gede Budi Astrawan & Hotel Team

AATSEA Staff: Mr. Sarayos Puangkrsaer, Mr. Akarat Jantub, Mr. Sommart Yoosukyingsataporn, Mr. Suchart Chayhard

Entertainment & IT:

Indonesia Staff: Ms. Ni Made Defy Janurianti, Mr. Krisnawan Kalimutu, Mr. I Kadek Eko Ariyadi, Ms. Ni Putu Laras Berliana Cahayani, Ms. Ni Made Ayu Wulandari, Ms. Wiwik Wahyuni

AATSEA Staff: Asst. Prof. Dr. Virapol Jamsawat, Dr. Banacha Wiangsamut

Flags presentation: Ms. Rujira Tongon (Thailand)

Indonesia staff: Ms. Ni Made Defy Janurianti, Mr. Krisnawan Kalimutu, Mr. I Kadek Eko Ariyadi

Ms. Ni Putu Laras Berliana Cahayani, Ms. Ni Made Ayu Wulandari, Ms. Wiwik Wahyuni, Mr. I Komang Supardika, Mr. Agus Juliantara, Mr. Made Takuma

AATSEA Staff: Ms. Leelawadee Ngoengam, Ms. Rujira Rakrawee, Ms. Krittayaporn Meesook, Ms. Pimchanok Tongsad, Mr. Krissada Natungnuy, Ms. Thanatchaporn Mangkarad, Mr. Danupat Thongkham, Mr. Punyanobpharat Adisorn, Ms. Kunwanlop Wanrawee, Mr. Wutthipong Pattarasaikul, Ms. Juthaporn Phonmakham, Ms. Araya Thanomwong, Ms. Mukrawee Kaikitsom, Ms. Kheedsara Unthuraloet

Reception, Hotel reservation and transportation: Manager – Ms. Ratna Dewi

Working Staff: Tatik Suteky, MSc., Ms. Lucy Anna, Ms. Mitha, Ms. Githa Saraswati, SE., Mr. Nyoman Sudarma, SE., Mr. Ojas Govardhana

Field Trip

Working Staff: Dr. Heri Dwi Putranto, Mr. Nyoman Sudarma, SE, Mr. Ketut Suryawan, Amir Husaini Karim Amrullah, S.Pt., M.Sc.

Oral presentation management:

Indonesia Staff: Dr. Dwatmadji, Prof. Nanik Setyowati, Dr. I. Dewa Nyoman Sudita, MP., Dr. I Gusti Bagus Udayana, Dr. I Gusti Agus Maha Putra Sanjaya

AATSEA staff: Dr. Auaree Suksomnit, Dr. Somyot Detpiratmongkol, Dr. Narumon Tangthirasunun, Ms. Rujira Tongon, Ms. Rungrat Vareeket

Best Oral Presentation Awards Management: Dr. Jakrapan Wongpa, Dr. Narumon Tangthirasunun, Asst. Prof. Dr. Ajchara Bunroj

Best Poster Presentation Awards Management: Dr. Pakkapong Pongsuk, Dr. Pailyn Thongsanitgarn, Dr. Sureemas Sukkasi

Poster presentation management:

Indonesia Staff: Dr. M. Chozin, Prof. Widodo, Dr. Yohannes Situmeang, Ir. Ida Bagus Komang Mahardika, M.Si.

AATSEA Staff: Dr. Anurug Poeaim, Asst. Prof. Dr. Naruemon Mongkontanawat, Dr. Boondarika Sumana, Ms. Rujira Tongon, Ms. Rungrat Vareeket

AATSEA Awards Management: Ms. Jiaojiao Song, Ms. Rujira Tongon

Session Chairpersons

Day 1

- Session 1:** Prof. Dr. Teodoro C. Mendoza (Philippines), Prof. Dr. Devarajan Thangaduri (India), Prof. Dr. Zainal Muktamar (Indonesia)
- Session 2:** Dr. Lalitha Ravikuma (India), Dr. Somyot Detpiratmongkol (Thailand)
- Session 3:** Dr. Samantha C. Karunarathna (Sri Lanka), Dr. Saithong Kaewchai (Thailand), Dr. Hoang ND Pham (Vietnam)
- Session 4:** Dr. Dwatmadji (Indonesia), Prof. Dr. John Moreki (Botswana)
- Session 5:** Dr. Olli-Matti Verta (Finland), Dr. Wattanachai Pongnak (Thailand), Dr. Wulandari Nilam Fadmaulidha (Indonesia), Prof. Dr. Young Ryun Chung (Korea)
- Session 6:** Prof. Dr. Hiroyuki Konuma (Japan), Dr. Adisak Singseewo (Thailand)

Day 2

- Session 1:** Prof. Dr. M A Sarker (Bangladesh), Prof. Dr. Somdej Kanokmedhakul (Thailand)
- Session 2:** Prof. Dr. Nagia Farag Ali (Egypt), Prof. Dr. Thanuku Samuel Sampath Kumar Patro (India)
- Session 3:** Prof. Dr. Wafaa M. Haggag (Egypt), Prof. Dr. Okigbo Raphel (Nigeria), Prof. Dr. Danesh Younes (Iran)
- Session 4:** Prof. Dr. John Moreki (Botswana), Dr. Chongko Saetung (Thailand)
- Session 5:** Prof. Dr. Teodoro C. Mendoza (Philippines), Prof. Dr. Danilo S. Josue (Philippines), Dr. Sigit Sudjarmiko (Indonesia)
- Session 6:** Prof. Dr. Teguh Adiprasetyo (Indonesia), Dr. Phattaraporn Soyong (Thailand)

Seminar “ Brainstorm for Institute (University) of Organic Agriculture (Sustainable Agriculture)

Chair: Dr. Kasem Soyong

Best Poster Award Committees – rearrange the names which depends on specialization.

- Session 1:** Prof. Dr. Danilo S. Josue (Philippines), Prof. Dr. Widodo Widodo (Indonesia), Dr. Mohammad Chozin (Indonesia), Dr. Narumon Tangthirasunun (Thailand)
- Session 2:** Prof. Dr. Rosemarie del Rosario Josue (Philippines), Dr. Fahrurrozi Fahrurrozi (Indonesia), Dr. Supattra Poeaim (Thailand)
- Session 3:** Prof. Dr. Bernadette C. Mendoza (Philippines), Dr. Tatik Suteky (Indonesia), Dr. Auaree Suksomnit (Thailand)
- Session 4:** Prof. Dr. Zainal Muktamar (Indonesia), Dr. Pakkapong Pongsuk (Thailand), Dr. Pailyn Thongsanitgarn (Thailand)

AATSEA Outstanding Achievement Awards 2018

Outstanding Achievement in Education and Research



**Prof. Dewa Ngurah Suprpta
(Indonesia)**

Professor Suprpta joined the University of Udayana in 1985 and have taken responsible in many strategic development programs of this University ever since. Prof. Suprpta has also proven himself to be an accomplished researcher, an outstanding teacher and a prolific writer. His focus of research is on the development of biopesticides for environmentally friendly plant diseases control where he has written more than 65 scientific publications in various international and refereed journals. He also holds 7 (seven) patent rights involving biopesticides and biofertilizers granted from 2005 to 2018. During his career he has received 16 local, national, and international Awards as recognition for his contribution in the field of agriculture. He also actively establishes bridges to bring the products of researches into the market and make them benefited to the farmers and society. In his opinion research is for prosperity of mankind in one hand, and nature on the other. In 7th ICIST 2018 Denpasar, Bali, Indonesia, as one of keynote speaker, he will present a scientific paper entitled “Importance of Biodiversity for Development of Sustainable Bio-business”.

His perseverance is amazing and his contributions to research and higher education development have been excellent and not limited to University of Udayana. I am extremely happy to endorse him as a candidate to be bestowed with the honor of the ‘Research and Higher Education’ Award for ICIST 2018.

Outstanding Achievement in Education and Research



**Professor Dr. Danilo Sarcon Josue
(Philippines)**

Dr. Josue or “Dani” as he is fondly addressed rose from the ranks as Teacher of Practical Arts, to Instructor I, Assistant Professor, Associate Professor and the highest rank of Professor 6 in Agronomy. In his 41 years in the academe, he teaches basic and major Crop Science and allied courses in the Agricultural Science Education for undergraduate level. He spearheaded the offering of Master of Science in Farming Systems as part of the graduate program of the University. He authored several Crop Science modules and co-authored in developing laboratory protocols in Crop Science and Farming Systems. He actively serves as Thesis adviser to numerous undergraduate and graduate researchers. He published a number of articles in both national and international scientific journals.

Dr. Josue is not a typical run-of-the mill Professor and University administrator as he stands out from the rest. His present engagement relates to Human Rights, Welfare, Human and Food Security, Livelihood and Farm Productivity, Environmental Protection, Conservation and Climate Change, S & T Action Frontline Emergencies (SAFE) program and inclusive development of communities especially in conflict-affected areas in Mindanao. Though he could easily take positions far from the conflict zones of the country, he opted to stay foot so he could directly help distressed people and communities. All these endeavours are being accomplished and expanded further through sincere commitment, perseverance, loyalty and love to serve distressed rural communities. He has been implementing a number of Development Programs in Conflict-affected areas in Mindanao and a lot of Farming Systems and Environmental Conservation development studies in the Philippines and in Oklahoma, U.S.A. He served as the Regional Technical Adviser and a Visiting Research Scientist of ARMM Integrated Agricultural Research Center (DA-ARMMIARC) in 2004-2010, and the founding Consortium Director of the Autonomous Region in Muslim Mindanao Agriculture and Aquatic Resources Research Consortium (ARMMAARRDEC) that is closely linked with DOST-PCAARRD in 2014-2018. Recognizing that the high external input modern agriculture excluded many farmers and resource-poor farmers in marginal and less market-accessible areas, his research and development efforts are now focused on development and adoption of appropriate and location-specific technologies for Diversified Integrated Farming Systems, and Climate- resilient Agriculture. In this way, he is able to tap the varied ecosystem services of multi-functional farms of Resource-poor farmers.

His 41 years of exemplary services and leadership to MSU-Maguindanao and communities earned him awards and distinctions from various scientific, civic, and social organizations including a Commission on Higher Education (CHED) Travel Grant at Michigan State University at East Lansing, U.S.A. in 2012. Highly appreciated in Muslim world is his contribution in the successful passage of the Muslim Mindanao Act No. 280, “an Act providing for the Gender and Development Code of ARMM, Philippines.” He was honoured with Outstanding Leadership Award by the Rotary Club of Cotabato East in 2016 and 2018.

Dr. Josue excelled in various fields of Agriculture, being in the academe with a rank of Full Professor 6. Currently, he is the Vice Chancellor for Research, Extension and Development (VCRED) of Mindanao State University –Maguindanao, Mindanao, Nemesio B. Mendiola Hall (Leon C. Gonzales Wing) College, Laguna, Philippines 4031 Tel. fax:+63-49-501-6649/536-2468, Tel.No:+63-49-536-2217 E-mail: odics.uplb@up.edu.ph; icsextension.uplb@up.edu.ph.

Philippines. Prior to his appointment as VCRED, he held numerous assignments as Director of Research, Extension and Development, Technical and Special Assistant, Consultant, Program Leader, Dean of the College of Agriculture, a Research Assistant of the International Rice Research Institute (IRRI, 1986-1988) and Research Fellow of Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA, 1998-1999) and of the Angelo King Institute of Economics and Business (AKIEBS, 2000-2002). He served as the Project Leader in the massive reforestation of Bondoc Peninsula in the Quezon Province of Luzon. He finished Doctor of Philosophy (Ph.D.) in Agronomy in 1999 at the University of the Philippines, Los Baños, Philippines.

Outstanding Achievement in Community Development/Research Leadership Award



**Prof. Dr. Thanuku Samuel Sampath Kumar Patro
(India)**

- Born on 31st August 1974 at Modavalasa, Vizianagaram district in Andhra Pradesh., India
- Ph.D in the faculty of agricultural Sciences from Indian Agricultural Research Institute, New Delhi, India
- Specialization: Molecular Plant Pathology
- 17 years of experience as a scientist to Principal Scientist
- Presently working as a Head and Principal Investigator of All India Smallmillets Improvement Project at Vizianagaram, Andhrapradesh, India

Prof. Dr. T. S. S. K. Patro had his schooling in the Modavalasa village and graduated in Agricultural Sciences in Andhra Pradesh Agricultural University presently ANGRAU in 1996 securing a distinction. Dr. Patro was selected for Junior Research Fellowship for the M.Sc (Agril) at Indian Agricultural Research Institute, NewDelhi and Senior Research Fellowship for PhD at IARI , New Delhi. He completed M.Sc. (Ag) and Ph.D during 1997-2002 with 8 gold medals including 2 SAARC awards, 3 International Young Scientist awards and 3 Institute gold medals. Dr. Patro has joined in the ANGR Agricultural University in 2002 and carried out his research on Sugarcane for four years and identified several new disease reports for the first time in the world. Later in 2005 he joined in millet crops and identified several new diseases some of them are first world records. The University has awarded Eminent Plant Pathologist in A.P state in 2009, ANGRAU Young Scientist award in 2010, Best researcher award in 2013. Dr. Patro has so far published more than 150 research papers in National and International Journals and conferences. He has attended many international conferences throughout the world as a lead speaker and has chaired many technical sessions. He has Life member and editorial board member of more than 12

scientific societies. He published around 100 popular articles for the benefit of extension officers and Farmers. Awards and laurels won by Dr. Patro run into volumes. So, far he has received 52 awards including fellow of nine Scientific organizations including worlds second oldest Indian Phyto pathological Society (IPS) New Delhi. Dr. Patro has also authored six popular books on IPM in Horticultural crops and Millets. He is also a faculty in first ever International Massive Open Online course (MOOCS) in Agricultural course conducted by ICRISAT, Hyderabad. Presently, he is heading Agricultural Research Institute at Vizianagaram and the station has won the best research station award at All India level and in the state as well. He is also a Hon'ble member of board of studies in botany department at Maharaja College, Vizianagaram for 2007 to till date. He has visited more than 18 countries for presenting his research work in various forums.

Outstanding Achievement in Community Development Award



**Prof Dr. Hiroyuki Konuma
(Japan)**

- Professor and the Director of Meiji University ASEAN Center (based in Bangkok, Thailand) since April 2016
- Visiting Professor, School of Economics, Srinakarinwirot University, Thailand, since September 2016
- Former Assistant Director-General and Regional Representative of United Nations (UN) Food and Agriculture Organization (FAO) (March 2010—July 2015)

Hiroyuki Konuma, a Japanese national, born in Tokyo in 1953, is a graduate of Meiji University (Agricultural Chemistry) and holds M.Sc. and Ph.D. in Agricultural Science from University of Tsukuba in Japan. Presently, he works as a Professor and the Director of Meiji University ASEAN Center based in Bangkok, Thailand. He is also teaching at Srinakarinwirot University in Thailand as a Visiting Professor. He had been an official of the United Nations (UN) FAO for nearly 35 years and retired from UN in July 2015. He started his professional carrier in Syria with JICA (JOCV) in 1977 as a Junior Expert in Animal Husbandry. He joined UN/FAO in 1980 in Yemen as an Associate Expert in animal husbandry. He moved to Somalia as the Head of UNHCR Field office in Jalalaqsi in 1983 and engaged in refugee agricultural settlement programme. He returned to FAO in 1985 and posted in Ghana (4 years), FAO HQs in Rome (7 years) and Bangladesh (4 years), and was transferred in 1999 to FAO Regional Office for Asia and the Pacific in Bangkok, Thailand, and stayed there for 16 years. He was appointed as the FAO Assistant Director--General and the Regional Representative for Asia and the Pacific in March 2010, and managed FAO Regional Office (which covered 46 countries in the region and held about 180 professional and support staff, and operated nearly 350 on-going projects at any time) in the area of agriculture (including crop, livestock, forestry and fisheries), agricultural policy, food security, nutrition, rural development and other associate fields. He also acted as FAO representative for Thailand. He retired from the United Nations FAO in July 2015, and joined Meiji University, Japan as a Professor in April 2016.

Outstanding Achievement in Community Development



**Ms. Junaflor Sarmiento-Cerilles
(Philippines)**

Ms. Cerilles started her social engagement when the Women Empowerment Movement- Rural Improvement Club (WEMRIC), a province-wide socio-civic women organization in Zamboanga del Sur was founded in 2008, wherein she was a municipal federation head for her hometown, Dumalinao. She led her women's group to run a vermiculture social enterprise. The women cultured earthworms, then they sold vermicasts or use them in their vegetable gardens. For showing success in her initial project, she was elected as the provincial head of WEMRIC in 2013. Under her leadership, the provincial federation has grown by leaps and bounds. Aside from the unrelenting support of the provincial government, WEMRIC was able to secure financial and material assistance from different sources that include the US Secretary's Office of Global Women's Issues and Australian Aid. The WEMRIC then conducted a series of activities that include women's forums, livelihood skills training, tree and mangrove planting, cleanliness drive, legal aid assistance, celebration of the women's month thru dance competitions, among others. All these are meant to raise the confidence level of the women and their capacity to improve their living conditions. To further equip them in improving their livelihood, financial assistance were provided, and retail outlets were opened wherein they could sell their agricultural products. As a result of this, WEMRIC was able to establish 27 social enterprises, benefitting 1500 women farmers including their families. With Ms. Cerilles at the helm, the living conditions of the families of women beneficiaries were improved due to increased family earnings. Moreover, the improved level of income and enhanced opportunities of mobility gave them self-confidence in terms of control of family resources. Thus, besides material development in the form of improvement of food intake and other amenities of life, non-tangible changes in the lives of women and their families, like improved decision-making capacity of the women within her family and her community, also came about. Because of her outstanding leadership in the women's federation at a young age of 32, she was selected in 2015 as a fellow of the Young Southeast Asian Leaders Initiative (YSEALI) of the US Government that provides five-week-long mentoring to its fellows. Her rich learnings with the YSEALI has helped her a lot in stretching her potentials as a leader as she assumed more

responsibilities in helping her fellowmen. As she became more conscious of the importance of taking care of the environment as a requisite of any community development, she tapped the youth to campaign for environmental advocacy. Like her co-fellows in the YSEALI, Ms. Cerilles knows very well the openness, drive and energies of the youth that can be maximized for the environmental campaign. Tapping the youth organizations, called the 4H clubs, formed by local agricultural offices throughout the province, she initiated a series of trainings of hundreds of youth leaders, and counting, with the support of the provincial government. The two-edge trainings are on marine protection coupled with ban on plastics drive and forest protection coupled with organic agriculture drive. The youths have been given the option to choose which campaign they are more comfortable. Hundreds of trained youths have already formed their local groups to campaign for the taking care of the environment in the province of Zamboanga del Sur. For Ms. Cerilles, there can be no sustainable development if we destroy our environment and if we exclude the participation of the emerging young generation, thus tapping the youth for the environmental campaign is a must in order to attain a genuine and sustainable development. As Ms. Cerilles successfully accomplished these noble advocacies for genuine and sustainable development implemented in the entire province of Zamboanga del Sur, she still manages to perform well her municipal-based tasks as a local executive of her hometown Dumalinao. She was elected as municipal mayor last May 2016 and was a consistent top performer in public service standards, so that she was as well elected as president of the provincial league of mayors. On the other hand, she is also a successful businesswoman. She is the proprietor of a meat shop, a few shell gas stations, an agribusiness firm, among others. She was notably successful that she was invited as a delegate to attend the Global Entrepreneurship Summit (GES) 2014 in Marrakesh, Morocco. Organized by the President of the United States, the GES is a gathering of successful young entrepreneurs around the world.

In totality, she is the epitome of a successful young woman leader who has assumed social responsibility to promote genuine and sustainable development of the community she serves. Because of that, she was invited last March 2018 to speak on rural women empowerment as part of the Philippine delegation in the 62nd Session of the Commission on the Status of Women at the UNITED Nations Headquarters in New York with the theme “Empowering Women and Girls.” Based from the above outstanding achievement of Ms. Junaflor “Sweet” Sarmiento-Cerilles in leading her community, especially the women and the youth, towards genuine and sustainable community development, plus her spotless record as a public servant.



**The 7th International Conference on Integration of Science and Technology
for Sustainable Development (7th ICIST)**

“Water Conservation, Biological Diversity, Food Safety and Agriculture”

The Patra Bali Resort and Villas, Bali, Indonesia
November 26-29, 2018

PROGRAM

November 26, 2018 16:00 Registration and Poster Display

DAY 1: November 27, 2018

Time	
7:00 – 7:30	Registration: Secretariat and Staff
	Master of Ceremony (MC): Ms. Juwita, Dr. Jackapan Wongpa
7:30 – 7:50	Welcome Addresses Prof. Dr. Timo Korpela (Finland), Chairman of International Advisory Committee Prof. Dr. Nanik Setyowati, Chairman of Local Organizing Committee Assoc. Prof. Dr. Kasem Soyong, President of AATSEA
7:50 – 8:10	Opening and Welcome Remarks: Dr. Ridwan Nurazi, Rector, University of Bengkulu
8:10 – 8:20	Traditional Welcome Dance
8:20 – 8:40	Parade of National Flags and Representatives on Stage Participants: country representatives Bangladesh (Dr. Md. Asaduzzaman Sarker) Botswana (Dr. John Moreki) Cambodia (Mr. SEM Savuth) China (Mr. Jun Zhao) Egypt (Dr. Wafaa M. Haggag) Finland (Dr. Timo Korpela) India (Dr. Lalitha Ravikuma) Indonesia (Dr. Fahrurrozi Fahrurrozi) Iran (Dr. Danesh Younes) Iraq (Dr. Al-Ubaidy Ridha Mustafa) Japan (Dr. Hiroyuki Konuma) Laos (Dr. Somlit Vilavong) Myanmar (Mr. Thet Lwin Htay) Nigeria (Dr. Raphel Okigbo) Philippines (Mr. Pablito M. Villegas) Russia (Mr. Dmitry Rubin) South Korea (Dr. Young Ryun Chung) Sri Lanka (Dr. Samantha C. Karunarathna) Syria (Dr. Moammar Dayoub) Thailand (Dr. Supattra Poeaim) Vietnam (Dr. Hoang ND Pham)

8:40 – 9:10

AATSEA Awarding Ceremony:

AATSEA awardees will be given Award Plaques and Souvenirs by Dr. Kasem Soyong, President of AATSEA

Prof. Dewa Ngurah Suprpta (Indonesia)

Professor Dr. Danilo Sarcon Josue (Philippines)

Prof. Dr. Thanuku Samuel Sampath Kumar Patro (India)

Prof. Dr. Hiroyuki Konuma (Japan)

Ms. Junaflor Sarmiento-Cerilles (Philippine)

AATSEA recognition awards to organizers

1. **ATQ, Hanoi, Tuem, Vietnam** (Mr. Nguyen The Quet)
2. **CAS Asian Agriculture Bio Engineering, China** (Ms. Yi Zhao)
3. **CGC Organic Coffee, Champasack, Laos** (Dr. Somlit Vilavong)
4. **Foundation of Environmental Education, Thailand** (Dr. Prayoon Wongchantra)
5. **Innofarming, Myanmar** (Mr. Thet Lwin Htay)
6. **King Mongkut's Institute of Technology Ladkrabang, Thailand** (Dr. Anurug Poeaim)
7. **Maharakham University** (Dr. Wannasakpijitr Boonserm)
8. **Rajamangala University of Technology Tawan-ok, Thailand** (Dr. Bancha Wiangsamut)
9. **Rambhai Barni Rajabhat University, Thailand** (Dr. Preeyanan Sittijinda)
10. **Society of Applied Biotechnology, India** (Dr. Devarajan Thangaduri)
11. **University of Bengkulu, Indonesia** (Dr. Ridwan Nurazi)
12. **University of Warmadewa, Indonesia** (Dr. Dewa Ngurah Suprpta)

9:10 – 9:20

**Keynote Session
(Denpasa
Ballroom)**

GROUP PHOTO and COFFEE BREAK

Chairs: Prof. Dr. Nanik Setyowati (Indonesia)

9:20 – 9:50

Prof. Dr. Dewa Ngurah Suprpta (Indonesia): Important of Biodiversity for Development of Sustainable Bio-Business

9:50 –10:20

Prof. Dr. Teodoro C. Mendoza (Philippines): Innovation as Game Changer for Scaling up the Adoption of Organic Farming: Focus in the Philippines

10:20 –10:50

Prof. Dr. Moammar Dayoub (Syria): Trends and challenges in organic farming in the European Union

10:50 –11:20

Prof. Dr. Kampon Sriwatanakul (Thailand): The Development of Agri-tourism on Organic Farms in Thailand and Laos

11:20 –11:50

Prof. Dr. Hiroyuki Konuma (Japan): New Challenges Towards Sustainable Future

11:50 –12:20

Ms. Cerilles Junaflor Sarmiento (Philippines): Impact Evaluation of the Women Empowerment Program of Zamboanga Del Sur

12:20 –13:00

LUNCH BREAK

RESEARCH FORUM
13:00 -19:00 ORAL PRESENTATIONS

Session 1	ORGANIC AGRICULTURE AND RELATED FIELDS
(Denpasar 1)	Chairs: Prof. Dr. Teodoro C. Mendoza (Philippines), Prof. Dr. Devarajan Thangaduri (India), Prof. Dr. Zainal Muktamar (Indonesia)
13:00 – 13:30	Invited Speaker: Prof. Dr. Zainal Muktamar (Indonesia): Residual Effect of Vermicompost on Sweet Corn Growth and Selected Chemical Properties of Soil from Different Organic Farming Practices
13:30 – 13:50	Wutthisak Bunnaen (Thailand): The Development of Organic Farming Network Learning Centers for Youths in Kantharawichai District, Mahasakham Province, Thailand
13:50 – 14:10	Pakkapong Pongsuk (Thailand): Facilitation of Organic Agriculture Learning in School and Community
14:10 –14:30	Fahrurrozi Fahrurrozi (Indonesia): Relationships between Potassium Uptakes and Yield Performances of Sweet Corn Grown Under Organic Production System
14:30 – 14:50	Danupat Thongkham (Thailand): Nano-particles Derived from <i>Chaetomium elatum</i> against Phytophthora rot of Durian
14:50 – 15:10	COFFEE BREAK
15:10 – 15:30	Somlit Vilavong (Laos): Oranic Agriculture in Lao PDR
15:30 –15:50	Thanatchaporn Mangkarad (Thailand): Effective of <i>Neosartorya</i> to Control <i>Phomopsis asparagi</i> Causing Stem blight Disease on Asparagus
15:50 – 16:10	Pitakpong Arunpak (Thailand): The use of Epiphytic Lichen as a Biomonitor on Air Quality, Nitrogen Dioxide and Sulphur Dioxide Deposition in Mab Ta Phut Industrial Estate, Rayong Province
16:10 – 16:30	Monnat Yamyang (Thailand): Callus Induction and Regeneration from Seeds of some Thai Indigenous Upland Rice (<i>Oryza sativa</i> L.) and Lowland Rice Varieties
16:30 –16:50	Wutthipong Pattarasaikul (Thailand): Biological control of Anthracnose Disease on ‘Namwa Mali-Ong’ Banana by <i>Neosartorya</i> sp
16:50 –17:10	Adisorn Punyanobpharat (Thailand): Effective of <i>Neosartorya</i> and <i>Talaromyces</i> use to control <i>Alternaria brassicicola</i> causing Leaf Spot Disease on Kale
17:10 –17:30	Juwita (Indonesia): Nano-particles from <i>Trichoderma harzianum</i> aginist rice blast pathogen
17:30 –17:50	Mongkutkarn Udomongsuk (Thailand): Nano–particles constructed from <i>Chaetomium brasiliense</i> against root rot disease of tangerine
17:50 –18:10	Sigit Sudjatmiko (Indonesia): Growth Analysis of Sweet Corn as Amended with Different Types of Organic Fertilizers
18:10 –18:30	Cavite Harry Jay Molato (Philippines): Phosphate-solubilizing Bacteria from Upland Rice (<i>Oryza sativa</i> L.) Rhizosphere and their Tricalcium Phosphate Solubilizing Abilities
18:30 – 18:50	Nithyapriya Subramanian (India): Production and Yield Attributes of Biofertilizers on Pulse Crops
19:00	WELCOME DINNER

Session 2	PLANT AND FOOD TECHNOLOGY
(Denpasar 2)	Chairs: Dr. Lalitha Ravikuma (India), Dr. Somyot Detpiratmongkol (Thailand)
13:00 – 13:30	Invited Speaker: Dr. Lalitha Ravikuma (India): Improvement of Oil Yielding Crops Yield Attributes using Plant Growth Promoting Rhizobacteria
13:30 – 13:50	Naphatrapi Luangsakul (Thailand): Effect of Oil Addition on In-vitro Starch Digestibility and Physicochemical Properties of Instant Rice
13:50 – 14:10	Boondarika Sumana (Thailand): The effect of Freezing Method, Packaging Type and Storage Time on the Quality of Moo-Chamoung Curry Frozen
14:10 – 14:30	Wattana Na Nakorn (Thailand): Diversity and Evenness of Indigenous Vegetables in Nakhon Si Thammarat Province, Thailand
14:30 – 14:50	Parichat Buamool (Thailand): Effect of Different Nitrogen Fertilizer Forms on Growth and Yield of Four Tropical Pasture Grasses
14:50 – 15:10	COFFEE BREAK
15:10 – 15:30	Wulandari Nilam Fadmaulidha (Indonesia): Probiotication of Black Jelly [<i>Mesona chinensis</i> (Benth)] by Encapsulated <i>Lactobacillus plantarum</i> Mar8 for A Ready to Drink (RTD) Beverages
15:30 – 15:50	Araya Thanomwong (Thailand): <i>Emericella</i> sp and <i>Neosartorya</i> sp for Controlling <i>Colletotrichum capsici</i> caused Anthracnose of Chili
15:50 – 16:10	Rujira Tongon (Thailand): Nano-particles from <i>Chaetomium brasiliense</i> to Control <i>Phytophthora palmivora</i> caused Root Rot Disease in Durian var Montong
16:10 – 16:30	Sommart Yoosukyingsataporn (Thailand): Effects of Sulfometuron-methyl as Chemical Ripener on Growth and Yield of Three Sweet Sorghum Cultivars
16:30 – 16:50	Sakulrat Hansuek (Thailand): Effects of BA and NAA on Plant Regeneration of Neck Orange (<i>Citrus reticulata</i> Blanco)
16:50 – 17:10	Namfon Jaisut (Thailand): Comparison of Antioxidant Properties in Different Herbal Fresh Sausages
17:10 – 17:30	Dwi Wahyuni Ganefianti (Indonesia): Acclimatization of Pencil Orchid (<i>Papilionanthe hookeriana</i> Rchb.f) using Types of Planting Media and Fertilization
17:30 – 17:50	Chankaew Wanninee (Thailand): <i>Chara corallina</i> Klein ex Willdenow (Charales), A New Record of Edible Freshwater Algae in Southern Thailand
17:50 – 18:10	Bunyarit Chumthong (Thailand): Response of Biomass and Yield of Stevia (<i>Stevia rebaudiana</i> Bertoni.) to Flower Removal
18:10 – 18:30	Al-Ubaidy Ridha Mustafa (Iraq): Response of Broad Bean Growth and Early Yield to Exposure Period of Vernalization
18:30 – 18:50	Kheedsara Unthuraloet (Thailand): Efficacy of <i>Eurotium</i> sp and <i>Serratia</i> sp to Control Brown Spot Disease of Rice caused by <i>Drechslera oryzae</i>
19:00	WELCOME DINNER

Session 3	MICROBIAL BIOTECHNOLOGY, BIODIVERSITY, TAXONOMY, BIOLOGICAL ACTIVITY
(Denpasar 3)	Chairs: Dr. Samantha C. Karunarathna (Sri Lanka), Dr. Saithong Kaewchai (Thailand), Dr. Hoang ND Pham (Vietnam)
13:00 – 13:30	Invited Speaker: Dr. Samantha C. Karunarathna (Sri Lanka): New Edible Mushroom from Discovery to Production
13:30 – 13:50	Phetchara Krubphachaya (Thailand): Biodiversity of Soil Macroarthopods and Relationship with Environmental Factors in Northeastern Thailand
13:50 – 14:10	Josue Rosemarie Del Rosario (Philippines): Mass Rearing and Dispersal of Biological Control Agents (BCAs) as Interventions in Coconut Scale Insect (CSI) Calamity Areas in Basilan, Philippines
14:10 – 14:30	Erniwati E Erniwati (Indonesia): Earthworm Biodiversity in Oil Palm Plantation and Secondary Forest Patch in Riau, Indonesia
14:30 – 14:50	Sujitra Jorjong (Thailand): Phenolic Compounds and Antioxidant Capacities of Mao-Luang Leaves (<i>Antidesma thwaitasianum</i> .) Cultivars from Northeastern Thailand
14:50 – 15:10	COFFEE BREAK
15:10 – 15:40	Invited Speaker: Prof. Dr. Kwanjai Kanokmedhakul (Thailand): Mycotoxin in Pathogenic Fungi
15:40 – 16:10	Invited Speaker: Dr. Hoang ND Pham (Vietnam): Deproteinization in Purification of Exopolysaccharide from <i>Ophiocordyceps sinensis</i> Olive Oil – Stimulated Culture
16:10 – 16:30	Nipon Sonhom (Thailand): In Vitro Antioxidant Activities and Phenolic Compounds Content from Karanda (<i>Carissa carandas</i> L.) Wine
16:30 – 16:50	Juthaporn Phonmakham (Thailand): Antibacterial and Anti-tyrosinase Activities of the Methanolic Extract from Leaves of <i>Tectona grandis</i>
16:50 – 17:10	Naruemon Mongkontanawat (Thailand): Fermentation of Gac Juice Mixture by Probiotic Lactic Acid Bacteria
17:10 – 17:30	Labaya Justine Bernadette España (Philippines): Phytochemical Screening of <i>Coffea arabica</i> Crude Extract and Its Inhibiting Activity Against <i>Aspergillus flavus</i>
17:30 – 17:50	Tipawan Thongjua (Thailand): The Efficacy of Plant Extracts, Bio-insecticides, Petroleum Oil and Insecticides for Controlling Thrips (Thysanoptera: Thripidae) in Pummelo cv. Tubtimsiam in Nakhon Si Thammarat Province, Thailand
17:50 – 18:10	Pennapar Tansian (Thailand): Mating Type and Genetic Diversity Analysis of <i>Pyricularia oryzae</i> Collected from Thai Rice Varieties during Year 2016 and 2017
18:10 – 18:30	Rungrat Vareeket (Thailand): Nano-particles from <i>Cheatomium brasiliense</i> against Brown Spot of Rice
18:30 – 18:50	Gonzales Piolo Luigi Austria (Philippines): Isolation, Characterization, and Identification of Pigmented Fungi from Mangrove Areas in Bataan, Philippines
19:00	WELCOME DINNER

Session 4	ANIMAL AND FISHERY SCIENCES
(Denpasar 4)	Dr. Dwatmadji (Indonesia), Prof. Dr. John Moreki (Botswana)
13:00 – 13:30	Invited Speaker: Dr. Dwatmadji (Indonesia): Feeding Strategy for Cattle Production under Cattle-Oil Palm Integration System in Bengkulu, Indonesia
13:30 – 13:50	Nion Chirapongsatonkul (Thailand): Virulence Factor Gene Profiles of <i>Aeromonas veronii</i> Isolated from Diseased Nile Tilapia (<i>Oreochromis niloticus</i>) in Nakhon Si Thammarat Province and Its Expression towards Diurnal Water Temperature Changes
13:50– 14:10	Roque Reginor Lyzza Argueza (Philippines): Phytochemical Screening and Masculinization of Nile Tilapia (<i>Oreochromis niloticus</i> Linnaeus) using The Needle and Root Crude Extracts of Benguet Pine (<i>Pinus kesiya</i> Royle ex Gordon)
14:10 –14:30	Mukcharat Non-see (Thailand): Degradation of Troponin-T associated with Calpain/ Calpastatin Genes Expression in Thai Native Beef Cattle Fed Different Levels of Energy
14:30 – 14:50	Bakhtiar Dedy (Indonesia): Acoustic Target Strength Measurement of Several Reef Fishes in Tikus Island Waters of Bengkulu
14:50 – 15:10	COFFEE BREAK
15:10 – 15:30	Karn Tippayakraisri (Thailand): Digestive Enzymes in Hybrid Catfish Fed with Spirulina (Arthrospira) Additive Feed
15:30 –15:50	Tatik Suteky (Indonesia): Effects of <i>Melastoma malabatricum</i> Extract on Nutrient Digestibility of Local Goat Infected with Gastro Intestinal Parasites
15:50 – 16:10	Panlert Jammongtoi (Thailand): Effect of Dietary Organic and Inorganic Selenium on Carcass Composition and Meat Characteristics of Broiler Chickens
16:10 – 16:30	Doetolero Jemuel Sagun (Philippines): Effects of Varying Levels of Horseradish (<i>Moringa oleifera</i>) Leaf Meal on The Growth and Survival of Red Nile Tilapia (<i>Oreochromis niloticus</i> L.).
16:30 –16:50	Meranee Inkam (Thailand): The Effects of Oil Enriched Diets on Growth, Feed Conversion Ratio and Fatty Acid Content of Nile Tilapia (<i>Oreochromis niloticus</i>) in Biofloc System
16:50 –17:10	Rea Mae C. Templonuevo (Philippines): DNA Barcoding of Two Major Commercially Important Fish Families (Carangidae and Lutjanidae) Collected from Cuyo, Palawan, Philippines
17:10 –17:30	Amrullah Amir Husaini Karim (Indonesia): Study on Vaginal Epithelial Cells in Brahman Cattle Suspected Reach Puberty
17:30 –17:50	Potinun Smithtinun (Thailand): Cholesterol Content and Fatty Acid Composition in Longissimus dorsi Muscle of Purebred and Crossbred Pigs
17:50 –18:10	Fajardo Lorenz Javier (Philippines): Inhibition of Acetylcholinesterase Activities in Whitegoby <i>Glossogobius giurus</i> from the East Bay of Laguna Lake, Philippines
19:00	WELCOME DINNER

Session 5

ENVIRONMENTAL SCIENCE, SOIL AND WATER CONSERVATION

(Jembrana Room) **Chairs: Dr. Olli-Matti Verta (Finland), Dr. Wattanachai Pongnak (Thailand), Dr. Wulandari Nilam Fadmaulidha (Indonesia)**

13:00 – 13:30 **Invited Speaker: Dr. Olli-Matti Verta (Finland)**

13:30 – 13:50 **Patticha Kulsuwan (Thailand):** Cost-benefit Analysis of Waste Segregation Business in Amnatcharoen Province of Northeastern Thailand

13:50– 14:10 **Suwakhon Phakeewai (Thailand):** The Development of Environmental Recreation Camp Activities for Youth in Roi-Et Province

14:10 –14:30 **Bandi Hermawan (Indonesia):** Spatial Variability in Soil Water under Adjacent Mature Oil Palm and Rubber Plantations: Application of a New Dielectric Method in Evaluating Soil Water

14:30 – 14:50 **Paiboon Limmanee (Thailand):** Promoting the Conservation of Watershed Forestry among Environmental Education Students at the Faculty of Environment and Resource Studies

14:50 – 15:10

COFFEE BREAK

15:10 – 15:30 **Phasini Supsuan (Thailand):** Effects of Organic Fertilizer Application on The Transformation of Nitrogen in Paddy Soil

15:30 –15:50 **S. M. Oasiqul AZAD (Bangladesh):** Ingestion of Microplastics by Some Commercial Fishes in the Lower Gulf of Thailand: A Preliminary Approach to Ocean Conservancy

15:50 – 16:10 **Jiranoot Thinkamchoet (Thailand):** The Development of a Camp on Natural Resources and Environmental Conservation in the ASEAN for youths in Roi-et Province

16:10 – 16:30 **Onausa Siriput (Thailand):** Participatory Action Research for Waste Management of KSL River Kwai Natural Agriculture Center, Kanchanaburi Province, Thailand

16:30 –16:50 **Herry Suhartoyo (Indonesia):** Landscape Assessment and the Use of Old Growth Rehabilitated Mined Site for Agroforestry System: Case of Coal Mined Site at Tanjung Enim, South Sumatra

16:50 –17:10 **Kingkan Puansurin (Thailand):** The Study of Participatory Monitoring of Air Quality and Urban Heat, Case Study Udon Thani Province, Thailand

17:10 –17:30 ~~**Sarong Marilou Mesagrande (Philippines):** Utilization of Continuous Type Rice Hull (CtRH) Pyrolizer: Co-Generation of Heat and Biochar for Enhance Agricultural Productivity in Degraded Acid Uplands Soils in Philippines~~

17:30 –17:50 ~~**Kolakanh Khamvong (Thailand):** Water Management Model for Lower Mekhong Basin of Lao People's Democratic Republic~~

17:50 –18:10 **Gapultos Renelyn Semira (Philippines):** Utilization of Pectin from Calamansi (*Citrofortunella microcarpa*) Peels as Superabsorbent Polymer for Soil Moisture Retention

19:00

WELCOME DINNER

Session 6	SOCIO ECONOMIC, COMMUNITY DEVELOPMENT AND AGRICULTURAL DEVELOPMENT
(Klungkung Room)	Chairs: Prof. Dr. Hiroyuki Konuma (Japan), Dr. Adisak Singsewo (Thailand)
13:00 – 13:20	Invited Speaker: Adisak Singsewo (Thailand): The Promotion of Adaptation to Climate Change using Manual for Matthayom Suksa 2 students at Si sawat Wittaya Municipality School, Mahasarakham Province, Thailand
13:20 – 13:35	Ratchadakorn Phonpakdee (Thailand): The People’s Participation on the Indigenous Serrated Mud Crab Fattening Practices in La-ngu District, Satun Province, Thailand
13:35 – 13:50	Debashis Roy (Bangladesh): Smallholder Farmers’ Perception to Climate Change Impact on Crop Production: case from drought prone areas of Bangladesh
13:50 – 14:05	Amorn Kritsanaphan (Thailand): Reciprocity and Participatory Approach in Decentralized Biodiversity Development and Cultural Heritage Management in Community-Based Tourism, Thailand
14:05 – 14:20	Jeeranun Khermkhan (Thailand): The Agriculture Tourism Management in Family Business: Case Study of Rayong Province in Thailand
14:20 – 14:35	Dante D. Lao-Ay (Philippines): Double Row Transplanting Method: A Novel Rice Crop Establishment but Why Farmers don not Adopt it?
14:35 – 14:50	Karn Hongmaneerat (Thailand): Quality of Life Development and Occupation Opportunity of the Elderly by the Selection of Herbal Plant Using: A case Study of Nakhon Phanom Province and Neighboring Provinces for the Development of Society and Environment
14:50 – 15:05	Juthamas Noinach (Thailand): Performance and Obstacles of the Royal Initiative Discovery Foundation in Thailand
15:05 – 15:20	Arada Phuknoi (Thailand): The Operation Performance of Khao Hin Sorn Agricultural Cooperative Rice Mill Ltd., Chachoengsao Province, Thailand
15:20 – 15:35	COFFEE BREAK
15:35 – 15:50	Invited Speaker: Juokslahti Tapio (Finland): The Effect of Ownership Form on The Productivity and Sustainability of Forests in Salla Municipality, Northern Finland
15:50 – 16:05	Panitan Grasung (Thailand): Factors Affecting Self-protection Behaviors of Pesticide use of Sugarcane Agriculture, Phetchabun Province
16:05 – 16:20	Sasima Fakkhong (Thailand): SWOT Analysis and Marketing Strategies Development of Agricultural Products for Community Group in Nong Chok, Bangkok, Thailand
16:20 – 16:35	Dianne Aruelo Peralta (Philippines): Studies on Macro-Invertebrates of Sto, Tomas Cove, La Union, Philippines
16:35 – 16:50	Pavida Charoenjindarat (Thailand): Application of Sufficiency Economy Philosophy of the Committee to Drive and Operate School Sufficiency Economy, Debsirinromkiao School, Thailand
16:50 – 17:05	Poon Khwansuwan (Thailand): Changes and Continuity of Agrarian System and Village Communities in the Central Plain of Thailand
17:05 – 17:20	Supreeya Worawetwattana (Thailand): Study on the causes and Weedy Rice Management of Farmers in Lumplatiw community, Ladkrabang District, Bangkok Metropolitan, Thailand
17:20 – 17:35	Sorrawas Boonyong (Thailand): Opportunity and Risk from Urban Planning Policy relating to Real Estate Development and Preservation of Rural and Agricultural Areas at the Present in Mueang Chantaburi of Thailand
17:35 – 17:50	Tolentino Josephine Joy Valera (Philippines): Visualization and Potential Risk-Mapping of Mosquitoes in the Philippines using Mosquito Habitat Mapper Application
17:50 – 18:05	Thatree Rodchamnan (Thailand): English Classroom Stress and Anxiety of Students and Teachers at Colleges of Agriculture and Technology in Upper Northern Thailand
18:05 – 18:20	Chai Samoraphum (Thailand): The Development of Network New Theory Agriculture in Ban Kung, Surin Province Thailand
18:20 – 18:35	Firma Viray (Philippines): A Research Output in Agriculture and Social and Related Study
19:00	WELCOME DINNER

DAY 2: November 28, 2018

Keynote Session (Denpasa Ballroom) 8:30 – 9:00	Chairs: Prof. Dr. Teodoro C. Mendoza Pablito M. Villegas (Philippines): Manufacturing-based Agro-industrialization: The Supply and Value-added Chain (Svac) and Agro-processing Cluster Framework and Business Models
9:30 – 10:00	Dmitry Rubin (Russia): Drone for Modern Agriculture
10:00 – 10:30	Prof. Dr. Okigbo Raphel (Nigeria): Ethnostudy of Mushrooms and Establishment of Pure Culture of <i>Cantharellus</i> Species (<i>Ero Umunwene</i>) A Newly Discovered Mushroom Found in Ukwa-East, Abia State, Nigeria
10:30 – 11:00	Prof. Dr. Danilo Sarcon Josue (Philippines): Biodiversity for the Development Sustainable Bio-Enterprise
11:00 – 11:30	Prof. Dr. M A Sarker (Bangladesh): Can Organic Agriculture Feed the Smallholders? - Experience from Rural Bangladesh
11:30 – 12:00	Dr. John C. Moreki (Botswana): Trade in Donkeys and its Implications on Food Production by Smallholder Farmers in Africa
12:00 – 12:30	Seminar “Brainstorm for Institute (University) of Organic Agriculture (Sustainable Agriculture)” Chairs: Prof. Dr. Timo Korpela, Dr. Kasem Soyong Bangladesh (Dr. Md. Asaduzzaman Sarker) Botswana (Dr. John Moreki) Cambodia (Mr. SEM Savuth) China (Mr. Jun Zhao) Egypt (Prof. Dr. Wafaa M. Haggag) Finland (Dr. Timo Korpela) India (Dr. Lalitha Ravikuma) Indonesia (Dr. Fahrurrozi Fahrurrozi) Iran (Dr. Danesh Younes) Iraq (Dr. Al-Ubaidy Ridha Mustafa) Japan (Dr. Hiroyuki Konuma) Lao (Dr. Somlit Vilavong) Myanmar (Mr. Thet Lwin Htay) Nigeria (Dr. Raphel Okigbo) Philippines (Mr. Pablito M. Villegas) Russia (Mr. Dmitry Rubin) South Korea (Dr. Young Ryun Chung) Sri Lanka (Dr. Samantha C. Karunaratna) Syria (Dr. Moammar Dayoub) Thailand (Dr. Supattra Poeaim) Vietnam (Dr. Hoang ND Pham)
12:00 – 13:00	LUNCH BREAK

RESEARCH FORUM -Day 2
13:00 -19:30 ORAL PRESENTATIONS

Session 1	ORGANIC AGRICULTURE AND RELATED FIELDS
(Denpasar 1)	Chairs: Prof. Dr. M A Sarker (Bangladesh), Prof. Dr. Somdej Kanokmedhakul (Thailand)
13:00 – 13:30	Invited Speaker: Nanik Setyowati (Indonesia): Growth and Yield Responses of Cauliflower on Tithonia (<i>Tithonia diversifolia</i>) Compost under Organic Farming Practices
13:30 – 14:00	Invited Speaker: Prof. Dr. Somdej Kanokmedhakul (Thailand): Fungal Elicitors and Their Nano-Product for Plant Immunity
14:00 – 14:20	Widodo (Indonesia): Growth and Yield Response of Pakcoy (<i>Brassica rapa</i> L.) On Various Concentrations of Organic Liquid Fertilizer of Jiringa Hulls [<i>Phithecellobium jiringa</i> (Jack) Prain]
14:20 – 14:40	Supattra Poeaim (Thailand): KMITL Organic Model
14:40 – 15:00	COFFEE BREAK
15:00 – 15:30	Invited Speaker: Prof. Dr. Young Ryun Chung (Korea): Sustainable Rice Production by Plant Health Improving Microbiome
15:30 – 15:50	May Soe Oo (Myanmar): The Energy Footprints of Inbred and Hybrid Rice Genotypes Grown under Organic and Conventional Production System in Laguna, Philippines
15:50 – 16:10	Wikanya Prathumyot (Thailand): Effect of Biogas Effluent from Pig Manure and Longan (<i>Dimocarpus longan</i>) Residues on Growth of Marigold (<i>Tagetes erecta</i>)
16:10 – 16:30	Mohammad Chozin (Indonesia): Performance of Sweet Corn Hybrids under Organic Crop Management across Three Agro-Climatic Zones of the Tropics
16:30 – 16:50	Narisara Ruaykijakarn (Thailand): Knowledge and Attitudes toward Marketing Innovation of Organic Rice Farmers in Sanam Chai Khet Organic Agriculture Group, Chachoengsao Province, Thailand
16:50 – 17:10	Jiaojiao Song (China): Nano-particles from <i>Chaetomium lucknowense</i> to Inhibit Rice Blast Pathogen caused by <i>Pyricularia oryzae</i> in Pot Experiment
17:10 – 17:30	Nguyen Van Thiep (Vietnam): A Survey of Nematode Disease Infecting Arabica Coffee Plants in the Northwestern Vietnam
17:30 – 17:50	Kasem Soyong (Thailand): Advanced Research and Development of Biological Products as Agricultural Inputs for Organic Agriculture

Session 2

PLANT AND FOOD TECHNOLOGY

(Denpasar 2)

Chairs: Prof. Dr. Nagia Farag Ali (Egypt), Prof. Dr. Thanuku Samuel Sampath Kumar Patro (India)

13:00 – 13:30

Invited Speaker: Prof. Dr. Nagia Farag Ali (Egypt): Improvement Antimicrobial Activity of Wool Fibers Dyed with Natural Dyes Extracted from Onion and Red Prickly Pear using Propolis Nanoparticles

13:30 – 13:50

Suriyan Supapvanich (Thailand): Effect of Preharvest Chitosan Application on Bioactive Compounds of Sunflower Sprouts During Storage

13:50 – 14:10

Racha Tepsorn (Thailand): Application of Advance Oxidation Process Combination with Fine Bubble Technology on the Reduction of Escherichia coli O157:H7 Contaminated on Bird Eye Chili (*Capsicum frutescens* L.)

14:10 – 14:30

Ratsamee Nampukdee (Thailand): Effects of Microbial Fermented Liquid (MFL) Supplementation on Gas Production Kinetics and Digestibility using In-vitro Gas Production Technique

14:30 – 14:50

COFFEE BREAK

14:50 – 15:20

Invited Speaker: Prof. Dr. Thanuku Samuel Sampath Kumar Patro (India): Millets- 21st Century Climate Resilient Nutricrop

15:20 – 15:40

Kannika Kunyae (Thailand): The Utilization of Ultrasound and Chilling Treatment to Reduce GI in Thai Glutinous Rice (RD6)

15:40 – 16:00

Montana Ruchirasak (Thailand): Appropriate Technology for Hom Kradung Nga Rice Production in Bacho Swamp

16:00 – 16:20

Bancha Wiangsamut (Thailand): Effect of Various Ethephon Concentrations on Flowering, Yield, Costs and Returns of Productions of Four Pineapple Varieties

16:20 – 16:40

Barrientos Dionie Salilid (Philippines): Effect of Indigenous Microorganism Extended Solution (IMO-ES) on Basmati Rice

16:40 – 17:00

Loetchai Chit-aree (Thailand): Effect of Potassium Chlorate Combining with Paclobutrazol, Monopotassium Phosphate and Mepiquat Chloride on Fruit Quality of Longan (*Dimocarpus longan*)

17:00 – 17:20

Jatuporn Anuchai (Thailand): Efficiency of Salicylic Acid Immersion Using Fine-Bubble Technique on Quality of Musa AAA Fruit During Ripening

17:20 – 17:40

Rachadaporn Benchawattananon (Thailand): Morphology and Anatomy of Rose Wood (*Dalbergia cochinchinensis*) and Relationship between its Elemental Components and Soil Properties for Identification of Endemic Species

17:40 – 18:00

~~**Sarong Marilou Mesagrande (Philippines):** Development of Ca and Si Nanofertilizer from Agricultural Waste for Enhanced Rice Crop Production~~

18:00 – 18:20

Waritchon Ninlanon (Thailand): Effect of Wheat Flour Replacement with Durian Seed Flour on the Quality of Egg Noodles

Session 3	MICROBIAL BIOTECHNOLOGY, BIODIVERSITY, TAXONOMY, BIOLOGICAL ACTIVITY
(Denpasar 3)	Chairs: Prof. Dr. Wafaa M. Haggag (Egypt), Prof. Dr. Okigbo Raphel (Nigeria), Prof. Dr. Danesh Younes (Iran), Dr. Bancha Wiangsamut (Thailand)
13:00 – 13:30	Invited Speaker: Prof. Dr. Wafaa M. Haggag (Egypt): Development and Application of Biotechnological Products for Sustainable Corn and Soybean Production under Stresses Condition
13:30 – 13:50	Aruna Basiboyana (India): Studies on Fungal Diversity of Coastal Region in Zhejiang Province and Fungal Resource Exploitation
13:50– 14:10	Arunrussamee Sangsila (Thailand): Antioxidant and Antityrosinase Activities in Germinated Brown Rice of Indigenous Thai Cultivars
14:10 –14:30	Maribelle P. Astejada (Philippine): Agronomic and Grain Quality Characterization of Different Special Rice Genotypes
14:30 – 14:50	COFFEE BREAK
14:50 – 15:20	Invited Speaker: Prof. Dr. Hong-Kai Wang (China): Construction of ATMT Transformation System in <i>Cordyceps cicadae</i>
15:20 – 15:50	Kramarenko Aleksei; Sayfudinov Sergey (Russia): Bio Product
15:50 –16:10	Rayas Alvin Toledo (Philippines): Isolation and Characterization of Keratinolytic Bacteria from Soil Samples of Poultry Waste Dumping Sites
16:10 –16:30	Krissada Natungnuy (Thailand): Biological Activities of the Methanolic Extracts from Two Varieties of <i>Dimocarpus longan</i> Seeds
16:30 – 16:50	Juthamas Chanyawiwatkul (Thailand): Physicochemical Properties and Oxidative Stability of Oils from Samrong (<i>Sterculia foetida</i>) Seed
16:50 – 17:10	Mendoza Bernadette Colle (Philippines): Forest Litter Filamentous Fungi Inhabiting Different Elevations of Mt. Makiling, Philippines and Screening of Selected Isolates for Enzyme Activities
17:10 –17:30	Natthakittiya Paiboon (Thailand): Dung Beetle Assemblages in Three Human-modified Landscapes in Northeastern Thailand
17:30 –17:50	Dizon Ina Cheska (Philippines): Detection of Putative Bioactive Compounds and Minimum Inhibitory Concentration of <i>Imperata cylindrica</i> Extract against Identified Seed-borne Fungi from Mung Beans

Session 4

ANIMAL AND FISHERY SCIENCES

(Denpasar 4)

Chairs: Prof. Dr. John Moreki (Botswana), Dr. Auaree Suksomnit (Thailand)

13:00 – 13:30

Invited Speaker: Chongko Saetung (Thailand): ~~Effect of Artificial Feed and Algae on Growth Rate of *Spondylus* sp.~~

13:30 – 13:50

~~**Uddin Nasir Mohammed (Bangladesh):** Effectiveness of Flood Coping Strategies Practiced by the Fish Farmers: An Empirical Study in Bangladesh~~

13:50– 14:10

Putranto Heri Dwi (Indonesia): Analyses of Body and Chest Morphometric Comparison between two Indonesian Local Poultry Species

14:10 –14:30

~~**Peralta Dianne Aruelo (Philippines):** Species Inventory and Assessment of Sea Cucumber in Key Marine Geographic Areas in the Philippines (Iuzon cluster)~~

14:30 – 14:50

COFFEE BREAK

14:50 – 15:10

Kittichon U-taynapun (Thailand): Efficacy of Herbal Extracts to Control Multi-Antibiotics Resistant (MAR) *Aeromonas veronii* Isolated from Motile Aeromonas Septicemia (MAS)-Exhibiting Nile Tilapia (*Oreochromis niloticus*)

15:10 – 15:30

Patricia Nañasca Pomer (Philippines): Comparison of Toxic Effects of *Psidium guajava* Leaf and Bark Extracts against Brine Shrimp (*Artemia salina*)

15:30 –15:50

Udomluk Sompong (Thailand): Potential of Microbial Degradation of Musty Odor in Aquaculture Pond

15:50 – 16:10

Dede Hartono (Indonesia): Present Status and Management Strategies of Tropical Eels Genus *Anguilla* in Bengkulu Province of Indonesia

16:10 – 16:30

Auaree Suksomnit (Thailand): Cultures of Siamese Fighting Fish (*Betta splendens*) Fed with Live Food and Commercial Feed added with Effective Microorganisms

16:30 – 16:50

Agustin Zarkani (Indonesia): Impact of Methyl Salicylate Lures on the Population of *Eucarazzia elegans* (Ferrari) (Aphididae) and its Natural Enemy in Common Sage

16:50 – 17:10

Phimook Thiwaratkoon (Thailand): Influence of Charolais Sires and Seasons on Growth Performance and Carcass Characteristics in Crossbred Steers

17:10 – 17:30

Joel M. Sabellano (Philippines): Integrated Rice-Duck Farming Systems: Addressing the Needs of the Farmers for Its Adoption in Zamboanga Del Sur, Philippines

17:30 – 17:50

Endang Sulistyowati (Indonesia): Milk Production and Milk Income over Feed Cost of Dairy Cow Fed Fermented Cassava, Tabut Block, and Concentrate Containing *C. xanthorhiza* and Yeast

Session 5	ENVIRONMENTAL SCIENCE, SOIL AND WATER CONSERVATION
(Jembrana Room)	Chairs: Prof. Dr. Teodoro C. Mendoza (Philippines), Prof. Dr. Danilo S. Josue Philippines), Dr. Sigit Sudjatmiko (Indonesia)
13:00 – 13:30	Invited Speaker: Prof. Dr. Teodoro C. Mendoza (Philippines): Outcoming the Source Barriers of Energy and Water: The Two Most Critical Resource for Agriculture and Food Systems
13:30 – 13:50	Sombat Appamaraka (Thailand): Diversity of Produce Hard resin and Oleoresin Plant in Khok Hinlad Nong Ku Nadoon Community Forest Wapi Pathum District, Maha Sarakham Province
13:50 – 14:10	Phattharaphol Banchajarurat (Thailand): The Application of Carbon Balance for Low Carbon Society Development in Kut Chik Sub-district Municipality, Sung Noen District, Nakhon Ratchasima Province
14:10 – 14:30	Uraivan Praimee (Thailand): The Feasibility Study in Development of the Kha-Kang Creek, Muang district, Maha Sarakham province
14:30 – 14:50	COFFEE BREAK
14:50 – 15:10	Odin Ramjie Yusop (Philippines): Restoring Livelihoods in Conflict Affected Areas in Maguindanao Province of the Autonomous Region in Muslim Mindanao in the Philippines through Aquaculture
15:10 – 15:30	Varangkha Thummanatsakun (Thailand): Effects of Interaction between Nitrogen and Potassium on The Growth and Yield of Cassava
15:30 – 15:50	Manisorn Panyada (Thailand): The Use of Bioreactor System and Aquatic Plants (Water Hyacinth) for Aquaculture Wastewater Treatment
15:50 – 16:10	Dhanita Doungwilai (Thailand): The Effects of a Learning Management Contributing to Creativity and Environmental Preservative Mind of 5th Grade Primary School Students Using Creativity-based Learning
16:10 – 16:30	Francia Maria Nereeza Dayao (Philippines): Mycodegradation of Synthetic Plastics by <i>Pleurotus florida</i> (Oyster Mushroom)
16:30 – 16:50	Wikanya Prathumyot (Thailand): Responses of Sago Palm under Water Deficiency Conditions
16:50 – 17:10	SEM Savuth (Cambodia): Comparative Energy Footprint of Cambodian Lowland Rice Grown under Different Establishment Methods
17:10 – 17:30	Catur Herison (Indonesia): Response of Several Hot Pepper Genotypes to Increasing Drought Stress
17:30 – 17:50	Ordonio Jeremias Lacsamana (Philippines): Identification of Best Segregating Family of NSIC Rc222/Jumbo Jet Under Salt Stress at Reproductive Stage for Use as a Mapping Population

Session 6	SOCIO ECONOMIC, COMMUNITY DEVELOPMENT AND AGRICULTURAL DEVELOPMENT
(Klungkung Room)	Chairs: Prof. Dr. Teguh Adiprasetyo (Indonesia), Dr. Phattaraporn Soyong (Thailand)
13:00 – 13:20	Invited Speaker: Prof. Dr. Teguh Adiprasetyo (Indonesia): Production Efficiency and Determinant Factors Affecting the Adoption of Indonesian Sustainable Palm Oil Production of Small Holder Farmers
13:20 – 13:35	Kanungchai Viriyasoonthon (Thailand): Ability Development for Reading Comprehension on Environmental Conservation: Brain Based Learning (BBL) of High School Students
13:35 – 13:50	Gajete Tomas Divina (Philippines): Enhancing Productivity and Profitability of Rainfed Rice Production Areas Through Adoption of Improved Rice Ratooning Technology in Nueva Ecija, Philippines
13:50 – 14:05	Namtip Cumrae (Thailand): The Promotion to grow upside down for villagers of Ban Thakhonyang, Thakhonyang, Kantharawichai Sub District, Maha Sarakham Province
14:05 – 14:20	Songsak Wangkhahat (Thailand): Assessment of the Project for Supplementary Incomes of Small Scale Farmers Raising Silver Barb in Baan Doong District, Udon Thani Province, Thailand
14:20 – 14:35	Kanang Setyo Hindarto (Indonesia): Land Resource Management Model in Transmigration Settlement: A Case Study in Pelabi Transmigration Settlement, Lebong District, Indonesia
14:35 – 14:50	Winyoo Kromkratoke (Thailand): Financial Performance Analysis of Rubber Cooperatives in Trat Province, Thailand
14:50 – 15:05	COFFEE BREAK
15:05 – 15:25	Invited Speaker: Dr. Phattaraporn Soyong (Thailand): Application of Geographic Information System-GIS for Human Settlement, case of Water based Community in Eastern Region of Thailand
15:25 – 15:40	Suchart Chayhard (Thailand): Application of Unmanned Aerial Vehicle to Estimate Seagrass Biomass in Kung Kraben Bay, Chanthaburi province, Thailand
15:40 – 15:55	Somchaivang Dethoudom (Lao): Application of Geo-information Technology for Vientiane Addressing Project Implementation in the Core Vientiane Municipality, Vientiane Capital, Lao PDR
15:55 – 16:10	Jeeranun Khermkhan (Thailand): Economic Effects of Agriculture Sector Affecting to Other Industry Sectors in North Eastern Region of Thailand
16:10 – 16:25	Suthep Mungkhun (Thailand): Utilization and Protection Welfare of Buffalo in Phuket
16:25 – 16:40	Pichitporn Pholgerddee (Thailand): The Study of Distribution and Spatial Relationship of Leptospirosis Incidence Using Geoinformation Technology: A case study of Nakhon Si Thammarat province, Thailand
16:40 – 16:55	Wanida Hongmaneerat (Thailand): Adaptation of Aging Farmer Life Style by Practice Teaching Media and Media Related to Health
16:55 – 17:10	Worawut Inthanon (Thailand): Adaptation of Way of Life and Occupation Opportunity of the Elderly Farmers by Khao Mao Product: A Case Study of Baan Nam Kam Community, That Phanom District, Nakhon Phanom Province
17:10 – 17:25	Pornsri Laurujisawat (Thailand): Analyze the Zoning Strategies on Supply and Demand Chain Management to Enhance Sustainable Agriculture in Thailand
17:25 – 17:40	Wannasakpijitr Boonserm (Thailand): The promotion of Bun Bang Fai tradition (Rocket Festival) in Community following Eco-culture concept

List of Posters

No. Poster Session 1: PLANT SCIENCES AND SOIL MANAGEMENT

Chairs: Prof. Dr. Danilo S. Josue (Philippines), Prof. Dr. Widodo Widodo (Indonesia), Dr. Mohammad Chozin (Indonesia), Dr. Narumon Tangthirasunun (Thailand)

1. **Adisak Puangbanyen (Thailand):** Effects of Gibberellin from Banana Stalk to Increase the Stem Elongation in Marigolds by Cuttings
2. **Alisa Kongjaimun Yoshida (Thailand):** Fine Mapping of Quantitative Trait Loci for Seed-related Traits in Yardlong Bean
3. **Chadaporn Senakun (Thailand):** Diversity, Utilization and Cultural Significance of Purple Rice in Northeastern Thailand
4. **Krittayaporn Meesook (Thailand):** Influences of Gamma Ray and Polyethylene Glycol to Identified the Drought-Resistant in the rice (*Oryza sativa* L. cv. Riceberry) by Plant Tissue Culture
5. **Leelawadee Ngoenggam (Thailand):** In-vitro Effect of Plant Growth Regulators (PGRs) for Callus Induction and Plant Regeneration from Suspension of Hamata (*Stylosanthes hamata* cv. *Verano*)
6. **Natnicha Jedoroh (Thailand):** Optimization on Micropropagation of *Kadsura heteroclita* (Kad 024) by In-vitro Node Culture
7. **Nittaya Phakamas (Thailand):** Application of Soil Test Kit for Evaluating Nitrogen Fertilizer Requirement of Napier Pak Chong 1 Grass in Thailand
8. **Pailyn Thongsanitgarn (Thailand):** Effect of Para Rubber Latex and Coir on Compressive Strength, Water Absorption, and Volumetric Change of Adobe Brick
9. **Pantipa Na Chiangmai (Thailand):** Alleviation of Salt Stress on Germination of Rice (*Oryza sativa* L.) by Exogenous Supply of Indole-3-acetic Acid (IAA) Derived from Bacteria
10. **Pattana Pasorn (Thailand):** Evaluate Characteristics of New Cherry Tomato Varieties of Mahasarakham University
11. **Paulina Justo Alvaran (Philippines):** Organic and Inorganic Fertilization in Direct Seeded and Transplanted Onion
12. **Pimchanok Tongsad (Thailand):** The Effect of Plant Growth Regulator and In-vitro Conservation of Teak (*Tectona grandis* L.) by Tissue Culture
13. **Rujira Rakrawee (Thailand):** Efficiency of Cytokinin for In-vitro propagation of *Gluta usitata* (Nampung3)
14. **Rustikawati (Indonesia):** Juvenil Stage and Field Selection for Salinity Tolerance Genotypes of Rice
15. **Sokhuma Pasukho (Thailand):** Effect of IBA and NAA on Rooting and Axillary Shoot Outgrowth of 'Himalayan' Mulberry Stem Cutting
16. **Somyot Detpiratmongkol (Thailand):** Effects of Different Harvesting Times on Growth, Yield and Quality of Kalmegh (*Andrographis paniculata* Wall Ex. Nees)
17. **Sukunya Yampracha (Thailand):** Effect of Secondary Nutrients and Micronutrients Deficiency on Growth of Cassava
18. **Supawadee Ramasoot (Thailand):** Colchicine and UV Radiation Treatment on Somatic Embryo Formation of Hybrid Oil Palm Sub-PSU Variety
19. **Wanrawee Kunwanlop (Thailand):** Effect of plant growth regulators on micropropagation of *Vanilla aphylla* and *Vanilla planifolia* sp. variegata

No. **Poster Session 2: MICROBIAL BIOTECHNOLOGY AND PLANT PROTECTION**

Chairs: Prof. Dr. Rosemarie del Rosario Josue (Philippines), Dr. Fahrurrozi Fahrurrozi (Indonesia), Dr. Supattra Poeaim (Thailand)

1. ~~**Dao Hong Nu Dteu (Vietnam):** Isolation, Screening and Identification of Antagonistic Root Rot Endophytic Bacteria of Black Pepper (*Piper nigrum* L.) In Dong Nai Province, Vietnam~~
2. **Fucheng Zhang (China):** Nano-particles Constructed from *Chaetomium brasiliense* and *Trichoderma harzianum* strain PC01 sp to Control Anthracnose Disease in Chili
3. **Komkhae Pilasombut (Thailand):** In vitro Antimicrobial Properties of Different Solvent Extracts from *Carissa carandas* L. Fruits
4. **Mongkol Rachsawan (Thailand):** Antimicrobial and herbicidal activities of *Senna spectabilis* extracts against plant pathogens
5. **Nguyen Huy Thinh (Thailand):** Optimal Extraction Solvents use for Extraction of *Thunbergia laurifolia* Linn. Leaves and its Mode of Action on Weed Control
6. **Nuchjaree Wanasiri (Thailand):** Efficiency of Antifungal Compounds Against Powdery Mildew Disease of Roses (*Podosphaera pannosa*)
7. **Saowapar Khianggam (Thailand):** Study on the Optimization for Increase Production of Indole Acetic Acid from Bacterial Endophyte RD4-1-1
8. **Sararat Monkhumg (Thailand):** Isolation and Characterization of Antagonistic Bacteria to Control Rice Fungal Diseases.
9. **Somporn Na Nakorn (Thailand):** Fruit Growth and Development of Pummelo cv. Tubtim Siam at the Difference Tree Age and Fruit Age for the Optimal Harvesting Time under the Climate Variation
10. **Wattanachai Pongnak (Thailand):** Research on biofertilizers for organic crop production

No. **Poster Session 3: ANIMAL, FISHERY SCIENCE AND ENTOMOLOGY**

Chairs: Prof. Dr. Bernadette C. Mendoza (Philippines), Dr. Tatik Suteky (Indonesia), Dr. Auaree Suksomnit (Thailand)

1. **Bhutharit Raksasiri (Thailand):** The Effect of Supplementation of Synbiotic in Broiler Diets on Production Performance, Intestinal Histomorphology and Carcass Quality
2. **Chaowanee Laosutthipong (Thailand):** Genetic Relationship of Maternal Lineages in Phetchaburi Native Cattle
3. **Nathaporn Hiranon (Thailand):** Effect of Different Forms of Selenium on Fatty Acid Composition in Broiler Meat
4. **Nion Chirapongsatunkul (Thailand):** Effectiveness of Split Mushroom (*Schizophyllum commune*) By Product Extracts as Antimicrobial and Antioxidant Activity for Aquaculture
5. **Panida Duangkaew (Thailand):** Nutritional Composition Improvement of Palm Kernel Meal Using Feed Enzyme and Yeast Cake
6. **Saranpong Thongruang (Thailand):** Effects of Tropical Forage Species on *Butyrivibrio fibrisolvens*, *Fibrobacter succinogenes* and Total Bacteria Population in Goat Rumen Observed using Real-time PCR Techniques
7. ~~**Sineenart Polyorach (Thailand):** Effects of Microbial Mixture Fermented Liquid (MMFL) Supplementation in Grass Silage on Chemical Composition Rumen Fermentation and Digestibility in Beef Cattle by using In vitro Gas Production Technique~~
8. **Supapan Boonkied (Thailand):** The Effect of Adding Mung Bean Meal Supplementation on Napier Pakchong 1 Silage on Fermentation Quality and Nutrient Composition
9. **Yada Singpun (Thailand):** The Occurrence of MRSA, MSSA and Antibiotic Resistance, Related Factors in Area of Dairy Farming of Mahasarakham Province, Thailand

No. Poster Session 4: ENVIRONMENT, TOXICOLOGY, SOCIO ECONOMIC, COMMUNITY DEVELOPMENT AND AGRICULTURAL DEVELOPMENT

Chairs: Prof. Dr. Zainal Muktamar (Indonesia), Dr. Pakkapong Pongsuk (Thailand), Dr. Pailyn Thongsanitgarn (Thailand)

1. **Ariya Wongphimsorn (Thailand):** The Development of Management Aspects Campus, Energy and Building, Waste, Water, Transportation and Education and Outreach for the Green University
2. ~~**Arunpak Pitakpong (Thailand):** The Quality of Drinking Water in School of Phayao Municipal, Phayao Province~~
3. **Dee Chunsuparek (Thailand):** The Agricultural Water Resource Management Model in Lam Se Bai Irrigation Area, Amnat Charoen Province, Thailand.
4. **Kannika Sookngam (Thailand):** The Public Hearing of the Communities around Mahasarakham University about the Economic, Social, Health and Environmental Impacts
5. **Likhit Junkaew (Thailand):** The Development of Environmental Education Teachers the King Bhumibol Adulyadej's Science
6. **Moammar Dayoub (Syria):** Adaptation to Climate Change using agricultural innovation for increasing income for small-scale farmers in Africa
7. **Nopphatsorn Siriwatthanamichai (Thailand):** The Development of Organic Farming Promoting Manual for Agriculturers of Ban Nongtokpan Tambon Nongtokpan, Amphoe Yang Talat, Kalasin Province
8. **Onuma Thonglor (Thailand):** Comparison Time Series Model of Mean Monthly Temperature in Prachuap Khiri Khan Province, Thailand.
9. **Prayoon Wongchantra (Thailand):** Treditional Community and Participation in Development Arae of Koh Lipe, Satun of Thailand on Environmental Good Governance
10. **Sigit Mujiharjo (Indonesia):** Implementation of Fine Sand's Capillary Force to Filter Polluted Water: A Study on Change of Capillary Force Height to the Debit and Physical Quality of Filtered Swamp Water
11. **Songvoot Sangchan (Thailand):** The Effect of Land Use Change on Surface Runoff (A Case Study of Fang Watershed, Northern Thailand)
12. **Suparat Ongon (Thailand):** Initial Environmental Impact Assessment Study Development Project of the Area of the Makkasan Bangkok, Railway of Thailand
13. **Surasak Kaeongam (Thailand):** The Development of Environmental Volunteer Spirit for High School Students
14. **Wanlee Lerdchai (Thailand):** The Initial Environmental Examination of Mangoes Plant Agricultures Community at Ban Lon, Nangdad Sub-district, Nong Bua Daeng District, Chaiyaphum Province
15. **Wirat Pansila (Thailand):** The Process of Learning to Strengthen the Public Policy Team to Social Well-being for Social Participation based on Intellectual Property (4P-W) Phase 2

18:00

CLOSING CEREMONY

Guest of Honour Award

Presentation of Best Paper Awards for Oral and Poster

Conclusion Remarks: Prof. Dr. Timo Korpera (Finland), Chairman of International Advisory Committee

Future Remarks: Prof. Dr. Nanik Setyowati, Chair, International Organizing Committee

Closing Address and Future Remark: Assoc. Prof. Dr. Kasem Soyong, President of AATSEA

Singing of the ICIST Theme Song

"IMAGINE"

19:00

FAREWELL DINNER

DAY3

29 November 2018 - Study Tour

CLOSING REMARK

The honorable Prof. Timo Korpela, the Chaiman of International Advisory Committee
The honorable Prof. Kasem Soyong, The President of AATSEA
Respected Ladies and Gentleman 7th ICIST participants

After 2 full days of the seminar, it is time for us to meet here in this ballroom for the closing ceremony.

Both oral and poster presentations during 2 days of seminar running well and the best either poster or oral presenters was decided at the end of each session. I would like to say Congratulations to all the winners.

At this special moment I would like to say thanks you very much to everyone involving in the International Advisory Committee, International Organizing Committee, Local Organizing Committe as well as the EO The Khama Bali Travel. All of us was trying to do our best for this conference. However during the conference, the committee would like to apologizes for unpleased service. Hope we can serve you much better in the future.

I also would like extend my thanks to Prof. Timo Korpela, the Chaiman of the International Advisory Committee and Prof. Kasem Soyong, The President of AATSEA who gave the opportunity to the University of Bengkulu as Local Organizer of this prestisious Conference. We also thank to Warmadewa University for the nice cooperation as Co-local Organizer. Thank you very much also extend to the other organizers for your nice cooperation so that the conference running successfully.

Tomorrow is the time we have been waiting, because it's time to look around Bali Island after the conference. You can visit many tourism spot and destination both cultural, beach, mountain, culinary and for sure shopping tourism. Enjoy your vacation on the island of Bali.

Finally, after the seminar here in Bali, Indonesia, next year we will have the 8th ICIST Seminar in China. For everyone, see you in China in 2019.

Organizing Committee
Prof. Nanik Setyowati

TABLE OF CONTENTS

	Page
Foreward	I
International Organizing committee	III
Program	XV
Abstract for Oral Presentation	XLIV
DAY 1: November 27, 2018	
Keynote session	
Important of biodiversity for development of sustainable bio-Business	1
Innovation as game changer for scaling up the adoption of organic farming: focus in the Philippines	1
Trends and challenges in organic farming in the European Union	2
The Development of Agri-Tourism on Organic Farms in Thailand and Laos	3
New challenges towards sustainable future	3
Impact Evaluation of the Women Empowerment Program of Zamboanga del Sur	4
Session 1: ORGANIC AGRICULTURE AND RELATED FIELDS	
Residual Effect of Vermicompost on Sweet Corn Growth and Selected Chemical Properties of Soil from Different Organic Farming Practices	4
The Development of Organic Farming Network Learning Centers for Youth in Kantharawichai District, Mahasakham Province, Thailand	5
Facilitation of Organic Agriculture Learning in School and Community	5
Relationships between Potassium Uptakes and Yield Performances of Sweet Corn Grown Under Organic Production System	6
Nano-particles derived from <i>Chaetomium elatum</i> against <i>Phytophthora</i> rot of Durian	6
Organic Agriculture in Lao PDR	7
Effective of <i>Neosartorya</i> to Control <i>Phomopsis asparagi</i> Causing Stem blight Disease on Asparagus	7
The use of Epiphytic Lichen as a Biomonitor on Air Quality, Nitrogen Dioxide and Sulphur Dioxide Deposition in Mab Ta Phut Industrial Estate, Rayong Province	8
Callus Induction and Regeneration from Seeds of some Thai Indigenous Upland Rice (<i>Oryza sativa</i> L.) and Lowland Rice Varieties	8
Biological Control of Anthracnose Disease on ‘Namwa Mali-Ong’ Banana by <i>Neosartorya</i> sp.	9
Effective of <i>Neosartorya</i> and <i>Talaromyces</i> Use to Control <i>Alternaria brassicicola</i> Causing Leaf Spot Disease on Kale	9
Nano-particles from <i>Trichoderma harzianum</i> against Rice Blat Pathogen	9
Nano-particles constructed from <i>Chaetomium brasiliense</i> against root rot disease of tangerine	10
Growth Analysis of Sweet Corn as Amended with Different Types of Organic Fertilizers	10
Phosphate-solubilizing Bacteria from Upland Rice (<i>Oryza sativa</i> L.) Rhizosphere and their Tricalcium Phosphate Solubilizing Abilities	11
Production and Yield Attributes of Biofertilizers on Pulse Crops	11
Session 2: PLANT AND FOOD TECHNOLOGY	
Improvement of Oil Yielding Crops Yield Attributes using Plant Growth Promoting Rhizobacteria	12
Effect of Oil Addition on In-vitro Starch Digestibility and Physicochemical Properties of Instant Rice	12
The effect of Freezing Method, Packaging Type and Storage Time on the Quality of Moo-Chamoung Curry Frozen	13
Diversity and Evenness of Indigenous Vegetables in Nakhon Si Thammarat Province, Thailand	13
Effect of Different Nitrogen Fertilizer Forms on Growth and Yield of Four Tropical Pasture Grasses	14
Probiotication of Black Jelly [<i>Mesona chinensis</i> (Benth)] by Encapsulated <i>Lactobacillus plantarum</i> Mar8 for A Ready to Drink (RTD) Beverages	14
<i>Emericella</i> sp and <i>Neosartorya</i> sp for Controlling <i>Colletotrichum capsici</i> caused Anthracnose of Chili	15
Nano-particles from <i>Chaetomium brasiliense</i> to Control <i>Phytophthora palmivora</i> caused Root Rot Disease in Durian var Montong	15
Effects of Sulfometuron-methyl as Chemical Ripener on Growth and Yield of Three Sweet Sorghum Cultivars	15

Effects of BA and NAA on Plant Regeneration of Neck Orange (<i>Citrus reticulata</i> Blanco)	16
Comparison of Antioxidant Properties in Different Herbal Fresh Sausages	16
Acclimatization of Pencil Orchid (<i>Papilionanthe hookeriana</i> Rchb.f) using Types of Planting Media and Fertilization	17
<i>Chara corallina</i> Klein ex Willdenow (Charales), A New Record of Edible Freshwater Algae in Southern Thailand	17
Response of Biomass and Yield of Stevia (<i>Stevia rebaudiana</i> Bertoni.) to Fower Removal	18
Response of Broad Bean Growth and Early Yield to Exposure Period of Vernalization	18
Efficacy of <i>Eurotium</i> sp and <i>Serratia</i> sp to Control Brown Spot Disease of Rice caused by <i>Drechslera oryzae</i>	19
Session 3: MICROBIAL BIOTECHNOLOGY, BIODIVERSITY, TAXONOMY, BIOLOGICAL ACTIVITY	
New Edible Mushroom from Discovery to Production	19
Biodiversity of Soil Macroarthopods and Relationship with Environmental Factors in Northeastern Thailand	20
Mass Rearing and Dispersal of Biological Control Agents (BCAs) as Interventions in Coconut Scale Insect (CSI) Calamity Areas in Basilan, Philippines	20
Earthworm Biodiversity in Oil Palm Plantation and Secondary Forest Patch in Riau, Indonesia	21
Phenolic Compounds and Antioxidant Capacities of Mao-Luang Leaves (<i>Antidesma thwaitasianum.</i>) Cultivars from Northeastern Thailand	21
Mycotoxin in Pathogenic Fungi	22
Deproteinization in Purification of Exopolysaccharide from <i>Ophiocordyceps sinensis</i> Olive Oil – Stimulated Culture	22
In Vitro Antioxidant Activities and Phenolic Compounds Content from Karanda (<i>Carissa carandas</i> L.) Wine	22
Antibacterial and Anti-tyrosinase Activities of the Methanolic Extract from Leaves of <i>Tectona grandis</i>	23
Fermentation of Gac Juice Mixture by Probiotic Lactic Acid Bacteria	23
Phytochemical Screening of <i>Coffea arabica</i> Crude Extract and Its Inhibiting Activity Against <i>Aspergillus flavus</i>	24
The Efficacy of Plant Extracts, Bio-insecticides, Petroleum Oil and Insecticides for Controlling Thrips (Thysanoptera: Thripidae) in Pummelo cv. Tubtimsiam in Nakhon Si Thammarat Province, Thailand	24
Mating Type and Genetic Diversity Analysis of <i>Pyricularia oryzae</i> Collected from Thai Rice Varieties during Year 2016 and 2017	25
Nano-particles from <i>Cheatomium brasiliense</i> against Brown Spot of Rice	25
Isolation, Characterization, and Identification of Pigmented Fungi from Mangrove Areas in Bataan, Philippines	26
Session 4: ANIMAL AND FISHERY SCIENCES	
Feeding Strategy for Cattle Production under Cattle-Oil Palm Integration System in Bengkulu, Indonesia	26
Virulence Factor Gene Profiles of <i>Aeromonas veronii</i> Isolated from Diseased Nile Tilapia (<i>Oreochromis niloticus</i>) in Nakhon Si Thammarat Province and Its Expression towards Diurnal Water Temperature Changes	27
Phytochemical Screening and Masculinization of Nile Tilapia (<i>Oreochromis niloticus</i> Linnaeus) using The Needle and Root Crude Extracts of Benguet Pine (<i>Pinus kesiya</i> Royle ex Gordon)	27
Degradation of Troponin-T associated with Calpain/ Calpastatin Genes Expression in Thai Native Beef Cattle Fed Different Levels of Energy	28
Acoustic Target Strength Measurement of Several Reef Fishes in Tikus Island Waters of Bengkulu	28
Digestive Enzymes in Hybrid Catfish Fed with Spirulina (Arthrospira) Additive Feed	29
Effects of <i>Melastoma malabatricum</i> Extract on Nutrient Digestibility of Local Goat Infected with Gastro Intestinal Parasites	30
Effect of Dietary Organic and Inorganic Selenium on Carcass Composition and Meat Characteristics of Broiler Chickens	30
Effects of Varying Levels of Horseradish (<i>Moringa oleifera</i>) Leaf Meal on The Growth and Survival of Red Nile Tilapia (<i>Oreochromis niloticus</i> L.)	31
The Effects of Oil Enriched Diets on Growth, Feed Conversion Ratio and Fatty Acid Content of Nile Tilapia (<i>Oreochromis niloticus</i>) in Biofloc System	31
DNA Barcoding of Two Major Commercially Important Fish Families (Carangidae and Lutjanidae) Collected from Cuyo, Palawan, Philippines	31
Study on Vaginal Epithelial Cells in Brahman Cattle Suspected Reach Puberty	32
Cholesterol Content and Fatty Acid Composition in Longissimus dorsi Muscle of Purebred and Crossbred Pigs	32

Inhibition of Acetylcholinesterase Activities in Whitegoby <i>Glossogobius giuris</i> from the East Bay of Laguna Lake, Philippines	33
Session 5: ENVIRONMENTAL SCIENCE, SOIL AND WATER CONSERVATION	
Cost-benefit Analysis of Waste Segregation Business in Amnatcharoen Province of Northeastern Thailand	33
The Development of Environmental Recreation Camp Activities for Youth in Roi-Et Province	34
Spatial Variability in Soil Water under Adjacent Mature Oil Palm and Rubber Plantations: Application of a New Dielectric Method in Evaluating Soil Water	34
Promoting the Conservation of Watershed Forestry among Environmental Education Students at the Faculty of Environment and Resource Studies	35
Effects of Organic Fertilizer Application on The Transformation of Nitrogen in Paddy Soil	35
Ingestion of Microplastics by Some Commercial Fishes in the Lower Gulf of Thailand: A Preliminary Approach to Ocean Conservancy	36
The Development of a Camp on Natural Resources and Environmental Conservation in the ASEAN for youth in Roi-et Province	36
Participatory Action Research for Waste Management of KSL River Kwai Natural Agriculture Center, Kanchanaburi Province, Thailand	37
Landscape Assessment and the Use of Old Growth Rehabilitated Mined Site for Agroforestry System: Case of coal mined site at Tanjung Enim, South Sumatra	37
The Study of Participatory Monitoring of Air Quality and Urban Heat, Case Study Udon Thani Province, Thailand	38
Utilization of Continuous Type Rice Hull (CtRH) Pyrolizer: Co-Generation of Heat and Biochar for Enhance Agricultural Productivity in Degraded Acid Uplands Soils in Philippines	38
Water Management Model for Lower Mekhong Basin of Lao People's Democratic Republic	39
Utilization of Pectin from Calamansi (<i>Citrofortunella microcarpa</i>) Peels as Superabsorbent Polymer for Soil Moisture Retention	39
Session 6: SOCIO ECONOMIC, COMMUNITY DEVELOPMENT AND AGRICULTURAL DEVELOPMENT	
The Promotion of Adaptation to Climate Change using Manual for high school students at Si sawat Wittaya Municipality School, Mahasarakham Province, Thailand	40
The People's Participation on the Indigenous Serrated Mud Crab Fattening Practices in La-ngu District, Satun Province, Thailand	40
Smallholder Farmers' Perception to Climate Change Impact on Crop Production: case from drought prone areas of Bangladesh	41
Reciprocity and Participatory Approach in Decentralized Biodiversity Development and Cultural Heritage Management in Community-Based Tourism, Thailand	41
The Agriculture Tourism Management in Family Business: Case Study of Rayong Province, Thailand	42
Double Row Transplanting Method: A Novel Rice Crop Establishment but Why Farmers don not Adopt it?	42
Quality of Life Development and Occupation Opportunity of the Elderly by the Selection of Herbal Plant Using: A case Study of Nakhon Phanom Province and Neighboring Provinces for the Development of Society and Environment	43
Performance and Obstacles of the Royal Initiative Discovery Foundation in Thailand	43
The Operation Performance of Khao Hin Som Agricultural Cooperative Rice Mill Ltd., Chachoengsao Province, Thailand	47
The Effect of Ownership Form on The Productivity and Sustainability of Forests in Salla Municipality, Northern Finland	47
Factors Affecting Self-protection Behaviors of Pesticide use of Sugarcane Agriculture, Phetchabun Province	46
SWOT Analysis and Marketing Strategies Development of Agricultural Products for Community Group in Nong Chok, Bangkok, Thailand	47
Studies on Macro-Invertebrates of Sto, Tomas Cove, La Union, Philippines	47
Application of Sufficiency Economy Philosophy of the Committee to Drive and Operate School Sufficiency Economy, Debsirinromklao School, Thailand	48
Changes and Continuity of Agrarian System and Village Communities in the Central Plain of Thailand	48
Study on the causes and Weedy Rice Management of Farmers in Lumplatiw community, Ladkrabang District, Bangkok Metropolitan, Thailand	49
Opportunity and Risk from Urban Planning Policy relating to Real Estate Development and Preservation of Rural and Agricultural Areas at the Present in Mueang Chantaburi of Thailand	49

Visualization and Potential Risk-Mapping of Mosquitoes in the Philippines using Mosquito Habitat Mapper Application	50
English Classroom Stress and Anxiety of Students and Teachers at Colleges of Agriculture and Technology in Upper Northern Thailand	50
The Development of Network New Theory Agriculture in Ban Kung, Surin Province Thailand	51
A Research Output in Agriculture and Social and Related Study	51
DAY 2: November 28, 2018	
Keynote Session	
Manufacturing-based Agro-industrialization: The Supply and Value-added Chain (Svac) and Agro-processing Cluster Framework and Business Models	52
Use of Ultra-Light Uav Drones in Agriculture: Analys, Monitoring and Control	52
Ethnostudy of Mushrooms and Establishment of Pure Culture of Cantharellus Species (Ero Umunwene) A Newly Discovered Mushroom Found in Ukwa-East, Abia State, Nigeria	53
Biodiversity for the Development Sustainable Bio-Enterprise	54
Can Organic Agriculture Feed the Smallholders? -Experience from Rural Bangladesh	54
Trade in Donkeys and its Implications on Food Production by Smallholder Farmers in Africa	55
Session 1: ORGANIC AGRICULTURE AND RELATED FIELDS	
Growth and Yield Responses of Cauliflower on Tithonia (<i>Tithonia diversifolia</i>) Compost under Organic Farming Practices	55
Fungal Elicitors and Their Nano-Product for Plant Immunity	56
Growth and Yield Response of Pakcoy (<i>Brassica rapa</i> L.) On Various Concentrations of Organic Liquid Fertilizer of Jiringa Hulls [<i>Phithecellobium jiringa</i> (Jack) Prain]	56
KMITL Organic Model	57
The Energy Footprints of Inbred and Hybrid Rice Genotypes Grown under Organic and Conventional Production System in Laguna, Philippines	57
Sustainable Rice Production by Plant Health Improving Microbiome	58
Effect of Biogas Effluent from Pig Manure and Longan (<i>Dimocarpus longan</i>) Residues on Growth of Marigold (<i>Tagetes erecta</i>)	59
Performance of Sweet Corn Hybrids under Organic Crop Management across Three Agro-Climatic Zones of the Tropics	60
Knowledge and Attitudes toward Marketing Innovation for Organic Rice Farmers in Sanam Chai Khet Organic Agriculture Group, Chachoengsao Province, Thailand	60
Nano-particles from <i>Chaetomium lucknowense</i> to Inhibit Rice Blast Pathogen caused by <i>Pyricularia oryzae</i> in Pot Experiment	61
A Survey of Nematode Disease Infecting Arabica Coffee Plants in the Northwestern Vietnam	61
Advanced Research and Development of Biological Products as Agricultural Inputs for Organic Agriculture	62
Session 2: PLANT AND FOOD TECHNOLOGY	
Improvement Antimicrobial Activity of Wool Fibers Dyed with Natural Dyes Extracted from Onion and Red Prickly Pear using Propolis Nanoparticles	62
Effect of Preharvest Chitosan Application on Bioactive Compounds of Sunflower Sprouts During Storage	63
Application of Advance Oxidation Process Combination with Fine Bubble Technology on the Reduction of Escherichia Coli O157:H7 Contaminated on Bird Eye Chili (<i>Capsicum frutescens</i> L.)	63
Effects of Microbial Fermented Liquid (MFL) Supplementation on Gas Production Kinetics and Digestibility using In-vitro Gas Production Technique	64
Millet-21 st Century Climate Resilient Nutricrop	64
The Utilization of Ultrasound and Chilling Treatment to Reduce GI in Thai Glutinous Rice (RD6)	65
Appropriate Technology for Hom Kradung Nga Rice Production in Bacho Swamp	66
Effect of Various Ethephon Concentrations on Flowering, Yield, Costs and Returns of Productions of Four Pineapple Varieties	66
Effect of Indigenous Microorganism Extended Solution (IMO-ES) on Basmati Rice	66
Effect of Potassium Chlorate combining with Paclbutrazol, Monopotassium Phosphate and Mepiquat Chloride on Fruit Quality of Longan (<i>Dimocarpus longan</i>)	67

Efficiency of Salicylic Acid Immersion Using Fine-Bubble Technique on Quality of Musa AAA Fruit During Ripening	67
Morphology and Anatomy of Rose Wood (<i>Dalbergia cochinchinensis</i>) and Relationship between its Elemental Components and Soil Properties for Identification of Endemic Species	68
Development of Ca and Si Nanofertilizer from Agricultural Waste for Enhanced Rice Crop Production	68
Session 3: MICROBIAL BIOTECHNOLOGY, BIODIVERSITY, TAXONOMY, BIOLOGICAL ACTIVITY	69
Development and application of biotechnological products for sustainable corn and soybean production under stresses condition	69
Studies on Fungal Diversity of Coastal Region in Zhejiang Province and Fungal Resource Exploitation	70
Antioxidant and Antityrosinase Activities in Germinated Brown Rice of Indigenous Thai Cultivars	70
Agronomic and Grain Quality Characterization of Different Special Rice Genotypes	71
Bio Product	72
Isolation and Characterization of Keratinolytic Bacteria from Soil Samples of Poultry Waste Dumping Sites	73
Biological Activities of the Methanolic Extracts from Two Varieties of <i>Dimocarpus longan</i> Seeds	74
Physicochemical Properties and Oxidative Stability of Oils from Samrong (<i>Sterculia foetida</i>) Seed	74
Forest Litter Filamentous Fungi Inhabiting Different Elevations of Mt. Makiling, Philippines and Screening of Selected Isolates for Enzyme Activities	75
Dung Beetle Assemblages in Three Human-modified Landscapes in Northeastern Thailand	75
Detection of Putative Bioactive Compounds and Minimum Inhibitory Concentration of <i>Imperata cylindrica</i> Extract Against Identified Seed-borne Fungi from Mung Beans	72
Session 4: ANIMAL AND FISHERY SCIENCES	
Effect of Artificial Feed and Algae on Growth Rate of <i>Spondylus</i> sp	76
Analyses of Body and Chest Morphometric Comparison between two Indonesian Local Poultry Species	77
Species Inventory and Assessment of Sea Cucumber in Key Marine Geographic Areas in the Philippines (Iuzon cluster)	77
Efficacy of Herbal Extracts to Control Multi-Antibiotics Resistant (MAR) <i>Aeromonas veronii</i> Isolated from Motile <i>Aeromonas</i> Septicemia (MAS)-Exhibiting Nile Tilapia (<i>Oreochromis niloticus</i>)	78
Comparison of Toxic Effects of <i>Psidium guajava</i> Leaf and Bark Extracts against Brine Shrimp (<i>Artemia salina</i>)	78
Potential of Microbial Degradation of Musty Odor in Aquaculture Pond	79
Present Status and Management Strategies of Tropical Eels Genus <i>Anguilla</i> in Bengkulu Province of Indonesia	79
Cultures of Siamese Fighting Fish (<i>Betta splendens</i>) Fed with Live Food and Commercial Feed added with Effective Microorganisms	80
Impact of Methyl Salicylate Lures on the Population of <i>Eucarazzia elegans</i> (Ferrari) (Aphididae) and its Natural Enemy in Common Sage	80
Influence of Charolais Sires and Seasons on Growth Performance and Carcass Characteristics in Crossbred Steers	81
Integrated Rice-Duck Farming Systems: Addressing the Needs of the Farmers for Its Adoption in Zamboanga Del Sur, Philippines	81
Milk Production and Milk Income over Feed Cost of Dairy Cow Fed Fermented Cassava, Tabut Block, and Concentrate Containing <i>C. xanthorrhiza</i> and Yeast	82
Session 5: ENVIRONMENTAL SCIENCE, SOIL AND WATER CONSERVATION	82
Overcoming the <i>Source</i> Barriers of Energy and Water: The Two Most Critical Resource for Agriculture & Food Systems	82
Diversity of Produce Hard resin and Oleoresin Plant in Khok Hinlad Nong Ku Nadoon Community Forest Wapi Pathum District, Maha Sarakham Province	83
The Application of Carbon Balance for Low Carbon Society Development in Kut Chik Sub-district Municipality, Sung Noen District, Nakhon Ratchasima Province	83
The Feasibility Study in Development of the Kha-Kang Creek, Muang district, Maha Sarakham province	84
Restoring Livelihoods in Conflict Affected Areas in Maguindanao Province of the Autonomous Region in Muslim Mindanao in the Philippines through Aquaculture	84
Effects of Interaction between Nitrogen and Potassium on The Growth and Yield of Cassava	85

The Use of Bioreactor System and Aquatic Plants (Water Hyacinth) for Aquaculture Wastewater Treatment	85
The Effects of a Learning Management Contributing to Creativity and Environmental Preservative Mind of 5th Grade Primary School Students Using Creativity-based Learning	86
Mycodegradation of Synthetic Plastics by <i>Pleurotus florida</i> (Oyster Mushroom)	86
Responses of Sago Palm under Water Deficiency Condition	87
Comparative Energy footprint of Cambodian Lowland Rice Grown under Different Establishment Methods	87
Response of Several Hot Pepper Genotypes to Increasing Drought Stress	88
Identification of Best Segregating Family of NSIC Rc222/Jumbo Jet Under Salt Stress at Reproductive Stage for Use as a Mapping Population	88
Session 6: SOCIO ECONOMIC, COMMUNITY DEVELOPMENT AND AGRICULTURAL DEVELOPMENT	89
The Production Efficiency and Determinant Factors Affecting Efficiency of Smallholder Farmers Implementing Indonesia Sustainable Palm Oil Production System	89
Ability Development for Reading Comprehension on Environmental Conservation: Brain Based Learning (BBL) of High School Students	89
Enhancing Productivity and Profitability of Rainfed Rice Production Areas Through Adoption of Improved Rice Ratooning Technology in Nueva Ecija, Philippines	90
The Promotion to grow upside down for villagers of Ban Thakhonyang, Thakhonyang, Kantharawichai Sub District, Maha Sarakham Province	90
Assessment of the Project for Supplementary Incomes of Small Scale Farmers Raising Silver Barb in Baan Doong District, Udon Thani Province, Thailand	91
Land Resource Management Model in Transmigration Settlement: A Case Study in Pelabi Transmigration Settlement, Lebong District, Indonesia	91
Financial Performance Analysis of Rubber Cooperatives in Trat Province, Thailand	92
Applications of Geographic Information System-GIS for Human Settlement, case of Water based Community in Eastern Region of Thailand	92
Application of Unmanned Aerial Vehicle to Estimate Seagrass Biomass in Kung Kraben Bay, Chanthaburi province, Thailand	93
Application of Geo-information Technology for Vientiane Addressing Project Implementation in the Core Vientiane Municipality, Vientiane Capital, Lao PDR	93
Economic Effects of Agriculture Sector Affecting to Other Industry Sectors in North Eastern Region of Thailand	94
Utilization and Protection Welfare of Buffalo in Phuket, Thailand	94
The Study of Distribution and Spatial Relationship of Leptospirosis Incidence Using Geoinformation Technology: A case study of Nakhon Si Thammarat province, Thailand	95
Adaptation of Aging Farmer Life Style by Practice Teaching Media and Media Related to Health	95
Adaptation of the Life way and Occupation Opportunity for the Elderly Farmers with Khao Mao Product: A Case Study of Baan Nam Kam Community, That Phanom District, Nakhon Phanom Province	96
Analyze the Zoning Strategies on Supply and Demand Chain Management to Enhance Sustainable Agriculture in Thailand	96
The promotion of Bun Bang Fai tradition (Rocket Festival) in Community following Eco-culture concept	97
Abstract of Poster Presentation	XLIII
Poster Session 1: PLANT SCIENCES AND SOIL MANAGEMENT	98
Effects of Gibberellin from Banana Stalk to Increase the Stem Elongation in Marigolds by Cuttings	98
Fine Mapping of Quantitative Trait Loci for Seed-related Traits in Yardlong Bean	98
Diversity, Utilization and Cultural Significance of Purple Rice in Northeastern Thailand	99
Influences of Gamma Ray and Polyethylene Glycol to Identified the Drought-Resistant in the rice (<i>Oryza sativa</i> L. cv. Riceberry) by Plant Tissue Culture	99
In-vitro Effect of Plant Growth Regulators (PGRs) for Callus Induction and Plant Regeneration from Suspension of Hamata (<i>Stylosanthes hamata</i> cv. <i>Verano</i>)	100
Optimization on Micropropagation of <i>Kadsura heteroclita</i> (Kad 024) by In-vitro Node Culture	100
Application of Soil Test Kit for Evaluating Nitrogen Fertilizer Requirement of Napier Pak Chong 1 Grass in Thailand	101

Effect of Para Rubber Latex and Coir on Compressive Strength, Water Absorption, and Volumetric Change of Adobe Brick	101
Alleviation of Salt Stress on Germination of Rice (<i>Oryza sativa</i> L.) by Exogenous Supply of Indole-3-acetic Acid (IAA) Derived from Bacteria	102
Evaluate Characteristics of New Cherry Tomato Varieties of Mahasarakham University	102
Organic and Inorganic Fertilization in Direct Seeded and Transplanted Onion	103
The Effect of Plant Growth Regulator and In-vitro Conservation of Teak (<i>Tectona grandis</i> L.) by Tissue Culture	103
Efficiency of Cytokinin for In-vitro propagation of <i>Gluta usitata</i> (Na-pong3)	104
Juvenil Stage and Field Selection for Salinity Tolerance Genotypes of Rice	104
Effect of IBA and NAA on Rooting and Axillary Shoot Outgrowth of 'Himalayan' Mulberry Stem Cutting	105
Effects of Different Harvesting Times on Growth, Yield and Quality of Kalmegh (<i>Andrographis paniculata</i> Wall Ex. Nees)	105
Effect of Secondary Nutrients and Micronutrients Deficiency on Growth of Cassava	105
Colchicine and UV Radiation Treatment on Somatic Embryo Formation of Hybrid Oil Palm Sub-PSU Variety	106
Effect of Plant Growth Regulators for In vitro <i>Vanilla aphylla</i> and <i>Vanilla planifolia variegata</i>	106
Poster Session 2: MICROBIAL BIOTECHNOLOGY AND PLANT PROTECTION	107
Isolation, Screening and Identification of Antagonistic Root Rot Endophytic Bacteria of Black Pepper (<i>Piper nigrum</i> L.) In Dong Nai Province, Vietnam	107
Nano-particles Constructed from <i>Chaetomium brasiliense</i> and <i>Trichoderma harzianum</i> strain PC01 sp to Control Anthracnose Disease in Chili	107
In vitro Antimicrobial Properties of Different Solvent Extracts from <i>Carissa carandas</i> L. Fruits	108
Antimicrobial and herbicidal activities of <i>Senna spectabilis</i> extracts against plant pathogens	108
Optimal Extraction Solvents use for Extraction of <i>Thunbergia laurifolia</i> Linn. Leaves and its Mode of Action on Weed Control	109
Efficiency of Antifungal Compounds Against Powdery Mildew Disease of Roses (<i>Podosphaera pannosa</i>)	109
Study on the Optimization for Increase Production of Indole Acetic Acid from Bacterial Endophyte RD4-1-1	110
Isolation and Characterization of Antagonistic Bacteria to Control Rice Fungal Diseases	110
Fruit Growth and Development of Pummelo cv. Tubtim Siam at the Difference Tree Age and Fruit Age for the Optimal Harvesting Time under the Climate Variation	111
Research on biofertilizers for organic crop production	111
Poster Session 3: ANIMAL, FISHERY SCIENCE AND ENTOMOLOGY	112
The Effect of Supplementation of Synbiotic in Broiler Diets on Production Performance, Intestinal Histomorphology and Carcass Quality	112
Genetic Relationship of Maternal Lineages in Phetchaburi Native Cattle	112
Effect of Different Forms of Selenium on Fatty Acid Composition in Broiler Meat	113
Effective of Split Mushroom (<i>Schizophyllum commune</i>) By Product Extracts as Antimicrobial and Antioxidant Activity for Aquaculture	113
Nutritional Composition Improvement of Palm Kernel Meal Using Feed Enzyme and Yeast Cake	114
Effects of Tropical Forage Species on <i>Butyrivibrio fibrisolvens</i> , <i>Fibrobacter succinogenes</i> and Total Bacteria Population in Goat Rumen Observes using Real-time PCR Techniques	114
Effects of Microbial Mixture Fermented Liquid (MMFL) Supplementation in Grass Silage on Chemical Composition Rumen Fermentation and Digestibility in Beef Cattle by using In-vitro Gas Production Techniq	114
The Effect of Adding Mung Bean Meal Supplementation on Napier Pakchong 1 Silage on Fermentation Quality and Nutrient Composition	115
The Occurrence of in MRSA, MSSA and Antibiotic Resistance Related Factors in Area of Dairy Farming, Maha Sarakham Province of Thailand	116
Poster Session 4: ENVIRONMENT, TOXICOLOGY, SOCIO ECONOMIC, COMMUNITY DEVELOPMENT AND AGRICULTURAL DEVELOPMENT	117
The Development of Management Aspects Campus, Energy and Building, Waste, Water, Transportation and Education and Outreach for the Green University	117

The Quality of Drinking Water in School at Phayao Municipal, Phayao Province	117
The Agricultural Water Resource Management Model in Lam Se Bai Irrigation Area, Amnat Charoen Province, Thailand	118
The Public Hearing of the Communes around Mahasarakham University about the Economic, Social, Health and Environmental Impacts	119
The Development of Environmental Education Teachers the King Bhumibol Adulyadej's Science	119
Adaptation to Climate Change using agricultural innovation for increasing income for small-scale farmers in Africa	120
The Development of Organic Farming Promoting Manual for Agriculturers of Ban Nongtokpan Tambon Nongtokpan, Amphoe Yang Talat, Kalasin Province	120
Comparison Time Series Model of Mean Monthly Temperature in Prachuap Khiri Khan Province, Thailand	121
Traditional Community and Participation in Development Area of Koh Lipe, Satun of Thailand on Environmental Good Governance	121
Implementation of Fine Sand's Capillary Force to Filter Polluted Water: A Study on Change of Capillary Force Height to the Debit and Physical Quality of Filtered Swamp Water	122
The Effect of Land Use Change on Surface Runoff (A Case Study of Fang Watershed, Northern Thailand)	123
Initial Environmental Impact Assessment Study Development Project of the Area of the Makkasan Bangkok, Railway of Thailand	123
The Development of Environmental Volunteer Spirit for High School Students	124
Environmental Investigation of Mango Plantation Community at Ban Lon, Nangdad Sub-district, Nong Bua Daeng District, Chaiyaphum Province	124
The Process of Learning to Strengthen the Public Policy Team to Social Well-being for Social Participation based on Intellectual Property (4P-W) Phase 2	125
Full text	XLV
Wannasakpijitra, B.- The Promotion of Bun Bang Fai tradition (Rocket Festival) in Community following Eco-culture concept	126
Charoenjindarat, P., Kuhaswonvetch, S. and Panrosthip Thunmathiwat, D. – Application of the Sufficiency Economy Philosophy by the Debsirinromklao School's Board of Operations and Driving the Sufficiency Economy Philosophy, Thailand	136
Cumrae, N., Inchai, P., Sittichai, S., Saowakontha, S., and Piboon, K. - The Promotion to grow upside down for villagers of Ban Thakhonyang, Thakhonyang, Kantharawichai Sub-District, Maha Sarakham Province.	147
Inthanon, W. and Hongmaneerat, K. - Adaptation Way of Life and Occupation Opportunity of the Elder Farmers through Khao Mao Product: A Case Study of Baan Nam Kam Community, That Phanom District, Nakhon Phanom Province	154
Wongchantra, P., Wongchantra, K., Junkaew, L., Sookngam, K., Ongon, S. and Phansiri, Ch. - The Development of environmental education teachers on the King Bhumibol Adulyadej's Science	161
Lerdchai, W. and Wongchantra, P. - The initial environmental examination of agriculturists in mango plantation community at Ban Lon, Nangdad Sub-district, Nong Bua Daeng District, Chaiyaphum Province	175
Pansila, W. - The process of learning to strengthen the public policy team to social well-being for social participation based on Intellectual Property (4P-W) Phase 2	191
Rodchamnan, T. , Rattanakamonwon, P., and Kruadsoongnern, C. - English Classroom Stress and Anxiety of Students and Teachers at Colleges of Agriculture and Technology in Upper Northern Thailand	199
Thonglor, O. and Wilaiwan, S. - Comparison Time Series Model of Mean Monthly Temperature in Prachuap Khiri Khan Province, Thailand	207
Wongchantra, P., Meakawichai, P., Nangkhalaphiwat, Y., Sinthumongkolchai, O., Wongyai, A., Chandanachulaka, S., Kaewwannisakun, Ch. and Sangdanjak, N. - Traditional Community and Participation in Developmental Area on Environmental Good Governance in Koh Lipe, Satun, Thailand	219
Puangbanyen, A., Phonpakdee, R., and Anuchai, J. - Effects of Gibberellin from Pseudo-stem of Banana to Increase the Stem Elongation in Marigolds by Cuttings	235
Thanomwong, A. and Soyong, K. - <i>Emericella sp.</i> and <i>Neosartorya sp.</i> for controlling <i>Colletotrichum capsici</i> caused Anthracnose of Chilli	238

Unthuraloet, K. and Soyong, K. - Efficacy of <i>Eurotium</i> sp. and <i>Serratia</i> sp. to control Brown leaf spot disease of rice caused by <i>Drechslera oryzae</i>	245
Banchajarurat, P., Viriya, H., and Kongritti, N. - The application of carbon balance for low carbon society development in Kut Chik sub-district municipality, Sung Noen district, Nakhon Ratchasima province, Thailand	251
Krubphachaya, Ph., Aroon, S., Sukteeka, S., Paiboon, N., Noinumsai, N., Tantipanatip, W. and Thanee, N. Biodiversity of soil macroarthopods and relationship with environmental factors in northeastern Thailand	256
Songvoot, S. and Duangthip, R. - The Effect of Land Use Change on Surface Runoff (A Case Study of Fang Watershed, Northern Thailand)	263
Hongmaneerat, K. and Hongmaneerat, W. - Quality of Life Development and Occupation Opportunity of the Elderly by the Selection of Herbal Plant Using: A Case Study of Nakhon Phanom Province and Neighboring Provinces for the Development of Society and Environment	268
Hongmaneerat, W. , Hongmaneerat, K., and Pongsuk, P. - Adaptation of Aging Farmer Life Style by Practice Teaching Media and Media Related to Health	276
Tippayakraisri, K., Saikaew, P., Chukwannuan, W., Suwan, N., and Tongsiro, S. - Digestive Enzymes in Hybrid Catfish Fed with Spirulina (<i>Arthrospira</i>) Additive Feed	286
Panyada, M., Whangchai, N., Pholchan, M. and Sompong, U. - Potential of Microbial Degradation of Musty Odor in Aquaculture Pond	299
Wangkhahat, S., Pongsuk, P., Hongmaneerat, K., and Sashiyo, M. - Assessment of the Project for Supplementary Incomes of Small Scale Farmers Raising Silver Barb in Baan Doong District, Udon Thani Province, Thailand	316
Mungkhun S. , Pongsuk, P., Intorrathed, S., and Sittijinda, P. - Utilization and Protection Buffalo Welfare in Phuket Province	329

ABSTRACT

DAY 1: November 27, 2018

Keynote Session

Important of Biodiversity for Development of Sustainable Bio-Business

Suprpta, D. N.

Laboratory of Biopesticide, Faculty of Agriculture Udayana University, Jl. PB. Sudirman Denpasar Bali Indonesia.

Corresponding Author: biop@dps.centrin.net.id

Biodiversity is variability among organisms within species, between species and between ecosystem. Biodiversity includes genetic diversity within species, the variety among species, and the range of ecosystems where organism exists. The total number of known species of living organisms on Earth is estimated 1.75 million, of which 250,000 species are plants. Among plant species, 30,000 species are edible, and 7,000 species are cultivated. About 80% of the human food supply comes from 20 species of plants, but many people are depending on about 40,000 species for food, shelter, and clothing. Biodiversity is important not only for human food, but it is also important as materials for pharmaceutical industries, as well as bio-control of pests and diseases. Biodiversity provides significant support for drug discovery and availability of medicinal resources. At least 50% of the pharmaceutical compounds on the US market are derived from plants, animal and microorganisms. The global market value of pharmaceutical derived from biodiversity is estimated at USD 75 billion to USD 150 billion annually, and some 80 percent of the world's population relies for healthcare on traditional medicines, which are derived directly from biodiversity. Many industrial materials derive directly from biodiversity. These include building materials, fibers, dyes, rubber, and oil. Several species of plants and microorganisms have been intensively used for plant pests and diseases control and provide a environmentally friendly control measure. This measure is not just reduce the use of synthetic chemical pesticides, but it is also contribute to the biodiversity conservation. Considering the economic and ecological values of biodiversity, it is worth to conclude that biodiversity is directly or indirectly influence the bio-business. In other words, the sustainability of bio-business is depending on availability of biodiversity. Consequently, biodiversity loss is a significant risk factor in sustainable bio-business development and a threat to long term economic sustainability. To reduce the risk factor resulted from biodiversity loss, it is necessary to develop better understanding about biodiversity, including its characteristic, inter-relation among species and within species, as well as variation of ecosystem in which organism is a part, through intensive development of bioscience and biotechnology. The progress and achievements of bioscience and biotechnology in the recent years have been proven to support and promote the birth of new bio-business for providing human needs in one hand, and provide environmentally friendly measures and products on the other. In this speech, importance of biodiversity for development of sustainable bio-business is highlighted.

Keywords: Biodiversity, sustainability, bio-business

Innovation as Game Changer for Scaling up the Adoption of Organic Farming: Focus in The Philippines

Mendoza, T. C.

College of Agriculture and Food Science, University of the Philippines, Los Banos, Laguna, Philippines.
Corresponding Author: ecofarm.mndz2011@gmail.com

Innovation characterizes humankind adjustments and adaptive response to deminishing resource situation, population increase, and climate change in the recent decades. To contextualize, it is the view that organic farming is already an innovation from the conventional agrochemical intensive farming. It is considered as the solution to farming in crisis. But two major barriers in its adoption must be overcome: (1) the nature of organic farming being difficult, laborious, knowledge and skills intensive, the required environment (air, soil, water) and the certification requirement; (2) in adequate support systems (from government and consumers) must be in place. Scaling up the adoption of organic farming requires : innovation from farmers -the farmers as innovators, scientist/ technologists from the academe and S/T institutions, innovative paradigm from supply chain to value chain approach in agriculture and food systems, a demand-led (consumer) instead of supply-led (the farmers) approach to promotion, innovative governance-led promotion, an innovative paradigm shift from food security to health security – from financesurance to healthsurance, from financial banking to health banking, from measuring yield per acre to health per acre as the world transitions agriculture and food system from agrochemical intensive monoculture to organic polyculture cropping systems. Reengineering agri-food systems into agroecotourism as a way of attracting farm visitors, tourist-enthusiasts and attracting human interests and investments flows to the rural areas, generating rural employment, slowing down or stopping out-migration to urban areas and overseas work (OFW). Finally, as game changer to an innovative shift from capital and resource intensive (land, water, energy, inputs) to restorative, regenerative and vibrant agriculture and food systems requires an innovative ecological-carbon emission-soil erosion -water consumption tax to finance the transition and conversion process to agroecology-based organic agriculture. Implementing these innovations requires 4P's& 2M's (pre-production, production, processing- post production linkages) + marketing & management), a consumption led greening of agroecosystems by consuming locally produced food, consume less- and- less meat, consume what we can, minimize food wastes to save energy and water.

Trends and Challenges in Organic Farming in The European Union

Dayoub*, M. and Korpela, T.

Department of Future Technologies, University of Turku, FI20014 Turun yliopisto, Finland.
Corresponding Author: modayo@utu.fi

Organic agriculture is a production and management system which takes into account the biodiversity, biological cycles, and increased biological activity of soil. Water balance in soil is one of the key factors in organic farming. Currently, organic farming is globally becoming more and more important because of people's environmental and health concerns. Economic reasons are the strongest motivators of farmers for converting from conventional to organic production, however; the savings coming from lower farming costs. In the European Union (EU), the organic farming area is increasing by about 500,000 ha per year representing now about 6.2% of the total agricultural area. The variation in different countries is high inside EU due to various factors. The best agricultural practices are deployed in organic farming helping farmers to adapt to climate change by strengthening agro-ecosystems, improving soil structure, water management, and water quality, diversifying crop and livestock production, while concomitantly building farmers' knowledge base.

Keywords: Organic farming in EU, agriculture, economics, organic products.

The Development of Agri-Tourism on Organic Farms in Thailand and Laos

Sriwatanakul, K.

President and CEO of Vatastem Co., LTD., Thailand.
Corresponding Author: drsrikul@gmail.com

Agri-tourism is a component of wellness tourism and healthy longstay projects in Thailand. It is being defined as any agriculturally based operation or activity that bring visitors to a farm or ranch. Agri-tourism is operated differently in different parts of the world. In Thailand, it includes a wide variety of activities, such as buying produce direct from a farm stand, picking fruits, feeding animals, going on a coffee journey, trying rice-farming and staying in the homestay accommodations. Since our team consists mainly of healthcare professional working in Thailand and Laos, we combine agri-tourism with wellness services. Both countries are rich in biodiversity. A large percentages of the total land areas are covered with various kinds of tropical forests providing terrestrial and aquatic habitats for life forms in complex ecosystems. In this presentation, our innovative projects on wellness and longstay services employing organic farming ingredients will be emphasized. These include organic diet plans, detoxification treatments, obesity and diabetic treatment packages, natural treatments for cancers and developing innovative healthcare products for supporting the immune system and improving the overall health.

Keywords: Agri-tourism, Organic Farms, Wellness Tourism, Healthy Longstay

New Challenges towards Sustainable Future

Konuma, H.

Meiji University ASEAN Center Former Senior Advisor to the President, Asia Institute of Technology (AIT) Former UN FAO Assistant Director-General and Regional Representative for Asia and the Pacific, Japan.
Corresponding Author: konuma@meiji.ac.jp

The world is expected to add nearly 2 billion population by the year 2050 from present level of 7.6 billion. The average per capita calorie consumption has also been increasing rapidly and would reach a range of 3,000 – 3,200 kcal per day by 2050 from that of 2,780 kcal in 2005/07. The combination of these factors would necessitate the increase of global food production by 49 percent by the year 2050 from the level in 2012 to satisfy rapidly increasing food demands. However, if we look at developing countries alone where the vast majority of chronic hunger population exist at present, and where almost all the world population increase would occur in the future, we need to increase food production by 112 percent during the same period (FAO, 2017). Against these challenges, on the other hand, the world has been experiencing serious constraints and uncertainties, such as the stagnation of expansion of arable lands, increasing scarcity of water resources, stagnation of annual crop productivity growth, loss of biodiversity which may affect advancement of agricultural research, high food losses and waste, increasing use of food grains for non-food purposes, increasing the competition on the use of land and water between food crops and bio-energy crops, and negative impacts of natural disasters and climate change. While FAO predicts that it would be possible to increase food production by 49 percent by 2050 mainly from existing arable lands with a benefit of technological innovation and yield increase, it would remain very uncertain if the target is achievable due to unpredictable impact of climate change and other factors. If we fail in achieving these targets, poor people in developing countries would most suffer, world food security would seriously be threatened, and it would result in losing world peace and stability. Under these constraints, it is obviously clear that agricultural research, science and technology have the highest importance in our development challenge and future sustainability. They must play a key role with increased investment, collaborative research and concerted efforts among all actors among governments, academic/research institutions and private sectors.

Impact Evaluation of the Women Empowerment Program of Zamboanga del Sur

Cerilles, J. S.

Zamboanga del Sur, Philippines.

Corresponding Author: juliusbreva@gmail.com

Around 30% of the rural population of Zamboanga del Sur, Philippines belongs to poor farming families. Most of them struggle to meet their basic needs. The situation of the women farmers, in particular, is more difficult despite their contribution to rural economic growth. Their role is hardly noticed, and their contribution is undervalued. Because of this, most of them lack confidence, unable to harness their potentials in agricultural development. To address this challenge, the Women Empowerment Movement- Rural Improvement Club (WEMRIC) launched a women empowerment program that seeks to improve the living conditions of the rural women by increasing income level, savings, livelihood opportunities, mobility, decision-making capacity, as well as changing gender relation in the area. The provincial government of Zamboanga del Sur and other agencies have provided support to the program. The program includes a series of activities, like women's forums, livelihood skills training, tree and mangrove planting, cleanliness drive, legal aid assistance, celebration of the women's month thru dance competitions, among others. To further equip them in improving their livelihood, financial assistance were provided, and retail outlets were opened wherein they could sell their products which are actually outputs of this program. Overall, the women improvement program of WEMRIC has shown a great deal of success. A total of 27 social enterprises were established, benefitting more than 1,500 rural women. The program has improved the living conditions of their families due to increased family earnings. The improved level of income, mobility and decision-making capacity of the women beneficiaries gave them self-confidence in terms of control of family resources. Thus, besides material development in the form of improvement of food intake and other amenities of life, the program also resulted to non-tangible changes in the lives of women and their families.

Keywords: Women empowerment, Non tangible changes, Material Development

Session 1: ORGANIC AGRICULTURE AND RELATED FIELDS

Residual Effect of Vermicompost on Sweet Corn Growth and Selected Chemical Properties of Soil from Different Organic Farming Practices

Muktamar, Z.¹, Adiprasetyo, T.¹, Yulia, S.² and Sari, L.¹

¹Department of Soil Science, University of Bengkulu, Indonesia; ² Agronomy Department, University of Bengkulu, Indonesia.

Corresponding Author: muktamar@unib.ac.id

Solid organic fertilizer releases plant nutrient slowly, however, the residue in soil is available for longer period. The study intended to investigate the effect of vermicompost residue on sweet corn growth and selected chemical properties of soils from different organic farming practices. A greenhouse experiment was carried out for two plantings in 2016, employing Completely Randomized Design (CRD) with two factors. The first factor was soils from different organic farming practices (OFP), i.e. 0, 5, and 10 years of OFP and the second factor was rates of vermicompost, i.e. 0, 10, 20, and 30 Mg ha⁻¹. The treatment was assigned at the first planting and the residual effect was observed at the second one. Sweet corn growth and soil properties were examined at the end of the first and second plantings. The study revealed that at the first and second plantings, vermicompost application considerably increased sweet corn growth and soil chemical properties, being the greatest at 30 Mg ha⁻¹. Likewise, soil from 10 years of organic farming practice had higher total organic carbon and pH than the other practices. But, those of the second planting was significantly lower than those of the first planting, indicating that there was depletion of nutrients after the second planting. The study confirms that regular fertilization on organic farm is yet necessary to maintain the availability of plant nutrients.

Keywords: residue, vermicompost, organic farming, sweet corn

The Development of Organic Farming Network Learning Centers for Youth in Kantharawichai District, Mahasarakham Province, Thailand

Bunnaen, W.* and Yartniyom, O.

*Mahasarakham University Demonstration School (Secondary), Mahasarakham University, Kantharawichai District, Mahasarakham, Thailand.

Corresponding Author: wutthisakcomplete@gmail.com

The research aimed to develop organic farming network learning centers for youth to investigate the needs of organic farming management in elementary schools in Kantharawichai District, Mahasarakham Province, Thailand, and to improve the attitude toward and awareness of organic farming and environmental conservation among youths. The samples consisted of 60 primary school students selected based on purposive sampling method. The research instruments were interviews, attitude questionnaire and awareness questionnaire on organic farming and environmental conservation. The research was conducted by organizing learning and training activities for youths. It was found that 74 percent of organic farming learning centers in schools had the size of 30-50 square meters and the most appropriate ratio of students to organic farming area in schools was 1 student: 30-50 square meters. The comparative analysis of average attitude toward organic farming and environmental conservation after participating in the activities showed that the attitude of youths was improved with the statistical significance of .05p-level and the comparative analysis average of awareness of organic farming and environmental conservation before and after participating in the activities indicated that the youth were more aware of organic farming and environment conservation with the statistical significance of .05p-level.

Keywords: Organic farming, Learning center, Youth, Attitude, Awareness

Facilitation of Organic Agriculture Learning in School and Community

Poungsuk, P.¹, Junlek, P.¹, and Poeaim, S.²

¹Department of Agricultural Education, Faculty of Industry Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand, ² Department of Biology, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: ppoungsuk@gmail.com

This study investigated how organic agriculture learning at Baan Dongsalao school, Dan Chang district, Suphanburi province could be facilitated. The participation of the school, the community around the school, and KMITL organic farm were solicited. Two Agriculture teachers, six local scholars, and 12 Agriculture teacher students were involved in this study. A participatory action research, Agriculture Learning Center, organic agriculture learning module, questionnaire and interview schedule were the research instruments used in this study. Obtained data were analyzed by using frequency, percentage, mean, standard deviation, and t-test (Dependent). Results of the study revealed that activities of organic agriculture learning and skills of the students after using the module was higher. Supporting factors were guardians and local scholars who supported activities of organic agriculture at home and in the community. It was found that the students and their guardians were satisfied with it at a highest level ($\bar{x} = 4.65$). Moreover, results indicated that guardians were interested at a highest level in terms of organic agriculture practice and knowledge transfer ($\bar{x} = 4.65$). They wanted to join organic agriculture activities with the school. It is suggested that organic farming must begin with simple activities and actual practice such as home-grown vegetables.

Keywords: Agricultural Learning Center, organic agriculture, organic learning module, learning facilitation, agriculture teachers

Relationships between Potassium Uptakes and Yield Performances of Sweet Corn Grown Under Organic Production System

Fahrurrozi, F.^{*}, Muktamar, Z.¹, Chozin, M., Setyowati, N. and Sudjatmiko, S.

^{*}Department of Crop Production, University of Bengkulu, Bengkulu 38121, Indonesia, ¹Department Soil Science, University of Bengkulu, Bengkulu, 38121, Indonesia.
Corresponding author: fahrurrozi@unib.ac.id

Growing sweet corn under organic production system uses both solid and liquid organic fertilizer. Such production system might alter potassium availability to sweet corn yields and performances. This study aimed to determine the relationships between potassium uptake and yield of sweet corn. A randomized complete block design experiment was arranged with three replications. Twenty sweet corn varieties were grown under organic environment where soil was fertilized with 30 tons ha⁻¹ of cattle-based vermicompost. Each plant was applied with thitonia-enriched liquid organic fertilizer of 50, 100, 200 and 300 ml at 14, 21, 28 and 35 days of planting. Data gathered were yield performances, leaf potassium content, green biomass per plant, weight of husked ear, and weight of unhusked ear, sweet corn yield per plot and days to harvesting. Potassium uptake by plants were calculated as ratio of leaf potassium content and green biomass per plant. Potassium uptake by sweet corn significantly increased the weight of husked ear ($r=0.656$), sweet corn yield per plot ($r=0.828$) and green biomass per plant ($r=0.932$). However, potassium uptake by sweet corn did not significantly increase leaf potassium content ($r=0.539$) and weight of unhusked ear ($r=0.515$). In addition, potassium uptake by sweet corn did not significantly decrease days to harvesting ($r=0.130$).

Keywords: Organic Production Systems; Potassium Uptakes; Sweet Corn Yields; Liquid Organic Fertilizer

Nano-particles derived from *Chaetomium elatum* against Phytophthora rot of Durian

Thongkham, D.¹, Soyotong, K.¹ and Kanokmedhakul, S.²

¹Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL), Ladkrabang, Bangkok, Thailand, ²Department of Chemistry and Center for Innovation in Chemistry, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand.
Corresponding Author: danupat1234@gmail.com

Durian are the economically fruit trees in Thailand. The important problem of durian is root rot disease caused by *Phytophthora palmivora*. This study was used *Chaetomium elatum* to control the *P. palmivora* causing root rot disease of durian by dual culture method, crude extract test and nano particles test derived from *Ch. elatum*. Dual-culture test showed that *Ch. elatum* gave efficiency to inhibit of spore and colony growth of *P. palmivora* which were 46.13 and 38.89%, respectively. Testing efficacy of crude extract from *Ch. elatum* to control *P. palmivora* found that crude ethyl acetate from *Ch. elatum* gave significantly highest against pathogen of *P. palmivora* at the concentration of 1000 ppm which the ED₅₀ of 175.31 ppm. Nano particles testing, nano particles of crude hexane, ethyl acetate and methanol from *Ch. elatum* showed the ED₅₀ values of 3.49, 3.47 and 3.41 ppm.

Keywords: *Chaetomium elatum*, *Phytophthora* sp., durian

Organic Agriculture in Lao PDR

Vilavong, S.

Department of Agriculture and Forestry, Champasak province, Lao PDR.
Corresponding author: kovilavong2002@yahoo.com

LAO PDR is a landlocked country with an area of about 236,800 km² and a population of 6.859 million. A round 4% of the land is arable, of which 80% are cultivated with rice, mainly for farmer's own consumption. Around 70.4% of rice population is grown under lowland rain-fed condition 18.2% as upland rice and only 11.4% in irrigated fields. After rice, other importance field crops are maize and peanut, less than 0.5% of land is under perennial crops, of which coffee is the most important. Subsistence agriculture is the main feature of the LAO PDR countryside which provides employment to 80% of the country population. For agriculture export, the coffee most importance product, bringing more than USD 90 million in 2017. Consumers increasingly express concerns over the quality and safety of the food they eat in a context of rising living standard, intensifying agricultural practice and deeper regional integration. Consumer awareness is also increasing in the LAO PDR is response to greater exposure to the market economy and to a progressive modernization of the farming sector. Modernization increases the access of consumers to new products. Imported goods, labeled or branded products. It also increases the assistance between consumers and producers, there by increasing the level of uncertainty. Organic agriculture may be understood as a way to reduce the exposure of the farmers, consumers and the environment to hazardous substances; eg. Chemicals. GMOs, antibiotics. It may also help governments improve food safety, support small holder farmers engaged in traditional farming systems that preserve the environment and build resilience to climate change, and achieve competitiveness in regional and international markets. However, in a country where live hoods are still very sensitive to changes in foods prices, the access to safe food should be understood as a key element of food security, rather than as a luxury good. In 2017 we interviewed over 700 consumers in organic and conventional food markets. Interviews were carried out in the capital cities of seven provinces. The survey provides a detailed pictures of the general purchasing habits of consumers and fresh insights on their knowledge beliefs and attitudes to wards organic agriculture. Consumers went to the conventional market everyday 48% three day a week 21% one or two days a week 31% product freshness, food safety and appearance were the most valued attributes of food products. Consumers who bought organic products 240 individuals visited organic markets one or twice per week to purchase vegetables, herbs and spices. Food safety 81% and product freshness 53% were the main reasons for going to the organic market 9% of the consumers bought organic products to support local farmers and 2% because they cared about the environment.

Effective of *Neosartorya* to Control *Phomopsis asparagi* Causing Stem Blight Disease on Asparagus

Mangkalad, T.¹, Soyotong, K.², Tangthirasunun, N.³ and Poeaim, S.¹

¹Department of Biology, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; ²Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Ladkrabang, Bangkok, Thailand.
Corresponding author: poeaim@hotmail.com

This study investigated biocontrol of stem blight disease on asparagus by *Neosartorya* and *Talaromyces*. Stem blight disease on asparagus is caused by *Phomopsis asparagi*. The symptoms of disease are the appearance of oval-shaped lesions with light brown centres and slightly darker margins. Ten isolates of fungi pathogen were isolated by tissue transplanting technique and identified based on morphology and molecular analysis based on internal transcribed spacer (ITS)-nrDNA sequence. Fungal mycelium showed flat type of mycelial growth about 8.00-9.00 cm colony diameter for 10 days after inoculations on PDA medium. Conidia morphology was oval to cylindrical shape, with a size of 2.65 × 7.82 μm. The fungal pathogenicity test showed asparagus was infected by *Phomopsis asparagi* within 2 days on moisture chamber at room temperature. *Neosartorya* and *Talaromyces* were evaluated for potential of antagonistic fungi of stem blight on stem asparagus using bi-culture technique. The best effective of antagonist should be selection and screening for new biological control agents in the future.

Keywords: Stem blight, *Phomopsis asparagi*, *Neosartorya* and *Talaromyces*

The use of Epiphytic Lichen as a Biomonitor on Air Quality, Nitrogen Dioxide and Sulphur Dioxide Deposition in Mab Ta Phut Industrial Estate, Rayong Province

Pitakpong, A.¹ and Maungsan, N.²

¹Department of Environmental Health, School of Medicine, University of Phayao, Thailand; ² Department of Environmental Biology, School of Science, Suranaree University of Technology, Thailand.

Corresponding author: aompitakpong@gmail.com

Lichens were the co-occurring organisms including of fungi and algae that were used as the environmental biomonitor or biomarker extensively. The purpose of this study was to study the results of air pollution to lichen diversity in surrounding area of Mab Ta Phut industrial estate, Rayong province. From October 2012 to September 2013, we studied the kind and frequency of lichen using the frequent surveying flame (20 x 50 cm²) on mango trees of 110, collected nitrogen dioxide and sulphur dioxide deposition using the method of atmospheric collection by tube of passive sampling and measured gas deposition by ion chromatography technique. In our study, we found 11 families, 20 genera and 26 species including the foliose lichens of 6 species and the crustose lichens of 20 species. Most lichens were in genera of *Arthonia*, *Dirinaria*, *Lecanora* and *Physcia*, and lichen species of *Physcia poncinsii* Hue. and *Pyxine cocoes* (Swartz) Nyl. were highly frequent to be found in all area. Measured nitrogen dioxide deposition was in the range of 0.28-5.08 ppbv and sulphur dioxide deposition of 0.52-7.60 ppbv. The analysis of correlation between lichen diversity of biomarker and gas deposition in each study area using the correlation coefficient of Pearson value were found that both of nitrogen dioxide and sulphur dioxide deposition were negatively correlated with lichen diversity index at 95% confidence interval ($r = -0.245$, $p < 0.05$) and ($r = -0.081$, $p < 0.05$), respectively. Increasing nitrogen dioxide and sulphur dioxide deposition had been affecting lichen diversity, so it is possible to use lichen as the atmospheric biomonitor.

Keywords: Lichen, Diversity, Nitrogen Dioxide, Sulphur Dioxide

Callus Induction and Regeneration from Seeds of some Thai Indigenous Upland Rice (*Oryza sativa* L.) and Lowland Rice Varieties

Yamyang, M.^{1*}, Na Chiangmai, P.¹, Meetum, P.¹, Rienghlam, P.¹ and Brooks, S.²

¹Faculty of Animal Sciences and Agricultural Technology, Silpakorn University, IT Campus, Phetchaburi 76120, Thailand; ²School of Science, Mae Fah Luang University, Chiang Rai 57110, Thailand.

Corresponding Author: thenightclub@hotmail.com

The objective of this study was to evaluate the effects of the combination of plant growth regulators; auxins and cytokinin in inducing callus and regenerating plantlets of indigenous landrace upland rice and some lowland rice varieties (*Oryza sativa* L.). The study was conducted by rice seeds cultured on three media which were supplemented with different types and different concentrations of plant growth regulators to induce the callus formation (MS1, MS2 and MS8). These calli were regenerated on medium (MSr) in experiment A. The results showed that MS8 and MS2 increased the percentage of callus formation on mature and immature seeds, respectively. The calli of upland rice varieties derived from mature seeds induced on MS8 medium were studied for shoot regeneration in experiment B. Three media (MS1, MSa and MSb) for inducing regeneration were supplemented with different types and concentrations of plant growth regulators in experiment B. The result showed that there was significant difference between varieties. Although, there was no significant difference between media and the interaction between media and varieties, further experiments with different rice varieties and cultural media *in vitro* should be investigated.

Keywords: Indigenous upland rice; Plant growth regulator; *In vitro* culture; Culture medium.

Biological Control of Anthracnose Disease on ‘Namwa Mali-Ong’ Banana by *Neosartorya* sp.

Pattarasaikul, W.¹, Soyong, K.² and Poeaim, S.^{1*}

¹Department of Biology, Faculty of Science, King Mongkut’s Institute of Technology Ladkrabang, Ladkrabang, Bangkok, Thailand; ²Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut’s Institute of Technology Ladkrabang, Ladkrabang, Bangkok, Thailand.
Corresponding Author: poeaim@hotmail.com

This study aimed to control anthracnose disease caused by *Colletotrichum musae* on banana by biological control, antagonist fungi instead of chemical control. Seven isolates of *C. musae* were collected from growing banana area in Suphanburi, Nakhonpathom, Ratchaburi and Nonthaburi province, Thailand. Test their pathogenesis on fresh banana. Isolate CMDC-01, CMKP-02, CMRM-01 and CMNS-01 were most pathogenic. They were re-isolated and confirmed species by molecular studies. *In vitro* test by bi-culture, four isolates of pathogen were co-cultured with fifteen isolates of antagonist fungi (*Neosartorya hiratsukae*, *N. pseudofischeri*, *N. aureola*, *N. spinosa*, *N. fennelliae*, *Talaromyces muroii* and *T. trachyspermus*). The result shown that *N. hiratsukae* and *T. muroii* were strongly inhibited growth of *C. musae*. *In vivo* test, the selected antagonist isolates were tested on fresh ‘Namwa Mali-Ong’ banana by spore suspension. The result showed that some isolates had inhibited growth of the pathogen and decreased the lesion when compared with control

Keywords: Biological control, Anthracnose, ‘Namwa Mali-Ong’ banana, *Neosartorya* and *Talaromyces*.

Effectiveness of *Neosartorya* and *Talaromyces* Use to Control *Alternaria brassicicola* Causing Leaf Spot Disease on Kale

Punyanobpharat, A.¹ Soyong, K.² and Poeaim, S.^{1*}

¹Department of Biology, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL), Ladkrabang, Bangkok, Thailand; ²Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut’s Institute of Technology Ladkrabang (KMITL), Ladkrabang, Bangkok, Thailand.
Corresponding Author: poeaim@hotmail.com

The purpose of this research was to evaluate the antagonistic potential of *Neosartorya* and *Talaromyces* in controlling leaf spot disease on kale caused by *Alternaria brassicicola*. Leaves with black spot symptoms were collected from Nakornpathom, Suphanburi, Ratchaburi and Nonthaburi provinces. Those pathogens were isolated and identified by morphological and molecular characterization. Ten isolates were confirmed as *A. brassicicola*. The pathogenicity test was done by detached leaf bioassay. AbK-NP01 was found to be a high virulent pathogenic isolate. To evaluate the potential of antagonistic fungi, the dual culture technique was used to assay eight species of antagonistic fungi (*Neosartorya hiratsukae*, *N. pseudofischeri*, *N. aureola*, *N. spinosa*, *N. fennelliae*, *Neosartorya* sp., *Talaromyces trachyspermus* and *T. muroii*). The best effectiveness of antagonist should be studied in the future.

Keywords: Leaf spot disease, *Alternaria brassicicola*, *Neosartorya*, *Talaromyces*

Nano-particles from *Trichoderma harzianum* against Rice Blast Pathogen

Juwita¹, Romeida, A.¹ and Soyong, K.²

¹Faculty of Agriculture, University of Bengkulu Indonesia, ² Faculty of Agricultural Technology, King Mongkut’s Institute of Technology Ladkrabang, Bangkok, Thailand.
Corresponding Author: juwitaparakoso6@gmail.com

Trichoderma harzianum PC01 was investigated to control *Pyricularia oryzae* causing rice blast disease. Morphological characters of *T. harzianum* PC01 and *P. oryzae* were studied under binocular compound microscope. Pathogenicity test was proved to be pathogenic isolate in rice var PSL 2. Bi-culture test between *T. harzianum* PC01 and *P. oryzae* was effective antagonistic reaction. Within, *T. harzianum* PC 01 could be antagonized the colony growth of *P. oryzae*, and grew over the colony of pathogen. The

fungal metabolites as crude extracts derived from *T. harzianum* PC01 were tested at different concentration against *P. oryzae*. Result showed some degree of inhibition affected to the tested pathogen. *In vitro* bioassay test using nano-particles derived from *T. harzianum* PC01 against *Pyricularia oryzae* was also showed the effective degree of inhibition. The detail information will be presented further in the conference.

Keywords: Rice blast, nano-elicitors

Nano-particles Constructed from *Chaetomium brasiliense* against Root Rot Disease of Tangerine

Udompongsuk, M.¹, Soyong, K.¹ and Kanokmedhakul, S.²

¹Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang (KMILT), Ladkrabang, Bangkok, Thailand; ²Department of Chemistry and Center for Innovation in Chemistry, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand.

Corresponding Author: zw.mink@gmail.com

Root rot is one of the most serious disease in Tangerine which caused by *Pythium* spp. This study tested efficacy of *Ch. brasiliense* to control *Pythium* sp. by bi – culture, crude extracts and nano particles testing from *Ch. brasiliense* to control *Pythium* sp., in vitro. The results from the bi – culture testing, *Ch. brasiliense* inhibited mycelium growth and sporangia production by 42.50% and 48.41%, respectively. In crude extracts from *Ch. brasiliense* gave ED₅₀ values of 30.15, 58.71 and 37.25 ppm for the hexane, EtOAc and MeOH, respectively. The efficacy of nano particles against *Pythium* sp. with the ED₅₀ values of 2.69, 3.00 and 3.96 ppm for the hexane, EtOAc and MeOH, respectively.

Keywords: *Chaetomium brasiliense*, Root rot, Tangerine

Growth Analysis of Sweet Corn as Amended with Different Types of Organic Fertilizers

Mujiharjo, S., and Winda, S.

Deptent of Agriculture Technology, Faculty of Agriculture, University of Bengkulu, Jl. W.R. Supratman, Kandanglimun, Bengkulu 38371, Indonesia.

Corresponding Author: smujiharjo@unib.ac.id

Purpose of this research was to identify the effects of change of capillary force height to the debit and some physical quality of swamp water filtered using Capillary-Gravitational Slow Sand Filter (SSF). The experiment was conducted following 4x4 LS with the capillary height of 5, 10, 15 and 20 cm as the treatment. Besides filtration debit, samples of the swamp water and the permeate were taken and analyzed for TSS, Turbidity, color and pH. Result of measurement showed that debit of SSF increased as the capillary force height was reduced. The average debit was 76.8 ml/mnt when capillary force height was 20 cm; it increased to 204.30 ml/mnt when capillary force height was reduced to 5 cm. TSS and Turbidity of the permeate also increased when the capillary force height was decreased; however, pH of the permeate decreased. The average TSS and turbidity of permeate were 3.9 mg/L and 0.3 NTU when capillary force height was 20 cm; it increased to 6.4 mg/L and 0.64 NTU when capillary force height was reduced to 5 cm. The average pH permeate was 7.7 when capillary force height was 20 cm; it decreased to 7.3 when capillary force height was reduced to 5 cm. The color of permeate; however, were constant at 0.5 PtCo. In conclusion, increase of capillary force height in a SSF Grapilar improved physical qualities of filtered swampy water, but it reduced filtration debit.

Keywords: Slow sand filter, swamp water pollutant removal

Phosphate-solubilizing Bacteria from Upland Rice (*Oryza sativa* L.) Rhizosphere and their Tricalcium Phosphate Solubilizing Abilities

Cavite, H. J. M.¹, Mactal, A. G. M.¹, Cruz, J. A.² and Khermkhan, J.³

¹Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines, ² Philippine Rice Research Institute, Science City of Muñoz, Nueva Ecija, Philippines, ³ King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: harryjaycavite@clsu.edu.ph

Insoluble forms of P may be converted to soluble P by phosphate-solubilizing organisms inhabiting soil ecosystems to make them available for plant roots absorption. In this study, isolation of rhizobacteria and screening of their ability for phosphate solubilization were done. A total of 25 isolates were obtained from upland rice rhizosphere in Isabela province, Philippines. Measuring the solubilizing efficiency revealed that seven out of 25 isolates were found to be promising phosphate-solubilizers showing clearing zone around the colony. Moreover, phosphorus solubilization index (PSI) of the isolates ranged from 1.25 to 1.60 and results obtained are higher than other observations indicating that strains of bacteria isolated are effective phosphate-solubilizers. Furthermore, these PSB could serve as efficient biofertilizer candidates for improving the P nutrition of the crop. This observation can be a promising contribution to cropping system of upland rice, which is constrained by drought leading to inefficient P acquisition. If further developed, this can be eco-friendly and prove to be cost effective strategy to improve upland rice production particularly in the Philippines.

Keywords: Phosphate-solubilizing bacteria, upland rice, solubilization index, rhizobacteria, isolation and screening

Production and Yield Attributes of Biofertilizers on Pulse Crops

Lalitha, S. and Nithyapriya, S.*

Department of Botany, Periyar University, Salem, Tamil Nadu, India.

Corresponding Author: lara9k@gmail.com

Biofertilizers are becoming increasingly popular in many countries and for many crops. Biofertilizers are fertilizers containing living microorganisms, which increase microbial activity in the soil. Biofertilizers are low cost renewable source of nutrient that supplements the chemical fertilizer. Biofertilizers gained importance due to its low cost amongst small and marginal farmer. Inoculation of nitrogen fixing bacteria with biofertilizer increases the phosphorus level. The application of biofertilizer containing beneficial microbes showed a promoting effect on the growth of *Vigna radiata* (green gram) and *Vigna unguiculata* (cow pea) plants and improvement of soil properties through a 45 days greenhouse study. Among the various microbes, treated with *Pseudomonas* the plant height, fresh weight and dry weight were higher in *V. radiata* plant compared to *V. unguiculata*. The highest chlorophyll 'a' content (1.757 mg/g) was observed in combined microbes *Bacillus* + *Pseudomonas* + *Trichoderma* treated on *V. unguiculata* plant than *V. radiata*. Chlorophyll 'b' and carotenoid contents were also higher in the treatment of combined microbes *Bacillus* + *Pseudomonas* + *Trichoderma* treated on *V. unguiculata* plant compared to *V. radiata* and untreated control plants. In conclusion, efficient plant nutrition management should ensure both enhanced and sustainable agricultural production and safeguard the environment.

Keywords: Biofertilizer, Mass multiplication, Plant Growth Promoting Rhizobacteria (PGPR)

Session 2: PLANT AND FOOD TECHNOLOGY

Improvement of Oil Yielding Crops Yield Attributes using Plant Growth Promoting Rhizobacteria

Lalitha, S.* and Nithyapriya, S.

Department of Botany, Periyar University, Salem, Tamil Nadu, India.

Corresponding Author: lara9k@gmail.com

Siderophores are small molecules that can easily bind to ferric iron. As a chelating agent they transport iron molecules inside the bacterial cell for various biochemical reaction. At present studies characterization of few siderophores producing bacteria from the soil samples collected from Salem district, Tamil Nadu. The siderophores production was assayed qualitatively and quantitatively through Chrome Azural S and the results showed positive for the strains PS01 and PS02 that grown in succinate medium. In pot culture studies *Brassica nigra* L. *Sesamum indicum* L. showed significantly increase in the root length, shoot length, fresh weight, dry weight and total chlorophyll and carotenoids significantly increased in treated plant. The antagonist activity of the siderophore producing *Pseudomonas spp* against fungal pathogen *Fusarium oxysporum*. This result showed that *Pseudomonas spp* is a good producer of siderophore which can be beneficial for its antagonistic activity towards fungal pathogen and increasing the Oil yielding crops.

Keywords: *Brassica nigra* L., chlorophyll, carotenoids, *Pseudomonas spp*, siderophore, *Sesamum indicum* L.

Effect of Oil Addition on In-vitro Starch Digestibility and Physicochemical Properties of Instant Rice

Luangsakul, N.* , Ritudomphol, O.

Faculty of Agro-Industry, King Mongkut's Institute of Technology Ladkrabang, Bangkok, 10520, Thailand.

Corresponding Author: naphatrapi.lu@kmitl.ac.th

Most varieties of rice have high starch digestibility and glycemic index (GI) which are unsuitable for diabetics. The processes involved in the production of instant rice, not only make it more convenient for the consumer, but it also lower its starch digestibility and GI through decrease in enzymatic accessibility to rice kernels. One way to control the enzymatic digestion of rice is to increase the amylose-lipid complex formation. Therefore, the objective of this research was to determine the effect of oil addition during rice cooking on *in vitro* starch digestibility, GI and some physicochemical properties (thermal properties, X-ray diffraction patterns and pasting properties) of instant rice. During rice cooking, 2 type of commercial oil, including coconut oil (C) and rice bran oil (R) at 2.5, 5 and 7.5% (w/w, on the basis of uncooked rice) were added to Sao Hai rice (SH), which had amylose content of 21.35 g/100g (dry weight basis, db). Thermal properties showed amylose-lipid complex dissociation peaks when rice was cooked with oil, and the highest enthalpy was found in the addition of oil at 2.5%. In X-ray diffraction patterns, cooked rice with oil showed A+V type crystalline structure and the addition of rice bran oil at 2.5% exhibited the highest relative crystallinity (19.98%). The formation of amylose-lipid complex of cooked rice with oil reduced *in vitro* starch digestibility and eGI compared to cooked rice without oil. The addition of rice bran oil at 2.5% had the highest slowly digestible starch (SDS) and resistant starch (RS) contents, which were consistent with their lowest estimated glycemic index (eGI). In pasting properties, the addition of oil to rice resulted in a lower peak viscosity (PV) and setback (SB), as compared to instant rice without oil.

Keywords: instant rice, amylose-lipid complex, starch digestibility and glycemic index

The effect of Freezing Method, Packaging Type and Storage Time on the Quality of Moo-Chamoung Curry Frozen

Sumana, B.*

Faculty of Agro Industrial Technology, Rajamangala University of Technology Tawan-ok Chanthaburi Campus, Chanthaburi, Thailand.

Corresponding Author: boonsumana@gmail.com

The effects of initial temperature of Moo-Chamoung curry before freezing (at 5 and 55°C), type of packaging (Low Density Polyethylene (LDPE) plastic bag and Polypropylene (PP) plastic box) and freezing methods (air blast and home freezers at -20 °C) on the chemical, physical, microbiological and sensory qualities of Moo-Chamoung curry frozen were examined. The freezing time was determined with the internal temperature at the geometrical center of -18 °C. The results showed that freezing time of Moo-Chamoung curry with the which has initial temperature at 5 °C and freezing by home freezer was 510 minutes while air blast freezer was 1110 minutes. However, the initial temperature at 5°C and 55°C with the freezing time of 1440 minutes are statistically similar. The packaging type and freezing methods were evaluated by thawing using a microwave at 600 watt for 15 minutes. The result showed that amount of titratable acidity expressed as total citric acid of Moo-Chamoung curry frozen products (filled in LDPE plastic bag and PP plastic box which freezing by air blast and home freezers) were significantly decreased during frozen storage time at 60 days. The protein content of all frozen products and storage time during 60 days were significantly decreased. For the microbiological test founded that there was no pathogen in products and the microorganism was less than 10 CFU/g before and after freezing. However, during the storage time the amount of microorganism was increased but less than 125 CFU/g. From sensory evaluation, all frozen products and storage time during 60 days had moderately overall acceptability (7.13-7.47). It was concluded that Moo-Chamoung curry frozen showed the good quality according to the Thai Community Product Standard No.1214 Subject Moo-Chamoung.

Keywords: Moo-Chamoung curry, Freezing, Curry quality, Storage time, Protein content

Diversity and Evenness of Indigenous Vegetables in Nakhon Si Thammarat Province, Thailand

Na Nakorn, W.^{1*}, Chaymeang, C.² and Chaison, C.³

¹Landscape Technology Department, Faculty of Agriculture, Rajamangala University of Technology Srivijaya, Nakhon Si Thammarat Campus, Thailand, ^{2,3} Plant Science Department, Faculty of Agriculture, Rajamangala University of Technology Srivijaya, Nakhon Si Thammarat Campus, Thailand.

Corresponding Author: wattana.nn@hotmail.com

Diversity and evenness of indigenous vegetables in Nakhon Si Thammarat Province, Thailand. The field study of indigenous vegetables was conducted from January, 2018 to August, 2018. The surveying of this study was used the Line Transect method in the scope of area 50 x 5000 meters for each district (station). The analysis of data was used the formula $H = -\sum^s (p_i) (\log_2 p_i)$ and $E = H / H_{max}$ for evaluating the diversity and evenness of indigenous vegetables. The result showed that the total kind of indigenous vegetables in 10 stations were found 4 groups. The most abundance is the group of ground cover (62.834 %), the second group is the group of shrub (15.843 %), the third group is the group of climbing (12.304 %) the fourth is the group of tree (4.516 % and the last group is the group of aquatic plant (4.501 %). The result showed that the taxonomy of indigenous vegetables was found 139 species and 50 families. The result showed that the most abundance of family in each group of indigenous vegetables, the group of ground cover are Apiaceae, Asteraceae and Zingiberaceae (16.55, 6.302 and 6.062 %), respectively. The group of shrub are Musaceae, Leguminosae and Poaceae (3.075, 1.180 and 1.095 %), respectively. The group of climbing are Cucurbitaceae, Piperaceae and Rubiaceae (5.002, 1.086 and 1.032 %), respectively. The group of tree are Leguminosae, Araceae and Meliaceae (1.144, 0.481 and 0.288 %), respectively. The group of tree are Leguminosae, Araceae and Meliaceae (1.144, 0.481 and 0.288 %), respectively. The group of aquatic plant are Convolvulaceae, Araceae and Fabaceae (1.581, 1.393 and 0.732 %), respectively.

Keyword: diversity, evenness, indigenous vegetables, shrub, ground cover, climbing

Effect of Different Nitrogen Fertilizer Forms on Growth and Yield of Four Tropical Pasture Grasses

Buamool, P. and Phakamas, N.

Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand.

Corresponding Author: smileday.kwang@gmail.com

Nitrogen fertilizer is an essential plant nutrient of tropical pasture crops. The objective of this study was to determine the effects of nitrogen fertilizer in forms of urea and ammonium sulphate on growth and yield of four tropical pasture grasses. A 4x3 factorial experiment was arranged in a randomized complete block design with four replications during August, 2017 to May, 2018. Four pasture grasses including Purple guinea, Mombasa guinea, Ruzi and Mulato II were assigned as factor A, and three nitrogen forms consisting of non-fertilized control, urea at the rate of 62.5 kg N/ha and ammonium sulphate at the rate of 62.5 kg N/ha were assigned as factor B. Data were recorded for tiller number, SPAD chlorophyll meter reading (SCMR), crop growth rate (CGR) during the regrowth period, fresh yield and dry matter yield for four times at 40-day intervals. Analysis of variance was performed for all data, and the differences between treatment means were compared by Duncan's multiple range test at 0.05 and 0.01 probability levels. The results showed that four tropical pasture grasses were significantly different for tiller number, SCMR, CGR during the regrowth, fresh weight yield and dry matter yield, when different forms of nitrogen fertilizer were applied. Application of urea resulted in higher fresh yield (9.6-10.7 t/ha/time) and dry matter yield (1.3-2.0 t/ha/time) than did application of ammonium sulphate and control. Application of urea also had higher tiller number and higher crop growth rate during the regrowth period after each cutting time than did application of ammonium sulphate and unfertilized control. Application of urea at the rate of 62.5 kg N/ha is recommended for growing Purple guinea, Mombasa guinea, Ruzi and Mulato II in Thailand. The interaction between pasture grass and nitrogen form was not significant in this study.

Keywords: Tropical pasture, *Panicum spp.*, *Brachiaria spp.*, Urea

Probiotication of Black Jelly [*Mesona chinensis* (Benth)] by Encapsulated *Lactobacillus plantarum* Mar8 for A Ready to Drink (RTD) Beverages

Wulandari, N. F.¹, Suharna, N.¹, Yulinery, T.¹, Saksono, B.² and Nurhidayat, N.¹

¹Microbiology Division, Research Center for Biology, Indonesian Institute of Sciences (LIPI), Jl. Raya Jakarta Bogor KM 46, Cibinong Science Centre, Cibinong 16119, West Java, Indonesia; ²Research Centre for Biotechnology, Indonesian Institute of Sciences (LIPI), Jl. Raya Jakarta Bogor KM 46, Cibinong Science Centre, Cibinong 16119, West Java, Indonesia.

Corresponding Author: nilamfungi@gmail.com

Lactobacillus plantarum is an important probiotic bacteria for intestinal microbiota. This study was aimed at the use of encapsulated the probiotic *Lactobacillus plantarum* Mar8 by agar, carrageenan, Arabic gum, konjac (*Amorphophallus konjac* K. Koch), and black jelly [*Mesona chinensis* (Benth.)] for its application for RTD packaged beverages product. The probiotic bacteria was prepared by cultivation, biomass collection by suspension, and encapsulation. The result showed that 2% of carrageenan was the best encapsulant for the probiotic based on its suitable elasticity of the black jelly for RTD use. The probiotic was maintained at 8-9 log cfu/ml. This result would be potential for the application of encapsulated probiotic for RTD jelly black beverages.

Keywords: beverages, microcapsule, probiotic, storage, viability

***Emericella* sp and *Neosartorya* sp for Controlling *Colletotrichum capsici* caused Anthracnose of Chili**

Thanomwong, A. and Soyong, K.

¹Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.
Corresponding Author: ajkasem@gmail.com

The antagonistic fungi, *Emericella* sp. And *Neosartorya* sp. Were proved to be antagonized *Colletotrichum capsici* causing chilli anthracnose in laboratory. The causal agent of chilli anthracnose was isolate from lesion on chilli fruits then morphological identification under bi-nocular compound microscope. Pathogenicity was proved the isolate to be virulent for disease incidence on chilli fruits. Bi-culture antagonistic test were proved that *Emericella* sp. And *Neosartorya* sp. Significantly inhibited *C. capsici* Further research findings are being tested the antagonistic potential in pot experiment.

Keywords: *Emericella* sp., *Neosartorya* sp., *Colletotrichum capsica*, Bi-culture test.

Nano-particles from *Chaetomium brasiliense* to Control *Phytophthora palmivora* caused Root Rot Disease in Durian var Montong

Tongon, R.¹, Soyong, K.¹, Kanokmedhakul, S.², Kanokmedhakul, K.²

¹Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; ²Department of Chemistry and Center for Innovation in Chemistry, Faculty of Science, Khon Kaen University, Khon Kaen, Thailand.
Corresponding Author: rutt1409@gmail.com

The antagonistic fungus is used *Chaetomium brasiliense* to control *Phytophthora palmivora* causing rot disease of Durian (*Durio zibithenus* L.) var Montong by crude extracts and Nano-particles derived from *Ch. brasiliense* were conducted. Crude extracts of antagonistic fungi were tested for antifungal biological activities. The crude extracts from antagonistic fungus with hexane, ethyl acetate and methanol were tested against *P. palmivora*. Crude ethyl acetate from *Ch. brasiliense* gave significantly against *P. palmivora* at the concentration of 500 and 1000 ppm, respectively. Which the ED₅₀ values were 17.46 and 120.22 µg/ml respectively. Testing Nano-particles antagonistic fungus were tested for antifungal activities. The results showed nano - particles from *Ch. brasiliense* gave effectively significantly inhibition of colony growth and spore production at the concentration of 5 ppm which the ED₅₀ values of growth inhibition were 1.08 µg/ml, whereas the ED₅₀ values of spore production were 8.68. Application of Nano - particles to control the *P. palmivora* causing root rot disease of durian in pot experiment was successfully done. The results showed nano-particles from *Ch. brasiliense* reduced the root rot disease on durain of 40%. The nano-particles from *Ch. brasiliense* gave significantly high plant growth which were 79.5 cm when compared to the non-treated control. Chemical treatment using metalexyl gave high plant growth which was 75.75 cm. which non-significantly differed when compared to nano-particles treatment.

Keywords: Nano-particles from *Chaetomium Brasiliense*, *Phytophthora palmivora*, biological control

Effects of Sulfometuron-methyl as Chemical Ripener on Growth and Yield of Three Sweet Sorghum Cultivars

Yoosukyingsataporn, S.* and Detpiratmongkol, S.

Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.
Corresponding Author: teetechno30@gmail.com

This study sought to investigate the effects of sulfometuron-methyl as chemical ripener on growth and yield of three sweet sorghum cultivars. The experiment was conducted at Faculty Agricultural

Technology, King Mongkut's Institute of Technology Ladkrabang, Ladkrabang, Bangkok, Thailand, during August to December 2015. A split-plot in randomized complete block design with three replications was used. Main plot was three sweet sorghum cultivars (Ethanol 2, KKU 40 and Cowley) and sub plots were six sulfometuron-methyl concentration levels (such as, 0, 500, 1,000, 1,500, 2,000 and 2,500 ppm). The results revealed that for three sweet sorghum cultivars, growth and yield of Ethanol 2 cultivar was largest followed by KKU 40 and Cowley cultivars, respectively. Sulfometuron-methyl mainly affected on growth and yield of sweet sorghum. As different sulfometuron-methyl concentration levels, the increase doses of sulfometuron-methyl concentration were decreased growth and yield of sweet sorghum. Juice extract yield, brix degree and stem fresh weight yield of sweet sorghum were the largest at 1,000 ppm sulfometuron-methyl concentration compared to the other concentration and control treatment. However, it was recommended that most suitable application of sulfometuron-methyl was 1,000 ppm concentration with Ethanol 2 cultivar. In addition, all of the growth parameters, had no significant interaction effects of sulfometuron-methyl concentrations and sweet sorghum cultivars.

Keywords: sweet sorghum, sulfometuron-methyl, chemical ripener

Effects of BA and NAA on Plant Regeneration of Neck Orange (*Citrus reticulata* Blanco)

Hansuek, S.^{1*}, Napassawan, L.² and Tassanee, K.³

^{1,2} Faculty of Agriculture, Rajamangala University of Technology Srivijaya Nakorn Sri Thammarat Saiyai Campus, Nakorn Sri Thammarat Province, Thailand; ³ Department of Plant Science, Faculty of Natural Resources, Prince of Songkla University, Hat Yai, Songkhla, Thailand.

Corresponding Author: sakulrat_s@hotmail.co.th

Neck Orange (*Citrus reticulata* Blanco) is a very popular native orange in Southern Thailand. It has health benefits and it is also used in many citrus processing industries, that explains its high market demand. Expansion of plantation area to increase production and to provide sufficient fruits to the consumers. The effect of benzyladenine (BA) supplemented with naphthalene acetic acid (NAA) to develop a new plant of Neck Orange were studied. The seeds of orange were surface sterilized with different sodium hypochloride and cultured on MS medium (Murashige and Skoog) gave the highest percentage of germination at 82.50 percent. The seeds of orange were surface sterilized cultured on MS medium with BA and NAA at 0-2 mg/l for 6 weeks. The result revealed that MS medium without plant growth regulators gave the highest percentage of germination at 83.93 percent, MS medium with BA 0.5 mg/l Adding charcoal 0.5 mg/l gave the shoot height at 3.17 cm., whereas MS medium with BA 2.0 mg/l gave the highest number of shoot at 3.33 shoots/seed and MS medium with 0.5 mg/l NAA and 0.5 mg/l BA Adding activated charcoal 0.5 mg/l gave root length at 21.30 cm. Types of oranges and culture media have a common effect on plant regeneration.

Keywords: Neck Orange, plant growth regulators, plant regeneration

Comparison of Antioxidant Properties in Different Herbal Fresh Sausages

Jaisut, N.¹, Teerarak, M.², Ngamyeesoon, N.² and Pilasombut, K.¹

¹Department of Animal Production Technology and Fisheries, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; ²Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: namfon.jaisut@gmail.com

This study evaluated the antioxidant properties of different herbal fresh sausages. Consumer acceptance of seven herbal adding to fresh sausage recipes No.1 – No.7 were examined. In addition, antioxidant properties were carried out using 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity, 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS) radical cation decolorization and thiobarbituric acid reactive substances (TBARS) methods. The results showed that the most favorite of cooked herbal fresh sausages recipes were NO.2 and No.5. Therefore, two of these recipes were further studied for antioxidant properties. The DPPH and ABTS of sausage NO.5 was

higher than sausage NO.2 and sausage contained 0.01% Butylated hydroxytoluene (BHT) ($P < 0.05$). However, TBARS of sausage recipes NO.2 and NO.5 were higher than 0.01% BHT ($P < 0.05$) which indicated that sausage recipes NO.2 and NO.5 was more rancid than the recipe with 0.01% BHT. This finding displayed the beneficial herbal fresh sausages as healthy food.

Keywords: antioxidant properties, fresh sausages, herbs

Acclimatization of Pencil Orchid (*Papilionanthe hookeriana* Rchb.f) using Types of Planting Media and Fertilization

Ganefianti, D. W.^{1*}, Romeida, A.¹, Herawati, R.¹, and Febriyani, S.²

¹Jurusan Budidaya Pertanian, Fakultas Pertanian, Universitas Bengkulu, Indonesia.; ²Alumni Fakultas Pertanian, Universitas Bengkulu, Indonesia.

Corresponding Author: dw_ganefianti@unib.ac.id

Acclimatization is a process of environmental adaptation from heterotrophic conditions to autotrophs. Pencil orchid plants whose seeds have been propagated in vitro require this environmental adaptation. Types of planting media and fertilization are important. This study aims to obtain the type of media and fertilization to acclimatize pencil orchids during the acclimatization period. This experiment used factorial completely randomized block design (CRBD). The first factor is the type of planting media; coconut coir, rockwool, wood shavings, and fern roots, and the second factor is the frequency of fertilization: once every 2 days, every 3 days, and once every 4 days. The results showed that there were significant interactions between the type of planting medium and the frequency of fertilization at the stem diameter variable. Orchid planting media significantly affected plant height, number of leaves, number of roots and root length, while fertilization significantly affected the number of leaves, number of roots and root length. The best planting medium to produce the best diameter orchid pencil stems is fern root which is fertilized once every four days, but the medium of coconut fiber and wood shavings that are fertilized three times a day is a good alternative. To produce plant height, the best number of leaves and root length can use fern root media and wood shavings. Pencil orchids fertilized four or three days can produce the best number of leaves, number of roots and root length.

Keywords: Pencil orchid, Acclimatization, planting media, fertilization

Chara corallina Klein ex Willdenow (Charales), A New Record of Edible Freshwater Algae in Southern Thailand

Chanwach W.*¹, Amornlerdpisan D.², Mahae N.³, Wattanakul U.³, Na Nakorn W.¹ and Amornwiriychai, V.⁴

¹Faculty of Agriculture, Rajamangala University of Technology Srivijaya, Nakhon Si Thammarat, Thailand; ²Faculty of Fisheries Technology and Aquatic resource, Maejo University, Chiang Mai, Thailand; ³Faculty of Science and Technology, Rajamangala University of Technology Srivijaya, Trang, Thailand; ⁴The College of Local Wisdom, Thaksin University, Phatthalung, Thailand.

Corresponding Author: wanninee81749@gmail.com

In the Krabi province, southern Thailand, it was found the bristle wort, *Chara corallina* Klein ex Willdenow, abundantly occurs in rainy season which some water and nutrients in the ditch and ponds are optimum. The alga locally known as “Kamkung” due to the top of thallus look like the claw of shrimp. This fresh alga is sold in the local market. The top part of fresh filaments are eaten with chili paste as style of local vegetable with traditional seasoning for long time. However, no information report as edible algae of this species, therefore, the focus of the present paper to provide the first report of this species as edible freshwater algae and conducted the local wisdom, nutritional value, pigmentation and phytochemical of this species. According to interviews conducted with local people as well as in local consumer, found that many people not knowledge of this species. From the nutritional values, it suggested that this species was the sources of mineral, and protein ($19.55 \pm 0.33\%$ dw) and carbohydrate. It was found to be rich sources of arginine ($3,244.52 \pm 6.98$ mg/100g dw) and lysine ($2,920.97 \pm 37.56$ mg/100g dw) for essential amino acid. Moreover, it found to be $20,369.95 \pm 676.49$ mg/100g dw of

calcium, which was higher than the small fish and also showed high content levels of selenium ($1,389 \pm 190 \mu\text{g}/100 \text{ g dw}$), which a well-known antioxidant. It also provided a good source of Ascorbic acid and linolaidic acid. In addition, the study of the bioactive compounds in *C. corallina* showed a high phenolic and flavonoid content and in some pigments, chlorophyll *a* and total carotenoid were 2.931 ± 0.16 and $0.408 \pm 0.04 \text{ mg/g cell dw}$, respectively. From this study, *C. corallina*, was a great interest as potential source of food supplement product or cosmetics industries.

Keywords: freshwater algae, Charales, edible algae, Thailand

Response of Biomass and Yield of Stevia (*Stevia rebaudianan* Bertoni.) to Fower Removal

Chumthong, B.* and Detpiratmongkol, S.

Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: bunyarit12151@gmail.com

It has never been studied on the effect of flower removal on the yield of Stevia plant. So, the purpose of this study was to resolve the effect of flower removal on growth and yield of Stevia. A plot experiment was operated out at Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok during November 2015 to February 2016. A randomized complete block design with three replications was used. The five of flower removal treatments were 1.) control (no flower removal) 2.) one time of flower removal at 30 days after transplanting (DAT) 3.) two times of flower removal at 30 and 60 DAT 4.) three times of flower removal at 30, 60 and 75 DAT and 5.) four times of flower removal at 30, 60, 75 and 85 DAT. The results revealed that flower removal produced significantly ($P=0.05$) greater number of leaves, dry biomass yield and leaf dry weight yield compared to the control. Four times of flower removal plant gave the highest number of leaves ($1,318.50 \text{ plant}^{-1}$), total biomass dry weight ($11.31 \text{ g plant}^{-1}$) and leaf dry weight yield (0.81 t ha^{-1}) compared to the control. Therefore, flower removal during the production of Stevia plant should be practiced in order to increase growth and leaf yield.

Keywords: Stevia, flower removal, growth, yield.

Response of Broad Bean Growth and Early Yield to Exposure Period of Vernalization

Al-Ubaidy, R. M.

Department of Horticulture, College of Agriculture, University of Baghdad, Iraq.

Corresponding Author: plantbreeding666@yahoo.com

An experiment was conducted in the field of Horticulture Department, College of Agriculture, University of Baghdad to investigate the influence of Vernalization periods on the vegetative characters, early and total yield components of broad bean. The experiment included three ranges of temperature (0, 5, 7 and room temperature $25 \text{ }^\circ\text{C}$) and three exposure periods (5, 15 and 25 days). Randomized Complete Blocks Design was used with three replicates. The result showed that vernalized seeds of broad bean at 5°C for 15 days increased significantly plant height to $86.80 \text{ cm plant}^{-1}$, number of branches 14.66 , dry weight of plant 115.48 g and earliness in flowering which lead to significantly increasing in yield and its component while the control treatment showed the lowest values at $22.00 \text{ pods plant}^{-1}$, $212.52 \text{ g plant}^{-1}$, and early yield 3.14 ton.ha^{-1} and total yield 7.48 ton.ha^{-1} .

Keywords: Broad bean, Vernalization, Leguminosae

Efficacy of *Eurotium* sp and *Serratia* sp to Control Brown Spot Disease of Rice caused by *Drechslera oryzae*

Unthuraloet, K. and Soyong, K.

Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.
Corresponding Author: ajkasem@gmail.com

Eurotium sp. is antagonistic fungus and *Serratia* sp. is antagonistic bacteria that were proved to be antagonisted *Drechslera oryzae* causing rice brown spot disease in laboratory. The causal agent of rice brown spot disease was isolated from lesion on leaves, then morphological identification under compound microscope. The rice pathogen was proved to be pathogenic isolate by Koch's Postulate method. Dual culture tests between the antagonists and the pathogen were proved that *Eurotium* and *Serratia* sp. significantly inhibited *Drechslera oryzae*. Further research findings are being tested the antagonistic potential in pot experiment.

Keywords: *Eurotium* sp, *Serratia* sp., *Drechslera oryzae*, Dual culture tests.

Session 3: MICROBIAL BIOTECHNOLOGY, BIODIVERSITY, TAXONOMY, BIOLOGICAL ACTIVITY

New Edible Mushroom from Discovery to Production

Karunarathna, S. C.^{1,2*}, Bandara, A. R.^{1,2,3}, Xu, J.^{1,2}, Mortimer, P. E.^{1,2} and Hyde, K. D.^{1,2,3}

¹Kunming Institute of Botany, Chinese Academy of Sciences, Kunming 650201, China; ²World Agroforestry Centre, East Asia, 132 Lanhei Road, Kunming 650201, China; ³Center of Excellence in Fungal Research, and School of Science, Mae Fah Luang University, 57100 Chiang Rai, Thailand.
Corresponding Author: samantha@mail.kib.ac.cn

The forests of Southeast Asia have the potential to be a rich source of cultivatable edible fungi. Although significant amounts of research on the taxonomy and phylogeny of edible mushrooms have been carried out, far fewer studies have focused on the domestication of wild fungi. Today, the most commonly cultivated strains are temperate species, but tropical and subtropical mushrooms are both abundant and highly diverse, with many species having long histories of human consumption. In addition, many new species have recently been introduced to science, including numerous species of high nutritional and medicinal value. The domestication and cultivation of tropical mushrooms therefore provides an enormous opportunity for Southeast Asian countries. Due to the difficulties of cultivating mycorrhizal species, we have concentrated on saprobic species. Most tropical and subtropical mushrooms, if provided with appropriate conditions, grow and produce fruiting bodies more quickly than temperate species. Tropical and subtropical mushrooms can be produced using cheap, readily available waste products such as sawdust, corn cobs, rice straw, sugarcane bagasse, and other forest and agricultural residues, making them an ideal crop for smallholder farmers. We have collected and isolated numerous strains of wild mushroom species from Southeast Asian forests, and have published some initial results documenting our progress in domesticating these species. Using a variety of steps including sample collection, isolation, spawn production and fruiting body production in sawdust and compost media, we showed for the first time that it is possible to domesticate the following fungi: *Pleurotus giganteus*; a new Thai-French hybrid strain of *Agaricus subrufescens*; *A. flocculosipes*; *A. subtilipes*; *Auricularia thailandica*; *A. cornea* (white); *Panus roseus*; *Macrolepiota dolichaula*; *Ganoderma australe*; and *G. leucocontextum*. These discoveries may create new opportunities for the mushroom growing industry and for smallholder farmers in Southeast Asia in particular.

Keywords: compost media, edible fungi, sugarcane bagasse, temperate species

Biodiversity of Soil Macroarthropods and Relationship with Environmental Factors in Northeastern Thailand

Krubphachaya, Ph.^{1, 2}, Aroon, S.¹, Sukteeka, S.¹, Paiboon, N.¹, Noinumsai, N.², Tantipanatip, W.³ and Thanee, N.^{1*}

¹ School of Biology, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand; ² Faculty of Science and Technology, Nakhon Ratchasima Rajabhat University, Nakhon Ratchasima, 30000, Thailand; ³ Faculty of Science and Technology, Phranakhon Si Ayuttaya Rajabhat University, Phranakhon Si Ayuttaya 13000, Thailand.

Corresponding Author: nathawut@sut.ac.th.

The aims of this research were to investigate the biodiversity and distributions of soil macroarthropods, and studied relationships between soil macroarthropods and environmental factors. The experiment was conducted at Suranaree University of Technology, Nakhon Ratchasima province during the period September 2014 to August 2015. The investigations were carried out at 1 month-intervals using hand collection and fundamental tools of three forest habitats such as degraded forest, plantation forest and agricultural farm. The results showed that there were 5 families, 5 genera and 268 individuals of millipedes. *Zephronia siamensis* was the most discovered (101 individuals) followed by *Cylindroiulus* sp. (61 individuals) and *Thyropygus allevatus* were the lowest number (15 individuals). Moreover, the total of 2,312 insects, 47 genera were found in 6 orders i.e. Blattodea, Coleoptera, Dermaptera, Hymenoptera, Isoptera and Orthoptera. The most diversity and distributions of insects was found in plantation forest (891 individuals) followed by degraded forest (7 individuals) and farm land was the lowest discovered (792 individuals). Order Hymenoptera (family Formicidae) was the most discovered (739 individuals) followed by order Coleoptera (Families Scarabacidae and Staphylinidae) (490 individuals) while order Blattodea (family Blaberidae) was the lowest collection (120 individuals). The correlation between macroarthropods and environmental factors was studied during September 2014 to August 2015. The results showed that phosphorus, pH, organic matter and soil texture showed significantly positive correlation with insect diversity ($P \leq 0.05$). Meanwhile, the density and diversity of millipede were significantly positive correlated with potassium, phosphorus and organic matter ($P \leq 0.05$).

Keywords: Soil macroarthropods, soil properties, Suranaree University of technology

Mass Rearing and Dispersal of Biological Control Agents (BCAs) as Interventions in Coconut Scale Insect (CSI) Calamity Areas in Basilan, Philippines

Rosemarie, dR J.

Mindanao State University-Maguindanao, Philippines.

Corresponding Author: rdrjosue@yahoo.com

Biological Control Agents (BCAs), Predatory beetles and Parasitoids were mass-reared using the squash medium and coconut seedling media in Basilan. The methods were used to mass-produce BCAs to control the infestations of Coconut Scale Insects (CSI) in Basilan, Philippines. CSI taken from infested coconut leaves were inoculated on squash fruits. When 80% of the fruits were coated by CSI, the adult predators of genus *Telsimia* and *Cybocephalus* and parasitoids *Comperiella calauanica* were separately placed in rearing boxes that contained the CSI-coated fruits. The BCAs were allowed to reproduce from eggs to adult stage. The inoculation of the fruit was done at least 1 week earlier to produce 80% CSI-coated fruits in 3 weeks on time for the transfer of adult female predators to lay their eggs or new larvae to grow. There were 5 methods used in rearing the *Comperiella calauanica*. These were the squash medium exposed in different laboratory temperatures and light exposures, the CSI-infested coconut seedlings in open backyard and CSI-infested seedlings in net cage. The squash medium method was used to rear the predatory beetles. The CSI-infested coconut seedlings in net cages were the best protocol used to subsequently mass-rear and disperse the parasitoids *Comperiella calauanica*. These parasitoids grow only in external net cages. The best protocol for the predatory beetles was the squash medium. The 3 introduced predators showed predation on the populations of 2 CSI species *Aspidiotus destructor* and *A. Excisus*. Of the 2 BCAs, the predatory beetles were the first to grow large population and

were the first ones released to the coconut farmers. A total of 234,000 predators and 379,500 parasitoids were harvested and dispersed in 6 Municipalities of Basilan within the year of project.

Keywords: Biological Control Agents, Coconut scale Insects, Calamity areas, Mass rearing and Dispersal

Earthworm Biodiversity in Oil Palm Plantation and Secondary Forest Patch in Riau, Indonesia

Erniwati ^{1*} and Anas, I.¹

Department of Forestry, Faculty of Agriculture, Universitas Bengkulu. Jl. W.R. Supratman, Kota Bengkulu 38371A, Bengkulu, Indonesia. ¹ Soil Biotechnology Division, Department of Soil Science and Land Resources, Faculty of Agriculture, Bogor Agricultural University, Indonesia.
Correspondence Author email : erniwati@unib.ac.id

Oil palm plantations are rapidly increasing in recent year. In the early development, large-scale oil palm plantations were dominated, while in recent years, independent smallholder oil palm plantations increased sharply and are likely to dominate in the future. In order to develop sustainable oil palm management, it is important to know the impact of management of oil palm plantation on soil fertility. The objective of the study is to determine the biodiversity, distribution and relative abundance of earthworms under different land use management and its relation to abiotic factors (physico-chemical properties) of the soil. The study was conducted from March to April, 2016 in Riau Province. Earthworms were collected by hand sorting method from different sites; 20 plots (1 m x 1 m) in secondary forest patches, 40 plots in smallholdings oil palm plantations and 40 plots in a large-scale plantation. Physico-chemical analysis of the soil was also done to know the important factors affecting earthworm biodiversity and distribution. Total two species of earthworms were identified: *Pontoscolex* sp dan *Pheretima* sp. *Pontoscolex* was the most abundant species and found in all the collection sites. The average density of soil organisms was found to be higher in smallholder oil palm plantations with an average value of 50 indv/m² compared to large-scale oil palm with an average value of 30 ind / m². Principal component analysis showed the main three abiotic factors: organic carbon, the clay content and sand content in the soil texture has strong positive effect on the distribution of earthworm. Earthworm density and distribution have been found to be positively correlated with type of oil palm management but not for the earthworm biodiversity.

Keyword: earthworm biodiversity, oil palm plantation, secondary forest patch

Phenolic Compounds and Antioxidant Capacities of Mao-Luang Leaves (*Antidesma thwaifasianum*.) Cultivars from Northeastern Thailand

Jorjong, S. ^{*}, Sakhunkhu, S. and Plaetita, W.

Department of Plant Science, Faculty of Natural Resource, Rajamangala University of Technology Isan Sakonnakon Campus, Sakon Nakhon, Thailand.
Corresponding Author: sujitar_9@hotmail.com

Mao-Luang or Mak Mao Sakhon Nakhon (*Antidesma thwaifasianum*.) is the one of the most popular local fruits in Northeastern Thailand and is widely used as food or beverages. There are medicinal and potent antioxidant properties in Mao-Luang play role in treating cancer and diabetes. However, lack of information such as phytochemicals and antioxidant capacities of Mao-Luang leaves cultivars. The objectives of this study were to determine polyphenolic compounds and the antioxidant capacity in fifteen leaves cultivars of Mao-Luang. The extracts were determined for antioxidant activities by DPPH[•], ABTS^{•+} scavenging activity, OH[•], reducing power and the quantity of phenolic contents were investigated by using HPLC method. The results showed that there were differences (p<0.05) in phenolic compounds and antioxidant activities among Mao-Luang leaves cultivars. The major polyphenolic components in all Mao-Luang leaves cultivars were Epicatechin, Gallic acid, p-Cumaric acid, Quercetin and Cinnamic acid. The highest contents were found in “Huoi-Bang” (9426.37, 3172.95, 17.46, 34.41, 20.57, and 0.46 mg/100 g DW, respectively) with values exhibited the highest antioxidant activity with the values of 80.96 % scarvening (DPPH assay), 83.54 % (ABTS^{•+}). Other cultivars e.g. Sang Krow No.2, Thong-Vae and Thappradit are also rich in these compounds.

Keyword: phytochemicals, local fruits, antioxidant properties, Mao-Luang

Mycotoxin in Pathogenic Fungi

Kanokmedhakul, K.^{1*}, Soyong, K.² and Kanokmedhaku, S.¹

¹Natural Products Research Unit, Department of Chemistry, and Center of Excellence for Innovation in Chemistry, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand; ²Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand.

Corresponding Author: kwanjai@kku.ac.th

Many common fungi growing in foods and feeds produce mycotoxins. These toxins have caused sickness or death in humans and animals since historical times. Whereas some mycotoxins may accumulate in infected plants lead to the development of plants diseases known as phytotoxicity. Trichothecenes are one of the major classes of mycotoxins, causing significant economic impact on cereal and grain crops worldwide. Our work on the isolation of trichothecenes in some pathogenic fungi is presented.

Deproteinization in Purification of Exopolysaccharide from *Ophiocordyceps sinensis* Olive Oil – Stimulated Culture

Thuy, H. L. T.^{1*}, Bao, C. H.², Phuong, T. V. T.², Lap, D. B.², Hai, N. T. V.², Minh, H. D.³, Tien, T. N.⁴

¹Faculty of Food Technology, University of Food Industry, Ho Chi Minh City; ²Faculty of Biology – Techbiology, University of Science, Ho Chi Minh City; ³Agricultural Hi-Tech Park, Ho Chi Minh City; ⁴Institute of Science and Technology HCM City, Vietnam Academy of Science and Technology, Vietnam.

Corresponding Author: hanglth@cntp.edu.vn

Exopolysaccharide (EPS) extracted from *O. sinensis* culture supplemented olive oil is analyzed not only includes polysaccharides which also have links with proteins. In this study, we evaluated the deproteinization methods from the crude EPS to increase the efficiency of exopolysaccharide extraction, and not to affect the biological activity of polysaccharide, the methods used: Sevag method, TCA (trichloroacetic acid) method, and the enzymatic method. Results showed that using protease method for efficient removal of protein on extraction, purification, and biological activity was greater than the residual methods. Deproteinized EPSs separated by Sephadex G-100 gel filtration chromatography, we obtained two segments, EPS I and EPS II. In that, polysaccharide content increased from 34.1% to 82.33% (2.4 times) for EPS I, 78.98% (2.3 times) for EPS II, protein content significantly reduced when using protease from 3.57% to 0.002%; and 0.0067%, for EPS I, EPS II respectively. Besides the antioxidant activity of the EPS segments increased significantly compared with the raw EPS.

Keywords: deproteinization, purification, exopolysaccharide, *Ophiocordyceps sinensis*

In Vitro Antioxidant Activities and Phenolic Compounds Content from Karanda (*Carissa carandas* L.) Wine

Rumjuankiat, K.¹, Sonhom, N.¹, Showpanish, K.¹ Somsri, A.¹ and Pilasombut, K.^{2*}

¹Faculty of Biotechnology, College of Agriculture Innovation Biotechnology and Food, Rangsit University, Lak Hok, Mueang Pathum Thani District, Pathum Thani 12000, Thailand.; ²Department of Animal Production Technology and Fisheries, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand.

Corresponding Author: nipon.s58@rsu.ac.th

Carissa carandas L. or karanda (in Thai called namdaeng or manaao ho) is widely used as a medicinal plant. Karanda juice was fermented for 22 days to produce alcohol using *Saccharomyces cerevisiae* TISTR5918. Total soluble solids or TSS of karanda juice (approximately 1.0°Brix) was adjusted to 24°Brix and samples were collected every 2 days for analysis of total soluble solids (TSS), pH and alcohol content. Yield of alcohol was measured at 12.50±0.35% in the final fermentation. TSS dropped gradually from 24°Brix to 9.17±0.58°Brix, whereas pH increased slightly from 2.47±0.06 to 2.80±0.00

(Day 0-22). Volatile compounds in karanda wine (KW) were examined and analyzed using gas chromatography-mass spectrometry (GC-MS). Volatile compounds detected in KW included 3-methyl-1-butanol, butanoic acid, butyrolactone, phenylethyl alcohol, butanedioic acid, benzene ethanol and 2-propenyl ester as a common flavor and aroma in wine. Heavy metals (Pb, As, Cu and Cd) determined by atomic absorption spectroscopy (AAS) were present in lower than their maximum allowed concentrations. Methanol was detected at only 0.005% in KW analyzed by gas chromatography equipped with a flame ionization detector (GC-FID). Antioxidant activities were determined by three methods comprising diphenyl picrylhydrazyl radical scavenging assay (DPPH), radical cation decolorization assay (ABTS) and reducing power. The IC₅₀ values of DPPH and ABTS were 0.84±0.03% and 3.28±0.03%, respectively, and the EC₅₀ of reducing power was 11.03±0.11%. Total phenolic content, measured according to the Folin-Ciocalteu procedure, was determined as 746.64±3.10 mg GAE/100 ml sample.

Keywords: *Carissa carandas* L., karanda wine, antioxidant activities, volatile compounds

Antibacterial and Anti-tyrosinase Activities of the Methanolic Extract from Leaves of *Tectona grandis*

Phonmakham, J.¹ Wattanasuksakul, S.² and Poeaim, S.^{1*}

¹Department of Biology, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang, Ladkrabang, Bangkok, Thailand; ²Forest Research and Development Bureau Royal Forest Department Paholyothin Road, Chatuchak, Bangkok, Thailand.

Corresponding Author: poeaim@hotmail.com

The purpose of this study was compared antibacterial and anti-tyrosinase activities of methanolic extracts from fresh and fallen leaves of *Tectona grandis* (Teak). Fresh and fallen teak leaves were collected from Thongphaphum and Phitsanulok silviculture research station. Antibacterial activity was determined by disc diffusion method with concentration at 500 µg/disc. Fresh and Fallen of teak leaves extract was showed good activity against *Staphylococcus aureus* and *S. epidermidis*. In other hand, fresh teak leaves inhibited growth of *Propionibacterium acnes* better than fallen teak leaves. The anti-tyrosinase activity was determined by Dopachrome method with concentration at 1500 µg/ml. fresh and fallen leaves extracts the percentage values between 35.45%-73.65% inhibition of tyrosinase enzyme.

Keywords: Antibacterial, Anti-tyrosinase, *Tectona grandis*, Teak

Fermentation of Gac Juice Mixture by Probiotic Lactic Acid Bacteria

Mongkantanawat, N.¹, Laohkitikul, S. and Lertnimitmongkol, W.

Department of Product Development and Management Technology, Faculty of Agro-Industrial Technology, Rajamangala University of Technology Tawan-ok Chanthaburi Campus Chanthaburi, Thailand.

Corresponding Author: jeabn2009@gmail.com

Probiotic Gac juice from Gac fruit (*Momordica cochinchinensis* Spreng.) was fermentated using various strains of *Lactobacillus* sp. There were 8 treatments representing various strains of *Lactobacillus* sp which were laid out in Completely Randomized Design (CRD for sensory evaluation. Treatment 3 (Gac juice fermented by *L. fermentum* TISTR 391) was highest in terms of overall acceptability with the score 6.07 (moderately like). Changes in pH, acidity, total soluble solid and viable cell counts during fermentation under controlled conditions (30°C) at 0, 24, 48 and 72 h fermentation were evaluated. Our results showed that change in pH and total soluble solid of probiotic Gac juice significantly ($p \leq 0.05$) decreased at 72 h fermentation. On the other hand, the amount of titratable acidity expressed as lactic acid significantly ($p \leq 0.05$) increased at fermentation for 72 h. Then, shelf life on viable cell count in cold storage (4°C) was investigated. The viable cell reached 1 week of storage, then sharply declined when the stored time was extended and lowest at 4 weeks storage. Finally, the amount of vitamin C, antioxidant activity and cytotoxicity to human colon cancer cell SW620 were evaluated. Interestingly, the amount of vitamin C content increased two fold higher than the control. In addition, the free radical

scavenging capacity was assayed by DPPH method. It showed that IC₅₀ values was significantly ($p \leq 0.05$) higher than the control. However, both fermented Gac juice and control tended to affect colon cell SW620 when the juice concentration was increased. For the bacterial cell behavior, they were scanned using electron microscope. It showed that lactic acid bacteria grew around the polysaccharide on the juice. Overall, the results showed that Gac juice could be an alternative healthy non-dietary probiotic source for vegetarians and milk allergy consumers in the future.

Keywords: Fermentation, Gac juice, Probiotic lactic acid bacteria

Phytochemical Screening of *Coffea arabica* Crude Extract and Its Inhibiting Activity Against *Aspergillus flavus*

Labaya, J. B. E.*, Peniano, S. M. D., Tolentino, J. J. V. and Pelagio, B. A.

Philippine Science High School – Central Luzon Campus, Lily Hill St., Clark Freeport Zone, Pampanga, Philippines.

Corresponding Author: jblabaya@clc.pshs.edu.ph

The accelerated development of resistance of pathogens against conventional treatments arises from several factors, including the improper or lengthened use of antibiotics especially in immunocompromised patients. In example, cases of aspergillosis that occurs primarily in those with weakened immune systems or respiratory illnesses have been recorded to be one of the leading causes of severe fungal infections globally, amounting to roughly 300,000 each year. As a result, potential antimicrobial substances are being derived and developed from plants and their metabolites, which are used as traditional medicine in various countries across the world. In this study, extracts of *Coffea arabica* were obtained through maceration of ground green seeds with 50% v/v water:ethanol and were investigated for its inhibiting activity against *Aspergillus flavus* through the poisoned food technique with concentrations of 0.5:15, 1:15, and 2:15 extract:medium (in mL). All concentrations inhibited the growth of the fungus with the highest concentration showing no significant difference to the control setup at 39.7% to 44.4% ($p > 0.05$), respectively. Furthermore, qualitative and quantitative phytochemical screening were performed to determine the major metabolites present in the seeds of *C. arabica*. The most abundant bioactive compounds were alkaloids and tannins, which have previously been reported to exhibit fungal growth inhibition abilities. These findings indicate that further studies concerning *C. arabica* extracts and its constituents can be performed to develop natural alternatives to treat invasive fungal infections, especially cases caused by *A. flavus*.

Keywords: antifungal activity, *Aspergillus flavus*, *Coffea arabica*, phytochemicals, poisoned food technique

The Efficacy of Plant Extracts, Bio-insecticides, Petroleum Oil and Insecticides for Controlling Thrips (Thysanoptera: Thripidae) in Pummelo cv. Tubtimsiam in Nakhon Si Thammarat Province, Thailand

Thongjua, T.* and Thongjua, J.

Faculty of agriculture, Rajamangala University of technology Srivijaya, Nakhon Si Thammarat 80110, Thailand.

Corresponding Author: kai_thipawan@hotmail.com

The main problems in pummelo qualitative production are thrips, that destroy young leaves, flowers and young fruits. The damage was found that fine leaf margins roll upward bend on both sides, brown marks leaves. If the outbreak occurs during young fruit stage, it may cause fruit-retarded, rough scarring on fruit surface. Chemicals is usually the first choice for farmer to use for controlling. The purpose of study was to investigate the efficiency of the different insecticides, such as neem and tobacco extract or petroleum oil or the mix of these substance, to be an alternative treatment for the farmers could replace synthetic insecticides. The experimental was conducted in 4-5 years old Tubtimsiam pummelo plantation in Nakhon Si Thammarat Province of Thailand from 7-28 October 2017. The RCBD, experimental design was using with 4 replication and 9 treatments. The number of thrips and leaf damage were counted and evaluated by sampling 15 leaves/tree before application treatments and after application treatments 7, 14 and 21 days. The result showed that the highest effectiveness was abamectin 98.67% followed by imidacloprid, petroleum oil mix tobacco, petroleum oil mix neem extract

(azadirachtin 0.1%), neem extract (azadirachtin 0.1%), petroleum oil, tobacco and water spraying, was giving 95.54 89.53 88.14 86.14 84.56 77.19 and 76.69 % respectively, compared with control (non-treated). The average percentage of leaf damage after application treatment at 7, 14 and 21 days were found that all treatments were significant differences from non-treated leaf damage.

Keywords: neem, petroleum oil, abamectin, imidacloprid

Mating Type and Genetic Diversity Analysis of *Pyricularia oryzae* Collected from Thai Rice Varieties during Year 2016 and 2017

Tansian, P.^{1,2} and Parinthawong, N.¹

¹Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand; ²Center of Excellence on Agricultural Biotechnology: (AG-BIO/PERDO-CHE), Bangkok 10900, Thailand.

Corresponding Author: nonglak.pa@kmitl.ac.th

Rice blast disease caused by *Pyricularia oryzae*, is one of the most damaged of rice production worldwide. The fungi have a great diversity on both genotype and pathotype. The purpose of this study was to analyze genetic relationship of *P. oryzae* collected in Thailand during year 2016 and 2017. Rice plants appeared blast symptom were collected from disease epidemic areas and isolated for single spore. All isolates were identified for mating type using MAT1-1 and MAT1-2 primer sets. In this result, the mating type MAT1-2 was mostly found in Thailand and only about 7.7 % of MAT1-1 was found in the population. In this observation, both MAT1-1 and MAT1-2 were found in isolates collected from the same location in Phetchabun province. Therefore, the genetic analysis of 14 *Magnaporthe grisea* microsatellite (MGM) markers was cluster-analyzed using UPGMA method of the SHAN program. The result showed cluster analysis was separated the population into 11 groups. Group 1 to 7 showed the percentage of the population with 3.8, 5.8, 36.5, 13.5, 3.8, 25.1 and 3.8, respectively. For group 8-11, the rice blast fungi from North and South of Thailand were separated into single isolate group. Group 6 was the highest diversity of province numbers, obtained from diverse rice varieties that showed similar genotype but difference in pathogenicity. The difference isolates of fungi could infect the same rice variety. Genetic diversity and determining of mating type of rice blast populations in Thailand are essential studies and will be useful for predicting an epidemics of rice blast disease and choosing appropriate blast isolates for using in rice blast breeding programs.

Keywords: rice blast disease, *Pyricularia oryzae*, genetic diversity analysis, *Magnaporthe grisea* microsatellite (MGM) markers

Nano-particles from *Cheatomium brasiliense* against Brown Spot of Rice

Vareeket, R.¹, Soyotong, K.¹ and Kanokmedhakul, S.²

¹Department of Plant Production Technology, Faculty of agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand; ²Department of Chemistry and Center for Innovation in Chemistry, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand.

Corresponding Author: rungrat.kmitl@gmail.com

Cheatomium brasiliense was used in this study to control rice brown spot disease pathogen, *Drechslera oryzae*. The result of bi-culture test showed that *Ch. brasiliense* gave the highest percentage of growth inhibition at 26.38% and had the highest spore inhibition at 23.81%. In crude extracts test, it was found that crude methanol extract obtained from *Ch. brasiliense* at 1000 ppm showed the highest inhibitory effect on colony growth and spore production. *Ch. brasiliense* gave a growth inhibition and spore inhibition rates at 83.50 and 99.78% respectively. The effective dose (ED₅₀) on growth and spore inhibition of *Ch. brasiliense* was 80.54 and 0.35 µg/ml, respectively. It was also found that Nano-particles obtained from crude methanol extract of *Ch. brasiliense* (nano CBM) at 10 ppm had the best inhibitory effect in terms of growth and spore inhibition. Nano CBM can inhibit the growth at 70.00% and spore production at 79.92%. The ED₅₀ values for spore inhibition of *Ch. brasiliense* was 2.86 µg/ml.

Keywords: *Cheatomium brasiliense*, biological control, rice disease

Isolation, Characterization, and Identification of Pigmented Fungi from Mangrove Areas in Bataan, Philippines

Gonzales, P. L. A.*, Mendoza, A. S. and Pangilinan, G. M. Y.

Philippine Science High School - Central Luzon Campus, Clark Freeport Zone Pampanga, Philippines.

Corresponding Author: plgonzales@clc.pshs.edu.ph

Pigments and colorants are utilized by humans for various applications in food, clothing, cosmetics, and medicine. However, the use of harmful synthetic dyes such as azo dyes have degraded the environment through the use of these dyes and its cytotoxicity proves lethal to many organisms affected by its production. As a result, there has been an increase in research regarding the pigments derived from natural sources such as bacterial and fungal metabolites. The research aims to find alternative water-soluble pigment sources from fungi found in the mangrove environments of Bataan. Soil samples were serially diluted and isolated with the use of PDA and the researchers isolated 7 relevant fungi with pigmentation after 7 days of incubation. 3 of the samples exhibiting pigmentation were re-isolated under PDB to observe its pigmentation through the medium and were also morphologically analyzed using a microscope. The samples were identified as *Aspergillus* spp. and *Aureobasidium* spp. Through the PDB medium, a change in color within the broth confirms the presence of water-soluble pigments in the samples. The research confirms the presence of pigmented fungi in the mangrove environment studied as the *Aureobasidium* spp. exhibited pigmentation in the medium. It is recommended to continue the research through further extraction of the pigments along with antimicrobial testing of the extracted samples.

Keywords: Fungi, Pigments, Mangroves

Session 4: ANIMAL AND FISHERY SCIENCES

Feeding Strategy for Cattle Production under Cattle-Oil Palm Integration System in Bengkulu, Indonesia

Dwatmadji* and Suteky, T.*

Department of Animal Science, Faculty of Agriculture, University of Bengkulu, Indonesia.

Corresponding Author: dwatmadji.2008@gmail.com, Tatiksuteky.2008@gmail.com

With the current cattle population, Indonesia is still struggling to fulfill its national beef self-sufficiency. Indonesia's expanding population, rapid urbanization and rising household incomes have increased demand for high quality beef meat. To meet this, Indonesia imported more than 512,000 live cattle from Australia and imported more than 130,000 tons of meat from other countries. Meantime, as the highest palm oil producer in the world, Indonesia has 14.03 Million ha of oil-palm plantation which have high potential to be used for cattle production. This paper aimed to describe the current features of feeding strategy under Cattle-Oil Palm integration system in Bengkulu, Indonesia. There were three main feeding strategies for maximising the cattle production under Cattle-Oil Palm integration system in Bengkulu: grazing system, semi-intensive system (combination of grazing and intensive), and intensive system where cattle were kept in the barn for all of the time. Most breed used were Indonesian native Bali cattle and all the feeding strategy involved feed supplementation

Keywords: cattle, oil palm, integration, feeding strategy

Virulence Factor Gene Profiles of *Aeromonas veronii* Isolated from Diseased Nile Tilapia (*Oreochromis niloticus*) in Nakhon Si Thammarat Province and Its Expression towards Diurnal Water Temperature Changes

Chirapongsatunkul, N.*, Srichanun, M. and U-taynapun, K.

Department of Fisheries, Faculty of Agriculture, Rajamangala University of Technology Srivijaya, Nakhon Si Thammarat, Thailand.

Corresponding Author: nim_nion@hotmail.com, nion.c@rmutsv.ac.th

Aeromonas spp is the causing agent of Motile Aeromonas Septicemia (MAS) which cause a great loss in Nile tilapia (*Oreochromis niloticus*) farming. More than 200 bacteria were isolated from Nile tilapia exhibiting MAS disease in Nakhon Si Thammarat province, an important tilapia culturing area in Southern Thailand, since 2014–2017. Every collected isolates was Gram-negative and short rod-shaped. Three isolates of bacteria, A2014–1, A2015–8 and A2016–28, were randomly selected. Characterization based on molecular cloning indicated that all 3 isolates are *A. veronii*. This present study aimed to elucidate the appearance of 5 virulence factor genes considerably relevant to pathogenesis including lipase, elastase, enolase, aerolysin (*aerA*), and heat-labile cytotoxic enterotoxin (*alt*) in these 3 isolates. The differences in virulence factor gene profiles were detected; lipase⁻/elastase⁺/enolase⁺/aerA⁻/alt⁺, lipase⁻/elastase⁻/enolase⁻/aerA⁺/alt⁻ and lipase⁻/elastase⁻/enolase⁻/aerA⁺/alt⁺ for A2014–1, A2015–8 and A2016–28, respectively. Moreover, the effects of diurnal water temperature change of 2 different patterns, which were actually recorded from the tilapia culturing pond, on bacterial growth and the mRNA expression level of the virulence factor genes were determined. In this regard, the variable relationships between the change of water temperature and bacterial growth as well as the expression of virulence factor genes were noticed. However, these data preliminary suggested the diversity of bacterial genotypes especially that of virulence factor gene profiles in the *Aeromonas* spp. causing MAS in Southern Thailand.

Keywords: Motile Aeromonas Septicemia (MAS), *Aeromonas veronii*, *Oreochromis niloticus*, virulence factor genes, diurnal water temperature change

Phytochemical Screening and Masculinization of Nile Tilapia (*Oreochromis niloticus* Linnaeus) using The Needle and Root Crude Extracts of Benguet Pine (*Pinus kesiya* Royle ex Gordon)

Roque, R. L. A.^{1*}, Bolivar, R.² and Rafael, R.³

¹Department of Aquaculture, College of Fisheries, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines; ³Department of Chemistry, College of Arts and Sciences, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines.

Corresponding Author: reginorlyzaroque@gmail.com

This study evaluated the effect of Benguet pine (*Pinus kesiya*) needle and root extracts in the masculinization of Nile tilapia (*Oreochromis niloticus*) fry. The crude extracts of Benguet pine were phytochemically screened and found positive for steroid for root extracts while chlorophyll and xantene were present in needle extracts. Toxicity assay was conducted to evaluate the median lethal concentration (LC₅₀) after 96 hours. Probit analysis revealed LC₅₀ was 150 ppm and 960 ppm for Benguet pine needles and roots, respectively. Temperature, dissolved oxygen (DO) and pH did not differ statistically in all treatments (P>0.05). For the sex-reversal, treatments were as follows; I-fry booster only, II- diet with 50 mg/kg Methyltestosterone, III- diet with 100 ppm Benguet pine needle extract and IV-diet with 500 ppm Benguet pine root extracts. Results revealed no significant difference was observed in the survival and growth rate of different treatments (P>0.05). No sex inversion was observed in the diet with 100 ppm Benguet pine needle crude extract and diet with 500 ppm Benguet pine root crude extracts 62.27±7.02% and 61.51±5.88%, respectively. Percent males were significantly different at 50 mg/kg Methyltestosterone compared to other treatments. No intersex gonads were observed in all treatments. Temperature, dissolved oxygen (DO) and pH did not differ statistically in all treatments (P>0.05) after 28-day sex-reversal in outdoor tanks.

Keywords: masculinization, methyltestosterone, phytochemical screening, sex-reversal

Degradation of Troponin-T associated with Calpain/ Calpastatin Genes Expression in Thai Native Beef Cattle Fed Different Levels of Energy

Non-see, M. ¹, Lukkananukool, A. ², Polyorach, S. ², Sommart, K. ³, Sazili, A. Q. ⁴ and Chaosap C. ^{1*}

¹Department of Agricultural Education, Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand; ²Department of Animal Production Technology and Fisheries, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand; ³Department of Animal Science, Faculty of Agriculture, Khon Kaen University, Khon Kaen 40002, Thailand; ⁴Department of Animal Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.
Corresponding Author: chanporn.ch@kmitl.ac.th

This study determined the influence of dietary energy level on the degradation of troponin-T protein and expression of calpain and calpastatin genes in native Thai cattle. Eighteen steers (at 200 days old and average body weight of 100 ± 20 kg) were randomly assigned to 3 dietary treatment groups of different metabolizable energy: Treatment 1 [(8.9 MJ/ kg DM; n=6), Treatment 2 (9.7 MJ/kg DM; n=6) and Treatment 3 (10.5 MJ/kg DM; n=6)]. The diets were in the form of fermented total mixed ration (FTMR). At the end of 520 days of feeding, the steers attained 300 ± 10 kg BW at slaughter. The *Longissimus dorsi* m. samples collected within 48 h postmortem were either aged for either 2 or 14 d for the troponin-T degradation immunoblot analysis while, the CAPN1, CAPN2, and CAST genes expression analyses only used samples aged for 2 d postmortem. The relative bands intensities of intact (37 kDa) and degraded troponin-T (30 kDa) were unaffected by the dietary treatments (p>0.05). Higher 37 kDa (p<0.01) and 30 kDa (p<0.001) troponin-T proteins expression were noted at 2 d and 14 d post-mortem, respectively. The CAPN1, CAPN2, and CAST genes expression remained unaffected (p>0.05) by the dietary treatment. Nonetheless, significant associations were observed between CAPN2 and CAST genes expression (r=0.93; p<0.0001), and between CAPN1 gene expression and 30 kDa troponin-T proteins expression at 14 d postmortem (r=0.58; p<0.05). This study concludes that neither troponin-T proteins nor calpain/ calpastatin genes expression were influenced by dietary energy levels in fattened native Thai cattle. The associations between CAPN2 and CAST genes expression, and between CAPN1 gene expression and 30 kDa troponin-T proteins expression at 14 d postmortem suggest the involvement of CAPN1 in myofibrillar proteolysis during the 14 d postmortem ageing of *Longissimus dorsi* m. in native Thai cattle.

Keywords: Dietary energy, troponin-T, calpain, calpastatin, native Thai cattle

Acoustic Target Strength Measurement of Several Reef Fishes in Tikus Island Waters of Bengkulu

Bakhtiar, D. ¹, Jaya, I. ², Manik, M. H. ², Madduppa, H. H. ², Febrianto, T. ³

¹Study Program of Marine Science Faculty of Agriculture of Bengkulu University (UNIB), Indonesia; ²Departement of Marine Science and Technology of Bogor Agricultural University, Indonesia; ³Faculty of Fisheries and Marine Science of Raja Ali Haji Maritime University (UMRAH) Tanjungpinang, Indonesia.

Corresponding Author: deddybakhtiar@unib.ac.id

Coral reef ecosystems have rich reef fish resources with high level of species diversity. Identification of the species and density of reef fishes are usually carried out using a visual census. This research was conducted with an acoustic approach to analyze the acoustic backscatter characteristics of the five reef fish specieses and to determine their relation to the morphology of the fish. The tethered method was used, in which the targeted reef fishes were measured *ex situ*. The acoustic measurements used the Echosounder Simrad EK 15 with a frequency of 200 kHz. The acoustic data were analyzed using Echoview 6 software and statistical analysis. The results showed that the mean target strength values of *Abudefduf saxatilis* was 54.35 dB, *Scolopsis lineatus* was 53.34 dB, *Halichoeres hortulanus* was 51.14 dB, *Ctenochaetus striatus* was 47.74 dB and *Chaetodon trifasciatus* was 50.66 dB. The acoustic backscatter of each species of reef fish was different and had relationship between standard length of

fish, and length of swimbladder. The target strength value of each fish species could be used as a basis for estimating the density of reef fish in coral reef ecosystems.

Keywords: Acoustic, target strength, reef fishes, Tikus Island, tethered method

Digestive Enzymes in Hybrid Catfish Fed with *Spirulina* (*Arthrospira*) Additive Feed

Tippayakraisri, K., Saikaew, P., Chukwannuan, W., Suwan, N. and Tongsir, S.*

Faculty of Fisheries Technology and Aquatic Resources, Maejo University, Chiang Mai, Thailand.
Corresponding Author: karntippayakraisri@gmail.com

Digestive enzymes in Hybrid Catfish fed with *Spirulina* (*Arthrospira*) additive feeds at the percentages of 0(T0), 5 (T5), 10 (T10), 15 (T15) compared with commercial floating diet (CF) were investigated. The CRD (Completely Randomized Design) was applied. An average initial body weight of 12.83 g of hybrid catfish was used. Four experimental diets were isonitrogenous (30%). Fish were fed twice a day with 5% of body weight. They were randomly weight and length measured every 30 days for a 120-day experimental period. Results showed that the increased weight and average daily gain were significantly higher in the T10 group than other experimental and control groups ($P < 0.05$). Amylase activity from fish intestine was the highest in the T10 group while amylase activity from fish intestine was the highest in the T5 group. Protease activity from intestine was the highest in the T5 group followed by the one in T10 group. Trypsin activity from intestine was the highest in the T0 group followed by the one in T10 group. Chymotrypsin activity from intestine was the lowest in the T5 group followed by the one in T10 group. Referring to the Trypsin enzyme per Chymotrypsin enzyme (T/C ratio) from intestine of catfish fed with different diets and their growth rates, there was a positive relationship in a T10 group. These results suggest that fish feed mixed with 10% *Spirulina* (*Arthrospira*)(T10) provided the best growth rate and suitable for a hybrid catfish culture to get the highest production.

Keywords: Hybrid catfish, Digestive Enzyme, Growth

Effects of *Melastoma malabatricum* Extract on Nutrient Digestibility of Local Goat Infected with Gastro Intestinal Parasites

Suteky, T., Dwatmadji, Hidayat and Sanata, D.

Department of Animal Science, Faculty of Agriculture, University of Bengkulu, Indonesia.
Corresponding Author: Tatiksuteky.2008@gmail.com

This study was conducted to evaluate the effects of *Melastoma malabatricum* extract on the intake and nutrient digestibility of goat infected with gastro intestinal parasites. Before the experiment all goats were dewormed with albendazole to removed gastro intestinal parasites previous infestation, then goats were naturally infected with parasites by allowing the experimental goats to graze on infected pasture under oil palm from 08.00-16.00 daily for 15 days and followed infected orally with 1000 infective larvae. After the infestation, 20 goats were stratified based on live weight and were confined individually in wooden pen. Goats divided in 4 treatments namely T0: No extract T1: Aquaoes extract *Melastoma malabatricum* 250mg/kg BB/ 3 week, T2: Aquaoes extract *Melastoma malabatricum* 250mg/kg BB/ 2 week and T3: single dose of Ivermectine (control positive). All experimental goats received 1% feed supplementation (50% Palm Kernel Cake and 50 % rice bran), forage and water were given ad libitum. Results indicated that treatment had significant effect ($P < 0.05$) on dry matter and crude fiber intake, the dry matter intake ($\text{gDM/kgW}^{0.75}$) was 44.93-49.55 or 2.69-2.91% per live weight. Feed intake of OM, Crude Protein, and Ether Extract did not differ ($P > 0.05$) among the treatments. There were no significant differences ($P > 0.05$) among treatments in dry matter, crude protein, crude fiber, extract ether digestibility. The organic matter digestibility was significantly higher in goat that received single dose of Ivermectine compared with the others.

Keywords: *Melastoma malabathricum*, goat, parasites, digestibility

Effect of Dietary Organic and Inorganic Selenium on Carcass Composition and Meat Characteristics of Broiler Chickens

Jamnongtoi, P., Sivapirunthep, P. and Chaosap, C*.

Department of Agricultural Education, Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.
Corresponding Author: chanporn.ch@kmitl.ac.th

The objective of this study was to compare the effects of organic selenomethionine (Se-Met) and inorganic sodium selenite (Na-Se) on broiler chickens' carcass composition and meat characteristics. The 360 one-day-old broiler chickens subjected to a 3 phases feeding program with basal diets of corn-soy. The subject was divided into 2 groups supplemented with 0.3 ppm of Na-Se or Se-Met throughout 37 days of raising period. Each treatment consisted of 6 replicated with 30 male sex broilers each. Birds were deprived of feed for 12 h and weighted prior to slaughter. Three birds from each treatment replicate were sacrificed by cervical dislocation before carcass compositions were measured. Breast muscles were collected and then determined meat characteristics. Carcass composition and meat characteristics were not affected ($P>0.05$) by different selenium sources except chicken fed Se-Met had higher cooking loss and lower color of L^* value compared to those fed with Na-Se. In conclusion, this study showed very little effect of different dietary selenium sources on carcass composition and meat characteristics.

Keywords: Selenomethionine, Sodium Selenite, Carcass Composition, Meat Characteristics, and Broiler Chickens

Effects of Varying Levels of Horseradish (*Moringa oleifera*) Leaf Meal on The Growth and Survival of Red Nile Tilapia (*Oreochromis niloticus* L.).

Doctolero, J. S.* and Bartolome, R. M.

Department of Aquaculture, College of Fisheries, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines.
Corresponding Author: jemsado09@yahoo.com.ph

Reduction of feed cost is one of the challenge that aquaculture production faces nowadays as most of expenses are allotted for feed provision among cultured species. It is considerably one of the effective ways in attaining better production outcome by reducing the level or substitute feed ingredients that are cheaper without neglecting its effectiveness as source of nutrition. The study was conducted to evaluate the effectiveness of incorporating *Moringa oleifera* leaf meal on the growth performance of red Nile tilapia, to evaluate varying levels of *Moringa oleifera* leaf meal and to identify what level of incorporation that provides best results in terms growth and survival of red Nile tilapia. The treatments evaluated were: Treatment I—control diet (0% *Moringa oleifera* leaf meal); Treatment II—diet with 10% *Moringa oleifera* leaf meal; Treatment III—diet with 15% *Moringa oleifera* leaf meal and Treatment IV—diet with 20% *Moringa oleifera* leaf meal. Result of proximate analysis revealed that experimental diets contain an acceptable levels of crude protein ranging from 29.84% to 31.63%. Result of the study showed that *Moringa oleifera* leaf meal had comparable growth and survival with the fish fed with control diet. The fish fed with experimental diet of 20% *Moringa oleifera* performed better than the fish fed with diets of 10% and 15% *Moringa oleifera* leaf meal. Utilizing up to 20% *Moringa oleifera* level of incorporation on the diet of red Nile tilapia could provide acceptable growth performance.

The Effects of Oil Enriched Diets on Growth, Feed Conversion Ratio and Fatty Acid Content of Nile Tilapia (*Oreochromis niloticus*) in Biofloc System

Inkam, M., Whangchai, N., Tonghiri, S. and Sompong, U.*

Faculty of Fisheries Technology and Aquatic Resources, Maejo University, Chiang Mai, Thailand.

Corresponding Author: udomluk.sompong@gmail.com

The effects of oil enriched diets in Nile tilapia (*Oreochromis niloticus*) by biofloc system of cultivation was studied to increase omega-3 fatty acids in the flesh. Six feed diets contained 30% protein. Diet treatments used were different types of oil; Control (feed diet + soybean oil), feed diet + fish oil (FO), feed diet + fish oil and soybean oil 1:1 ratio (FO:SO), feed diet + lard oil (LO), feed diet + lard oil and soybean oil 1:1 ratio (LO:SO) and feed a diet + fish oil and lard oil 1:1 ratio (FO:LO). Nile tilapia larvae were cultured (initial weight 30±1.20 g) in glass tanks and reared for 8 weeks. Tilapia fed with FO diet showed highest growth and weight gain (62.7±0.18 g) (p<0.05). However, there were no differences in the survival rate (95-97%) and feed conversion ratio in every treatments (1.4-1.5) (p>0.05). The fatty acids profile of flesh (fed with 6 oil supplemented diets) was studied. Fatty acid composition of FO was the highest total omega-3 (21.49%), followed by LO:SO (11.28%) (p<0.05). FO treatment had the highest total omega-6 (52.78%), followed by the control treatment (46.94%) (p<0.05). This study demonstrated the efficacy of omega-3 fatty acids supplementation of fish fed in biofloc system that could be commercially valuable in the future.

Keywords: Biofloc, Nile tilapia, Omega-3 fatty acid

DNA Barcoding of Two Major Commercially Important Fish Families (Carangidae and Lutjanidae) Collected from Cuyo, Palawan, Philippines

Templonuevo, R. M.*, Alcantara, S., Juanico, C. S. and Yambot, A.

Molecular Biology and Biotechnology Laboratory, College of Fisheries, Central Luzon State University, Science City of Munoz, Nueva Ecija, Philippines.

Corresponding Author: reamaectemplonuevo@gmail.com

DNA barcoding has been proven as an effective and accurate tool for species identification all throughout the world. In this study, the technique was used to molecularly identify different species of the two major commercially important fish families (Carangidae and Lutjanidae) collected in Cuyo Island, Palawan. The island is a part of Coral triangle which is well recognized as a global apogee of marine biodiversity. It is also a major source of commercially important fishes being shipped to Metro Manila. An estimated >600 base pair region of the mitochondrial cytochrome c oxidase subunit I (COI) gene was amplified using four sets of universal primers. Generated COI sequences represented 7 species of carangids and 7 species of snappers. Sequences were submitted to the GenBank and IBOL with respective Accession Numbers. The database revealed maximum identity matches of 99-100% for all the sequences of the 2 families. Genetic distances were calculated using Kimura-two parameter (K2P) model and was analyzed using Neighbour-joining (NJ) trees. Overall K2P distance was 20.3% with 22.5% and 20.5% corresponding to, interfamilial and interorder in all the collected species. All species were compared to the sequences in the Genbank and resulted to a very low K2P value of 0.000% which indicates the absence of genetic divergence between species. It means that species are correctly identified molecularly based on COI region. Overall GC content is 46.10% with average nucleotide frequencies of G: 18.4%, C: 27.8%, T: 29.5% and A: 24.5%. The study also revealed that one species of trevally, *Caranx sexfasciatus* is listed under the of category “decreasing population” by International Union for the Conservation of Nature (IUCN). These findings contributed to the correct identification and inventory of two major commercial fishes in the island and proper management of species.

Keywords: Cuyo, Palawan, cytochrome c oxidase subunit 1, species identification, Lutjanidae, Carangidae

Study on Vaginal Epithelial Cells in Brahman Cattle Suspected Reach Puberty

Amrullah A. H. K.¹, Widayati, D. T.^{1,2} and Maharani, D²

¹Department of Animal Science, Faculty of Agriculture, University of Bengkulu, WR Supratman street, Kandang Limun, Bengkulu 38371, Indonesia; ²Department of Animal Breeding and Reproduction, Faculty of Animal Science, Universitas Gadjah Mada, Fauna street No. 3, Bulaksumur, Yogyakarta 55281, Indonesia.

Corresponding Author: widayati@ugm.ac.id

Puberty can be characterized by the time when the cattle first exhibit estrus. Estrus in cattle can be observed through the cytology of the vaginal epithelial (Vaginal smear). The study aimed to observe the vaginal wall cytology of Brahman cattle predicted at the onset of puberty. Brahman cattles were developed by Livestock Breeding Center for Excellence and Forage (BPTU-HPT) Sembawa since 2012. The estimation of puberty was using 3 nonlinear mathematical models consisting of Gompertz (10.28 months, n = 4), Bertalanffy (09.96 months, n = 4), and Logistics (15.5 months, n = 7). Vaginal smear was done by smearing wet cotton bud using aquadest on Brahman cattle vaginal wall, then it was smeared to glass object. The object glasses were immersed in alcohol (70%) for 5 to 7 minutes, then it were soaked in liquid Giemsa stain (5%) for 45 minutes. The object glasses were dried, then it were observed using a microscope with a magnification 40 times. The vaginal smear samples were taken 8 times and done every 3 days for each cattles. The results described that there were only parabasal and intermediates cell in all ages of cattle observed. This represents that all the animals observed have not entered the age of puberty.

Keywords: Brahman, Estrus, Puberty, Smear, Vagina

Cholesterol Content and Fatty Acid Composition in Longissimus dorsi Muscle of Purebred and Crossbred Pigs

Smittinun, P., Sivapirunthep, P., Chaosap, C.

Department of Agricultural Education, Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand.

Corresponding Author: chanporn.ch@kmitl.ac.th

The aim of this study was to determine whether fat and cholesterol contents and fatty acid composition in *Longissimus dorsi* (LD) muscle differ between purebred and crossbred pigs. Duroc purebred (D, n=10), two-way crossbred (Largewhite x Landrace; LWLR, n = 10), and three-way crossbred (Largewhite x Landrace x Duroc; DLWLR, n=10) pigs were used in this study. Each group was further divided into 2 genders (5 barrows and 5 gilts). All pigs were reared under the same housing and feeding conditions for 6 months until slaughtered at 110 ± 5 kg live weight, following which, LD muscle was collected from the left side of each carcass for subsequent analyses. The results showed that D had higher ($P < 0.01$) fat percentage than LWLR and DLWLR. For fatty acid composition, D presented highest concentrations of C14:0, C16:0, C16:1, C18:0, C18:1n9c, C18:2n6c, C18:2n6c, C20:1, SFA (saturated fatty acid), MUFA (monounsaturated fatty acid), and PUFA (polyunsaturated fatty acid) than those recorded in samples obtained from DLWLR and LWLR ($P < 0.01$). DLWLR had significantly higher concentrations of C16:1, C18:1n9c and MUFA ($P < 0.05$), with a tendency of higher concentration of C16:0, C18:0, C18:2n6c, C20:1, SFA, and PUFA than LWLR ($P < 0.1$). The ratio of unsaturated to saturated fatty acid (P/S) was more favorable in LWLR compared with those of D and DLWLR ($P < 0.01$). There was a significant group x gender interaction for the concentration of C23:0 ($P < 0.05$). In Duroc purebred pigs, higher amount of C23:0 was observed in gilts than that in the barrow. However, barrow of DLWLR shown higher C23:0 than the amount recorded in the gilts. Fat percentage positively correlated with the concentrations of C14:0, C16:0, C16:1, C18:0, C18:1n9c, C18:2n6c, C20:1, C23:0, SFA, MUFA, PUFA, and P/S ($P < 0.01$) but negatively correlated with C23:0 ($P < 0.05$).

Keywords: Purebred pig, Crossbred pig, Cholesterol content, Fatty acid composition

Inhibition of Acetylcholinesterase Activities in Whitegoby *Glossogobius giuris* from the East Bay of Laguna Lake, Philippines

Fajardo L. J.^{1,2} and Ocampo P. P.³

¹College of Fisheries, Central Luzon State University, Nueva Ecija, Philippines; ²School of Environmental Science and Management, University of the Philippines Los Baños, Laguna, Philippines; ³Institute of Biological Sciences, College of Arts and Sciences, University of the Philippines Los Baños, Laguna, Philippines.

Corresponding Author: renz4881@gmail.com

Laguna Lake, the largest freshwater lake in the Philippines, has been threatened by fertilizers and pesticides runoff from agricultural land uses in the eastern bay. *Glossogobius giuris* is one of the native and commercially important fishes in the lake and is reported to be of declining population. Inhibition of acetylcholinesterase (AChE) activity is widely known as biomarker of exposure to organophosphates and carbamates pesticides. The study determined AChE activities using rapid colorimetric method in fish populations obtained from two predominantly agricultural sites (Bay and Santa Cruz) in Laguna and a reference population, reared in concrete tanks. Measured brain AChE activity across populations was significantly ($P < 0.05$) higher than muscle. This resulted to a significantly ($P < 0.05$) higher inhibition rate in muscle than brain in wild populations. However, inhibition rates were not significantly ($P > 0.05$) different between agricultural sites. Depressed AChE activity levels may indicate fish exposure and toxicity to anticholinesterase pesticides in the eastern bay of the lake. This could be supported by carbamates and organophosphates usage in rice and vegetable production along the lakeshore as revealed through Key Informant Interviews and Focus Group Discussions. Further assessment with increased sample size from other bays and tributaries is recommended. AChE, a specific biomarker, be used within a battery of biomarkers for neurotoxic contaminants.

Keywords: acetylcholinesterase activity, Laguna Lake, pesticides, whitegoby

Session 5: ENVIRONMENTAL SCIENCE, SOIL AND WATER CONSERVATION

Cost-benefit Analysis of Waste Segregation Business in Amnatcharoen Province of Northeastern Thailand

Kulsuwan, P.¹ and Sirisathit, P.²

¹Innovation for Social and Environmental Management Program, Mahidol University Amnatcharoen campus, Hazratbal, Thailand; ²Innovation for Social and Environmental Management Program, Mahidol University Amnatcharoen campus, Hazratbal, Thailand.

Corresponding Author: patticha.kul@mahidol.ac.th

A cost-benefit analysis of waste recycling and separating business in Senangkhanikom District, Amnatcharoen Province, northeastern Thailand was done. By using the purposive sampling method, a total of 13 waste recycling firms were selected in this study. Questionnaires were used as a research instrument for quantitative data collection in order to obtain information on costs and benefits of recycling materials as well as value-added products. Statistical analyses were performed including descriptive statistics, percentage, average, standard deviation, and reliability. Results showed the Net Present Value (NPV) was 313,502 baht while the Internal Rate Return (IRR) and Payback Period (PB) were 8% and 4.5 years, respectively. Problems and obstacles reported were in the medium level ($= 3.35$). It was found that the most problems and obstacles of the business was marketing ($= 4.23$). The rest of the problems and obstacles were the lack of technology ($= 3.84$) and financial liquidity as well as cash holdings for buying products ($= 2.76$), respectively. This waste recycling and separating business would grow if profits and satisfactory investment and it could help improve the communities in many aspects such as making money by selling waste materials, reducing pollutants into the environment, and building a better living environment.

Keywords: Cost-benefit analysis; recyclable waste; waste segregation business

The Development of Environmental Recreation Camp Activities for Youth in Roi-Et Province

Phakeewai, S.* and Wongchantra, P.

Faculty of Environment and Resource Studies, Mahasarakham University, Ban Kham Rieng, Kantharawichai, Maha Sarakham, 44150, Thailand.

Corresponding Author: aumigunso@gmail.com

This research aims to develop the Environmental Recreation Camp Activity for Youth in Roi-Et Province, to compare environmental knowledge, environmental attitudes before and after participating in the camp, as well as their participating in Environment Recreation camp activities during and after participating in the camp in youth with different gender and domicile, and to study the relationship between environmental knowledge, environmental attitudes and participation in Environmental Recreation camp activity. The data were collected through a survey with 40 youth from Phanom Phrai Wittayakarn School, Phanom Phrai District, Roi-Et Province. The research instruments were the manual questionnaire measuring environmental knowledge, environmental attitudes and participation in Environmental Recreation camp activity. The data were analyzed by using descriptive statistic and hypothesis testing by using t-test, One-way MANCOVA, One-way ANOVA and Correlation analysis. The results of this research indicated as below Environment Recreation Camp Activities for Youth in Roi-Et Province had effectively is 85.17/83.44 and an effectiveness index is 0.6117. After participating in Environment Recreation camp activities, youth had higher environmental knowledge and environmental attitudes than before participating in the camp. After participating in Environment Recreation camp activities, youth had higher participation in Environment Recreation camp activities than during participating in camp. The sample youth with different gender and domicile had no different environmental knowledge, environmental attitudes, and environmental participation. Environmental knowledge, environmental attitudes, and participation in environmental recreation camp activity were not related.

Keywords: environmental recreation camp, knowledge, attitude, participation

Spatial Variability in Soil Water under Adjacent Mature Oil Palm and Rubber Plantations: Application of a New Dielectric Method in Evaluating Soil Water

Hermawan, B.¹, Suhartoyo, H.², Anandyawati¹, Hasanudin¹, and Agustian, I.³

¹Department of Soil Science, Faculty of Agriculture, Jalan WR. Supratman Kandang Limun, Bengkulu, Indonesia; ²Department of Forestry, Faculty of Agriculture, Jalan WR. Supratman Kandang Limun, Bengkulu, Indonesia; ³Department of Electrical Engineering, Faculty of Engineering, University of Bengkulu, Jalan. WR. Supratman, Bengkulu, Indonesia.

Corresponding Author: bhermawan@unib.ac.id

Oil palm plantations have commonly been addressed to release much more water from the ground by evapotranspiration compared to other crops. The current research aimed to compare the spatial variability in soil water content under adjacent oil palm and rubber plantations established in 2005 and 1995, respectively. Ten pairs of soil electrical impedance data (Z , in $k\Omega$) were collected from the oil palm and rubber sites using a newly-developed electrical impedance meter, then converted to soil water content (θ , in $g\cdot g^{-1}$) using the equation of $\theta = 0.45Z^{0.2}$. The impedance measurements were conducted at 0-10 and 10-20 soil depths to allow the comparisons of actual soil wetness between two crops for the rooting zones. At the same time, disturbed soil samples were taken from the measurement points for the laboratory determination of soil water using the standard gravimetric method. Results showed that soils under oil palm plantation were consistently wetter than under rubber in all pairs of measurements. At the 0-10 cm depth, the average soil water content at the time of measurements was $0.04 g\cdot g^{-1}$ higher for oil palm than for rubber. The field water content ranged from 0.310 to 0.384 and 0.268 to 0.318 $g\cdot g^{-1}$ for oil palm and rubber, respectively. The standard deviations of samples were about $0.02 g\cdot g^{-1}$ for both crops indicating the statistical confidence that the oil palm site contained more water than the rubber site. Similar trends were found at the 10-20 cm soil depth suggesting the consistent benefit of the oil palm plantation in preserving soil water in the 0-20 cm rooting zone. Results in soil water variability gained from the dielectric method were similar to those obtained using the standard gravimetric method.

Keywords: Electrical impedance, oil palm, rubber, soil water.

Promoting the Conservation of Watershed Forestry among Environmental Education Students at the Faculty of Environment and Resource Studies

Limmanee, P.

Department of Environmental Education, Faculty of Environment and Resource Studies, Mahasarakham University, Kantarawichai District, Maha Sarakham, Thailand.

Corresponding Author: paiboon3698@gmail.com

This research aimed to 1) study and compare knowledge in the conservation of watershed forestry of the second-year students majoring in Environmental Education, and 2) study and compare the attitudes of the second-year students towards the conservation of watershed forestry. The sample of the study was 30 sophomores majoring in Environmental Education at the Faculty of Environment and Resource Studies, Mahasarakham University. They all volunteered to participate in this research study. The research instruments comprised a manual on the conservation of watershed forestry, a leaflet on the conservation of watershed forestry, a test on the conservation of watershed forestry which is a multiple-choice test composed of 20 items each with four choices to choose from, and an attitude test towards the conservation of watershed forestry comprising 10 items each with a 3-point response scale. The statistics used included percentage, mean, standard deviation and t-test. The findings are as follows: (1.) Prior to their participation in the conservation of watershed forestry, the student knowledge was assessed to be at the moderate level (=13.57) and identified to be at the high level (=17.60) once the conservation was complete. Knowledge scores before and after their involvement in the conservation were compared and were found to significantly difference from each other at the level of .05, (2.) Before they participated in the conservation of watershed forestry, the students' attitudes were rated at the 'agreed' level (=2.63), and still remained at the same level once their participation ended (=2.91). However, when compared to each other, these two figures showed the difference in student attitudes before and after their involvement in the conservation at the level of .05

Keywords: Promoting, Conservation of watershed forestry, Knowledge, Attitudes

Effects of Organic Fertilizer Application on The Transformation of Nitrogen in Paddy Soil

Supsuan, P., Surin, P., and Yampracha, S. *

Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: sukunya.ya@kmitl.ac.th

Nitrogen (N) is one of the essential macronutrients for rice growth and yield. Organic fertilizer is a major source of N for an organic farming and the availability of N may depend on organic fertilizer types. The objective of this research was to determine the effect of different type organic fertilizers on the availability of nitrogen in paddy soil. The soil was collected from an organic rice field at Nongchok district, Bangkok and incubated with three organic fertilizers in the laboratory. The experimental design was a completely randomized design with 3 replications consisting of four treatments, namely :1) non-fertilizer application (control) 2) amended with cow manure 3) amended with compost and 4) amended with green manure as sunn hemp and each organic fertilizer amended at the rate 300 mg N/kg. All treatments were incubated at 30° C for 120 days. Soil pH, hydrolyzable N, and ammonium were measured at 0, 3, 5, 7, 14, 21, 28, 42, 56, 70, 98 and 120 day after incubation. N mineralization potential and mineralization rate of each organic fertilizer were estimated using a non-linear model. The results showed that the soil pH of all treatments was increased from 5.3 (strongly acid) to 6.9-7.2 (neutral). The cumulative N mineralization of sunn hemp was highest (121.33 mg N/kg) but no significant difference with other organic fertilizers. The change of hydrolyzable N was increased at the beginning of incubation (3-14 days) and decreased after 70 days of incubation. It can be indicated that hydrolyzable N change to ammonium. The potential N mineralization of control, cow manure, compost and sunn hemp were 95.34, 109.90, 107.23 and 114.53 mg N/kg, respectively. The k value which indicated the mineralization rate of control, cow manure, compost and sunn hemp were 0.2095, 0.2075, 0.2053 and 0.1992 mg N/kg, respectively.

Keywords: Nitrogen, Organic fertilizers, Paddy soil

Ingestion of Microplastics by Some Commercial Fishes in the Lower Gulf of Thailand: A Preliminary Approach to Ocean Conservancy

Azad, S. M. O.^{1,2}, Towatana, P.^{1,2}, Pradit, S.^{1,2}, Patricia, B. G.^{1,2}, and Hue, H. T. T.^{1,2,3}

¹Marine and Coastal Resources Institute (MACORIN), Prince of Songkla University (PSU), Hat Yai, Songkhla 90110, Thailand; ²Coastal Oceanography and Climate Change Research Center (COCC), Prince of Songkla University (PSU), Hat Yai, Songkhla 90110, Thailand; ³Central Institute for Natural Resources and Environmental Studies (CRES), Vietnam National University (VNU), Ha Noi, Vietnam. Corresponding Author: prawit.t@psu.ac.th, smoasiq664@gmail.com

Microplastics have been acknowledged as evolving marine contaminants of noteworthy apprehension, due to their ubiquity, persistence and toxic potentiality. It's very urgent and important to study about microplastic pollution not only in Thailand but also for the world because of its harmful effects on marine biota as well as for human health. This study focuses, on the presence of plastic debris in the stomach contents of some economically important pelagic fish caught in the lower Gulf of Thailand between January to April 2018. Size and weight range of the samples were 9.2 to 21.9 cm and 4 to 99 gm. Results highlighted the ingestion of plastics in the 52.08% samples. The plastics ingested were microplastics (62.56%) (<5 mm), mesoplastics (37.44%) (5-25 mm). Net fibres were the major types of plastics found during this study. These preliminary findings of the study underline the ubiquitous presence of microplastics in the lower Gulf of Thailand marine biota, as well as the water column where pelagic fish live, and feed and it also represents an urgency to reduce the use of plastics or to ensure the proper recycling of it.

Keywords: Microplastics, marine litter, plastic ingestion, plastic debris, marine pollution, ocean conservancy

The Development of a Camp on Natural Resources and Environmental Conservation in the ASEAN for youth in Roi-et Province

Thinkamchoet, J.¹ and Wongchantra, P.²

^{1,2}Faculty of Environment and Resource Studies, Mahasarakham University, Mahasarakham, Thailand. Corresponding Author: jt726920@hotmail.com

The research aimed to i) develop a camp on natural resources and environmental conservation in ASEAN countries for 35 youths in Roi-et Province, using a manual with an efficiency criteria of 80/80, ii) create an effectiveness index of the camp, and iii) analyze the youths' knowledge, attitude and leadership skills before and after attending the camp, differentiated by sex and age, using three different survey questionnaires. The data was calculated by percentage, mean average, standard deviation of the response items and analyzed through t-test and f-test (One-Way MANOVA) to measure the efficiency criteria and create the effectiveness index. The results showed that the camp had an efficiency criteria of 90.04/83.44. The effectiveness index of the camp had a value of 0.6670, which means that 66.70% of the youths had improved their learnings on natural resources and environmental conservation in ASEAN knowledge, attitude and leadership skills were significantly higher after attending the camp than before, illustrated through a statistical significance value of .05 p-level. Moreover, there were no differences observed in the results regarding the youths' sex. However, there were differences observed among three different age groups of the youths, i.e., 14 to 15, 16 to 17 and 18 to 19 years old, as an univariate test showed ($p < .000$).

Keywords: Camp, Manual, Natural Resources and Environmental Conservation in the ASEAN, Knowledge, Attitude, Leadership skills.

Participatory Action Research for Waste Management of KSL River Kwai Natural Agriculture Center, Kanchanaburi Province, Thailand

Siriput, O.*, Thummathiwat, P. D. and Limunggura, T.

Department of Agricultural Development and Resource Management, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.
Corresponding Author: onausa_s@hotmail.com

KSL River Kwai Natural Agriculture Center is a learning center for the implementation of the philosophy of sufficiency economy with agriculture by knowledge dissemination to students, government agencies, employees, companies, interested parties and the general public. The center consists of accommodation in the form of a resort, agricultural garden and learning center. It has been found waste management still lacked effective management, lack of discipline, responsibility, lack of members participation in the center. Research objectives were to create a participatory process for waste management of the center by using participatory action research. This research was done in the year 2018. The results from three groups participation which were 1. researcher 2. community representatives, (10 persons) 3. staff of KSL River Kwai Natural Agriculture Center (19 persons) collaborated to diagnose common problems by brainstorming, meeting and to find the problem solving solutions together. Waste banks, bio-composting, garbage potted plant processing and animal feed processing were the research activities. As a result, there was a realization to solve the problem of waste management efficiently and members have learned to work together. In addition, it promoted the quality of life of its members and it became a source of knowledge for the community.

Keywords: waste management, participatory action research, natural agriculture center

Landscape Assessment and the Use of Old Growth Rehabilitated Mined Site for Agroforestry System: Case of coal mined site at Tanjung Enim, South Sumatra

Suhartoyo, H.^{1*}, Wiryono¹ and Rosa, D. S.²

¹Forestry Department, University of Bengkulu, Bengkulu 38121, Indonesia; ² PT Bukit Asam (Persero), South Sumatra, Indonesia.

Corresponding Author: herysuhartoyo@unib.ac.id

Rehabilitation of mined land was intended to improve the degraded environment and to meet sustainable land-use after mining operation was closed, especially to fulfill our demand for food, fodder, and timber. However, the majority of coal companies, in respect to rehabilitation, only conducted "greening" program with single timber species, such as Acacia. The progress of landscape development and an application of Agroforestry system has been studied and implemented in the Acacia forest. The study intended to explore options of Agroforestry on mined land. The old growth of Acacia stand, resulted from rehabilitation of mined coal, at Tanjung Enim, South Sumatra was assessed, prepared and intervened using agroforestry system based on two varieties of sorghum plants. An assessment using landscape function analysis was performed before the selection of the experimental site. A field experiment was, then, set to explore the growth performance of two varieties of sorghum plants. The results indicated that, first, the soil development of rehabilitated mined site were progressing in term of soil chemical and physical properties; second, sorghums were relatively well adapted to mined land, and sorghum CTY-33 performed better than sorghum Numbu in term of leaf area and for fodder use. Constraints for implementing agroforestry system in the mined land were also discussed in this paper, as well as its potency to optimize final land-use of post-mine land.

Keywords: mined land, landscape, rehabilitation, agroforestry, sorghum

The Study of Participatory Monitoring of Air Quality and Urban Heat, Case Study Udon Thani Province, Thailand

Puansurin, K.^{1*}, Wongtragoon, U.², Singchan, B.³, and Suwanmaneepong, S.⁴

¹Department of Computer Information System, Faculty of Business Administration and Liberal Arts, Rajamangala University of Technology Lanna, Chiangrai, Thailand; ²Department of Civil Engineering and Environment, Faculty of Engineering, Rajamangala University of Technology Lanna, Chiangrai, Thailand; ³Satellite Positioning Development Sub-Bureau, Mapping Technology Bureau, Department of Lands, Bang Phut Sub-district, Pak Kret District, Nonthaburi, Thailand; ⁴Department of Agricultural Development and Resource Management, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.
Corresponding Author: kinggan@gmail.com

Urbanization in Thailand is experiencing similar pace and patterns. Land use planning, zoning and environmental safeguards are largely ineffective. Air quality and heat obviously affect environmental problem due to urbanization and harm human health especially respiratory disease. The lack of participatory planning process means that citizens have limited ability to influence what is happening on the ground. In fact, the lack of public access to information to inform decision-making process is common across this country. Udon Thani municipality, Udon Thani province, the study area, encounters mentioned problems. Consequently, this study proposed the development of the simple method for monitoring the concentrations of Particulate Matter 2.5 μm (PM_{2.5}) and urban heat in order to build social participation and provide the scientific information that is well perceived for decision-makers and key stakeholders of the community. We offered the direct measurement using three devices, called mobile traverse method, for measurement; 1) a mobile visible light scattering device to measure PM_{2.5} concentrations, 2) a digital thermometer and 3) GPS device to obtain spatial data. We seasonally observed the behaviors of air quality and urban heat island (UHI) by daytime and nighttime observations from April 2017 to January 2018 in hot season, rainy season and cool season with five time intervals (16:00, 20:00, 00:00, 08:00 and 12:00) on a selected observation date of each season. The results indicated the peak spots of PM_{2.5} Concentrations and UHI around the study area, so we can estimate air pollution and urban heat occurrences in particular specific time interval and season. Finally, we provided the simple method and scientific information to key stakeholders in the study area to monitor air quality and urban heat through training workshops and Shared Learning Dialogues (SLDs). It was obvious that the participations of the key stakeholders were encouraged and their perception on social scientific information was well responded.

Keywords: Urban heat island, air temperature and air quality monitoring, mobile traverse, land surface

Utilization of Continuous Type Rice Hull (CtRH) Pyrolizer: Co-Generation of Heat and Biochar for Enhance Agricultural Productivity in Degraded Acid Uplands Soils in Philippines

Sarong, M. M.¹, Orge, R. F.², and Boyles, J. K.³

¹Department of Soil Science, Central Luzon State University, Science City of Muñoz, Nueva Ecija Philippines; ²REMD, Philippine Rice Research Institute, Central Experimental Station, Science City of Muñoz, Nueva Ecija Philippines; ³Department of Agricultural Engineering, Visayas State University, Visca, Baybay, Leyte, Philippines.
Corresponding Author: malousarss@gmail.com

Continuous type rice hull (CtRH) pyrolizer produces two important products: heat energy for various farm activities and biochar which serves as a soil conditioner. With CtRH, farmers can be provided with opportunities for additional income and reduce fossil fuel dependence. This system operates in continuous mode with almost smokeless emission. Various heat recovery attachments were developed, making use of the heat for activities like cooking, baking, or drying farm products for added value, pasteurizing mushroom fruiting bags, pumping of irrigation water and space heating (poultry houses). As a soil amendment, biochar creates a recalcitrant soil carbon pool that is carbon negative, serving as a withdrawal of atmospheric carbon dioxide stored in highly recalcitrant soil carbon stocks. Rice husk biochar (RHB) produced from CtRH was used as an amendment of degraded acid upland soil (Annam

series) grown with peanut and upland rice. There were six treatment combinations from levels of amendment (0, 10, 20, 30, 40 and 50 g kg⁻¹ soil). The processed biochar was applied at levels specified in the treatment on oven-dried weight basis. In peanut, increasing levels of RHB had positive impacts on the nodulation though not manifested in the pod yield. In upland rice, a linear trend was observed in the plant biomass and grain yield with increasing RHB levels up to 40 g kg⁻¹ soil. N and P uptake of both plants increases up to level 30 g kg⁻¹ soil. Results revealed that aside from being a carbon sink, biochar helps improve soil condition and fertility while maintaining crop yields and, ultimately, sustained higher income of the farmers.

Keywords: rice husk biochar, degraded upland soil, soil fertility

Water Management Model for Lower Mekhong Basin of Lao People's Democratic Republic

Khamvong, K. and Pianchana, A.

Ubon Ratchathani Rajabhat University, Thailand.
Corresponding Author: kkmv899@gmail.com

The aims of this research were to investigate water management in Lower Mekhong Basin of Lao People's Democratic Republic and to develop water management model in the specific region. The methodology was explored the secondary data regarding natural resource in two scoped areas; Ban Pon Kung and Ban Lak Muang, located in Pakse, Lao People's Democratic Republic. The collected data were distributed in the participatory forum and workshop with the purposes to publicize the local resources circumstances and to generate participatory water management model via participatory session. The results found that the majority of Ban Pon Kung and Ban Lak Muang were located in the riverside plains with high density of population; 1,543 people with 257 households in Ban Pon Kung and 1,463 people with 233 households in Ban Lak Muang. Both villages were residential areas and local business center. Most of locals were farmers, merchants, service providers, laborers, and handicraftsmen. Brooks such as Huay Yang and the others flowing through the landscapes enticed tourists' attraction. Living with two significant rivers; Khong River and Sedone River, agriculture and related fields were crucial occupations in the areas. However, the resource management in Lower Mekhong Basin was found inefficient. Merchants and communities lacked wastewater management, especially the wastewater treatment. The current water inspection indicated that the water was in the third or fourth condition causing from municipal solid waste, incomprehensive regulation, inaccessible legal public relation, deficient human resource, and underprovided monitoring tool. The water management model for Lower Mekhong Basin was conducted by rigorous law enforcement, community to community and community to government synergization, persistent watershed ecology observation, sustainable land use reinforcement based on economy, society and environment, and efficiency escalation of watershed organization management.

Keywords: Model, Management, Mekhong Basin

Utilization of Pectin from Calamansi (*Citrofortunella microcarpa*) Peels as Superabsorbent Polymer for Soil Moisture Retention

Gapultos, R.¹, Mallari, A. K.¹, Tolentino, J. J.¹ and Go, W. H.^{1,2}

¹Faculty of Chemistry and Life Sciences Unit, Philippine Science High School – Central Luzon Campus, Clark Freeport Zone, Philippines.
Corresponding Author: rgapultos@clc.pshs.edu.ph

Citrofortunella microcarpa, also known as Calamansi, is a type of citrus fruit that is widely grown in the Philippines. As the pectin extracted from its peels was cross-linked using CaCl₂, this study was able to produce a superabsorbent polymer that would address fruit waste management and low levels of soil moisture during drought. Water absorption capacity of the polymer was evaluated along with its effects on soil moisture retention and plant growth. In addition, the extracted pectin was subjected to physicochemical characterization as well as structural characterization with the use of Fourier-transform infrared spectroscopy (FTIR).

Keywords: Pectin Extraction, Polymer Cross-linking, Fruit waste management

Session 6: SOCIO ECONOMIC, COMMUNITY DEVELOPMENT AND AGRICULTURAL DEVELOPMENT

The Promotion of Adaptation to Climate Change using Manual for high school students at Si sawat Wittaya Municipality School, Mahasarakham Province, Thailand

Singseewo, A.* and Chawishborwornwong, C.

Environmental Education Research Group [EERG], Department of Environmental Education, Faculty of Environment and Resource Studies, Mahasarakham University, Kantarawichai District, Maha Sarakham, Thailand.

Corresponding Author: Singseewo@yahoo.com

This research aimed to investigate the differences on the levels of knowledge, attitude, and awareness on adaptation climate change among group of junior high school students before and after the application of the Manual for Adaptation to Climate Change. Thirty-two of the eighth-graders from Si sawat Wittaya Municipality School, located on Mahsarakham's Muang district, were selected via a purposive sampling method. The research tools were three sets of evaluation forms that tested the participants' levels of knowledge, attitude and awareness on the climate change adaptation. The data was analysed by using mean, percentile, standard deviation, and Paired-Test. It was observed that the students' knowledge on adaptation to climate change in the pre-test and in the post-test were at a Low level and a moderate level, respectively. The students' knowledge level in the post-test was found to be significantly different from the pre-test score at .05 p-level. With regard to the students' attitude toward the adaptation to climate change, the pre-test score was rated at an Agree Level while the figure was observed at a Highly Agree Level in the post-test. Accordingly, the attitude score in the post-test was significantly higher than the score in the pre-test at the level of .05 p-level. Moreover, after having been introduced to the Manual for Adaptation to Climate Change, the students' awareness was raised to a Highly Agree Level.

Keywords: Adaptation to Climate Change, Knowledge, Attitude, Awareness

The People's Participation on the Indigenous Serrated Mud Crab Fattening Practices in La-ngu District, Satun Province, Thailand

Kaewploy, N., Aquino, U. M. and Phonpakdee, R.*

Department of Agricultural Education, Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Thailand.

Corresponding Author: ratchadakorn.ph@kmitl.ac.th

The strong participation of the local farmers/fishers on the indigenous practices in the community is a manifestation on the inclusion of cultural beliefs and people's lifestyle and livelihood. The study aimed to assess the involvement of the local people in enhancing the production and marketing of the indigenous serrated mud crab fattening (ISMCF) practices in La-ngu District, Satun Province. It utilized qualitative methodology using key informant interviews, observations and cases analysis on the different activities of the farmers-fishers on the (ISMCF) practice over a period of six months. Results showed that utilizing the ISMCF practice starts with the protection and management of the natural vegetation of the mangrove area, adherence to the local cultural practices, increase in the level of awareness and utilization of the ISMCF practices based on local wisdom and marketing of the produce using local materials to increase income and improve the lives of the local people. Strong participation in the dissemination and application of the indigenous fattening practices were observed from the locals. However, there is a declining interest among the youth to engage in the practice. The local people has a strong and well-defined attachment to the indigenous serrated mud crab fattening practices because of cultural beliefs and practices. It supports the daily activities and provides an alternative livelihood for the farmers/fishers engaged as a community effort in making the practice a part of a productive living tradition.

Keywords: indigenous, participation, tradition, farmer, rural

Smallholder Farmers' Perception to Climate Change Impact on Crop Production: case from drought prone areas of Bangladesh

Roy, D.¹, Kowsari, M. S.¹, Nath, T. D.¹, Taiyebi, K. A.² and Rashid, M. M.³

¹Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh; ²Department of Fisheries, Government of the People's Republic of Bangladesh;

³Department of Agricultural Extension, Government of the People's Republic of Bangladesh.

Corresponding Author: droyagext@bau.edu.bd

Agriculture sector, due to its sensitivity, is vulnerable to climate change and it experiences several extreme climatic events such as droughts, flooding, natural catastrophes and salinity intrusion. Coping climate change events and mitigating its impacts on crop production need to assess farmers' perception. The purpose of the study was to assess smallholder farmers' perception to climate change impact on crop production in drought prone areas of Bangladesh. Mixed methods approaches including quantitative and qualitative data were employed. Primary data were collected using a structured questionnaire through household survey during September and October 2017. The study respondents were 100 smallholder farmers in the drought prone areas of Bangladesh. The data were analysed using descriptive statistics, coefficient of correlation and stepwise regression. The major findings reveal that the perceived impacts of climate change on crop production was severe followed by moderate impact. Among twelve statements regarding climate change impact on crop production, increased pest infestations was perceived as most important impact. Increased frequency of drought occurrences was perceived as second most important impact of climate change. However, the least important impact of climate change was increased intensity of floods. Among the socio-economic characteristics of the respondents, age, year of schooling, farming experience, access to information sources and training experience were significantly associated with their perception to climate change impacts on crop production. In addition, year of schooling, farming experience and training experience were the most influential factors that affected smallholder farmers' perception. The study identified important issue for the policy makers and other development practitioners to address and to recommend suitable programs. The methods employed in and the findings of this study could be used in other districts of Bangladesh with similar socio-economic and regional context.

Keywords: climate change, smallholder farmer, drought, impact, crop production

Reciprocity and Participatory Approach in Decentralized Biodiversity Development and Cultural Heritage Management in Community-Based Tourism, Thailand

Kritsanaphan, A.

Department of Architecture and Planning, Faculty of Architecture, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: amorn.kr@kmitl.ac.th

This paper illustrated on the decentralization of biodiversity development and cultural heritage management in local Thailand. On the other hand, biodiversity and cultural heritage including its managements were supposed to improve through multi-stakeholder participation and decentralization. In this regard, Community-Based Tourism has been readdressed to develop the local economic and conserved the local identities at the same time. However, under the decentralization, processes and outcomes were far from being straightforward and depended on a variety of contingencies and contexts involved. This study explored the reciprocity and participatory approach between biodiversity development and cultural heritage management in local Thailand. To achieve the objectives of the study, a quantitative method was applied. The major findings of this study indicated that participatory approach ensures community involvement for effective sustainable management as well as supporting biodiversity and cultural heritage conservation practices. Moreover, the strengthening of biodiversity development and cultural heritage management was reciprocated each other. The most remarkable contribution from decentralization in biodiversity development and cultural heritage management had formulated the political space where various local stakeholders that became active, responded and addressed their concerns in various ways. However, decentralization and participatory approach was by no means certain but the shift instead creates spaces potent with possibilities for a meaningful and constructive engagement between and among local state and non-state actors that can lead to synergies and positive outcomes.

Keywords: Reciprocity, Participatory Approach, Decentralization, Biodiversity Development, Cultural Heritage Management, Community-Based Tourism

The Agriculture Tourism Management in Family Business: Case Study of Rayong Province, Thailand

Khernkhan, J.¹ and Mankeb, P.²

¹Department of Agricultural Development and Resource Management, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Ladkrabang, Thailand.
Corresponding Author: Jeeranan.kh@kmitl.ac.th

The agriculture tourism management as family business of 7 farms in Eastern of Thailand was investigated. We used the quality research with 7-S McKinsey principle. In the study, it was found that there are seven fruit farms with the informal organization structure as family business. By using the organic farming and integrated farming, it reduced fertilizer application by using pickled with left over and fruits. The food strategy and tour service group formed part of attracting farm tourist. Thus, most personnel are the members in family business, and there are a few of Alien neighbors to do farming. On the other hand, the owner of farm also has his much knowledge in agriculture. Similarly, the management style in family business needs flexibility although it doesn't have the fulltime worker. In this case, family members help each other by determining the tourist numbers in viewing with durian and the number of fruits to be consumed in each day. Thus, it is easy to manage the system because family members are not strict to do the accounting and they do not feel the need to have IT system to collect data. In the part, agriculture tourism has not been regulated clearly to identify different uniqueness for business tourist attractions. As the result, it is flexible with no strictness as to the requirements of the private tourists.

Keywords: agriculture tourism management, organic farming and integrated farming, food strategy, tourist attractions

Double Row Transplanting Method: A Novel Rice Crop Establishment but Why Farmers don not Adopt it?

Lao-Ay, D. D^{1*}, Sabellano, J. Jr., Ebillo, A. P., Mendoza, T. C.², Cerilles, A. H.

¹Agricultural Department of Zamboanga del, sur, Philippines; ² Faculty, Institute of Crop Science, College of Agriculture and Food Science, University of the Philippines Los Baños, Philippines.
Corresponding Author: ecofarm.mndz2011@gmail.com

Found by our on-farm research and also by other researchers, a double row rice transplanting (DRT) method was yielding higher grain yield from 1.0 to 2.0 tons per ha compared to traditional "waray" or random transplanting method. DRT is also fit for rice+duck integrated farming. The ducks graze in between the large space (40 cm) between the double rows. Other researchers are determining how much feed reduction could be obtained by grazing ducks in the field. In our previous trial, we grow rice under organic (no synthetic fertilizer and pesticides) while other farmers around our fields apply chemicals. Our organically grown rice under DRT methods, yields were still higher especially for the location adapted variety. We have identified the location adapted varieties (inbred or hybrid), production of organic fertilizers (composts, and amplified liquid fertilizers from cattle). But farmers find difficulties in adopting this novel rice crop establishment method. We interviewed about 160 farmers to determine what are their difficulties in adopting this organic DRT rice farming. The reasons they mentioned were also as follows: availability of location adapted seed, source of materials for making organic fertilizer, rotary weeder, The Zamboanga del Sur Provincial Government is trying to address these difficulties of our farmers. On organic fertilizer, we facilitate the on-farm production of the nitrogen source by convincing them to grow multipurpose tree legumes, raising animals (cattle, Carabao, Swine). The carbon source could be produce by carbonizing their rice hulls while rice bran is a by-product of rice milling. The provincial government is into bulk purchase of molasses since sugar mill is quite far in Zamboanga del sur but we are growing sugarcane also in the field to determine if the fresh sugarcane juice could replace molasses which is so rich in nutrients and sugar concentrates. One of the required practice in organic rice production is rotary weeding to avoid using herbicides to control the weeds. To address this, we are re-designing machine rotavator used in upland gardening. Manually-pushed rotary tiller is labor intensive and tiring. The cost of labor is high and they are difficult to find. There is an

upsurge of construction (roads, buildings) in the country due to the build-build-build project of the government. Transplanters are also decreasing in numbers since ladies prefer to work as salesladies in supermarket, malls and restaurants. We are trying to introduce drum seeder and mechanized planter.

Quality of Life Development and Occupation Opportunity of the Elderly by the Selection of Herbal Plant Using: A case Study of Nakhon Phanom Province and Neighboring Provinces for the Development of Society and Environment

Hongmaneerat, K.^{1*} and Hongmaneerat, W.²

¹Faculty of Liberal Arts and Science, Nakhon Phanom University, Thailand ²Faculty of Education, Nakhon Phanom University, Thailand.

Corresponding Author: dr.whmnr@gmail.com

This study was conducted to investigate: 1) needs for quality of life development and occupation opportunity of the elderly by the selection of herbal plant using in Nakhon Phanom Province and Neighboring Provinces as well as some parts of Khammoun province, Lao P.D.R. and 2) a guideline for developing quality of life and occupation opportunity of the elderly. The sample group consisted of 12 community, 7 ethnic groups, and 2 races (420 persons). Data were obtained through question venue, interview, learning exchange, lesson, and conclusions of the lesson. Results of the study revealed that the elderly needs for the development of quality of life and occupation opportunity by using herbal plants rather than modern medicine to reduce expenses and increase incomes. This was based on 5 aspects of the philosophy of sufficiency economy: 1) body, 2) spirit, 3) society, 4) life security, and 5) environment. This could be developed by educational trip and learning by doing. Besides, they were suggested by the committee of Quality of Life Development/center, Nakhon Phanom province and the Project for Knowledge Management for sustainable development.

Keywords: the elderly, quality of life, herbal plants, the development of society and environment

Performance and Obstacles of the Royal Initiative Discovery Foundation in Thailand

Noinach, J.[§], Limunggura, T. and Mankeb, P.

Department of Agricultural Development and Resource Management, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: juthamas.nn@gmail.com

The missions of the Royal Initiative Discovery Foundation were knowledge management and extension to solve the problem depending on geosocial base for sustainable development. This institution cooperated with government, private, local and international sector covering 9 provinces in four regions. The objectives of this research were to identify performance and obstacles of the institution. The study was conducted in the year 2018. The results showed that the institute has implemented by area base approach to develop agricultural occupations and the quality of life of rural farmers. The main activities were 1) water management including weir and pond construction as well as the water delivery system 2) soil improvement including soil analysis, green manure, compost manure, bio fertilization 3) agricultural occupations development including rice yield improvement, vegetable cultivation, fruit production, and 4) group formation including group of waterusers, groups of plant and animal production. The problems were group management, production and marketing. In addition, the target farmers lacked of knowledge in agriculture, lack of record keeping, high production cost and the standards of agricultural products.

Keywords : institution performance, obstacle, area base approach

The Operation Performance of Khao Hin Sorn Agricultural Cooperative Rice Mill Ltd., Chachoengsao Province, Thailand

Phuknoi, A., Suwanmaneepong, S. and Kuhaswonvetch, S.

Department of Agricultural Development and Resource Management, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.
Corresponding Author: screen_09@hotmail.com

The objective of this research was to study the operation performance of the Khao Hin Sorn Agricultural Cooperative Rice Mill Ltd., Chachoengsao Province, Thailand. Carrying out qualitative research, in-depth interviews with the rice mill managers were conducted in August 2018. SWOT analysis was applied to determine the operation performance. The results revealed that Khao Hin Sorn Agricultural Cooperative Rice Mill Ltd. is royal patronage which is supported by various agencies such as the Cooperative Promotion Department, and Land Development Department. This cooperative collected paddy from 10 farmer members, with average amount of paddy at 14 tons per year, and then paddy were delivered to the cooperative rice mill for processing. The full mill capacity is 1.2 ton paddy per day. The service charge rate is one Thai baht per kilogram. The cooperative has produced rice in both packaging and non-packaging for sale to consumers by themselves. Regarding the SWOT analysis results, concerning the strengths, the cooperative rice mill is royal patronage that can provide inexpensive milling service charge for farmers. Additionally, operation staff had experience in rice milling for a long time. Whilst the weaknesses were that the rice mill did not check the quality of paddy before milling-process and did not have specialized technicians to repair a milling machine as well as budget deficit. In terms of the opportunities, the rice mill had a wide range of support from organizations in terms of budgeting, staff, and administration. Moreover, farmers preferred consuming rice grown by their own. Finally, the threats were that the rice mill is located in a non-rice-farming area, and it operated less than the full milling capacity. The collaboration with supply chain partners should be encouraged to increase the quantity of paddy for the milling process.

Keywords: Rice Mill, Agricultural Cooperative, SWOT, Supply Chain, Operation, Rice Mill Performance

The Effect of Ownership Form on The Productivity and Sustainability of Forests in Salla Municipality, Northern Finland

Tapio, J.

University of Helsinki, Finland; University of Eastern Finland, Finland; China Northeast Forestry University, Harbin, China.
Corresponding Author: tapio.juokslahti@kolumbus.fi

Three fourths of the land area of Finland, 23 million hectares, is covered by forests. The forest area has remained almost unchanged over the last 50 years, whereas the volume of growing stock has increased by more than 40% in the same period, being 2,357 million cubic metres (1). Annual growth is 104,4 million m³, and the cutting is 59,6 million m³. Privately owned forests make 53 % of the total forested area, government owns 35 %, and companies own 7 %. Annually 3, 2 % of forested area is harvested, 95 % of forests are certified, and 2, 0 % of forests are protected, ea. 9, 0 % of total area (1). Sustainability of wood production is promoted systematically both by government measures and the active participation of private forest owners, and through forest planning. Carbon storage stocks in forests are extensive, and are constantly growing due to the increasing volume of growing wood stock. Since the annual volume of wood use is far less than the annual increment to the growing stock, the carbon balance is currently positive in Finnish forests, amounting to 30 million tonnes of CO₂ per year (2). Salla municipality is situated in Northern Finland; the Arctic Circle traverses the municipality. Forest vegetation zone is Northern boreal. In Salla there are 13 718 private forest farm lots with combined forested area of 214 984 hectares (3). Salla Forest Cooperative (Sallan yhteismetsä) manages 68 500 hectares forests, outside the rest of the private forested area (4). Salla Forest Cooperative was founded year 1936 by allotting government forest land to the local farmers as cooperatively owned common forest area. Currently the cooperative has 1 548 owner farms, elected governing body and four employed

forestry management specialists. Practical wood harvesting and forest management work is done by outside contractors. Annual harvested wood volume is 115 000 m³ (5). Salla Forest Cooperative has management advantages over other ordinary private forest owners; it has benefit of scale in forest management, price negotiation power and benefit of expert management and knowledge. This study aims at analysing the possible benefits of cooperative large scale ownership over the other privately owned forests.

Table 1. Forest land productivity types distribution in Salla Forest Cooperative forests and Other private forests in Salla Municipality.

Forest land productivity types	Salla Forest Cooperative	Other private forests
Humid type forests (kp 1-3)	28,1 %	42,8 %
Dry type forests (kp 4-6)	71,9 %	57,2 %
Growth potential m ³ /hectare	1,39	2,88

The forest land productivity classification is based on the six main forest types (6). The forest land of Salla Forest Cooperative is less productive than the forest land of other private forests. The more productive humid type forests make 28,1 % of the total area, and the less productive dry forests make 71,9 %. Private forests have more humid type forests, and less dry type forests than Salla Forest Cooperative. The growth potential of Salla Forest Cooperative is only 1,39 m³ per hectare as compared to the 2,88 m³ per hectare of other private forests. This is due to the historical reason, that government allotted the more remote, and less productive forests to the cooperative, than were originally owned privately by the farmers close to their homesteads.

Forest harvest potential depends on forest growth phases (7). Seedling phase forest is youngest growth phase, young forest phase allows partial harvesting yielding mainly wood for cellulose industry, grown forest allows partial harvesting yielding mainly stocks for sawmill industry, and prime for harvest forest yields stocks for sawmill industry.

Table2. Forest Growth Phase Distribution (%) of Salla Forest Cooperative and Other private forests, and the recommendation (7).

Forest Growth Phase	Salla Forest Cooperative	Other private forests	Recommendation (7)
Seedling phase forest	29,9	19,1	25
Young forest	13,8	36,9	30
Grown forest	36,4	25,8	30
Prime for harvest forest	19,9	18,2	15

Table 2. shows that Salla Forest Cooperative forests have more grown forest and prime for harvest forest yielding primarily more valuable stock timber wood in harvestings. The growth cycle annuity is 20 % shorter in Salla Forest Cooperative forests than in the Other private forests due to more favourable forest growth phase distribution (4).

Table 3. Wood volumes (m³ per hectare), timber wood and cellulose wood shares (%) of total wood volumes, and wood values (EUR/hectare) of Salla Forest Cooperative forests and Other private forests hard land forests (forested land less marshlands).

	Salla Forest Cooperative	Other private forests
Wood volume m ³ /hectare	77,7	78,5
Timber wood %	31,5	16,8
Cellulose wood %	68,5	83,2
Wood value EUR/hectare	2318	1125

The table shows that the wood volumes per hectare in the both ownership categories are similar, despite the more favourable forest productivity of the land of the Other private forests. According to actual wood selling prices of Northern Finland in September 2018; timber wood price 57,25 EUR/m³, and cellulose wood price 17,23 EUR/m³ (8), the calculated wood value for Salla Forest Cooperative is two times higher than the corresponding value for Other private forests.

Salla Forest Cooperative has certified its forests both by PEFC (Programme for the Endorsement of Forest Certification) and FSC (Forest Stewardship Council) programmes. FSC auditing is done by

outside auditor once a year, ea. 5% of forests are left outside harvesting, and 5 % of the harvestings are done leaving partial cover in the forests.

As a summary can be concluded, that cooperatively owned forest results into better forest growth phase distribution, shorter growth cycle of the forests, higher volume of valuable stocks in the forests, and higher value of the forest per hectare. Cooperatively owned forest with professional management ensures also sustainable management as seen by the coverage of certified forest area.

References

- 1) Metsätalostolinen vuosikirja, Metsäntutkimuslaitos, 2014. www.forest.fi
- 2) <http://www.metla.fi/metinfo>
- 3) <https://www.metsakeskus.fi/yksityismetsien-metsavaratieto>
- 4) Sallan yhteismetsä (Salla Forest Cooperative), Sinkkila, T. 2018, personal communication. tapio.sinkkila@sallanyhteismetsa.fi
- 5) Sallan yhteismetsä, annual report 2017. www.sallanyhteismetsa.fi
- 6) Cajander, A.K. 1926, The theory of forest types. Acta Forestalia Fennica 29 (3). 108 p.
- 7) Metsäkoulu, Metsäkasvatus Oy, Hameenlinna 2005. 285 p.
- 8) Metsälehti, 2018, 16, p. 13. www.metsalehti.fi

Factors Affecting Self-protection Behaviors of Pesticide use of Sugarcane Agriculture, Phetchabun Province

Grasung, P.

Faculty of Environment and Resource Studies, Mahasarakham University, Thailand.

Corresponding Author: pranitan2519@gmail.com

As Descriptive Research, this study aimed to determine the condition problem, knowledge, attitude, self-defense behavior on the use of pesticides and factors affecting behavioral self-defense behaviors of sugarcane farmers. Sample size use table Robert V. Krejcie and Daryle W. Morgan, 1970 involving 341 people identified through systematic random sampling. Data collection questionnaire with IOC at 0.80, discriminative power at 0.70, Difficulty at 0.60, and reliability at 0.92. Statistics used in data analyses were frequency, percentage, mean, standard deviation and Pearson product moment correlation coefficient and Spearman rank correlation coefficient. The study of the problem found Levels of cholinesterase in the blood of farmers at the most insecure level 147 people, 40.30 percent. At risk level, 107 people 29.30 percent. Normal level, 36 people 9.90 percent. Knowledge on the use of pesticides was at low level ($\bar{X}=2.02$, S.D.=0.50). Attitude towards the use of pesticides was at high level ($\bar{X}=31.18$, S.D.=3.20). Behavioral practices to protect themselves from pesticide use at the most practical level ($\bar{X}=43.48$), (S.D.=3.16). Age, Education, Income did not correlate with practice behavior to protect themselves from pesticide use. Knowledge, Attitude relationship of behavioral behaviors to self-protection from pesticide use were statistically significant at 0.05 ($r=0.111^*$, $p=0.04$), ($r=0.112^*$, $p=0.03$) Training on knowledge of pesticides, practice demonstration for farmers to adopt self-protection from the use of pesticides to protect the health and the environment must be done.

Keywords: Pesticide, farmer, behavior

SWOT Analysis and Marketing Strategies Development of Agricultural Products for Community Group in Nong Chok, Bangkok, Thailand

Fakkhong, S.

Department of Food Science and Technology, Faculty of Agro-Industrial Technology, Rajamangala University Tawan-ok, Chanthaburi Campus 22210, Thailand.
Corresponding Author: sunthon282516@gmail.com

The objective of this study was to investigate the use of golden banana flour to substitute wheat flour in soft bread. The substitution of wheat flour with golden banana flour at 0 (control), 25, 50 and 75 % by weight of whole flour on soft bread production was further carried out. The results found that wheat flour substituted with banana flour at a 25% had highest overall acceptability score ($p \leq 0.05$), but the preference score for color, flavor, and were not different from control group ($p > 0.05$). However, the preference score for texture was highest in a ratio of 25:75 ($p \leq 0.05$). The value of lightness, bread volume decreased when the proportion of golden banana flour substituted to wheat flour was increased. However, the value of redness and shear force was in vice versa. Almost chemical properties such moisture, fat lipid ash and carbohydrate were not significant different among all treatments ratio ($p > 0.05$). However, a fiber property was increased; when, the proportion of golden banana flour substituted to wheat flour was increased. Consumer test was conducted with 30 consumers and the majority of the tested consumers (75%) accepted brownie substituted with 25% of golden banana flour.

Keywords: Golden Banana Banana Flour Fibber Soft Bread

Studies on Macro-Invertebrates of Sto, Tomas Cove, La Union, Philippines

Mamhot, J. R., Peralta, D. A. and Bejar, J. L.*

College of Fisheries, Don Mariano Marcos Memorial State University, Santo Tomas, La Union, Philippines.
Corresponding Author: dianneperalta16@yahoo.com

Macroinvertebrates usually inhabit coastal areas. Being numerous in the shallow zones, they provide readily available food source. They are mostly exposed to high fishing pressure as most of them are immobile or slow moving animals. Results of the three-year survey from 2013 August to June 2016 on the status of macroinvertebrates collected by a modified trawl net (locally known as Karkar) at four established stations in Sto. Tomas cove are presented in this study. This include species composition, abundance and distribution of invertebrates in the area. Four groups were identified: Mollusks, Arthropods, Echinoderms and Cnidarians. Of these, mollusks were the most diverse, widespread and common group throughout the sampling months. The mollusks consist of three groups in the collections: Bivalves, Gastropods and Cephalopods. Two species: *T. terebra* and *A. pleuronectes* represented the most abundant taxa. Arthropods were also abundant in the collected samples and consisted primarily important species such as shrimps (*Metapenaeus* spp.); crabs: *Charybdis* sp., *Portunus* sp., *S. serrata* and other species of Portunidae. *S. mantis* is also common and abundant in the collected samples. Others were collected in small quantity. Echinoderms were less common and represented by two species of sea cucumbers (*H. ocellata* & *H. scabra*). Few samples of Cnidarians were collected and may come from other source or carried by water currents into the cove. They may also have entered the cove in search of food. Considering the catches of these resources, a need for an immediate action towards their sustainability seems necessary.

Keywords: assessment, macroinvertebrates, mollusks, arthropods, echinoderms, cnidarians, Sto. Tomas, Cove

Application of Sufficiency Economy Philosophy of the Committee to Drive and Operate School Sufficiency Economy, Debsirinromkiao School, Thailand

Charoenjindarat, P. *, Kuhaswonvetch, S. and Thunmathiwat, D. P.

Department of Agricultural Development and Resource Management, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.
Corresponding Author: pavida_kik@hotmail.co.th

This study's objectives are 1) To study in depth of sufficiency economy philosophy 2) To study the level of adopting the sufficiency economy philosophy to daily life. 3) To compare whether different status in Debsirinromkiao community effect the understanding the sufficiency economy philosophy, and 4) To compare whether different status in Debsirinromkiao community among the committees result in differences in applying the sufficiency economy philosophy. The study was conducted by collecting 81 questionnaires. We analyzed the data by descriptive statistic and t-test. We found that The committee's level of understanding the sufficiency economy philosophy in overview can be classified as high level with the average score of 25.14. The average rational dimension, the immunity dimension and the modesty dimension score are 8.04, 8.57 and 8.65 respectively. The degree of applying the sufficiency economy philosophy among the committee is in average level with the average score of 20.15. The score for house gardening and farming dimension and the life-style dimension score are both also considered be in the average level with the average score of 8.26 and 12.11 respectively. The comparison between the status of the committee, namely among on present students and alumni, on understanding the sufficiency economy philosophy result shows that there is no different to both groups with the statistic significant score of 0.05. On comparison the adopting the sufficiency economy philosophy between the present students and alumni shows the difference score in term of house gardening and farming dimension but not the life-style dimension. The life-style indifference score statistic significant score is 0.05.

Keywords: Sufficiency Economy, Applying the Sufficiency Economy Philosophy, Debsirinromkiao

Changes and Continuity of Agrarian System and Village Communities in the Central Plain of Thailand

Khwanuwan, P.

Department of Architecture and Planning, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.
Corresponding Author: poon.kh@kmitl.ac.th

Water and human settlements has been relatively closed, especially for Thai culture as a water based society in all dimensions. Water morphology has shaped a significant pattern of settlements. Amphibious settlements in the flood plain areas of the central region of Thailand have long been sustained. They have been adapting themselves through the changes of urbanization and development such as infrastructures and irrigation system. This adaptation of amphibious settlements not only occurred under the force of development but also the force of resistance to maintain local cultural identity and their way of life among dynamic change of the country. Adaptation of community systems has created a kind of management, while retaining relationship with various factors of the environment. Amphibious settlements in the flood plain of Ayutthaya Province, Thailand, can maintain their rural village community degree for a period of time since development and urbanization under the force of capitalization has changed those settlements to be more and more developed and adapted. The spatial characteristic of those communities has been more playing in a role of urban fringe as transitional urbanity. The importance of this study is to analyze the fits of urbanization degree, modern agrarian system and their original aquatic environment. Those fits will be shown by both physical and socio-cultural adaptation under both internal and external factors which affect the people of the area. The result of the study found that the adaptability of amphibious settlements which shows in both physical environment and local wisdom of management system will give a meaning of existence of water based vernacular settlements in developing world. This will offer some clues for policy making and appropriate development of the flood plain area.

Keywords: agrarian system, changes, continuity, communities, modern

Study on the causes and Weedy Rice Management of Farmers in Lumplatiw community, Ladkrabang District, Bangkok Metropolitan, Thailand

Worawetwattana, S.*, Kuhaswonvetch, S. and Thunmathiwat, D. P.

Department of Agricultural Development and Resource Management, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: sk54040715@hotmail.com

This research's objectives were to 1) Collect basic farmer information in the target area. 2) Identify causes for weedy rice. 3) Formulate weedy rice management for farmers. Ten farmers who have had weed rice problems are our informants. Our methodology included semi-structured interview, focus group and non-participant observation. Standard statistic methods such as percentage, average were used to analyze basic information. We adopted triangulation technique to identify causes of weedy rice and approaches for managing weed rice. In this study, most of the farmers were males. Their average age was 57 years old. The majority of informants marital status were married. 50% of them stated their education level as primary school. Their average income was 7,000 baht per month. 40% of them purchase rice seed from local shops. 80% of them cultivated Pathum Thani 1 jasmim rice. The average farm area was 26.6 Rai. The average length of time with weedy rice problem is 5.2 years. Farmers estimated that weedy rice penetrated 27% of their cultivated field. Their expected produces prior of spread of weedy rice is 955 Kg./Rai, and 780 Kg./Rai otherwise. Major causes for weedy rice included 1) The rice seed source like local shops may be not reliable. 2) The weedy rice might be at farming equipment. 3) By repeatedly cultivate the same type of produce over time. Farmers currently handled the problem by 1) Cut weedy rice before it matures. 2) Lure the weedy rice for plowing. 3) Let the weedy rice wilt. Avoid continuously restart the planting too soon. Farmers had tried these techniques. Yet, there seemed to be no improvement on this weedy rice problem. Thus, there should be a collaboration among farmers, agents and local researcher to formulate an effective action plan which would be logical and proper for this community.

Keywords: Weedy Rice Management, Weedy Rice at Lamplatiw

Opportunity and Risk from Urban Planning Policy relating to Real Estate Development and Preservation of Rural and Agricultural Areas at the Present in Mueang Chantaburi of Thailand

Boonyong, S.*, Ngamsangie, C. and Ruengthara, P.

Department of Industrial Engineering, Rambhai Barni Rajabhat University, Chanthaburi, Thailand.

Corresponding Author: sorrawas@hotmail.com

This research aimed to study the opportunity and risk relating to real estate development and preservation of rural and agricultural areas occurring from urban plan policy at the present in Mueang Chanthaburi of Thailand. The study compared the Chanthaburi's comprehensive plan, which was more a skim plan, with the town plan which was more specific in detail of land use, issued in different period of time, investigating current development's area by using Google Earth, and interviewing experts in private and government sectors to seek their relevant opinions. Comparing the 5 year plans, the town plan in 2002, the comprehensive plan in 2012 and the town plan in 2018 indicated the differences in regulation regarding allowable types of land uses. These differences created opportunity that might allow more rooms for land owners to develop their estates but somehow could add more risk in the case that the lands were restricted and not allowed for re development as per the plans. From public point of view, the differences also could create more risk in reduction of the green areas of the town in case the plans could favor re development. In contrast, these could create more opportunity for preservation of the green areas of the town. Additionally, to illustrate this concern, Google Earth was used to capture the satellite photos of the re development being built in the selected areas from 2007 to present 2017 to analyze the distribution of the urban areas and the green areas around the town. Furthermore, interviewing relating government agencies and re developers to seek their relevant opinions revealed the risks of re development in various aspects involving, for example, lack of knowledge of project feasibility study, construction methodology, and urban plan regulation and relating laws.

Keywords: Risk and Opportunity, Real Estate Project Development, Rural and Green Area Preservation, Chanthaburi Thailand

Visualization and Potential Risk-Mapping of Mosquitoes in the Philippines using Mosquito Habitat Mapper Application

Tolentino, J. J. V.

Faculty, Philippine Science High School – Central Luzon Campus, Philippines.

Corresponding Author: jjvtolentino0126@gmail.com

Mosquitoes are considered to be the most important insect pests which tremendously affect human health, while the mitigation and control of mosquito-borne diseases remain to be challenging due to various reasons. Prevalence of vector-borne diseases in many parts of the Philippines has been a major public health concern. Hence, this study targeted to assess the feasibility of Mosquito Habitat Mapper (MHM) application to visualize data on mosquitoes, its identification and potential breeding sites in the Philippines as a new approach. Larvae samples collected at Ninoy Aquino Parks and Wildlife Center at Quezon City, Philippines were viewed under the Newer Clip-on Micro Lens and incorporated in the MHM application and distinguishing features such as thorax, siphon, terminal segments and comb scales were used for larval identification. The data collected were submitted into an online visualization tool of Global Learning and Observations to Benefit the Environment (GLOBE) website for data visualization. Results showed that the selected area was a breeding site of mosquitoes since larval samples were obtained. The larval samples were at the 3rd and 4th instar stages, and were partially identified as *Aedes* species. Through the online visualization tool, it can be observed that there were minimal records of mosquito habitats in the Philippines as of the present. Due to the easier use of the clip-on micro lens attached to a mobile device and the MHM app, the reporting of breeding sites as well as identification of larvae samples has been easier for citizens, not only for professionals but as well as for the students. The data visualization system enables an individual to freely access data of mosquito cases in every region of a country. Hence, the MHM app lifted the common barriers for the reporting breeding sites and can be a promising tool to map mosquito habitat and cases.

Keywords: Mosquito, Mosquito Habitat Mapper Application, Risk-Mapping

English Classroom Stress and Anxiety of Students and Teachers at Colleges of Agriculture and Technology in Upper Northern Thailand

Rodchamnan, T.^{1*}, Rattanakamonwon, P.² and Kruadsoongnern, C.³

¹Maejo University, Thailand; ²Mae Hong Son College of Chiang Mai Rajabhat University, Thailand,
³Phrae Panyanukool School, Phrae province, Thailand.

Corresponding Author: poungsuk@gmail.com

The study aimed to explore English classroom stress and anxiety of students and teachers at College of Agriculture and Technology in upper northern Thailand. A set of questionnaires was administered with students and teachers at the college. Moreover, focus group discussion was conducted with the teachers. Obtained data gained from the questionnaire were analyzed in terms of mean, percentage, and standard deviation. Results of the study revealed that more than one-half of the student respondents were male, 18-20 years old and they stayed on the campus (92.10%). Regarding their English skills in listening, speaking, reading and writing, it was found at a moderate level ($\bar{X} = 3.14, 2.81, \text{ and } 2.86$, respectively). They claimed that English teaching/learning activities in their classroom was appropriate at a moderate level ($\bar{X} = 3.07$) and they had a lowest level of English classroom stress and anxiety based on behavioral and physical deficiency ($\bar{X} = 1.37 \text{ and } 1.25$, respectively). For the teacher respondents, most of them (90.00%) were female, 30-39 years old, and bachelor's degree holders. One-half of the teacher respondents (50.00%) were married, had a salary of 15,000-20,000 baht and 6-10 years of service. They claimed that the following were at a moderate level: 1) personality and behaviors of their students ($\bar{X} = 3.34$); 2) teaching performance ($\bar{X} = 3.33$), and 3) teaching/learning activities ($\bar{X} = 3.53$). However, they had a lowest level of English classroom stress and anxiety ($\bar{X} = 3.01$). Based on the focus group discussion, the following should be ensured: 1) English teachers should learn and focus on agricultural terminology which will be beneficial to Agriculture students; 2) English teachers should have a sense of humor; 3) English teachers must create appropriate classroom atmosphere; and 4) Teaching media must be modern and interesting.

Keywords: Agricultural Learning Center, organic agriculture, organic learning module, learning facilitation, agriculture teachers

The Development of Network New Theory Agriculture in Ban Kung, Surin Province Thailand

Samoraphum, C., Thongplew, W. and Phiewjun, C.

Surindra Rajabhat University, Surin, Thailand.
Corresponding Author: dr.chai2559@gmail.com

This research aimed to develop a New Agricultural Theory Network Group in Ban Kung, Surin Province by Participatory Action Research method. The emphasis was on the important participation of all important key stakeholders. It is based on the belief that farmers and all responsible persons had enough potential to develop New Agricultural Theory Networks Group. So research and development is used to develop the learning process. Starting from the current study, problems and development needs, seeking guidance and development methods were studied. Network group development processes were as follows:- 1) Network Grouping. 2) The role arrangement of group members. 3) Learning together system arrangement. The research found that (1) before the development of farmers to do New Agricultural Theories, people do farming according to their own aptitude. No meeting no sharing and no communication were found. But they also aimed to establish a New Theoretical in Ban Kung, Surin Province to convey their expertise to the farmers together or share learning together, (2) guidelines and methods for developing New Agricultural Network Group of Ban Kung, Surin Province were set up the New Agricultural Network Group in Ban Kung, Surin Province by provide farmers with clear information, establish the role of network members clearly, Set up a communication system that members can communicate with each other, provide a participatory learning exchange, and increased knowledge skills New Theory Agriculture for farmers. And (3) appropriate model network group development was started by organizing opportunities and processes for farmers to learn together by sharing experience. Farmers had a good attitude towards farming according to New Theory Agriculture. It was guaranteed that farmers can rely on themselves, table career, enough income, quality of life improvement, the community had strengthened, community economy is stable and sustainable.

~~A Research Output in Agriculture and Social and Related Study~~

~~Firma Viray~~

~~Corresponding Author: fecviray@gmail.com~~

DAY 2: November 28, 2018

Keynote Session

Manufacturing-based Agro-industrialization: The Supply and Value-added Chain (Svac) and Agro-processing Cluster Framework and Business Models

Villegas, P. M.*

Philippine Chamber of Agriculture and Food Inc (PCAFI), General Manager, Malvar Organic Farmers Agriculture Cooperative (MOFAC), Owner-Operator, Villegas Organic and Hobby Farm Complex, Philippines.

Corresponding Author: pabsvillegas2010@gmail.com

In this study, our key findings stressed that there must be integration of the core industry systems composed of agricultural component, primary processing sub-system and downstream processing system. Driven by relative and absolute comparative advantages and strong home or domestic demand and/or a strong export market or emerging market foothold, these core industries must have strong economic foundation or factor conditions such as policy and business environment, technology and research and development capability covering 4Ps, natural resource endowments, physical infrastructure and human resources. The enabling laws or legal endowment are in place (Republic Act 8435, as amended by RA 10601, Agri-Agra Law, Republic Act 11032). On the other hand, the supplier industries consisting of suppliers of agricultural inputs, technology, machinery and equipment and other material goods and the related, allied and supporting industries consisting of the services providing sectors from finance, transportation, machinery design, marketing, sales and distribution, capacity building and other critical business development services should also be fully active across the value chain. Agriculture could become a major growth driver in the Philippines and other ASEAN countries with similar status, but efforts must be directed towards value added processing and manufacturing. For this to be operationalized, the Department of Trade and Industry, and Department of Agriculture as the lead drivers, DTI and DA must work in tandem and utilize the agro-based industrialization business model. Moreover, the DA and DTI in convergence with DAR, DENR, DOST and DBM must redirect its program planning and budgeting management system towards integrated area and community development at the district levels, including river basins and watersheds for socio-economic development and ecological security. The BSP and Banking Sector must pro-actively implement its "Inclusive Finance and Value Chain Financing Policies" by focusing on agro-based industrial clusters and value chain business models. The banking and investment sector must establish competency in agro-based industrial knowledge management systems including skills and pro-poor and pro-food security attitude and culture. Also, Banking and Investment Sector must immediately forge strategic partnership with the LandBank's corporative agribusiness investment and financing program and the insurance/guarantee institutions.

Use of Ultra-Light Uav Drones in Agriculture: Analys, Monitoring and Control

Rubin, D.

Engineering Technologies Group (RF), Moscow, Russia.

Corresponding Author: mr.r.dmitry@gmail.com

PRACTICAL USE OF AGRO DRONES AND KNOWN ISSUES

NDVI method allows to evaluate plant health level. The method is based on study of light absorption and reflection in red and UV specters. The main drawback in using NDVI method is caused by the lack of proper data collection and analysis methods.

NDVI is heavily influenced by outside factors, such as humidity, lighting, etc. Ways to resolve the above-mentioned issue are currently developed by our company jointly with Russia's leading agrochemical and chemical research institutes. Agricultural drones allow to solve two groups of tasks. The first group of tasks is connected to the methods of control and diagnostics for prompt detection of diseases contamination centers and damage from insects on the early stages. Innovative methods allow to identify and facilitate specialized approaches to selecting decryption keys for remote images of fields.

This allows to speed up the process of contamination centers detection. The second group of tasks is connected to the emerging possibilities in the field of analytics. First, that is the perennial mapping on the basis of visual and echolocational methods which present the data on the volume and quality of the fertile soil level for the purposes of the differentiated and precise cadastral valuation of agricultural land. Second, that is creating maps of the availability of nitrogen nutrition for plants, creating 3D topographic maps for predicting locations of moisture accumulation. Dosages of mineral fertilizers for the planned crop yields are to be estimated based on these indicators. These developments will be aimed at achieving the planned levels of crop yields and at the decrease in ecological risks associated with intensive agriculture activities, including the precise ones. The UAV complexes help to solve the following problems: Detection of foci infection, Identification of plant death, Assessment of lesion size and damage assessment, Assessment of the effectiveness of any means of plant protection, Identifying the most effective means of plants protection, Detection of the accumulation of moisture, Increase the usable area by analyzing the 3D elevation model, Verification of the declared area in documents with the actual, Determine the area of land Bank for various purposes, Identification of the land, illegal structures, water reservoirs, landfills, Identification of unused farmlands, Equitable spreading of plant protection products, Detection of violations in the operation of equipment, Identify gaps in the sowing of crops, Identification of facts of illegal grazing

Conclusion: Systems with UAVs can be very useful in agriculture industry. Although today this technology has some issues. AgroDroneGroup technology is aimed to reduce the issues and make UAVs more useful for agriculture.

Ethnostudy of Mushrooms and Establishment of Pure Culture of *Cantharellus* Species (Ero Umunwene) A Newly Discovered Mushroom Found in Ukwa-East, Abia State, Nigeria

Okigbo, R. N.* and Okigbo, J. E.

Department of Botany, NnamdiAzikiwe University, Awka, Nigeria.

Corresponding Author: okigborn17@yahoo.com, rn.okigbo@unizik.edu.ng

The investigation focused on indigenous knowledge of mushrooms and establishment of pure culture of *Cantharellus* species (Eroumunwene) a newly discovered mushroom found in Ukwa-East, Abia State. A well-structured questionnaire was designed to assist in obtaining crucial information from the people of the study area. Fresh mushrooms of *Cantharellus* species (Eroumunwene) were harvested from bush around Ohanso in Ukwa-East Local Government Area of Abia State. Mushroom samples were prepared for spore printing which were used in identification and characterization. Also establishment of pure culture using both tissue culture and spore culture methods were adopted. Descriptive statistics were adopted and relationships among some variable were checked with percentage error bars in MS EXCEL. Eighty-five (60.71%) of the 140 administered questionnaires successfully retrieved were fully responded to. The results were analyzed by gender, age groups, and locations. The people in the study area consume about fourteen mushroom species. The study showed that more than 85% of the respondents consume edible mushrooms because of its palatability and nutritional importance, also 23% respondents take them as substitute for meat, while 10% of the respondents consume mushrooms because of its medicinal purpose. The study also showed that more than 95% of respondents use sun drying, 13% use refrigeration, 9% make use of flaming, 1% oven dry while 2% of the respondents use salt solution to preserve harvested mushrooms. Over 87% and 54% of respondents regarded mushroom hunting as work for young women and children respectively. More than 84% of the respondents have interest in mushroom cultivation. Pure culture of *Cantharellus* species was not established. The residents of Ukwa-East Local Government Area of Abia State have indigenous knowledge of mushrooms and their uses. However, further studies on establishment of pure culture are highly recommended.

Keywords: mushrooms, ethnostudy, *Cantharellus* species, pure culture, Abia state.

Biodiversity for the Development Sustainable Bio-Enterprise

Josue, D. S.

Mindanao State University-Maguindanao, Mindanao, Philippines.
Corresponding Author: dani_josue28@yahoo.com

The Philippines farms are mostly characterized by small land holdings where farmers continually experience poverty and food insecurity. With predominant areas of less than 1 hectare from the 5.56 million farms or 7.19 million hectares, these farms are mostly operated by households or individual farmers. These farms covered 6.78 hectares and are mostly operating under a monocropping scheme. The continuous practice of monocropping in these farms has been a major culprit in the erosion of major economic crops species, inefficient use of farm resources and low productivity. Thus farmers in these areas are living with low income and in a survival state. The practice of monocropping has been putting small farms into a very risky position considering other factors that influenced production. The significance of biodiversity impressed upon by enterprise mixes could turn these small farms into an efficient, productive, profitable and sustainable bio-enterprise. The development of a multifunctional farm that diversity and integrate every component present in the agroecosystem could enhance productivity and profitability while conserving the environment. This system is a “risk breaker” that utilizes the by-product of 1 farm component as an input in the production of another farm component. In spreading the risk in the production process, the system ensures that other farm components could still produce something in case 1 component fails in the cycle of production. These components include annual, perennial, leguminous, & forage crops mixed with the animal components like goats, chickens & ducks along with aquaculture production.

Keywords: small farms, biodiversity, bio-enterprise, monocropping, multifunctional farm, productivity, risk breaker

Can Organic Agriculture Feed the Smallholders? -Experience from Rural Bangladesh

Sarker, M. A.¹, Hoque, M.² and Chowdhury, A. H.³, Khanam, R.⁴

¹Department of Agricultural Extension Education, Bangladesh Agricultural University, Bangladesh; ²Ministry of Education, Govt. of the People’s Republic of Bangladesh, Bangladesh. ³Department of Environmental Design and Rural Development, University of Guelph, Canada. ⁴School of commerce, University of Southern Queensland, Australia.
Corresponding Author: masarker@bau.edu.bd

The study was conducted in two districts of Bangladesh namely Mymensingh and Bogra. The respondent small farmers (80) were the beneficiaries of the organic agriculture promotion project of Bangladesh Agricultural University (BAU). Three years data were collected by the project staff and were crosschecked with the base line. Findings of the study explored that before joining with the project extreme majority (93 percent) of the small farmers were involved in rice mono-culture and more than half (67 percent) of them were food deficit. The study also revealed that at the initial year of joining organic agriculture project their farm productivity was 10-12 percent lesser and it increased continually in the succeeding years. In some cases it crossed the yield compared to conventional farming. The findings of the study showed that 100 percent of the farmers have followed crop diversification with high value vegetables and spices along with rice. Due to adoption of organic practices the cost of production of the smallholders has declined 27 to 36 percent and additionally they are enjoying 10 to 15 percent premium prices which have enhanced their farm income significantly. Thus, adoption of organic agriculture effectively increased smallholders’ access to safe and nutritious food. However, the study also explored that age, farm size, extension contact, access to assured market and access to institutional support are the most important factors in improving smallholders’ food and nutritional security through participation in organic agriculture programme.

Keywords: Food security, organic agriculture, smallholders and Bangladesh

Trade in Donkeys and its Implications on Food Production by Smallholder Farmers in Africa

Moreki, J. C.

Ministry of Agricultural Development and Food Security, Private Bag 003, Gaborone, Botswana.
Corresponding Author: jcmoreki@gmail.com

The donkey (*Equus asinus*) is indigenous to Africa. The world's donkey population is estimated to be 44 million with 50% of donkeys found in Asia and slightly over a quarter in Africa, whereas the remainder is found mainly in Latin America. The population of donkeys has declined over time and this is causing a major concern, especially in Africa where donkeys still play important roles in smallholder agricultural production. This paper reviews literature on the donkey trade in most African countries and its likely negative impact on arable production by smallholder farmers who use donkeys to produce food for their families. Smallholder farms produce approximately 80% of food in sub-Saharan Africa and Asia. The multiple roles played by donkeys in descending order include transport (i.e., water, feeds and produce), draught power, weeding and harvesting, as well as, serving as livestock guardian. Other uses include meat, milk, onotherapy, cosmetics, medicine and hides. It is the last three uses (cosmetics, medicine and hides) that have contributed to increased slaughter of donkeys across Africa to supply the insatiable markets in Asia. It is hypothesised that if the harvesting of this resource (donkeys) is not controlled livelihoods of smallholder farmers and their families will be adversely affected leading to food and nutrition insecurity, and political instability. Therefore, it is suggested that African governments must put in place policies that promote sustainable utilization of donkeys to guard against this trade hurting the agricultural sector by drastically reducing the donkey populations. Furthermore, research on donkey breeding should be initiated across the continent.

Keywords: Africa, donkeys, food insecurity, smallholder farmers, sustainable utilization

Session 1: ORGANIC AGRICULTURE AND RELATED FIELDS

Growth and Yield Responses of Cauliflower on Tithonia (*Tithonia diversifolia*) Compost under Organic Farming Practices

Setyowati, N.^{1*}, Sudjatmiko, S.¹, Muktamar, Z.², Fahrurrozi, F.¹, Chozin, M.¹ and Simatupang, P.¹

¹Agronomy Department, University of Bengkulu, Bengkulu, Indonesia; ²Soil Science Department, University of Bengkulu, Bengkulu, Indonesia.
Corresponding Author: nsetyowati@unib.ac.id

Recently, organic cauliflower has been highly demanded in Indonesia since the horticultural product is healthier and pesticide free. The study was intended to determine the effect of tithonia (*Tithonia diversifolia*) compost on the growth and yield of cauliflower under organic farming practice. The experiment was carried out at CAPS Research Station in Air Duku Village, Rejang Lebong District, Indonesia, located at 1054 m above sea level, assigning Randomized Completely Block Design (RCBD). The treatment consisted of 0, 5, 10, 15, 20, and 25 ton of tithonia compost ha⁻¹ with three replications. Tithonia compost contained 0.85% nitrogen, 0.22% phosphorous, 0.63% potassium and pH of 8.5. The result indicated that application of tithonia compost at the rate of 20 ton ha⁻¹ exhibited highest plant height and number of leaves as compared to the other treatments. An insignificant difference of plant height and leaf dry weight was detected among treatments of 20 and 25 ton ha⁻¹. So did the curd diameter and total plant dry weight. Likewise, the greatest fresh curd weight was observed at the compost application of 25 ton ha⁻¹. Curd diameter of cauliflower fertilized with 20 ton ha⁻¹ was 12.8%, 17.5%, and 72.8% larger than those of 15, 10, and 5 ton ha⁻¹, respectively while curd fresh weight at the rate of 25 ton ha⁻¹ was 44.9%, 51.5%, and 100% greater than those of 20, 15, and 10 ton ha⁻¹, respectively. Nonetheless, the yield of the cauliflower is lower than its potential.

Keywords: Brassica oleracea, organic fertilizer, Tithonia

Fungal Elicitors and Their Nano-Product for Plant Immunity

Kanokmedhakul, S.^{1*}, Kanokmedhakul, K.¹ and Soytong, K.²

¹Natural Products Research Unit, Department of Chemistry and Center for Innovation in Chemistry, Faculty of Science, Khon Kaen University, Khon Kaen, Thailand; ²Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Ladkrabang, Bangkok, Thailand.

Corresponding Author: somdej@kku.ac.th

Elicitors are compounds, which activate chemical defense in plants. Various biosynthetic pathways are activated in treated plants depending on the compound used. Common elicitors have been known such as salicylic acid, methyl salicylate, benzothiadiazole, benzoic acid and chitosan which affect the production of phenolic compounds and the activation of various defense-related enzymes in plants. Some elicitors are isolated from fungi. Several of them can also stimulate plants to produce compounds call phytoalexins to defense themselves from diseases. Their introduction into agricultural practice could minimize in the scope of chemical control for the sustainable agriculture. Searching for elicitor from the fungal secondary metabolites has been studied by our group. Now a day, nanotechnology has great potential in agriculture. This presentation describes the elicitors from secondary metabolites of antagonistic fungi and the development of these compounds to be Nano-products for plant immunity and biocontrol agent against plant diseases.

Growth and Yield Response of Pakcoy (*Brassica rapa* L.) On Various Concentrations of Organic Liquid Fertilizer of Jiringa Hulls [*Phithecellobium jiringa* (Jack) Prain]

Hardiansyah, P.¹, Nurjanah, U.² and Widodo^{2*}

¹Student of the Agroecotechnology Study Program, Faculty of Agriculture, University of Bengkulu; ² Faculty of Agriculture Lecturer, University of Bengkulu, Indonesia.

Corresponding Author: widodo@unib.ac.id

Pakcoy (*Brassica rapa* L.) is a type of vegetable crop and one of the short-lived species needed by the body because it contains good nutrition. In order to meet the needs of Pakcoy, it must also be balanced with the production level. One of the efforts to increase the production of Pakcoy is the nutrient application of organic liquid fertilizer (OLF) made of jiringa hulls. Organic liquid fertilizer can be absorbed by plants quickly rather than organic solid fertilizers and it does not damage soil structures such as synthetic chemical fertilizers. This study aimed to determine the optimum concentration of organic liquid fertilizer on growth and production of Pakcoy. The research took place at the Green House Laboratory of Agronomy, Faculty of Agriculture, University of Bengkulu. This research used Completely Randomized Design (CRD) with one treatment factor and repeated 5 times, each treatment unit included 3 potted plants. Treatment of five organic liquid fertilizer concentrations consisted of T0: OLF 0% (Control), T1: OLF 25%, T2: OLF 50%, T3: OLF 75%, T4: OLF 100%. The concentration of OLF 100% produce the best growth and production of Pakcoy and significantly affected canopy length variables (22, 18 cm), leaf number (15, 86 strands), leaf width (34, 26 cm²), fresh canopy weight (68, 85 gram), total dry weight (6.92 grams), greenish leaves (48.48), and dried root weight (1.72 grams).

Keywords: Organic Liquid Fertilizer, Jiringa Hulls, Pakcoy, Concentration

KMITL Organic Model

Soytong, K.¹, Poeaim, S.^{2*}, Ponknak, K.¹, Luenam, L.¹, Poeaim, A.², Kuhaswonvetch, S.¹, Pongsuk, P.³, and Laipas, P.³

¹Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; ²Department of Biology, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; ³Faculty of Industrial Education, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: poeaim@hotmail.com

KMITL organic agriculture model is established by supporting from King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand to contribute the research findings of biological products as agricultural inputs to be used for organic agriculture in practice. It is located at Danchang district, Supanburi province, Thailand. It is to promote the farmers to gain the based knowledge of organic agriculture. KMITL organic model are divided into five parts as follows:- production, agricultural inputs, organic certification, marketing, research and extension. The model is including all processes from production to marketing including research findings which necessary to serve the model.

Keywords: Agricultural inputs, Organic agriculture, Organic certify, Organic model

The Energy Footprints of Inbred and Hybrid Rice Genotypes Grown under Organic and Conventional Production System in Laguna, Philippines

Oo, M., S.¹ and Mendoza, T. C.²

¹Department of Agriculture, Ministry of Agriculture, Livestock and Irrigation; ² Faculty, Institute of Crop Science, College of Agriculture and Food Science, University of the Philippines Los Baños, Philippines.

Corresponding Author: ecofarm.mndz2011@gmail.com

Fossil fuel oil is burnt to generate energy but burning is accompanied by carbon emission also called energy footprint. The energy footprints of two rice genotypes- inbred and hybrid- were compared. They were grown in two systems: organic and conventional system under rice growing conditions of Bay, Laguna, Philippines from December 2016 to April 2017. To estimate the total energy inputs, direct and indirect energy based inputs from crop establishment, harvesting, milling, transport, cooking and grain yield for estimating energy output of both production systems were recorded. The results showed that organic production system had equivalent energy footprint of 0.485 tCO₂e ha⁻¹ which was 81% lower compared to the conventional production system at 2.524 tCO₂e ha⁻¹. The major energy footprints for the conventional system were nitrogen fertilizer at 1.658 tCO₂e ha⁻¹ (66%) and pesticides at 0.205 tCO₂e ha⁻¹ (8%) . The major energy consumer for the organic system were the preparation and application of organic fertilizer and labor which gave an indirect energy footprint equal to 0.118 tCO₂e ha⁻¹ (25%) and 0.094 tCO₂e ha⁻¹ (20%), respectively. Post-production and cooking added significant amount of energy footprint. The energy footprint of hybrid rice was only 154 kg CO₂e/ton (organic) while it was 428 kg CO₂e/ton (Conventional, 2.8 times higher). This was due to the 64% decrease in energy use; hence, energy footprint. Transport accrued the highest energy footprint per ton of milled rice in post-production (18% to 38% more) when rice is transported over long distances of 200 km and above. Energy footprints in transportation increased from 5.54 kg CO₂e/ton/30km to 95 kg CO₂e/ton/500km in both systems. Organic rice production systems reduced the direct and indirect fossil fuel energy use, thus, reducing the total energy bill and energy footprint (CO₂ emission) in rice- the staple food in the Philippines and the ASEAN region.

Sustainable Rice Production by Plant Health Improving Microbiome

Rashid, Md. H. O. and Chung, Y. R.

Division of Applied Life Science (BK21 Plus), Plant Molecular Biology and Biotechnology Research Center, Gyeongsang National University, Jinju 52828, Republic of Korea.

Corresponding Author: yrchung@gnu.ac.kr

Microbiome emerges as a hot topic in researches of human diseases and plant biotic stresses during the last decade. Plant and microbial biology researchers have found relationships between the root microbiome and plant resistance against plant pathogens and herbivore insect pests recently. The plant microbiome comprises all of the genetic material within a microbiota (the entire collection of microorganisms in a specific niche, such as the rhizosphere, spermosphere and host tissues). Some of the microorganisms that inhabit the rhizosphere or inside tissues are known to have growth-promoting and broad-spectrum resistance inducing activities against plant diseases and insect herbivores. These beneficial microbes are generally called biostimulant, biopesticide or plant strengthener depending upon their main function, which improve plant health in a variety of different ways. Here, we provide evidence that beneficial endophytic bacteria isolated from rice roots enhance rice yields by modulating plant defenses against pathogens and insect herbivores. Salt tolerance and other yield-related metabolisms are also affected by the bacterial treatment in rice. Two novel endophytic *Bacillus* species (strains YC7007 and YC7010) were selected for the analysis among more than 250 isolates from the roots of rice in paddy fields at Jinju, Republic of Korea. The taxonomic position of the strains was determined based on the polyphasic studies. Two strains YC7007 and YC7010 represent novel species of the genus *Bacillus*, for which the name *Bacillus oryzicola* (*velezensis*) sp. nov. was proposed. These strains showed antimicrobial and systemic resistance (SR) inducing activities against bacterial and fungal pathogens and insect herbivores of rice. Bacterial blight and panicle blight caused by *Xanthomonas oryzae* pv. *oryzae* (KACC 10208) and *Burkholderia glumae* (KACC 44022), respectively, were controlled effectively by drenching a bacterial suspension (10^7 cfu/ml) of strain YC7007 to the rhizosphere of rice and foliar sprays of the suspension. Strain YC7007 also inhibited mycelial growth of major rice fungal pathogens including *Magnaporthe oryzae*, *Fusarium fujikuroi*, *Rhizoctonia solani*, *Pythium* sp. strongly *in vitro* and field tests. This strain showed controlling efficacy of the bakanae disease caused by *F. fujikuroi* and its interaction mechanism with the pathogen and host was elucidated. Root drenching of the YC7007 suspension reduced the bakanae severity significantly comparing with the untreated controls by 46–78% in pots and nursery box tests containing autoclaved and non-autoclaved intact soils. The accumulation of hydrogen peroxide was observed at an early stage of rice seedlings and a hormonal defense was elicited with and without pathogen inoculation by the root drenching of YC7007 suspension. Development of necrotic lesion and mycelial expansion of *F. fujikuroi* were inhibited significantly by spraying the culture filtrate of strain YC7007 in the detached rice leaves bioassay. Drenching of ethyl acetate extracts of the culture filtrate to the rhizosphere of rice seedlings also reduced the bakanae disease severity in the plant culture dish tests. In addition to the controlling efficacy of strain YC7007 against rice diseases, the other strain YC7010 has been found to reduce infestation by herbivore insects, aphid and brown planthopper (BPH). Aphids and BPH which suck the plant sap and transmit viruses are the most destructive insect pests causing widespread yield losses of many crops including rice. We have elucidated the cellular and molecular defense mechanisms of the strain with these insects in the host plants. The strain YC7010 induced SR against green peach aphid (GPA), *Myzus persicae* and BPH, respectively, by treatment of the suspension of YC7010 to *Arabidopsis* and rice seedlings. Root drenching of *Arabidopsis* plants induced higher accumulation of hydrogen peroxide, more cell death and callose deposition in leaves compared to untreated plants at six days after infestation of GPA. Unlike other SR inducing bacteria, salicylic acid (SA), jasmonic acid (JA), ethylene (ET) and abscisic acid (ABA) were not required to induce SR against GPA in *Arabidopsis*. The bacterial treatment with YC7010 significantly reduced feeding and reproduction of GPA on *Arabidopsis* leaves via strong expression of senescence-promoting gene *PHYTOALEXIN DEFICIENT4 (PAD4)* while suppressing *BOTRYTIS-INDUCED KINASE1 (BIK1)*. Based on these results, YC7010-induced SR to GPA appears to be a hypersensitive response with more accumulation of hydrogen peroxide, cell death and callose deposition mainly dependent on higher expression of *PAD4* with suppression of *BIK1* in *Arabidopsis*. However, the mechanism of SR against BPH induced by YC7010 in rice was different from that of aphid. Next generation deep-sequencing transcriptome analysis of rice treated with YC7010 and BPH show for the first time the endophytic strain YC7010 induce defense against BPH through both SA and JA dependent pathways, in which flavonoid changes and cell wall

strengthening were the key defense mechanisms. These strains also showed salt tolerance inducing activity and plant-growth promotion in *Arabidopsis* and rice. Taken together, our findings suggest that the specific component of rice root microbiome, novel endophytic *Bacillus* strains YC7007 and YC7010 coevolved for a long time with the host plant, can be used to improve plant health effectively via biological control of rice diseases and insects.

Keywords: endophytic bacterium, *Bacillus oryzicola* YC7007 (*B. velezensis* YC7010), rice bacterial blight, rice blast, bakanae, brown planthopper, induced systemic resistanceA

Effect of Biogas Effluent from Pig Manure and Longan (*Dimocarpus longan*) Residues on Growth of Marigold (*Tagetes erecta*)

Prathumyot, W.¹, Chakhatrakan, S.², Frank, M., B. and Chit-aree, L.¹

¹Faculty of Agricultural Technology, Rambhai Barni Rajabhat University, Muang District, Chanthaburi, Thailand; ²Faculty of Science and Technology, Thammasat University, Clong Luang District, Pathumthani, Thailand.

Corresponding Author: wikanya.p@rbru.ac.th

The efficiency of biogas effluent fermented with pig manure and longan residues on growth of marigold was investigated. The experimental design was carried out in a Completely Randomized Design with 4 replications. Six treatments were as follows:-control (no fertilizer), four concentrations (10%, 20%, 30% and 40%) of biogas effluent and chemical fertilizer. Marigolds were transplanted 10 days after planting to pots and the experiment was started. Each biogas effluent concentration was watered 400 ml per pot every 5 days. 15-15-15 and 12-24-12 formula were used in chemical fertilizer treatment. The experiment was conducted for 69 days at Rambhai Barni Rajabhat University. The data of plant height, stem diameter and bush diameter were collected every week. After flowering, number, initiated day, fresh weight and dry weight of blooming flower were measured every day. The chlorophyll concentration of leaves, fresh weight and dry weight of roots, branches and leaves were measured at the end of experiment. The results showed that the growth of marigold in the control was lowest as compared to that in biogas effluent and chemical fertilizer treatments. There was no significant difference in the plant height, stem diameter, bush diameter, blooming flower number, fresh weight of total blooming flower, dry weight of total blooming flower and flower initiated days of marigolds treated by biogas effluents and chemical fertilizer at the end of experiment. The chlorophyll concentration in leave of marigolds treated by chemical fertilizer did not differ as compared to that in 20%, 30% and 40% biogas effluent treatments. There was no significant difference in whole plant fresh weight of marigolds treated by chemical fertilizer and 20% biogas effluent treatments. The whole plants dry weight of marigolds treated by chemical fertilizer also did not significant differ as compared to that in 10%, 20% and 30% biogas effluent treatments.

Keywords: biogas effluent, longan, marigold growth

Performance of Sweet Corn Hybrids under Organic Crop Management across Three Agro-Climatic Zones of the Tropics

Chozin, M.* and Sudjatniko, S.

Faculty of Agriculture, University of Bengkulu, Jl. W.R. Supratman, Kandang Limun, City of Bengkulu 38121, Indonesia.

Corresponding Author: mchozin@unib.ac.id

Sweet corn is best adapted to warm climate and it can be grown year-round in the tropics. The tropical regions are well reputed for the climatic conditions favored the plant growth but the crop performances can vary substantially along the elevation gradients. This study was conducted to compare the relative performances of sweet corn hybrids as grown organically in three tropical agro-climatic zones of the tropics. Twenty-eight hybrids generated from a half diallel crossing scheme involving eight inbred lines (Caps 2, Cap 3, Caps 5, Caps 15, Caps 17A, Caps 17B, Caps 22, and Caps 23) and a commercial hybrid (as a check variety) were evaluated for their growth, development, and ear performances under organic crop management at three locations differed in the elevations (10, 618, and 976 m above sea level). The observations were made on plant height, stalk diameter, biomass, tasseling and silking dates, and ear length, ear diameter, ear weight, kernel-row number, and kernel number row⁻¹. A pooled analysis of variance was performed to elucidate the significant effects of the predetermined sources of variation followed by Scott-Knott cluster analysis for means separation. No significant effect of location x hybrid interaction was found on all observed traits. The higher elevation tended to produce higher growth and ear performances, but slower in both tasseling and silking dates. There were five hybrids (Caps 5 x Caps 17A, Caps 15 x Caps 17A, Caps 17B x Caps 22, Caps 17A x Caps 22, and Caps 5 x Caps 17B) exhibited better than or similar to the check variety with respect to the performances in growth, tasseling and silking dates, and ear characteristics.

Keywords: sweet corn, hybrid performances, elevation, organic crop management

Knowledge and Attitudes toward Marketing Innovation for Organic Rice Farmers in Sanam Chai Khet Organic Agriculture Group, Chachoengsao Province, Thailand

Ruaykijakarn, N.*, Suwanmaneepong, S. and Kuhaswonvetch, S.

*Department of Agricultural Development and Resource Management, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: nd.narisara@gmail.com

This research aimed to investigate socio-economic, knowledge, and attitude towards marketing innovation of organic rice farmers in Chachoengsao Province, Thailand. Data were collected during July to August 2018 by using structured questionnaires from 20 organic rice farmers who were members of the Sanam Chai Khet Organic Agriculture Group, Chachoengsao province. The snowball sampling method was applied. Data were analyzed by using descriptive statistics. Knowledge of farmer was tested through true-false statements, and attitude of the farmers was examined through five-point-Likert scale questions. The findings revealed that most farmers are female (65%), aged between 51-60 years old (35%), graduated from primary school (80%). Experience in organic rice production was 11-20 years (55%). The area of organic rice production was less than 15 Rai (50%), most of which were their own areas (95%). The most commonly used rice was Jasmine Rice (Red How Mali Rice) (85%). The farmers produced rice in accordance with the IFOAM, EU, and Canada Standard Organic Farming Procedures (90%). The main distribution channel of organic rice product was farmers' group shop (70%). There was no bargain with buyers (70%) and no marketing promotions for customers (90%). The result of participant farmer knowledge of marketing innovation exposed that average farmers were knowledgeable about organic rice marketing innovation at a moderate level (55%). They had a high knowledge of price (91.70%), and of promotion (81.65%), while knowledge of place and product were at moderately levels (70% and 68.75%, respectively). Considering the attitude, the farmers had high level of attitude towards marketing innovation (80%). Interestingly, they strongly agreed on price (\bar{x} = 4.37), but they agreed on product (\bar{x} = 3.98), and on promotion (\bar{x} = 3.64). However, the farmer's attitude towards place was undecided (\bar{x} = 3.47).

Keywords: organic rice, marketing innovation, farmer's knowledge, farmer attitudes

Nano-particles from *Chaetomium lucknowense* to Inhibit Rice Blast Pathogen caused by *Pyricularia oryzae* in Pot Experiment

Song, J. J.¹, Soyong, K.¹, Kanokmedhakul, S.² and Kanokmedhakul, K.²

¹Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand, ²Department of Chemistry, Faculty of Science, Khon Khan University, Khon Khan, Thailand.

Corresponding Author: missongjiaojiao@gmail.com

Nano-particles derived from *Chaetomium lucknowense* proved to be antagonized *Pyricularia oryzae* causing rice blast disease var. RD57. Result showed that nano-ECL, nano-MCL and nano-HCL expressed antifungal activities against *P. oryzae* (rice blast disease) at the ED₅₀ values were 82, 114, 181ppm, respectively. In pot experiment, the nano-CL gave significantly better to control rice blast than the chemical fungicide (Tricyclazole) in rice var. RD57. Rice blast disease showed that nano-CL gave the highest reduction of 54 %, when compared to the chemical fungicide that the disease decreased 29.26 %. Application of nano-CL gave the highest plant strands of 87.62 cm when compared to Tricyclazole (74.91 cm). Nano-particles from *Ch. lucknowense* is being developed to be nano-elicitors for plant immunity.

Keywords: Chaetomium, nano-particles, rice blast

A Survey of Nematode Disease Infecting Arabica Coffee Plants in the Northwestern Vietnam

Thiep, N. V.¹, Soyong, K.², Oanh, N. T. K.³, Hung, P. M.⁴

¹Biotechnology and Protection Department, NOMAFSI, Vietnam; ²Biocontrol Research Centre, Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: nvthiep30@hotmail.com

Arabica coffee is one of the most important crops grown in Northwestern Vietnam. The growing area is estimated to be 20,000 ha, accounting for approximately 40% of Vietnam's Arabica coffee area, and it mainly distributed in Son La and Dien Bien provinces. The climate and elevation of those areas are suitable for growing Arabica coffee. Especially, the coffee is recognized as one of the high quality in the world trade. However, Arabica coffee cultivation in this region is threatening by nematode disease, causing leaf fall, twig dieback, dry fruit and leading to reduce productivity. In this study, 85 soil samples, which taken from infected arabica coffee orchards in the northwestern provinces (Son La and Dien Bien provinces), were investigated. Using Whitehead tray and Baermann funnel method for isolation active nematodes from soil, we found that 94.45% and 83.33% of soil samples taken from Son La and Dien Bien, respectively, were infected with nematodes. In Son La soil samples, the population density were 40.54 nematodes per 100 gram of soil. Meanwhile, the population density of nematode in Dien Bien samples was 31.20 individuals per 100 gram of soil. Furthermore, all found nematodes were parasitic movement species.

Keywords: Arabica coffee, nematode diseases

Advanced Research and Development of Biological Products as Agricultural Inputs for Organic Agriculture

Soytong, K.

Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Chalongkrung Road, Bangkok 10520, Thailand.
Corresponding Author: ajkasem@gmail.com

Biological products have been investigated to be the agricultural inputs for organic agriculture. The commercial scale of organic agriculture as follows:- Bio-fertilizer consists the potent isolates of fungi producing enzymes eg. cellulase, amylase, protease and ligninase to stimulate composting processes and degrade organic matter and nutrients, including fungi degrading rock phosphate and potassium feldspar to get available forms for plant absorption. The bio-fertilizer contains many growth stimulating enzymatic fungi. Bio-decomposer is a powder or liquid formulations used to produce compost. It consists several enzymatic. Ketomium is as a new broad spectrum biological fungicide that mixing 22-strains of *Chaetomium cupreum* and *C. globosum*. It produces antibiotic substances to inhibit plant pathogens. It is compatible for mixing with selected chemical pesticides. Microbial elicitors for plant immunity is developed to induce immunity in plants eg inducing phytoalexin in chili against anthracnose and in tomato proved to produce phytoalexin against. It has been tested to inhibit pathogen inoculum. Metarhizium and Beauveria-bioinsecticide is formulated in liquid formulation and used to repellent some insect pest. Bio-nutricrop for plant growth is a liquid formulation with a high quality of organic food base to promote plant growth. It consists of photosynthesizing bacteria. It is high amino acids and high levels of nitrogen in organic forms which are nutrients for plant growth including microorganism which play the role of bio-decomposer and bio-stimulator for plant growth. The application rate is 10 g/20 liters of water spraying into soil and above plants. Bio-nutrifood for increasing yield:- It is developed in powder formulation with high natural potassium incorporate with photosynthesizing bacteria.

Keywords: Agricultural inputs, organic agriculture, biological products

Session 2: PLANT AND FOOD TECHNOLOGY

Improvement Antimicrobial Activity of Wool Fibers Dyed with Natural Dyes Extracted from Onion and Red Prickly Pear using Propolis Nanoparticles

Ali, N. F.^{1*} and EL-Mohamedy, R. S. R.²

¹Dyeing and printing department, National Research Centre, 12421-Dokki, Cairo, Egypt; ²Plant pathology department, National Research Centre, 12421-Dokki, Cairo, Egypt.
Corresponding Author: aali_04@hotmail.com

Nanotechnology provides a new concept for improvement the antimicrobial activity of the textile fibers. Natural dyes extracted from red prickly pear and red onion peels using microwave heating were used for dyeing wool fibers. Chitosan and propolis nanoparticles were applied as treatment of wool fibers before dyeing using microwave and ultrasonic methods. Dyes concentration and pH factors, color strength, color data and fastness properties of the dyed wool fibers were investigated. The results obtained indicated that wool fibers pretreated with the tested nano materials exhibited higher results than the untreated. Nanoparticles (NPs) of chitosan and propolis show antimicrobial activity against some pathogenic fungi and bacteria. The results obtained indicated that the antimicrobial activity for natural dyes under investigation were good and enhanced by treatment with chitosan and propolis NPs. The morphologies structure of the untreated and pretreated wool fibers were examined by scanning electron microscopy (SEM). The untreated wool fibers have a rough surface. The pretreated wool fibers were swelling compared to the untreated fibers. The diameter of the fibers increased and has smooth and even surfaces. The changes in the surface morphology due to the effect of pretreatment with and nano chitosan and propolis.

Keywords: nano chitosan, propolis, red prickly pear, red onion peels, natural dye, antibacterial activity

Effect of Preharvest Chitosan Application on Bioactive Compounds of Sunflower Sprouts During Storage

Supapvanich, S.^{1*}, Chimsoontorn, V.¹, Anan, W.¹, Boonyarittongchai, P.², Tepsorn, R.³ and Techavuthiporn, C.⁴

¹Department of Agricultural Education, King Mongkut's Institute of Technology Ladkrabang, Ladkrabang, Bangkok, Thailand; ²Postharvest Technology Program, School of Bioresources and Technology, King Mongkut's University of Technology Thonburi, Bangkhuntien campus, Bangkhuntien, Bangkok, Thailand; ³Department of Food Science and Technology, Faculty of Science and Technology, Thammasat University, Rangsit Center, Klong-Luang, Pathumthani, Thailand; ⁴Food Science and Technology Program, Faculty of Science and Technology, Hau-Chew Chalermprakiat University, Bangpree, Samutprakran, Thailand.
Corresponding Author: suriyau.su@kmitl.ac.th

The effects of preharvest chitosan treatments on antioxidant activities and bioactive compounds of sunflower sprouts during cold storage were investigated. The sprouts were watered with 0, 0.1, 0.5 and 1.0 % (w/v) chitosan solutions prior harvest 24 hr. After harvest, the sprouts were stored at 4 ± 1 °C for 9 d. The investigated parameters were visual appearance, antioxidant activities such as ferric reducing antioxidant potential (FRAP), DPPH radical scavenging (DFRS) activity and bioactive compounds including total phenols, flavonoids and ascorbic acid concentrations. The visual appearance of the sprouts of all treatments was maintained during storage at 4 ± 1 °C for 9 d. Preharvest chitosan treatment enhanced antioxidant and DFRS activities, total phenols, flavonoids and ascorbic acid contents of the sprouts, especially at 0.1 % chitosan. During the storage, 1.0 % chitosan treatment induced FRAP, DFRS activity and all bioactive compounds rather than others treatments. These suggest that preharvest chitosan treatment is an effective alternative improving nutritional quality of the sunflower sprouts during cold storage.

Keywords: antioxidants, bioactive compounds, chitosan, sunflower sprouts

Application of Advance Oxidation Process Combination with Fine Bubble Technology on the Reduction of Escherichia Coli O157:H7 Contaminated on Bird Eye Chili (*Capsicum frutescens* L.)

Pimrat, T., Lilitsajja, P. and Tepsorn, R.

Department of Food science and Technology, Faculty of Science and Technology, Thammasat University (Rangsit Centre), KlongNeung, KlongLueng, Phathumthani, 12121, Thailand.
Corresponding Author: rtepsorn@tu.ac.th

Nowadays there are continuously increasing worldwide concerns for development of alternative microbiocidal inactivation. In this context, Advance Oxidation Processes (AOPs) are considered a highly competitive technology for the elimination of contaminated microorganism due to their high chemical stability and low biodegradability. In addition, the novel technology, as known bubble technology, has been applied for food washing to reduce the contaminated microorganism on food. This work aims to access the effectiveness of UV/O₃ in AOP system combination with Fine bubble technology (FB) for the reduction of *E. coli* O157:H7 contaminated on Bird Eye Chili (*Capsicum frutescens* L.). A batch-type prototype of the UV/O₃ and FB generator treatments were constructed. Consideration the antimicrobial effectiveness of individual technique, the results indicated that the population of *E. coli* O157:H7 was reduced as 96.36% within 10 minutes when UV were applied. In case of the O₃ applications, the results demonstrated that O₃ provided 97.18% reduction within 10 min. The application of AOP, UV/O₃ system, it can be found that the use of AOP provided 98.62% reduction of *E. coli* O157:H7. This finding knowledge indicated that AOP with UV/O₃ system presented the more antimicrobial potential than the use of UV or O₃ alone. The studies of FB with or without AOP on the microorganism elimination were also conducted. FB alone processed contamination reduction of *E. coli* O157:H7 at 96.53% reduction. The combination with AOP demonstrated 98.05% reduction. The use in dynamic assist process, 99.96% reduction was observed. Furthermore, applying AOP with FB technology in dynamic assist process did not affect the quality of Bird Eye Chili after washing process. It was indicated the use of UV/O₃ as AOP combination with FB technology in dynamic assist process could be applied for microbial contamination reduction on fresh produces.

Keywords: Advance oxidation process, Ultraviolet, Ozone, Fine bubble technology, Escherichia coli O157:H7, *Capsicum frutescens* L.

Effects of Microbial Fermented Liquid (MFL) Supplementation on Gas Production Kinetics and Digestibility using In-vitro Gas Production Technique

Nampukdee, R.¹, Polyorach, S.^{1*}, Wanapat, M.², Kang, S.³, Cherdthong, A.², Gunun, P.⁴, Gunun, N.⁵ and Sitthigripong, R.¹

¹Department of Animal Production Technology and Fisheries, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; ²Tropical Feed Resources Research and Development Center (TROFREC), Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand; ³Agricultural Unit, Department of Education, National Institute of Education, Phnom Penh, Cambodia; ⁴Department of Animal Science, Faculty of Natural Resources, Rajamangala University of Technology-Isan, Phang Khon, Sakon Nakhon, Thailand; ⁵Program in Animal Production Technology, Faculty of Technology, UdonThani Rajabhat University, UdonThani, Thailand.
Corresponding Author: nampukdeerutsamee@gmail.com

The objective of this study was to determine the effects of microbial fermented liquid (MFL) supplementation on rumen fermentation and digestibility of dairy steer using in vitro gas production technique. Two males, rumen fistulated dairy steers were used as rumen fluid donors. The treatments were arranged according to a 2x4 factorial arrangement in a completely randomized design (CRD). Factor A was 2 levels of source of microbes (yeast (Y) and microbial fermented liquid (MFL)) and factor B was 4 levels of supplementation (0, 10, 20 and 30 % of concentrate). It was found that the intercept value (a) and IVDMD and IVOMD have interaction ($p < 0.01$) between microbial source and supplement levels, while, supplement levels effected the insoluble fraction (b), microbial source affected on b, potential extent of gas production (a+b) and cumulative gas production at 96 h and IVOMD. Moreover, supplementation of YFL with 20 % of concentrate were the highest ($p < 0.05$) of b, c, a+b, cumulative gas production at 96 h, IVDMD and IVOMD. In conclusion, supplementation of MFL could improve nutritional digestibility and a possible increased productivity in ruminants.

Keywords: microbial fermented liquid (MFL), yeast, rumen fermentation, digestibility, *in vitro* gas production

Millets-21st Century Climate Resilient Nutricrop

Patro, T. S. S. K., Meena, A. and Divya, B. S.

All India Coordinated Small Millets Improvement Project, Agricultural Research Station, Vizianagaram-535001, Andhra Pradesh, India.
Corresponding Author: drsamuelpatro@gmail.com

Millets are the one of the oldest foods known to humans and possibly the first cereal grain to be used for domestic purposes. Millet grain is the basic foodstuff for farm households in the world's poorest countries and among the poorest people. Today, millet ranks as the sixth most important grain in the world. Millets being less expensive compared to other cereals and the staple for poorer section of the population. Fortification of millets is a cost-effective method that can be exploiting the deficiency and it is a feasible strategy to enhance the intake of fortified millet products. In most parts of the world, millet is grown as a subsistence crop for local consumption. Commercial millet production is risky, especially in Africa, because the absence of large market outlets means that fluctuations in output cause significant price fluctuations, particularly in areas where millet is the main food crop. Apart from grain production, millet is also cultivated for grazing, green fodder or silage. Like other cereals, sorghum and millets are predominantly starchy. The protein content is nearly equal among these grains and is comparable to that of wheat and maize. Finger millet contains the lowest fat. One of the characteristic features of the grain composition of millets is their high ash content. They are also relatively rich in iron and phosphorus. Finger millet has high fibre content and the highest calcium content among all the food grains. Differences in grain composition in genotypes of millets have been reported. In finger millet, the value ranges reported are protein, 5.8 to 12.8 percent; fat, 1.3 to 2.7 percent; total ash, 2.1 to 3.7 percent; and carbohydrate 81.3 to 89.4 percent. Variations in the mineral content of these varieties were also large. Differences in the protein and mineral composition of finger millet hybrids have also been reported. Millets are miles ahead of rice and wheat in terms of their mineral content, compared to rice and wheat. Each one of the millets has more fibre than rice and wheat. Finger millet has thirty times more calcium

than rice while every other millet has at least twice the amount of calcium compared to rice. A study has been carried out and was found to be millet is the only grain able to supply experimental animals with all the essential amino acids and vitamins when fed as the exclusive food. When cooked a mucilaginous substance rises to the surface of millet. It appears that this substance has some healing action in cases of gastrointestinal inflammation and ulceration. Fortification may be the cheapest, easiest and best way to combat micro nutrient deficiencies which is the major problem facing in our country like India. Millet being less expensive compared to other cereals and staple food for the downtrodden people could be chosen as the best vehicle for fortification. Micronutrients such as iron, zinc, calcium and vitamins can be used as fortificants in millets. Millets such as finger millet, pearl millet, barnyard millet are some of the millets that are used in various food items. It is also one of the most nutritious cereal among the various crops. Fortification of millet flours with iron might be beneficial in combating iron deficiency. A study has showed that a discoloration was perceived in the dumplings prepared from the same flours where as the overall quality of items like roti prepared was acceptable to the sensory panelists. Finger millet and sorghum flours seem to be suitable as vehicles for fortification with iron. Millets are highly nutritious and has antioxidant properties which provide balanced nutrition. Pearl millet consists of secondary metabolites like tannins, flavonoids, terpenoids, glycosides, phenol and steroids. Based on its pharmacological properties, it can cure several health problems like cancer, diarrhea and cardiovascular diseases. Also finger millet is considered as one of most important minor millet, due to its high nutritional content which includes calcium, iron, magnesium, potassium, zinc. Calcium present in the finger millet is higher than the other nutrients and when compared to rice, finger millet is rich in protein, iron content and other medicinal properties. Keeping all this points in view millets are considered as a miracle grains or magic grains.

Keywords: Millets, fibre, fortification, antioxidant

The Utilization of Ultrasound and Chilling Treatment to Reduce GI in Thai Glutinous Rice (RD6)

Kunyane, K. and Luangsakul, N.*

Faculty of Agro-Industry, King Mongkut's Institute of Technology Ladkrabang, Bangkok, 10520, Thailand.

Corresponding Author: naphatrapi.lu@kmitl.ac.th

The source of carbohydrate of Thais in the North and North-Eastern area are predominantly based on glutinous rice which has high glycemic index (GI75-92). Lower GI glutinous rice was the interesting prospect to be developed for diabetics. There have been the modification methods to reduce GI by limits the accessibility of the digestive enzymes on starch molecule. The most common physical modification method used for reducing GI on starch were hydrothermal and gelatinization-retrogradation methods. Ultrasound is the sound wave at frequency exceeding audible threshold of the human hearing range. It has been studied on starch to change the molecular structure for improving some physicochemical properties. Therefore, this study focused on the utilization of ultrasound and chilling treatment to reduce GI in Thai glutinous rice (RD6). The glutinous rice was treated with ultrasound for 15 and 30 min and amplitude at 40, 70, and 100%. Then, all of the ultrasound-treated rice was stored at 4 °C for 24 h. Then, they were analyzed on the ratio crystalline to amorphous by FTIR, thermal properties by DSC, RVA pasting properties, and GI. With increasing time and amplitude of ultrasound, the ratio of crystalline to amorphous decreased from 0.779 to 0.662. The onset temperature and enthalpy (ΔH) decreased from 62.38 to 58.10 °C, and 1.81 to 0.70 J/g, respectively. The peak viscosity, and final viscosity from RVA increased from 3079 to 3838.67 cP and 2407.33 to 2922 cP, respectively. When increasing time and amplitude of ultrasound, the hydrolysis index (HI) and eGI slightly increased with longer time and higher amplitude. The chilled samples after ultrasound treatments showed that the ratio of crystalline to amorphous, and ΔH increased while HI and eGI decreased compared to unchilled ultrasound treated rice.

Keywords: glutinous rice, ultrasound treatment, chilling, and glycemic index

Appropriate Technology for Hom Kradung Nga Rice Production in Bacho Swamp

Ruchirasak, M. and Kaewchai, S.

Faculty of Agriculture, Princess of Naradhiwas University, Thailand.
Corresponding Author: mruchirasak@gmail.com

Hom Kradung Nga rice was grown in Bacho Swamp in Narathiwat province, Thailand in 2 seasons to study (1) the feasibility of throwing method for rice production compare to transplanting method in 2013/14 cropping season and (2) the feasibility of ratoon rice production in 2014/15 cropping season. The results showed that grain yield of the rice grown in degraded *Melaleuca* spp. forest land in Bacho swamp by both methods of throwing and transplanting were not significant difference. Throwing method is suitable for inadequate labour situation but some cultural practices to reduce unfilled grains are necessary to improve the rice yield. In case of having enough labour, transplanting method is the appropriate technology for growing rice in this area. If irrigation can be done to control water level in a period of transplanting, intensive method or using one seedling for transplanting could lead to more grain yield. On the other hand, ratoon rice cannot be done for Hom Kradung Nga rice production in Bacho swamp in Narathiwat province.

Keywords: Hom Kradung Nga, throwing method rice production, ratoon rice, Bacho swamp

Effect of Various Ethephon Concentrations on Flowering, Yield, Costs and Returns of Productions of Four Pineapple Varieties

Wiangsamut, B.* and Koolpluksee, M.

Division of Crop Production and Landscape Technology, Faculty of Agro-Industrial Technology, Rajamangala University of Technology Tawan-Ok Chanthaburi Campus, Chanthaburi, Thailand.
Corresponding Author: timbancha@yahoo.com

Yields of ETP₅ (mixture of ethephon and urea fertilizer (12.5 ml to 400 g and dissolved in 20 L water = 60 ml/sucker/time) was poured on top of the sucker for one time. Battavia and ETP₆ [a mixture of ethephon and urea fertilizer (12.5 ml to 400 g dissolved in 20 L water = 60 ml/sucker/time) was poured on the top of the sucker for two times; 5 days interval. Phechaburi1 were higher than those of the rest, mainly due to the highest fruit weight and fruit height. ETP₅ and ETP₆ yielded significantly higher than those of the rest because of the significantly higher fruit weight and fruit height. Battavia gave the significantly highest yield, fruit weight, and fruit height; followed by Phechaburi 1, Phuket, and MD2, respectively. The total cost of production under the six ethephon concentration levels applied was similar; but benefits derived from each concentration levels were noticeably different due to the different yields obtained. ETP₆ was the best concentration as it gained the highest returns.

Keywords: Pineapple, Battavia, benefit-cost-ratio

Effect of Indigenous Microorganism Extended Solution (IMO-ES) on Basmati Rice

Sanchez, R. G.¹, Barrientos, D. S.^{1*} and Galindez, J. L.²

¹Department of Crop Science, College of Agriculture, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines; ³Ramon Magsaysay Center for Agricultural Resources and Environment Studies, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines.
Corresponding Author: dioniebarrientos@clsu.edu.ph

The findings showed that application of 1L per ha of Indigenous Microorganism Extended Solution (IMOES) every four weeks in Basmati rice has significantly improved the plant height, productive tiller that results to higher panicle and also improved the yield components such as number of filled grains per panicle, total grain yield per panicle, grain length and harvest yield per hectare. Application of IMO-ES once a month in rice plant to supply nutrients for growth and yield showed significant interaction indicating appropriate frequency application of IMO-ES is needed.

Keywords: Basmati rice, Indigenous Microorganism Extended Solution, yield components

Effect of Potassium Chlorate combining with Paclobutrazol, Monopotassium Phosphate and Mepiquat Chloride on Fruit Quality of Longan (*Dimocarpus longan*)

Loetchai, C.¹, Werawat, K.¹, Tana, S.¹, Wikanya, P.¹, Matta, F. B.²

¹Faculty of Agricultural Technology, Rambhi barni Rajabhat University, Thailand; ²Department of Plant and Soil Science, Mississippi State University, USA.

Corresponding Author: loetchai151980@hotmail.com

The effect of potassium chlorate combining with paclobutrazol, monopotassium phosphate and mepiquat chloride on fruit quality of longan was investigated. Treatments were potassium chlorate (control), potassium chlorate + paclobutrazol (PP), potassium chlorate + monopotassium phosphate (PM) and potassium chlorate + mepiquat chloride (PMC). The potassium chlorate was sprayed on 16 longan trees and the other chemicals were sprayed after potassium chlorate for 7 days. The results were not significant differences in the fruit width, fruit length, fruit fresh weight, fruit dry weight, peel thickness, pulp thickness, pulp firmness and sweetness among treatments. However, the sprayed chemicals did not reduce fruit quality of longan.

Keyword: longan, potassium chlorate, paclobutrazol, monopotassium phosphate, mepiquat chloride, fruit quality

Efficiency of Salicylic Acid Immersion Using Fine-Bubble Technique on Quality of Musa AAA Fruit During Ripening

Anuchai, J.^{1*}, Chumthongwattana, M.¹, Tepsorn, R.² and Supapavnich, S.¹

¹Department of Agricultural Education, Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; ²Department of Food Science and Technology, Faculty of Science and Technology, Thammasat University, Rangsit Center, Pathumthani Province, Thailand.

Corresponding Author: jatuporn.an@kmitl.ac.th

To determine the physiological quality and bioactive compound in changes of banana (*Musa* AAA) fruit, we used 2 mM salicylic acid solution with 2 different methods. Dipping (SAD) and immersion using fine-bubble technique (SAF) with 2 different period of time (15 and 30 minutes) were used. Peel color, fruit firmness, total acidity (TA), antioxidant, total phenol and total flavonoid were investigated. The result showed that banana treated with SAF for 15 minutes maintained lightness (L*) and yellowness (b*) of peel color. In term of fruit firmness, there were not significantly different among the treatments. After 4 days of color break, banana treated with SAF for 15 minutes also resulted in high TA, antioxidant and total phenol. While SAF for 30 minutes resulted in high total flavonoid contents. We conclude that SAF technique can maintain and strengthen physiological quality and bioactive compound changes of banana (*Musa* AAA) fruit during ripening.

Keywords: Fine-bubble technique, *Masa* AAA, Postharvest quality, Salicylic acid

Morphology and Anatomy of Rose Wood (*Dalbergia cochinchinensis*) and Relationship between its Elemental Components and Soil Properties for Identification of Endemic Species

Sriudorn, N.¹ and Benchawattananon, R.^{2*}

¹Graduate Forensic Science, Faculty of Science, Khon Kaen University, Khon Kaen, Thailand; ² Integrated Science, Forensic Science Faculty of Science, Khon Kaen University, Khon Kaen, Thailand. Corresponding Author: rachadaporn@kku.ac.th

Dalbergia cochinchinensis or rosewood is an important plant listed in the Appendix II of CITES. There are found in 15 of 20 provinces in northeastern Thailand. In response to its higher value and demand, international trade is great and lead to dramatically increase to illegal logging. Lost of rosewood is about 20% in the past 6 years. There are 3,280 cases of criminal acts and offenses of 2014, evidence of the rosewood 31,935 logs or 2,727,939 m³ cost 719,159,550 million baht. There are smuggling rosewood criminal acts cross over Thailand, Laos and Cambodia. This research aimed to study rosewood and surrounding soil of rosewood trees from various sources, including Thailand, Laos, Cambodia, and to determine morphology and anatomy of rose wood and relationship between its elemental components and soil properties for identification of endemic species. The elemental compositions of the soil and wood samples were analyzed using FTIR, SEM-EDX, and SEM-EDS. The relationship between the elemental components of rosewood trees and soil properties was established using PCA. The result found the different pattern of graph of FTIR: Cambodia has unique than Laos and Thailand. The leaf and bark of rosewood and soil from the result by SEM-EDX, and SEM-EDS have different pattern which each country. The different soil, humidity and sun light have effect on the morphology and anatomy in plant. The results of the study can be used as a basis planning for surveillance or prevent illegally logging of rosewood or used as a basis for investigation in the case of illegally logging of rosewood.

Keywords: *Dalbergia cochinchinensis*, illegal logging, Cambodia, Laos, Thailand

Development of Ca and Si Nanofertilizer from Agricultural Waste for Enhanced Rice Crop Production

Eselante, L. B.^{1*}, Maatal, A. G.¹, Monserate, J. J.² and Sarong M. M.²

¹Department of Crop Science, Central Luzon State University, Philippines; ²Physical, Inorganic, Material Science (PIMS), Central Luzon State University, Philippines. Corresponding Author: malousarss@gmail.com

Agricultural wastes such as rice husks and egg shells can be converted into high value novel materials nano-Silica (nSi) and nano-Calcium oxide (nCaO) which can be used as foliar fertilizer for rice. Thus, this study aimed to synthesize, characterize and evaluate the effectiveness of nano-structured foliar fertilizer (NSFF) on the growth and yield of irrigated rice. Nano-silica (nSi) was synthesized from rice husks using "optimum precipitation condensation" method and nano calcium oxide (nCa) from chicken eggshells using optimized carbonization precipitation method. Six fertilizer combinations: control, NSFF (FAA-nCa-nSi thrice), RRIF (Full Recommended Rate of Inorganic Fertilizer), ½ RRIF+NSFF twice, ½ RRIF+NSFF thrice, and RRIF + Commercial K Silicate thrice was conducted in the field arranged in RCBD. Characterization of nSi and nCa through SEM micrographs revealed that the synthesized nSi was less than 30 nm, while XRD analysis of revealed to have a broad peak at 2θ= 21°-22° indicating that the synthesized silica nanoparticles is amorphous. XRD analysis confirmed the purity of nano-calcium oxide. SEM analysis of nCaO revealed that the shape of particles was semi-hexagonal which confirmed its crystallinity. Nano-structured foliar fertilizer combined with RRIF improved plant height, number of tillers per hill, number of productive tillers over the RRIF-treated plants while grain yield and harvest index are at par with RRIF. NSFF can be a good supplement to inorganic fertilizers which can promote synergistic effect with lowland irrigated rice.

Keywords: FAA, Nano-Structured Foliar Fertilizer, Nano-Silica, Nano-calcium oxide

Effect of Wheat Flour Replacement with Durian Seed Flour on the Quality of Egg Noodles

Waritchon, N. *, Kunlaporn, P. and Jiraporn, S.

Faculty of Agricultural Technology, Rambhai Barni Rajabhat University, Thailand
Corresponding Author: waritchon_n@hotmail.com

The objective of this research was to investigate the effect of partial replacement of wheat flour with durian seed flour (DSF) (0-50% w/w) on quality of egg noodles. Results showed that the addition of DSF led to increase its fat, fiber and ash contents, which the sample containing 50% DSF had the highest of all samples. Whereas the moisture and protein were decreased as the percentage of DSF was increased. In the hardness and adhesiveness, the noodle containing 50%DSF had the highest hardness and lowest adhesiveness, as same as the cooking time was increased as the DSF increased. The sensory evaluation demonstrated that noodles containing DSF received the high score at 10-20%. The average value showed no significant difference ($p>0.05$) on taste and overall when compared with control. This research shows that DSF can be a useful replacement of wheat flour for production of egg noodles.

Keywords: Durian, Durian seed flour, egg noodle

Session 3: MICROBIAL BIOTECHNOLOGY, BIODIVERSITY, TAXONOMY, BIOLOGICAL ACTIVITY

Development and application of biotechnological products for sustainable corn and soybean production under stresses condition

Haggag, M. Wafaa

Plant Pathology Department, National Research Centre, Dokii 12622, Giza, Egypt.
Corresponding Author: wafaa_haggag@yahoo.com

The object of the research was to increase the productivity of strategic crops as corn and soybean grown in new reclaimed region and reduce their losses causes by biotic and abiotic stresses using biotechnological products of *Rhodotorula glutinis*, *Paenibacillus polymyxa*, *Bacillus subtilis*, *Pseudomonas putida*, *Pseudomonas aeruginosa*, *Trichoderma spp* and *Marin actimycete*. So, we modified bioproducts by formulated in natural components to improve the plant resistance to both biotic stress as diseases and environment stress, climate change and increase yield productivity. Kaolin clay and Bentonite formulation (1 :1) was more effective as formulation in all microorganisms that viability and stability were high till 12 months . Our experiments showed that under stress condition, bio-products reduced diseases incidence significantly of all crops, whereas *P. putida* and *P. polymyxa* showed significant potential against all diseases as well as increased yield of three crops in both regions i.e. Sahl El Tena and Bohera . *Pseudomonas putida* and *P. polymyxa* also were more effective in increasing total phenols, peroxidase, chitinase and total soluble protein. Using modified formulations of bio elicitors as kaolin and bentonite, gives possibility to provides guarantee to obtain ecological pure products.

Keywords: Corn, Soybean , Biotechnological products, Stresses

Studies on Fungal Diversity of Coastal Region in Zhejiang Province and Fungal Resource Exploitation

Basiboyana, A.^{1*}, Wang, H. K.¹, Lin, F. C.¹, Li, P. D.¹

¹Institute of Biotechnology, Zhejiang University, Hangzhou 310058, P. R. China.

Corresponding Author: 0617101@zju.edu.cn

This study assessed the diversity and distribution of fungal communities in different coastal areas of Zhejiang province in China. Samples were collected from coastal areas of three sampling stations (Nigbo city, Sanmen city & Wenzhou city) during October 2017 and stored in sterile polythene bags for further analysis. Phenotypic and genotypic characterizations of fungal isolates were done using standard techniques. Fungal communities showed high diversity in different stations belonged to the 62 Ascomycota, 7 Basidiomycota, 2 Mucoromycota, and 7 unknown fungi. The major known orders were included. The common fungal genera were *Pichia*, *Fusarium*, *Alternaria*, *Aspergillus*, *Penicillium*, *Cladosporium* and *Yeast* was isolated. The fungal genera isolated from coastal areas showed 98-100% similarity with the related fungi recorded in gene bank in which they were deposited. The samples were examined by spread plate method in Potato Dextrose agar medium. These results suggest the existence of diverse fungal communities in the coastal areas, which may serve as a useful community model for further ecological and evolutionary study of fungi in the different coastal areas. The species richness and diversity of fungi at three sampling stations were determined using Shannon and Simpson indices. There is no uniformity in the diversity of fungi and their distribution pattern in different geographical regions. Most of these fungal isolates exhibited considerable production of extracellular enzymes like cellulase, lipase, protease and laccase. Fungi exhibits a wide diversity of forms also represent by functional diversity and play such a dominant role in human society that they are sustainably, biotechnologically the most important group of organisms. The adaptation of coastal fungi in an extreme environment recommends that they are promising sources for screening secondary metabolite products.

Keywords : Molecular diversity, Zhejiang province (China), Fungi, Species richness, fungal diversity, Fungi exploitation

Antioxidant and Antityrosinase Activities in Germinated Brown Rice of Indigenous Thai Cultivars

Sangsil, A.^{1*}, Promden, W.¹ and Pimda, W.²

¹Division of General Science, Faculty of Education, Buriram Rajabhat University, Buriram 31000, Thailand; ²Faculty of Sciences and Liberal Arts, Rajamangala University of Technology Isan, Nakhon Ratchasima 30000, Thailand.

Corresponding Author: sangsi.a19@gmail.com

This study was undertaken to examine the antioxidant and antityrosinase activities in germinated brown rice of three indigenous Thai cultivars, namely Riceberry (purple), KDML 105 R-PSL-2 (red) and KDML 105 (white), which are grown in Buriram province of Thailand. Germination was induced by steeping brown rice of each cultivar in distilled water (water: grain ratio = 2:1) at ambient temperature for 6 h. After low temperature induction at 8 – 10 °C for 24 h, the rice kernels were spread over a double-layered cotton cloth and allowed to germinate under dark conditions at room temperature for 0, 24 and 48 hr, in which the antioxidant and antityrosinase activities of germinated brown rice were determined. The results revealed that 24-hr soaking was most effective in maximizing the antioxidant and antityrosinase activities in germinated brown rice, with the highest contents of total phenolics, total flavonoids and antityrosinase detected in Riceberry (25.26%), KDML 105 R-PSL-2 (99.67%) and KDML 105 (12.92%), respectively. It was also found that germinated brown rice of all studied cultivars appeared to contain higher levels of antioxidant and antityrosinase activities than ungerminated brown rice. Additionally, there was a strong correlation between antioxidant activities, antityrosinase activities and germination time. This study had provided the foundation for future research aiming at the development of functional foods and additives.

Keywords: Antioxidants, Antityrosinase, Germinated brown rice, *Oryza sativa*

Agronomic and Grain Quality Characterization of Different Special Rice Genotypes

Astejada, M. P.^{1*}, Tapic, R. T.², Dela Cruz, Q. D.¹, Agustin, M. B.¹ and Garcia, F. C.²

¹Research Office, Central Luzon State University (CLSU), Science City of Muñoz, Nueva Ecija, Philippines. ²College of Agriculture, Central Luzon State University (CLSU), Science City of Muñoz, Nueva Ecija, Philippines.

Corresponding Author: belleastejada@gmail.com

Six special rice genotypes namely CL-1, Dujali Black, Porac-1, Blonde Red, Luna Red and CLH10-3-4 were evaluated to characterize their agronomic and grain quality trait that could be used by the plant breeders from selecting superior genotypes or as source of genetic variability that could be exploited for present and future breeding programs. The evaluation was undertaken during dry season (December 2016 to April 2017) and was done under irrigated lowland condition at the Research Experimental Station, Central Luzon State University. Different genotypes were laid-out in a Randomized Complete Block Design (RCBD) with three replications. It was revealed that most of the special rice varieties/lines were matured early (104-112 days). All varieties/lines were short to intermediate type (83.9-128.1 cm). More productive tillers were produced from Blonde Red (19 tillers). Longer panicle was measured from CL-1 with 26 cm. Likewise, highest percent spikelet fertility was recorded from Blonde Red (84.7%), Dujali Black (84.6%) and Porac-1 (84.1%). In terms of 1000 grain weight, Luna Red produced heaviest grains of 30.3 g. Grain yield was highest in Dujali Black (6.2 t/ha), CL-1 (5.9t/ha), Porac-1 (5.8t/ha) and Blonde Red (5.8t/ha). With respect to grain quality, CL-1 and CLH10-3-4 produced long-slender type of grains while Porac-1, Blonde Red, Luna Red and Dujali Black were identified with wider grains of 2.3, 2.3, 2.3 and 2.2 mm, respectively. In addition, all the varieties/lines had higher translucent grains. Milling recovery in terms of percent brown rice (76%), milled rice (70%) and head rice (35%) were highest in Blonde Red.

Keywords: agronomic, genotypes, irrigated lowland, special rice

Construction of ATMT Transformation System in *Cordyceps cicadae*

Wang, H. K.^{*}, Wang, X. Q. and Lin, F. C.

Department of Plant protection, Biotechnology Institute, Zhejiang University, Hangzhou 310058, China.
Corresponding Author: hkwang@zju.edu.cn

To establish highly effective transformation system in *Cordyceps cicadae*, H3 promoter and TEF promoter were amplified from genomic DNA of *Botryosphaeria kuwatsukai* to construct ATMA vector. A binary vector containing H3 promoters and TEF promoters fused with GFP and G418 gene cassettes were used for transforming. We confirmed that the vector were integrated into the genomic DNA of *C. cicadae* with high transformation frequency by ATMT method. Transformants can growth at PDA plate containing G418. GFP can strongly expressed in hyphae, conidia, germ tubers, but not in conidiphores when the transformants observed under fluorescent microscope. Southern blot results confirmed that the screening marker were inserted into the genomic DNA of *C. cicadae*. The stability of fungal transformation were analyzed on PDA plate containing G418 after five successive subcultures, result showed the transformants contained the inserted genes stably. Our system provides a powerful tool to explore molecular genetic studies on *C. cicadae* in the future.

Keywords: ATMT Transformation, *Cordyceps cicadae*, GFP

Bio Product

Kramarenko, A. and Sayfudinov, S.

AGRATEC Bio LLC, 377-3 , Boulevard Large, 42 Str 1the Territory of The Skolkovo Innovation Center, Moscow, 121205, Russia.

Corresponding Author: agratecbio@gmail.com

The project company AgraTek Bio LLC	
Project name:	Concentrated plant growth stimulator, immunomodulator, fungicide
Product description:	Bioactive soil is non-toxic, biologically active organosilicon compound possessing growth-stimulating, adaptogenic, antifungal properties (against root rot). The active substance was developed with the participation of leading Russian scientists on the basis of years of practical experience. The use of Bioactive soil provides the crop yields even under unfavorable and stressful conditions, guaranteeing the quality of the final product.
Classification:	Immunomodulator plants, growth stimulator.
Project description, properties, and mechanism of action of the product:	<p>Project stage: created a working prototype, a prototype drug</p> <p>Description of technology: the Drug with the properties of the inductor that can change the metabolism of plants towards resistance to biotic and abiotic stresses.</p> <p>Composition : organosilicon compound, dicarboxylic acid, humic acid, magnesium compound $[Mg(H_2O)_6]^{2+}$ (in .h. halogenide complexes of the type MX_4^-, where X – halide-anion; magyarkanizsa compounds $RMgX$), zinc sulfate, hydroxocuprate iron (II)/(III) $FeOHSO_4$, copper sulfate.</p> <p>Action:</p> <ol style="list-style-type: none"> 1. Pronounced growth stimulator (research data) Activates the life processes of plants and increases drought resistance, stimulates the growth area of the photosynthetic active leaf surface increases the number of productive ears from grain and fruit weight in fruit crops. 2. Immunomodulator The decrease in toxic/stressful effects of herbicides, prevent factor "herbicidal hole." 3. Fungicide. Non-Systemic Fungicide. Is expressed in decreasing the incidence of root rot in 2-2,2 times, in comparison with the control, also the stability of the sheet to some parasites-insects. The silicon contained in the drug, inhibits the plant invertase and acid phosphatase. In transpiration organs, such as sheet, silicon is localized in the epidermal cells, forming the double cuticular-silicon layer preventing the plants from excessive evaporation and penetration of the hyphae of the fungus, thus exhibiting fungizidnyi properties. Agroecological aspects of application of silicon compounds in plant protection is the reduction of pesticide load in agrocenoses , limit receipt of xenobiotics in environmental objects, increased plant tolerance to mutations. 4. Micronutrient fertilizers. The product contains all essential micronutrients in chelate form, for proper growth <p>Method of application:</p> <ul style="list-style-type: none"> - fertigation during the growing season <p>The drug allows you to:</p> <ul style="list-style-type: none"> - To increase the yield of vegetable, fruit, berry, grape and grain crops not less than 20-25%. - Reduction of pesticide load by 30-40%. - Reduction in the incidence of root rot by 50%. - Resistance of plants to frost and drought. - Improvement of soil structure
Sphere of application	Agriculture: vegetable growing (indoor/outdoor soil growing).
Competitive advantages	Concentrated product with the function of plant growth stimulator, immunomodulator, fungicide:

	<ol style="list-style-type: none"> 1. The drug provides a stable yield increase under conditions of biotic and abiotic stresses, and high and prolonged protective fungicidal effect (late blight, Fusarium, Alternaria) for solanaceous crops. 2. High concentration of active substances in the preparation is a balanced composition of micro - and macro-elements, in this case, the drug is not toxic (4th class). 3. Pronounced stimulating effect (from tomatoes increased root system min. 25%, the period of fruiting of tomatoes is increased, the average yield of potatoes and tomatoes above control 30% or more) 4. Low price 5. Consumption of the drug does not exceed 0,3-0,5 litres per 10, 000m² 6. The product is compatible with most pesticides used for plants and crops 7. The use of the drug allows to reduce the use of mineral fertilizers by 25%
The development stage of the project:	<p>Received prototype (samples)</p> <ul style="list-style-type: none"> - Conducted field tests on Solanaceae and cereals, grapes. -Prepared technical regulations, technical conditions for the organization of serial production

Isolation and Characterization of Keratinolytic Bacteria from Soil Samples of Poultry Waste Dumping Sites

Reyes, A.^{1, 2*}, Ambita, I. D¹, Batalon, J. L.¹, Aba, B. L.¹, Cortes, A.¹, Macabecha, C. G.¹ and Montecillo, A.¹

¹University of the Philippine Los Baños, College Laguna Philippines, 4031; ²College of Fisheries-Freshwater Aquaculture Center, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines.

Corresponding Author: alvinreyes1845@gmail.com

The study aimed to isolate, characterize and identify keratinolytic bacteria isolated from soil samples containing degrading feathers. Thirteen (13) bacterial isolates were selected and were subjected to preliminary screening through protease assay using Milk Agar Medium. Six (6) isolates were detected positive for protease activity and were further characterized via biochemical and microscopic assays. Isolates were grown in basal medium containing feathers as sole nutrient source and the degree of feather degradation was monitored. Two isolates exhibited conspicuous keratinase activity. DNA from these two candidate organisms were isolated and subjected to PCR using 16S rRNA specific primers. PCR products were sequenced and analysis revealed that both of them belong to *Bacillus cereus* species. Isolation of potential keratinolytic microorganisms could have potential biotechnological use especially in processes which involve keratin hydrolisis.

Keywords: Keratinolytic bacteria, soil, biochemical assays, *Bacillus cereaus*, 16S rRNA

Biological Activities of the Methanolic Extracts from Two Varieties of *Dimocarpus longan* Seeds

Natungnuy, K.¹, Chareonsap, P. P.² and Poeaim, S.^{1*}

¹Department of Biology, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL), Ladkrabang, Bangkok 10520, Thailand; ²Plant Genetic Conservation Project under the Royal Initiative of Her Royal Highness Princess Maha Chakri Sirindhorn, Bangkok 10303, Thailand.
Corresponding Author: poeaim@hotmail.com

Dimocarpus longan belongs to the Sapindaceae family from which two varieties are found in Thailand. In addition to commercial longan (*Dimocarpus longan* ssp. *longan* var. *longan*), there is another type of longan called Thao (*Dimocarpus longan* ssp. *longan* var. *obtusus*) this flora is found in the eastern part of Thailand. The aim of this study was to investigate various biological activities including the total phenolic content, antioxidant, antibacterial, anti-tyrosinase and cytotoxic activities of the methanolic extracts from 2 varieties of these longan seeds. The result showed the most of the activities of Edor seed extract presented higher biological activities than Thao seed extract. The total phenolic content by Folin-ciocalteu method related to antioxidant activity in DPPH, ABTS, and FRAP assay. In antibacterial activity using disc diffusion method both of extracts (5 mg/disc) can inhibit *Staphylococcus aureus*, *Micrococcus luteus*, and *Bacillus subtilis*. However, in anti-tyrosinase activity by the Dopachrome method Thao revealed similar activity to Edor with 50% inhibitory concentration: IC₅₀ values of 504.73 and 527.04 µg/ml, respectively. In cytotoxic activity using MTT assay with L929 (Mouse fibroblast cell line), Thao seed extracts are non-cytotoxic activity and also can stimulate these skin cell lines, while Edor showed low cytotoxic activity. Therefore, their bioactive compounds should be studied further for developing longan seed extracts to pharmaceutical products in the future.

Keywords: Antibacterial activity, Antioxidant activity, Anti-tyrosinase activity, Cytotoxic activity, *Dimocarpus longan*

Physicochemical Properties and Oxidative Stability of Oils from Samrong (*Sterculia foetida*) Seed

Chanyawiwatkul, J.¹, Supapavnich, S.¹ and Takeungwongtrakul, S.^{1*}

¹Department of Agricultural Education, Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.
Corresponding Author: sirima.ta@kmitl.ac.th

Somrong seeds consist of 5.91 ± 0.12% moisture, 2.80 ± 0.17% ash, 46.09 ± 0.44% fat, 11.68 ± 0.16% protein and 33.52 ± 0.07% carbohydrate. The crude oil was extracted from somrong seed using cold hexane. The oil from samrong seed contained 27.32% saturated fatty acid, 5.30% mono-unsaturated fatty acid and 55.95% polyunsaturated fatty acid. Gamma-linolenic acid (47.80%) was the dominant fatty acid, followed by palmitic acid (16.49%) and steric acid (10.45%). The physicochemical properties including color, viscosity, tocopherol content, total phenolic content, acid value, free fatty acids, peroxide value (PV), thiobarbituric acid reactive substances (TBARS) and p-anisidine value of seed oil were determined. When seed oil was stored at 30°C for 7 weeks, oxidative stability of seed oil was also examined. The seed oil had the increase in PV and TBARS within the first 5 weeks of storage ($P < 0.05$). Subsequently, a decrease in PV and TBARS were noticeable up to week 7 ($P < 0.05$). Thus, somrong seed could be used as a potential source of oil for industrial and cosmetic uses.

Keywords: Somrong seed, Oil quality, Fatty acid, Oxidative stability

Forest Litter Filamentous Fungi Inhabiting Different Elevations of Mt. Makiling, Philippines and Screening of Selected Isolates for Enzyme Activities

Mendoza, B. C.¹, Elayda, M. T. C.¹, Mapaapac, C. G. V.¹, Torres, K. A. R., Rostro, M. C. M.¹ and Dalisay, T. U.²

¹Microbiology Division, Institute of Biological Sciences, College of Arts and Sciences, University of the Philippines Los Baños, College, Laguna, Philippines; ²IWEP Cluster, College of Agriculture and Food Science, University of the Philippines, Los Baños, College, Laguna, Philippines.

Corresponding Author: bcmendoza@up.edu.ph

Mt. Makiling, a dormant volcano straddling the provinces of Laguna and Batangas in the southern part of Luzon Island in the Philippines, is one of the mountains subject to conservation efforts by both the local government units and the national government. It was declared as a Forest Reserve under Republic Act 6967 and is administered by the University of the Philippines. It has a peak height of only 1, 130 meters but its forest ecosystem provides a unique environment for a great diversity of species, including microbial. Among the lesser investigated microorganisms in Mt. Makiling are its filamentous fungal inhabitants. This study specifically aimed to determine the diversity of filamentous fungi along selected elevations of Mt. Makiling and to conduct an initial screening of selected mold isolates for pectinolytic and cellulolytic activities. Forest litter samples were collected from different altitudinal gradients of Mt. Makiling, particularly 100m and 200m at the bottom gradients, and 900m and 1000m at the top gradients. Isolated filamentous fungal genera were morphologically and culturally characterized, and identified to determine possible diversity patterns by elevation and potential agro-industrial significance. At least 15 genera have been identified. In a separate study, twentyfive filamentous fungi were also isolated from forest litter obtained at 160m and 260-265m elevations within the designated Mt. Makiling Forest Reserve Area. Phenotypic characterization and identification of the isolates were similarly conducted. When screened for selected enzyme activities, eight isolates exhibited pectinolytic activity in a Peanut Extract Pectin Medium while only one manifested cellulolytic activity in Carboxymethyl Cellulose Agar with Trypan Blue.

Dung Beetle Assemblages in Three Human-modified Landscapes in Northeastern Thailand

Paiboon, N.¹, Aroon, S.^{1*}, Thane, N.¹ and Jitpukdee, S.²

¹School of Biology, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand, ²Faculty of Science and Fisheries Technology, Rajamangala University of Technology, Trang, 92150, Thailand.

Corresponding Author: sarawee_777@hotmail.com

Dung beetles are good indicators of various terrestrial ecosystems. Their number and diversity usually associated with environmental factors. The aims of this study were to investigate dung beetle assemblages in degraded forest, plantation forest and agricultural land as well as their relationship with temperature, rainfall and soil properties. Each study area was set up by 18 bait pitfall traps once per month from October 2014 to September 2015. The results showed that a total of 3,634 dung beetles from 1 order, 1 family, and 10 genera were captured. The most common genus was *Copris* (35.14%), followed by *Onthophagus* (22.62%), *Heliocopris* (14.45%) and *Onitis* (14.42%), respectively. Most dung beetles were captured from agricultural land (1,653; 45.49%) followed by plantation forest (1,028; 28.29%) and degraded forest (953; 26.22%). The number of dung beetles was not different among seasons ($F = 3.126$, $df = 2$, $p > 0.05$). The highest number of dung beetles was found in summer followed by rainy season and winter, respectively. The number of dung beetles had positive correlation with temperature ($r = 0.73$, $p < 0.01$) and had negative correlation with soil potassium ($r = - 0.7$, $p < 0.01$). However, there were no relation between the number of dung beetles and rainfall, soil phosphorus, soil types, soil pH and organic matter.

Keywords: Dung beetle, diversity, degraded forest, plantation, farm, Thailand

Detection of Putative Bioactive Compounds and Minimum Inhibitory Concentration of *Imperata cylindrica* Extract Against Identified Seed-borne Fungi from Mung Beans

Aromin, J. H.¹, Dizon, I. C. *, Estanislao, A. M. and Tolentino, J. J.

¹Philippine Science High School – Central Luzon Campus, Lily Hill St., Clark Freeport Zone, Pampanga, Philippines.

Corresponding Author: icdizon@clc.pshs.edu.ph

Imperata cylindrica, commonly known as cogongrass, is an aggressive and invasive grass considered to be one of the world's worst weeds since it threatens the native species. This research aims to test the inhibiting property of the aqueous extract of cogongrass against two of the most common fungi isolated in *Vigna radiata* mung beans. This research is limited to evaluating the inhibiting activity of the extract against seed-borne fungi isolates viz. *Aspergillus flavus* and *A. niger* isolated from mung beans (*V. radiata*). Cold maceration technique and evaporation through rotary vacuum evaporator were subjected to the dried *I. cylindrica* leaves. One-point inoculation method in potato sucrose agar media was used for the inhibiting property test. Moreover, the detection of the putative bioactive compounds of *I. cylindrica* was done through Fourier Transform Infrared Spectroscopy (FTIR) analysis and qualitative phytochemical screening. The minimum inhibitory concentration (MIC) was recorded at 10% concentration, and the putative bioactive compounds identified were cardiac glycosides, flavonoids, saponins, and tannins. These bioactive compounds are said to inhibit fungal growth, which may have contributed to the antifungal property of cogongrass. Keywords: antifungal, mycology, phytochemical analysis.

Session 4: ANIMAL AND FISHERY SCIENCES

Effect of Artificial Feed and Algae on Growth Rate of *Spondylus* sp

Saetung, C.^{1*}, Hmunkaew, S.² and Nuldad, N.³

¹Department of Fisheries, Faculty of Agriculture and Natural Resources, Rajamangala University of Technology Tawan-ok, Chonburi 20110, Thailand; ²Department of Mathematics and Statistics, Faculty of Science and Technology, Rajamangala University of Technology Tawan-ok, Chonburi 20110, Thailand; ³Student Development Division, Rajamangala University of Technology Tawan-ok, Chonburi 20110, Thailand.

Corresponding Author: chongko_s@yahoo.com

Spondylus sp. or rock scallop or rabbit teeth shell (local name, because of a few prominent teeth in hinge) is native bivalve in Thailand. This species is classified in the Spondylidae family and also found in Colombia, Mexico and Gulf of California. The outer shell is rough, spiny and dark in color. The inner shell is white pearl. This spondylid is used in many ways and can be cooked into a variety of food. Currently, this shell is not cultured. It must be taken from nature and more natural catches every year, especially in the eastern part of Thailand. Because it has the potential to develop into an economic mollusc in Thailand so this study was conducted on the possibility of raising *Spondylus* sp. by using 3 different levels of artificial feed as 3 4.5 and 6 mg/l and 3 different species of algae as *Chaetoceros* sp., *Tetraselmis* sp. and *Thalassiosira* sp. under experimental conditions in wet laboratory for 4 months. The experimental design was 3x3x3 factorial in CRD. It was found that all groups had no significant difference in length and height ($P < 0.5$) after 4 months and had no significant difference in length and height when compared with the beginning of the experiment. In cases of survival rate, there were no statistically significant differences. Survival rates ranged from 83.3 to 100 percent, indicating that *Spondylus* sp. could be raising under indoor condition

Keywords: *Spondylus* sp., artificial feed, algae, growth rate, survival rate

Analyses of Body and Chest Morphometric Comparison between two Indonesian Local Poultry Species

Putranto, H. D.¹, Setianto, J. ¹, Yumiati, Y. ²

¹Department of Animal Science, Faculty of Agriculture, Universitas Bengkulu, Bengkulu, Indonesia;

²Agribusiness Study Program, Faculty of Agriculture, Universitas Dehasen Bengkulu, Bengkulu, Indonesia.

Corresponding Author: heri_dp@unib.ac.id

Indonesia is well known for its endemic fauna diversity including various poultry species, especially birds and local chickens. Sumatera island where Bengkulu province is located has varied endemic chickens such as balenggek chicken in West Sumatera, burgo chicken and Talang Benih duck in Bengkulu, and merawang chicken in Bangka Belitung. Burgo chicken is a cross mated species between male red jungle fowl and female kampung chicken. Unfortunately, an itemized morphometric studies to compare the size of its body part to its parental, kampung chicken, is not yet done until this present study was conducted. The research result found that female burgo chicken had a smaller values of morphometrical size on body weight, chest girth, and chest length compare to kampung chicken, except for its body length. Average of burgo chicken and kampung chicken body weight, body length, chest girth and chest length were 0.7598 kg and 1.284 kg, 27.57 cm and 30.72 cm, 11.10 cm and 13.78 cm, 24.97 cm and 28.02 cm, respectively. Then, the coefficient of variation for burgo chicken and kampung chicken body weight, body length, chest girth and chest length were 17.48% and 19.58%, 7.73% and 6.67%, 8.71% and 14.44%, 6.53% and 8.32%, respectively. Furthermore based on t-test result, burgo chicken morphometrical size was significantly smaller than kampung chicken ($P < 0.05$). It can be concluded that variance of morphometric size of burgo chicken was smaller compared to kampung chicken.

Keywords: Body size, burgo chicken, kampung chicken.

~~Species Inventory and Assessment of Sea Cucumber in Key Marine Geographic Areas in the Philippines (Luzon cluster)~~

~~Mamhot, J. R., Malaya, V. N., Quesada, A. L. Jr., Grande, V. O., Sanidad, V. C., Bangui, H. G. P., Jontilla, J. and Peralta, D. A.*~~

~~Don Mariano Marcos Memorial State University, South La Union Campus, College of Fisheries, Santo Tomas, La Union Philippines.~~

~~Corresponding Author: dianneperalta16@yahoo.com~~

~~In this paper, we integrated the results of sea cucumber field surveys and interviews we conducted in different provinces of Luzon particularly the provinces of the Ilocos Norte, Ilocos Sur and La Union in Region 1, the province of Cagayan in Region 2, and Palawan in Region 4 A. In total, sea cucumbers of Luzon comprised one class: Holothuroidea; three subclasses, four orders, six families, ten genera and forty two species. Of these, family Holothuridae was the most specious with more than 30 species belonging to six genera. Other families contained one to six species (*Notation is on the unidentified taxa or whose identity cannot be ascertained*). Catch consists of 51 identified species in the five provinces. In general, sea cucumber catch consists mainly of medium to low value species. Discussed in the fishery independent surveys were the species collected during the surveys from 2012-2013, their temporal and area distributions, together with characterization of their habitat. The fishery dependent surveys give information on the gatherers and traders; their collection and trading collection, processing techniques and marketing network of the commodity.~~

~~**Keywords:** Sea cucumber, Holothuroidea, Species inventory, Luzon, Philippines~~

Efficacy of Herbal Extracts to Control Multi-Antibiotics Resistant (MAR) *Aeromonas veronii* Isolated from Motile *Aeromonas* Septicemia (MAS)-Exhibiting Nile Tilapia (*Oreochromis niloticus*)

U-taynapun, K.*, Mueangkan, N. and Chirapongsatonkul, N.

Department of Fisheries, Faculty of Agriculture, Rajamangala University of Technology Srivijaya, Nakhon Si Thammarat 80110, Thailand.

Corresponding Author: e_aquatic1@hotmail.com, kittichon.u@rmutsv.ac.th

Motile *Aeromonas* Septicemia (MAS) is a disease causing a devastating loss in fish farming including Nile tilapia (*Oreochromis niloticus*). This disease is caused by pathogenic bacteria *Aeromonas* spp. Our previous study has revealed that *A. veronii* is one of commonly isolated species from the MAS-expressing Nile tilapia cultured in Southern Thailand. Among the collected bacteria, one isolate exhibiting multi-antibiotic resistance against tetracycline and oxytetracycline was selected as a model for testing the biological control ability of herbal extracts. The herbal extracts obtained from 6 herbal plants; *Caesalpinia sappan* (Cs), *Allium sativum* (As), *Illicium verum* (Iv), *Alpinia galanga* (Ag), *Piper longum* (Pl), and *Foeniculum vulgare* (Fv), extracted using 3 different solvents, 95% ethanol (E95), water (W) and soybean oil (O) were first screened for their inhibitory potential by disc diffusion method compared with tetracycline (30 µg). The clear zones (7–18 mm) were detected in Cs-E95, Cs-W, As-E95, Iv-E95, IV-W, and Ag-E95 while the clear zone in tetracycline was about 13 mm. All 6 herbal extracts showing clear zone were further evaluated for their minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) against the MAS-*A. veronii*. The greatest MIC of 0.469 mg/ml was recorded in Cs-E95 and Cs-W and MBC of 0.938 mg/ml in Cs-W. Moreover, the inhibitory effect of Cs-E95, at the concentration of MIC and MBC, on growth of MAS-*A. veronii* cultured under the water temperature observed in the fish farm, was also demonstrated. This finding revealed the potential of herbal extracts as a favorably health and environmental friendly approach in modern aquaculture to control the bacterial pathogen instead of using antibiotics.

Keywords: Motile *Aeromonas* Septicemia (MAS), *Oreochromis niloticus*, multi-antibiotics resistance, herbal extract, *Aeromonas veronii*

Comparison of Toxic Effects of *Psidium guajava* Leaf and Bark Extracts against Brine Shrimp (*Artemia salina*)

Bautista, M. L.¹, Pomer P.¹ and Salonga, J. J.¹

¹Philippine Science High School – Central Luzon Campus, Lily Hill St., Clark Freeport Zone, Pampanga, Philippines.

Corresponding Author: ppomer@clc.pshs.edu.ph

Psidium guajava, also known as guava, is a medicinal plant that is mainly found in tropical or subtropical areas like the Philippines. This plant has been used in treating different diseases and is also known for its medicinal and antimicrobial properties. Despite this, there are only a few number of studies regarding the toxicology of *P. guajava*. In this study, Brine Shrimp Lethality Assay (BSLA) was done to identify if the leaf and bark extracts of *P. guajava* have toxic effects against *Artemia salina* (brine shrimp). Results showed bark extracts having an LC₅₀ value of 480.14 µg/mL and leaf extracts with an LC₅₀ value of 949.13 µg/mL, and the mortality rates of brine shrimps for the bark extracts are relatively higher than the leaf extracts. This reveals that *P. guajava* bark extracts are more toxic than the leaf extracts.

Keywords: guava, BSLA, LC₅₀, toxicology

Potential of Microbial Degradation of Musty Odor in Aquaculture Pond

Sompong, U.*, PongUdom, P. and Whangchai, N.

Faculty of Fisheries Technology and Aquatic Resources, Maejo University, Chiang Mai, Thailand.
Corresponding Author: udomluk.sompong@gmail.com

Musty Odor (geosmin and MIB) is currently the most serious economic problem faced by aquaculture export industry. They are susceptible to biodegradation with several microorganisms responsible for their removal from water. This study reports the potential use of microbes on the degradation of musty odor isolated from 10 Tilapia farms in northern Thailand. For microbial isolation on medium containing geosmin and MIB standard solution, 20 isolates were selected in order to test the efficacy on degradation of musty odor. Experiments revealed that after 48 hr, TS1 had the highest efficacy in reducing geosmin in media (92.16%), as analyzed by headspace solid phase micro-extraction (HS-SPME) and gas chromatography–mass spectrometry (GC/MS). Whereas, LS6 isolate had optimum efficacy to reduce MIB (76.61%). Five isolates (*Achromobacter denitrificans*, *Delfia tsuruhatensis*, *Comamonas* sp., *Acinetobacter calcoaceticus*, and *Raoultella ornithinolytica*) with optimal efficacy to reduce geosmin and MIB were then *in vivo* tested for pathogenesis in fishes. The result showed that all of bacterial species did not cause pathogenesis in fish with survival rate of 96.67-100%. The efficacy of musty odor degradation in water from tilapia farms was obtained. After 48 hr, *Comamonas* sp. and *Achromobacter denitrificans* had the highest efficacy to reduce geosmin and MIB (about 40% removal). Microbial cultures in water with subsequent community profile analysis using 16S rRNA-directed PCR-DGGE identified uncultured bacterium species were grown after 48 h. of incubation. Five bacteria most likely involved in the biodegradation of musty odor within the pond water.

Keywords: Geosmin, MIB, Microbial degradation, Musty odor, Off-flavor

Present Status and Management Strategies of Tropical Eels Genus *Anguilla* in Bengkulu Province of Indonesia

Hartono, D.

Faculty of Agriculture, University of Bengkulu, Jl. Raya Kandang Limun, Bengkulu, 38122, Indonesia.
Corresponding Author: perikanan_unib@yahoo.com

There are about 19 species and subspecies of eel genus *Anguilla* around the world. Five species among them are in the Indonesian waters. These tropical eels just spread out from east, center, to west of Indonesian archipelagos in various species composition and pattern of abundance. However, mostly Indonesian people did not recognize the important of eels as a kind of fish or as a luxury food, but just a kind of snake that completely forbidden for consumption in the majority of Moslem Indonesian society. The present study aims to clarify the potential resources of tropical eels in Bengkulu Province. For these purpose, data from field survey is collected to defined status of potential tropical eel in Bengkulu. At present, eels are collected everyday using traditional fishing gears such as bamboo or rattan traps. Eels from Bengkulu are dominantly collected to fulfilled demand from Java for aquaculture purpose. In small number of them, are consumed as traditional food in local market. Some potential areas in Bengkulu Province waters should be carefully managed to avoid eels population decline. In order to avoid decreases in tropical eel resources, we need to understand the basic causes, and the mechanisms, and also to develop technology in order to maintaining stable population of eel in the tropic. Aquaculture of single species caught from the nature maybe problem for such a great species diversity of the Indonesian tropical eels. It was realized that control and monitoring in the field also needed for conservation and management. First step is to conserve the tropical eels on their natural habitat, second is to manage fishing activities in some long traditional catching area, third is to develop aquaculture technology.

Keywords: Bengkulu, eel, natural, resources

Cultures of Siamese Fighting Fish (*Betta splendens*) Fed with Live Food and Commercial Feed added with Effective Microorganisms

Suksomnit, A., Chaleoisak, P., and Saengphan, N.

Suphanburi College of Agriculture and Technology, Danchang, Suphanburi, Thailand.
Corresponding Author: fairyshrimp1966@gmail.com

The study focused on growth rates and survival percentage of Siamese fighting fish which was fed with different foods including: live food (water flea (control); water flea adding with 10% of Effective Microorganisms - EM), fairy shrimp adding with 10% of EM and commercial feed adding with 10% of EM. The experiment was set in 42 cm plastic basins. Each basin carried 600 ml of water with 30 Siamese fighting fish. The fish were fed for 30 days. Except for the survival rates where groups showed no significant difference, it was found out that Fairy shrimp added with 10% EM yielded significantly better results compared to commercial feed added with 10% EM in terms of average lengths, weights, weight gains, specific growth rates at $p < 0.05$. The results revealed the various average lengths, weights, weight gains, specific growth rates, and survival rates of Siamese fighting fish fed with water flea (control), fairy shrimp added with 10% of EM, commercial feed added with 10% EM, and water flea added with 10% EM. The average lengths were 2.532 ± 0.076 , 3.009 ± 0.728 , 1.764 ± 0.195 , and 2.553 ± 0.112 cm, respectively. The average weights were 0.424 ± 0.036 , 0.460 ± 0.030 , 0.181 ± 0.011 and 0.436 ± 0.030 g, respectively. Weight gains were 0.275 ± 0.029 , 0.313 ± 0.035 , 0.010 ± 0.033 , and 0.287 ± 0.027 g, respectively. The specific growth rates were 3.494 ± 0.197 , 3.790 ± 0.330 and 0.668 ± 0.185 , and 3.575 ± 0.222 g/day, respectively. As compared to other food meals, the findings indicated that Siamese fighting fish fed with fairy shrimps added with 10% EM yielded better growth performance in terms of average length, average weight, weight gain, and growth rate.

Keywords: *Bettasplendens*, *Moinamacrocopa*, *Streptocephalussirindhornae*, commercial feed, Effective Microorganisms

Impact of Methyl Salicylate Lures on the Population of *Eucarazzia elegans* (Ferrari) (Aphididae) and its Natural Enemy in Common Sage

Zarkani, A.^{1*} and Turanli, F.²

¹Department of Plant Protection, Faculty of Agriculture, University of Bengkulu, 383711, Bengkulu, Indonesia; ²Department of Plant Protection, Faculty of Agriculture, Ege University, 35100, Izmir, Turkey.

Corresponding Author: agustinzarkani@unib.ac.id

Methyl salicylate (MeSA) is naturally produced by some plants as a herbivore-induced plant volatile that attracts natural enemies as well as inhibits herbivore populations. This study evaluated the attractiveness of synthetic MeSA lures to the natural enemies of *Eucarazzia elegans* (Ferrari) (Aphididae), a pest of common sage plants (*Salvia officinalis* Linnaeus), and any direct effects on this aphid. MeSA lures were distributed around a sage field and sticky yellow traps were used to measure the population of natural enemies in treated and untreated blocks. The effect of MeSA on *E. elegans* populations with and without natural enemies were conducted under semi-field conditions and the impact of MeSA on *E. elegans* were evaluated in the laboratory. Several natural enemies, *Rhagoxychafulva* (Scopoli) (Chantariidae), *Chrysoperlacarnea* (Stephens) (Chrysopidae), *Coccinellaseptempunctata* Linnaeus (Coccinellidae), and *Syrphusribesii* (Linnaeus) and *Syrphus vitripennis* (Meigen) (Syrphidae) were caught in high numbers on traps adjacent to the MeSA lures. Moreover, the population of *E. elegans* in MeSA-treated blocks was significantly lower than untreated blocks. In the semi-field experiments, the aphid populations were significantly lower on treated common sage plants exposed to the natural enemies in the second and third weeks after MeSA deployment. In the laboratory, treated and untreated aphid growth rates were not significantly different, indicating no effect of MeSA on the aphid population and indicate that the benefits of MeSA deployed in response to aphid herbivory will be indirect, such as by attracting natural enemies.

Keywords: *Eucarazzia elegans*, herbivore-induced plant volatile, methyl salicylate, *Salvia officinalis*

Influence of Charolais Sires and Seasons on Growth Performance and Carcass Characteristics in Crossbred Steers

Thiwaratkoon, P.¹, Sivapirunthep, P.², Tuntivisoottikul, K.², Sithigripong, R.¹, Chongcharoen, M.³ and Chaosap, C.^{2*}

¹Department of Animal Production Technology and Fisheries, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; ²Department of Agricultural Education, Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; ³Pon Yang Kham Livestock Breeding Cooperative NSC.Ltd. Ban Pon Yang Kham Moo 10, Tambon Non Hom, Muang District, Sakhonnakhon Province, Thailand.
Corresponding Author: chanporn.ch@kmitl.ac.th

The objective of this study was to determine the factors of Charolais sires, fattened seasons, and age from birth to months 8 of fattening period (age) on growth performance and carcass characteristics of beef cattle fattened at Pon Yang Kham Livestock Breeding Cooperatives N.S.C. Ltd., Sakhonnakhon Province. Sample was 18 crossbred (Charolais X (Brahman x Thai Native)) steers. They were offsprings of 4 different sires, which were 4, 6, 5, and 3 steers from sires 1-4, respectively. Animals were fed *ad libitum* with fresh grass, concentrate, rice straw, and molass used as supplement. The data were collected during 8-12 months of fattening period. Weight gained and average daily gain (ADG) were calculated. After the animals were slaughtered, the data of carcass characteristics were collected and analysed. The results showed that the sires did not affect all the growth performance and carcass characteristics, except the trait of total lean in kg. ($P<0.05$). Furthermore, the factor tended to affect percentage of lean ($P=0.09$). The seasons affected Weight gained, ADG, and carcass length ($P<0.05$), while the age did not affected all studied traits ($P>0.05$).

Keywords: Charolais sire, growth performance, carcass characteristics

Integrated Rice-Duck Farming Systems: Addressing the Needs of the Farmers for Its Adoption in Zamboanga Del Sur, Philippines

Fajardo, L. J.^{1,2} and Ocampo, P. P.³

¹College of Fisheries, Central Luzon State University, Nueva Ecija, Philippines; ²School of Environmental Science and Management, University of the Philippines Los Baños, Laguna, Philippines; ³Institute of Biological Sciences, College of Arts and Sciences, University of the Philippines Los Baños, Laguna, Philippines.
Corresponding Author: renz4881@gmail.com

Laguna Lake, the largest freshwater lake in the Philippines, has been threatened by fertilizers and pesticides runoff from agricultural land use in the eastern bay. *Glossogobius giuris*, whitegoby, is one of the native and commercially important fishes in the lake and is reported to be of declining population. Inhibition of acetylcholinesterase (AChE) activity is widely known as biomarker of exposure to organophosphates and carbamates pesticides. The study determined AChE activities in brain and muscle using rapid colorimetric method in fish populations obtained from two predominantly agricultural sites (Bay and Santa Cruz) in Laguna and a reference population, reared in concrete tanks. Measured brain AChE activity across populations was significantly ($P<0.05$) higher than muscle. This resulted to a significantly ($P<0.05$) higher inhibition rate in muscle than brain in wild populations. However, inhibition rates were not significantly ($P>0.05$) different between agricultural sites. Depressed AChE activity levels may indicate fish exposure and toxicity to anticholinesterase pesticides in the eastern bay of the lake. This could be supported by carbamates and organophosphates usage in rice and vegetable production along the lakeshore as revealed through key informant interviews and focus group discussions. Further assessment with increased sample size from other bays and tributaries of the lake and the use of AChE within a battery of biomarkers for neurotoxic contaminants are recommended.

Keywords: biomarker, carbamate, fish muscle, organophosphate

Milk Production and Milk Income over Feed Cost of Dairy Cow Fed Fermented Cassava, Tabut Block, and Concentrate Containing *C. xanthorhiza* and Yeast

Sulistiyowati, E.¹, Jarmuji¹, Mujiharjo, S.², Listiono, D. D.¹, and Supriadi, T.¹

¹Department of Animal Science, Faculty of Agriculture, University of Bengkulu, Indonesia;

²Department of Agriculture Technology, Faculty of Agriculture, University of Bengkulu, Indonesia.

Corresponding Author: ensulistiyowati@yahoo.com

Three types of diet had been applied in lactating dairy cows. A combination of Fermented cassava (1.7kg/d) and *C. xanthorhiza* liquid (0.7kg/d), Tabut block (6 blocks/d), and concentrate (2kg/d) containing *Curcuma xanthorhiza* and yeast diet were provided alternately in 10 days/period. The milk yields were 5.23, 5.0, and 5.15 respectively. Milk incomes were Rp. 36,610/d, Rp. 35,000, and Rp. 36,050/d, respectively. Feed costs were Rp. 27,250/d, Rp. 28,564/d, and Rp. 29,688/d, respectively. The milk incomes over feed cost (MIOFC) were Rp.9,360/d, Rp. 6,436/d, and Rp. 6,362/d, respectively. Forage consumptions were 38.36kg/d, 38.16kg/d, and 38.64kg/d, respectively. Water intakes were 17.60l/d, 16.80l/d, and 16.78l/d, respectively.

Keywords: curcuma, milk, MIOFC, Tabut, yeast

Session 5: ENVIRONMENTAL SCIENCE, SOIL AND WATER CONSERVATION

Overcoming the Source Barriers of Energy and Water: The Two Most Critical Resource for Agriculture & Food Systems

Mendoza, T. C.

Institute of Crop Science, College of Agriculture & Food Sciences, U.P. Los Baños, College, Laguna 4031, Philippines.

Corresponding Author: ecofarm.mndz2011@gmail.com

Energy and water, the 2 most critical resources for food were examined to determine their interrelationships in causing food insufficiency and suggested options to overcome the source barriers in agricultural production and in the food systems. On energy, about 6-8 cal of energy is used (ready-to-eat) per 1 cal of rice-the ASEAN food staple (70% for production, 24% post production, 16% for cooking). On water, up to 5000 li of water is needed to produce the average food energy value at 2000 cal /day per person. While there are some debates, it is now accepted that fossil fuel oil supply has reached its GLOBAL peak or half of it had been used. Consuming oil had liberated 70% to 80% of Carbon causing global warming (about 1°C rise in temperature). Burning all the oil will liberate 17 Tgt CO_{2e} eq. but the calculated limit was only 1Tgt so temperature rise will not exceed 2°C. Water, while it is so abundant but 97% is saltwater. Desalinating ocean/ sea water is energy intensive. The rest, 2% of freshwater is stored in ice caps of the North, high rise mountains, and underground. The remaining 1% is the usable fresh water. Tapping underground water is energy expensive and its replenishment takes centuries which means a huge water debt for at least 4 generations away. The other source-diminishing factor for fresh water is pollution attributed to solid wastes, heavy metals, plastics, agrochemicals (fertilizers, pesticides) livestock manure and pathogenic microorganisms. Altogether, if un treated and this polluted water is used to produce food and drinks, can cause human illness. Purifying/distilling this heavily polluted water is energy/ storage expensive. Drinking 2.0 li purified or distilled water per day costs about US \$ 1.5 (PhP60-75/day) equivalent to about 30% of rural wage in the Philippines. Energy efficient and water conserving technological innovations are indeed necessary but we look for multi-pronged but complementary approaches as follows : 1) eat less-and-less meat and reduce animal pets (cats,dogs) to reduce lands utilize to feed animals and to have more lands freed for re-planting trees to recapture back CO₂ emitted. In, turn reducing the use of oil-based manufactured agrochemicals and their energy foot print in producing animal feeds;2) a cultural shift from food eating culture -to- food growing culture to reduce manage and the food miles effect;3) re-design human settlements to include home-grown food and to localize food production and distribution. Globalizing food or free trading has both socio-political/economic ill effects and ecological massive influence due to carbon emission (called energy footprint) of long distance food transport (food miles); urbanization is now presenting logistics challenges if not virtual nightmares. Processing, storage, packaging, transporting /distributing food use more energy for transport that increases carbon food prints and food prices;4)grow crops the agroecological way to reduce the energy and water footprint ; so the food systems become net carbon sequestering instead of net carbon emitting; finally,5) production, consumption/distribution/ should metamorphose into agri-food value chain where producers and

farmers through their organization/ cooperatives , handle and manage the food from farm-to-plate so they can reap the benefits of the value added along the way so they will be inspired more to produce more foods the agroecological ways. Carried out in the rural areas, more livelihood and rural employment preventing out-migration and solve the problems of massive population congestion in urban centers.

Diversity of Produce Hard resin and Oleoresin Plant in Khok Hinlad Nong Ku Nadoon Community Forest Wapi Pathum District, Maha Sarakham Province

Appamaraka, S.¹ and Appamaraka, P.²

¹Walai Rukhavej Botanical Research Institute, Mahasarakham University, Khantharawichai District, Maha Sarakham 44150, Thailand; ²Nongpor school, Na Chueak District, Maha Sarakham 4170, Thailand.

Corresponding Author: sombat_amp@yahoo.co.th

This study was conducted to explore the diversity of plants producing hard resin and oleoresin in Khok Hinlad Nong Ku Nadoon community forest, Wapi Pathum district, Maha Sarakham province. Survey questionnaire, In-depth Interview, and forest walking - survey were used for collecting data. The results of survey questionnaire and In-depth Interview of local wisdom showed that, there were 6 species of plants which produce hard resin and oleoresin, namely: *Dipterocarpus tuberculatus* Roxb, *Shorea obtusa* Wall, *Dipterocarpus obtusifolius* Teijsm.ex.Miq, *Dipterocarpus intricatus* Dyer, *Shorea siamensis* Miq, and *Shorea roxburghii* G.Don. The forest walking- survey revealed that 9 species of plants which produce hard resin and oleoresin were found in this area, 5 species of them are producing hard resin - *Shorea obtusa* Wall, *Dipterocarpus tuberculatus* Roxb, *Dipterocarpus obtusifolius* Teijsm.ex.Miq, *Dipterocarpus intricatus* Dyer, and *Shorea siamensis* Miq. Another 4 species of plants that are oleoresin producing - *Pterocarpus mocrocorpus kurz*, *Gardenia sootepensis* Hutch, *Canarium subulatum* Guil, and *Buchanania lanzan* Spreng- are also found in the forest. In this study, it was found out that *Dipterocarpus tuberculatus* Roxb. could produce highest resin ($\bar{X} \pm 450$ gm) compared to *Dipterocarpus tuberculatus* Roxb. ($\bar{X} \pm 390$ gm), *Dipterocarpus obtusifolius* Teijsm.ex.Miq ($\bar{X} \pm 320$ gm), and *Dipterocarpus intricatus* Dyer ($\bar{X} \pm 270$ gm), respectively. Another *Shorea siamensis* Miq has smallest amount of resin production ($\bar{X} \pm 120$ gm).

Keyword: plant diversity, hard resin, oleoresin

The Application of Carbon Balance for Low Carbon Society Development in Kut Chik Sub-district Municipality, Sung Noen District, Nakhon Ratchasima Province

Banchajarurat, P., Viriya, H.* and Kongritti, N.

Faculty of Science and Technology, Nakhon Ratchasima Rajabat University, Nakhon Ratchasima, 30000, Thailand.

Corresponding Author: Both.Wealth@gmail.com

The application of carbon balance for low carbon society development in Kut Chik sub-district Municipality Sung-noen District, Nakhon Ratchasima Province, Thailand was investigated. The aim of this research was to analyzed the total greenhouse gas emission from consumption (food and energy) of residential (1,193 households) in Kut Chik sub-district municipality for compared with CO₂ absorption efficiency of non-naturally plant in 8 public areas (592 hectares) in Kut Chik sub-district municipality. The result showed the greenhouse gas emissions from consumption is 2,462.4986 ton CO₂eq / year, compared with CO₂ absorption in 8 public areas equal to 24.325 ton CO₂eq / year. It showed that the storage of greenhouse gases in biomass form of non-naturally plants in public areas. It is not enough to absorb greenhouse gases from consumption of people in Kut Chik sub-district municipality. Therefore, people in Kut Chik should reduce consumption and increase the green space by applying efficiency economic.

Keyword: Biomass, global warming, greenhouse gas, low carbon society

The Feasibility Study in Development of the Kha-Kang Creek, Muang district, Maha Sarakham province

Wongchantra, P.^{1*}, Wongchantra, K.², Praimee, U.¹, Junkaew, L.¹, Sookngam, K.¹, Ongon, S.¹, Phansiri, C.¹

¹Center of Environmental Education Research and Training, Faculty of Environment and Resource Studies, Mahasarakham University, Mahasarakham, Thailand 44150; ² Srimahasarakham Nursing College, Mahasarakham, Thailand.

Corresponding Author: Praimee_ta@hotmail.com

The Kha-Kang creek was originated from the Kok-Hin-Lad forest, Muang district, Maha Sarakham province and has total length of 60.82 Kilometers. A creek that are important to the public by utilization in agriculture and production of water supply. The objective of this research was to study the feasibility in developing the Kha-Kang creek Muang district, Maha Sarakham province by dividing them into 3 phases as follows : community around the university, early stages of Maha sarakham thalai water water and downstream distances. The study had 4 aspects of space and situation Kha-Kang creek; technical development of water resources Kha-Kang creek. economics, management Kha-Kang creek and public hearing. The research found that space and situation Kha-Kang creek. Kha-Kang creek runs through the 2nd district, including Khok-ko sub-district, Nong No sub-district, Thalad sub-district, Kaeng Loeng Jan sub-district, koeng Khwao sub-district and Tha Tum sub-district, Maha Sarakham province. The situation here Huai Chin mainly used in agriculture and livestock. The technical development of water resources Kha-Kang creek example dredging, building a reservoir, build a dam, make a canal, economics irrigation project with a total budget of 25.3 million baht, and has budget of 10 million baht. Which is appropriate in the operation restoration of the canal management Kha-Kang creek. Included was the reconstruction of the canal water delivery and integrated water management. The results of the public hearing showed that most agree to develop chin Creek appropriate to the area.

Keywords: feasibility study, development of the Kha-Kang creek, Maha Sarakham Province

~~Restoring Livelihoods in Conflict-Affected Areas in Maguindanao Province of the Autonomous Region in Muslim Mindanao in the Philippines through Aquaculture~~

~~Odin, R. Y.~~

~~Mindanao State University, Maguindanao, Philippines.~~

~~Corresponding Author: ramjicodin@gmail.com~~

~~The Province of Maguindanao in the Philippines with its vast resources for fisheries is home to at least 63, 000 internally displaced persons (IDPs) which comprised 10, 550 farming and fishing households. These IDPs were the target beneficiaries of a livelihood project which was funded by the Government of New Zealand through its Aid Programme and being implemented by the Food and Agriculture Organization of the United Nations and the Department of Agriculture and Fisheries of the Autonomous Region of Muslim in Mindanao with the overall aim of improving the food security of the most vulnerable internally displaced fishing families in the conflict affected communities of the Maguindanao Province. Specifically, it restored livelihoods of the target IDPs who have already returned to their communities by providing them fishing gears, tilapia cage farming inputs and conduct of trainings. It also reduced their overall dependency on external food aid. A total of 330 target IDPs from the seven municipalities of this Province received inputs like 200 sets of gill nets and ten (10) sets of floating fish cages with grow-out feeds and stocked with 10, 000 tilapia fingerlings per set and ten (10) units of non-motorized boats. The introduction of aquaculture in the form of floating fish cages in marsh and other inland waters of Maguindanao is indeed a productive and alternative source of livelihood for the returned IDPs. This is deemed beneficial not only to the IDPs but also to the enhancement of natural fishery stocks as fishing pressure is reduced because most fishermen were encouraged to shift into aquaculture through tilapia cage farming. It could also be considered as activity with peace integration because it has promoted the value of team building among the beneficiaries to ensure successful operation of their cage culture. Hence, promoting social transformation among the beneficiaries.~~

~~**Keywords:** Aquaculture, Fisheries, Internally Displaced Persons, Livelihood Restoration, ARMM~~

Effects of Interaction between Nitrogen and Potassium on The Growth and Yield of Cassava

Thummanatsakun, V. and Yampracha, S.*

Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: sukunya.ya@kmitl.ac.th

Nitrogen and potassium are necessary nutrients for cassava in generally deficient soils especially nitrogen. But high nitrogen fertilizer application may induce more potassium requirement. The objective of this study was to determine the effects of interaction between nitrogen (N) and potassium (K) on growth and yield of cassava. The greenhouse experiment was conducted as a 3×3 factorial in a randomized complete block design with 4 replications. Three different nitrogen rates (500 (N1), 1000 (N2) and 1500 (N3) μmol/L) combined with three different potassium rates (500 (K1), 1000 (K2) and 1500 (K3) μmol/L) were provided by drip irrigation for cassava (Kasetsart 50 varieties) planted in sponge for 4 months. Plant height and SPAD value of lower and upper leave were measured every week. The fresh and dry weight of leave blade, stalk+petio, crown, and tuber were collected at 4 months. The results showed that increasing nitrogen rates significantly increased plant height, SPAD value of upper and lower leave, the fresh and dry weight of leave blade, stalk+petio, tuber and total weight. While increasing potassium rates decreased only SPAD value of lower leaves. Nitrogen uptake in crown and tuber were significantly affected by an interaction between N and K but N uptake in leaf blade and total N uptake was affected by increasing N rates. Potassium uptake in tuber and total K uptake was significantly affected by an interaction between N and K but K uptake in stalk+petio and crown affected by increasing K rates. Furthermore, total uptake of N and K were highly and positive correlation with the fresh and dry weight of all plant parts except crown. The correlation coefficient between uptake N and K in leave blade, stalk+petio, crown, and tuber were 0.85**, 0.83**, 0.35* and 0.87**, respectively.

Keywords: cassava, nitrogen, potassium, interaction

The Use of Bioreactor System and Aquatic Plants (Water Hyacinth) for Aquaculture Wastewater Treatment

Panyada, M.¹, Whangchai, N.¹, Pholchan, M.² and Sompong, U.^{1*}

¹Faculty of Fisheries Technology and Aquatic Resources, Maejo University, Chiang Mai, Thailand; ² Division of Biotechnology, Faculty of Science, Maejo University, Chiang Mai, Thailand.

Corresponding Author: udomluk.sompong@gmail.com

The bioreactor (volcanic rock) and aquatic plants (Water Hyacinth) were applied to determine their efficiency as wastewater treatment in aquaculture pond. Complete randomized design (CRD) of five treatments was assigned in this experiment; Control, 5% Water Hyacinth with 5% bioreactor (WH5%, RA5%), 5% Water Hyacinth with 15% bioreactor (WH5%, RA15%), 15% Water Hyacinth with 5% bioreactor (WH15%, RA5%) and 15% Water Hyacinth with 15% bioreactor (WH15%, RA15%) in 9×9×1.2 m pond, contained with aquaculture wastewater, for 30 days. Fifteen percent of Water Hyacinth with 15% of bioreactor (WH15%, RA15%) had the highest efficiency in the reducing ammonia-N, nitrite-N, nitrate-N, phosphate-P, total phosphorus, COD and chlorophyll-a content; the reduced efficiency were 91.94 ± 2.45, 64.75 ± 5.36, 95.99 ± .27, 86.19 ± .94, 88.24 ± .10, 77.95 ± 0.62, 91.70 ± 1.54 % respectively. The bioreactor made from volcanic rock and Water Hyacinth was found effective to treat wastewater and could be applied to control Water Hyacinth in pond management.

Keywords: Bioreactor, Wastewater treatment, Water Hyacinth

The Effects of a Learning Management Contributing to Creativity and Environmental Preservative Mind of 5th Grade Primary School Students Using Creativity-based Learning

Doungwilai, D.

Department of Curriculum and Instruction, Faculty of Education, Mahasarakham University, Thailand.
Corresponding Author: channipha@hotmail.com

The purposes of the current study were 1) to investigate creativity of 5th grade primary school students with the requirement that 70% of students or more must pass the set criteria of 70%, 2) to study environmental preservative behaviors of 5th grade primary school students with the requirement that 70% of students or more must pass the set criteria of 70%, 3) to study learning achievement of a learning management plan entitled “Environmental Preservation” with the requirement that 70% of students or more must pass the set criteria of 70%, and 4) to evaluate the students’ satisfaction level toward the learning management plan contributing to creativity and environmental preservative mind using creative-based learning. Selected by purposive sampling method, the samples were 93 5th grade primary school students in Mahasarakham University Demonstrative School, 1st semester, 2018 academic year. The statistics used in data analysis were Percentage, Mean Score, and Standard Deviation. The results of the study were as follows: (1.) Creativity of the 5th grade primary school students were found at 85.16 %. The proportion of the students passing the criteria were at 78.75 %, (2.) Environment preservative mind of the 5th grade primary school students were found at 90.00 %. The proportion of the students passing the criteria were at 78.33%, (3.) The learning achievement of the participants were at 83.32 %. The proportion of the students passing the criteria were at 72.00, and (4.) Satisfaction level toward the creative-based learning management of the 5th grade primary school students were found at high level ($\bar{x}=2.67$) compared to the full mark of 3.0.

Keywords: Creativity, Environment Preservative Mind, Creative-based Learning

Mycodegradation of Synthetic Plastics by *Pleurotus florida* (Oyster Mushroom)

Francia, M. D., Gadaza, R. E., Gayo, J. P., and Tolentino, J. V.

Philippine Science High School – Central Luzon Campus, Clark Freeport Zone, Pampanga, Philippines.
Corresponding Author: mnfrancia@clc.pshs.edu.ph

With the rise of biodegradation as an environment-friendly solution to the global plastic crisis, mushrooms are now being studied for their ability to degrade various materials when used as substrates. In this study, *Pleurotus florida*, an edible mushroom species belonging to the *Pleurotus* genus, was chosen as a prospective candidate in the biodegradation of plastics commonly dumped in bodies of water globally and in the Philippines, which are food wrappers, non-biodegradable, and oxo-biodegradable plastic bags. Each of the three aforementioned synthetic plastics was utilized as artificial fruiting logs for the cultivation of *P. florida* and observed for 43 days. SEM Analysis of randomly selected plastic strips from the chosen best replicate for each set-up showed signs of biodegradation (any surface irregularities, such as rough patches), except for food wrappers. FTIR Spectroscopy Analysis of these plastic strips exhibited observable changes in the presence of functional groups for all set-ups as compared to untreated plastic strips, which therefore implies a positive evidence for biodegradation.

Keywords: biodegradation, mushrooms, synthetic plastics

Responses of Sago Palm under Water Deficiency Condition

Prathumyot, W.^{1*}, Chitaree, L.¹, Chakhatrakan, S.², Romkaew, J.³, Waramit, N.³ and Ehara, H.⁴

¹Faculty of Agricultural Technology, Rambhai Barni Rajabhat University, Muang District, Chanthaburi 22000, Thailand; ²Faculty of Science and Technology, Thammasat University, Clong Luang District, Pathumthani 12121, Thailand; ³Agriculture Faculty, Kasetsart University Kamphaeng Saen Campus, Kamphaeng Saen District, Nakornpathom 73140, Thailand; ⁴Applied Social Science Institute of ASIA, Nagoya University, Japan.

Corresponding Author: wikanya.p@rbru.ac.th

The purpose of this research was to investigate the response of sago palm under water deficiency conditions. The experimental design was Completely Randomized Design (CRD). It consisted of four treatments, including daily, every 3 days, every 5 days and every 7 days watering. Each treatment had 4 replications. The experiment was carried out at Faculty of Agricultural Technology, Rambhai Barni Rajabhat University for 60 days. Plant height, leaf number and green value of leaf (using SPAD) were recorded every week. Leaf water potential, chlorophyll concentration, dry weight, water content and nutrient concentrations in leaf were measured at the end of the experiment. The result showed that plants watered 7-day interval had lower leaf water potential which resulted in lower water content in roots and plants. There was no effect on the growth of sago palm including height, leaf number, green value of leaf (SPAD), chlorophyll concentration, leaf dry weight and dry weight of whole plant. The concentrations of nitrogen, phosphorus, potassium, calcium and magnesium in leaves of the plants treated with water deficiency treatment did not differ in comparison to the plants treated with the normal water supply treatments.

Keywords: sago palm, water deficiency, response

Comparative Energy footprint of Cambodian Lowland Rice Grown under Different Establishment Methods

Savuth, S.^{*}, Mendoza, T. C.

Faculty, Institute of Crop Science, College of Agriculture and Food Science, University of the Philippines Los Baños, Philippines.

Corresponding Author: ecofarm.mndz2011@gmail.com

Rice is associated with energy use. From *farm to plate* - crop establishment to harvesting, milling, transport, cooking, fossil fuel energy (oil) is used. To generate energy, oil is literally burnt but it is accompanied by carbon dioxide emission (1 L oil = 3.96 kg CO₂ eq.) also called energy footprint. In Cambodia, rice is grown in different establishment methods, namely: direct seeded rice (DSR), transplanted rice (TPR) and System of Rice Intensification (SRI). One hundred sixty one farmers and six rice millers were interviewed to quantify the energy footprint of Cambodian rice grown in different establishment methods. The total energy footprint of the different establishment methods were in the following order: TPR, DSR, and SRI at 1850.20, 1845.73, 780.02 kg CO₂e ha⁻¹, respectively. DSR (0.61 kg CO₂e kg⁻¹) had the highest energy footprint in producing 1 kg of paddy rice and the lowest was SRI (0.23 kg CO₂e kg⁻¹). Nitrogen was the major source of energy footprint at 77% and 73% of the total energy footprint in DSR and TPR, respectively, but not in SRI. The energy footprint in SRI was 58% lower compared to DSR and TPR. At production level, reducing N application can reduce significantly total energy footprint of Cambodian rice. The total energy footprint of Cambodian rice from farm to plate was estimated at 0.58 kg CO₂e kg⁻¹ wherein 82% was liberated in production, 16% in post-production and 3% in cooking. The major contributor of the energy footprint in post-production was transportation. When rice was milled and transported up to 280km-distance, the energy used in post-production increased 2.05 times compared to 5km-distance. Cambodians consume rice at 143kg per capita (70% of caloric intake). Reducing rice to 50% of the caloric intake would lead to a reduction of 0.67 million tons of rice which is equal to 0.23 million ton of CO₂e eq. Rice can be replaced by healthier caloric energy source like corn (20-30%), root crops such as cassava, sweet potato (and eating brown rice can also reduce another 30-50% of rice). All these crops can be grown in Cambodia. Rice is the major contributor of GHG emission especially methane, a leading global warming and climate

change gas. Moreover, producing rice needs much water (1kg of rice=3000-5000 L of water), this would lead to water scarcity in the future. Reducing rice consumption is reducing not only energy footprint but also water footprint. In summary, three major pathways could significantly reduce the energy footprint Cambodian rice namely: 1) adopt SRI-organic, 2) avoid long distance transport; 3) reduce rice intake.

Keywords: energy footprint, organic, SRI, direct seeded rice (DSR), transplanted rice (TPR)

Response of Several Hot Pepper Genotypes to Increasing Drought Stress

Herison, C.¹, Rustikawati¹, Ganefianti, D. W.¹, Listiana, S.²

¹Faculty of Agriculture, The University of Bengkulu, Indonesia, ²Estate Services Agency of the Central Bengkulu District, Bengkulu, Indonesia.

Corresponding Author: catur_herison@unib.ac.id

Hot pepper (*Capsicum annum* L.) is an important and most valuable vegetable in Indonesia. Drought stress is the major limiting factor for hot pepper during the dry season production in the upland field. Information on tolerance of certain genotypes to the increasing drought stress is important to develop drought-tolerant genotypes. This is essential in increasing plant production in water limiting fields. The objective of this study was to evaluate growth and yield of several hot pepper genotypes in increasing drought stress and determine the genotype most tolerant genotype drought stress. The research was conducted in November 2016 to April 2017 in the green house of Faculty of Agriculture, the University of Bengkulu. The experiment was carried out in a complete randomized design (CRD) arranged in a Split Plot Design, with 3 replications. The Main Plots were the drought treatments i.e. 0%, 20%, 40% or 60% drought, which is 100%, 80%, 60% or 40% of the field capacity (FC), respectively. The Sub Plots were chili pepper genotypes, i.e. PBC521, PBC592, PBC 622, PBC146, PBC155, Tanaka Tsung, Ferosa, Kopay, Bogota or 'Keriting Hitam'. Except for stem diameter and fruit length, all genotypes responded similarly to the increasing of drought stress. Moisture levels of below 60% FC inhibited growth and highly reduced yield of hot pepper. Genotypes of Ferosa and PBC155 were considered more tolerant to drought stress based on growth and yield reduction in 60% FC compared to PBC521, PBC622, PBC146, PBC592, Bogota, Kopay, Tanaka Tsung and 'Keriting Hitam'.

Keywords: chili, stress tolerance, water limiting

Identification of Best Segregating Family of NSIC Rc222/Jumbo Jet Under Salt Stress at Reproductive Stage for Use as a Mapping Population

Ordonio, J. L.^{1,*}, Vergara, G. V.² and Gregorio, G. B.³

¹Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines; ²Plant Breeding Division, International Rice Research Institute, Los Baños, Laguna, Philippines; ³University of the Philippines Los Baños, College, Laguna, Philippines.

Corresponding Author: jer_ordonio@yahoo.com.ph

From the cross between the salt-tolerant rice landrace Jumbo Jet and the high yielding salt-sensitive variety NSIC Rc222, ten BC₁F₂ families were grown and evaluated for reproductive stage salt tolerance at International Rice Research Institute. Salt was applied to achieve an electrical conductivity of 6 dS/m during panicle initiation stage (60 days after sowing). Results of the salinity evaluation score showed wide variation in phenotypes among the ten BC₁F₂ families ranging from 3 to 8. The most saline tolerant families were T109284 (BC₁F₂-JJ10-P2) and T109285 (BC₁F₂-JJ10-P3) with salinity evaluation scores of 4 and 3, respectively, while the most sensitive to salt stress were T109286 (BC₁F₂-JJ10-P2), T109288 (BC₁F₂-JJ10-P2) and T109289 (BC₁F₂-JJ10-P2) scoring 8. Clear segregation pattern was observed in four families (T109282 (BC₁F₂-JJ04-P1), T109287 (BC₁F₂-JJ15-P3), T109290 (BC₁F₂-JJ29-P1) and T109291 (BC₁F₂-JJ29-P2)), showing susceptible and tolerant plants within the family. However, segregation pattern was most pronounced in T109290 (BC₁F₂-JJ29-P1), making it the best segregating family suited for use as a mapping population. The following traits were also evaluated at the reproductive stage: days to flowering, plant height, number of panicles, number of fertile spikelets, number of sterile spikelets, spikelet fertility, 100-grain weight and grain yield. The analysis of variance revealed significant differences between parents and among ten BC₁F₂ families for almost all traits except for the number of panicles and grain yield. Results also showed that among the eight parameters evaluated, grain yield was the most severely affected, and the reduction of number of fertile spikelets and spikelet fertility are the primary causes of yield loss.

Based on correlation analysis, number of fertile spikelets and spikelet fertility have strong positive correlation with grain yield, hence, these traits are the most important traits contributing to grain yield of rice.

Keywords: Jumbo Jet, Mapping population, Rice, Salinity

Session 6: SOCIO ECONOMIC, COMMUNITY DEVELOPMENT AND AGRICULTURAL DEVELOPMENT

The Production Efficiency and Determinant Factors Affecting Efficiency of Smallholder Farmers Implementing Indonesia Sustainable Palm Oil Production System

Adiprasetyo, T.^{1*}, Irnad, I.² and Nusril, N.^{2,1}

¹Natural Resources and Environmental Management Study Program, University of Bengkulu, Bengkulu, Indonesia; ²Agribusiness Study Program, University of Bengkulu, Bengkulu, Indonesia.

Corresponding Author: teguhadi@yahoo.com

Palm oil is an essential and strategic commodity for Indonesia because it has a significant role in the economy, both nationally and locally. This role is becoming increasingly important because the palm oil industry is based on renewable natural resources so that it has the potential to support Indonesia's economy and development in the long run. Smallholder farmers own almost half of the palm oil plantation. Smallholder farmers are highly vulnerable to price fluctuation of fruit bunches since palm oil commodity is the primary source of family income. Improving production efficiency of smallholder palm oil plantations may improve the family economic resilience. This study was intended to find out if implementing sustainable palm oil production system could contribute to improve the production efficiency, to identify determining factors affecting the production efficiency, and to propose alternative policy intervention for enhancing the production efficiency through implementation of sustainable palm oil production of smallholder farmers. The results show that implementing sustainable palm oil production increased the production efficiency of palm oil farming. Factors influencing the production efficiency are the age of palm oil plants, formal and informal education of farmers, the involvement of farmers in the farmer's association, maintenance of plantation according to technical guidelines, and implementation of Indonesia sustainable palm oil production. This study also recommended alternative policy interventions for fostering production efficiency by implementing sustainable palm oil production of smallholder farmers. The suggestions are developing linkage between farmer's association, local government and university research centre to supply the technical information and supports, strengthening community outreach activities of the university and agricultural extension officers to address the specific need of smallholder farmers, and enhancing dissemination knowledge of sustainable palm oil farming practices to smallholder farmers.

Keywords: production efficiency, smallholder farmer, sustainable palm oil

Ability Development for Reading Comprehension on Environmental Conservation: Brain Based Learning (BBL) of High School Students

Viriyasoonthon, K.

Thai Language Program, Faculty of Education, Sisaket Rajabhat University, Thailand.

Corresponding Author: Kanungchai@gmail.com

This study was aimed to 1) find the effectiveness of lesson plan of reading comprehension on the environmental conservation according to BBL of Matthayom Two students based on the criteria of 80/80, 2) find the effectiveness index (E.I) of reading comprehension and 3) make a comparison between scores of a pretest and a posttest. The sampling used in the study was 25 students of Matthayom Two at Kantharalak Wittayakhom School, Kantharalak District, the Secondary Educational Office, Area 28 in the first semester of academic year 2018. They were chosen by the purposive sampling. The tools used in the study included 1) the lesson plan of reading comprehension, the test with four alternatives and 30 items. The statistics for data analysis were percentage, mean and standard deviation. In addition, the t-test (Dependent Samples) was used to examine the assumption. The results were as follows: 1) The lesson plan of reading comprehension's effectiveness was 84.38/90.00 which met the determined criteria of 80/80, 2) The effectiveness index of reading comprehension was 0.8500, showing that the scores of posttest was higher the pretest's by the percentage of 85, 3) Since the posttest of reading comprehension was higher than the pretest's, the statistical significance was at level .05

Enhancing Productivity and Profitability of Rainfed Rice Production Areas Through Adoption of Improved Rice Ratooning Technology in Nueva Ecija, Philippines

Gajete, T. D., Legaspi, T. D., Abesamis, E. P., Marquez, N. N., Cabute, Z. C., Padilla, J. N. and Aquino, F. B.

Central Luzon State University, Philippines.
Corresponding Author: frinzphilipgajete@yahoo.com

The technology was piloted in the Science City of Muñoz and in Guimba, Lupao and Talugtug, Nueva Ecija, with 84 farmer cooperators trained on the improved rice ratooning. Four farmers' field days were attended by 319 participants. Five (5) inbred and three (3) hybrid rice varieties were ratooned. The 47 farmers ratooned NSIC Rc-222 and 20 farmers used NSIC Rc-216, seven (7) farmers for SL-9H, four (4) farmers for NSIC Rc-308, three (3) farmers for NSIC Rc-10 and one (1) farmer each for NSIC Rc-396, SL-8H and IL-29. In Science City of Muñoz, NSIC Rc-216 produced the highest yield of ratoon rice with a mean of 950 kg/ha and 820 kg/ha in Guimba followed by 660 kg/ha in Lupao and 500 kg/ha in Talugtug. For NSIC Rc-222, the highest yield was recorded in Lupao with 517 kg/ha and in Science City of Muñoz with 438 kg/ha then in Guimba with 407 kg/ha and the lowest in Talugtug with 405 kg/ha. The highest yield of NSIC Rc-308 with a mean of 783 kg/ha was recorded in Lupao followed by 352 kg/ha in Science City of Muñoz. In Guimba, NSIC Rc-396 has a mean yield of 800 kg/ha and in Talugtug NSIC Rc-10 yielded 435 kg/ha. Hybrid rice SL-8H and SL-9H of Science City of Muñoz which were ratooned for the first time produced a mean yield of 230 kg/ha and 238 kg/ha respectively. In Lupao, IL-29 yielded 632 kg/ha. In all the pilot sites, the NSIC Rc-216 having an average yield of 950 kg/ha obtained a gross income of Php 16,910.00 at a price of Php 17.80 per kg. The total expenses in ratooning was Php 8,112.00. The value cost ratio was 1.92. The breakeven yield of 494.97 kg/ha is an implication that rice ratooning is profitable.

The Promotion to grow upside down for villagers of Ban Thakhonyang, Thakhonyang, Kantharawichai Sub District, Maha Sarakham Province

Cumrae, N.¹, Inchai, P.^{2*}, Sittichai, S.¹, Saowakontha, S.², and Piboon, K.³

¹Faculty of Environment and Resource Studies, Mahasarakham University, Maha Sarakham, Thailand; ²Faculty of Medicine, Burapha University, Chon Buri, Thailand; ³Faculty of Public Health, Burapha University, Chonburi, Thailand.

Corresponding Author: puangtong@go.buu.ac.th

The research aimed to study the pattern of villagers' vegetable consumption, to promote growing vegetables upside down and to compare their knowledge and attitude. Ten Thakhonyang villagers were selected for interviewing on vegetable consumption. Thereafter, training manuals and brochures were produced from the structured interview information. After 30 villagers voluntarily participated in program using the Tyler training model, all data on knowledge and attitude were collected by interviewing, knowledge test, and attitude questionnaires. The analysis statistics of percentage, mean, standard deviation and paired t- tests were used to test the statistical hypotheses. The results revealed that all participants had never received information about the growing upside-down gardening before promoting, with the knowledge average score at the low level, and after promoting the knowledge average score was increased to the high level. While the attitude average score was at the uncertain level before the promotion, it increased to the agreed level after participating in the promotion activities. Comparison of the means of both knowledge and attitude scores of the villagers participating in the promotion activities by using posttest higher than pretest were statistically significant at the .001 level. In conclusion, the promotion of growing vegetables upside down has enhanced, not only their knowledge, but also the villagers' attitudes.

Keywords: attitude, knowledge, promotion, to grow upside down, vegetable

Assessment of the Project for Supplementary Incomes of Small Scale Farmers Raising Silver Barb in Baan Doong District, Udon Thani Province, Thailand

Wangkhat, S.^{1*} Pongsuk, P.², Hongmaneerat, K.³, and Sashiyo, M.⁴

¹Banthungyaiphochai school, Baan Doong District, Udon Thani Province, Thailand, ²Department of Agricultural Education, Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Thailand, ³Faculty of Liberal Arts and Science, Nakhon Phanom University, Thailand, ⁴Director, Baan Khaen School, Hora sub-district, Atsamart district, Roi Et province, Thailand. Corresponding Author: songsak_09@hotmail.com

The assessment of the project for supplementary incomes of small-scale farmers raising Silver Barb in Baan Doong District, Udon Thani Province, Thailand in 2017 was the project assessment using CIPP model. It aimed to assess the project based on environmental condition, input factor, process and yields as well as problems encountered. Questionnaire, interview, and training achievement test were used for data collection conducted with the population of 225 persons. The sample group consisted of 120 persons and another 5 persons provided in-depth data. Findings showed that the project was successful. Most of the informants (76.2%) could earn an income for more than 30,000 bath after finishing the project and they had a high level of quality of life. They had highly level of satisfaction with the project (= 4.80). The training on silver barb raising met needs of the informants and it was consistent with way of life of local people. Their silver barb raising was found at a very high level. This implied that they had learned techniques of silver barb raising. About 41 percent of them wanted to rear silver barb as their main occupation and 30.5 percent wanted to do to for supplementary incomes. Results also revealed that : 1) an amount and quality of water; 2) part of the yields was for household consumption; and 3) some of them took some feed of the project for their own fish raising. Appropriateness of environmental condition, input factors, and process of the project were found at a moderate level. Adequate budgets and the establishment of technology transfer on silver barb raising center were advantage of the project. However, there were problems in lack of personnel monitoring the project and operation plan.

Keywords: assessment, supplementary income project, silver barb raising, small scale farmers

~~Land Resource Management Model in Transmigration Settlement: A Case Study in Pelabi Transmigration Settlement, Lebong District, Indonesia~~

~~Hindarto, K. S., Wicaksono, H. and Sulistio, B.~~

~~Soil Science Departement, Agricultural Fraculty, Bengkulu University, Indonesia.~~

~~Corresponding Author: bandi.unib@gmail.com~~

~~Pelabi transmigration settlement unit is adjacent to Bukit Resam conservation forest in Lebong District, Bengkulu Province, Indonesia. The unit was designed to be a model of regular transmigration settlement at once as buffer zone of the conservation forest. The study was carried out to evaluate existing land resources for designing of Palabi transmigration settlement development. Field survey was conducted to determine land suitability. The study revealed that most soil in the area was classified as dystrandep with low fertility; therefore, its land suitability was S3 with limiting factors of soil fertility and slope of the land. In addition, the area has a sufficient water resource. In summary, the Pelabi transmigration unit should be developed as an agriculture area highlighted in annual and perennial crops as well as fisheries.~~

~~**Keywords:** Transmigration Settlement, low fertility, Land Suitability~~

Financial Performance Analysis of Rubber Cooperatives in Trat Province, Thailand

Kromkratoke, W.¹ and Suwanmaneepong, S.¹

¹Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: winorraff@gmail.com

A rubber cooperative in Trat province was first established in 1994. In 2016, eight rubber cooperatives are still operational. The main businesses of these rubber cooperatives are to gather rubber products, supply and sell fertilizer and agricultural chemicals, including granting of loan and deposit money. This study aimed to investigate the financial performance of rubber cooperative in Trat Province, Thailand. Data were collected from Annual Reports in 2016 of eight rubber cooperatives provided by the Department of Cooperative Promotion, Trat Province. Financial performance was analyzed by using ratio analysis, included liquidity ratio, and efficiency ratio. The results revealed that characteristics of rubber cooperatives were divided into primary and secondary businesses. Four rubber cooperatives obtained the highest revenue from gathering rubber products as primary business, accounting for 50 percent of all rubber cooperatives, covering annually 22.53 million (THB.). Regarding secondary business, two rubber cooperatives generated the highest revenue by supplying and selling fertilizer and agricultural chemicals, and processing rubber products accounting annually 4 million (THB). Seven cooperatives (87.5%) had a financial performance are accepted ratio. This finding implied that these cooperatives were successful in terms of operation. The ability of rubber cooperatives to meet current obligations and the use of resources were effective. In contrast, only one cooperative investing in rubber processing gained an unacceptable financial performance ratio which was below than 2. The Acid-test (-0.17) demonstrated rubber cooperatives' dependency upon inventory. Additionally, the inventory turnover ratio was excessively high, since there were heavy investment in rubber processing, machinery, and equipment. Cooperative management should consider financial ratios as an important tool to investigate the performance of rubber cooperatives.

Keywords: rubber cooperative, cooperative performance, cooperative financial ratio, agricultural cooperative, financial performance

Applications of Geographic Information System-GIS for Human Settlement, case of Water based Community in Eastern Region of Thailand

Soytong, P.¹, Janchidfa, K. and Chayhard, S.

Faculty of Geoinformatics, Burapha University, Chon Buri, Thailand.

Corresponding Author: phat_jan@yahoo.com

The results of this study showed that the Eastern region of Thailand has a long history of the human settlements wayback 10,000 years ago. The study found that there were many historic sites located in the region's provinces: Srakaew (129 historic sites), Chonburi (96 sites), Chachoengsao (63 sites), Chanthaburi (48 sites), Rayong (17 sites) and Trat (13 sites). The analysis revealed the city in the eastern area was settled down based on the geographical condition of the region, as well as the natural environment conditions. Furthermore, the settlement pattern in the region was influenced by the environmental factors, such as soil fertility, water sources, etc., and the most significant factor was the location of the region, located of several short rivers and canal. Many of evidences showed that several old communities or ancient city that were located on the basin, had agriculture-based livelihood. For example, the settlement on the coastline in the BangPakong basin began about 5,000 - 1,400 years ago, a community that formed a group, farmed the village, exchange trade and culture from the outside. Historically, the settlement of the people in the eastern region is usually located in the basin of the BangPakong River, Chanthaburi River, Prachinburi River, Prasae River, also along the eastern coast. Nowadays, the old community can be found in the vicinity of these river basins. The study found that there were 98 communities' settlement in this region, and most of them were located along the coast/island (34 sites) and along the river/canal (36 sites). Most of them were the old markets, and they were located along the seafont of the rivers, especially the bay area. The old community reflected the origins of urban settlement, both urban structures and lifestyles, which were shaped by the landscape reflecting how community adapted to the environment conditions.

Keywords: Urbanization, Water-based community, GIS, Environment, Human Settlement

Application of Unmanned Aerial Vehicle to Estimate Seagrass Biomass in Kung Kraben Bay, Chanthaburi province, Thailand

Chayhard, S.^{1*}, Manthachitra, V.¹, Nualchawee, K.², and Buranapratheprat, A.¹

¹Environmental Science, Faculty of Science, Burapha University, Chonburi Campus, Saen Sook, Mueang, Chonburi, Thailand; ²Department of, Faculty of Geoinformatics, Burapha University, Chonburi Campus, Saen Sook, Mueang, Chonburi, Thailand.

Corresponding Author: suchart_chayhard@outlook.com

The seagrass beds are a unique marine productive ecosystem that provides a shelter, a food source for the marine community of animals and act as a biofilter in marine environments. The objective of this study was to use an aerial photograph by applying the Unmanned Aerial Vehicle (UAV), it was to classify seagrass beds in the Kung Kraben Bay. The study area covered 5.59 km², which was shallow (depth 2.5 m) and clear water in the Tha Mai district, Chanthaburi province, Thailand. The visual interpretation with field survey data assisted to be classified in 3 classes such as a long seagrass leaves type (*Enhalus acoroides*), short seagrass leaves type (*Halodule pinifolia* and *Halodule uninervis*), and another object. The classification results show that visual interpretation with the field survey data that was the overall accuracies and Kappa coefficients such as 88.88% and 0.568, respectively. The estimated biomasses of (i) *E. acoroides* and (ii) *H. pinifolia* and *H. uninervis* were 361.89 and 53.83 grams dry weight per square meter, respectively. The average biomass of seagrass zone showed that (i) *E. acoroides* was 454.24 Ton and (ii) *H. pinifolia* and *H. uninervis* were 54.28 Ton in 2017.

Keywords: Seagrass beds, Aerial photograph, UAV, Kung Kraben Bay

Application of Geo-information Technology for Vientiane Addressing Project Implementation in the Core Vientiane Municipality, Vientiane Capital, Lao PDR

Dethoudom, S.

Faculty of Geo-Informatics, Burapha University, Chonburi Campus, Saen Sook, Mueang, Chonburi, 20131, Thailand.

Corresponding Author: somchavang2002@yahoo.com

The Vientiane Addressing Project has received a grant from Association Internationale Des Maires Francophones with the amount of 140,000 Euro and combining funds from Lao Government as well as Vientiane Capital with the amount of 40,000 Euro. The project's boundary covers 50 villages in the Core Vientiane Municipality, Vientiane Capital, Lao PDR which covered 4 districts of Vientiane Capital such as Chanthaburi, Saysettha, Sisattanak and Sikhottabong districts. This project was to create spatial databases based on aerial photos, satellite imageries, and ground surveys, the databases were included the district and village administration boundaries; the sequence of the roads; the buildings (housings) types; produce the tour brochures and maps, and then install the housing and road signs. After implementation of this project, received the spatial databases included the administrative boundary of district and village. It covered 85 villages in the 4 districts; the total number of 833 roads (including 21 arterial roads, 62 collector roads, and 750 access roads); the total number of 22,918 buildings (including the number of 9,413 commercial buildings, 50 gasoline stations, 37 hospitals, 1,057 public buildings, 360 monasteries, 9 monuments, 16 churches, 1 stupa, 420 schools, 7 water towers, and 11,548 private houses). This project installed 23 arterial and collector road signs and 510 access road signs. Productions of tour brochures and maps are not operated yet. This project could serve and provide further works on socio-economic development; urban environmental management (including wastewater, and water supply management), infrastructure planning and construction; administration, public administration, tourism, and society.

Keywords: Vientiane addressing, Spatial databases, Aerial photograph, Satellite imagery, Ground survey, Road sign installation, Core Vientiane Municipality

Economic Effects of Agriculture Sector Affecting to Other Industry Sectors in North Eastern Region of Thailand

Kaenmanee, S.¹, Khermkhan, J.^{2,1}, Latteerasuwan, S.³

¹Faculty of Economics, Khon Kaen University, Thailand; ²Department of Agricultural Development and Resource Management, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Ladkrabang, Thailand; ³Research Institute of Strategy and Coordination for Northeastern Development, Khon Kaen University, Thailand.

Corresponding Author: Jeeranan.kh@kmitl.ac.th

This research has shown of the advantages for agriculture sector in North Eastern region of Thailand involving to the relevant industries with totally for 58 sectors. Besides, it has been analyzed with using the mathematics model based on the information of Input-Output Table. In this case, according to the result it was found that the agriculture business sector has been involved to the backward linkage which has been affected to the economics as the most way. For example, the three most effects to the economics are Beans and Nuts, Cassava and Maize sectors connecting with other industries that are Petroleum Refineries sector, Trade, Banking and Insurance sectors. In addition, for the connecting with the forward of the agriculture business sector it was found that the three most effects to the economics in the most way are Cassava, Livestock and Maize with involving to other industries. What's more, it has seen that it has the same connection to Other Foods and Slaughtering in Cassava sectors and Livestock sector too.

Keywords: Input-Output Table, Agriculture, Economic Effects

Utilization and Protection Welfare of Buffalo in Phuket, Thailand

Mungkhun, S.¹, Pongsuk, P.², Intorrathed, S.² and Sittijinda, P.³

¹Department of Industrial Education, Faculty of Industrial Education, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; ²Department of Agricultural Education, Faculty of Industry Education, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; ³Faculty of Agricultural Technology, Rambhi barni Rajabhat University, Thailand.

Corresponding Author: mungkhuns@hotmail.com

This research aimed to determine the problems and needs of buffalo-rearing farmers in Phuket province of Thailand. Twentyseven (27) male farmers were interviewed, and their main occupation was rearing buffalos. In the study, it highlighted the advantages of buffalos in tourism business. The advantages of buffalos included the following: could demonstrate tilling paddy farming, buffalo riding, buffalo waste is saleable, opening of buffalo learning center in the area, buffalo fare for tourism, and the development of buffalos meat, among others. The buffalos can increase income and popularity of the communities. However, only few people take care of the buffalos. Some buffalos eat food waste from tourists including hazardous waste; and are more susceptible to accident and injury from high density traffic and tourists activities. These caused the reduction of buffalos and buffalo-rearing among farmers as an occupation.

Keywords: Problems of buffalo rearing, buffalos, tourism

The Study of Distribution and Spatial Relationship of Leptospirosis Incidence Using Geoinformation Technology: A case study of Nakhon Si Thammarat province, Thailand

Pholgerdee, P.^{*} and Wantavee, K.

Faculty of Geoinformatics, Burapha University, Thailand.

Corresponding Author: pichitporn.p@gmail.com

The distribution and spatial relationship of leptospirosis incidence using Geoinformation technology, a case study of Nakhon Si Thammarat province was conducted. Results of the study revealed that the crisis and intensity level of leptospirosis incidence in 2016 was higher than any other years in the past, and it secondly occurred in 2014, 2013, and 2015, respectively. The crisis was caused by agglomeration and distribution. Most of the areas that had high crisis value or high intensity were around the lower areas of Nakhon Si Thammarat province. For the analysis result of relationships through the crisis level and land use observed with the Landsat 8 OLI satellite, by translating and classifying the land use and the point of crisis level for leptospirosis incidence in Nakhon Si Thammarat province in terms of area relationships through the land use found that the land use in a building type had the proportion concordant and in the same direction with the crisis of leptospirosis incidence, namely, the higher the crisis was (Level 10), the higher the percent proportion of the land use in a building type appeared, rearranged from 100%, 82.75%, and 61.63%, respectively, and for the agricultural areas, the least intensity was found, which was, 48.33%, 50.49%, and 58.95%, respectively.

Keywords: Leptospirosis incidence, Spatial relationship, Land use, Geoinformation technology

Adaptation of Aging Farmer Life Style by Practice Teaching Media and Media Related to Health

Hongmaneerat, W.¹, Hongmaneerat, K.², and Pongsuk, P.³

¹Faculty of Education, Nakhon Phanom University, Thailand; ²Faculty of Liberal Arts and Sciences, Nakhon Phanom University, Thailand; ³ Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Thailand.

Corresponding Author: dr.whmnr@gmail.com

The objectives of this study were to: 1) construct knowledge about health by using media 20/80; 2) investigate effectiveness index of media related to health; 3) compare learning outcome of aging farmers about health before and after media using; and 4) explore aging farmers satisfaction with media using. The target group consisted of 120 aging farmers in Baan Nongpladuk community. Research instruments in this study were: 1) a tool used for the experiment was a media related to health: animation on tumbling of the elderly; computer assorted instruction on quality of life and family relationships of the elderly; website on quality of life planning of the elderly; and video on emotion of the elderly and 2) a tool used for data collection-test paper measuring knowledge gained from the media and a questionnaire on satisfaction with each type of media using. Percentage, mean, standard deviation, and t-test (Dependent) were used for data analysis. Results of the study were as follows: 1) The aging farmers gained knowledge about health through a type of media with the efficiency of 83.0/088.30, 83.33/98.66, 83.33/85.33, and 92.00/88.66, respectively which were higher than the criteria as set. 2) Effectiveness index value of the media the aging farmers gained increased knowledge for 81.00, 52.00, 69.00, and 58.00 percent. 3) knowledge of the aging farmers about health after using the media was more than before with a statistical significance level at .05, and 4) The aging farmers had a high level of satisfaction with media using (\bar{X} = 4.01, S.D.= 0.86; \bar{X} = 4.39, S.D.= 0.57; \bar{X} = 3.99, S.D.= 0.44; \bar{X} = 4.18, S.D.= 1.06, respectively).

Keywords: aging farmer, farmer life style, practice teaching media, health media

Adaptation of the Life way and Occupation Opportunity for the Elderly Farmers with Khao Mao Product: A Case Study of Baan Nam Kam Community, That Phanom District, Nakhon Phanom Province

Inthanon, W.* and Hongmaneerat, K.

Faculty of Liberal Arts and Science, Nakhon Phanom University, Thailand.
Corresponding Author: dr.whmnr@gmail.com

This qualitative study aimed to 1.) determine the needs for adaptation of way of life and occupation opportunity of the elderly farmer by Khao Mao Product and 2.) recommend a guideline for developing it learning to sustainability. Data were obtained through lesson and conclusions of the lesson. Results of the study revealed that all of the elderly in Baan Nam Kam community needed for adaptation of their quality of life and occupation opportunity by unmilled rice processing to be Khao Mao product. It was a guideline for developing their quality of life. All of them could do it through educational trips and learn from Quality of Life Developing and Occupation Promotion for the Elderly Center, Nakhon Phanom province. This could be a guideline for quality of life development on the basis of life aspects for philosophy of sufficiency economy: body spirit of intellect emotion, society, life security and environment.

Keywords: adaptation of way of life, the elderly farmers, Khao Mao processing

Analyze the Zoning Strategies on Supply and Demand Chain Management to Enhance Sustainable Agriculture in Thailand

Laurujisawat, P.

Faculty of Administration and Management, King Mongkut's Institute of Technology Ladkrabang, Thailand.
Corresponding Author: pornsri.lau@gmail.com

The study was an analytical endeavour to explore the implications of the “zoning strategies” concept aimed at “managing agricultural land use for efficiency productivity benefits in Thailand.” The management technology of Zoning is a strategy on the sustainability of the entire green supply and demand chains because it is related from farms to virtual manufacturing as sustainable production network and consumers. Specifically, it addresses the questions of whether or not and how such strategy can lead to the actualization of development goals of increasing in production efficiency, improvement of competitiveness, mitigation of environmental problems, and generation of sustainable agriculture. The researcher adopted the reviewing technique to gather global selected data, information, and literatures, etc. The published literature was extensively searched by using the key words; zoning, efficiency, competitiveness, environmentally friendly, sustainability of agriculture. After, the results were critical analysed to find out valuable meaningful contents. All outcomes explained why and how zoning enhance sustainability. The results presented the Zoning Strategy is an important answer in solving inefficient production problems. It is used to reduce agricultural land loss by finding suitable lands to match with suitable trees in rapidly growing and achieved a flexible response regulatory, discretionary, and hybrid systems to manage cope with uncertainty and future development. This means planting the right trees to the right lands. The outcomes affected not only increased efficiency but also more balanced pattern of development through stable prices, more equitable income distribution, and a higher degree of social stability. Because after production efficiency increased, the cost of production decreased. This affects price and quality of outputs, as well as marketing competitiveness.

Keywords: zoning, efficiency, virtual manufacturing as sustainable production and network, green supply chain, environmentally friendly, sustainability agriculture, manufacturing

The promotion of Bun Bang Fai tradition (Rocket Festival) in Community following Eco-culture Concept

Boonserm, W.

Department of Environmental Education, Faculty of Environment and Resource Studies, Mahasarakham University, Thailand.

Corresponding Author: eiddy101@hotmail.com

Bun Bang Fai tradition (Rocket Festival) is one of the Northeastern traditions that is called for the 6th month ceremony, is one of the Heet 12 of Isan people during the rainy season in the rice fields to sow the plow to worship Phraya Than for Rain to fall. The villagers held a Bun Bang Fai tradition (Rocket Festival) to worship the God. Villagers believe Phraya Than is responsible for keeping the rainy season accurate and enthusiastic about Bun Bang Fai tradition (Rocket Festival). If any village does not organize Bun Bang Fai tradition (Rocket Festival) to worship. Rain will not fall by the seasons. It may cause disaster to the village. It is held every 6th month or May - June every year. As a result, the Isan people make Bun Bang Fai tradition (Rocket Festival) every year to remind the Phraya Than. Has been trained for generations. Bun Bang Fai tradition (Rocket Festival) has a long history and also is important. Besides, it is a symbol of harmony and friendship. It also demonstrates the natural understanding that affects Isan agriculture. Thus, Bun Bang Fai tradition (Rocket Festival) are important for Isan people in northeastern Thailand. The purposes of study were to study and compare Knowledge, and attitudes about Bun Bang Fai tradition (Rocket Festival) community before and after the promotion. The samples were 30 voluntary students majoring in environmental studies, faculty of environment and resource studies of Mahasarakham university. The research tools were manuals, brochures, achievement tests and the attitudes test. The statistics used for data analysis were frequency, percentage, means, standard deviation, and pair t-test. The findings found that before the promotion students had achievement score at good level and after promotion had achievement score at very good level. When compared mean score between before and after indicated that students had achievement score after more than before the promotion at statistically significant level of 0.05. Before promotion students had attitude score at agree level and attitude score after promotion is at agree level. When compared mean score between before and after the promotion indicated that students had attitude score after the promotion higher than before the promotion at statistically significant level of 0.05.

Keywords: Bun Bang Fai traditional (Rocket Festival), promotion, knowledge, attitudes, eco-culture

List of Posters

Poster Session 1: PLANT SCIENCES AND SOIL MANAGEMENT

Effects of Gibberellin from Banana Stalk to Increase the Stem Elongation in Marigolds by Cuttings

Puangbanyen, A.*, Phonpakdee, R. and Anuchai, J.

Department of Agricultural Education, Faculty of Industrial Education, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: icecooling38053@gmail.com

Stem elongation in marigold is controlled by gibberellins. The purpose of this study was to examine effects of gibberellin from the pseudo-stem of banana to increase the stem elongation in marigolds (*Tagetes erecta* L.) by cuttings. The result was found that the increasing of stem elongation in cutting apical bud of marigold by using the gibberellin from the pseudo-stem of banana inverted with gibberellin synthesis. However too high volume of gibberellin from both pseudo-stem of banana and synthesis induce increasing of the stem elongation less. Whether using gibberellin from synthetic or pseudo-stem of banana effect to the stem stretching of the cutting apical bud in the first pinching better than the second pinching.

Keywords: Gibberellin from banana pseudo-stem, cutting apical bud of marigold, stem elongation

Fine Mapping of Quantitative Trait Loci for Seed-related Traits in Yardlong Bean

Yoshida, A. K.¹ and Tomooka, N.^{2*}

¹Faculty of Animal Science and Agricultural Technology, Silpakorn University Phetchaburi IT Campus, Cha-am, Phetchaburi 76120, Thailand; ²Genetic Resources Center, National Agriculture and Food Research Organization (NARO), Tsukuba, Ibaraki, Japan.

Corresponding Author: tomooka@affrc.go.jp

Yardlong bean is an important legume of Southeast and East Asia. It is believed to domesticate from vegetable (pod) cowpea. Among domestication-related traits, seed size is a distinctly trait that distinguish yardlong bean from wild ancestor which has resulted in an approximately three-fold increase in seed length. Previously, we identified major QTLs for seed-related traits on linkage group 7, which were located on pleiotropic quantitative loci. Seed-related traits are highly complex quantitative traits that are controlled by multiple quantitative loci (QTLs) with a major and several minor effects and are influenced by multiple genetic and environmental factors. Thus, it is challenging to identify the major genes for controlling seed-related traits in yardlong bean. As the basis for fine mapping, a set of near isogenic lines (NILs) was developed from the cross between yardlong bean (JP81610) and wild cowpea (JP89083) population based on three generations of backcrossing and three generations of selfing. We have been able to narrow down the location of the genes underlying seed-related traits from 4.3 Mbp to 1.65 Mbp region. The locus was associated with transgressive variation for seed- and pod-related traits in this population. The phenotype was difficult to evaluate due to the influence of pod-related traits (pod length, pod width and pod softness) affected to seed size variation, underscoring the value of using multiple approaches to phenotyping, including extreme sampling and NILs group-mean comparisons. The fact that the QTLs controlling pod-related traits are also detected on this target region, in which the genes for seed-related traits were associated, suggesting that this region may generally not randomly distributed across the genome.

Keywords: yardlong bean, QTL, fine mapping

Diversity, Utilization and Cultural Significance of Purple Rice in Northeastern Thailand

Senakun, C.¹, Chunta, S.², Somboonwattanakul, I.³, Yodsiri, S.¹, Kurukodt, J.⁴ and Senakun, A.⁵

¹Walai Rukhvej Botanical Research Institute, Mahasarakham University, Maha Sarakham, Thailand

²Department of Energy and Environmental Science, Faculty of Science and Technology, Chiang Rai Rajabhat University, Chiang Rai, Thailand; ³Department of Biotechnology, Faculty of Technology, Mahasarakham University, Maha Sarakham, Thailand; ⁴Department of Environmental Education, Faculty of Environment and Resource Studies, Mahasarakham University, Maha Sarakham, Thailand;

⁵Academic Resource Center, Mahasarakham University Maha Sarakham, Thailand.

Corresponding Author: chadaporn.sen@gmail.com

Fifteen cultivars of purple rice, including eleven of glutinous rice and four of non-glutinous rice were studied for diversity, culture and utilization in Northeastern Thailand. The morphological study found a difference in terms of color of leaf blade, leaf sheath, ligule, leaf collar, auricle, and husk and grain width and length. Morphological data of 28 characteristics were used for purple rice classification by UPGMA method and Principal Coordinate Analysis by NTSYS program. The results of the analysis showed the genetic similarity at 0.00-0.93 which could be divided into 3 groups. Purple rice is a source of household income of the farmers. However, a certain amount of the rice would be saved and exchanged for ritual purposes. Purple rice is believed to be sacred among Northeastern farmers. They hold high regard of it as the queen of rice due to the fact that it can be grown during the annual planting season only. The farmers believe that purple rice is resistant to diseases and pests, acts as an insect repellent, and induces white rice growth. In terms of utilization, purple rice can be consumed either as a staple diet or as a healthy drink. Moreover, purple rice can be used as a kind of herbs for its medicinal property. The result of this study demonstrated that the diversity of purple rice had both cultural and ecological significances. In addition, it can be a geographic indicator. Thus, it is recommended that further studies concerning the promotion as well as conservation of local wisdom relating to purple rice diversity, utilization and significance should be encouraged by both government and private sectors.

Keywords: diversity, purple rice, morphology, utilization, cultural significance

Influences of Gamma Ray and Polyethylene Glycol to Identified the Drought-Resistant in the Rice (*Oryza sativa* L. cv. Riceberry) by Plant Tissue Culture

Meesook, K.¹, Pongtongkam, P.² and Poeaim, A.^{1*}

¹Department of Biology, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang (KMIL), Ladkrabang, Bangkok 10520, Thailand; ²128/13 Moo5 Tambon Sano Loi, Bang Bua Thong, Nonthaburi, 11110, Thailand.

Corresponding Author: anurug@hotmail.com

Rice is the most important food crop in the world and feeds over half of the global population, but there are limited areas of cultivation and affected by various biotic and abiotic stress factors that hinder the production of rice. This study was to improvement of drought resistant on rice (*Oryza sativa* cv. Riceberry) by mutation and tissue culture techniques. The dry seeds of rice were exposed to gamma ray at 0, 20, 25, 30, 35 and 40 krad. Naked seeds were cultured on NB medium without growth hormone. The result indicated of LD50 values 28 krad that, could be highly related to mutagenic agent. The seeds were exposed to a dose at 28 krad of gamma rays and transferred onto NB medium which enhanced with 0, 5, 10, 15 and 20% polyethylene glycol (PEG) compared with non-irradiation. The effect of irradiation and PEG was assessed on root and shoot length, fresh and dry seedling weight, total chlorophyll, carbohydrate content and proline accumulation for 28 days. The non-irradiated seeds results to appear the highest mean shoot and fresh weight. On the contrary, the irradiated seeds presented the highest proline concentration and root length. The PEG provided a decrease in the mean of all the characteristic, except for the means of proline content. The irradiated seeds produced the highest values of root length, dry weight, chlorophyll, proline and carbohydrates in concentration of 15% PEG. These results showed a signal characteristic in drought tolerance which was selected for against drought stress.

Keywords: Drought stress, Gamma radiation, LD₅₀, PEG, Rice (*Oryza sativa* L. cv. Riceberry)

In-vitro Effect of Plant Growth Regulators (PGRs) for Callus Induction and Plant Regeneration from Suspension of Hamata (*Stylosanthes hamata* cv. Verano)

Ngoenggam, L.¹, Pongtongkam, P.², Arananant, J.³, Poeaim, S.¹ and Poeaim, A.^{1*}

¹Department of Biology, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang, Bangkok, 10520, Thailand; ²128/13 Moo5 Tambon Sano Loi, Bang Bua Thong, Nonthaburi, 11110, Thailand; ³Feed and Forage Analysis Section, Animal Nutrition Division, Department of Livestock Development, Pathumthani Province, Thailand.
Corresponding Author: anurug@hotmail.com

This study was found plant regeneration from seeds of Hamata (*Stylosanthes hamata* cv. Verano). Seeds were induced on Murashige and Skoog (MS) medium with different concentration of Cytokinin were used 0.5 1 and 3 mg/L 6-benzyladenine (BAP) *meta*-Topolin (*mT*) or Thidiazuron (TDZ) respectively. The result showed that, the highest percentage of seed induction was 65% and average shoots 9.50 shoots per seed on MS medium supplemented with 3 mg/L *mT* for 12 weeks. The node of Hamata was studied on callus and shoot induction on MS medium supplemented of 0.5 mg/L Indole-3-butyric acid (IBA) and combined with 0.5 1 and 3 mg/L TDZ. The highest percentage of callus and shoot induction was 100% gave average areas of callus at 11192.845 mm² and the number of shoots per callus was 13.50 shoots on MS medium supplemented with 0.5 mg/L IBA combined 3 mg/L TDZ for 8 weeks. Cell suspension culture of callus was developed from node of Hamata. The friable calli were transferred to liquid MS medium supplemented of 0.5 mg/L IBA combined with 3 mg/L TDZ for 30 days. After that, it was transferred to MS medium supplement with 3 mg/L *mT* for shoots regeneration. The percentage of shoots generation from callus was shown on 90% and the number of shoots per callus was 23.25 shoots for 8 weeks. The shoots were transferred to root medium containing of MS medium supplemented of IBA Naphthaleneacetic acid (NAA) or Indole-3-acetic acid (IAA) at 0.1 0.2 0.3 and 0.5 mg/L. The result showed the highest percentage of root induction was 80% and gave average roots of 4.00 roots per explant on MS medium supplement with 0.2 mg/L NAA for 12 weeks.

Keywords: node, suspension, *Stylosanthes hamata* cv. Verano

Optimization on Micropropagation of *Kadsura heteroclita* (Kad 024) by In-vitro Node Culture

Jedoroh, N.¹ Laipas, P.² Chareonsap, P. P.³ and Poeaim, A.^{1*}

¹Department of Biology, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL), Ladkrabang, Bangkok 10520, Thailand; ²Department of Statistics, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL), Ladkrabang, Bangkok, Thailand; ³Plant Genetic Conservation Project, Chitralada Villa, Dusit, Bangkok, Thailand.
Corresponding Author: anurug@hotmail.com

It has been reported in 2008 to be found on sixteen species of *Kadsura* spp., the member of Schisandraceae Family is a vines glabrous woody that found mainly in high forests of East and South East Asia such as China, Bangladesh, Bhutan, Indonesia, Malaysia, Sri Lanka, Vietnam and Thailand. Especially, *Kadsura heteroclita* is used for medicinally purpose but it was rare plant which become extinct in presently. This study was described on shoot and root induction from node of medicinal plant, *Kadsura heteroclita*. The sterilized nodes were used an explants and cultured on solid synthetic medium, Murashige and Skoog (MS) medium supplemented with single or combined Plant Growth Regulators (PGRs) of 6-benzylaminopurine (BAP), *meta*-Topolin (*mT*), Indole-3-butyric acid (IBA), 1-Naphthaleneacetic acid (NAA) and Gibberellin (GA3). For shoot induction the best result was shown on the medium supplemented with 0.5 mg/L of *mT* after 8 weeks. The shoots were transferred to MS medium supplemented with combination PGRs of 0.5 mg/L of *mT* and 0.50, 1.00, 1.50 and 2.00 mg/L of IBA NAA or GA3, after 16 weeks. The explants were developed to multiple shoots that gave the average number of shoot as 3 shoots/explant, and roots were not perfectly exhibited like sore on medium supplemented with 0.5 mg/L of *mT* and 1.50 mg/L of GA3. An efficiency of high concentration of Auxin can inhibit growth roots, for roots induction cut the shoot from last section cultured on MS medium supplemented with combination PGRs of 0.5 mg/L of *mT* and 0.01, 0.02, 0.03, 0.04 and 0.05

mg/L of IBA after 4 weeks found root length from the beginning around 2 mm approximately on 0.5 mg/L of mT and 0.05 mg/L of IBA.

Keyword: Multiple shoot, Plant regeneration, *Kadsura heteroclita*

Application of Soil Test Kit for Evaluating Nitrogen Fertilizer Requirement of Napier Pak Chong 1 Grass in Thailand

Phakamas, N.* and Yampracha, S.

Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand.

Corresponding Author: nittaya.ph@kmitl.ac.th

A soil test kit may be applicable for nitrogen management in pasture grass production. The objective of this study was to evaluate the nitrogen fertilizer requirement of Napier Pakchong 1 grass (*Pennisetum purpureum* × *Pennisetum americanum* cv. Pakchong 1) by using a soil test kit (STK). Seven treatments including unfertilized control, three recommended rates of urea, ammonium sulphate and cattle manure at the rate of 62.5 kg N/ha and three rates of urea, ammonium sulphate and cattle manure recommended by STK were arranged in a randomized complete block design with four replications during November, 2017 to August, 2018. Data were recorded for plant height, tiller number, SPAD chlorophyll reading meter (SCMR), fresh yield and dry matter yield at 60 day intervals for three cutting times. The data were analyzed statistically and the differences between treatments means were compared by Duncan's new multiple range test. Applications of nitrogen fertilizer in the forms of urea and ammonium sulphate could increase dry matter yield of Napier Pakchong 1 grass, whereas applications of cattle manure at both recommended rate and the rate recommended by STK had the dry matter yield similar to that of unfertilized control. Application of ammonium sulphate seemed to be better than application of urea. Under clay soil with moderate soil fertility and high soil moisture content, the soil test kit provided the acceptable guideline for nitrogen management in Napier Pakchong 1 grass. The applications of the soil test kit for nitrogen fertilizer management of Napier Pakchong 1 grass in other soil types are discussed.

Keywords: Ammonium sulphate, Urea, *Pennisetum purpureum*, Forage crop

Effect of Para Rubber Latex and Coir on Compressive Strength, Water Absorption, and Volumetric Change of Adobe Brick

Wongpa, J.¹ and Thongsanitgarn, P.^{2,3,1}

¹Faculty of Industrial Technology, Rambhai Barni Rajabhat University, Chanthaburi, Thailand; ²Aviation Industrial Institute, Rajamangala University of Technology Isan, Nakorn Ratchasima, Thailand; ³Faculty of Sciences and Liberal Arts, Rajamangala University of Technology Isan, Nakorn Ratchasima, Thailand.

Corresponding Author: y.pailyn@gmail.com

The objective of research was to develop of adobe brick that made from soil in Chanthaburi province, Thailand, combined with para rubber latex and coir for environmentally sustainable development. Water content was fixed at a ratio of 0.4 by weight of soil for all mixtures. The amount of water was suitable for mixing and molding of adobe brick. The para rubber latex was added to the traditional mixture at the ratios of 5, 10, 15, and 20 percent by weight of water, respectively. Coir was added as reinforcement of soil structure at 1.0 percent by weight of soil. The compressive strength, water absorption, and volumetric change of adobe bricks were investigated at the ages of 28 days. The results showed that the mixtures containing para rubber latex and no coir gave an outstanding property in dissolution resistance by water. All samples were remained in shape after 28 days of water immersion. While the traditional mixture and mixtures with coir were dissolved within 24 hours. Moreover, the mixture with 15 percent of para rubber latex gave the highest compressive strength, which was 1.58 MPa compared to 0.92 MPa of traditional adobe brick. It could be concluded that para rubber latex can improve compressive strength of adobe brick, significantly. In addition, it was found that mixture containing para rubber latex and coir showed lower volumetric change than that of traditional adobe brick.

Keywords: Adobe brick, Para rubber latex, Coir

Alleviation of Salt Stress on Germination of Rice (*Oryza sativa* L.) by Exogenous Supply of Indole-3-acetic Acid (IAA) Derived from Bacteria

Na Chiangmai, P. *, Rienghlam, P., Anuphanchai, J., Khianggam, S., Yamyang, M., Meetum P. and Duangkaew, P.

Faculty of Animal Sciences and Agricultural Technology, Silpakorn University, Phetchaburi IT Campus, Cha-am, Phetchaburi, Thailand.

Corresponding Author: mchiangmai@gmail.com, nachiangmai_p@silpakorn.edu

The objective of this study was to evaluate the effects of exogenous indole-3-acetic acid (IAA) on germination of lowland rice seed under culture in different salinity levels. In this study, the experiment was conducted in the area's problem from salinity stress for rice planting in farmers' field which located closely to the coastal area at Ban Laem District, Phetchaburi province, Thailand. Exogenous IAA produced from endophytic bacteria; *Enterobacter* sp. RD4-1-1, was investigated to alleviate salt stress in the germination stage of lowland rice (*Oryza sativa* L. cv. RD31 and cv. RD41) under testing in the laboratory. The results showed that salinity culture medium decreased the germination growth of the shoots at 6 dS/m and 8 dS/m in cv. RD31 and cv. RD41, respectively. The different concentrations of exogenous IAA (0, 0.25, 2.5, 25, and 50 μ M) for seed soaking before sowing increased the germination growth in these two cultivars. The interaction effect between IAA concentrations for seed soaking and salinity levels in culture medium was found on the germination growth in two rice cultivars. The higher germination growth was found in seeds soaked with 2.5 μ M IAA and 50 μ M IAA when cultured the seeds at 0-8 dS/m and 10 dS/m salinity, respectively in rice cv. RD31. For rice seeds cv. RD41, applying 2.5 μ M IAA and 50 μ M IAA for seed soaking and cultured at 0-6 dS/m and 8-10 dS/m salinity, respectively increased the growth germination. Exogenous IAA for soaking the seed increased the percent of germination (both root and shoot emergence) in rice cv. RD41, particularly in treatment that seed soaked in 2.5 μ M IAA concentration, and followed by 50 μ M IAA.

Keywords: auxin, indole-3-acetic acid, salt stress, rice germination, exogenous hormone

Evaluate Characteristics of New Cherry Tomato Varieties of Mahasarakham University

Pasorn, P.^{1*}, Senakun, C.¹, Saensouk, S.¹, Sinsiri, W.² and Somboonwattanakul, I.³

¹Research Unit of Biodiversity and Conservation, Walai Rukavej Botanical Research Institute, Mahasarakham University Maha Sarakham, Thailand; ² Department of Agriculture Technology, Faculty of Technology, Mahasarakham University, Maha Sarakham, Thailand; ³ Department of Biotechnology, Faculty of Thechnology, Mahasarakham University, Maha Sarakham, Thailand.

Corresponding Author: pattanapasotn@gmail.com

The new cherry tomatoes varieties were pollinated from two commercial tomato varieties (F1-hybrid) and then selected by pure line method. The study was conducted between October 2017 and February 2018 at Walai Rukhavej Botanical Research Institute, Mahasarakham University and Wang Nam Khiao district, Nakhon Ratchasima Province. The farmer practice method was used for all sites. The results show two new cherry tomato varieties are better than tomato commercial varieties. The MSU50-1 variety has average yield of 1,468.2 Kgs/plant, 11.48 g fruit weight, 8.56 brix, 13.50 fruit/cluster fruit set number and 50% flowering since 35.83 day after planting. The MSU50-6 variety has average yield of 1,084.7 Kgs/plant, 11.0 g fruit weight, 8.60 brix, 7 fruit/cluster fruit set number and 50% flowering since 40.33 day after planting.

Keywords: cherry tomato, characteristics, breeding, pure line selection

Organic and Inorganic Fertilization in Direct Seeded and Transplanted Onion

De la Cruz, Q. D., Quilantang, J. R., Atejada, M. P. and Alvaran, P. J. *

Central Luzon State University, Science City of Munoz, Nueva Ecija, Philippines.
Corresponding Author: alvaranpaulina@gmail.com

Balanced fertilization is a key to high quality and good bulb yield. The study aimed determine the effects of different fertilizer combinations of organic and inorganic fertilizers on the growth and yield of direct and transplanted onion. The experiment was laid out in 2 factorial experiment in a randomized complete block design (RCBD) with three replications, factor A: method of planting (1-Transplant, 2-Direct seeded) and factor B (8 fertilizer treatment combinations). Data were analyzed using the SAS statistical software (v. 9.1). Results indicated that higher percent survival (96.4%) was observed in transplanted than in direct seeded (63%). Likewise, higher percentage of medium bulbs were produced on transplants (65.6%) than in direct seeded. However, shorter maturity was observed on direct seeded than in transplanted while longer maturity in plants without fertilizer and those applied with organic fertilizer. The computed fresh yield per hectare was higher in transplants (89.8 t) than in directly seeded (74.7 t). Fertilizer combination T5 (10 DAT=10 bags OF ha⁻¹, 20 DAT=20 bags OF ha⁻¹, 30 DAT= 20 bags OF ha⁻¹) registered the highest computed fresh yield of 87.3 t/ha but was comparable with T1, T8, T3, T6, T7 and T2 which obtained yield of 78.7, 78.7, 84.3, 85.0, 86.0 and 87.7 t/ha, respectively. Likewise, yield is higher in plants applied with fertilizer combination particularly in Treatment 4 (10 DAT= CaNO₃ + 16-20-0 = 5 bags ha⁻¹, 20 DAT=16-20-0 = 3 bags ha⁻¹, 30 DAT= 21 -0-0 + ZnSO₄ (30:10) = 4 bags ha⁻¹) which was significantly different from T5. Based on the results of the study, transplanted seedlings produced higher bulb yield but delayed maturity as compared to direct seeded. However, all the fertilizer treatments in both methods gave comparable yield. Hence, there is a need to further study the nutrient requirement of onion for bulb quality and higher yield in both methods of planting.

Keywords: Organic, inorganic, fertilization, direct seeded, transplanted onion

The Effect of Plant Growth Regulator and In-vitro Conservation of Teak (*Tectona grandis* L.) by Tissue Culture

Tongsad, P.¹, Laipasu, P.², Chareonsap, P. P.³ and Poeaim, A.^{*1}

¹Department of Biology, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL), Ladkrabang, Bangkok 10520, Thailand; ²Department of Statistics, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL), Ladkrabang, Bangkok, Thailand; ³Plant Genetic Conservation Project, Chitralada Villa, Dusit, Bangkok, Thailand.
Corresponding Author: anurug@hotmail.com

The purposes of research were to examine on the efficient plant regeneration of teak (*Tectona grandis* L.). The experiment was chosen a protocol for rapid *in vitro* teak propagation that used shoot tips and node were sterilized explants. The explants cultured on Murashige and Skoog (MS) medium supplemented with Thidiazuron (TDZ) benzyladenine (BAP) and *meta*-Topolin (*mT*) used 0.25, 0.5, 1 and 2 mg·L⁻¹ for shoot induction. The highest number of shoot induction was obtained at 0.25 mg·L⁻¹ TDZ, and followed by 0.25 mg·L⁻¹ *mT* after 4 weeks. Shoots were cut after elongation to prepare the shoot tip explants that used in studies for cryopreservation on teak by vitrification (Vi), encapsulation-vitrification (EnVi) and encapsulation-dehydration (EnDe) technique. The shoot tip was used as the explants, encapsulated apices were precultured on MS medium with 0.3 M sucrose for 1 and 3 days, then dehydrated, direct immersed in liquid nitrogen for 24 h, and thawed in thermal bath at 40 °C and washed in 1.2 M sucrose solution. Vi and EnVi protocol, treated with a loading solution composed of 2 M glycerol with 0.4 M sucrose, dehydrated by plant vitrification solution 2 (PVS2). EnDe protocol, encapsulate were desiccated under laminar air flow and dehydrated with silica gel. The experiments showed that EnVi resulted in an excellent shoot tip explants for recovery and regrowth. The highest percentage of recovery achieved was 30% with EnVi.

Keyword: Plant regeneration, Cryopreservation, Vitrification, Encapsulation-vitrification, Encapsulation-dehydration

Efficiency of Cytokinin for In-vitro propagation of *Gluta usitata* (Na-pong3)

Rakrawee, R.¹, Kittibanpacha, K.², Chareonsap, P. P.³ and Poeaim, A.^{1*}

¹Department of Biology, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand; ²Silvicultural Research Group, Forest Research and Development Bureau, Royal Forest Department, Bangkok 10900, Thailand; ³Plant Genetic Conservation Project, Chitralada Villa, Dusit, Bangkok 10303, Thailand.

Corresponding Author: anurug@hotmail.com

Gluta usitata is a lacquer tree and can be utilizing in many aspects especially art and culture. Currently, the conservation of plant has reduced and become extinct in the future. The experiment was explained an effect of plant growth regulators (PGRs) for young seeds induction and shoot multiplication of *Gluta usitata* (Na-pong3) by plant tissue culture technique to preserve and increase this plant. In these studies, young seed induction was compared the effect of 0.5, 1, 1.5, 2 and 3 mg/L 6-Benzyl amino purine (BAP), Thidiazuron (TDZ) or *meta*-Topolin (*mT*) on Woody Plant Medium (WPM). The results showed the highest percentage of seed regeneration at 0.5 mg/L TDZ of 100% germination, but the best of shoot induction was 1 mg/L BAP after culture for 6 weeks. After that, shoots were transferred to WPM medium containing with BAP, TDZ or *mT* for multiple shoot and root induction. The maximum number of shoots were observed on WPM medium combined with 3 mg/L BAP (about 5 shoots per explant) after subcultured for three time. The best of root induction was observed on WPM medium without PGRs.

Keywords: *Gluta usitata*, shoot multiplication, young seeds regeneration

Juvenil Stage and Field Selection for Salinity Tolerance Genotypes of Rice

Rustikawati, Herison, C. and Ganefianti, D. W.

Faculty of Agriculture, the University of Bengkulu, Indonesia.

Corresponding Author: rustikawati@unib.ac.id

The expansion of rice plantations in Indonesia can only be done on marginal lands including coastal area subjected to highly salinity stress. The use of tolerant cultivars is a recommended strategy to overcome the adverse effect of salt stress. Selection with NaCl stressing media followed by selection on saline soil is expected to provide the most tolerance genotypes. The objective of this study was to evaluate the tolerance of twenty Bengkulu's local rice genotypes to salinity stress. The experiment consisted of three steps, namely (1) determination of Lethal Concentration of 90% (LC₉₀) for NaCl stress, (2) screening of tolerance of 20 Bengkulu's local rice genotypes to NaCl stress at LC₉₀ concentration, and (3) evaluation of 20 local Bengkulu rice in saline soil of coastal area of Bengkulu City. Assessment of tolerance levels was conducted during vegetative and generative phases following the standard methods for rice of IRRI's evaluation system. The value of the symptom score of the damage was then converted into the tolerance index value. Tolerance index values were used as a basis for grouping to be very tolerant, tolerant, medium tolerant, sensitive and very sensitive. The results showed that LC₉₀ for NaCl tolerance was obtained at a concentration of 3910 ppm. Furthermore, selection of Bengkulu's local rice in nutrient culture was carried out at 4000 ppm NaCl concentration and of the 20 genotypes, there were 3 medium tolerant genotypes i.e. 'Humbur', 'Kuning Tinggi' and 'Padang Bakung'. While genotypes classified as very sensitive were 'Beram', 'Imperata' and 'Kuning'. In the testing of local rice in coastal land, there were two genotypes considered medium tolerant based on vegetative and generative observations, namely Humbur and Kuning Tinggi. Humbur and Kuning Tinggi were the most consistence genotype which were medium tolerant in either culture media or coastal land.

Keywords: coastal area, NaCl stress, *Oriza sativa*, screening

Effect of IBA and NAA on Rooting and Axillary Shoot Outgrowth of ‘Himalayan’ Mulberry Stem Cutting

Sokhuma, P., Intorrathed, S. and Phonpakdee, R.

Department of Agricultural Education, Faculty of Industrial Education, King Mongkut’s Institute of Technology Ladkrabang, Thailand.

Corresponding Author: sarawut.in@kmitl.ac.th

The objective of this experiment was to study the effect of IBA and NAA on root and shoot initiation of ‘Himalayan’ mulberry stem cutting. The effect of IBA and NAA of 4 different concentrations (500, 1000, 2000 and 3000 ppm) were compared and used in closed system. The result showed that after 40 days of cutting, 2000 and 3000 ppm of IBA were the best result and not significant different in both concentrations. The result showed 3000 ppm of IBA was 86.67 % of rooting, with 18.8 roots, 10.82 cm of root length, and 13.11 cm of shoot initiation. While, 2000 ppm of IBA resulted to 73.33 % of rooting, 19.20 roots, 9.88 cm of root length, and 10.65 cm of shoot initiation. Therefore, IBA 2000 ppm was appropriated to apply in “Himalayan” mulberry propagation with stem cutting because cheaper cost.

Keywords: auxin, stem-cutting, mulberry, rooting, axillary shoot

Effects of Different Harvesting Times on Growth, Yield and Quality of Kalmegh (*Andrographis paniculata* Wall Ex. Nees)

Detpiratmongkol, S.* and Liphan, S.

Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut’s Institute of Technology Ladkrabang, Bangkok, Thailand.

Corresponding Author: kdsomyot@hotmail.com

This experiment was undertaken during June to November 2016, to investigate the effect of harvesting times on growth, yield and quality of kalmegh. The treatments were laid out in a split plot design, with three local kalmegh cultivars (Pitsanulok 5-4, Prachinburi and Nakhon Prathom cultivars) as the main plots and four harvesting times (harvesting at 120, 135, 150 and 170 days after planting (DAP)) as sub plots with three replications. The results were disclosed that for three local kalmegh cultivars, stem and leaf dry weight and total dry weight of Prachinburi cultivar which were the the highest, and followed by Nakhon Prathom and Pitsanulok 5-4 cultivars, respectively. Leaf dry weight and seed dry weight of Prachinburi cultivar were the highest. Harvesting times affected on growth and yield of kalmegh. The highest leaf dry weight yield (13.59 g plant⁻¹) and andrographolide content (2.54%) were recorded at harvesting times of 135 DAP, but the highest seed dry weight was detected 170DAP. However, it is recommended that harvesting times at 135DAP in Prachinburi local kalmegh cultivar should be adopted.

Keywords: Kalmegh, Harvesting time, Growth, Yield

Effect of Secondary Nutrients and Micronutrients Deficiency on Growth of Cassava

Yampracha, S.¹, Thummanatsakun, V.¹, Tawinteung, N.¹, Amornpon, W.² and Tancharoen, S.³

¹Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut’s Institute of Technology Ladkrabang, Bangkok, 10520, Thailand; ²Field and Renewable Energy Crops Research Institute, Huaipong, Muang, Rayong 21150, Thailand; ³Soil science Research Group Agricultural Production Science Research and Development Division, Bangkok 10900, Thailand.

Corresponding Author: sukunya.ya@kmitl.ac.th

Plant secondary nutrients and micronutrients become important for the cassava growth and yield. The objective of this study was to examine the effect of secondary nutrients and micronutrients deficiency on the growth of cassava using omission trial technique. The experiment was designed in randomized complete block with 4 replications. Cassava (Kasetsart 50 varieties) was planted in sand culture for 4 months. Ten different plant nutrition solutions were applied for four months which consisted distillation

water (control), all nutrient (Complete), minus calcium (-Ca), minus magnesium (-Mg), minus sulfur (-S), minus boron (-B), minus copper (-Cu), minus zinc (-Zn), minus nickel (-Ni) and minus molybdenum (-Mo). The experiment was repeated in the same way but using spongy instead of sand to confirm the results. The results showed that aboveground dry weight of -Ca, -Mg -S and -Zn treatments were decreased when compared with complete treatment at 34.13, 38.37, 37.60 and 11.85 %, respectively. Fresh and dry tuber weight of -S treatment were significantly different with complete treatment and dry weight that was decreased by 23.37 % as compared with complete treatment. Nutrient concentration in the youngest fully-expanded leaf indicating that nutrient status in cassava showed that sulfur status was deficient in -S treatment. It was related to the growth and yield in -S treatment. Sulfur uptaked significantly different with complete treatment. The repeat experiment showed that sulfur and iron deficiency symptom was found in -S and -Fe treatment at the first month after planting. At the second months after planting, calcium, magnesium, boron, copper, manganese, zinc and molybdenum deficiency were found in -Ca, -Mg, -B, -Cu, -Mn -Zn, and -Mo treatments, respectively.

Keywords: cassava, nutrient deficiency, deficiency symptom

Colchicine and UV Radiation Treatment on Somatic Embryo Formation of Hybrid Oil Palm Sub-PSU Variety

Ramasoot, S.^{1*}, Nuannut, W.¹ and Khawniam, T.²

¹Department of biology, Faculty of Science and Technology, Nakhon Si Thammarat Rajabhat University, Tumbon Thayew, Mueang district, Nakhon Si Thammarat Province, Thailand; ²Department of Plant Science, Faculty of Natural Resources, Prince of Songkla University, Hat-Yai campus, Songkhla Province, Thailand.

Corresponding Author: supawadee.rs@gmail.com

Colchicine at 0, 0.1, 0.2, 0.3 and 0.5 % for 12, 24 and 48 hour or UV-C irradiation at doses of 0, 1.8, 3.6, 7.2 and 9.0 kJ/m² were used to treat embryogenic callus (EC) of oil palm cv. SUP-PSU, followed by culturing on Murashige and Skoog (MS) medium supplemented with 0.1 mg/l dicamba and 200 mg/l ascorbic acid. The results showed that the LD₅₀ of colchicine treatment was 0.5% for 24 hour after culturing for one month. Colchicine at 0.1% for 48 hour gave the highest proliferation of EC induction (98.33%), average number of EC (16.88 ECs/explant), somatic embryo (SE) induction (5.00%) and average number of SE (0.75 SE/explant), significant difference ($p \leq 0.05$) after 3 months of culture. The LD₅₀ of UV-C irradiation was 1.8 kJ/m². ECs irradiated without of UV-C gave the highest proliferation of EC induction and SE induction at 38.88% and 16.25% respectively, significant difference ($p \leq 0.05$) after 3 months of culture.

Keywords: oil palm, colchicine, UV-C irradiation, somatic embryo

Effect of Plant Growth Regulators for In vitro *Vanilla aphylla* and *Vanilla planifolia variegata*

Kunwanlop, W., Boonmee, W.¹, Laipasu, P.², Chareonsap, P. P.³, Krajangvuth, T.⁴ and Poeam, A.^{*1}

¹Department of Biology, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL), Ladkrabang, Bangkok 10520, Thailand; ²Department of Statistics, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL), Ladkrabang, Bangkok 10520, Thailand; ³Plant Genetic Conservation Project, Chitralada Villa, Dusit, Bangkok 10303, Thailand; ⁴Phratammak Suan Pathum, Tumbon Bang Khayaeng, Amphoe Mueang, Pathum Thani, 12000, Thailand.

Corresponding Author: anurug@hotmail.com

Vanilla (*Vanilla planifolia* Andr.) is the plant in family orchidaceae. It is a commercial species, normally propagated by cutting from parent strain. Tissue culture is the alternate method of propagation for mass products. This research aimed to study on plant growth regulators that suitable for propagating a large number of vanilla in short time. In this study, axillary bud was an explants of *Vanilla planifolia variegata* and *Vanilla aphylla* were cultured on solid media and compared with liquid Gamborg's B5 medium, supplemented with 0, 0.5, 1, 1.5 and 2 mg/l 6-benzylaminopurine (BA) for 8 weeks. The result

showed the highest average number of shoot proliferation and root induction was obtained at 1 mg/l BA on solid medium for *Vanilla planifolia* variegata and *Vanilla aphylla* was on solid medium also but different concentration at 1.5 mg/l BA. After 12 weeks explants from the best results of last step were transferred to plantlet in simulated green house by took plastic bag cover for 4 week was founded that the survival rate was 80% of the rooted plantlets after acclimatizations.

Keyword: Axillary bud, Shoot induction, *Vanilla planifolia* Andr.

Poster Session 2: MICROBIAL BIOTECHNOLOGY AND PLANT PROTECTION

~~Isolation, Screening and Identification of Antagonistic Root Rot Endophytic Bacteria of Black Pepper (*Piper nigrum* L.) In Dong Nai Province, Vietnam~~

~~Le, C. T. M. *, Nguyen, N. T. A., Tran, T. T., Dao, H. N. D and Duong, X. H.~~

~~Biotechnology center of Ho Chi Minh City, Vietnam.~~

~~Corresponding Author: lumaicham.bio@gmail.com~~

~~*Pythium vexans* is one of the agents causing root rot disease of black pepper (*Piper nigrum* L.) plantations. There were several methods to control root rot disease, but their results were still limited. Endophytic bacteria are the most potential agents to reduce the damage of such disease. From 112 tissue samples of black pepper were collected in Cam My and Xuan Loc of Dong Nai province, 56 endophytic bacterial strains were isolated. In which, the most significant proportion of strains was found in Xuan Loc (59%). After evaluating as well as screening for those which can antagonize against *Pythium vexans* in black pepper, three strains including XL12T1, XL22T1, XL73R1 can inhibit the growth of *Pythium vexans* with over 70% after 5 days of incubation. Nucleotide sequence analysis of the 16S regions showed that these isolates are *Pseudomonas aeruginosa*.~~

~~**Keywords:** Black pepper, *Piper nigrum* L., *Pythium vexans*, Root rot disease, endophytic bacteria~~

Nano-particles Constructed from *Chaetomium brasiliense* and *Trichoderma harzianum* strain PC01 sp to Control Anthracnose Disease in Chili

Zhang, F.¹, Soyong, K.¹, Kanokmedhakul, S.² and Kanokmedhakul, K.²

Department of Plant Production Technology, Faculty of Agricultural Technology, King Miongkut's Institute of Technology Ladkrabang, Bangkok, Thailand, Department of Chemistry, Faculty of Science, Khon Khan University, Khon Khan, Thailand.

Corresponding Author: ajkasem@gmail.com

In this study, *Ch. brasiliense* and *T. harzianum* strain PC01 were used to evaluate the inhibition effect on *Colletotrichum capsica* causing chili anthracnose. In bi-culture tests, *Ch. brasiliense* was able to inhibit the growing of a pathogen with growth inhibition rate at 40% and it also gave spore inhibition rate at 49.68%. *T. harzianum* can inhibited growth and spore production at 85.44% and 73.33%, respectively. It was found that crude ethyl acetate extracted from *Ch. brasiliense* and crude methanol extracted from *T. harzianum* at 1000 ppm were significantly inhibited growth and sporulation of a pathogen. The crude extract obtained from *Ch. brasiliense* inhibited the growth at 80.25% and gave spore inhibition rate at 99.71% with ED₅₀ value of growth and spore inhibition at 3.29 and 66.02 µg/ml respectively. While crude extracts obtain from *T. harzianum* can inhibited pathogen growth and sporulation of a pathogen at 82.25% and 90.19%, respectively, and it had ED₅₀ value of growth and spore inhibition at 4.74 and 10.30 µg/ml respectively. It was also found that the nano-particleless obtained from crude hexane extract of *Ch. brasiliense* (Nano CBH) and crude methanol extracts of *T. harzianum* (Nano THM) at 10 ppm were the most effective substances for inhibiting the growth and Sporulation. Nano CBH were inhibited the growth at 33.00% and spore inhibition is 96.26%, and it had ED50 value of spore inhibition at 11.03 µg/ml Nano THM was able to inhibit growth and spore production at 31.50 and 81.79%, respectively whereas ED50 value of spore inhibition was 43.70 µg/ml. In pot experiment, it was found that a chili sprayed with nano-particles was indifference to non-inoculated control and chemical treatment plants. it showed that the antagonistic fungi can effectively inhibit the growth of plant pathogenic fungi.

Keywords: nano-particles, Chaetomium, Trichoderma, anthracnose, chilli

In vitro Antimicrobial Properties of Different Solvent Extracts from *Carissa carandas* L. Fruits

Pilasombut, K.¹, Laosinwattana, C.², Nguyen, T. K. T.² and Teerarak, M.^{2*}

¹Department of Animal Production Technology and Fisheries, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand; ²Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand.

Corresponding Author: montinee.te@kmitl.ac.th

The objective of this research was to investigate an *in vitro* antimicrobial activities of various solvent systems (0%, 25%, 50%, 75% and 100%) ethanol in water of *Carissa carandas* fruit extracts. Agar well diffusion, Minimum Inhibitory Concentration (MIC), Minimum Bactericidal Concentration (MBC) and killing time were determined. The results found that, absolute ethanol and 75% ethanol extracts inhibited all 11 strains of both pathogenic and spoilage bacteria at the concentration of 100 mg/ml. The absolute ethanol extract was selected as an optimal extraction solvent for the following study showed the strongest antimicrobial activity. The MIC values of absolute ethanol extract to inhibit *Pseudomonas fluorescens* TISTR 358, *Staphylococcus aureus* TISTR 118, *Salmonella* Typhimurium TISTR 292, *Escherichia coli* TISTR 780 were 25, 25, 50, and 50 mg/ml, respectively whereas the MBC values to inhibit these bacteria were 100, 25, 50, and 100 mg/ml, respectively. Moreover, *S. aureus* and *S. typhimurium* were completely killed at 20 and 6 minutes exposure time by absolute ethanol extract from *C. carandas* fruits at the concentration of 25 mg/ml and 50 mg/ml, respectively.

Keywords: *Carissa carandas* fruit extract, antimicrobial

Antimicrobial and herbicidal activities of *Senna spectabilis* extracts against plant pathogens

Mongkol, R.¹ and Chavasiri, W.²

¹Program in Crop Production Technology, Faculty of Animal Science and Agricultural Technology, Silpakorn University, Phetchaburi IT Campus, Cha-Am, Phetchaburi 76120, Thailand; ²Center of Excellence in Natural Products Chemistry, Department of Chemistry, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand.

Corresponding Author: mongkol_r@silpakorn.edu

Senna spectabilis or *Cassia spectabilis* belonging to family Leguminosae-Caesalpinioideae is widely grown as an ornamental plant in Thailand. Antifungal and antibacterial activities of plant disease and weed inhibitory germination were studied. The flowers and leaves extracts of *S. spectabilis* displayed low to moderate inhibit *C. gloeosporioides* and *F. oxysporum* (%44.44-85.1 at 1,000 ppm. Among the extracts, flowers extracts from dichloromethane was shown highest against *Rhizoctonia solani* (%0.47). However, these extracts could not inhibit the mycelial growth of *Phytophthora parasitica*. Moreover, heartwood of methanol extract inhibited *Erwinia chrysanthemi* and *Xanthomonas axonopodis* at 16.001±. 20 and 25.005±. 00mm. at 10,000ppm, respectively. Furthermore, the methanol extract from leaves and dichloromethane extract from flower of *S. spectabilis* at 10,000 ppm were completely inhibited the germination, the growth of shoots and roots of Swollen finger grass (*Chloris barbata*), and followed by methanol extracts of flower and heartwood with 95.50% germination inhibitory. While the seed germination of Chinese Cabbage-PAI TSAI (*Brassica chinensis* Jusl var. *parachinensis* (Bailey) Tsen & Lee) was inhibited by dichloromethane flower extract at 71.38%. However, the growth of Chinese Cabbage-PAI TSAI was completely inhibited by methanol leaves extract and flower extracts from this plant. This research was demonstrated the potential of *S. spectabilis* to inhibit plant pathogens, weed germination and growth. These extracts should be applying to agriculture, weed and microbial control plant diseases to reduce chemical usage and non-toxic to the environment.

Keywords: *Senna spectabilis*, plant disease, germination, weed

Optimal Extraction Solvents use for Extraction of *Thunbergia laurifolia* Linn. Leaves and its Mode of Action on Weed Control

Thinh, N. H., Laosinwattana, C. and Wichittrakarn, P.*

Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Landkrabang, Bangkok 10520, Thailand.

Corresponding Author: gao_ga@hotmail.com

Thunbergia laurifolia Lindl. leaves were extracted by various ratios (0, 25, 50, 75 and 100%) of ethanol in water as solvents for crude extraction. The highest crude extract yield was obtained by using 25% ethanol solvent with three time extractions. The inhibitory effect of each extract on seed germination and seedling growth of *Amaranthus gracilis* was investigated. The results indicated that the 100% ethanol extract expressed the best inhibitory effect. At concentration of 1250 ppm, the 100% ethanol extract completely inhibited seed germination of *A. gracilis*. The 100% ethanol extract also inhibited α -amylase activities in *A. gracilis* seed during seed germination. However, it had no effect on seed imbibition. The inhibition of induction of α -amylase increased with increasing concentration of the 100% ethanol extract.

Keywords: *Thunbergia laurifolia*, Allelopathy, Solvent, Weed control.

Efficiency of Antifungal Compounds Against Powdery Mildew Disease of Roses (*Podosphaera pannosa*)

Wanasiri, N.*, Noireung, P., McGovern, R. J., To-anun, C.* and Cheewangkoon, R.*

Department of Entomology and Plant Pathology, Faculty of Agriculture, Chiang Mai University, Thailand.

Corresponding Author: chaiwat.toanun@gmail.com, ratcha.222@gmail.com, nunun_nw@hotmail.com

The Powdery mildew (*Podosphaera pannosa*) on rose cultivar "Queen Sirikit" is the most serious disease problem. The fungus was identified as genus *Fibroidium* (Anamorph: *Oidium rosae-indicae*) based on the morphological characteristics of the anamorph using light microscope (LM). The observations revealed mycelium with indistinct or nipple-shaped appressoria, conidia with fibrosin bodies that measured approximately 6 to 8 x 17 to 18 μ m., germ tubes fuliginea-type. Conidiophores were straight, ca. 5 to 7 x 41 to 80 μ m with cylindrical foot-cells. For the reason to reduce chemical for controlling powdery mildew on roses. The study efficacy of antifungal compound, chosen among salicylic acid (SA), fresh cow milk (10%/V.), biocontrol agents *Bacillus subtilis* (BS) and the hyperparasitic fungus *Ampelomyces* sp. compared with fungicide were tested for inhibition of spore germination on thin layer of onion. The experiment indicated that SA was inhibit conidia germination 99.72% efficiency followed by BS (98.99% efficiency). Then, *Ampelomyces* sp. (95.41%) and carbendazim (83.24%). Meanwhile, fresh cow milk was the lowest efficient in reducing the severity of the disease being 80.81% efficiency. Control treatment recorded 53.80% disease severity.

Keywords: *Podosphaera pannosa*, *Oidium* sp., Controlling powdery mildew, management plant disease, powdery mildew, Biological control.

Study on the Optimization for Increase Production of Indole Acetic Acid from Bacterial Endophyte RD4-1-1

Khianggam, S., Meetum, P., Duangkaew, P. and Na Chiangmai, P.

Faculty of Animal Sciences and Agricultural Technology, Silpakorn University, Phetchaburi IT Campus, Phetchaburi, Thailand.

Corresponding Author: khianggam_s@silpakorn.edu

The RD4-1-1 was endophytic bacteria that isolated from the indigenous upland rice seeds, which produced indole acetic acid (IAA) as 49.21 µg/ml and evaluated against *Curvularia* sp. as 52.14±3.92%. The isolate was selected to increase IAA production, which was identified as *Enterobacter cancerogenus* RD4-1-1 by nucleotide sequence of 16S rRNA gene and phylogenetic tree. After optimization, IAA production increased as 161.39±2.52 µg/ml when the nutrient broth (NB) medium was supplemented with L-tryptophan 500 µg/ml, mannitol 1% at pH 6.5, 1% of inoculum and incubated at 30 °C, 150 rpm for 3 days. IAA was confirmed by extraction and subsequent thin layer chromatography analysis. The color spot of RD4-1-1 sample was found to close with a spot of standard IAA with R_f value at 0.79 and 0.80, respectively. Further, IAA of bacteria at 2.5 µM concentration was demonstrated to display stimulatory effect on growth of rice RD 31, which could significantly enhance root emergence of rice over the control treatment. Overall, the results indicated that *E. cancerogenus* RD4-1-1 can produce IAA up-scale after optimization and had potential for stimulatory effect on growth of rice RD 31.

Keywords: Endophytic bacteria, Indole-3- acetic acid, Bacterial culture conditions, *Enterobacter cancerogenus*

Isolation and Characterization of Antagonistic Bacteria to Control Rice Fungal Diseases

Monkhung, S.* , Duangkaew, P., Srichoke, N. and Kongkriengkrai, R.

*Faculty of Animal Sciences and Agricultural Technology, Silpakorn University, Phetchaburi IT campus, Sampraya, Cha-am, Phetchaburi, Thailand.

Corresponding Author: apple.sararat@gmail.com

A total of 59 bacterial isolates were isolated from rhizosphere soil of rice in Tha-rang sub-district, Ban-Lham district, Phetchaburi province. The preliminary study was conducted using dual culture assay to investigate the efficacy of antagonistic bacteria to control rice fungal diseases including *Curvularia* spp., *Fusarium* spp. and *Rhizoctonia* spp. The result showed that 5 isolates: BL-44, BL-48, BL-55, BL-56 and BL-59 showed the efficiency to control the fungal pathogens. The BL-59 isolate revealed maximal percentage of mycelial growth inhibition against *Curvularia* spp. and *Fusarium* spp. and BL-44 isolate was showed maximal mycelial growth inhibition percentage against *Rhizoctonia* spp. (P<0.05). Microscopic observation of hyphal morphology of fungal diseases revealed the severely damaged hyphae, including deformation loss of apical growth, and lysis. Furthermore, morphological and biochemical studies of the antagonistic bacteria demonstrated that BL-44, BL-48, BL-56 and BL-59 isolates were classified into gram-positive rod-shaped whereas BL-55 isolate was classified into gram-negative, cocci-shaped. In addition, BL-44, BL-48 and BL-59 isolates can form endospore. All isolates can produce catalase enzyme whereas BL-55 and BL-59 isolates revealed a positive reaction in the oxidase enzyme test. BL-48 and BL-59 isolates showed a survival growth under salinity stress (7% NaCl). As a result, the antagonistic bacteria isolated from this study can be used as an alternative choice to control rice diseases cause by fungal pathogens.

Keywords: rice disease, antagonistic bacteria, *Curvularia* spp., *Fusarium* spp., *Rhizoctonia* spp

Fruit Growth and Development of Pummelo cv. Tubtim Siam at the Difference Tree Age and Fruit Age for the Optimal Harvesting Time under the Climate Variation

Preecha, C. and Na Nakorn, S.*

Department of Plant Science, Faculty of Agriculture, Rajamangala University of Technology Srivijaya, Nakhon Si Thammarat Campus, Thailand.

Corresponding Author: nanakornsp@yahoo.com

The fruit growth and development of pummelo cv. Tubtim Siam at the difference tree age and fruit age for the optimal harvesting time under the climate variation. The experimental was used 3x3x5 factorial in completely randomized design (CRD) with single tree plots and replicated five times. The treatments included 3 factors; A : the different time of harvesting (beginning of the year, mid year and end of year) B: the different age of the pummelo tree (5, 10 and 15-year-old trees) and C : the different age of pummelo fruit (6th, 6.5th, 7th, 7.5th and 8th month), the experiment was conducted at the orchard in the Klongnoi sub-district, Pak Panang district, Nakhon Si Thammarat province, Thailand, This experiment was starting from January, 2017 to September, 2018. The effect of the harvesting time around the year divided to beginning of the year, mid year and end of the year was advanced significant difference of the harvesting time, beginning of the year and mid year could develop as indicated fruit weight(g), peel weight (g), pummelo fresh (g), diameter of fruit (cm) and fruit circumference (cm) compared to the during the time end of year. Also the fruit quality of the beginning of the year and mid year, the most higher total soluble solid (TSS), titratable acidity (TA) and TSS/TA ratio. The effect of tree age 10 and 15-year-old trees could develop as indicated fruit weight(g), peel weight (g), pummelo fresh(g) was advanced significant difference compared to the 5-year-old trees, but the diameter of fruit (cm), fruit circumference (cm) and peel thickness was not significant difference of all treatments. The fruit quality of tree age 10 and 15-year-old trees most higher total soluble solid (TSS), titratable acidity (TA) and TSS/TA ratio than 5-year-old trees. The fruit age at 6th, 6.5th, 7th, 7.5th and 8th month was develop of fruit weight(g), peel weight (g), pummelo fresh(g), diameter of fruit (cm) and fruit circumference (cm), the result shown that fruit age at 6.5th, 7th and 7.5th month could develop the highest of fruit weight(g), peel weight (g), pummelo fresh(g), diameter of fruit (cm) and fruit circumference (cm) and highest of fruit quality as indicated of TSS, TA and TSS/TA ratio.

Keywords: tree age, fruit age, fruit development, fruit quality, pummelo

Research on biofertilizers for organic crop production

Pongnak, W. and Soyong, K.

Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand.

Corresponding author: ajkasem@gmail.com

Degrading rock phosphate and potassium feldspar was conducted by mixing the potent microorganism namely: *Aspergillus* sp., *Penicillium* sp., *Chaetomium* sp. and Actinomycetes to sterilized ground rock phosphate and/or potassium feldspar. Results showed that sterilized rock phosphate incubated with *Penicillium* sp. gave significantly better available phosphorus than the non-treated control. Moreover, the sterilized potassium feldspar incubated with Actinomycetes gave significantly better available potassium than the non-treated control. As results, it is further developed the biofertilizers as high phosphorous biofertilizer used to induce flower formation and high potassium biofertilizer used for high yield in organic crop production.

Keywords: biofertilizer, microorganism

Poster Session 3: ANIMAL, FISHERY SCIENCE AND ENTOMOLOGY

The Effect of Supplementation of Synbiotic in Broiler Diets on Production Performance, Intestinal Histomorphology and Carcass Quality

Raksasari, B. V.^{1*}, Paengkoum, P.², Paengkoum, S.³ and Poonsuk, K.⁴

¹ Faculty of Animal sciences and Agricultural Technology, Silpakorn University, Cha-am, Petchaburi, Thailand; ² School of Animal Production Technology, Institute of Agricultural Technology, Suranaree University of Technology, Muang Nakhon Ratchasima, 30000 Thailand; ³ Program in Agriculture, Faculty of Science and Technology, Nakhon Ratchasima Rajabhat University, Muang Nakhon Ratchasima, Thailand; ⁴ K.M.P. BIOTECH CO.,LTD., Muang Chonburi, Chonburi, Thailand.
Corresponding Author: bhutharit@gmail.com

The objective for this study was conducted to investigate the effect of synbiotic in broiler diets on productive performance, intestinal histomorphology and carcass quality. Jerusalem artichoke (*Helianthus tuberosus* L.) and BACTOSAC-P[®] were used as synbiotic sources, respectively. Four hundred Ross 308 chickens were assigned into a Complete Randomized Design (CRD) with 4 replicates (25 chickens per replicate). There were four dietary treatments: control diet (T1), synbiotic supplemented 0.025 % of DM (T2), 0.050 % of DM (T3) and 0.075 % of DM (T4) in broiler diets, respectively. Data were collected at 42 days old for productive performance, intestinal histomorphology, and carcass qualities. Jerusalem artichoke and BACTOSAC-P[®] were used at ratio 1:9 (w/w) at the sources of prebiotic and probiotic, respectively. The results showed that feed intake and average daily gain were significantly different ($p < 0.05$), specifically with the supplementation of synbiotic at 0.05% of DM. Using synbiotics at higher levels were affected on decrease feed conversion ratios ($P < 0.05$) in all the groups are synbiotic supplementation. And dietary supplementation of 0.05% of DM synbiotic significantly ($P < 0.05$) increased the villus height. Moreover, it was found that decreased in ammonia concentration in the intestinal and found to decrease of visceral fat with synbiotic 0.05% of DM ($P < 0.05$) of chicken feed supplementation of synbiotic that not affected on crypt depth, lactic acid bacteria, carcass quality and meat quality. Based on this study, it was concluded that supplementation of synbiotics could improve FCR and reduce ammonia concentration in the intestinal tract.

Keywords: Broiler, Synbiotic, Intestinal histomorphology, Productive performance and Carcass quality

Genetic Relationship of Maternal Lineages in Phetchaburi Native Cattle

Laosutthipong, C.^{*1} and Chuawongboon, P.¹

¹ Faculty of Animal Sciences and Agricultural Technology, Silpakorn University, Phetchaburi IT campus, Sampraya, Chaam, Phetchaburi 76120, Thailand.
Corresponding Author: laosutthipong_c@silpakorn.edu

Maternally inheritance can be described via mitochondrial DNA (mtDNA) analysis for evolution and genetic diversity study in animals and human, especially in cattle. This study aimed to investigate the genetic relationship and cluster analysis of Phetchaburi native cattle in Thailand. All 7 semen samples collected from male native cattle breeders in sperm bank collection from Phetchaburi province. The mtDNA at D-loop region (450 bp.) was analyzed and the high variable region (285 bp.) was aligned with reference cattle sequences. The results revealed 26 polymorphic sites. The sequence identity of all samples ranged from 96.8 to 99.7% which most of them similar to *Bos taurus* (AY515627), except MT-1 showed 99% identity to *Bos indicus* (HQ234738). All mtDNA sequences were classified into 3 haplotypes from 7 sperm samples and the haplotype diversity 0.524. The phylogenetic tree analysis indicated 6 breeders were grouped into *B. taurus* clade whereas only one breeder was located in *B. indicus* clade. This current results provided the genetic background of native breeder cattle in Phetchaburi province including genetic diversity and breeder grouping which may have implications for breeding management and conservation of Thai native cattle.

Keywords: genetic relationship, maternal lineages, native cattle

Effect of Different Forms of Selenium on Fatty Acid Composition in Broiler Meat

Hiranon, N., Sivapirunthep, P., Chaosap, C.*

Department of Agricultural Education, Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand.

Corresponding Author: chanporn.ch@kmitl.ac.th

The objective of this study was to investigate the effect of forms of selenium (Se) in diets on fatty acid composition, lipids indices, and enzyme indexes for desaturase, elongase, and thioesterase in *Pectoralis* muscle of broiler chicken. A total of 360 one-day-old chicks (Arbor Acres) were randomly assigned to 2 treatments with 6 replicates, giving 30 birds per replicate. The birds were fed ad libitum in 3 feed phases of giving 2 dietary treatments comprised 0.3 ppm of inorganic Se from sodium selenite and 0.3 ppm of organic Se from seleno-methionine. At 39 days of age, one bird from each treatment replicate was randomly selected for slaughter. *Pectoralis* muscle was collected and stored at -40 °C before fatty acid composition analysis. There were no different between organic and inorganic selenium treatment on fatty acids composition, lipids indices, and enzyme indexes ($P > 0.05$). In conclusion the dietary supplementation of different forms of selenium at 0.3 ppm did not effect the composition of fatty acid in this study.

Keywords: Forms of Selenium, Fatty Acid Composition, Broiler Chicken

Effective of Split Mushroom (*Schizophyllum commune*) By Product Extracts as Antimicrobial and Antioxidant Activity for Aquaculture

Srichanun, M.*, Lerssutthichawal, T., Nganwisuthiphan, T. and Chirapongsatonkul, N.

Department of Fisheries Science, Faculty of Agriculture, Rajamangala University of Technology Srivijaya, 80110, Thailand.

Corresponding Author: nim_nion@hotmail.com, nion.c@rmutsv.ac.th

Schizophyllum commune (SC) or split mushroom is one of the popular edible mushrooms and is commercially cultivated in Thailand especially in the southern Thailand. The evident of bioactive compound from whole SC (cap and stalk) has been reported in several studies as well as antioxidant, antimicrobial and immunomodulator in human. However, the study of SC by-product (SCB) extracts as an antimicrobial and antioxidant activity for aquaculture has not been reported. This study was to investigate the effective of the SCB extracted from different organic solvent having the different relative polarity consisting of hexane, ethyl acetate, dichloromethane, 2-butanol, ethanol, methanol and water as antimicrobial and antioxidant activity in order to added value of waste from agriculture. The antibacterial assay to pathogenic bacteria for economic fish culture; *Aeromonas hydrophila* and *Streptococcus agalactiae* was tested by disc diffusion method. Antioxidant capacity was measured by DPPH assays. The result found that the inhibitory to pathogenic bacteria was not observed in all SCB extracts compared to positive disc of commercial antibiotic (oxytetracyclin and norfloxacin) at the concentration of 20,000 ppm. While, the DPPH radical scavenging activity of each solution extract was significantly different ($p < 0.05$). SCB was extracted by methanol showing the highest activity (IC₅₀=23 ug/mL) with no significant difference to SCB extracted by 2-butanol while, the lowest level was observed in SCB extracted by ethyl alcohol and ethyl acetate (IC₅₀=35 ug/mL). This study indicated that the different of organic solvent gave the different capacity of antioxidant level and SCB extract might be used as antioxidant agent in aquaculture.

Keywords: *Schizophyllum commune*, Mushroom by-product, antioxidant, antimicrobial

Nutritional Composition Improvement of Palm Kernel Meal Using Feed Enzyme and Yeast Cake

Duangkaew, P.^{*}, Poommarin, P. and Sasiwimolrit, K.

Faculty of Animal Sciences and Agricultural Technology, Silpakorn University, Phetchaburi IT campus, Sampraya, Cha-am, Phetchaburi, Thailand.

Corresponding Author: duangkaew_p@silpakorn.edu

Palm kernel meal (PKM) is one of the most available agro-industrial by-products in Thailand. However, its use for non-ruminant diets is limited due to the high fiber content and moderate protein composition as compared to soybean. Thus improvement of PKM in order to reduce fiber content and increase protein composition could be benefit. In this study, feed enzyme HemicellTM HT and yeast *Saccharomyces cerevisiae* cake is used for improving PKM nutritive composition. The experiment was done by mixing PKM with yeast cake (0, 20% and 40%) and feed enzyme (0, 0.02%, and 0.04%), then incubated for 0, 12, and 24 h at 40 °C. The percentage of crude protein (%CP), percentage of crude fiber (%CF), neutral detergent fiber (NDF) and acid detergent fiber (ADF) were analysed using proximate analysis. The results showed that %CP was increased while %CF was reduced in accordance with increasing incubation time and percentage of yeast cake (P<0.05). NDF and ADF values were decreased significantly when PKM was mixed with yeast cake. The improved PKM with 40% yeast cake and 0.04% enzymes at 24 h incubation contained %CP equal to 40.86±1.87 and %CF equal to 4.84±0.85. In conclusion, improvement of PKM using enzymes and yeast cake increased %CP and reduced %CF to the suitable levels for using as non-ruminant diets.

Keywords: Palm kernel meal, yeast cake, feed enzymes, nutritional composition, improvement

Effects of Tropical Forage Species on *Butyrivibrio fibrisolvens*, *Fibrobacter succinogenes* and Total Bacteria Population in Goat Rumen Observes using Real-time PCR Techniques

Thongruang, S.^{1,2}, Paengkoum, P.¹, Suksombat, W.¹ and Bureenok, S.³

¹Institute of Agricultural Technology, Suranaree University of Technology, Nakhon Ratchasima, Thailand; ²Faculty of Animal Sciences and Agricultural Technology, Silpakorn University, Phetchaburi, Thailand; ³Faculty of Sciences and Liberal Arts, Rajamangala University of Technology Isan, Nakhon Ratchasima, Thailand.

Corresponding Author: thongruang_s@silpakorn.edu

The experiment was to investigate the effects of tropical forage species on *Butyrivibrio fibrisolvens*, *Fibrobacter succinogenes* and total bacteria population in goat rumen. Three male ruminally fistulated crossbred Saanen goats (approximately 33 ± 3.0 kg BW) were used as replicates to determine content of *B. fibrisolvens*, *F. succinogenes* and total bacteria population in goat rumen by effect of 6 tropical forage species diets using real-time PCR techniques. The results showed that in grass experiment, three grass species including Purple Guinea (*Panicum maximum* TD58), Chinese Pennisetum (*Pennisetum purpureum* x *Pennisetum alopecuroides*) and Napier Pak Chong 1 (*Pennisetum purpureum* x *Pennisetum americanum*) were not significantly (p>0.05) different in the population of *B. fibrisolvens* (1.51-2.97 x 10⁶ copies/ml), *F. succinogenes* (4.21-5.98 x 10⁶ copies/ml) and total bacteria (4.08-6.58 x 10¹⁰ copies/ml) in goat rumen at 0, 2, 4 and 6 h after feeding. Similarly, legumes experiment, the population of ruminal *B. fibrisolvens* (1.31-3.01 x 10⁶ copies/ml), *F. succinogenes* (4.01-5.73 x 10⁶ copies/ml) and total bacteria (3.12-5.40 x 10¹⁰ copies/ml) of goats were not significantly (p>0.05) different between three legume species including Hamata (*Stylosanthes hamate*), Hedge Lucern (*Desmanthus virgatus*) and Leucaena (*Leucaena leucocephala*) at 0, 2, 4 and 6 h after feeding.

Keywords: forage species, *Butyrivibrio fibrisolvens*, *Fibrobacter succinogenes*, total bacteria, population

Effects of Microbial Mixture Fermented Liquid (MMFL) Supplementation in Grass Silage on Chemical Composition Rumen Fermentation and Digestibility in Beef Cattle by using In-vitro Gas Production Technique

Polyorach, S.^{1*}, Wanapat, M.³, Pongchompu, O.², Gunun, P.², Kang, S.⁴, Cherdthong, A.³, Gunun, N.⁵, Mapato, C.³ and Sitthigripong, R.¹

¹Department of Animal Production Technology and Fisheries, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; ²Department of Animal Science, Faculty of Natural Resources, Rajamangala University of Technology Isan, Phang Khon, Sakon Nakhon, Thailand; ³Tropical Feed Resources Research and Development Center (TROFREC), Faculty of Agriculture, Khon Kaen University, Muang, Khon Kaen, Thailand; ⁴Agricultural Unit, Department of Education, National Institute of Education, Phnom Penh, Cambodia; ⁵Program in Animal Production Technology, Faculty of Technology, UdonThani Rajabhat University, UdonThani, Thailand.
Corresponding Author: neenart324@hotmail.com; sineenart.po@kmitl.ac.th

The objectives of this study aimed to investigate the effect of Microbial Mixture Fermented Liquid (MMFL) supplementation in grass silage on chemical composition rumen fermentation and digestibility in beef cattle by using *in vitro* gas production technique. The experimental design was a completely randomized design (CRD). The treatments were 4 levels of MMFL ensile grass silage there were 0, 0.5, 1.0 and 1.5% of grass. It was found that additional MMFL could improve nutritional value of silage by increasing DM, OM and CP, while decreasing NDF and ADF. Gas kinetics of MMFL ensile grass silage affected on the insoluble fraction (b), gas production rate (c), potential extent of gas production (a+b) and cumulative gas production (96 h) ($P < 0.01$), but did not affect on the immediately soluble fraction (a) ($P > 0.05$). Cumulative gas production (96 h) was higher than in non-supplemented group ($p < 0.01$). In addition, *in vitro* degradability (IVDMD and IVOMD) at 48 h of incubations were shown to have high correlation with gas volume which was significantly higher in supplemented group. In conclusion, potential used of MMFL could improve nutritional values of silage and *in vitro* true degradability. However, further researches for *in vivo* trial could be conducted.

Keywords: Grass silage, digestibility, Microbial Mixture Fermented Liquid (MMFL), Effective microorganism (EM), *in vitro* gas production technique

The Effect of Adding Mung Bean Meal Supplementation on Napier Pakchong 1 Silage on Fermentation Quality and Nutrient Composition

Boonkoed, S., Suphalucksana, W., Sitthigripong, R., Srikijkasemwat, K., Mitchaothai, J. and Lukkananukool, A.*

Department of Animal Production Technology and Fisheries, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand.
Corresponding Author: vincent_valentine-13@hotmail.com

The objective of the study was to investigate the effect of mung bean meal supplementation on Napier Pakchong 1 silage on fermentation quality and nutritional value. The experimental design was completely randomized designs (CRD) to receive 6 treatments, T1: 100% Napier Pakchong 1 grass (control), T2: 90% Napier Pakchong 1 grass and 10% mung bean meal, T3: 80% Napier Pakchong 1 grass and 20% mung bean meal, T4: 70% Napier Pakchong 1 grass and 30% mung bean meal, T5: 60% Napier Pakchong 1 grass and 40% mung bean meal and T6: 50% Napier Pakchong 1 grass and 50% mung bean meal Napier Pakchong 1 grasses harvested at age of 60 days. The All treatments had 1% molasses added. After the grass harvesting, the experimental grass were immediately chopped into 1-2 cm. length pieces. Three replication plastic buckets per each treatment were prepared and allowed to ferment for 21 days at room temperature. The results from this study was found that pH of all treatments of mung bean meals on Napier Pakchong 1 silage ranges from 4.17-4.73 by lowest value found in the treatment 1 whereas highest value found in the treatment 6 ($P < 0.01$). When volatile basic nitrogen (VBN) in silage was considered, the VBN in the ailage of the treatment 5 had the highest value (35.56%) and followed by that of the treatment 6 (32.98%) while the lowest VBN found in the silage of the treatment 1 (8.57%) ($P < 0.01$). Moreover, the silage in the treatment 6 had the highest nutritional proportion by increasing dry matter (DM), crude protein (CP), ether extract (EE) and gross energy (GE), while decreasing ash, neutral detergent fiber (NDF) and acid detergent fiber (ADF) ($P < 0.01$). Thus, making silage by adding mung bean meals on Napier Pakchong 1 could improve nutritional value of silage in term of increasing DM, CP, EE and GE contents, but decreasing contents of ash, NDF and ADF. In addition, making silage from Napier Pakchong 1 grass by replacing mung bean meal at 10-20% could be applicable for preserving ruminant roughage.

Keywords: Mung bean meal, Napier Pakchong 1, Silage

The Occurrence of in MRSA, MSSA and Antibiotic Resistance Related Factors in Area of Dairy Farming, Maha Sarakham Province of Thailand

Intrakamhaeng, M.^{1*}, Singpun, Y.², Sriward, C.² and Phakhunthod, S.²

¹The Foodborne Contaminants Research Unit (FCR), Faculty of Veterinary Science, Mahasarakham University, Mahasarakham, Thailand; ²Faculty of Veterinary Science, Mahasarakham University, Mahasarakham, Thailand.

Corresponding Author: meawnarakmak@hotmail.com

The occurrence of *Staphylococcus aureus* isolates, especially MRSA and MSSA isolates contaminated in raw milk, can cause endemic chronic bovine mastitis in area of dairy farming, Maha Sarakham province of Thailand. A total of 165 milk samples were collected and *S. aureus* isolation were conducted by using conventional method and PCR reaction of 994 bp of coagulase gene fragment. The results revealed 25 isolates of *S. aureus* that showed positive result of coagulase gene. All 25 isolates were tested for MRSA and MSSA identification by *mecA* gene that demonstrated 2 *mecA*-positive MRSA isolates (n=2) and 23 *mecA*-negative MSSA isolates (n=23). Two isolates of MRSA indicated that the antibiotic resistance was a continuing problem in this area. All isolates have also been found to be isolates having enterotoxin producing genes including *sea*, *seb*, *sec*, and *sed* but not found any enterotoxin genes in MRSA and MSSA. For investigate factors related to MRSA, a survey research was conducted and showed that all farms used both of injecting drug and intramammary infusion antibiotics for their bovine mastitis treatment. The case-control study was divided into farms using oxytetracycline and penicillin as the first choice. The study found that oxytetracycline have been used routinely to treat mastitis in 2 and 18 farms having MRSA and MSSA, respectively. The odds of MRSA among farms using oxytetracycline was more than the odds of MSSA among farms using oxytetracycline. This study found that the often use of oxytetracycline in this area might create new properties of bacteria to become resistant to antibiotics. However, it may have other factors affecting bacterial resistances that need to study in further research to more understanding and to introduce the result of risk factors investigation to farmers.

Keywords: *Staphylococcus aureus*, MRSA, MSSA

Biological Control of Rhizoctonia Diseases and Enhancing the Growth and Yield of Potato using Compost Fortified with *Chaetomium globosum*

El-Mohamedy, R. S. R.^{1*} and Salamaa, D. M.²

¹Plant Pathology Department, National Research Centre, Dokii 12622, Giza, Egypt; ²Vegetable Research Department, National Research Center, Dokii 12622, Giza, Egypt.

Corresponding Author: riadelmohamedy@yahoo.com

Potato (*Solanum tuberosum* L.) plants are susceptible to devastation by various diseases such as Black scurf caused by *Rhizoctonia solani* Kühn (teleomorph: *Thanatephorus cucumeris* (Frank). *Chaetomium globosum* (Ch) isolate Ch 2 and Ch 5 showed highly antagonistic effect against all tested isolates of *R. solani* *in vitro*. Extract of composted agricultural wastes (CAW) fortified with *C. globosum* (isolate Ch2) at 50% concentration showed highest reduction against linear growth of *R. solani*. In greenhouse trials, coated potato tubers with *C. globosum* Ch 2 (6.8×10^6 cfu/ml) plus manipulating soil with composted agricultural wastes fortified with *C. globosum* (CAWCh) at the of 1.2, 1.78 and 2.38 kg/m² as single or combined treatments showed significant decrease in Rhizoctonia black scurf disease incidence in *R. solani* infested soil. Under field conditions, drenching soil with CAWCh at the rate of 1.78 kg/m² and 2.38 kg/m² treatments plus coated potato tubers with spore suspension of *C. globosum* (6.8×10^6 cfu/ml) treatment before sowing significantly reduce Rhizoctonia black scurf disease during two cultivation seasons 2016 and 2017. Moreover, high records of plant growth parameter as well as quantity and quality of potato tuber yield were obtained with such treatments if compared with control. Through these results it could be suggested that integrative treatments of manipulating soil with composted agricultural wastes fortified with *C. globosum* and coated seed tubers with such bio control agent could easily applied as alternative fungicide for controlling soil borne pathogens of potato.

Keywords: Potato- Black scurf- *Chaetomium globosum*- Compost –Control

Poster Session 4: ENVIRONMENT, TOXICOLOGY, SOCIO ECONOMIC, COMMUNITY DEVELOPMENT AND AGRICULTURAL DEVELOPMENT

The Development of Management Aspects Campus, Energy and Building, Waste, Water, Transportation and Education and Outreach for the Green University

Wongphimsorn, A.* and Wongchantra, P.

Faculty of Environment and Resource Studies, Maharakham University, Maharakham, Thailand.
Corresponding Author: kapooknnl@hotmail.com

This research aims to develop university management training activities green, effective and productive. To study and compare knowledge, attitudes and volunteerism towards green university management. Before and after training to study and compare knowledge, attitudes and volunteerism towards green university management. By gender and age, the sample was Year 1-4 students in Environmental Education, Faculty of Environment and Resource Studies. The 40 students in the academic year 2556 were volunteered to attend the 10th year training. The tools used in the research were the green university management training manual. Knowledge management test of green university a measure of attitudes toward green university management and volunteer metrics on green university management. Statistics used in data analysis were frequency, percentage, mean, standard deviation, paired t-test, and F-test (One-Way MANOVA) at .05 level. The study found that the training manual the efficiency is 84.06/83.50, which is higher than the 80/80 set. The efficiency index of the training manual was 0.7346, show that undergraduate students major environmental education, progress in learning was 73.46%. Students have knowledge about green university management before training at a low level = 15.12). After the training, the overall knowledge score was at a high level. Attitude towards green university management, before the training, the overall level was in agreement unteer in green university management o towards green university management. The difference ($p < .025$) but students with different levels knowledge, attitude and volunteering towards green university management are not different. Statistically significant at the .05 level.

Keywords: training activities, green university management, knowledge, attitude, skills training as a lecturer.

The Quality of Drinking Water in School at Phayao Municipal, Phayao Province

Pitakpong, A.* and Sangkham, S.

Department of Environmental health, School of Medicine, University of Phayao, Thailand.
Corresponding Author: aompitakpong@gmail.com

The study was to determine the quality of drinking water and to determine the environment at the service point of schools in Phayao municipality, Phayao district, Phayao province. Data were collected in 5 schools by surveying using checklist and analyzed in laboratory of physical, chemical and biological quality of drinking water. Seven parameters were colour, odour, pH, turbidity, total dissolved solids, hardness, free chlorine content and coliform bacterial. Data were analyzed by using the descriptive statistics. The result showed that the condition of the water filter were dirty and not cleaning around the service point. The testing on physical characteristic from the service point showed colour and odour passed 100% that were not colour and odor. In laboratory showed in turbidity passed the standard 100% and pH in ranged 6.32-6.89 that passed the standard. The chemical characteristic were total dissolved solid, hardness and free chlorine content passed standard 100%. The biological laboratory found the contamination of coliform bacteria 100% (< 3 240 MPN/100 ml). As a result the schools should be cleaning the filter on the time of maintenance and set the condition of the environment around the drinking water service point for the good hygiene.

Keywords: Drinking water, Schools, Phayao

The Agricultural Water Resource Management Model in Lam Se Bai Irrigation Area, Amnat Charoen Province, Thailand

Chunsuparerak, D.*

The Regional Development Strategies Graduate School, Ubon Ratchathani Rajabhat University, Thailand.

Corresponding Author: dee@somite.co.th

Upon encountering crisis from climatic and geographical influences in Lam Se Bai irrigation in Hua Taphan district, Amnat Charoen province particularly during summer and rainy season and the impacts of drought and flood were considered as persistent obstacles to the subsistence and economic security for domestic farmers. Regarding its consequence as a principal stakeholder of approximately 474 Acres in the affected area, this research was conducted to investigate, developed and evaluated the practical agricultural water management model in the areas. To sustainably advance agricultural water management solution, significant problems were specified as follows:- frequent submerging floodplains, water deficiency, inefficient water management, negligent maintenance, inadequate water conservation, and limited knowledge in agricultural water management, identified by mixed methodology. The findings indicated that participation and involvement was a priority influence, and followed by water management, agricultural support, maintenance, and water conservation. These five elements, according to research problems, enabled authorities and relevant sectors to unravel the repetitious agricultural water management problems were proved. Primarily, water management encompassed policy, measure to conform with regional potential and geosocial, and management machinery improvement. The policy comprised exploration and management, effective water usage, and inundation countermeasure. However, management machinery progress required multi-institute cooperation, where efficacy was demanded. Regarding the limitation, participation and involvement was more accessible. Management integration process facilitated public to engage in water management plan, development, appliance, investment, evaluation, involvement, maintenance, preservation, and public relation. This allowed domestic water users and stakeholders to promptly resolve unexpected situations in a specific circumstance. Agricultural support required collaboration with regional irrigation, water user association, stakeholders, and farmers to set action plans. The general strategies centered in drought and flooding. Canalization for agricultural purpose in seven water shortage areas, where water from irrigation would be delivered according to the cultivation plan that had been constructed. During seasonal flooding, off-season and floating rice paddy field were developed as an ecological alternative to adapt and elongate to floods. Coherently, these strategies enabled farmers to sustainable living with the climate variability. Tool and system maintenance entailed the coordination between water users and regional irrigation office to distribute an applicable regulation and monitoring strategy, along with water conservation. Sustainable agriculture was regularly concurrent with resource conservation. Natural calamity and farming activities inevitably affected water quality. Organic farming and new theory agriculture practically conserved resource quality in the studied areas. Additionally, the assessment was peer reviewed by experts and the secondary confirmatory factor analysis was statistically tested to evaluate and measure the effectiveness and validity of the model for further research in the future. This model was established in cooperation with government and locals to a real practice and policy with 200 million Thai Baht government funding to solve an inconclusive water management and enhance better management.

Keywords: Agricultural Water Management Model, Water Management, Water Sustainability, Agricultural Support, Water Conservation

The Public Hearing of the Communities around Mahasarakham University about the Economic, Social, Health and Environmental Impacts

Wongchantra, P.^{1*}, Wongchantra, K.², Sookngam, K.¹, Junkaew, K.¹, Ongon, S.¹, Kaeongam, S.¹, Phansiri, C.¹

¹Center of Environmental Education Research and Training, Faculty of Environment and Resource Studies, Mahasarakham University, Maha Sarakham, Thailand; ² Srimahasarakham Nursing College, Maha sarakham, Thailand.

Corresponding Author: kannika.m1991@gmail.com

Public hearing in nearby communities in a radius of 2 kilometers was investigated in 4 communities of Ban DonViangchan, Ban Kham Rieng, Ban Tha Khon Yang and Ban Donna including 5,743 households. The purposes were to study the opinion of the communities surrounding Mahasarakham university on the environmental impact. There were 4 aspects as follows:- economic, social, health and environment. The result showed that the economy found that after the establishment of Mahasarakham university neighborhood dwellers get income from doing business. The people in the surrounding area have jobs and economic expansion of the community. The social impact found that the people in the surrounding area are changed positively to be values, social networks, the employment of local people are provided the opportunities for people to work in the university, and reduced family issues leading to social problems, drug problem, garbage problem and transportation problem. The health found that the both positive and negative impacts. The positive impacts were that people living in the surrounding area were better living and better quality of life. The negative impact on the community were air pollution, noise pollution the result of the traffic. Environment impact found that the both managed and unmanaged. The environment managed, such as tap water used for consumer and consume, energy consumption and the environmental issues that unmanaged, such as communication problems and noise.

Keywords: Public Hearing, Economic, Social, Health and Environmental Impact, community

The Development of Environmental Education Teachers the King Bhumibol Adulyadej's Science

Wongchantra, P.^{1*}, Wongchantra, K.², Junkaew, L.¹, Sookngam, K.¹, Ongon, S.¹, and Phansiri, C.¹

¹Center of Environmental Education Research and Training, Faculty of Environment and Resource Studies, Mahasarakham University, Mahasarakham, Thailand; ² Srimahasarakham Nursing College, Mahasarakham, Thailand.

Corresponding Author: Driftking.LDK@gmail.com

The King Bhumibol Adulyadej's Science is acknowledged to help the Thai people as a planning concept, conceptual, theory of sufficiency economy philosophy, principle steps to work and project due to the initiative in order to solve the problems of the people. The objectives were to enhance the knowledge and understanding the environmental education of teachers. The King Rama IX of Thailand project deserves to promote skills and conscious mind of environmental education teachers King Rama IX of Thailand. The sample consisted of 40 teachers who were volunteered to participate in the training. The research found that the process of environmental education teachers King Rama IX of Thailand was gained the knowledge from lecture, practice, discuss and case study. The contents were natural resources and ecology, problems and solutions environmental problems, King Rama IX of Thailand, features and skill of environmental education teacher, environmental education course and teaching plan, the use of media and learning resources, measurement and evaluation of environmental education. A case study of the King Rama IX of Thailand on water, soil, forest and theory of sufficiency economy philosophy were noticed.

Keywords: teachers, environmental education, King Rama IX of Thailand

Adaptation to Climate Change using agricultural innovation for increasing income for small-scale farmers in Africa

Dayoub^{1*}, M., J. Helminen¹, V. Myllynpää¹, M. Apiola¹, T. Westerlund¹, and E. Sutinen¹

¹Department of Future Technologies, University of Turku, FI20014 Turun yliopisto, Finland.
Corresponding Author: modayo@utu.fi

Climate variability is one of the most complex problems the world faces. It especially affects the most vulnerable people in Africa. One group extremely impacted by the changing climate are small-scale farmers. Small-scale farming is an important way of generating income and employment for a large number of people. Together small-scale farmers produce an incredible 70% of the world's food. Lack of climate knowledge is the main problem facing Africa. We need to use, measure and ensure that this innovations will help farmers develop their practices for better livelihood. The aim of the project is to offer climate information, and use new innovation in farm to based solutions for small-scale farmers, government officials and decision makers to adapt to the effects of climate change in food production. The project will be a co-design based development of a mobile climate service application, built functions, which shares climate knowledge (based on the climate and weather data-water resources) and provides knowledge about new farming techniques, best practices, and adaptation measures to local farmers. It will also help farmers to use this knowledge to choose methods modern irrigation, crops, and seeds, growing methods, as well as sowing and harvesting times, which are better suited to the changing climate. This process will eventually help farmers improve their income generation, through improved yields and higher cash crops. The results can be scaled up also in other areas, this will be done by utilizing different user-interface kits, suited for certain target user groups. The application would be eventually suitable for diverse user groups (women/men, old/young, technologically literate / technologically illiterate, etc.) as well as being suited for illiterate people since it would utilize visual material such as pictures, graphs, and oral stories.

Keywords: small-scale farmers, co-design, mobile climate service

The Development of Organic Farming Promoting Manual for Agriculturers of Ban Nongtokpan Tambon Nongtokpan, Amphoe Yang Talat, Kalasin Province

Siriwatthanamichai, N.* and Kurukodt, J.

Faculty of Environment and Resource Studies, Mahasarakham University, Maha Sarakham, Thailand.
Corresponding Author: nopphatsorn.s@acc.msu.ac.th

The purposes of this research were to study the behavior using of chemicals in rice fields farmers of Ban Nongtokpan, Nongtokpan sub-district, Yang Talat district, Kalasin province, to develop a manual for organic farming for Ban Nongtokpan farmers, to study and compare knowledge, attitude and to study the skills of doing organic farming for farmers of Ban Nongtokpan. The sample used to study the chemical use behavior of farmers were 55 peoples from 25% farmers of Ban Nongtokpan, and the sample used in organic farming training were 35 farmers of Ban Nongtokpan, Nongtokpan sub-district, Yang Talat district, Kalasin province by volunteery. The research found that farmers had a meaningful understanding and how about the use of chemicals in rice field on the overall level at low ($\bar{x} = 2.19$). The efficiency of the training manual was 94.85/ 81.85. The farmers who use the training manual have advanced learning accounted for 63.86%. The farmers attending training are knowledge and attitude after training rather than pre-training at the .05 level, the farmers had good skills in organic farming.

Keywords: organic farming manual, farmers, using of chemicals in rice fields, knowledge, attitude, skills

Comparison Time Series Model of Mean Monthly Temperature in Prachuap Khiri Khan Province, Thailand

Thonglor, O.* and Wilaiwan, S.

Faculty of Animal Sciences and Agricultural Technology, Silpakorn University, Cha-Am, Phetchaburi, Thailand.

Corresponding Author: thonglor_o@silpakorn.edu

The study analyzed the time series characteristics of temperature data for Muang Prachuap Khiri Khan, Prachuap Khiri Khan Province, Thailand which collected from information services and climate statistics, meteorological department in consecutive monthly from 1983 – 2016 (34 years). From the trend line of mean monthly temperature, it showed a slight linear trend. There was season component but there was no cycle and irregular component. The study compared five time series models (naïve method, three – month moving average, three – month weighted moving average, exponential smoothing and seasonal decomposition) from forecast accuracy by considering from value of MAD, MSE and MAPE. The result showed that exponential smoothing by using winter's multiplicative method was the most forecast accuracy because it had the lowest value of MAD, MSE and MAPE. The forecast values in the future (2017 – 2019) by this model showed that temperature in April, May and June are high while temperature in December and January are low. Moreover, the result from seasonal decomposition showed that temperature in January, December, February November and October, respectively, are lower than normal level. For the higher than normal level is April, May, June, March, July, August and September, respectively. Farmer can apply this result for planning to produce agricultural production which one is suitable with low or high temperature.

Keywords: temperature, time series, trend, cycle, decomposition, forecast

Traditional Community and Participation in Development Area of Koh Lipe, Satun of Thailand on Environmental Good Governance

Wongchantra, P.*, Meakawichai, P., Nangkhalaphiwat, Y., Sinthumongkolchai, S., Wongyai1, A., Chandanachulaka, S., Kaewwannisakun, C. and Sangdanjak, N.

Center of Environmental Education Research and Training, Faculty of Environment and Resource Studies, Maharakham University, Maharakham, Thailand.

Corresponding Author: Prayoon_nam@yahoo.co.th

The traditional community and participation in development area of Koh Lipe, Satun province on environmental good governance were investigated. The objectives were to study the history of the traditional community in Koh Lipe, Satun province, the present condition and problems of the traditional community in Koh Lipe, Satun province and to propose the participation in development area of Koh Lipe, Satun province on environmental good governance. The study area was Koh Lipe Village, Moo 7, Koh Sarai sub-district, Muang district, Satun province. The samples used in the study were community leaders, philosopher, head of government and villagers in Koh Lipe, Koh Sarai sub-district, Muang district, Satun province. Tools used in research were structured interview, study of traditional community and participation in development area of Koh Lipe, Satun province on environmental good governance. The results showed that Urak Lawoi community Koh Lipe, Satun of Thailand, Urak Lawoi was moving the first group of immigrants from the Koh Lanta about a decade since 1897. Urak Lawoi group has settled in Koh Lipe. The Island is flat, can be settled and agriculture, including the abundance of resources both land and sea. The pioneers and leaders of Urak Lawoi in this era is the Toakeeree, is a Muslim from Indonesia. The scull boat came from Aceh about 100 years ago. Later in the year 1909, Urak Lawoi is the another group of immigrants that settled in Koh Lipe and other. For political reasons, the demarcation, when drafting the borderline between Thailand – Malaysia, The governor of Satun. So

the Toakeeree muslims at Urak Lawoi is respected to come and persuade chieftains from koh-sirey, Phuket province and Koh Lanta, Krabi province, that settled in the Koh Adang-Ravee were changed. When it was announced in the Tarutao national park that established in 1974 with the rules of the national park. Urak Lawoi had settled spread on the Islands in the Koh Adang-Ravee that moved to the area where the national park is permitted on the Koh Lipe of Koh Adang-Ravee. Since 1974, Urak Lawoi lives in the area of Koh Lipe and be the par of the Koh Adang. The government has 504 designated in this area as Village 7 "Ban Koh Lipe" of Koh Sarai sub-district, Muang district, Satun province. The condition of current Urak Lawoi community, the Island stretched east to the west that shaped like horseshoes, and the most areas on Koh Lipe are flat. There are 3 main beaches: Pattaya Beach (Bundayha Beach), Chao Lay Beach or Sunrise Beach and fishing Beach or Sunset Beach. Houses in the Chao Lay are simply built houses, a single storey building and high platform. There are 548 households living in Koh Lipe and the latent population was 145.59%. Most of the people has worked in the restaurants, resorts, tourist accommodation, trade, taxi drivers. Chao Lay has a unique tradition and culture: Urak Lawoi language, wedding tradition, floating boat tradition, culture building houses and Paepaegina sweets. The problem of the Urak Lawoi community are caused by capitalists or entrepreneurs, waste problem, flood problem, wastewater problem, narrow public road problem, utilities shortage problem, drug problem, influence problem, community problems unemployment and migrant workers, land dispute with the national park and the community with capitalists, change of settlement community and home. Guidelines participation in development area of Koh Lipe, Satun province on environmental good governance were recorded. The 5 levels of participation were as follows:-level 1 = inform, level 2 = consult, level 3 = involve, level 4 = collaborate, level 5 = empower. The 7 principles of environmental governance was analyzed as principle 1 =n people can access information, principle 2 = citizens participate in problem solving, principle 3 = transparency, principle 4 = corporate social responsibility, principle 5 = rule of law, principle 6 = justice and principle 7 = sustainability.

Keyword: Urak Lawoi community, participation, Koh Lipe, environmental good governance

Implementation of Fine Sand's Capillary Force to Filter Polluted Water: A Study on Change of Capillary Force Height to the Debit and Physical Quality of Filtered Swamp Water

Mujiharjo, S., Syafnil and Santika, W.

Department of Agriculture Technology, Faculty of Agriculture, University of Bengkulu, Jl. W.R. Supratman, Kandanglimun, Bengkulu 38371, Indonesia.
Corresponding Author: smujiharjo@unib.ac.id

Purpose of this research was to identify the effects of change of capillary force height to the debit and some physical quality of swamp water filtered using Capillary-Gravitational Slow Sand Filter (SSF). The experiment was conducted following 4x4 LS with the capillary height of 5, 10, 15 and 20 cm as the treatment. Besides filtration debit, samples of the swamp water and the permeate were taken and analyzed for TSS, Turbidity, color and pH. Result of measurement showed that debit of SSF increased as the capillary force height was reduced. The average debit was 76.8 ml/mnt when capillary force height was 20 cm; it increased to 204.30 ml/mnt when capillary force height was reduced to 5 cm. TSS and Turbidity of the permeate also increased when the capillary force height was decreased; however, pH of the permeate decreased. The average TSS and turbidity of permeate were 3.9 mg/L and 0.3 NTU when capillary force height was 20 cm; it increased to 6.4 mg/L and 0.64 NTU when capillary force height was reduced to 5 cm. The average pH permeate was 7.7 when capillary force height was 20 cm; it decreased to 7.3 when capillary force height was reduced to 5 cm. The color of permeate; however, were constant at 0.5 PtCo. In conclusion, increase of capillary force height in a SSF can improve physical qualities of filtered swampy water, but it reduced filtration debit.

Keywords: Slow sand filter, swamp water pollutant removal

The Effect of Land Use Change on Surface Runoff (A Case Study of Fang Watershed, Northern Thailand)

Songvoot, S.* and Duangthip, R.

Department of Agricultural Engineering, Faculty of Engineering, King Mongkut's Institute of Technology Ladkang, Bangkok 10520, Thailand.

Corresponding Author: svsangchan@yahoo.com

This research was conducted to examine the relation of land use change and climate on surface runoff in the Fang watershed, Chiang mai province. Fang watershed has met the natural disaster as floods and droughts. The water deficit has been taking place within the watershed influencing the agricultural production and other uses. The collected data was based on the land use maps and climate data in watershed area in 2008, 2012 and 2017. The surface runoff were estimate using SCS curve number method. The result of study was found that there were two trends of land use change during 2008 – 2017 which are forest to cropland and cropland to urban. The meteorological data were collected from the Metrological Department. The surface runoff has gradually decreased from 965.40 mm. in 2008 to 914.25 mm. and 905.14 mm.in 2012 and 2017, respectively. The results of surface runoff estimation using the lowest, highest and average rainfall show the relationship rainfall and surface runoff that the amount of rainfall is the major factor influencing a rise of surface runoff. show the land use conversion and surface runoff relation and surface runoff relationship also examine that the transition of land use among 2008, 2012 and 2017 influenced the changes in surface runoff in this watershed.

Keywords: surface runoff, land use change, watershed

Initial Environmental Impact Assessment Study Development Project of the Area of the Makkasan Bangkok, Railway of Thailand

Wongchantra, P.^{1*}, Wongchantra, K.², Ongon, S.¹, Junkaew, L.¹, Sookngam, K.¹, Kaeongam, S.¹, and Phansiri, C.¹

¹Center of Environmental Education Research and Training, Faculty of Environment and Resource Studies, Mahasarakham University, Mahasarakham, Thailand; ² Srimahasarakham Nursing College, Mahasarakham, Thailand.

Corresponding Author: prayoon_nam@yahoo.co.th

The purpose of research was to initial environmental impact assessment and making suggestions, measured to prevent editing environmental effects that may occur in the development of the surrounding area Makkasan. The study covered 4 areas natural resources physical, natural resources biological, value of human use and quality of life devises. It included four steps as follows: 1) study the details of the project according to the preliminary design, 2) study the primary and secondary data, 3) environmental impact assessment and 4) environmental impact prevention and mitigation measurement, and the appropriate environmental monitoring was also measured. The scope of spatial study was within 1 kilometer radius. The results showed that the project coverage an area of 745 rai in the Lower Chao Phraya River Basin, high surface subsidence explaining that 1) physical, the risk of earthquakes was moderate, the climate was hot and humid, the quality of surface water quality was lower than standard and noise problems exceeded the standard, 2) natural resources project implementation may affect forest resources, and aquatic resources in the area, 3) the value of human consumption was the most using space pertaining to commercial and residential, and a desolate area. It is expected that the development of the project would not affect the land use in the project area. It was improved public utilities and transportation, and 4) the value for quality of life, the project may have an impact on population growth, transportation, but also the economy, education and recreation.

Keywords: Initial environmental impact assessment, Makkasan Bangkok, Railway of Thailand

The Development of Environmental Volunteer Spirit for High School Students

Wongchantra, P.^{1*}, Wongchantra, K.², Kaeongam, S.¹, Sookngam, K.¹, Junkaew, L.¹, Ongon, S.¹, Phansiri, C.¹

¹Center of Environmental Education Research and Training, Faculty of Environment and Resource Studies, Mahasarakham University, Maha Sarakham, Thailand; ²Srimahasarakham Nursing College, Maha Sarakham, Thailand.

Corresponding Author: prayoon_nam@yahoo.co.th

This research aimed to study environmental volunteerism spirit, and to compare the environmental volunteer spirit before and after training. The sample were 4-6 grades of high school level at Na Chueak Pittayasan School, Na Chueak district in Maha Sarakham province, Office of the Secondary Education Region 26. It is estimated approximately 106 individuals. The instruments used in the research were environmental volunteer spirit questionnaire. Data were statistically calculated by frequency, percentage, mean standard deviation of the response items and analyzed through a t-test and F-test (One-way ANOVA and One-way MANCOVA). The research found that the hoboed environmental Volunteer spirit was 93.78/86.01. The effectiveness index of the course had a value of 0.6716, which mean of 67.16. The sample group was an average score of volunteer spirit higher post training than before training statistical significance value of .05.

Keywords: Environmental volunteer spirit, Natural resources and environment conservation

Environmental Investigation of Mango Plantation Community at Ban Lon, Nangdad Sub-district, Nong Bua Daeng District, Chaiyaphum Province

Lerdchai, W.^{1*}, and Wongchantra, P.¹

Faculty of Environment and Resource Studies, Mahasarakham University, Maha Sarakham, Thailand.
Corresponding Author: wanlee088377@gmail.com

Ban Lon community nangdad Sub-district, Nong Bua Daeng District, Chaiyaphum province was investigated for mango plation. The community is located in the valley. It is a community located in the valley and origin of the Chi River which is the main river of the northeast. Villagers focus on producing quality mangoes both in and out of season. The export of mango var Nun Dok Mai. The most are exported through export companies for delivery to china, South Korea, Singapore, Russian. Low grade are sold in the country. Purpose of this researoh were to study the problem and occupational issues mango plation community at Ban Lon, Nangdad Sub-district , Nong Bua Daeng District, Chaiyaphum Province, to assess the initial environment in mango plation community at Ban Lon, Nangdad Sub-district , Nong Bua Daeng District, Chaiyaphum Province, Ban Na Yai Chi, Ban Ki-moon on, Ban Huai Sam Klong and Ban Don Khao Khao Nangdad Sub-district , Nong Bua Daeng District, Chaiyaphum Province, It was to study and compare knowledge and conscious mind environmental conservation in the community before and after the activities. The sample used in the study initial environmental investigation and used in the campaign to conserve the environment in the community were 100 mango plation community by choosing from the groups plantation community at Ban Lon. The 5 villages, each village, there were 20 volunteers. The tools for the environment investigation for the mango growers was to achieve in environmental conservation for mango growers. The results divided into 4 categories were 1) physical environment included soil resource. Soil is silt loam, reddish brown. The climate is not hot in the summer, 2) biological environment included mountains which are surrounded by forests, mostly deciduous forest and deciduous forest. The wildlife in the villages were found such as lamb, monkey, boar, snake, etc., and the aquatic animals eg shrimp, crabs, fishes such as catfish, carp, tilapia. etc., 3) The value of human use, including land use for planting mango, rubber, and rice, and 4) silence community which has a good economy due to the export of mango.

Keywords: Initial environmental examination, A guide to advocacy of environmental conservation for agriculture producers, mangoes plant agriculturers

The Process of Learning to Strengthen the Public Policy Team to Social Well-being for Social Participation based on Intellectual Property (4P-W) Phase 2

Pansila, W.

Faculty of Public Health, Mahasarakham University, Maha Sarakham, Thailand.

Corresponding Author: wpansila57@gmail.com

The social well-being can be achieved by learning together the people in society and sharing responsibility for their well-being and their communities. The objective of this research was to develop the network capacity to drive the public policy process at the provincial level on the 4-step of technical action research process. The main activities consisted of a series of public policy processes, "elevation of plans for participatory public policy (4P-W)" and a series of learning activities. "Widget" from The National Health Act. 2007, conducted in 12 health areas include: team of 408 people and the provincial working group lessons and conclusions of 4 people. Data were collected and analyzed by qualitative method. Conclusions on triangulation techniques. The research found that targeted development in the first set. The target audience has been engaged in the issue and process of engaging public policy, practice writing policy documents. (Announcement/Policy statement), strategic analysis training and a strategy to drive the policy. There are presentations and exchanges of learning plans for the provinces. A 4PW mapping process map was a learning process that learned from the real world. For the learning set 2, all participants learned and practiced the tool. It can show the selection of tools that are relevant to the issue of driving public policy-making (4P-W). These tools can be linked. Summary of learning and practicing tools "Health Assembly Process Tool" is an exchange of experiences from the work of the local health ministry. The network has learned a variety of general assembly tools. Participants bring their knowledge to the 4P-W design through the health assembly process. That can be link between the network. Recommendations should be encouraged to organize learning activities to strengthen the public policy team by focusing on self-learning. The development of the internal potential of each and the network should continue.

Keywords: social health, public health policy, participation, network

Full Papers

The Promotion of Bun Bang Fai tradition (Rocket Festival) in Community following Eco-culture concept

Wannasakpijitra, B.¹

Department of Environmental Education, Faculty of Environment and Resource Studies, Mahasarakham University, Thailand.

Abstract Bun Bang Fai tradition (Rocket Festival) is one of the Northeastern traditions that is called for the 6th month ceremony, is one of the Heet 12 of Isan people during the rainy season in the rice fields to sow the plow to worship Phraya Than for Rain to fall. The villagers held a Bun Bang Fai tradition (Rocket Festival) to worship the God. Villagers believe Phraya Than is responsible for keeping the rainy season accurate and enthusiastic about Bun Bang Fai tradition (Rocket Festival). If any village does not organize Bun Bang Fai tradition (Rocket Festival) to worship. Rain will not fall by the seasons. It may cause disaster to the village. It is held every 6th month or May - June every year. As a result, the Isan people make Bun Bang Fai tradition (Rocket Festival) every year to remind the Phraya Than. Has been trained for generations. Bun Bang Fai tradition (Rocket Festival) has a long history and also is important. Besides, it isa symbol of harmony and friendship. It also demonstrates the natural understanding that affects Isan agriculture. Thus, Bun Bang Fai tradition (Rocket Festival) are importantforIsan people in northeastern Thailand. The purposes of this study were to study and compared Knowledge, and attitudes about Bun Bang Fai tradition (Rocket Festival) community before and after the promotion. The samples were 30 voluntary students majoring in environmental studies, faculty of environment and resource studies of Mahasarakhamuniversity. The research tools were manuals, brochures, achievement tests and the attitudes test. The statistics used for data analysis were frequency, percentage, means, standard deviation, andpair t-test. The findings found that before the promotion students had achievement score at good level and after promotion had achievement score at very good level. When compared mean score between before and after indicated that students had achievement score after more than beforethe promotion at statistically significant level of 0.05. Before promotion students had attitude score at agree level and attitude score after promotion is at agree level. When compared mean score between before and after the promotion indicated that students had attitude score after the promotion higher than before the promotionat statistically significant level of 0.05

Keywords: Bun Bang Faitraditional(Rocket Festival), promotion, knowledge, attitudes, eco-culture

Introduction

Nowadays the majority of world's populations depend on beliefs. Beliefis a path or a guideline for human's practices and actions which has uniqueness for each nation and is used in the particular area. It has beenbeing inherited from ancestors and it is the path for all human's activities, not only creative contributions, thoughts, values, but also a wide branch of knowledge which those are created from a complex social process—conclusion of

¹ **Coressponding Author:** Wannasakpijitra, B.; **E-mail:** eiddy101@hotmail.com

dimensions of objects, minds, intellects, and moods. The complex social process is unique in particular area together with living patterns, values, beliefs, traditions, manners and so forth. (Wongchantra, 2553)

Tradition is begun from states of society, nature, attitudes, traits, and values which is influenced by belief of population in the society, for instance, influence of unreasonable weathers and events. It can be easily seen when any disasters happen, human will plead whoever they think that can help them. After the disaster ended, human would express thankful feelings by doing rituals for their great fortune following their knowledge. Whenever the rituals are well known in the society, it will be repeatedly done and finally become the tradition and culture. It does not concretely exist but it is conjointly created by the population in the particular community. Then, it is passed on opinions, feelings, and beliefs through many ways until it becomes a social habit or tradition. (Rajadhon, 1971)

Bun Bang Fai tradition, Rocket festival, is one of the Northeastern traditions known as The 6th Month Ritual, that is one of the Heet 12—12 traits—of Isan people during the rainy season in the rice fields to sow the plow to worship Phraya Than forrain. The villagers hold a Bun Bang Fai tradition to worship the God called Phraya Yhan. Villagers believe Phraya Than is responsible for keeping the rainy season accurate and enthusiastic. If any villages do not organize Bun Bang Fai tradition, rain will not fall by the seasons and it may cause disasters to the village. It is held in the 6th month or May to June of every year. For this reason, the Isan people holding Bun Bang Fai tradition every year in order to remind Phraya Than has been trained for generations. Bun Bang Fai tradition not only has long history but also is a symbol of friendship and harmony.

From the villager interview of Ban Vaeng Nang, Muang district, Mahasarakham province, found that this village was an example of the 6th month ritual preservation. The villagers believe that the 6th Month Ritual is very crucial. Since they could remember, if they did not hold the ritual, that year, there would not rain causing drought, no water for agriculture. On the other hand, if they held the ritual, the rain would normally come and there would be fertility and no harmful diseases. Hence, Bun Bang Fai is an importantly annual tradition of Isan people. When the ritual soon arrives, Isan people who live in other places will surely get back home to participate Bun Bang Fai ceremony. This keeps Isan people well harmonious and it is a tool for them to get related to nature and environment especially water which is a necessary factor for agriculture. As a result, Bun Bang Fai tradition is a strategy to show how important of water to human and remind them to consume water wisely for preserving future environment. (Boonsorn, 2558)

The first-year students majoring in environmental studies, faculty of environment and resource studies, Mahasarakham university, are new generations who have intention to study about environment in order to gather knowledge in variety of branches which are from family, community, and

society to preserve the world's environment. They have to specialize in this field of area and be able to employ knowledge to educate people in their community to have accurate, and precise understanding. Thus, each student has to learn until cognitive knowledge appears which they can pass on it to others using the environmental processes as a medium to create true knowledge for people in the community. As a result, researcher was interested in promoting Bun Bang Fai tradition for the first-year students majoring in environmental studies. The students would have knowledge of water preservation and realized the importance of water in human's lives. Also, they have to have true understanding of Bun Bang Fai tradition that they would conserve this fine trait from generation to generation.

Objectives

1. to study and compare knowledge before and after promoting Bun Bang Fai tradition of community following eco-culturalism concept.
2. to study and compare attitudes before and after promoting Bun Bang Fai tradition of community following eco-culturalism concept.

Research Hypothesis

1. After promoting student about Bun Bang Fai tradition, students have knowledge of Bun Bang Fai tradition higher than before promotion.
2. After promoting student about Bun Bang Fai tradition, students have higher positive attitudes towards Bun Bang Fai tradition than before the promotion.

Materials and methods

1. Research Area

The research areas of promoting student about Bun Bang Fai tradition following eco-culturalism concept were as follows:

- 1) The area for studying Bun Bang Fai tradition was Ban Nong Waeng, Moo 1, Waeng Nang sub-district, Muang district, Maharakham province.

- 2) The area for promoting knowledge was environmental training and communication research center at environmental studies department, faculty of environment and resource studies, Maharakham university.

2. Population and Sample

Populations used in promoting student about Bun Bang Fai tradition following eco-culturalism concept were as follows:

- 1) The populations for studying Bun Bang Fai tradition were 1,375 villagers of Ban Nong Waeng, Waeng Nang sub-district, Muang district, Maharakham province.

- 2) The populations for promoting were 103 people of the first-year students majoring in environmental studies, faculty of environment and resource studies, Maharakham university.

Samples used in promoting student about Bun Bang Fai tradition following eco-culturalism were as follows:

1) The samples for studying Bun Bang Fai tradition were 5 people. There were a chief of the village, a village sage, and 3 villagers which were selected by purposive sampling.

2) The samples for teaching were 30 people of the first-year students majoring in environmental studies, faculty of environment and resource studies, Maharakham university who volunteered to participate.

Research Length

There are 3 phases as follows:

The 1st phrase: Survey and gather primary data of the area.

The 2nd phrase: Design tools and examine the quality of the tools.

The 3rd phrase: Promote student knowledge and analyze the evaluation results.

Research Pattern

The promotion of Bun Bang Fai was a quasi experimental research using one group pretest-posttest design. Then compare both knowledge and attitudes before and after the promotion. (Srisa-art, 2543) See table 3.1.

Table 3.1 One Group Pretest-Posttest Design

Group Pretest Promoting processes posttest

EO1 XO2

Symbols used in the research

E stands for experimental group.

O1 stands for the pretest score of knowledge and attitudes.

O2 stands for the posttest score of knowledge and attitudes.

X stands for the promotion of Bun Bang Fai tradition.

Data Collecting Tools

Tools used for collecting data were:

1. Studying Bun Bang Fai tradition tools

- Interviewing documents about Bun Bang Fai tradition of villagers in Ban Nong Waeng, Waeng Nang sub-district, Muang district, Maharakham province

- Articles of Bun Bang Fai tradition

2. Teaching Bun Bang Fai tradition tools

- Bun Bang Fai training guidebooks

- Pamphlets of Bun Bang Fai Tradition

3. Analyzing and evaluating tools

- Pretest-posttest documents of Bun Bang Fai tradition

- Questionnaires of attitude evaluation towards Bun

Bang Fai tradition

Data Collection

Data collecting design was separated into 3 phrases:

The 1st phrase: Study Bun Bang Fai tradition.

The 2nd phrase: Design tools and examine the quality of tools.

The 3rd phrase: Promote environmental knowledge.

Data Analysis and Statistics

Data analysis was completed through computer program. Statistics used in the research were:

1. Fundamental statistics: frequency, percentage, average, and standard deviation
2. Quality analyzing statistics of tools: content validity (IOC: Index of Item Objective Congruency), Reliability, Discrimination, and Difficulty

3. Hypothesis testing statistics: Paired t-test which statistically significant level was at 0.05

Discussion

About the promotion of Bun Bang Fai tradition in community following eco-culturalism concept, the researcher discussed the relation of the research objectives as follows:

1. The results of comparing attitudes before and after the promotion of Bun Bang Fai tradition in community following eco-culturalism concept found that before the promotion, participated students had an average of achievement score at the good level. After the promotion, students had the average of achievement score at the very good level. Comparing before and after the promotion, the researcher found that participated students after the promotion had higher average score than before the promotion. Because of the patterns employed and the environmental process used consisting of lecture together with guidebooks, pamphlets, and various integrated techniques including Q and A sessions, those gathered attention and made students feel positive towards Bun Bang Fai tradition. Moreover, it indicated that the promotion process was able to create a bunch of knowledge about Bun Bang Fai in the community and inspired them to have great attention. This caused the positive achievement which could be referred to the ideas of Singiwo (2011) who stated that the effective process of spreading content of environmental studies to others had to have suitable means and regulations. The used process was already written in education system. It depended on which part would be chosen to use, for instance, a curriculum of environmental studies was interdisciplinary which was developing systemic thoughts, picturing everything as a big picture and supporting student centered learning approach. Early process was taken from Subject of Education. Furthermore, Wangpanich (2526) said when person had got knowledge through learning, practice, training, and experiencing with direct perceptions,

he would know facts and details called personal experience that would be passed on to others known as knowledge. Chankaew (1997) had researched about the promotion of Heet 12 Kong 14 in order to conserve the cultural environment. Nunthasuk (2014) studied about the promotion of bio extract from Siamese Neem tree for eliminate insect pest in the fields of Ban Sa Wittaya school, Klong Kham sub-district, Yangtalad district, Kalasin province. Chankunok (2014) studied about the promotion of planting herbs in public area at Ban Ta Khon Yang community, Ta Khon Yang sub-district, Kantarawichai district, Mahasarakham province. Wongsompong (2556) studied about the promotion of getting rid of trash in household for Sriwilai village, Nongpling sub-district, Muang district, Mahasarakham province. Khun-arsa (2014) studied about waste management by building a simple incinerator for Ban Nonghin school, KogGoasub-district, Muang district, Mahasarakham province. Gunlaya (2014) studied the promotion about planting herbs for cooking for Ban NongOom school students, Na Sri Nuansub-district, Kantarawichaidistrict, Mahasarakham province. As the result, all details indicated that the promotion of Bun Bang Fai tradition in community following eco-culturalism concept enhanced knowledge level of the students. There were various integrated techniques causing interest among the students which helped to increase the average of knowledge score.

2. The results of comparing attitudes before and after the promotion of Bun Bang Fai tradition in community following eco-culturalism concept found that before the promotion, participated students had average score of attitudes at 2.87 which was at the agreed level. After the promotion, students had average score of attitudes at 2.96 which was at the same level, agreed, but the score was higher. Comparing before and after the promotion, the researcher found that participated students after the promotion had higher average score than before the promotion at statistically significant level of 0.05 which showed that the promotion of Bun Bang Fai tradition in community following eco-culturalism concept increased the attitudes level of the students. The processes of creating positive attitudes were related to the idea of Wongchantra. He stated that environmental studies were the knowledge-transfer processes for environment, evaluating and improving environmental problems. Also, it caused a good environment and good quality of lives which followed the same principle as the environmental interdisciplinary. Environmental studies learned about lives. It was a lifelong learning—learn to live together, learn current events and future, and create morals about environment, be systemic learning process. Moreover, it was the integration of lessons which the learners had to participate and realize. The learners would have positive attitudes, values about environment. They would learn to solve problems themselves. Suwan stated that factor of creating attitudes was learning stimulated by stimulations causing not only positive impressions, such as, preferred feeling but also negative feelings namely, hated feeling. The process of learning might cause a person to accept other

attitudes which the person could be pursued to act out through visible behaviors.

Norman (1971) said that attitudes were person's feelings and opinions of things, situations, institution, and offers whether in a agreeable or a refusing way that influenced him to always react with the same behaviors. This research could be related to the research of Sadjanun (2556). She studied the promotion of employing ground worms for erasing solid waste in household for Sriwilai village, Nongpling sub-district, Kantarawichai district, Mahasarakham province. Wannapo studied about the promotion of planting and preserving Gros Michel banana for bachelor-degree students majoring in environmental studies. Sidachompoo studied about the promotion of using guidebooks for planting Plumeria tree both for preservation and decoration for bachelor-degree students majoring in environmental studies. Chaiyuth Posarod studied about the promotion of using grease trap for preventing waste in the community water resources, KaengLoengChansub-district, Muang district, Mahasarakham province. Boonbumrung researched about the promotion of using guidebooks for planting galangal both for preservation and decoration for bachelor-degree students majoring in environmental studies. Rodjanathiwat researched about the promotion of Mek, herb, conservation in Ban Hua Khao, Ta Khon Yang sub-district, Kantarawichai district, Mahasarakham province. From the research, it indicated that the promotion of Bun Bang Fai tradition in community following eco-culturalism concept together with various integrated techniques increased the attitudes level of the students.

Conclusion

From studying about promotion of Bun Bang Fai tradition following eco-culturalism concept, the researcher had studied, and compared knowledge and attitudes that the first-year students majoring in environmental studies, faculty of environment and resource studies, Mahasarakham university, had with the Bun Bang Fai tradition. The findings were as follows:

1. The results of comparing knowledge before and after the promotion of Bun Bang Fai tradition in community following eco-culturalism concept.

Before the promotion, participated students had an average score at the good level. After the promotion, students had the average of achievement score at the very good level. Comparing before and after the promotion, the researcher found that participated students after the promotion had higher average of achievement score than before the promotion at statistically significant level of 0.05 which showed that the promotion of Bun Bang Fai tradition in community following eco-culturalism concept enhanced knowledge level of the students.

2. The results of comparing attitudes before and after the promotion of Bun Bang Fai tradition in community following eco-culturalism concept.

Before the promotion, participated students had average score of attitudes at 2.87 which was at the agreed level. After the promotion, students had average score of attitudes at 2.96 which was at the same level, agreed, but the score was higher. Comparing before and after the promotion, the researcher found that participated students after the promotion had higher average score than before the promotion at statistically significant level of 0.05 which showed that the promotion of Bun Bang Fai tradition in community following eco-culturalism concept increased the attitudes level of the students.

Suggestion

1. Suggestion for research adoption

1) The guidebooks and pamphlets that promote Bun Bang Fai tradition knowledge contain background history, rituals, beliefs, and local wisdoms of Bun Bang Fai tradition. Moreover, there were processes of promoting Bun Bang Fai tradition which were studied and developed by experts. Anyone who is interested in this field of study can take it for creating your personal learning and good attitudes towards Bun Bang Fai tradition and passes on to people, departments, constitutions, and so on to have better understanding, to see the importance, and to change attitudes they have with Bun Bang Fai tradition.

1. Suggestion for further research

1) The study process should relate beliefs of Bun Bang Fai tradition with natural resources and environment in order to analyze the relevant between the beliefs and natural phenomenon and to explain the origin and importance of Bun Bang Fai tradition and environment following eco-culturalism concept.

2) The study process should learn Bun Bang Fai tradition while creating relationship with people in community and other nearby community in order to link eco-culturalism with living in the community.

References

- Boonbumrung, P. (2014). The Promotion of Using Guidebooks for Planting Galangal Both for Preservation and Decoration for Bachelor-degree Students Majoring in Environmental Studies. (Bachelor thesis). Environmental Studies. Mahasarakham University.
- Boonsorn, J. (2015). The study of Bun Bang Fai Tradition of Nong Waeng community, Waeng Nang sub-district, Muang district, Mahasarakham province.
- Chankunok, L. (2014). The promotion of planting herbs in public area at Ban Ta Khon Yang community, Ta Khon Yang sub-district, Kantarawichai district, Mahasarakham province. (Bachelor thesis). Environmental Studies. Mahasarakham university.
- Gunlaya, C. (2014). The Promotion of Planting Herbs for Cooking for Ban Nong Oom school students, Na Sri Nuan sub-district, Kantarawichai district, Mahasarakham province. Thesis. B.Sc. Environmental Studies. Mahasarakham University.
- Jankeaw, L. (2013). The promotion of Heet 12 Kong 14 in order to conserve the cultural environment. (Master thesis). Environmental Studies. Mahasarakham University.

- Norman, L. M. (1971). Introduction to Psychology. Boston: Houghton Mifflin company.
- Nunthasuk, P. (2014). The promotion of bio extract from Siamese Neem tree for eliminate insect pest in the fields of Ban Sa Wittaya school, Klong Kham sub-district, Yangtaladdistrict, Kalasinprovince. (Bachelor thesis). Environmental Studies. Maharakham University.
- Wangpanich, P. (1983). Educational Measurement. Bangkok, Thai WatanaPanich.
- Rajadhon, P. A. (1971). Thai Traditions and Culture. PhraNakhon: KlungWittaya.
- Rodjanathiwat, R. (2013). The promotion of Mek-herb conservationin Ban Hua Khao, Ta Khon Yang sub-district, Kantarawichai district, Maharakhamprovince. (Bachelor thesis). Environmental Studies. Maharakham university.
- Sadjanun, P. (2013). The promotion of employing ground worms for erasing solid waste in household for Sriwilai village, Nongpling sub-district, Kantarawichai district, Maharakham province. (Bachelor thesis). Environmental Studies. Maharakham University.
- Sidachompoo, P. (2014). The promotion of using guidebooks for planting Plumeria tree both for preservation and decoration for bachelor-degree students majoring in environmental studies. (Bachelor thesis). Environmental Studies. Maharakham University.
- Singsiwo, A. (2011). Basic of Environmental Study. Maharakham: Maharakham University.
- Srisa-art, B. (2000). Research Plan. Bangkok, Suweeriyasart.
- Suwan, P. (1977). Attitudes: Measurement of Changes and Healthy Behavior. Bangkok, Peerapattana.
- Wannapo, S. (2014).The promotion of planting and preserving Gros Michel banana for bachelor-degree students majoring in environmental studies. (Bachelor thesis). Environmental Studies. Maharakham University.
- Wongchantra, P. (2010). Environmental Technology. Maharakham, Maharakham University.
- Wongsompong, T. (2013). The Promotion of Getting Rid of Trash in Household for Community.Thesis.B.Sc. Environmental Studies. Maharakhamuniversity.

Application of the Sufficiency Economy Philosophy by the Debsirinromklaio School's Board of Operations and Driving the Sufficiency Economy Philosophy, Thailand

Charoenjindarat, P.* , Kuhaswonvetch, S. and Panrosthup Thunmathiwat, D.

Department of Agricultural Development and Resource Management, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520 Thailand.

Abstract The study in depth of sufficiency economy philosophy, the level of adopting the sufficiency economy philosophy to daily life, compare whether different status in Debsirinromklaio community effect the understanding the sufficiency economy philosophy, and were investigate to compare the different status in Debsirinromklaio community among the committees result in differences in applying the sufficiency economy philosophy. The study was conducted by collecting 81 questionnaires. We analyzed the data by descriptive statistic and t-test. We found that The committee's level of understanding the sufficiency economy philosophy in overview can be classified as high level with the average score of 25.14. The average rational dimension, the immunity dimension and the modesty dimension score are 8.04, 8.57 and 8.65 respectively. The degree of applying the sufficiency economy philosophy among the committee is in average level with the average score of 20.15. The score for house gardening and farming dimension and the life-style dimension score are both also considered be in the average level with the average score of 8.26 and 12.11 respectively. The comparison between the status of the committee, namely among on present students and alumni, on understanding the sufficiency economy philosophy result shows that there is no different to both groups with the statistic significant score of 0.05. On comparison the adopting the sufficiency economy philosophy between the present students and alumni shows the difference score in term of house gardening and farming dimension but not the life-style dimension. The life-style indifference score statistic significant score is 0.05.

Keywords: Sufficiency Economy, Applying the Sufficiency Economy Philosophy, Debsirinromklaio

Introduction

The sufficiency economy philosophy and its code for daily life is the guideline longed introduced to us by King Bhumibol Adulyadej (Rama IX). The guideline was based on the modesty principle, the rational principle, the sustainable immunity to life financial crisis principle, and the wisdom and the good believe in morals principle. Thai people in modern day in every level and in every part of the society, the bureaucratic, the privates, academics and ordinary people are seriously enthusiastic to its importance of it to counter the seemed to be too fast present day life style. As the result, the ministry of education which is the main unit to develop youths for good qualities, is aware of its value in delivering the sufficiency economy philosophy into actions. It

* **Corresponding Author:** Charoenjindarat, P.; **E-mail:** pavida_kik@hotmail.co.th

proposed a policy which creating the process of understanding the sufficiency economy through the sufficiency economy philosophy as the core to build quality members of our society which people are able to earn their money by themselves (Ministry of Education: MOE, 2009). The ministry advocated its strategy in driving the sufficiency economy philosophy to schools. Nationwide schools under its command as well as schools under its regulation joined in driving the sufficiency economy philosophy principles into their schools (Jaiyakieow, 2012). By driving the philosophy to its communities, Schools have focused that the children and youths in every level to embrace the sufficiency economy philosophy to their thinking, working and codes in their daily life. The students would be able to keep their balance in their life and be ready to wisely deal with changes that might occur anytime. They would rationally apply their wisdom and knowledge for the benefits of themselves and the society in present days as well as in the future. (Mulnee, 2014)

The Debsironromklao school is one of the schools which see the significance of adopting the sufficiency economy philosophy and promote the policy into their school. Operated by the board of operations and driving the sufficiency economy, the team's main objective is to publicize the sufficiency economy and pushing sufficiency economy activities both inside and outside their school. In 2009, the school organized a camp to promote sufficiency economy philosophy. Other activities were also organized. In 2011, the school expanded their effort and organized sufficiency economic youth camp as well as other related activities such as sufficiency economy young leader, promoting sufficiency economy promoting booth outside their school, sufficiency economy market. The activities have been repeatedly organized until the school was honored to be a sufficiency economy school model. In 2015, they were selected among the honored schools with an "best practice" excellence operations in the national level with the recognition of achieving in the practical adopting sufficiency economy in real life. Their examples in recognized achievements are growing home vegetable, bio-fermented water production, clay house, and agriculture, etc. The school has consistently continued to drive the publicizing the sufficiency economy. They have appointed 9 generation of committees. Each team still continue to give their supports to activities. In addition, they've enhanced the sufficiency economy philosophy to agriculture and daily life. They've shared their work to other schools in the area. The authors are, thus, interested in studying the level of their understanding in the sufficiency economy philosophy, the level of their applying the sufficiency economy philosophy to agriculture and their daily life, whether the different in the Debsirinromklao school's board of operations and driving the sufficiency economy philosophy status cause any difference in applying the sufficiency economy philosophy. This study aim to gain this information to adjust and improve the driving of Debsirinromklao's sufficiency economy operations as well as to promote the sufficiency economy philosophy to other schools and communities.

Materials and methods

The population and the samples

The population in this study was members of the Debsirinromklao school's board of operations and driving the sufficiency economy. There are 222 members from 9 different batches. Some of the members are ex-students and the others are current students.

The samples for this study were ex-students and current students of are members of the Debsirinromklao school's board of operations and driving the sufficiency economy. There are 81 persons 61 of which are ex-students and the other of 20 persons are current students.

The study technique

The study was a quantitative research. We used questionnaires to collect data. Our data was validated for validity content by analyzing the index of item objective congruence: IOC from the study's advisor and experts. The questionnaires was composed of 3 parts – the general information, their understanding of sufficiency economy, and the applying the sufficiency economy to agriculture and daily life. The IOC score is 0.844.

Data collection

The authors compiled questions which were verified that they met the study's objectives. The questionnaires were sent in the form of Google form to alumni via recipients' Facebook and The committee Line group account. For the present students, the questionnaires were handed out and collected in person.

The data analysis

1) In descriptive statistic, frequency, percentage, average and standard deviation, are used in analysis on fundamental information, the knowledge regarding sufficiency economy, and the applying the sufficiency economy philosophy. There are 30 questions on the knowledge of the sufficiency economy philosophy. The questions can be divided into 3 dimension – the modesty, the rational and the (robust financial) immunity. Each dimension contain 10 questions (10 points). The informant shall be awarded 1 point for each correct answer and 0 point for each wrong answer. Each dimension can be classified according to the average score. There are 3 classes of the average score – good, average, and poor

Average score of	6.68 - 10.00	means good level
Average score of	3.34 - 6.67	means average level
Average score of	0.00 - 3.33	means poor level

The authors classified overall score analysis. There are 3 classes of as follow.

Average score of	21.00 - 30.00	means good level
Average score of	11.00 - 20.00	means average level
Average score of	0.00 - 10.00	means poor level

On applying the sufficiency economy philosophy to agriculture and daily life. The questions were closed questions in the amount of 20 questions (2 points each, total of 40 points). The questions were divided into 2 area – 10 questions for agriculture and 10 questions for daily life. Each question had 3 choices of value to answer – none, sometime, and regular. The point awarding system is as follow - 0 point for none, 1 for sometime, and 2 for regular. Again, the average score can be classified into 3 levels – the low, the medium, and the high as follow.

Average score of	1.33 - 2.00	means high level
Average score of	0.67 - 1.32	means medium level
Average score of	0.00 - 0.66	means low level

The authors classified overall score analysis. There are 3 classes of as follow.

Average score of	26.67 - 40.00	means high level
Average score of	13.34 - 26.66	means medium level
Average score of	0.00 - 13.33	means low level

2) Inferential statistics refers to t-test (Independent sample t-test) is used for comparison between ex-student score and present student score on the knowledge on sufficiency economy and the score on applying the sufficiency economy philosophy.

Results

The basic background of the board of operations and driving the sufficiency economy.

The majority of the committee are female. 60.49% of informants are female. The majority of age range is 20 -25 years old. 61.73% of informants age are in this range. 75.31% of informants are alumni. 70.37% of informants are currently / have earned bachelor degree. 62.96% of informants said their occupation are students / university students. The majority of the informants income is between 5,000 – 10,000 Baht. There are 38.27% of them.

The most common channel to access to news related to sufficiency economy philosophy is Facebook pages or group of sufficiency economy related pages at the rate of 81.48%. The average frequency for receiving the news once / week is most common at 24.69%. The time used on each received news of 10 minutes or less is the most common at 49.38%. The most common place to receive the news is at home for 75.31%. The most common area for receiving the news is at the club room at rate of 35.80%.

The knowledge on sufficiency economy philosophy.

The study found that the board of operations and driving the sufficiency economy has high level on knowledge on sufficiency economy philosophy with the average score of 25.14. The three dimension average scores are also in high level. The descending order of the three dimension are as follow – the modesty (8.65), the immunity (8.57), and the rational (8.04). (Table 1)

Table 1 Understanding Sufficiency Economy 3 dimension.

Understanding Sufficiency Economy	S.D.	Average (Meaning)
Modesty	1.131	8.65 (high)
Rational	0.843	8.04 (high)
Immunity	1.405	8.57 (high)
All	1.998	25.14 (high)

In detail, we can explore the board of operations and driving the sufficiency economy score as shown below. (Table 2)

Overall, the majority of the committee are considered to have good understanding on sufficiency economy in the level of high (96.30%). The other (3.70%) are consider to be in the average level.

The authors scanned the information on the 3 dimensions. The average scores are all in high level for modesty, rational, and immunity. The modesty and the rational are equal at 95.06%. The immunity is at 96.30%.

Applying the sufficiency economy philosophy to agriculture area and daily life area.

From the study result, the majority of the committee of Debsirinromklao apply the sufficiency economy philosophy to agriculture area and daily life area are in medium level of 64.20%. The high level is next with 19.75% and the low at 16.05% (Table 3)

Exploring results on each area, the agriculture area and daily life area, the level of this information for both area is medium with the total average of 20.25 (Table 4)

For agriculture area, the overall level on applying sufficiency economy philosophy is considered to be in medium level at 8.26. When sorting the specific activities in descending, the top activity is planning before harvesting with the score 1.31. The second activity is to plan home vegetables for extra income with the score 1.12. The third activity is whether the informant grow home vegetable for home domestic consumption with the score of 1.05. The 10th is collecting seeds or being able to reproduce seeds. (Table 5).

Table 2 Amount and Percentage of Committee on knowledge on sufficiency economy philosophy. (n = 81)

Knowledge level on sufficiency economy philosophy	Amount	Percentage
Overall		
High	78	96.30
Medium	3	3.70
Low	-	-
Average (SD) 25.14 (1.998)		
Modesty		
High	77	95.06
Medium	4	4.94
Low	-	-
Average (SD) 8.65 (1.131)		
Rational		
High	77	95.06
Medium	4	4.94
Low	-	-
Average (SD) 8.65 (1.131)		
Immunity		
High	78	96.30
Medium	3	3.70
Low	-	-
Average (SD) 8.57 (1.405)		

Table 3 Level of applying sufficiency economy philosophy to agriculture area and daily life area. (n = 81)

Level of applying sufficiency economy philosophy to agriculture area and daily life area	Count	Percentage
High	16	19.75
Medium	52	64.20
Low	13	16.05

Table 4 Overall level of applying sufficiency economy philosophy.

Level of applying sufficiency economy philosophy	S.D.	Average (Meaning)
Agriculture	4.914	8.26 (Medium)
Daily Life	4.071	12.11 (Medium)
Overall	7.051	20.25 (Medium)

On applying sufficiency economy philosophy on daily life basis, the overall level is medium. The average overall is 12.11. When sorting the specific activities in descending, the top activity is saving part of their money for saving with the score 1.52. The second activity is planning on their spending. This includes finding reasons / ways to solve obstacles against buying what is planned for. The score is 1.40. The third is to have plan for their life. The activity at the bottom, the 9th, is making their own consumer products to reduce expense. (Table 6).

Comparison on informant's status on knowledge in overall sufficiency economy philosophy.

The authors want to analyze whether there is any differences between the alumni and current students' knowledge in overall sufficiency economy. By using t-test (Independent sample t-test), we found that there is no different among the status on sufficiency economy philosophy principals-the modesty, the rational, and the sustainable immunity. The not-difference has a statistic significant score of 0.05 (Table 7).

The authors looked into detail scores on each dimension and found that the alumni and current students have proper knowledge on sufficiency economy philosophy at the same level on all 3 dimensions - modesty, rationality, and sustainable immunity (Table 8).

Table 5 Applying sufficiency economy on agriculture area (n = 81)

Question	Count (Percentage)			S.D.	Average	Meaning (Order)
	None	Sometime	Regularly			
1. Grow plants for domestic consumption	16 (19.75)	45 (55.56)	20 (24.69)	0.669	1.05	Medium (3)
2. Planning before growing	9 (11.11)	38 (46.91)	34 (41.98)	0.664	1.31	Medium (1)
3. selling home grown produces	20 (24.69)	31 (38.27)	30 (37.04)	0.781	1.12	Medium (2)
4. Grow plants all year long	31 (38.27)	36 (44.44)	14 (17.28)	0.720	0.79	Medium (5)
5. Grow plant for domestic consumption (sell or give away if available)	45 (55.56)	27 (33.33)	9 (11.11)	0.689	0.56	Low (9)
6. Able to self-prescribe herbs if ill	40 (49.38)	32 (39.51)	9 (11.11)	0.681	0.62	Low (8)
7. Allocation of land space for agriculture	35 (43.21)	31 (38.27)	15 (18.52)	0.751	0.75	Medium (6)
8. Make bio-fermented water for home use	33 (40.74)	36 (44.44)	12 (14.81)	0.703	0.74	Medium (7)
9.(Capable) Collecting seeds for reproduction techniques	49 (60.49)	23 (28.40)	9 (11.11)	0.691	0.51	Medium (10)
10. Promote in the area of planting home vegetable	28 (34.57)	40 (49.38)	13 (16.05)	0.91	0.81	Medium (4)
Overall				4.914	8.26	Medium

Table 6 Applying sufficiency economy on daily life activities (n = 81)

Question	Count (Percentage)			S.D.	Average	Meaning (Order)
	None	Sometime	Regularly			
1. Plan on spending	6 (7.41)	37 (45.68)	38 (46.91)	0.626	1.40	high (2)
2. Income and Expense Bookkeeping	25 (30.86)	38 (46.91)	18 (22.22)	0.728	0.91	Medium (8)
3. Regularly save for Saving	6 (7.41)	27 (33.33)	48 (59.26)	0.635	1.52	high (1)
4. Reuse and Repair	7 (8.64)	46 (56.79)	28 (34.57)	0.608	1.26	Medium (5)
5. Wisely finding conclusion rationally before making decision	6 (7.41)	37 (45.68)	38 (46.91)	0.626	1.40	high (2)
6. Identify true need before buying	6 (7.41)	44 (54.32)	31 (38.27)	0.605	1.31	Medium (4)
7. Keep themselves updated incidents	5 (6.17)	51 (62.96)	25 (30.86)	0.560	1.25	Medium (6)
8. Has a plan for life	4 (4.94)	47 (58.02)	30 (37.04)	0.566	1.32	Medium (3)
9. Produce consumer product for saving	43 (53.09)	25 (30.86)	13 (16.05)	0.749	0.63	Low (9)
10. Promote the sufficiency economy knowledge to your family and neighbor	13 (16.05)	55 (67.90)	13 (16.05)	0.570	1.00	Medium (7)
Overall				4.07	12.11	Medium

Table 7 Comparison on informant's status on knowledge in overall sufficiency economy philosophy (n = 81)

Status	n	\bar{x}	S.D.	t	Sig. (2-tailed)
Alumni	61	25.08	2.099	0.421	0.675
Current Student	20	25.30	1.689		

Table 8 Comparison on informant's status on knowledge in sufficiency economy philosophy on modesty dimension, rational dimension, and sustainable immunity dimension (n = 81)

Sufficiency Economy Philosophy Principal	Status	n	\bar{x}	S.D.	t	Sig. (2-tailed)
Modesty	Alumni	61	8.61	1.242	0.661	0.510
	Current Student	20	8.80	0.696		
Rationality	Alumni	61	7.98	0.885	0.996	0.322
	Current Student	20	8.20	0.696		
Sustainable Immunity	Alumni	61	8.49	0.721	0.595	0.558
	Current Student	20	8.30	1.380		

Comparison on informant's status on overall applying sufficiency economy philosophy.

Analyzing informants applying sufficiency economy philosophy with t-test (Independent sample t-test), the authors found that both alumni and current students do apply to their life on both area - agriculture and daily life. The significant score is at 0.05. (Table 9)

Table 9 Comparison on informant's status on overall applying sufficiency economy philosophy (n = 81)

Status	n	\bar{x}	S.D.	t	Sig. (2-tailed)
Alumni	61	19.52	0.915	1.627	0.108
Current Student	20	25.30	1.434		

The authors looked into each area and found that alumni and current students differently apply the sufficiency economy philosophy on agriculture area with the significant score 0.05 while there is no difference in daily life area with the significant score 0.05. (Table 10)

Table 10 Comparison on informant's status on applying in sufficiency economy philosophy on Agriculture area and Daily life area. (n = 81)

Sufficiency Economy Philosophy Principal	Status	n	\bar{x}	S.D.	t	Sig. (2-tailed)
Agriculture area	Alumni	61	7.54	4.508	2.362	0.021*
	Current Student	20	10.45	5.549		
Daily life area	Alumni	61	11.98	4.338	0.490	0.626
	Current Student	20	12.50	3.187		

Discussion

Having validated understanding on sufficiency economy philosophy and evaluated the degree of applying the sufficiency economy philosophy in agriculture area and daily life area, the authors found that the levels on its knowledge on sufficiency economy on modesty, rationality, and sustainable immunity are high. All 3 average scores are 8.65, 8.04, and 8.57 respectively. Because the board of operations and driving the sufficiency economy has continued to consistently conduct activities regarding sufficiency economy, the committee has gained deep knowledge on the matter. The knowledge, in fact, has been revised through activities because of their commitment to achieve their objectives. This should explain why their knowledge on all principals are in high level. This is in line with (Sanguanrat *et al.*, 2012) This community has applied their knowledge to sufficiency economy on agriculture area and daily life area. On the agriculture area, the authors found that the level of the applying the sufficiency economy philosophy on cultural area and daily life are both in the medium level with the average score of 8.26 and 12.11 respectively which is consistent with (Lornil, 2013) However, with

our finding on committee statuses among committee's knowledge and applying the sufficiency economy philosophy, we found that the level on their knowledge is not effected by their statuses. This is because the operation of the board of operations and driving the sufficiency economy has been consistent from generation to generation with well-familiar activities. Yet the different statuses caused differences in applying the sufficiency economy philosophy. This is because current students have more chances to practice agriculture related activities that alumni while the alumni were in school through new school courses and school activities. Furthermore, the alumni work in companies in town. Thus there is no time and space for them to perform agriculture activities. Finally, because both alumni and current students have strong believe in sufficiency economy philosophy in their daily life, there is no difference on applying the philosophy to their daily life. The result was particularly shown through the score on the saving and the plan on spending.

Conclusion

From our study, the board of operations and driving the sufficiency economy has the following basic background. The majority of the committee are female. Female committee are 60.49%. The majority of the committee are at the age between 20 - 25 years old. There are 61.73% of committee in the age range. The majority of the committee are alumni. They are accounted for 75.31%. The majority of the committee education level is bachelor degree. There are 70.37% of them. The majority of the committee occupation is students / university students. There are 62.96%. The most common range of their income is 5,000 - 10,000 Baht. The most common channel for sufficiency economy philosophy is from pages or groups of sufficiency economy related projects. There are 81.48 responses for the channel. The most frequency getting in touch with the incidents updates is one day per week. There are 24.69% responses for the information. 49.38% of responses is for the 10 minutes or less on the time spent on the incidents updates. The most common place to receive updates are at home with 75.31% while the most common area in school to receive updates is at the club room with 35.80%. On the knowledge of sufficiency economy philosophy, 96.30 of the committee has the knowledge at the high level and 3.70% at the medium level. On levels of the applying sufficiency economy philosophy for the board of operations and driving the sufficiency economy, most of them engage at medium level. There are 64.20%, 19.75% and 16.06% on medium, high, and low respectively. On analyzing committee status on levels on knowledge on philosophy principals - the modesty, the rationality, and the sustainable immunity, alumni and current students has no different level with the statistic significant score of 0.05 on all 3 principals. On analyzing committee status on levels of applying sufficiency economy philosophy on 2 area which are

agriculture and daily life, the alumni and current students have applied the sufficiency economy philosophy differently on agriculture area but not different on daily life with the statistic significant score of 0.05.

Recommendation

As we have discussed the study of applying the sufficiency economy philosophy on the operation of the Debsirinromklao's board of operations and driving the sufficiency economy, the committee could emphasize even more on applying the sufficiency economy philosophy on both agriculture area and daily life area to be more practical, especially on the agriculture area. There could set up a space for collaboration on agriculture for example growing home vegetables. They could consume the produces or sell them so that they gain even deeper understanding on applying the sufficiency economy philosophy. Participants could even extend the activity or expand the activity to their family.

References

- Jaiyakieow, U. (2012). Application of Sufficiency Economy Philosophy in School, Chiangrai Primary Educational Service Area Office 3: Case study Baansankong School, Mae Chan District, Chiangrai Province.
- Lornil, W. (2013). Factors Related to Application of the Sufficiency Economy Philosophy to Daily Student Live in the Project of the Community Sufficiency Economy Learning Center. *King Mongkut's Agricultural Journal* 31:45-52.
- Ministry of Education: MOE. (2009). An approach of demonstration on sufficient economy to school. Bangkok. Center of Coordination of The Royal Development Projects. Office of Special Activity Office of the Permanent Secretary Ministry of Education. Ministry of Education.
- Mulnee, K. (2014). Using Sufficient Economy Principle in Education Administration of MatayomSuksa Schools in District 26 Area. *Sri PratumChonburiAcademic Journal* 1-10.
- Sanguanrat, M., Poomphan, S. and Weerakultawan, S. (2012). Factors Affecting the Application of Sufficiency Economy Philosophy on the way of Live of People at Moei Wadi District, Roi Et Province. *Graduate Studies Journal* 10:157-171.

The Promotion to grow upside down for villagers of Ban Thakhonyang, Thakhonyang, Kantharawichai Sub-District, Maha Sarakham Province.

Cumrae, N.¹, Inchai, P.^{2*}, Sittichai, S.¹, Saowakontha, S.², and Piboon, K.³

¹Faculty of Environment and Resource Studies, Mahasarakham University, Maha Sarakham, Thailand; ²Faculty of Medicine, Burapha University, Chon Buri, Thailand; ³Faculty of Public Health, Burapha University, Chonburi, Thailand.

Abstract The pattern of villagers' vegetable consumption was studied to promote growing vegetables upside down and compared their knowledge and attitude. Ten Thakhonyang villagers were selected for interviewing on vegetable consumption. Thereafter, training manuals and brochures were produced from the structured interview information. The 30 villagers voluntarily participated in program using the Tyler training model, all data on knowledge and attitude were collected by interviewing, knowledge test, and attitude questionnaires. The results revealed that all participants had never received information about the growing upside-down gardening before promoting. The knowledge was averaged score at the low level and after promoting the knowledge average score was increased to the high level. The attitude averaged score was uncertain level before the promotion. It increased to agree level after participating in the promotion activities. Comparison of both knowledge and attitude scores of the villagers who participating in the promotion activities was higher than pretested. The promotion of growing vegetables upside down was not only enhanced their knowledge but also the villagers' attitudes.

Keywords: attitude, knowledge, promotion, to grow upside down, vegetable

Introduction

At present, farmers use chemicals during growing their crops. The consumers have taken the chemical contaminated vegetables that may affect their health as well as the environment. Office of Agricultural Economics, Department of Agriculture in Thailand has offered insecticides and fungicides to growers during 2012-2017 with tended to increase in 2012 and 2017 which imported herbicides 106,860 and 148,979 tons, respectively, and imported insecticides 16,797 tons in 2012 and 21,601 tons in 2017. Thai-PAN (Thailand Pesticide Alert Network) reported residual pesticides found in 10 vegetables including basil, tomatoes, morning glory, white cabbage, cucumber, long beans, kale, eggplant, red pepper and cabbage (Thai-PAN, 2018:). To save consumer health, growing vegetables for self-consumption is another way to avoid consuming toxic substances that may remain in the food.

Self-growing vegetables have many advantages including consuming non-chemical contaminated vegetables, save cost, expand a green area and

* **Corresponding Author:** Inchai P.; **E-mail:** puangtong@go.buu.ac.th

make a good relationship in the family. Various planting methods such as organic vegetables in farms, planting vegetable on plots, and growing vegetables in pots, etc. (Limpakooptathavorn, 2015). In case of the people who live in areas with limited cultivation areas and intend to self-growing vegetables, the way of growing vegetable upside down is not only to help plants grow well but also reduce weed problems diseases and insects. Moreover, it can be decorated an accommodation as home garden (Somboonwong and Siri, 2018). The growing upside down plant would apply more water and nutrients. It also can alleviate the disruption of water and nutrient transport, because of the state of the upside down plant, the gravity will help in pushing the flow of water to its top (Rhoades, 2016).

Thakhonyang community, Kantharawichai Sub District, Mahasarakham Province, has been rapidly transformed from rural to urban communities since Mahasarakham University had been moved from Mahasarakham city proper to be located about 1 kilometer away from the community. Consequently, the community has considerably changed from agricultural to urban community such as there have been many houses and building being built to serve as student dormitories, businesses, and food shops etc. Villagers have also changed their lifestyle e.g. from self-growing agricultural crops for their consumption and being sold to earn for their income generation to urbanize lifestyle. As an example the community needs to buy many food items including vegetables from the market for their consumption because of the limited land which majorities of lands has been mostly changed to crowded residential areas and population.

For all the significance reasons mentioned above, the research team has been aware of villagers health, therefore, the study was to provide villagers with knowledge on how to grow crops and it can be implemented in households so that villagers can consume their own vegetables and be saved from toxic residues was performed.

The objectives were to find out the circumstance of regular vegetable consumption in villagers at Ban Thakhonyang community. Thakhonyang Sub District, Kantharawichai District, Mahasarakham province, to promote growing vegetable upside down in Ban Thakhonyang community, Thakhonyang Sub District, Kantharawichai District, Mahasarakham province., and to compare the knowledge and attitude about the growing upside down plant of Thakhonyang villagers between before and after they participated in the promotion activities.

Materials and methods

This research is quantitative study, classified into 2 phases as follows

Phase I the circumstance of regular vegetable consumption in villagers was conducted as 10 household representatives were purposively selected by the community leader from total 320 households. 10 representatives. were divided into two groups with the criteria of the first five

with the regular consumption of vegetables (5 - 7 days/ week), from self-growing without using chemical and another five having regular consumption of vegetables (5 - 7 days/ week) being bought from shops. Both groups were interviewed about vegetable consuming behavior. All of the interview information was analyzed, synthesized, and produced as a manual, leaflet, knowledge and attitude questionnaires.

Phase II one group Pretest-Posttest Quasi Experimental design was conducted as follows:-

30 household representatives were voluntarily selected from total 320 households, to participate in the promotion of upside down cultivation program,



Designing growing upside down planting by using Tyler's training model with two day sessions, consists of four steps as follow; *firstly*, creating learning objective i.e., training activities, enhancing knowledge and encouraging participants' attitude. *Secondly*, conducting learning experience from the manual and leaflet including general knowledge and guideline of how to grow vegetable upside down. *Thirdly*, training on the growing techniques followed the guidelines in the manual. *Finally*, performing reflection and evaluation.



Creating training methods consisted of lecture, discussion, recreation, and demonstration,



Providing the most popular vegetable in the household consumption to demonstrated and provided materials for demonstration and experimentation of upside down plants including coconut husk, ash, rice husk, pots (with holes in the bottom and sides), wire, and tiles or plastic board plates.



The 3 of 4 steps of training including knowledge and attitude pretest – posttest was determined, as shown in Table 1

Table 1 the one group Pretest-Posttest Quasi Experimental design

Group	pretest	treatment	posttest
E	O ₁	X	O ₂

Symbol used in the research;

E stand for Experimental Group

O₁ stand for Pretest, a week before training

O₂ stand for Posttest, immediately took after finished the course

X stand for the growing vegetable upside down promotional activities



Analyzed and conclusion the study.

Research instruments: the instruments have been verified by three experts in the field, all research instruments consisted of the structured interview with five main topics including: 1) ever growing vegetables for household consumption in the past, 2) the main sources of vegetables for household consumption, 3) the most popular vegetable for their family, (4) previous experience on the growing upside-down gardening and information, and 5) their intention to participate in the growing vegetable upside down activities. The manual has two main topics composed of the general knowledge of growing upside down plant and the guideline of how to grow upside down vegetables with being tested for Indexes of Item-Objective Congruence (IOC = 0.945), the leaflet with IOC = 1.00, the knowledge questionnaires with dichotomous scales for 2 choices selection of “Yes” or “No” for the correct choice has received 1 score and incorrect choice has received 0 score with IOC = 0.93, and the attitude questionnaires with three-point Likert scale, which the categorized of “agreed”, “uncertain”, and “disagreed” which response categories could be given the weight of value score 3, 2 and 1, respectively, with IOC = 0.90.

The collected data were done by using interview, knowledge test, attitude questionnaire, training manuals and brochures. The data were analyzed as percentage, mean, standard deviation, and paired t-test statistical hypothesis were used to test significance.

Results

The finding was divided into two phases according to three study objects revealed that the regular vegetable consumption of villagers used to grow vegetables for their own consumption, however, the problem of pet disturbances, such as dogs, cats, chicken caused damage to the farms, consequently, they stopped planting vegetables. The main sources of vegetables for household consumption was mostly bought vegetables from the fresh market less frequent from local shops and some planted in their farmlands, which were away from their houses. It was inconvenient to bring back for consuming due to the long distance, consequently, they decided to buy vegetables from the shops for consuming. The most popular vegetable in their family was the popular vegetables for the household consumption including Acacia pennata, bergamot, garlic, onion, parsley, peppermint, sweet basil, chili, thyme, coriander leaves, galangal, and lemongrass, however, the most commonly vegetables bought for consumption are composed of Chinese Coriander, Peppermint, Sweet Basil, Basil, Parsley, Thyme, Galangal, and Lemongrass. The perception of experience on the growing upside-down gardening information that perceived information about the growing upside-down gardening. The intention to participate in the growing vegetable upside down activities was promoted. The reasons to participate in the research project because of their interesting in growing vegetables upside down, intended to have organic vegetables, and being healthier was in Ban

Thakhonyang community. Thakhonyang Sub District, Kantharawichai District, Mahasarakham province.

All 30 villagers paid attention to fully participated in the process of two days, the reflection expressed through discussion session and demonstration session with smiling face. They followed every step of lesson session, and brought their product back home after program closing. The popular products which they brought them back home including, peppermint, chili, parsley, and onion. They acted as the active learners.

The knowledge and attitude about the growing upside down plant before and after they participated in the promotion activities were compared as a result, the knowledge of participants for growing upside down plant were low, before participated in the project; an average score was 6.86 from 20. The score increased to the very high level after participating in the activities, an average score was 19.50 by an individual aspect found that general knowledge and benefits were mostly increased. It was shown that after participating in the activities score was significantly increased higher than before participated at level of .01, as shown in Table 2. The participants had uncertain level of attitude, before participating and after the activity an average score was 2.01 from 3.00. The score increased after participating in the activities, an average score was 2.95. The comparison of an average attitude score between before and after actions revealed significantly increased higher than before participating at .01 level, as shown in Table 3. Results can be attributed to compare the knowledge and attitude about the growing upside down plant before and after they participated in the promotion activities, comparison of the mean both knowledge and attitude score of the villagers participating in the promotion activities by using posttest higher than pretest were statistically significant at 0.01.

Table 2 Comparison of the mean knowledge score about the growing vegetables upside down in villagers participating in pre and post-promotion activities (n = 30)

Knowledge score	pretest			posttest			df	t	p
	\bar{X}	S.D.	level	\bar{X}	S.D.	level			
Total score (N=20)	6.86 (34.30%)	1.92	low	19.50 (97.50%)	0.97	highest	29	-	<.000*

*p < .01

Table 3 Comparison of the mean attitude score about the growing vegetables upside down in villagers participating in pre and post-promotion activities (n = 30)

Attitude score	pretest			posttest			df	t	p
	\bar{X}	S.D.	level	\bar{X}	S.D.	level			
Total score (N=3)	2.01	0.42	uncertain	2.95	0.10	agreed	29	-	<.000*

*p < .01

Discussion

The results revealed that the regular vegetable consumption of the villagers mostly bought vegetables from the fresh market or local shops, even though they were concerned about the chemical contamination because of their living areas which had limited cultivation areas. Some cases planted vegetables in their farmlands, which were located well away from their houses. Hence, it was inconvenient to bring their vegetables home for consuming due to the long distance, so that they decided to buy vegetables from the shops for consuming. These results are in line with the findings in Hat Yai, Thailand urban home garden (Santos, Thungwa and Worrapiumphong, 2017). Moreover Santo *et al.* (2017) demonstrated that gardening mostly was practiced as a hobby and most plants received organic substances which were free from toxic chemicals and good for consumption. The main motive was to take care of their health and save the cost of buying vegetables. From the findings in this study, the reasons to participate in the research project were interest in growing vegetables upside down, intention to have organic vegetables, and to achieve healthier lives. Even though all 30 villagers had never been received information about the growing upside-down gardening, they also wanted to improve their health and save money. The findings were consistent with the studies in Mueang Lampang District, Lampang Province (Surinwong, 2015).

The promotion activities, all 30 villagers was fully participated in the two-day learning process, with their reflection being expressed through discussion and demonstration with smiling faces, and they also acted as active learners. The danger of chemicals accumulated in vegetables sold in the market had been widely reported. The results showed that the villagers were interested in participating in the promotion activities, because of their lack of knowledge about growing vegetable upside down which did not require much space and safety from agrochemicals, in line with the findings of Santos, Thungwa, and Worrapiumphong (2017), Surinwong (2015), Atcharyamontre (2017) and also according to the promotion of the Jerusalem artichoke for Thakhonyang Villagers in Thakhonyang subdistrict, Kantharawichai district, Maha Sarakam province (Cumrae. and Supa, 2017). In 2017, It was conducted a well-constructed training program by using Tyler's training model, the villagers were familiar with the program. Therefore, they enthusiastically accepted and joined the program.

Concerning the knowledge and attitude about the growing upside down plant before and after they participated in the promotion activities, the comparison of the means of both knowledge and attitude scores of the villagers participating in the promotion activities by using posttest were statistically higher than their pretest scores. These results are in line with the findings of Cumrae, Toomhome and Faiseengam (2017) and Cumrae and Supa (2017).

In conclusion, the promotion of growing vegetables upside down enhanced, not only the villagers' knowledge, but also their attitudes. Based on the results, this study did not evaluate the output of their vegetable growing practices. The follow-up phases for the sustainability of growing vegetables upside down in the community and to extend to other urban agriculture communities were recommended for future study.

Acknowledgements

We would like to thank the Department of Environment Education, Faculty of Environment and Resource Studies, Mahasarakham University, for the research funding and coaching by the head of department. Special gratitude for villagers and community leader of Ban Thakhonyang community. Thakhonyang Sub District, Kantharawichai District, Mahasarakham province, who provided assistance and sacrificed their time by participating in the research project.

References

- Atchariyamontree, A. (2017). Participatory action research and demonstration field for production of pesticides free local vegetables of Cho Lae Community, Mae Taeng District, Chiang Mai province. *Journal of community development and life quality*. 5:118-128.
- Cumrae, N. and Supa, Y. (2017). The promotion of jerusalem artichoke for thakhonyang villagers in Thakhonyang subdistrict, Kantharawichai District, Maha Sarakam Province. *Prawarun Agricultural Journal* 14:115-164.
- Cumrae, N., Toomhome, P., and Faiseengam, S. (2017). The promotion of kitchen mint utilization for people in thakhonyang, tambon thakhonyang, amphur kantharawichai, maha sarakam province. *prae-wa kalasin Journal of Kalasin University* 4:242-260.
- Limpakooptathavorn, N. (2015). Growing vegetables: an alternative to safe food. Retrieved from <http://www.thaihealth.or.th/Content/282460>
- Rhoades, H. (2016). Hanging vegetable gardens: what vegetables can be grown upside down. Retrieved from: <https://www.maximumyield.com/-hanging-vegetable-gardens-what-vegetables-can-be-grown-upside-down>.
- Santos, T., Thungwa, S., and Worrapiumphong, K. (2017). How Well Do Hat Yai, Thailand Urban Gardeners Meet Their Aims?. *International Journal of Agricultural Technology* 13:651-661.
- Singseewo, A. (2015). *Development of Environmental Education Curriculum*. Maha Sarakham: Kakayear.
- Somboonwong, P. and Siri, S. (2018). Upside down. Retrieved from: <http://researchex.rae.mju.ac.th/agikl/index.php/knowledge/24-vegetable/74-invert>.
- Surinwong, P. (2015). Marketing mix affecting consumers in Mueang lampang district towards purchasing pesticide-safe vegetables. *AccBA Journal CMU* 1:39-61.
- Thai,-PAN. (2018). The situation of importing pesticides. Retrieved from http://www.thaipan.org/sites/default/files/conference2559/pesticide_conference_2559_1.3.pdf
- Thanatamrongkul, P. and Aphichartphongchai, R. (2013). Knowledge, Attitude, and Practices of Trained Farmers from Local Wisdom Elite Network Center, Nakhon Sawan Province. *Journal of Agriculture, Faculty of Agriculture Chiang Mai University* 29(1): 79-88.
- Tyler, R.W. (1949). *Basic Principle of Curriculum and Instruction*. Chicago: University of Chicago Press.

Adaptation Way of Life and Occupation Opportunity of the Elder Farmers through Khao Mao Product :A Case Study of Baan Nam Kam Community, That Phanom District, Nakhon Phanom Province

Inthanon, W.* and Hongmaneerat, K.

Faculty of Liberal Arts and Science, Nakhon Phanom University, Thailand.

Abstract This qualitative study resulted the need for adaptation of life's way and occupation opportunity of the elder farmers through Khao Mao Product. 25 families were guided to develop the life's way for sustainability. Results revealed that all of the elder farmers in Baan Nam Kam community that was needed to adapt their quality of life and occupation opportunity by unmilled rice processing through Khao Mao product .It was a guideline for developing their quality of life. All of them were trained through educational tours and learn from quality of Life and occupation promotion fo the Elderly Center, Nakhon Phanom province .This could be concerned the guideline tom improve life's quality for quality on the basis of life philosophy for sufficiency economy.

Keywords: adaptation of way of life, the elderly farmers, Khao Mao processing,

Introduction

Baan Nam Kam community is located in a low land area at Kam esterine which is closed to the Mekhong river in southern part of That Phanom district. The origin of Kam river is from Norgharn, Sakolnakhon province and flows through Wangyao district, Nakae district, and That Phanom district, It is 50-80 meters in width and 79 kilometers in length. After 2006, King Bhumibol who has proposed a royal project of floodgate construction. It was 10 meters in width and 9 meters in height with 4 spillways. It could keep water for agricultural purpose throughout the year, particularly in off-season rice growing covered the area of at least 20,000 rai (REF).

The construction of project made Baan Nam Kam community has enough water and irrigation system for cultivation and livestock domestication throughout the year. In the past, peoples grew rice once a year but now they can grow rice three times a year. At present, farmers in Baan Na Kam community begin to grow organic rice. People in Baan Na Kam community particularly on aging peoples of 25 households to set up a group to adopt the concept of Sufficiency Economy Philosophy (SEP). They have developed to process organic rice to make Khao Mao product before the harvest period. This is value added for the rice yield. Khao Mao product of Baan Nam Kam community is popular and it is needed by tourist markets (REF)

* **Corresponding Author:** Inthanon, W., **E-mail :**dr.whmnr@gmail.com

Therefore, the general purpose was to investigate a guideline for way of life adaptation and the creation of alternative occupation of the elder farmers in Baan Nam Kam community. This aimed to develop Khao Mao product for local and international markets. Objectives of the study aimed to explore the basic data of Baan Nam Kam community, That Phanom district, Nakhon Phanom Province, to investigate way of life adaptation of the elder farmers to process unmilled rice of organic Khao Mao product and to develop quality of rice which was based on concept of Sufficiency Economy Philosophy by educational tours at the Center for the Elderly Quality of Life Development and Career Creation at Nakhon Phanom province which focused on health, social life, economy, and environment.

Conceptual Framework

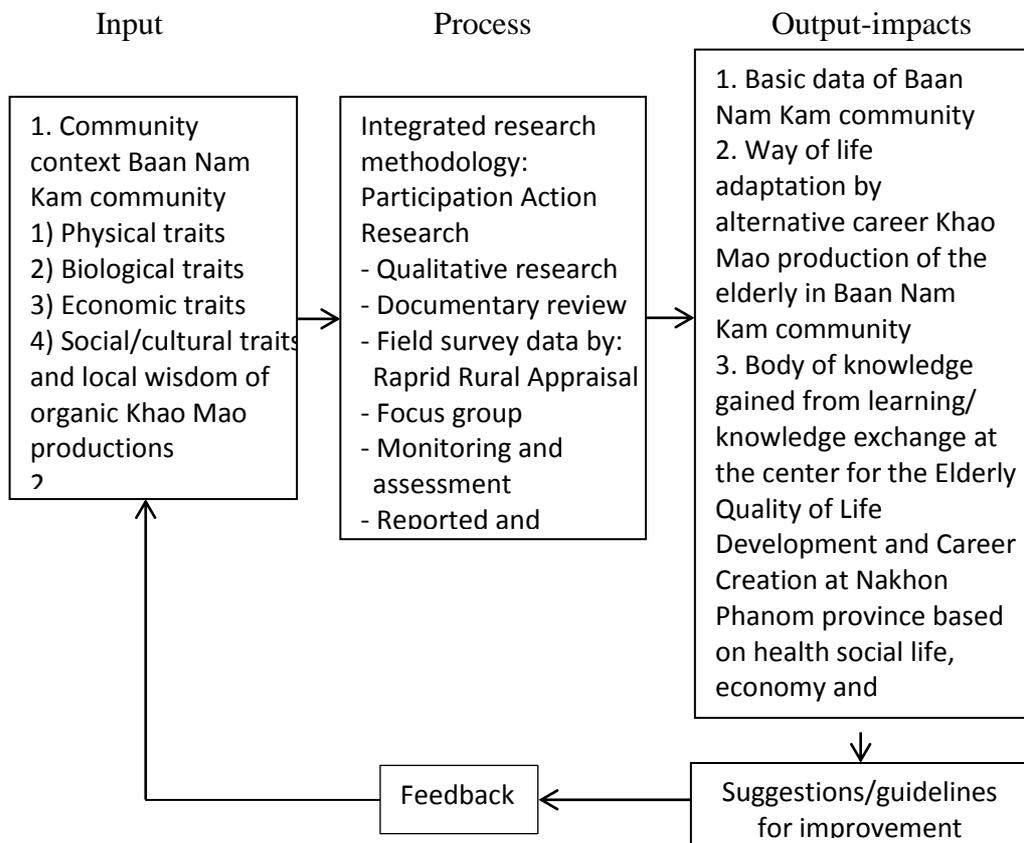


Figure 1. Conceptual framework

Materials and methods

The documentary research and field survey research were compared which focused on Participatory Action Research (PAR). It involved the transformation of unmilled rice growing for processing the organic Khao Mao

product. The methodology was is included the community context of Baan Nam kam which compared to physical traits, biological traits, socio/economic traits, tradition and local wisdoms. The way of life adaptation was searched from the elder farmers in Baan Nam Kam community by processing unmilled rice to be organic Khao Mao product for value-added. Guidelines was used to suggest for developing quality of life in Baan Nam Kam community by education tours. This led to develop the elderly farmers and the community based on 4 aspects of health, social life, economy, and environment.

- Target group - Family of the elderly representatives forming a group for organic Khao Mao processing for health care (25 families).
- Research instruments in this study was structural interview, observation, and focus group discussion.
- Data analysis - qualitative research was mainly conducted. Must be stated data analysis ?????

Project Planning

Date/time/place	Activities	Outcomes
10-20 February, 2018 - Faculty of Liberal Arts, Nakhon Phanom University - Baan Nam Kam community, That Phanoma district, Nakhon Phanom province	contacted the elderly group producing organic Khao Mao product Informed survey details of the target community context and participation process	some basic data of Baan Nam Kam community
10-20 March 2013 - Faculty of Liberal Arts, Nakhon Phanom University - Baan Nam kam, That Phanom district, Nakhon Phanom province	- Collected data on organic Khao Mao production by participation (hearing by doing) - Observation and discussion on the process of organic Khao Mao production	- Data were obtained in accordance with the objectives - Pictures of activities
10-20 April, 2018 -Faculty of Liberal Arts, Nakhon Phanom University - Baan Namkam. That Phanom district, Nakhon Phanom province	- Discussion and returned obtained data to the elderly group producing organic Khao Mao product	Gained data in accordance with the objectives and pictures of activities

Date/time/place	Activities	Outcomes
10-20 May, 2018 -Faculty of Liberal Arts, Nakhon Phanom University - Baan Namkam. That Phanom district, Nakhon Phanom province	Preparation of a complete research report	- A complete research report - Ready to submit the complete research report

Results

The research finding was known that Baan Nam Kam community separated from That Phanom community over 200 years ago, because it was a crowded community. Besides, it was a low land and some parts of it became a wet land during the rainy season. In the cold season, however, farmers there grew vegetables such as red onion and tomato and sent the yields to Si Mum Muaeng market in Bangkok. The yield price depended on the market conditions. After the floodgate construction, the community could grow rice three times a year and the yields at the dough stage could be processed to be organic Khao Mao product. Nowadays, there are specialists from Khon Kaen University and Nakhon Phanom University to extend knowledge about Khao Mao processing, preserving, and packaging. Since, Baan Nam kam community has community spirit and close good relationships so this makes the community be strong. Interestingly, local wisdoms are applied to organic production.

Way of life adaptation of the elderly in Baan Nam Kam community by processing unmilled rice to be organic Khao Mao product for value-added. It was found that people there employed the traditional method which is a local wisdom to produce organic Khao Mao product. “Krog Kra Dueng” a wooden mortar having a foot operated pestle for pounding rice is used as part of the production. The production begins with the selection of rice seed from organic sticky rice plots at the dough stage. The rice grain at the dough stage could be tested by pressing or separating. Then the ears of rice were brought to be threshed and cleared with water before it was roasted in an earthen pot or a large base-shaped pan for about 25-30 minutes. After that, it was exposed to the sun and then peeted into the “Krok Kra Dueng” for pounding (12-20 minutes). Later on, the rice husk was removed by winowing. Finally, aromatic, flat, light green, rice grain would be obtained ready for consumption. In addition, it could be mixed with sugar and scraped coconut for those who preferred sweet taste, for preservation to keep its quality and shelf-life of organic Khao Mao product, it must pass food preservation process, packaging, and keeping.

The following were production costs of organic Khao Mao product: 1) 1 kg. of unmilled rice (8-10 baht), 2) 1 kg. of unmilled rice could gain (0.5 kg.), 3) 1 kg. of organic Khao Mao (70-100 baht), 4) the elderly group could produce Khao Mao for three times a year (30 days each), and 5) an average income/dividen = 12,000 -15,000 baht/month/household.

3. Developing the elderly quality of life and career creating based on the concept of sufficiency economy based on health, social, life, economy, and environment. It was round that the elderly sample group wished to attend training or join an educational trip in order to perceive principles and guidelines for developing quality of life and organic Khao Mao product.

However, in order to develop the elderly quality of life it needed to have local administrative organizations to play roles as a host for developing the elderly quality of life in the community.

Discussion

According to results of the study, it was found that the elderly in Baan Nani Kam community were energetic to produce organic Khao Mao product with the application of local wisdoms. In other words, they can produce fresh non-toxin food with nutritive values. This income greeting was in accordance with the philosophy of sufficiency economy. That was the reduction of expenses but increased incomes by increasing quality and quantity of the product. It was consistent with Tawalai (2017) found that the group of organic Khao Mao product in Roi Et province could reduce the revenue and increase the opportunity to increase the quantity and quality of their products with application of local wisdoms of elderly members. Moreover, Khao Mao product can be used as a main raw material for the processing of other new food products, such as traditional desserts and new style of appetizer, etc. (Tomeeboon, 2016). Regarding organic Khao Mao production, the elderly there were willing to join this program and there was knowledge/ experience exchange as well as knowledge transfer to interested persons of all ages. This denoted that the elderly sample group accepted themselves and was pleased to join development activities. This conformed to a study of which reveal elderly were willing to join social activities because the section accepted that they had potential or capability and accompted experience (Puangsuk. 2017; Butler and Ciarrochi. 2007). It also conformed to Hierarchy of Needs Theory of Maslow on social needs-safe life job security, friendships, compassion and esteem needs-responsiveness of social needs (Wikipedia, 2018). In term the cooperation of the elderly and the relevant agencies found that there was a harmonious combination which good transfer of knowledge through out of community relationship. This consis to a study of Hongmaneerat (2016) which a member of Baan Noen Sa-ard was a simple agricultural community where local people know one another very well and they often formed a group to do activities together such as merit making and festival cerebration. There are community's leaders in the form of village committee managing the

community in accordance with designated roles. This conformed to a study of Ratiown (2012) which found that urban growth with non-direction caused a decrease in social capital. That was, in the past, although there were informal relationships but they truly had close relationships.

The elderly group in Baan Nam Kam community wished to attend a training and join an educational trip at the center for the Elderly Quality of Life Development and Career Creation at Nakhon Phanom province. This center was ready for developing the elderly covering 4 areas: health, social life, economy, and environment. In fact, it was the quality of life development and career creation for the elderly which could be a model for other communities which exchange of learning under the Philosophy of Sufficiency Economy (PSE). (Boonphadung, S. 2011). Nevertheless, concerned public and private agencies must anchor the said form of development for formulating a development plan. It is an accelerated policy to alleviate needs and cope with growth of the aging society.

1. Concerned agencies or networks such as local administrative organization, Sub-district Agriculture office, District Agriculture Office,. etc. help develop what they are responsible for the project. Meanwhile, Nam kam administrative organization should find resource persons to extend knowledge about organic Khao Mao product packaging and keeping as well as marketing.

2. Concerned agencies or organizations should encourage and promote farmers there to grow sticky rice throughout the year so as to be a raw material for organic Khao Mao production all year round.

3. Concerned agencies or organization should give an opportunity for the elderly group producing organic Khao Mao product to join an educational trip at Center for the Elderly Quality of Life Development and Career Creation at Nakhon Phanom province This is because they will have alternative to develop their quality of life covering 4 aspects: health, social life, economy, and environment.

4. Content and results of the study can be basic data for developing the elderly in other communities.

References

- Boonphadung, S. (2011). Developing the Life Quality of the Elderly by Applying Sufficiency Economy- Based Schooling (Phase I). Research report. Suan Sunandha Rajabhat University.
- Butler, J., and Ciarrochi, J. 2007. Psychological acceptance and quality of life in the elderly. *Quality of Life Research*. Springer 16: 607–615.
- Center for the Elderly Quality of Life Development and Career Creation at Nakhon Phanom Province. (2018). A Manual on the elderly quality of life development. Charoen Khunying Wattana Siriwat Pak di building, Nakhon Phanom province.
- Hongmaneerat, K. (2016). The Lifestyle Adjustment of the Agricultural Community to Cope with the Expansion of Urban Community : A Case Study of Baan Noen Sa-ard, Na Rat Khwai Sub-district, Muang District, Nakhon Phanom Province, Thailand. *Journal of Agricultural Technology* 12(7.2): 1947-1954.

- Puangsuk, P. (2013). *Philosophy of Sufficiency Economy and Agricultural Education*. Department of Agricultural Education, Faculty of Industrial Education KMITL. Bangkok.
- Ratiown S. (2012). *The Growth of the City with Disorderly Impact on Health*. Health Science. Sukhothai Thammathirat Open University Bangkok.
- Tawalai, P. (2017). *A Guideline for Developing Organic Khao Mao by the Coordination of Organic Rice Grouing Group Project: A Case Study of Namkam -Namom Khao Mao Rice Growing Group, Namom District and Baan Sa Luang Organic Rice Growing Group, Laeng Luand Sub-district, Kasetwisai District, Roi Et Province, Phase 1 Research report*. Thailand Research Fund.
- Tomeeboon, W. (2016). *Khao Mao research*. Department of Industrial Promotion, Bangkok.
- Wikipedia. (2018). *Maslow's hierarchy of needs*. Retrieved from https://en.wikipedia.org/wiki/Maslow%27s_hierarchy_of_needs.

The Development of environmental education teachers on the King Bhumibol Adulyadej's Science

Wongchantra, P.^{1,*}, Wongchantra, K.², Junkaew, L., Sookngam, K.¹, Ongon, S.¹ and Phansiri, Ch.¹

¹Center of Environmental Education Research and Training, Faculty of Environment and Resource Studies, Mahasarakham University, Mahasarakham, Thailand 44150.

²Srimahasarakham Nursing College, Mahasarakham, Thailand 44000.

Abstract The King Bhumibol Adulyadej's Science was knowledged help the Thai people as a planning concept, conceptual, theory of sufficiency economy philosophy, principle steps to work and project due to the initiative in order to solve the problems of the people. The objective of this studied were to enhanced knowledge and understanding of environmental education teachers on the King Rama IX of Thailand to promoted skills and conscious mind of environmental education teachers on the King Rama IX of Thailand. The sample consisted of 40 teachers who were volunteered to participate in the training. The research found that the process of environmental education teachers on the King Rama IX of Thailand was contained lecture, practice, discussion and case study. The contents were as follows: natural resources and ecology, problems and solutions environmental problems, on the King Rama IX of Thailand, features and skill of environmental education teacher, environmental education course and teaching plan, the use of media and learning resources, measurement and evaluation of environmental education. A case study of the on the King Rama IX of Thailand on water, soil, forest and theory of sufficiency economy philosophy.

Keywords: teachers, environmental education, on the King Rama IX of Thailand

Introduction

At present, Thailand is experiencing many environmental problems. The deterioration of the environment has increased rapidly, such as the decline of forests. The problem of soil loss, fertility, floods, floods and floods. As a result, environmental issues are getting more attention. The impact of environmental problems is not only a deterioration of the environment. But the cause of the deterioration of the economy, society, the city and the government, which is the main cause of environmental problems are many, such as the Rapid population growth unused resources rapid economic growth misuse of technology unbalanced development people do not participate in conservation and solving environmental problems. Human behaviour is selfish and selfish. Take into account the personal benefits rather than the collective benefits, the lack of conscience in conservation and development of the environment.

"The King Bhumibol Adulyadej's Science " that remains in Thailand, it covers both. "Royally initiated project " is the concept and philosophy, " royal

* **Corresponding Author:** Inthanon, W., **E-mail :** prayoon1979nam@gmail.com

words " is the instruction to warn consciousness, "Royal Activities" is the principle of work and "Royal Commission" of On the King Rama IX of Thailand during the past 70 years, Thai people has taken a good role in the conduct. Both government and government officials have applied to the administration, to develop a balanced and sustainable nation. (Poonyaban, 2017)

Royal speech to the Board of Directors Association Alumni College of Education on March 28, 1970 one. "Each surely realizes that education is important for the nation. Because humanity has lived to this day. The experience of those who have, researched and lived through it. Teach those who know less, Education is an important mechanism and a mechanism that must be for the public in particular today. The life of our people is increasingly difficult. Because there is a lot of technical advancement. I have to transfer this knowledge to later generations, it has mental knowledge. It means knowledge in the conduct or in the way of life to be beneficial to the society and not harmful to the person. You must teach the same. (The Government Pension Fund, 2007).

According to the National Economic and Social Development Plan No. 12, (A.D.2017-2020), focus on 1) apply and apply philosophy of sufficiency economy. 2) people are the center of participatory development. 3) support and promote the concept of nation reform. and 4) to develop a stable, prosperous, sustainable society. (Office of the National Economics and Social Development Board. 2017. This is consistent with the National Education Act (2010), The emphasis is on the knowledge and moral. The learning process must integrate Including cultivating moral values. and the desirable characteristics of the learner. The study focused on the development of knowledge and virtue are of paramount importance. It is the development of young people into the world of the 21st century. The purpose is to promote the moral, love is Thai, have analytical skills, creative work with others and be able to live happily with other people in the society as Thai citizens and world citizens. (Kongchai and Boonsong, 2017)

From above, Researchers have realized the importance for the development of environmental education teachers on the on the King Rama IX of Thailand, the purpose is to enhance knowledge and understanding about environmental education teachers on the King Rama IX of Thailand, and to strengthen the consciousness as a teacher on the on the King Rama IX of Thailand, to allow teachers to apply the principles of environmental education to integrate with the on the King Rama IX of Thailand, teachings leading to the practice of teaching and learning.

Objectives: to enhance knowledge, skills and conscious mind as a teacher of environmental education on the King Bhumibol Adulyadej's science.

Materials and methods

Population and sample

The population used in this training were teachers working in schools, and teaching lower secondary education from throughout the country.

The samples used in this training were teachers working in schools, and teaching lower secondary education, 40 people registered for the teacher development Project (teacher coupon), In the course of environmental education teachers on the King Rama IX of Thailand, of the Foundation of Environmental Education.

Research tools

1. The instruments to convey, training manual for Environmental Education teachers on the King Bhumibol adulyadej's science.

2. Tools used to measure and evaluate.

1) Knowledge test for environmental education teachers on the King Bhumibol adulyadej's science.

2) A model of teaching skills as a teacher of environmental education on the King Bhumibol adulyadej's science.

3) Measurement of consciousness as a teacher of environmental education on the King Bhumibol adulyadej's science.

Data collection

The process of collecting information on the training course on environmental education teacher on the King Bhumibol adulyadej's science, researchers have divided the data into 3 phases.

Phase 1: Creating and developing tools

1. Creating and developing a training tool for environmental education teachers on the King Rama IX of Thailand, training manual for environmental education teachers on the King Rama IX of Thailand, content is composed of 3 groups, content group, the content of the science teaching profession, and the content integration with teaching profession. The duration of the training is 30 hours as shown in Table 1.

Table 1: Contents of training for environmental education teacher on the King Rama IX of Thailand.

Content Group Name	Duration of training (hours)
Content group	It takes 9 hours.
1. Natural resources, environment and ecology.	3
2. Natural resources and environment problems and solutions to environmental problems.	3
3. King Bhumibol adulyadej's Science.	3
The content of the science teaching profession	It takes 12 hours.
1. Qualifications of environmental education teachers and skills as an environmental education teacher.	3
2. The curriculum and the environmental education curriculum.	3
3. The use of media and learning resources for environmental education.	3
4. Measurement and Evaluation of Environmental Studies.	3
The integration of the content with the science teaching profession.	It takes 9 hours.
1. A case study of the king on water including bile dehydration theory, Wastewater treatment with water hyacinth, to build a dam, Chaipattana Water Turbine and Monkey Cheek Project.	3
2. Case study by king Soil and forest The vetiver grass care for the soil, the reforestation 3 benefits 4, the afforestation without planting. wet wild theory reforestation in mind.	3
3. Case study on the King Bhumibol adulyadej's science , sufficiency economy theory and the philosophy of sufficiency economy.	3
Total training time	30

2. Create training measurement and evaluation tools.

- 1) Knowledge test A B C D is a choice of 40 items.
- 2) A model of teaching skills as a teacher of environmental education on the King Rama IX of Thailand, is the rating Scale 5 options, most, very, moderate, minimal, minimal.
- 3) The consciousness test of environmental education teachers on the King Rama IX of Thailand, there are 20 items divided into 10 sections according to the topic of activity.

3. Construct a tool to send experts to the appropriate consistency, appropriateness, accuracy, completeness, and coverage, according to the content of the manual (IOC), then the tool was updated and used to collect data.

Phase 2: Teacher training for environmental education. The steps are as follows.

1) Recruit teachers who are active in the school, there are 40 teachers who are interested in participating in the Teacher Development Project, In the project of environmental education teachers on the King Bhumibol adulyadej's science.

2) The duration of the event is 30 hours.

3) Conduct training with the process described by the content group, organizing activities, discussing and sharing experiences, incorporation of environmental recreation activities periodically. The Case Study on the King Rama IX of Thailand, research, and present work, practice, and lesson summary.



Figure 1. Training activities by process, lecture, and brainstorming.

4) The media is learning resources. environmental education book, environmental science books, royal documentaries on conservation of natural resources and environment, leaflets, training logs, and study tours.



Figure 2. Training activities using learning resources.

Phase 3: Follow up or work with a teacher after development.

- 1) Follow up the trained teachers using the questionnaire.
- 2) Inviting teachers to participate in environmental education conference once a year.
- 3) Monitor the implementation of the curriculum in practice in the school, according to the availability of trainees.

Statistics used in research

- 1) Basic statistics: frequency, percentage, mean, and standard deviation.
- 2) The statistics used to determine the quality of the tool: consistency difficulty the power of classification and the whole confidence.
- 3) The statistics used to test the hypothesis were Paired t-test at the statistical significance level of .05.

Results

1. The result of enhancing the knowledge about the teacher of environmental education on the King Bhumibol adulyadej’s science, found that, the sample group had an average score on knowledge about environmental education teachers on the King Rama IX of Thailand, pre-training is overall moderate ($\bar{x} = 20.21$) after training. The sample group had a high level of overall knowledge ($\bar{x} = 35.50$), and when compared the average score of knowledge about teacher education on the King Rama IX of Thailand, before and after the training, teachers' knowledge of post-test was higher than before training, showed in table 2.

Table 2 compares the mean score of knowledge about teacher education on the King Bhumibol adulyadej’s science, Before and after training (n = 40)

side	Pre-training			Post-training			t	df	p
	\bar{X}	S.D	Knowledge level	\bar{X}	S.D	Knowledge level			
Knowledge (N = 40)	20.21 (50.52%)	1.34	medium	35.50 (88.75%)	0.25	high	15.29	39	.000*

* There were statistically significant at .05 level.

2. The effect of enhancing teachers' skills in environmental education on the King Rama IX of Thailand, before and after training, showed that, A comparison of the teacher's environmental education teachers' skills scores. Be to training, the samples had a lower average overall skill score, ($\bar{x} = 2.34$). After training the sample group had the overall average score, ($\bar{x}=4.31$). When compared, the mean scores of the teachers' environmental education skills were as follows, teachers had a mean score on the skills of environmental education teachers after the training, higher than before the training, showed in table 3

Table 3. Comparison of the mean scores on the skills of environmental education teachers on the King Bhumibol adulyadej’s science, Before and after training (n = 40)

side	Pre-training			Post-training			t	df	p
	\bar{X}	S.D.	Teacher Skills level	\bar{X}	S.D.	Teacher Skills level			
Teacher Skills (N = 5)	2.34 (46.8%)	0.99	low	4.31 (86.2%)	0.28	high	-30.102	39	.000*

* There were statistically significant at .05 level.

3. The effect of enhancing the consciousness as a teacher of environmental education on the King Rama IX of Thailand, before and after training, show that Pre-training, the sample of teachers who participated in the training had a mean score of environmental consciousness as a teacher of environmental education on the King Rama IX of Thailand, at the moderate level (\bar{X} = 15.00). after training the samples who participated in the training had an average score of consciousness as a teacher of environmental education on the King Rama IX of Thailand, At the high level (\bar{X} = 18.30). And when comparing average scores before and after training. The sample of teachers who participated in the training had the average score of consciousness as a teacher of environmental education on the King Rama IX of Thailand, as showed in table 4.

Table 4. Analysis of the mean score of the consciousness as a teacher of environmental education on the King Bhumibol adulyadej’s science, Before and after training(n = 40)

side	Pre-training			Post-training			t	df	p
	\bar{X}	S.D.	conscious mind level	\bar{X}	S.D.	conscious mind level			
conscious mind (N = 20)	15.00 (75.00%)	0.42	medium	18.30	0.23	high	-17.202	39	.000*

* There were statistically significant at .05 level.

Discussion

Training of environmental education teachers on the King Bhumibol adulyadej’s science. The research findings were as follows.

1. The results of the study on the environmental education teachers on the King Rama IX of Thailand, found that the teachers had the average

score on knowledge about the teachers. Pre-training is overall moderate. And after training the sample group had a high level of overall knowledge. And when compared the average score of knowledge about teacher education on the King Rama IX of Thailand, Before and after training, it was found that teachers had higher average knowledge after training than before training. But the process of building knowledge is the integration of the concept, interdisciplinary environmental education of Wongchantra (2009). It says that interdisciplinary environment. It combines environmental knowledge or environmental knowledge, or knowledge that incorporates several environmental disciplines, which respond to the realities of today's complex environment under complex conditions, new and diverse. The researcher has taken into account the concept of Singsewo. The content of environmental education to convey to people. It is necessary to have appropriate methods or procedures to make knowledge transfer effective and meet the objectives. And the methodology that will be used is already in the field of environmental education is interdisciplinary. (Not a monologue) is the development of systematic thinking is to look at everything holistically. This is a curriculum based on educational science. (Singsewo, 2011). The researcher then measured the knowledge using the knowledge test, as mentioned above, the measurement of knowledge is mostly. most popular this test is a commonly used textual tool. This is a subjective and multiple choice that can be summarized as knowledge of the facts of the various actions. The researcher found that the sample teachers had higher average knowledge after training than before training. The results of the knowledge test correspond to the results of research Chasangoun *et al.* (2558). Research Promotion of academic knowledge to the community of educational institutions. In the municipality of Nakhon Phanom Province, the purpose of this research was to study and compare the promotion of academic knowledge to the communities of educational institutes in Nakhon Phanom municipality, Nakhon Phanom province. Classified by size of school and work experience. The research found that the promotion of academic knowledge to the community is at a high level. The highest mean is the promotion. The exchange of learning, and experience among individuals, families, local communities, with the lowest mean of education surveyed, support the academic community. And also consistent with the research results of Mangkang (2018). The research was conducted to study the knowledge transfer on the King Rama IX of Thailand, of the community learning center to promote the green lifestyle of the students in the Royal Project area, Northern part of Thailand. The research was to 1) study the on the King Rama IX of Thailand, transfer knowledge of the learning center. Community to promote the green way of citizenship in the community, Royal Project area, and 2) Synthesis of knowledge. The King of Applied Science is a good practice in the Royal Project area. Northern part of Thailand. The research found that the knowledge on the King Bhumibol adulyadej's science, that the students apply to the good practice in the

community found that the learners who are farmers in the Royal Project area have been searching, developing, creating activities in the area to strengthen. The community has the potential to be a self-reliant learning resource. Field study learn to synthesize and remove synthesized data into lessons that can be defined as 5 elements. 1) Contextual Analysis for Contextual Development 2) Support for Input 3) Process for Process 4) Productivity of Knowledge Transfer) And 5) Supporting Agencies (Supporting Agencies), The researcher focuses on allowing the teacher to apply the knowledge efficiently and successfully. This is consistent with research by Teerachanachaiikul (2014). research knowledge management success factors are the power of knowledge (Knowledge Power), Because knowledge is bound to work or activity. Individuals in the organization The knowledge that is used in the work. Will be created by the worker, or groups of workers, this may be based on the choice of theoretical knowledge or external knowledge to be customized for use, or created The knowledge that will be used to achieve the goals of the organization requires a process or step in the systematic knowledge management. Knowledge management is not a science of development. Organization focused exclusively on the use of technology, and the only network anymore. But it has become a new science to the organization. worldwide.

2. The results of the comparison of the skills of environmental education teacher on the King Rama IX of Thailand. The teacher's sample. Prior to the training, the subjects had a moderate average of their skills. And after the training, the medium level is high level. When compared, the mean scores of the teachers' environmental education on the King Rama IX of Thailand, skills were the same. The average skill score after training was higher than before training. The creation of skills as teachers. The researcher uses the process of creating the experience by integrating the principles, theories, methods and processes of environmental education on the King Rama IX of Thailand. To create the skills for the teacher, to be a teacher in the 21st century is to follow the guidelines of the study Meeraka (2017) Study "What kind of teacher do you have?" In the 21st century, "said. Good education for the new generation. The teachers have to change completely. Teachers who love disciple care, but also the traditional teaching methods. It is not a teacher who is beneficial to the disciple, that is, teachers who are not good enough for the disciple. Teachers need to change their focus or focus on teaching. The emphasis is on learning to learn and improve the learning style that they provide to students. Teachers need to change roles. "Teachers" (coach) or "facilitators to learn" (learning facilitator). And to learn the skills to do this. Grouped to Learn together systematically and continuously. 21st-century teachers must master the 21st century to learn the "21st Century Skills", The teachers who attended the training were primary teachers, they play a key role in bringing these skills to use in creating children and youth. And consistent with the concept, Bilbai (2016), saying that from the changes

and problems arising from the change of technology and communication, educators turned their attention. And it sets the skills of 21st century learners. Critical thinking Skills collaboration (Collaboration Skill) communication skills communication skill, creative thinking skills, digital skill, career skill & life skills, teachers must be able to create students. This is consistent with the research, Panthong (2013), study the development of teacher education for students in schools, under the jurisdiction of the Office of the Primary Education Service Area, the results showed that. Development of teacher education for students in schools, under the Office of Primary Education Area, the researchers created a key component 3 parts. Systematic development Process and the level of development. In the systematic component, the focus is on the characteristics of the teacher, the 3 disciplines: the practice of knowledge and skills, and the performance. That results in student characteristics and skills. The teacher development process for the disciple is 5 steps, determine the purpose and scope, determine how to develop, develop, evaluate, develop. There are three levels of teacher development: individual, group and organizational levels. Consistent with the research of Sanglerduthai (2011), Study Enhancing knowledge management skills using learning processes of professional teachers (Phase 2), The results show that when comparing the knowledge management skills of a grouped student teaching using the normal learning process. This is the method used by the researcher in this research. That is the process used to practice, a good teacher in the 21st century needs to strengthen the skills. This is consistent with the research, Chalalak (2015), a study of the role of teachers and teaching in the 21st century, the results show that the changes in the 21st century affect the way people live in society. The education system needs to be developed in response to this change, the study focuses on literacy only, but for the 21st century it must focus on learning, practice, and inspiration simultaneously. Passive Learning is not only a passive learning, but requires learners to learn from practice. And learning self (Active Learning) with teachers as "coaches" who designed the learning. Most importantly, the 21st century teacher must not be a "knower" but must seek knowledge simultaneously with the learner at the same time. The above principles will focus on learning activities. This is consistent with research by Ruangrong (2558). The study was conducted in the 21st century, when society is aware of the importance of technology as a part of everyday life, teachers in the 21st century must adapt to learning. to change the era, continuously develop skills, especially in information technology. The role in the education. In the present and future, to be able to guide and encourage students to learn by themselves. You have to know the truth in the subject. The students need to know how to build knowledge from their experience, and how to use knowledge from external sources, teach students to work as a team, designing appropriate learning activities, providing an environment conducive to learning. And expressing love and concern to the students, the learning process will be effective. If all sectors

work together to reduce the barriers to teacher development, the approach and possibilities for teacher development in the 21st century must be addressed, and the self-development of teachers in parallel. This will make teachers truly digital teachers.

3. The effect of enhancing the consciousness as a teacher of environmental education on the King Rama IX of Thailand. Before and after training, it was found that before training. The sample of teachers who participated in the training had a mean score of environmental consciousness as a teacher of environmental education on the King Rama IX of Thailand. At the high level (\bar{X} = 15.00). After training the samples who participated in the training had an average score of consciousness as a teacher of environmental education on the King Rama IX of Thailand. At the high level (\bar{x} = 18.30), showed that training activities for environmental education teachers, awareness of teachers attending training courses is very high, which is consistent with the belief that, consciousness is the determinant of human behavior or behavior. (And subsequently affect society and the environment), it is explained that the mind is the first human mind. It will encourage us to do things according to the intuition of the higher animals, including eating, sleeping, self-defense. Reproduction, or simply, our consciousness is the primary function that will enable us to live safely and preserve our human race. (Armartkun, 1996), and also consistent with the research, Paphapsit *et al.* (2012), study a model of community consciousness. This research aims to 1) study the theory of consciousness in community development, 2) Study community contexts related to community development consciousness, 3) Develop a model for raising awareness in community development, 4) Study the use of community awareness models in community development, Applying Mixed Methods (Mixed Methods), Qualitative Research to analyze the content of texts, textbooks, articles and research related to the development of mental models for community development. And field research Analyze topics from interviews, interviews, in-depth interviews. And the observation of the community. And quantitative research. To analyze data expressed as numbers. The research found that The condition of the consciousness in the development of community is 3 types: 1, the non-action of causing problems to the community in the community, 2. Participation in development activities, 3 Have mercy on each other. And consistent with the research of Ketsripongsa *et al.* (2017), Study Mental Formation Local wisdom for sustainable forest conservation in Khok Klang, Lam Sub-District, Lam Plai Mat district, Buriram province, the purpose is to study the relationship of Local people and community forest and to find a model of local people's consciousness for sustainable forest conservation. Lam Plai Mat district, Buriram province, Data were collected from in-depth interviews. Group discussion The research found that: 1) the relationship between the way of life of the people in the community and that of the forest was from the ancestors. This forest is a wildlife sanctuary, it is a source of food and income, but

people lack the consciousness to take care of the forest. I do not care because I think that the forest is not exhausted and think that government agencies have to look after. Local people's consciousness for sustainable forest conservation, using the youth model helps to drive the creation, consciousness in forest management and establishment. Throughout the year, make awareness of wildlife activities, and the news is more recognizable, by inserting the elevation. People in the community through activities such as the use of research networks. The ceremony and the forest conservation signs around the forest. forest preservation camp forest mapping by the community, so that the forest management model by the use of senior citizens in the community. And using relational systems, the process of creating cross-learning. lead to change. (Children - Elderly) is to increase community groups. The network of cooperation within and outside the area to conduct activities to raise awareness of forest community has set up rules, and make a wild card label, establishment of village committees for forest management and management and the administration of the Khok Klang Central Administration Organization, Plan for Delegate the military budget to dredge the jungle in the jungle and dig the canal to block the remaining forest areas to prevent forest encroachment. This is consistent with the research by Pongkaew, W. and Koontin, C., (2014: 462-475), to study the ways to raise awareness of energy conservation of youth. The research aims to 1) study the process of enhancing energy conservation awareness among youth and 2) to propose ways to enhance energy conservation awareness of youth. Data were collected by using mixed methodology. The research was conducted by questionnaires with the youths who received the energy conservation award in 6 schools. Field research was conducted by observation and in-depth interviews with youth leaders. And those who are involved in the energy conservation of youth. The research found that: 1) Energy Conservation Awareness Process consists of 5 steps: (1) Purification (2) Creation (3) Additive Attitude (4) Practice (5) Factors in enhancing consciousness which are classified into two categories are internal factors, i.e., thoughts, attitudes, behaviors and perceptions. External factors include opportunities and access to motivation, budget, policy, examples, participation, time, administration, agency Personnel development and learning management. 2) The guideline for enhancing awareness of energy conservation among youth is the policy formulation from the national level to the community level. Focus on participation from all sectors of society, motivating to encourage participation. Learn to focus on the youth as a center for real action. Integration of energy conservation with content in all subjects. Develop personnel to educate and organize activities. Improve the media and activities and create a network of energy conservation to create a conscious and continuous energy conservation. Moreover, it is consistent with the research of Sri Chandra, T., (2017: 268-282). Use of water resources management. for students of Srinakharinwirot University Srinakharinwirot University the University has a

unique academic service is involved, and encourage students to have public consciousness. The link between academic service delivery and teaching and learning in the academic year 2013 - 2014 in the general education curriculum 151, human and public consciousness. set up a problem. Water management "We built a dam," which aims to publicize and serve the community. For undergraduate students enrolled in the course. The service areas were Nakhon Nayok Province and Sa Kaeo provinces. The total number of dams was 8 in Nakhon Nayok Province 4 in and 4 in Sa Kaeo Province. The students participated in the survey. Public hearing process Creating Process and the follow-up process showed that students had more public consciousness. Students participating in the program were self-determined. Which shows that the process, the activity can create a consciousness for the teacher. The sample is conscious of becoming a teacher of environmental education on the King Bhumibol adulyadej's science.

Acknowledgement

This research achievement went well with good grace because of the teachers working in schools and teaching lower secondary education. Join the Teacher Development Program Training Course for Environmental Education on the King Bhumibol adulyadej's science. The participants in the training, activities and responses to the information in this research. The research is highly appreciated.

References

- Armartkun, K. (1996). ATTASIGKA the science of self-knowledge. 5th edition. Bangkok: TP Printing.
- Bilbai, S. (2558). Performance and roles of Thai teachers in the 21st century. Teacher Training College Mahidol University, Phra Nakhon.
- Chalalak, N. (2016). Teacher's Role and Teaching in the 21st Century. Journal of Far Eastern University 9 (1): 64-71.
- Chasangoun, N., Anantarak, M., Thongpradit, S. (2558). Promoting Academic Knowledge to the Community of Schools. In the municipality of Nakhon Phanom Nakhon Phanom Province. Journal of Nakhon Phanom University 5(1): 115-125.
- Government Pension Fund (2007). The Royal Record of His Majesty King Bhumibol Adulyadej of Thailand, Bangkok, Gray Matters Co., Ltd, pp. 1970 – 1971.
- Ketsripongsa, U., Makeaw, J., Peanjad, S. Sarnsenee, T., Moondee, P. (2017). Local Spiritual Model for Sustainable Community Forest Conservation. Buriram province. Journal of Research and Development, Buriram Rajabhat University 12(1): 48-60.
- Kongchai, Th. Boonsong, K. Refer to the Ministry of Education. (2017). Factors affecting the quality of teacher education in the 21st century in Phetchaburi province. Office of the Vocational Education Commission. Silpakorn University 10 (2): 353-354.
- Mangkang, Ch. (2018). The King's Knowledge Transfer. A green citizen of the students in the Royal Project area. Northern part of Thailand. Silpakorn University 11 (1): 1503-1521.
- Meeraka, N. (2017) How do teachers look ... 21st. Century Journal of Education, Faculty of Education Mahamakut Buddhist University 5 (2): 23-35.

- Panthong, W. (2014). The development of teacher education for students in schools. The Office of Primary Education Area. *Journal of Education Naresuan University* 15 (Special): 193-205.
- Paphapsit, A., Maneechot, Th., Worakitphokatorn, S. and Kamsrichantorn, W. (2012). A model for building a consciousness in community development. *Journal of Phra Nakhon Rajabhat University* 7 (2): 98-110.
- Poonyaban, D. (2017). 9 Follow the Footprints-King Bhumibol's Science. *Journal of the Association of Researchers* 22(2): 13-20.
- Priyamkae, J. (1992). Techniques for measuring and evaluating learning with remedial teaching. Thai Wattana Panich Printing House, Bangkok, pp. 22-29.
- Ruangrong, Ph. (2017). Educational Technology with Thai Teachers in the 21st Century. *Journal of Panyapiwat* 5 (Special): 195-207.
- Sanglerduthai, J. (2011). Enhancing knowledge management skills using learning processes. Teacher Education (Phase 2). *Journal of Education Khonkaen University* 34 (3-4): 14-20.
- Singsewo, A. (2011). Environmental Education, University Press, Mahasarakham.
- Srichantra, T. (2016). Creating a Public Consciousness, Environmental Conservation, and Community Service. Use of water resources management. For students at Srinakharinwirot University, Office of Learning Innovation Srinakharinwirot University. *Journal of Science, Technology and Environment for Learning* 6 (2): 268-282.
- Teerachanachaikul, K. (2014). Knowledge Management. Success Factors *Journal of Psychiatry* 5 (Special): 134-144.
- Wongchantra, W. (2009). Environmental Science. Mahasarakham: Mahasarakham University Press.

The initial environmental examination of agriculturists in mamgo plantation community at Ban Lon, Nangdad Sub-district, Nong Bua Daeng District, Chaiyaphum Province

Lerdchai, W. *, and Wongchantra, P.

Faculty of Environment and Resource Studies, Mahasarakham University, Maha Sarakham, Thailand.

Abstract Ban Lon community locates in Nangdad Sub-district, Nong Bua Daeng District, Chaiyaphum. It is origin of the Chi River which is the main river of the northeast Thailand. Villagers focus on producing quality mangoes var. Numdokmai both in and off seasons forv export China, South Korea, Singapore, and Russia. The problem and occupational issues of agriculturists in mango plantation community was studied to assess the initial environment examination in community at Ban Lon, Ban Na Yai Chi, Ban Ki-moon on, Ban Huai Sam Klong and Ban Don Khao Khao to compare knowledge and environmental conservation in the community before and after the activities. The sample were 100 agriculturists in mango plantation community. Each village was 20 agriculturists. The results showed that initial environmental examination of agriculturists in mango plantation community divided into 4 categories as follows:- 1) physical environment including soil resource that is silt loam, and reddish brown, 2) biological environment including mountains are surrounded by mostly deciduous forest. The wildlife is till in nature such as lamb, monkey, boar, snake, etc. The aquatic animals including shrimp, crabs, fish eg catfish, carp, tilapia. etc. are found. Moreover, 3) the values of human use including lands for planting mango, rubber, and rice. Lastly, 4) community economy revealed good due to exporting mangoes.

Keywords: Initial environmental examination, A guide to advocacy of environmental conservation for agriculture producers, mangoes plant agriculturerers

Introduction

The situation of natural resources and the environment is changing in the direction of degeneration, shabby much more observed from important natural resources and are essential to the life of humans and animals were destroyed. The environment around humans, it worsens, respectively to the point that it is generally accepted that the environmental crisis. Destruction of natural resources and environment caused by natural disasters and at the hands of humans caused by the selfishness of the man himself. By concentrating the money is a factor, so the object is set to cause destruction to find out what's coming meet their own needs. Natural resources are a problem of the country during this time because of deterioration or deteriorate, down include forestry and land use mineral water, energy, marine and coastal resources, environmental issues include water pollution air pollution & audio pollution from the waste and sewage pollution from hazardous substances, air pollution from hazardous waste, etc. in the midst of developing countries in the

* **Corresponding Author:** Lerdchai, W., **E-mail :** wanlee088377@gmail.com

globalization of the convenience of modern technology advancements, the modern rise of population has brought the issues of natural resources and environment. Human being is the creator and problem must be problems, but it seems to solve the problem will be delayed too late. Solving is no point even solve the problem has increased budget waste conflicts between people in the community and socially (khchayuththdech Boonlert 2008). The current population of the country its income from farming such as planting grain crops, horticulture, fruits, vegetables, flowers and ornamental plants as well as animal husbandry, fisheries, agriculture and others by country, the overall space, with an estimated 320 million hectares, which is used in agriculture, approximately 125 million hectares. The current agricultural cultivation has developed advanced. The production technology and production support farmers mainly aims to manage agricultural productivity to survive and increase their revenue has been adopted in a variety of chemical substances used to accelerate productivity. Production control and production support to achieve the goals set forth by specific chemical pesticides. Since Thailand is a country located in the tropics, where the species of insect pest species as well as the development of insect resistance to chemical pesticides will do the farmers experiencing outbreaks of pests Ministry of Science. (Technology and Environment, 2011).

In addition to pesticides which harmful to humans and animals. Some chemicals remain in the environment and contaminated in natural water, soil as well as in food. It results to the health of human beings by the nervous system. Muscular system and the excretory system of the body or may be sick with chemical allergies. Which can cause death. (wirawathanaanon winay, 2541). From the situation, human diseases are caused by overuse toxic agrochemicals from the year of 2007. It was found that pesticide poisoning patients averaged 1,452 farmers who faced the problem (Kulkankhay Phinet, 2011). Health problems are caused by pesticides. It is a big problem and a very serious problem in Thai society, which is related to Thai society and society. Especially the impact on farmers and the general public. Pesticides have short-term and long-term health effects. If a person has been exposed to a chemical that is severely toxic to the body. In sufficient quantities, it will cause sudden symptoms. Symptoms vary depending on the type of chemical that enters the body, such as skin irritation. Eye contact eyes. And when the chemical is absorbed into the body. May cause abnormalities in the body's system, such as the body fatigue. And tired muscular contraction, etc. Some substances may affect the development of growth and some substances are carcinogenic.

The impact on the environment and natural resources is a phenomenon that causes damage. So many affect the livelihood of agriculture in the community and related to economic and social conditions. It also results in environmental pollution that directly affects organisms. This may cause loss of life or lead to the condition that some plants and animals are extinct. (Siriratanpruek 2005).

The community Ban Lon, tambon Nangdad.Sub-district, Nong Bua Daeng District, Chaiyaphum province is a community located in the Valley. The villagers mainly agricultural careers, rice farming, mango park is made specifically. This is the

main economy of the people in the village in 1999. Department of Cooperative Promotion and set up a group of women agricultural cooperatives Ban Lon.

There are approximately 6,000 to 10,000 acres of mango plantation variety Numdokmaun no 4. These mangoes produce over 1,933 kg of rai, cost is 49,124 baht per rai, Income 154,500 baht per ra, return of 105,541 baht per The return on investment is 3.15. The investment of 1 baht has returned 3.15 baht. The mango harvest is almost a year include, pre-harvest yield February - March harvesting season April – May harvest after harvest August - July (Kwanlii vijit interview, 18 March 2018). From this situation, the researcher is interested in research. The initial environmental examination of mangoes plant agriculturers' community at Ban Lon, Nangdad Sub-district, Nong Bua Daeng District, Chaiyaphum province, to convey knowledge and conscious mind give people in the community for conservation of natural resources and sustainable local environment.

The objective was to assess the initial environment examination agriculturists in mango plantation community at Ban Lon, Ban Na Yai Chi, Ban Ki-moon on, Ban Huai Sam Klong and Ban Don Khao Khao, and to compare knowledge and conscious mind environmental conservation in the community before and after the activities.

Materials and methods

The research area is community at Ban Lon, Nangdad Sub-district, Nong Bua Daeng District, Chaiyaphum province, 5 Villages include Ban Lon, Ban na yai chi, Ban Chi Bon, Ban Huai Sam Klong, Ban Don Khaw Kiew.



Figure 1. Area Ban Lon

Population: the population used in this study is mangoes plant agriculturers community at Ban Lon 5 Village include Ban Lon, Ban na yai chi, Ban Chi Bon, Ban Huai Sam Klong, Ban Don Khaw Kiew.

Sample: the sample used in the study the initial environment examination is mango growers in Ban Lon, the number of 100 people choose from mango growers group home all 5 villages the village of 20 people each of voluntary participation. The sample used in the study the initial environment examination is mangoes plant agriculturers Ban Lon the number of 10 people choose from mango growers group home all 5 villages. The village of 20 people each of voluntary participation.

Research tools were the environmental conservation guide for mango growers community and **achievement tool** in environmental conservation campaign for mango growers community; measurement of knowledge about environmental conservation, environmental conscious mind measurement.

Data were collected as the initial environment examination data mangoes plant agriculturers' community at Ban Lon, Nangdad Sub-district, Nong Bua Daeng District, Chaiyaphum Province.

Phase 1: study information related to research papers and explore the community context of Ban Lon.

- 1) Contact the 5 community leaders to ask for help in the data collection
- 2) Study papers and research related to initial environmental assessment.
- 3) Into the data collection area community context 5 villages

Phase 2: Design and quality of research tools;

1) Prepare a guide to environmental conservation for mango growers Ban Lon community to the advisors and experts the number 5 people to determine the consistency of the questionnaire, the objective and document of environmental conservation for mango growers Ban Lon community.

2) Bring information to create a knowledge questionnaire environmental conscious mind measurement to the advisors and experts the number 5 people to determine the consistency of the questionnaire, the objective and document of environmental conservation for mango growers Ban Lon community.

3) Tools used to measure and assess the results include knowledge questionnaire about environmental conservation and environmental conscious mind measurement go to trial (experimentation) with the Ban Lon find the difficulty, discrimination design guide for environmental conservation for mango growers Ban Lon community.

Phase 3: environmental conservation campaign for mango growers Ban Lon community.

1) The measurement and evaluation tools used in the process Environmental education activities in environmental conservation campaign for environmental conservation for mango growers Ban Lon community.

2) Carry out environmental campaigning activities for environmental conservation for mango growers Ban Lon community by distributing pubs, conservation of the environment.

4) Use measurement and evaluation tools in the process, environmental education, measurement of knowledge about environmental conservation and environmental conscious mind measurement.



Figure 2. Context community Ban Lone



Figure 3. Exploring natural resources



Figure 4. Training and workshop area



Figure 5. Community cleaning

Statistics used in research

1. The statistics based on the data analysis, this time consisting of basic statistics include; percentage, mean and standard deviation.

2. Statistics used to determine the value of the tool.

1) Quality of test; 1) Identify the discriminative power of the knowledge test and find the whole confidence. 2) Find the craving of the test.

2) Quality of questionnaire; 1) Determine the classification power. 2) Find the confidence of the questionnaire.

3. Statistics used to test the hypothesis include t-test (Paired t-test) at statistically significant level .05.

Results

1. The study of initial environmental examination of mangoes plant agriculturers community at Ban Lon, Ban na yai chi, Ban Chi Bon, Ban Huai Sam Klong ,Ban Don Khaw Kiew, Nangdad Sub-district, Nong Bua Daeng district, Chaiyaphum province followed as:

1.1 Physical resources assessment.

- Soil resources : soil in Chaiyaphum province there will be soil clay found in the lower basin mostly in the county Muang Chaiyaphum district, Kaset Sombun district, Kaeng Khor district, Mueang Songkhla district and Nong Bua Daeng. Fine loam in highland areas mostly in the county Kaset Sombun district, Consan district and Nong Bua Daeng (Figure 7) and the most common soil unit in Chaiyaphum province is group 1 soil series with an area of approximately 483,428 rai or 66.116% of the area province, suitable for rice farming in the rainy season and planting crops in the dry season not suitable to grow vegetables. Because the soil is clay soil group found that respectivel is group 33 soil series with an area of approximately 331,440 rai or 81.96%, appropriate to make field crops the fruit or vegetables and still state forest and group 33 soil series soil degradation caused by decaying stationary. The soil is moderately deep good drainage to medium in the soil below the depth of approx 50-100 cm. mostly sedimentary rocks. The soil is brown,

yellow, or red the soil has a moderate to high pH 6.0-8.0 Clay is clay reddish yellow at medium 100 cm. Soil group 55 potential suitable for growing crops vegetables, fruit trees or woody plants and development is a pasture but it is quite appropriate to not use in farming but it is quite reasonable to use that is not appropriate farming due to unfavorable conditions. It is too high and partly high for rice fields keep the water away.

- Weather : Chaiyaphum province has hot and humid weatherv live in a climate. The monsoon winds through is southwest monsoon and Northeast monsoon. In tropical monsoon climate, there are 3 seasons. The duration of each season may be vary according to weather conditions of each year. The winter is cold in winter hot summer.



Figure 7. The land of the Ban Lon community.



Figure 8. Surrounding environment Ban Lon

1.2 Environmental assessment of biological resources.

- Forest resources: Ban Lon community has two forest resources such as; Phukratha community forest have total area of 1,200 rai, the villagers to find food such as bamboo shoots, mushrooms, etc. to use for cooking which are crucial to the livelihoods of local people for a long time. And Phu Khieo forest has an area of 975,000 rai or 1,500 rai of fertility and high biodiversity. The most important plant species found are: *Plerocapus indicus*, *Dalbergia oliveri* Gamble, *Dracontomelon dao*, *Xylia xylocarpa*, *Dalbergia cochinchinensis* Pierra and *Aquilaria crassna* Pierre, *A. malaccensis* Lamk,

etc., and a variety of wildlife. It is a forest area. The villagers did not find the forest.

- Water resources and aquatic animals : Ban Lon community is a community adjacent to the Chi river origin. This river is the birthplace of Chi water is between Chaiyaphum and Phetchabun the river is a major river of the east. It is the longest river in the northeast from the eastern plains of the Phetchabun Mountains ridge Nampan, Ksrlangtatad Mountain, Oum Nam Mountain, Yod Chi Mountain, Krok Mountain and Tew Wa Da. It is a mountain range north of the border of Chaiyaphum province. There are 4 reservoirs for agriculture include small earthen dam keep the water flowing from the hills built in the Phu Khieo forest development. It is 130 meters long and 4 meters wide. The average rainfall is 2.5 square miles and rainfall is 1,123 mm. Reservoir Rong tamarind. The source of the tamarind grout is there are immigrants from Phetchabun province to grow a lot of tamarind all villagers used to work together in agriculture and the three canals Creek (Huai Ban Thai) Natural water flows from the mountains. There are 2 flowing lines with a depth of about 6 meters. The dam was built to slow down the water consume and agricultural including other uses the dam is about 100 meters, long 3 meters wide, with a capacity of 120,000 cubic meters.

- Aquatic: found in community area of Ban Lon most are natural aquatic animals include striped snakehead fish Siamese mud carp, spiny eel, Macrognathus Mystus nigriceps, etc. and fish farming include; Clarias, Anabas testudineus, Oreochromis niloticus, Cyprinus carpio and Barbonymus gonionotus, etc.

- Terrestrial animal: found in most areas are home pets and pets for agriculture include, chicken, dog, cat, pig, duck and rabbit, etc. Wildlife found in the are include, barking, deer, wide, monkey, snake, squirrel, bird, chipmunk, etc.



Figure 9. Forest resources in the community.



Figure 10. Water resources in Ban Lon.

1.3 The assessment of environmental aspects of human utilization value.

- Residential land use: currently, Ban Lon community has an area of about 14,540 rai of living space. Agribusiness buy mangoes from farmers. There are government offices, including Ban Laen Samakkee school, health promotion hospital ban borrow and child development center.

- Land use in agriculture mostly farming mango planting planting rubber, planting rice, planting bananas, planting corn, date palm, eucalyptus and most of the mango. There are about 7,956 rai of mangrove plantation in 438 households.



Figure 11. Land use for agriculture

1.4. Assessment of environmental quality of life.

- Socio-economic aspects: in this area, a community banlon if the superintendent of the area with demonstrator which supplemented resources that are suitable for farming in planting mango yields, is a village that is exported for sale abroad include mango flowers gold, mango flowers gold no. 4, green mango, mango thunder, etc. because the revenue/increasing income to the household, and are harvested all year round except for May - July is the only pruning. The community has expanded the export business mango season. The community has a final three, including a Ban Lon Samakkhi temple, Na Yay Chi temple of the woods and aran wiwek temple of the woods. The government all 2 agencies; health promoting hospita Ban Lon community Ban Na Yay Chi, swine 12 district, Nong bua daeng Chaiyaph province. There is no government belongs to the village, but there are agencies in the area; Bandon Khao Khieow Moo 21, Bannonmao Moo 3 and 2 hospital is health promotion, Nang daet. Tambon Administration Organization Nang daet has studied two of the school's final harmony located at 10 Moo 21 Tambon Nang daet district, Nong bua daeng Chaiyaphum province, Chaiyaphum primary Educational Service Area Office 1 Students from pre-primary education. Secondary school located on 20 acres with a child development center at Bandon Khao Khieow, Tambon Nang Daet, Nong Bua Daeng district, Chaiyaphum province located at Bandon Khao Khieow swine 21 Tambon Nang Daet, Nong Bua Daeng district, Chaiyaphum province. Opening in 21 January 2008 with an area of 2 acres or one square meters and has a total of 31 establishments, shops, restaurants include a gas station, a pharmacy, grocery and fresh food stores, etc. The painful climb in home communities if the most common child health examination and Routine Z001 found minimal essential (primary) hypertension I10.



Figure 12. Mango export to foreign countries.

2. The study and comparison of knowledge and conscious mind in environmental conservation in the community before and after joining the campaign.

Analysis of knowledge about environmental conservation pre-training is overall moderate after the training, the overall knowledge score was at a high level comparing the average scores of conservation knowledge before and after training. It was found that mango growers in Ban Lon the average score of post-training knowledge was higher than before training at statistically significant level .05 (Table 1).

Score analysis conscious mind pre-training is overall moderate and after training at a high level comparing average scores consciousness about conservation before and after training. It was found that mango growers in Ban Lon the average score of post-training knowledge was higher than before training at statistically significant level .05 (Table 1).

Table 1. Comparison of knowledge and conscience in environmental conservation in the community before and after joining the campaign.

	Before training		After training		t	df	p
	\bar{x}	S.D.	\bar{x}	S.D.			
knowledge (N = 20)	27.97 (69.92 %)	5.53	39.48 (98.7 %)	.784	- 20.76	99	.000
conscious mind (N = 20)	3.2284	.54161	4.4185	.42537	- 17.89	99	.000

* Statistically significant level .05.

Discussion

1.The study of the initial environmental examination of mangoes plant agriculturers community at Ban Lon, Ban Na Yai Chi, Ban Ki-moon on, Ban Huai Sam Klong and Ban Don Khao Khao Nangdad Sub-district, Nong Bua Daeng district, Chaiyaphum province found that study the environment 4 is the resources of physical, resources to the biodiversity, the value propositions to take advantage man and the value to the quality of life by the area is the unique is that there is the main source of cheese and mango orchards. According to the concept of Wongchantra, P., (2011: 23) found that the environment is divided into two types of environment that occurs naturally that is a living and do not have the life and the environment that man up on both the biodiversity, physical, and social important cultural life are often based on factors on the environment is the temperature, light, oxygen, minerals, acid - the bass, salinity air flow and moisture. Living organisms and non-living according to the natural and man-made life which a man-made with what is concrete and abstract is useful for the life of the man. According to the concept of Songsontornwong, (Ch., 2007: 10) said that environmental

conservation is the use of the environment in the reasons for the good quality of life forever to the man. The conservation of natural resources will need to have a relationship with each other, the environment or the eco-systems in the balance, but the non renewable resources quickly. As well as the manufacturing process of the privatization of resources and the use of resources that can be increased to cause toxic substances in the environment to the environment of the balance and in accordance with the work of the research. According to the concept of Wongchantra, P., and corps (2017: 1805) said that learn to assess the impact of the environment and health management projects trash community Ban Don Yom, Tah Khon Yang sub-district, Kantharawichai distric, Maha Sarakham province, meteorology and the air quality, hydrology surface water and underground ecology on land ecology on the water use of land and socio-economic concluded that the project will not cause any impact both in the construction and operation range. Consistent with the research. Wongchantra, P., Wongchantra, K., Ongon, S., Junkaew, L., Sookngam, k., Kaeongam, S., Phansiri, C. and Oncharoen, A. (2017: 1805) found that initial environmental examination study report: project of effective waste management with production as renewable energy of the Maha Sarakham Provincial Administrative Organization: 1) physical environmental impact : surface water had a BOD value that exceeds the established standards, groundwater values were standard. 2) effects on the biological environment, including the forest and wildlife effect was low. 3) effect on the value of human use, including land use was in low level in residential areas in the industrial areas. And the use of the area livestock, did not have any effect on the project area. 4) impact on economy and society. Project of solid waste management effectively with the production of renewable energy changing from the area of no use was the value added of land use by the impact on the well-being of society or community was very low.

2. The study and compare the knowledge and awareness in the preservation of the environment in the community before and after the event.

2.1 The study and compare the knowledge in the preservation of the environment in the community home. Lorn farmers who grow the mango tree house lorn have the knowledge after the training more than before the training. This is because the manual is used in the trainee has the substance environment that allows the user to access training. Easy to understand. Which is based on the concept Sangsawang, O (1997: 257) said that the training methods in the most popular in use today is the practice, orientation, a technician training simulations, learning program, case studies, the role-play, and a short course. The tool that is used to measure the knowledge each type is suitable for the measurement of the knowledge in the manner that is different from the tool that is used to measure the knowledge of the most popular is the quiz or a measure according to the concept of (Whanganit, P,1983 : 35-36) said that this person will be able to talk about it if there is a

better understanding of the subject that will be talking enough that the sender will be required to analyze the recipient of that will be in any level and then try to send it in a manner that will sleep and understand that will make the process of communication with the intended. This person will be able to talk about it if there is a better understanding of the subject that will be talking enough that the sender will be required to analyze the recipient of that will be in any level and then try to send it in a manner that will sleep and understand that will make the process of communication with the in accordance with the work of the research Sookngam, K. (2015 : 495-510). The development of training manual about ASEAN natural resource and environment : Lao People's Democratic Republic. The results showed that the effectiveness of the training manual. The experimental group students had an average score of knowledge and attitude after the training than before training. And the experimental group students had the knowledge and attitudes than the control group. And the experimental student groups had the skills to become trainers, the student self-assessment and trainers to evaluate, after the training was at the highest level. And the experimental group students had the knowledge, attitudes and skills as trainners than those in the control group at the level of statistical significance .05 .

This is consistent with the research Lahpanthong, W. (2015) found that development of ASEAN natural resources and environmental training manual republic of Singapore. The study indicated that experienced students have knowledge. As a guest speaker. There was a statistically significant difference at level. 05. Comply with the research Tumhome S. (2015: 189-22) development of ASEAN natural resources and environmental training manual: Republic of Indonesia. The research found that the experimental group had a total knowledge score and five aspects. Higher than the control group the experimental group had skill scores as a training instructor. Self-assessment and guest speakers are evaluators. After the training, the overall level was very high. Experienced students have the knowledge, attitude and skills as a lecturer. Higher training than control group students. Statistically significant at the level.05 and consistent with the research of Chuthongrattana Sathaporn (2015) said that transfer of folk wisdom in forest and water resource conservation of Nakhon Phanom ethnic group. The research found that knowledge of folk wisdom in forest and water conservation. Maintained by the community through the knowledge of folk wisdom in the form of beliefs about power. Sacred ghost defendant take care both for you and to blame the person who follows the traditions and traditions of the wrongdoers. Utilization and conservation of forest resources for subsistence using firewood make tools, tools and equipment use forest as a source of forest food wild hunt the forest is used for rituals the donkey's eyes are used to make a funeral ceremony. Utilize and conserve water resources. As a source of food for aquatic animals, there are many prohibitions that conserve water. Forbidding urine, Feces into water used for ceremonial purposes. Study results both men

and women have knowledge. not different knowledge of local wisdom in forest and water conservation classified by age did not differ.

2.2 Awareness of environmental conservation in the community, found that the Ban Lon community, had a good conscience in preserving the environment at the moderate level, and after training is good. It shows that the process used in the training can promote the increased awareness of agriculture. Which corresponds to the research of Wisootthanawit, R. (2005) found that awareness of student waste management: a case study of secondary school. Research showed that the process of creating a consciousness of the students' waste management starts from the first stage, the socialization is being cultivated from home and school. Second, building a home and school network means a school that builds a connection between home and school, to clarify the policy of the school. Third, the integration of activities is to educate and promote activities related to waste management. Fourth, reinforcement and punishment the morale of those who follow the norm, and punish those who do not strictly follow, in order for the students to adjust their behavior in the direction they want. And finally, the fifth stage, evaluation the school issued an order appointing a waste management evaluation committee. Which corresponds to the research of Kawongklang, J. (2007), found that the development of local learning materials on natural resources conservation in Kham Khan Sub-district, use the learning community, learning content, social studies, religion and culture, 1st grade (grade 3). Learning by using learning resources requires collaboration between schools and communities, which will benefit students, it also promotes good relationships between schools and communities. And which corresponds to the research of Thongpanya, Th., et.al. Thongpunya, T. (2015) found that on awareness for community development of youth: a case study of Huai Monthong community. The research found that, Youth are more aware of environmental community development than other aspects, while youth play a role in the development of most cultural communities, and role play, the youth is just a participant. And which corresponds to the research of Hankla, R. and Hankla, B. (2008) found that participatory learning for environmental consciousness of youth. The research found, that patterns and methods of learning to raise awareness for the environment, there are 3 forms of learning: formal learning, Informal learning and independent learning, all 3 characteristics must be consistent, there are 3 ways to learn Thai, how to organize a learning process that focuses on learning the real story about local communities, integrated and integrated learning management plan that maximizes participation, and there is interaction in learning together. Which corresponds to the research of Wattana, A. (2010), said that relationships between executive consciousness and good governance in secondary schools under the Office of educational service, area 3. The research found that, 1) Management consciousness relationship with good governance at high level, 2) The level of managerial consciousness was at a high level, 3) The level of administration using good

governance is at a high level, 4) Executives with higher education there was a statistically significant difference at 0 .01 level.

Acknowledgement

This research was completed successfully because of kindness and great help from the villagers, community leader Ban Lon, Ban Na Yai Chi, Ban Chi-Boon, Ban Huai Sam Klong and Ban Don Khao Khaw, Nangdad sub-district, Nong Bua Daeng district, Chaiyaphum province and thanks to the director Ban Lon Samakkhi school, District Health Promotion Officer at support the researcher.

References

- Chuthongrattana, S., Wongchantra P., Sali, B. (2015). Transfer of Local Wisdom on the Forest and Water Resource Conservation of the Thai Yo Ethnic Group in NakhonPhanom. *Journal of Education Mahasarakham university*. 9(3). 223-235.
- Hankar, R . and Hankar, B. (2008). Participatory Learning for Environmental Consciousness of Youth. Buddhist Research Institute. Mahachulalongkornrajavidyalaya University.
- Kachayooddeat, B.(2008). The role of media in environmental crisis. (Institutional conferences King Prajadhipok's Institute 10th Annual Report 2008). Nonthaburi: King Prajadhipok's.
- kulkankhay,P. 2011 : Changes in knowledge and attitudes of pesticide use among farmers Khok Dua Pai-Sa-Lee District, Nakhon Sawan Province.(Master thesis) Environmental Education Mahrasarakham University.
- Kwanlai. (2017). Mango Ban Lon. Online <https://kehakaset.com>. Browse March 18.
- Lobphanthong, W., Wongchantra, P. (2015). The Development of Training manual about ASEAN Natural Resource and Environment : Socialist Republic of Singapore. *AEE-T Journal of Environmental Education* . 7(14). 136-148.
- Ministry of Science Pest and prevention.Technology and Environment. (2011). Pest and prevention.. <http://natres.psu.ac.th>
- Sanyaviwat, S. (2001). Organizational Theory. *Articles of Sociology and Anthropology*. Bangkok.
- Singhapol, S. (1999). Must teach new consciousness. *sreemajan*, 13(27), 15-16.
- Sirirattanapruk, S. (2005). Study Report Occupational Health and Environment in Thailand: Nonthaburi: Health System Research Institute.
- Songsoonthornwong, Ch. (2007). Human and environment. Bangkok: Chulalongkorn University Printing House.Kasetsart University Social Sciences, 36(3), 483-497.
- Sookngam, K., Wongchantha, P. (2015). Development of the ASEAN Natural Resources and Environmental Training Manual. *Journal of Cultural Diversity Year 14(33)*, 497-510.
- Toomhome, P., Wongchantra, P. (2015). Develop of training manual about ASEAN natural resource and environment: Republic of Indonesia. *AEE-T Journal of Environmental Education*. 7(14). 189-22.
- Wattana ,E. (2010). The Correlation of Administrators Conscience and Good Governance of Public Secondary Schools in Educational Area Bangkok 3. (Master thesis). Education (Educational Administration). Dhonburi Rajabhat University.
- WeeraWattananon, V. (1998). Environment and development. Bangkok: Chulalongkorn University Book Center.
- Whangpanit, P.(1983). Educational Measurement. Bangkok, Thailand
- Wisoothanawit, R. (2005). The process of raising awareness of student waste management: Case study Secondary education. Phuket Rajabhat University. Information and Technology Resource Center.

- Wongchantra, P. (2011). Environmental Science. Mahasarakham, Mahasarakham University.
- Wongchantra, P. (2017). Initial Environmental Examination Study Report: Project of Effective Waste Management with Production as Renewable Energy of the Mahasarakham Provincial Administrative Organization. *International Journal of Agricultural Technology* 2017, 13(7.2), 1805-1820.
- Wongmaung, M. (2005). Environmental Assessment of the Youth Preservation Project in Chae Son National Park. Chiang Mai University Library.

The process of learning to strengthen the public policy team to social well-being for social participation based on Intellectual Property (4P-W) Phase 2

Pansila, W.*

¹ Faculty of Public Health, Mahasarakham University, Maha Sarakham, Thailand.44150

Abstract The social well-being can be achieved by learning together the people in society and sharing responsibility for their well-being and their communities. The objective of this research was to develop the network capacity to drive the public policy process at the provincial level on the 4-step of technical action research process. The main activities consisted of a series of public policy processes, "elevation of plans for participatory public policy (4P-W)" and a series of learning activities. "Widget" from The National Health Act. 2007, conducted in 12 health areas include: team of 408 people and the provincial working group lessons and conclusions of 4 people. Data were collected and analyzed by qualitative method. Conclusions on triangulation techniques. The research found that targeted development in the first set. The target audience has been engaged in the issue and process of engaging public policy, practice writing policy documents. (Announcement/Policy statement), strategic analysis training and a strategy to drive the policy. There are presentations and exchanges of learning plans for the provinces. A 4PW mapping process map was a learning process that learned from the real world. For the learning set 2, all participants learned and practiced the tool. It can show the selection of tools that are relevant to the issue of driving public policy-making (4P-W). These tools can be linked. Summary of learning and practicing tools "Health Assembly Process Tool" is an exchange of experiences from the work of the local health ministry. The network has learned a variety of general assembly tools. Participants bring their knowledge to the 4P-W design through the health assembly process. That can be link between the network. Recommendations should be encouraged to organize learning activities to strengthen the public policy team by focusing on self-learning. The development of the internal potential of each and the network should continue.

Keywords: social health, public health policy, participation, network

Introduction

Creating a healthy society is a process that must be carried out continuously and systematically with the shared responsibility of the people in society and the community. The importance of the health system in people and in society is defined as the essence of the health act. The "Health Assembly" is one of the tools for building the health of people and communities. It is a tool of people in the community to participate in the research, find out issues and use health assessment in the community to bring about the improvement and development of the community based on participation and systematic work as a process. There is a hierarchy of work based on the potential of the community and the capacity of the community

* **Corresponding author:** Pansila, W.; **E-mail:** wpansila57@gmail.com

and network. The goal of the process is "Community Participatory Health Policy" was derived from the results of the Health Assembly Process and Public Participatory Health Policy Process (PHPP). The "Health Assembly" is the tool of the people to create health by meeting on a participatory basis and working systematically. On the principles and messages learned in the area. For the benefit of people in the area. By people in the area. And activities belong to people in the area (National Health Commission, 2017). There are also two important tools for public health policy development, the Community Health Impact Assessment (CHIA), which aims to assess the health effects of changing public policy processes to promote good health and the constitution of the health system is the agreement or the common law of the people in the district want to see the desired wish. This will lead to better health in the physical, emotional, intellectual and social processes health assembly ago. It has been operating in 76 provinces and has organized health conferences in more than 60 provinces over the years 2011-2016. And the health assembly. The resolution is pushed to action through the channel / budget plan of the various agencies. The results show that the process of driving public health policy through participation (PHPP) has been successful in driving the policy into action. The important factor that caused this phenomenon is the past. The National Health Commission has provided a policy to support the process. Develop a policy proposal or step up the output of the process is the policy proposal. And the resolution of the provincial health assembly. However, a report from the synthetic set of knowledge tools to drive public health policy found that policy driving has not been able to systematically and forcefully mobilize public policy. The success is also low in both quality and quantity. Both in the area and in the provinces (Techa-athik, 2017)

In addition, the current paradigm of public health process and public policy processes has changed in addition, the development of knowledge in the process of health assembly and participatory public policy process. There is another step. When considering back to the potential of the lead in each area is different. It seeks support both academically and processively. Especially when "Health Assembly Process"

At present, the way of thinking has changed and the changes in the productivity of the health assembly process at the regional and local levels have changed. Especially the cause "Public policy" from the public health policy process. Thus, the image of the potential development needs of the members and the network partners. There is a clear and distinct need for the potential for both processes to be realized in a more concrete way.

The limitation of adaptation to the space support approach requires a knowledge-driven set of policies to be implemented. Additional policy assessments and space can be used for other tools according to the National Health Act 2007, at various stages of the process, And Community Health

Impact Assessment (CHIA), which has mechanisms in 76 provinces and 6 Bangkok metropolitan areas.

Other organizations, including public, private, educational institutions. And local government organizations. To drive a participatory public policy process based on intellectual (4P-W) is more complex and challenging. It is necessary to develop personnel in the area. To be able to make public policy. The data for this study is based on the research.

Having a social network working together Participatory management and public communication to create, adopt and push policy into action. All three tools can be used effectively. There are important issues to be addressed.

1) Motivational 2) The concept of public policy. Public policy process, 3) public health research and general tools under the National Health Act, (2007), 4) policy advocacy and action, best practices, negotiation, coordination and policy push, and 5) lesson summary. Knowledge management and follow-up evaluation.

The National Health Commission has coordinated with the academic team to develop a learning process to strengthen the public policy team. There are 5 sets of learning packages that will be implemented in two ways: the 5 learning processes and the voluntary learning packages. To strengthen people and public policy team or called "Team 5 Power". Have knowledge can be thought of as an analysis of public morality, ethics, good co-inspire together. In the public policy process. The use of tools under the 2007 National Health Act and other technical tools applied in practice. We can create sustainable work.

This is essential and important in the 4P-W process of contributing to public policy with such learning.

Objectives: To develop the network capacity to drive the public policy process at the provincial level with the Public Policy Process Learning Series, "Improving Public Participation Plans (4P-W)" and the Learning Series "Widget" National Health Act BE 2007".

Materials and methods

Research scope

The main activities of this research were the learning process, the public policy process, "the improvement of the public participation policy plan (4PW)" and the learning package. "Widget" The National Health Act BE 2007" in 12 health areas and Bangkok. Research participants included: 11 academic staff, 408 provincial team members, and 4 staff members worked out the lesson and the results of the research.

Research Methodology

This research utilizes the Technical Action Research model. There are 4 steps and 9 research activities.

1. Preparation and planning.

1.1 Presentation and Sharing of Learning Plan.

1.2 Review of the 4PW Process Map.

1.3 Elevated design is participatory public policy and policy options / activities.

2. Steps include:

2.1 Powerful listening activities "Policy Statement" and recommendations based on the concept, process, mechanism.

2.2. Tool Overview and Integration Including the lessons of each province.

2.3 Learn and practice the tool. "Health Assembly Process Tool.

Activity 1: Experience from the Health Assembly Area / province.

Activity 2: Designing General Assembly Tools the General Assembly is the process of bringing people together to exchange learning together, joint decisions find a solution together, drive together and see together. It is a public space and is a tool to create a public policy model that is Soft Power.

The speakers presented the contents of the exchange. The level of development of the general assembly, the area of learning is the stage where people come together. Sharing common learning is a common decision in finding development proposals that are mutually driven. Successful and progressive is to look at the results together.

2.4 Learn and practice the tool. "Health Impact Assessment (HIA)", with sub-activities, is Activity 1, Principles, Concepts, Health Impact Assessment, Activity 2, health impact assessment

3. Observation includes activities to follow up on the results of the activity.

4. Reflecting on the results of the seminar, summarize the results of the two learning models in the area.

Data collection and analysis

Use After Action Review (AAR), participatory dialogue (ORID), and systematic application evaluation. Qualitative data collection content analysis and inductive analysis and validation of triangulation results. (Triangulation Techniqu

Results

The research found that the development of potential targets in the learning package: Public Policy Process, "Enhancement of the Public Participation Plan (4P-W)," and "Learning Toolkit". National Health Act BE 2007". The workshop is as follows.

1. Learning Kit "Raise the agenda for participatory public policy" that aims to train the public policy-driven team in the province or the '5 Power Team' to address the issues and processes that drive public policy. Practice writing policy documents. (Statement of Policy) Strategic analysis training and a strategy to drive the policy. The plan to drive policy with network partners to make a draft statement/policy statement accepted in the province. In this learning kit conclusions from the training are as follows.

1.1 Presentation and sharing of learning plan participants in each province sent out representatives presenting the results of a joint action plan or participatory public health policy. In a lively fashion the result and the lessons learned by presenting the delegates or 'friends' from other provinces. The speaker is a partner. Come out for suggestions, comments or compliments and encourage the province to present a plan of merit. The lecturer also provided comments/suggestions. Then each group answered 4 questions: 1) What is the most obvious sight or touch? 2) How do you feel about presenting today? 3) What did you learn? 4) What benefit? And how to use it?

1.2 Reviewing the 4P-W Walkway Map the 4P-W walkway review provides participants with a peer review of public policy driving in their province. Using the 4P-W process map 11 steps before reviewing the facilitator explained the details of the map. In pursuit of public health policy, the following 11 steps are required: (1) There must be a coordinated and coordinated core of the leadership. (2) There are multilateral mechanisms in the province that encourage co-ordination. Strategic management and public communication. The mechanism can be clearly identified and strengthened (3) There are network partners. (4) There is information in the province. The problem. And the potential for social capital. Cultural capital experience of the province to be used for development of public policy issues. (5) There is a public leverage (co) from the database and participatory decision making. (6) A clear goal or determination of achievement indicators. 4P-W has been designed on the basis of social/cultural capital appropriately and is possible. (7) It has developed into a policy proposal that is inspired by the idea. (8) The proposal to be a public policy for the well-being of the province has been pushed forward. (9) The public policy on health has been put into practice in the province. Follow up, evaluate and summarize lessons. To raise the level of knowledge. (11) Continuing to develop a healthy and sustainable society. (Self-reliance/decision-making/self-management with dignity) by bringing knowledge together with other subjects. Continuing to be a self-managed area.

1.3 Elements of participatory public policy and policy options/activities. There are two types of participatory policy-making, namely, Form 1. The participants divided the participants into 4 groups according to their interest in public policy issues. What is public policy? What are the elements of public policy? What is the public policy process? What is the format of public policy? Then, participants in each group. Brainstorm using the 'World Café' learning process, participants are encouraged to share their knowledge, experiences and opinions on the issues that they have set. Under the atmosphere of friendship, all four rounds will be held every 15 minutes. The participants will exchange information to complete. The learning curve is deep.

2. Learning series "Tool by the National Health Act BE 2550". The purpose is to allow all participants to learn and practice the tool. And select tools that are relevant to the issues driving the development of participatory public policy on intellectual basis. (4P-W) and to create an action plan. With

network partners in the area. The content consists of the following. 1) Powerful story. "Policy Statement" and provide feedback. Based on the concept of process, mechanism, organization, health, space/issue. Each province presented its performance. Presentation of the group for 5-7 minutes and other provinces to contribute. 2) Tool overview and integration. Include the lessons of each province. 3) Learn and practice the tool. 4) Learning and practicing tools. "Health Impact Assessment (HIA)" In this topic, there will be two main speakers.

Type 1 Speakers have mentioned the importance of evaluating health effects because the effects are unpredictable. To reduce or avoid impact Is there a better alternative? To seek more useful alternatives. Give lecture participants a video on the case study and explain the six steps to a health impact assessment: Step 1 Public Screening to see what the HIA should do. Step 2 Public Scoping See what should be assessed. What is the scope of assessment? Step 3 Assessing Impact Assessment to assess the problems / impacts that will occur. Step 4 Public Review. Step 5 Influencing pushing the decision maker to find a solution that will benefit the public. Step 6: Public Monitoring & Evaluation is tracking what is expected or not. To get an alternative approach. Health Impact Assessment Training The speaker gives the space to the group to brainstorm. 2) What is the organization / group / person who is involved in this decision? 3) Draw a community map. 4) Define the scope. Of the impact 5) Make choices. Choose from small to large scale. 6) Choose the evaluation approach. 7) What are the requirements for the National Health Office (NPS)?

Type 2 The speaker has stated that the health impact assessment can be classified into three categories: "evaluation", "impact", "health". The information must be complete and enough for evaluation. In order not to prejudice the decision. Health Impact Assessment Need to evaluate around. Including the magnitude of the intensity of the impact.

Activity 1: Jigsaw Meaningful Step of Health Impact Assessment (HIA) by giving the participants a triangle paper surrounded by square paper. HIA 6 Steps 1) Public Screening Consider whether to do the HIA or not, and to answer what you want to do HIA. Step 2) Public Scoping Public Scoping and Scoping It is the most important step. 3) Assessing the health impact assessment. The data is collected. 4) Public Review Review of public education reports. Step 5) Influencing the process of decision making. 6) Public Monitoring and Evaluation.

Activity 2: Health Impact Assessment Training Inviting participants to join the group and brainstorm the group to practice steps 1-3, with the following issues: What is the issue and why should the HIA determine who is doing what? Analysis of the effects on health, physical, mental, social and intellectual. Level of health Impact types include positive, negative, acute, chronic, short-term, medium-term, long-term, direct, indirect, cumulative.

Learning and practicing tools the "Health Statute Tool" in this topic will feature two main speakers, with two types of training sessions: the one where the trainer gives participants a real-world view of the subject. "Operation Changing Alarm" in Nong Hin, Muang Suang District, Roi Et, which solved the problem of community violence and adolescence.

Summary of lessons from observation and evaluation. In the learning series: Public policy process, "Improving Public Participation Plans (4P-W)" Knowledge of public policy writing process. See other ways of thinking. Speakers are diverse. Explain the content clearly. There are techniques to convey, ready to practice, give examples of issues. Process can be used. Very engaging material ready easy to learn. But some of the content is also academic, making it difficult to understand for a limited time. Some sessions take less practice. I want to stimulate for excitement. Some sessions are too short for lectures. To understand the issues.

For in the learning kit "Tool by National Health Act BE 2007" with technical understanding. The use of more tools. There are links to past lessons. The speakers are experienced and directly involved in the content. Can understand the meaning and importance. And the use of tools to understand. Use the lead to content. More understandable Focus on the thought process. Analyze and act to make learning truly. Some topics are not very well understood. It may be a matter of time to get rid of the less time intensive. The learning process is not complete. Should increase each time more. The team of lecturers to relay continuously to support the movement in the area. Ask for content requirements from participants. To organize the program to develop appropriate capacity.

Discussion

Overview of Participant Information (Team 5 Power) in the Learning Series: Public Policy Process "Elevation of Plans for Participating in Participatory Public Policy Process (4P-W)" and Learning Series "Tools of the National Health Act BE 2007".

There were 408 participants in the workshop, including 330 working groups based on intellectual disability (4P-W) and 59 individuals and a network of health impact assessments. Or 19 Health Impact Assessment (HIA).

The result of the development of the potential is the drive to promote the province. A total of 91 plans (some provinces do 2 or more). The province has a plan to promote common good together. The application of methods or techniques from the potential training. Include Using a technique or a problem-solving approach (ORID uses the Action Planning Methodology), which includes a seven-step learning process. Mae Hong Son Province Use it to create good in the community, etc. By analyzing sectors in the area (local) using the concept of public participation with the people.

Understand the process of raising public policy. In developing a public-based, intellectual-based (4P-W) public policy, each province has a

different basis for its work. Include Province with working group and the issue is clear and ongoing with the new province, with new working groups, so it affects understanding. And public policy issues.

The focus must be on analyzing the causes (problems, problems). , Support information and how to solve Save the policy message. Of participation by providing participants. Has practiced the statement/policy statement. And together, set the framework for writing the policy message. SWOT analysis and policy development. So, we can see that the participants can take the information. And the process techniques that are practiced in the training. I used to work in the area. It must be done with the target audience in the area. With the engagement process Frameworks for self-review Driven Development of Public Participatory Intelligence (4P-W).

Learning and practicing tools according to the National Health Act (2007) include the Health Impact Assessment (HIA), the Health Assembly Process , Health Statute, Good Death Rights By learning case or concrete examples from the area, the Provincial Working Group Mechanism is developing a public-based, intellectual-based (4P-W) public policy that will be implemented in the area.

Acknowledgement

Thank you very much. In support of capital action. The process of learning to strengthen the public policy team for the second phase of social welfare throughout the project.

References

- Kemmis, S., McTaggart, R., Nixon, R. (2014). *The Action Research Planner: Doing Critical Participatory Action Research*. Springer Singapore.
- National Health Commission. (2017). 10th National Health Assembly 10th National Health Assembly 20 - 22 December 2560 at IMPACT Forum Muang Thong Thani. Retrieved from <https://www.samatcha.org/nha/website/mains/index/10/2017>
- Pansila, W. (2015). *Technology for Participation (TOP) Training Materials for Public Health Educators 2nd edition of Mental Health*, Chantra Resort. Nakhon Nayok.
- Techa-athik, S. (2017). *Project Report on Learning Process to Strengthen Public Policy Team for Second Phase of Social Welfare (Number Agreement B-61-B-001)* National Health Commission.
- Wasi, P. (2017). *The theory of mountain triangulation. Make a point to change the country*. Retrieved from <http://www.thaihealth.or.th/Content/34866>
- Wieringa, R. J. and Morali, A. (2012). *Technical Action Research as a Validation Method in Information Systems Design Science*. In *Seventh International Conference on Design Science Research in Information Systems and Technology (DESRIST)*. Pp. 220-238.

English Classroom Stress and Anxiety of Students and Teachers at Colleges of Agriculture and Technology in Upper Northern Thailand

Rodchamnan, T.^{1,*}, Rattanakamonwon, P.², and Kruadsoongnern, C.³

¹Faculty of Liberal Arts, Maejo University, Thailand, ²Lecture, Mae Hong Son College of Chiang Mai Rajabhat University, Thailand, ³Teacher, Phrae Panyanukool School, Phrae province, Thailand.

Abstract English classroom stress and anxiety of students and teachers at College of Agriculture and Technology in upper northern Thailand was studied. Results revealed that one-half of the student respondents were male, 18-20 years old and stayed on the campus (92.10%). Regarding their English skills in listening, speaking, reading and writing, it was found at a moderate level ($\bar{x} = 3.14, 2.81, \text{ and } 2.86$, respectively). They claimed that English teaching/learning activities in their classroom was appropriated at a moderate level ($\bar{x} = 3.07$) and had a lowest level of English classroom stress and anxiety based on behavioral and physical deficiency ($\bar{x} = 1.37 \text{ and } 1.25$, respectively). For the teacher respondents, most of them (90.00%) were female, 30-39 years old, and bachelor's degree holders. One-half of the teacher respondents (50.00%) were married, had a salary of 15,000-20,000 baht and 6-10 years of service. They were at a moderate level, personality and behaviors of their students ($\bar{x} = 3.34$), teaching performance ($\bar{x} = 3.33$), and teaching/learning activities ($\bar{x} = 3.53$). However, they had a lowest level of English classroom stress and anxiety ($\bar{x} = 3.01$). According to the focus groups, they were agreed that english teachers should be learned and focused in agricultural terminology which would be beneficial to Agriculture students. English teachers should have a sense of humor and creates an appropriate classroom atmosphere and teaching with the media modern media.

Keywords: Agricultural Learning Center, learning facilitation, agricultural teachers

Introduction

English is a global language playing important role in communication throughout the world. Thai students, however, are not fluent in English and have a hard time in using English for communication. This is because English is a foreign language to Thai people and it is a compulsory subject in Thailand. Thus, many Thai students are bored with English classroom due to many factors such as classroom atmosphere, teaching methods, learning content, etc. According to a study in Thailand, it is found that English learning achievement of Thai students is at a dissatisfactory level and it is inadequate for the level of needs of the business entrepreneur (Chanwimol, 1992). Students at College of Agriculture and Technology are interested in agriculture but they have to take English course which most of them do not

* **Corresponding Author:** Rodchamnan, R., **E-mail:** pongsuk@gmail.com

enjoy it. Thus, there is stress and anxiety in their English classroom which has an effect on their mind and physical health as well as behaviors. Yiamsawat (2016) had conducted a study on stress and anxiety in studying English of higher education students. It was found that stress and anxiety are main variables of factors having an effect on second and foreign language learning. However, this problem can be solved by the following: friendly classroom atmosphere, pair work, appropriate classroom activities and learning content, interesting media, etc.

Therefore, the team of researchers has conducted a study about stress and anxiety in English classroom of students and teachers at four College of Agriculture and technology in upper northern Thailand. This aims to find facts and give an opportunity for the students and the teachers to express their opinions so as to be a guideline for preventing and solving the problem arised from stress and anxiety in English classroom.

The objectives of the Study were to find out the Socio-economic attributes of the students and the teachers, a level of stress and anxiety in English classroom of the students and the teachers, mental and physical deficiency of the students and the teachers caused by stress and anxiety in English classroom.

Mareials and methods

Scope and Delimitation of the Study: locations of the study were 4 Colleges of Agriculture and Technology in upper northern Thailand as Chiang Mai College of Agriculture and technology (English teachers and 71 student), Lamphun College of Agriculture and technology (English teachers and 61 students), Phayao College of Agriculture and technology (2 English teachers and 42 students), Chiang Rai College of Agriculture and technology (3 English teachers and 40 students). All students were second year of vocational students majoring in Animal and Plant Sciences and all of them were obtained by purposive sampling. The English teachers were teaching the students in first semester, academic year 2018 and obtained by purposive sampling. There were 4 variables used in this study: -Socio-economic attributes of the students (sex, age, domicile, main occupations of parents, and major field of study) and the teachers (sex, age, marital status, educational attainment, academic rank, monthly income, and years of service),

Mental aspect of the teachers and the students-personality and management ability, physical and behavioral deficiencies of the teachers and the student and classroom facilitation environment-teaching/learning facilitation and relationships among the students.

Hypothesis Testing:- the Animal and Plant Sciences' students at the four Colleges of Agriculture and Technology were a high level of stress and anxiety in English classroom or not, the English teachers at the four Colleges of Agriculture and Technology were to be a high level of stress and anxiety in English classroom or not.

Research Instruments: a set of questionnaire was used for data collection which administered with 214 student respondents. Another set of questionnaires was administered with the teacher respondents. Focus group discussion was conducted with the teachers.

Results

According to socio-economic attributes of the student respondents, results of the study revealed that more than one-half (56.10%) of them were male, 18-20 years old (85.50%), and Plant Science students (78.00%). Most of the (92.10%) lived in upper northern Thailand but stayed at a dormitory while studying (79.00%). Most of their fathers and mothers were farmers (63.60% and 62.10% respectively). The student respondents claimed that they had a moderate level of the four skills in English language: listening, speaking, reading, and writing (Table 1). Most of them (86.00%) studied English for their future careers and 19.60% stated that that had no objective of study English because it was a compulsory subject (Table 2).

Perception about personality and management ability of the students respondents

Personality: the student respondents had a moderate level of stress anxiety in their personality ($\bar{x} = 3.26$). They had a high level of stress based on 3 aspects: 1) disappointments since no one in the class was not interested in the respondents ($\bar{x} = 3.46$); 2) uncomfortable with some classmates who often asked the teacher questions ($\bar{x} = 3.63$); and 3) uncomfortable with the teacher who was strict about the student uniform ($\bar{x} = 3.49$).

Management Ability: it was found that respondents had a moderate level of stress and anxiety ($\bar{x} = 3.24$) accepted the creation of conditions and rationalize in studying English which was found at a high level ($\bar{x} = 3.50$). Management of teaching/learning system had a moderate level of stress and anxiety in the management of teaching/learning system ($\bar{x} = 3.16$). However, there were 2 aspects found at a high level: make up class which they lost private time ($\bar{x} = 3.44$) and the teacher did not always teach since he/she had other assigned tasks ($\bar{x} = 3.57$).

Learning Content: result showed that the student respondents had a moderate level of stress and anxiety in learning content of English subject ($\bar{x} = 3.14$) as shown in Table 3.

Form of Teaching/Learning Activities: it was found that the student respondents had a moderate level of stress and anxiety in forms of teaching/learning activities ($\bar{x} = 3.25$) excepted the teacher did not give a chance for the students to participate in it or express their opinions which was found at a high level ($\bar{x} = 3.61$) as shown in Table 4.

Table 1. The 4 skills in English language proficiency of the student respondents

Skill	\bar{x}	S.D.	Description
Listening	3.18	0.91	Moderate
Speaking	2.81	0.85	Moderate
Reading	2.93	0.84	Moderate
Writing	2.86	0.89	Moderate

Table 2. Objectives in English language studying of the study respondents

Item	N=214	%
1. For future careers	184	86.00
2. To communicate with foreigners	137	64.00
3. To travel or study abroad	118	55.10
4. Advantage in applying for a job	97	45.30
5. For entertainment	111	51.90
6. Do not have any objective	42	19.60

Table 3. Learning content

Learning content	\bar{x}	S.D.	Description
Responsiveness to needs of student	3.33	0.99	Moderate
Focusing on grammar	3.31	1.02	Moderate
Up-to-date and consistent with real-life	2.82	0.92	Moderate
Inappropriate with the student	3.08	0.92	Moderate
\bar{x}	3.14	0.96	Moderate

Table 4. Form of teaching/learning activities

Teaching/learning activities	\bar{x}	S.D.	Description
1. The teacher did not give a chance for students to participate in it or express opinions	3.61	1.04	High
2. The teacher seldom used teaching media so it was not interesting	3.33	0.95	Moderate
3. It focused on English practice both inside and outside the classroom	3.00	0.94	Moderate
4. The teacher mostly give a lecture	3.07	0.97	Moderate
\bar{x}	3.25	0.97	Moderate

Measurement Method: it was found that student respondents had a moderate level of stress and anxiety in measurement method of the teacher (\bar{x} =2.87). They preferred the scoring system most-10% class attendance, 40% mid-term, and 50% Final exam (\bar{x} =3.05).

Personality of the Teacher: The findings showed that the student respondents had a high level of stress and anxiety in the teacher (\bar{x} =3.47) accepted 2 aspects which were found a moderate level: the teacher did not have a sense of humor (\bar{x} =3.24) and the teacher did not create confidence to students (\bar{x} =3.29) which were found at a moderate level (Table 5).

Using Media/Technology for Teaching/Learning: results showed that the student respondents had a moderate level of stress and anxiety in media/technology for teaching of the teacher (\bar{x} =2.98).

Relationships with Classmates: the findings indicated that the student respondents had a moderate level of stress and anxiety in their relationships with classmates (\bar{x} =2.91).

Table 5. Personality of the teacher

Personality of the teacher	\bar{x}	S.D.	Description
1. Feeling that the teacher was bias and had a negative attitude towards the students	3.72	1.13	High
2. The teacher was not interested in problems of the students	3.45	1.05	High
3. The teacher did not have a sense of humor	3.24	0.97	Moderate
4. The teacher did not create confidence to the students	3.29	0.99	Moderate
5. The teacher interfered personal matters of the students	3.64	1.06	High
\bar{x}	3.47	1.04	high

Quality of Teaching Materials: it was found that the student respondents had a moderate level of stress and anxiety in the quality of teaching material (\bar{x} =2.99). It was based on responsiveness to needs of the students; effective learning, and no need to use other materials.

Classroom Atmosphere and Environment: it was found that the student respondents had a moderate level of stress and anxiety in their classroom atmosphere and environment (\bar{x} =3.04). This was in terms of air ventilation, temperature, disturbing noise, and cleanliness.

Physical and Behavioral Deficiency: the findings showed that the student respondents had a lowest level stress and anxiety about physical and behavioral deficiency (\bar{x} =1.43). Only under stress was found at a low level (\bar{x} =1.84).

Problem-solving Methods in the Case of Stress and Anxiety: it was found that most of the student respondents (81.30%) chose to take a rest or sleep and watch a movie/listen to songs. Only 4.70% met a psychiatrist (Table 6).

Table 6. Problem-solving methods

Item	N=214	%
1. Met adviser	58	27.10
2. Consulted the English teacher	38	17.80
3. Met a psychiatrist	10	4.70
4. Consulted friends/parents	123	57.50
5. Took a rest/slept	174	81.30
6. Watched a movie/listened to songs	174	81.30
7. Hanged around at night	18	8.40
8. Drank beer with friends	25	11.70
9. Sitting meditation	43	20.14
10. Did not care anything	60	28.00
11. Others	10	4.70

Socio-economic Attributes of the Teachers: results revealed that almost all of the teachers were female (9 persons or 90%). Most of their age range was 30-39 years (40%). One-half (50%) of the teachers were married. Most of the teachers (80%) were bachelor's degree holders. One-half (50%) of the teachers' salary range was 15,000-20,000 baht. Forty percent of the teachers had 6-10 years of service.

Personality/behaviors of the students having an effect on stress and anxiety of the teachers: results showed that, as a whole, the teachers had a moderate level of stress and anxiety in personality/behaviors of their students (\bar{x} =3.36). Based on its details, the following were found at a high level: respectfulness to the teacher (\bar{x} =4.00); personal matter interference (\bar{x} =4.10); creation of conditions and student rationalization (\bar{x} =3.60); fear of failure or committing mistakes; and teacher assessment by their students (\bar{x} =3.90).

Ability in the teaching/learning facilitation: it was found that the teachers had a moderate level of stress and anxiety in the teaching/learning facilitation (\bar{x} =3.33). Based on its details the following were found at a high level: the students were sure that their communication with the teachers was clear and straight to the point (\bar{x} =3.70); the students could study with those having less or more maturity (\bar{x} =3.60); the students could not adopt themselves to various problem (\bar{x} =3.50); and the students put more importance on their field of study than English subject (\bar{x} =3.70).

Teaching/learning activities: the findings showed that the teachers had at a high level of stress and anxiety in terms of teaching/learning activities (\bar{x} =3.53). Only anxiety and irritancy when making up a class or remedial class were found at a highest level (\bar{x} =4.30).

Physical and behavioral deficiency: the teachers had a low and a lowest level of stress and anxiety about physical and behavioral deficiency (\bar{x} =2.23 and 1.80, respectively).

Problem-solving methods when stress and anxiety: results showed that most of the teachers (90%) preferred to take a rest or sleep, followed by talked with the students (70%), watch a movie/listen to songs (60%), and ignore the stress and anxiety (\bar{x} =40%).

Discussion

The study on English language classroom stress and anxiety of English teachers and students at College of Agriculture and Technology in upper northern Thailand could be discussed as follows:-mental traits and personality, it was found that the students at the four College of Agriculture and Technology had the mental traits based on personality at a moderate level based on its details, the following were found at a high level, disappointment since no one in the class was not interested in the students. The uncomfortable with some classmates who asked the teacher questions and uncomfortable

with the teacher who was strict about the student uniform. This conformed to an idea of Khotrakul (1998) that no one wants to be blamed, people are usually interested in themselves rather than other; and want other people listen to them. Management ability, the students had a moderate level of stress and anxiety in their management ability. However, it was found at a high level, the student rationalization in studying English. This conformed to an opinion of Mesap (1998) that every cannot avoid various forms of pressure which includes tasks/responsibility, ailment, change in life, etc. Classroom atmosphere and environment included into 3 aspects: teaching/learning system management, teaching/learning activities, and relationships with classmates. Teaching/learning system management, the students had a moderate level of stress and anxiety in the management of teaching/learning system. However, there were 2 aspects found at a high level: make up class which they lost private time and the teacher did not always teach since she/he had other assigned tasks. This conformed to an opinion of Na Ayutthaya (2006) that the teacher plays important roles on the development of learning process of the student and he/she must be responsible to their assigned tasks. Teaching/learning activities, it was found that the students had a moderate level of stress and anxiety in forms of teaching/learning activities excepted the teacher did not give a chance for the students to participate in it or express their opinions which was found at a high level. This conformed to a study of Waenthong (2006) which revealed that successful classroom activities were based on various factors such as appropriateness of the teacher personality, learning material, media, teaching method and technique, classroom atmosphere/environment, etc. Relationships with classmates, it was found that the students had a moderate level of stress and anxiety in their relationships with classmate. Stress in physical and behavioral of the students was found at a lowest level. Department of Mental Health (1998) revealed that stress is the physical and mental reaction due to internal and external stimulus which results in undesired behaviors.

Stress and anxiety in classroom activities that the English teachers had a moderate level of stress and anxiety in personality and behaviors of their students; teaching/learning facilitation and a lowest level of physical and behavioral deficiency. For problem-solving methods of the English teachers when stress and anxiety occurred, most of them preferred to take a restore sleep, followed by talk with the students, watch a movie/listen to songs, and ignore the stress and anxiety. According to the focus group discussion with the English teachers, It suggested that the English teachers should be open-minded and they must accept learning ability of their students. This is because the students are interested in agriculture but they have to take English course as a compulsory subject, they need not to follow the teaching material. The learning material must be interested and its content must meet needs of the students and not too difficult. The English teachers should not much focus on grammar but agricultural terminology or vocabulary related to daily life

activities. The English teachers should employ diverse teaching methods with interesting teaching media. The English teachers should always give a chance for their students to participate in classroom activities or express their opinions. The English teacher should be careful not to interfere personal matters of their students and they must be friendly and have a sense of humour.

References

- Chanwimol, M. (1992). Teaching English Interims of Individual Differences of Students. Kaoklai.
- Department of Mental Health. (1998). National Survey on stress of Thai people. Bangkok: Siam Inset Marketing.
- Khotrakul, S. (1998). Educational Psychology. Bangkok: Chulalongkorn University Printing.
- Mesap, K. (1998). Stress Behavior and Responsiveness to the Stress. Bangkok: Office of Medical Development, Ministry of Public Health.
- Na Ayutthaya, K. (2006). Curriculum Development journal. January-March, 2006.
- Waenthong, S. (2006). Learning English in the Form of Friend-based. A research report of Wat Trimit School, Samut Prakan province.
- Yiamsawat, T. (2016). Anxiety in Learning English: Components, Impacts, and Guidelines for Solving the Problem. Research article. Bangkok: Durakitpandit University.

Comparison Time Series Model of Mean Monthly Temperature in Prachuap Khiri Khan Province, Thailand

Thonglor O.* and Wilaiwan S.

Faculty of Animal Sciences and Agricultural Technology, Silpakorn University, Cha-Am, Phetchaburi.

Abstract: The time series characteristics of temperature data was analysed for Muang Prachuap Khili Khan, Prachuap Khiri Khan Province in Thailand. Data were collected from information services and climate statistics, meteorological department in consecutive monthly from 1983 – 2016 (34 years). From the trend line of monthly temperature, it showed a slight linear trend. There was season component but no cycle and irregular component. The study compared five time series models (naïve method, three – month moving average, three – month weighted moving average, exponential smoothing and seasonal decomposition) from forecast accuracy by considering from value of MAD, MSE and MAPE. The result showed that exponential smoothing by using winter's multiplicative method was the most forecast accuracy because it was the lowest value of MAD, MSE and MAPE. The forecast values in the future (2017 – 2019) by this model showed that temperature in April, May and June are high while temperature in December and January are low. Moreover, the result from seasonal decomposition showed that temperature in January, December, February November and October, respectively, are lower than normal level. For the higher than normal level is April, May, June, March, July, August and September, respectively. Farmers can apply this result for agricultural production which one is suitable with low or high temperature.

Keywords: temperature, time series, trend, cycle, decomposition, forecast

Introduction

Time-series models attempt to predict the future by using historical data. These models make the assumption that what happens in the future is a function of what has happened in the past. In other words, time-series models look at what has happened over a period of time and use a series of past data to make a forecast. There are many time series models to forecast the future such as moving averages, exponential smoothing, trend projections, decomposition, and least squares regression analysis (Render et al., 2012). The study intended to analyze the time series characteristics of temperature data in Muang Prachuap Khili Khan, Prachuap Khiri Khan Province, Thailand. It is a province in western area of Thailand. This area is suitable for agriculture. The farmers have been encouraged by the government for the field of knowledge and study since this province has high potential in the field of professional animal husbandry. Moreover, it is suitable for animal feed, such as pineapple, cassava, and corn. The ground conditions of this area are suitable for most crops, into the

* **Corresponding author:** Thonglor O.; **E-mail:** thonglor_o@silpakorn.edu

trees, farm-grown vegetables, flower and medicinal plants, respectively. Industrial gaining a lot of income are pineapple, coconut, sugarcane, rice, vegetables and fruit. The principal income of Prachuap Khiri Khan Province come from agricultural production. Thus, this area should be considered to develop agricultural production to gain high income by consideration factors that impact on efficient agricultural production.

One of the principal factors that impact on efficient agricultural production is environmental factors. These are physical factors including climate, relief and soil. For climate, the most influential factors in the climate are temperature and moisture. Plants can grow only within certain limit of temperature. For each species and variety, there are not only optimal temperature limits, but also optimal temperatures for different growth stages and functions, as well as lower and upper lethal limits. Temperature is determined which species can survive in a particular region. Air temperature is important to agriculture because it influences plant growth through photosynthesis and respiration, affects soil temperature, and controls available water in the soil. Farmers use soil temperatures and soil moisture to decide when to plant, what varieties of crops to choose, and to determine the likely development of key plant characteristics like flowering as well as emergence of insect pests and plant diseases. However, temperature is changeable because of many factors such as climate change, season and so on. If we study about trend and prediction of temperature, we can plan how to manage agricultural production process to be suitable for temperature at that time (Rasul *et al.*, 2011). Therefore, the aims of study were thus to determine the best time series models for the data set of temperature and predict temperature in Muang Prachuap Khili Khan, Prachuap Khiri Khan Province, Thailand.

Materials and methods

Data collection: weather data for temperature in Muang Prachuap Khilikhan, Prachuap Khiri Khan Province, Thailand was collected from information services and climate statistics, meteorological department. These data set was consecutive monthly from 1983 – 2016 (34 years).

Time series analysis: data set of temperature was analyzed by using five time series models: Naïve method as three – month moving average. This method was compared with five – month moving average. Mean square error (MSE) value of three – month moving average was lower than five – month moving average, three – month moving average was more precision than five – month moving average. Thus, the investigation was considered three – month moving average. Three – months weighted moving average as exponential smoothing which there were two techniques being used as simple exponential smoothing at $\alpha = 0.9$ by considering the value alpha from

minimizing the MSE, and exponential smoothing by using winter's multiplicative method.

Decomposition method was used with multiplicative model to identified trend cycle seasonal and irregular analysis. Multiplicative Model:

$Y = T \times C \times S \times I$ where:

Y is temperature (° C)

T is the trend component

C is the cycle component

S is the seasonal component and

I is the irregular component

Seasonal decomposition.

Measures of Forecast Accuracy was measured Mean Absolute Deviation (MAD)

$$MAD = \frac{\sum |\text{forecast error}|}{n}$$

Mean Squared Error (MSE)

$$MSE = \frac{\sum (\text{errors})^2}{n}$$

Mean Absolute Percent Error (MAPE)

$$MAPE = \frac{\sum \left| \frac{\text{error}}{\text{actual}} \right|}{n} \times 100\%$$

where forecast error = actual value – forecast value.

Results

Descriptive Statistics

The descriptive statistics of the pattern of mean monthly temperature in Muang Prachuap Khilikhan, Prachuap Khiri Khan Province, Thailand (1983 – 2016) was presented in table 1. It was observed that most of highest mean monthly temperature were recorded range from 28.4 °C (1986) to 30.8 °C (2013) in April and May, respectively. This table further showed that January and December recorded the lowest mean monthly temperature values of range from 23.5 °C (1986) to 26.8 °C (2013) , respectively.

Table 1. Mean monthly temperature in Muang Prachuap Khili Khan, Prachuap Khiri Khan Province, Thailand (1983 – 2016).

Year	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec
1983	25.6	26.7	28.3	28.8	29.2	28.2	27.5	27.3	27.5	26.9	26.2	24.5
1984	24.7	26.4	27.8	29.1	29.3	27.6	27.7	28.0	27.8	27.0	26.7	25.4
1985	23.8	25.8	27.3	28.4	28.2	27.6	28.1	27.3	27.5	27.3	25.7	23.9
1986	23.5	26.2	27.2	28.0	28.4	27.6	27.1	26.7	27.4	26.7	26.7	24.4
1987	24.4	25.9	27.7	29.4	29.3	28.5	28.7	28.0	27.5	27.1	25.1	25.1
1988	24.4	26.1	27.4	29.0	29.0	27.4	27.6	27.9	26.8	26.7	26.8	25.8
1989	25.2	26.7	27.8	28.9	27.9	27.2	27.1	27.4	26.8	26.6	26.3	25.0
1990	23.9	25.7	26.9	28.7	28.3	28.1	27.6	27.8	27.5	26.8	26.5	25.1
1991	25.2	25.9	27.2	29.1	29.0	28.1	29.0	28.1	27.8	27.6	26.3	24.3
1992	25.5	27.1	28.4	28.6	28.6	28.1	27.8	28.2	27.5	26.6	26.0	24.4
1993	25.8	25.6	26.7	29.1	28.4	27.7	28.4	27.5	27.6	26.6	26.7	24.3
1994	25.9	26.3	27.7	29.6	28.8	28.8	28.5	28.3	28.0	27.2	26.6	25.7
1995	26.5	26.9	28.5	29.3	28.9	28.4	27.9	27.3	27.8	26.3	26.2	26.0
1996	24.9	26.0	28.0	29.9	30.2	28.6	28.1	27.5	28.1	26.2	25.7	25.2
1997	25.6	25.7	27.5	28.9	29.1	29.2	28.7	28.0	27.9	26.7	27.1	25.5
1998	25.6	27.4	27.2	29.3	29.3	27.8	27.3	27.2	27.6	26.7	27.7	26.5
1999	25.9	26.8	28.9	30.2	30.1	29.2	27.9	28.2	27.4	27.2	26.7	25.2
2000	25.1	26.3	28.2	29.2	29.0	28.6	27.6	28.0	27.1	26.9	26.9	24.8
2001	24.3	26.6	27.8	28.5	29.6	29.4	27.8	27.7	28.0	27.9	27.0	27.1
2002	27.1	28.4	28.9	30.2	30.2	29.3	29.2	28.4	27.9	27.3	26.9	26.1
2003	26.2	26.1	28.1	28.4	27.9	27.9	27.9	27.9	28.2	26.9	26.8	24.1
2004	25.7	25.7	27.1	28.0	28.7	28.0	28.1	28.0	28.0	27.5	26.8	26.9
2005	26.8	27.3	27.4	30.6	27.8	28.1	27.9	27.4	28.2	27.0	25.7	25.9
2006	25.6	27.3	28.3	28.9	28.6	28.4	28.5	27.0	27.6	28.1	26.8	26.9
2007	25.7	27.4	28.1	29.9	28.7	29.3	27.9	28.1	27.6	26.8	27.7	25.5
2008	25.8	26.5	28.8	30.4	28.5	28.1	28.7	27.7	27.8	27.1	27.5	25.1
2009	25.9	27.5	28.3	29.2	28.6	28.6	27.6	27.2	27.7	27.5	27.6	25.7
2010	25.8	26.5	29.0	29.5	28.2	29.4	27.6	28.0	28.0	27.2	25.8	26.0
2011	26.0	26.7	27.4	28.7	27.9	28.4	27.7	28.6	27.6	27.7	26.4	25.3
2012	24.5	27.2	28.7	29.3	28.5	28.0	27.5	28.6	28.0	27.7	27.1	26.8
2013	27.1	28.2	28.8	30.3	30.8	29.8	28.7	27.8	28.3	27.0	27.2	26.8
2014	25.9	27.4	26.1	28.4	29.0	28.3	27.5	27.8	27.8	27.5	27.8	25.9
2015	26.5	27.1	28.7	29.8	29.1	28.7	27.8	28.4	27.8	27.5	27.0	27.2
2016	26.1	27.4	29.0	29.5	30.1	28.1	27.6	28.1	27.5	27.0	27.1	24.5

Trend line of mean monthly temperature in Muang Prachuap Khili Khan, Prachuap Khiri Khan Province, Thailand (1983 – 2016) was presented in Figure 1. It was observed that the result showed slight linear trend. Furthermore, it was observed that there was season component but there was no cycle and irregular component.

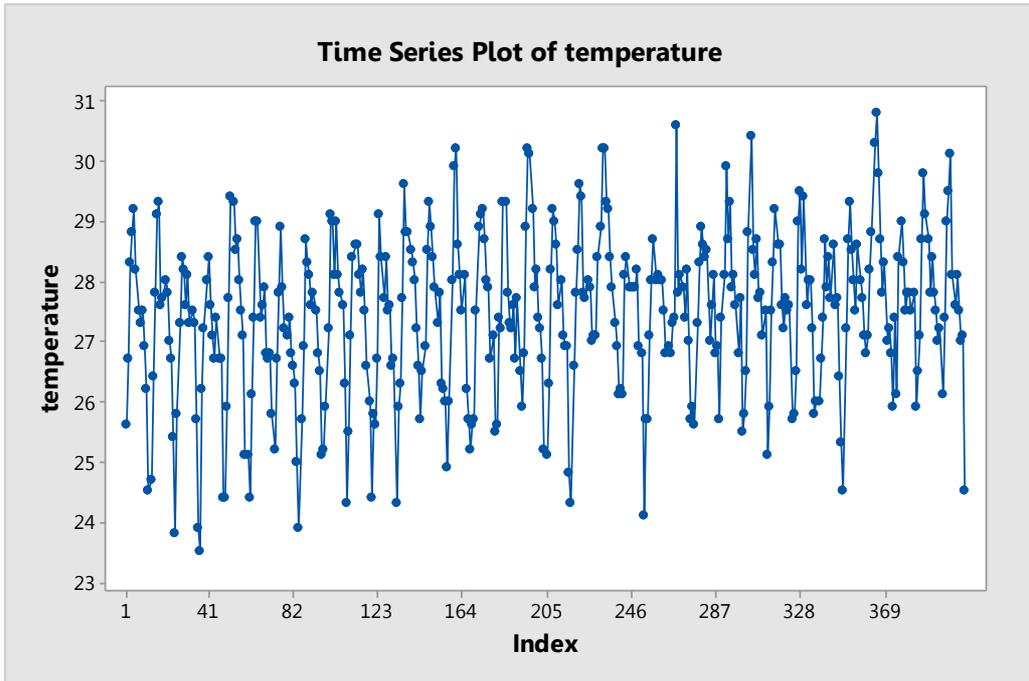


Figure 1. Trend line of mean monthly temperature in Muang Prachuap Khili Khan, Prachuap Khiri Khan Province, Thailand (1983 – 2016).

Time series analysis

Naïve method: the result of time series analysis was done by using naïve method. It is indicated that Mean Absolute Deviation (MAD) was 0.819. Mean Square Error (MSE) was 1.079. Mean Absolute Percentage Error (MAPE) was 3.006. Trend line of actual and forecast value were presented in figure 2.

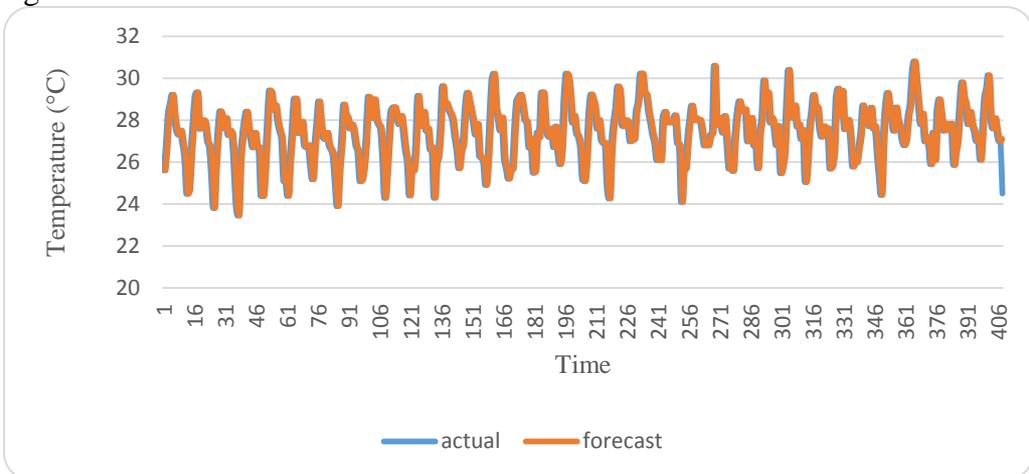


Figure 2. Trend line of actual and forecast value from naïve method.

Three – month moving average: the result of time series analysis was done by using three – month moving average. It is indicated that Mean Absolute

Deviation (MAD) was 1.098. Mean Square Error (MSE) was 1.075. Mean Absolute Percentage Error (MAPE) was 4.009. Trend line of actual and forecast value were presented in figure 3.

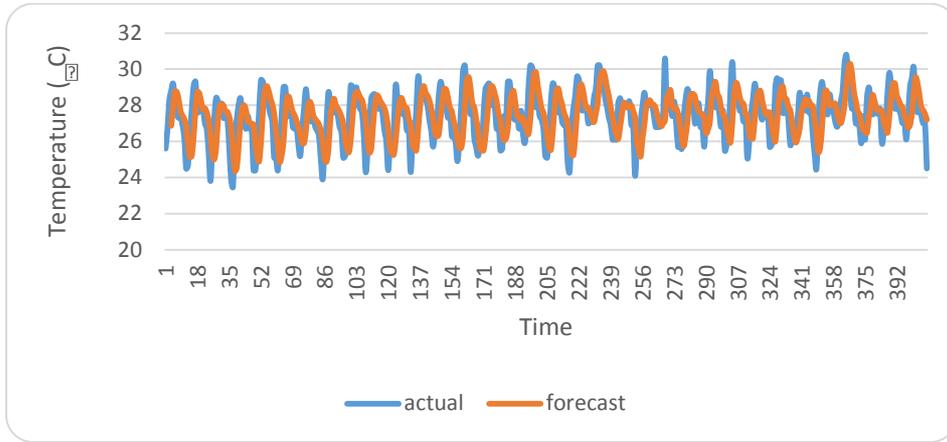


Figure 3. Trend line of actual and forecast value from three – month moving average model.

2.3 Three – month weighted moving average

The result of time series analysis by using three – month weighted moving average indicated that Mean Absolute Deviation (MAD) was 0.990. Mean Square Error (MSE) was 1.527. Mean Absolute Percentage Error (MAPE) was 3.621. Trend line of actual and forecast value were presented in figure 4.

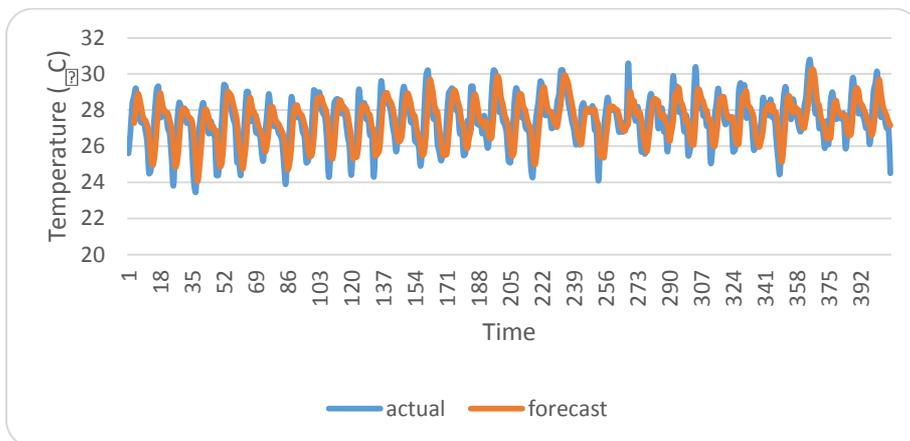


Figure 4. Trend line of actual and forecast value from three – month weighted moving average model.

Exponential smoothing

Simple exponential smoothing at $\alpha = 0.9$: the result of time series analysis was done by using simple exponential smoothing. It is indicated that Mean

Absolute Deviation (MAD) was 0.832. Mean Square Error (MSE) was 1.110. Mean Absolute Percentage Error (MAPE) was 3.050. Trend line of actual and forecast value were presented in figure 5.

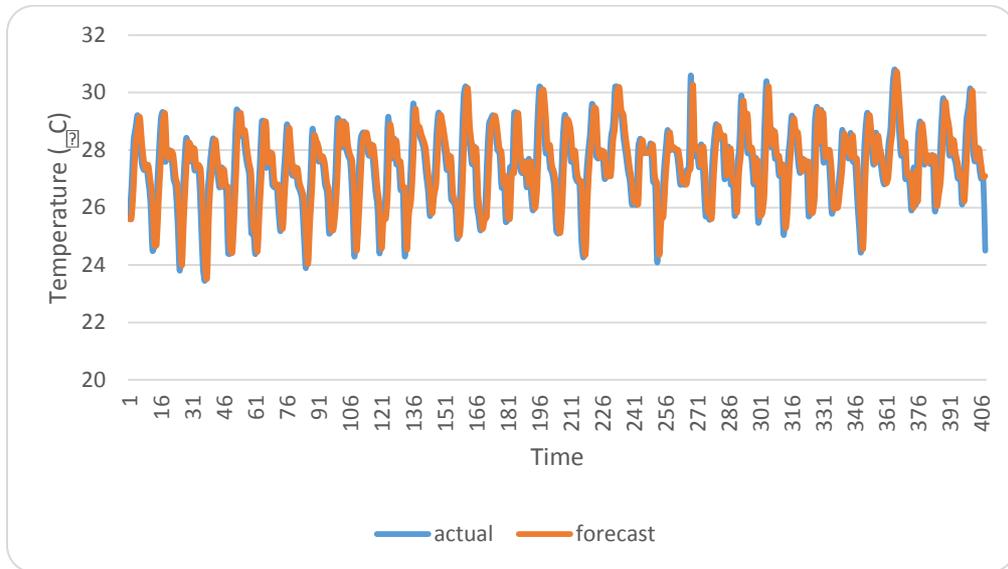


Figure 5. Trend line of actual and forecast value from simple exponential smoothing model.

Exponential smoothing by using winter's multiplicative method

The result of time series analysis was received by using exponential smoothing (winter's multiplicative method) indicated that Mean Absolute Deviation (MAD) was 0.465. Mean Square Error (MSE) was 0.354. Mean Absolute Percentage Error (MAPE) was 1.704. All of them were low values that consistent with trend line in figure 6 that was comparing of trend line between actual and forecast values including forecast value in the future (2017 – 2019). From trend line, it was observed that actual line value close to forecast line values. Moreover, forecast values in the future was presented in table 2.

Table 2. Forecast values of temperature (°C) in the future (2017 – 2019).

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
2017	25.29	26.40	27.53	28.79	28.50	28.06	27.56	27.55	27.43	26.88	26.51	25.36
2018	25.28	26.39	27.53	28.78	28.49	28.05	27.55	27.54	27.42	26.87	26.50	25.35
2019	25.28	26.38	27.52	28.77	28.49	28.04	27.54	27.53	27.41	26.86	26.50	25.34

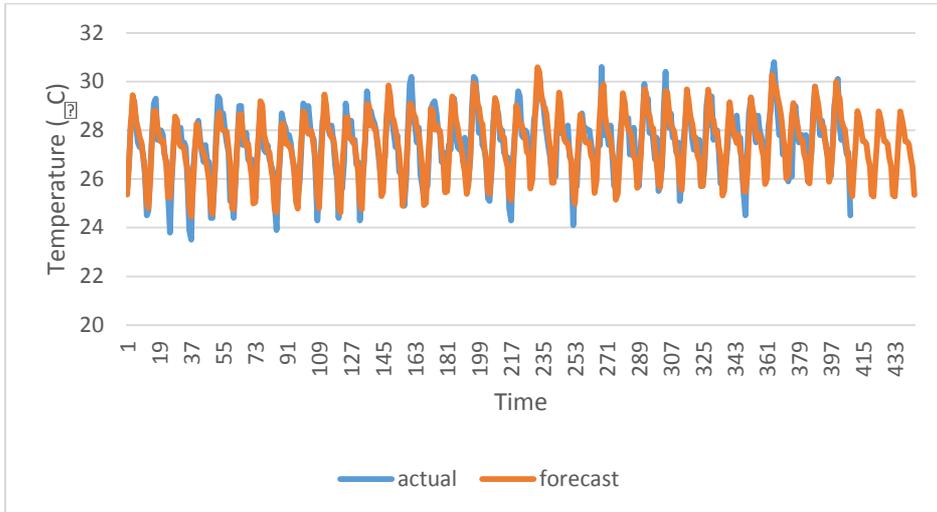


Figure 6. Trend line of mean monthly temperature in Prachuap Khiri Khan Province, Thailand (1983 – 2016) of actual and forecast values including forecast value in the future (2017 – 2019).

Seasonal decomposition

The result of time series analysis was received by using seasonal decomposition indicated that Mean Absolute Deviation (MAD) was 0.477. Mean Square Error (MSE) was 0.370. Mean Absolute Percentage Error (MAPE) was 1.747. Trend line of actual and forecast value were presented in figure 7.

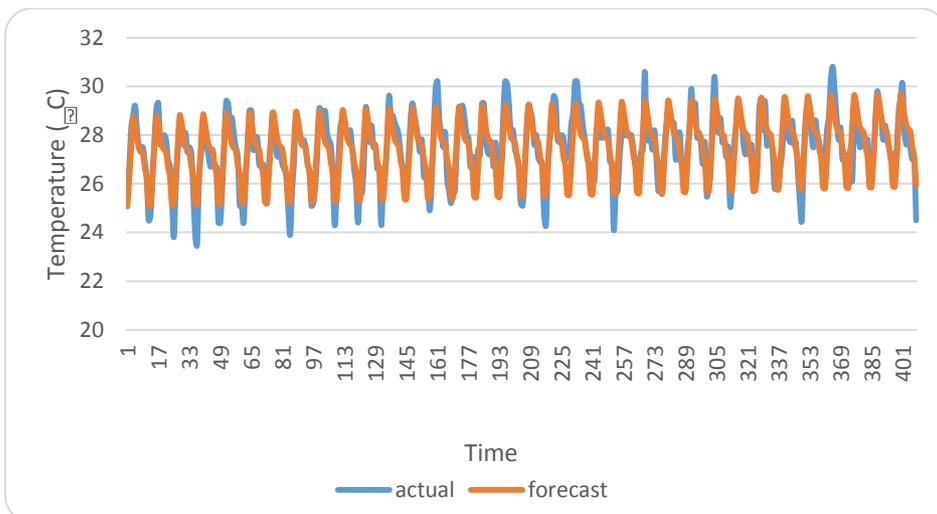


Figure 7. Trend line of actual and forecast value from seasonal decomposition model.

The result of seasonal indices was presented in table 3. It showed that temperature in January was the most lower than normal level at 7.1 percent. Secondary was December (7.0 percent), February and November (2.8 percent)

and October (1.3 percent). For the higher than normal level was April at 6.4 percent. Secondary was May (5.3 percent), June (3.3 percent), March and July (1.8 percent), August (1.3 percent) and September (0.9 percent).

Table 3. Seasonal Indices.

Seasonal Period	Index
January	92.9
February	97.2
March	101.8
April	106.4
May	105.3
June	103.3
July	101.8
August	101.3
September	100.9
October	98.7
November	97.2
December	93.0

From regression analysis, the result of the linear regression was

$$\hat{Y} = 26.988 + 0.002^{**}t,$$

where \hat{Y} is trend-cycle for temperature from season
 T is time (case sequence).

From linear regression, time can explain variation of component of adjusted trend-cycle at 28 percent ($R^2 = 0.28$). Trend line of mean monthly temperature of observed and linear line were shown in figure 8.

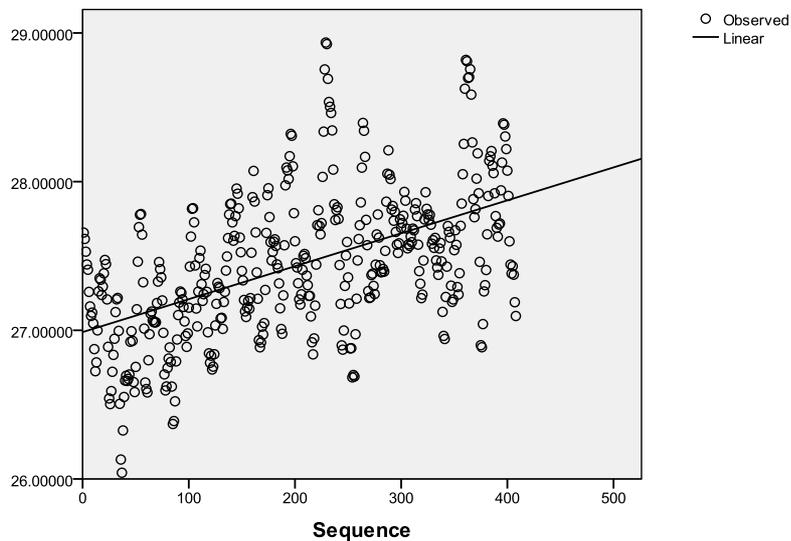


Figure 8. Trend line of mean monthly temperature in Muang Prachuap Khili Khan, Prachuap Khiri Khan Province, Thailand (1983 – 2016) of observed and linear line.

Discussion

The highest value of temperature in Prachuap Khiri Khan Province is April and May because surface temperature upper Thailand such as the Northern, North-eastern, Central and Eastern Parts usually experiences a long period of warm weather because of its inland nature and tropical latitude zone. March to May, the hottest period of the year, maximum temperatures usually reach near 40 °C or more except along coastal areas where sea breezes will moderate afternoon temperatures. The onset of rainy season also significantly reduces the temperatures from mid-May and they are usually lower than 40 °C. The lowest value of temperature is December and January because in winter the outbreaks of cold air from China occasionally reduce temperatures to fairly low values, especially in the Northern and North-eastern Parts where temperatures may decrease to near or below zero. In the Southern Part temperatures are generally mild throughout the year because of the maritime characteristic of this region. The high temperatures common to upper Thailand are seldom occur. The diurnal and seasonal variations of temperatures are significantly less than those in upper Thailand (Virat, 2015).

The result showed that temperature in January, February, October, November and December were lower than normal level. For the higher than normal level was April, May, June, March, July, August and September. The result is consistent with season in Thailand. Winter season is during mid-October to mid-February, so January and December are low temperature. Summer season during mid-February to mid-May, so April and May are high

temperature (Virat, 2015). Farmers can apply this result for planning to produce agricultural production which one is suitable with low or high temperature.

From results of time series models, they showed different to each other. The investigation was compared forecast accuracy by considering from value of MAD, MSE and MAPE in table 4.

Table 4. Forecast accuracy of each model.

Time series model	Forecast Accuracy		
	MAD	MSE	MAPE
1. Naïve method	0.819	1.079	3.006
2. Three – month moving average	1.098	1.075	4.009
3. Three – month weighted moving average	0.990	1.527	3.621
4. Simple exponential smoothing ($\alpha = 0.9$)	0.832	1.110	3.050
5. Exponential smoothing (winter's multiplicative method)	0.465	0.354	1.704
6. Seasonal decomposition	0.477	0.370	1.747

The study found that exponential smoothing was done by using winter's multiplicative method (Table 4). It had the most forecast accuracy because it was the lowest value of MAD, MSE and MAPE. The winter's method and decomposition model are suitable for data series that exhibited a seasonal pattern and with or without trend. The decomposition fit a model that weighted all observations equally to determine the best regression fit of seasonally adjusted data. However, the disadvantage of decomposition model is that the hypothesis may be too strong for the epidemic behaviour, so that the model may not perform well sometimes (Zhang et al., 2014). For winter's method, the data is smoothed by using a method that gives decreasing weights to older observations and provide short-term forecast (Render et al., 2012). However, winter's multiplicative method was better than decomposition model for this data set.

According to principal of moving average model, it is not suitable with the data with trend and seasonality (Render et al., 2012). Therefore, three – month moving average and three – month weighted moving average showed the value of accuracy measurement was higher than exponential smoothing and seasonal decomposition.

In summary, exponential smoothing by using winter's multiplicative method was a proper model to predict data set of mean monthly temperature in Muang Prachuap Khili Khan, Prachuap Khiri Khan Province, Thailand. The forecast values in the future (2017 – 2019) by this model showed that temperature in April, May and June are high while temperature in

December and January are low. Moreover, the result from seasonal decomposition showed that temperature in January, December, February November and October, respectively, are lower than normal level. For the higher than normal level is April, May, June, March, July, August and September, respectively.

Acknowledgment

The author would like to offer particular thanks to the faculty of animal science and agricultural technology, Silpakorn University and those who provide guidance, sharing knowledge and giving help.

References

- Rasul, G., Chaudhry, Q. Z., Mahmood, A. and Hyder, K. W. (2011). Effect of Temperature Rise on Crop Growth and Productivity. *Pakistan Journal of Meteorology* 8: 53-62.
- Render, B., Ralph, M. S. J. R. and Michael, E. H. (2012). Forecasting. In: *Quantitative Analysis for Management.*, Pearson Education, U.S.A., pp. 154-181.
- Virat, M. (2015). Geography and Climatology in Every Season of Various Parts in Thailand. Retrieved from https://www.tmd.go.th/en/archive/thailand_climate.pdf.
- Zhang, X., Zhang, T., Young, A. A. and Li, X. (2014). Applications and comparisons of four time series models in epidemiological surveillance data. *PloS one*, 9(2), e88075.
- Zhang, X., Zhang, T., Young, A. A. and Li, X. (2014). Information of Prachuap Khiri Khan Province, Thailand. Retrieved from <http://www.prachuapkhirikhan.go.th/>

Traditional Community and Participation in Developmental Area on Environmental Good Governance in Koh Lipe, Satun, Thailand

Wongchantra, P.,^{1,*} Meakawichai, P.,² Nangkhalaphiwat, Y.,² Sinthumongkolchai, O.,² Wongyai, A.,² Chandanachulaka, S.,² Kaewwannisakun, Ch.² and Sangdanjak, N.²

¹ Center of Environmental Education Research and Training, Faculty of Environment and Resource Studies, Mahasarakham University, Mahasarakham, Thailand 44150

² Department of Environmental Quality Promotion, Ministry of Natural Resources and Environment, Phaya Thai, Bangkok, Thailand 10400

Abstract The traditional community and participation in developmental area on environmental good governance in Koh Lipe, Satun province, Thailand was studied. The history of the traditional community in Koh Lipe, Satun province, the condition and problems of the traditional community were investigated. The participation in development area on environmental good governance was proposed. The community leaders, philosopher, head of government and villagers in the studied were participated. Results showed that Urak Lawoi community Koh Lipe, had moved the first group of immigrants from the Koh Lanta since 1897. This group was settled in Koh Lipe. The Island is flat and as agricultural land including the abundance of resources both land and sea. The pioneers and leaders of Urak Lawoi in this era is the Toakeeree, is a Muslim from Indonesia. The scull boat came from Aceh about 100 years ago. Later in the 1909 Urak Lawoi, another group of immigrants settled in Koh Lipe and other for political reasons that borderline between Thailand – Malaysia. Toakeeree muslims at Urak Lawoi came and persuaded chieftains from koh-sirey, Phuket province and Koh Lanta, Krabi province, settled in the Koh Adang-Ravee were changed. Tarutao national park was established in 1974. Urak Lawoi had settled in the Islands of Koh Adang-Ravee which moved to the area where the national park is established in the Koh Lipe and Koh Adang-Ravee. Urak Lawoi had lived since 1974 in the area of Koh Lipe and parts of Koh Adang. The government has designated this area as Village 7 “Ban Koh Lipe” of Koh Sarai sub-district, Muang district, Satun province. It found the condition of Urak Lawoi community, the island likes horseshoes There are 3 main beaches as Pattaya beach (Bundayha beach), Chao Lay beach or Sunrise beach and fishing beach or Sunset beach. The house of the Chao Lay will look like a house built simply, a single storey building, high platform. There are 548 households living in Koh Lipe and the latent population is 145.59 %. Most of the peoples work in the restaurant, resort, tourist accommodation, trade, taxi drivers to serve the tourists. Chao Lay is a unique tradition and culture as Urak Lawoi language, wedding tradition, floating boat tradition, culture building houses and Paepaegina sweets. The problem of the Urak Lawoi community is found mostly caused by capitalists or entrepreneurs, waste, flooding, wastewater, narrow public roads, utilities shortage, drugs, unemployment and migrant worker problems. Land disputed with the national park and community with capitalists. Guidelines participation in development area on environmental good governance was introduced.

Keywords: Urak Lawoi community, participation, Koh Lipe, environmental good governance

* **Corresponding author:** Wongchantra, P.; **E-mail:** prayoon_nam@yahoo.co.th

Introduction

Koh Lipe locates in Satun province, Thailand. It is the responsibility of Tarutao National Park. There are many families living in the island, most of them are fishing career. There is a tradition of floating boat and another highlight of Koh Lipe. The nature of the coral around the island, beautiful bay, sandy beach, beautiful sea. Koh Lipe is an Island with a community of fishermen Urak Lawoi group. It was featured that attracts tourists to experience the lifestyle and culture of this community (Jaroonthong, 2007). Formerly, the Urak Lawoi group was a unique way of life and culture which different from the way of life and culture of the indigenous or large groups in the south. Urak Lawoi is a way of life closely to the sea. The way of life of Urak Lawoi is a simple in the subsistence economy (Satun Primary Educational Service Area Office, 1990). The fishermen communicate with the Austronesian language, some words are originated from Melayu language. The way of life and culture of Urak Lawoi, Koh Lipe had changed since 1950ndue to affect in traditional lifestyles such as the death of traditional leaders. The arrival of the middleman and the expansion of state power until 1984, the Urak Lawoi community are transformed by a policy of promoting tourism. Urak Lawoi community has changed their way of life in line with the developed community as a major tourist destination (Jaroonthong, 2007). Koh Lipe is located in the Andaman Sea. The area around the island is about 2 square kilometers. The problems of fast growing tourism include pollution, waste, flood caused by waste water from the community and the facilities for tourism, such as hotels, resorts, shops and restaurants. The growth in tourism has affected the quality of life of communities living on the Island (Pukkalanun, 2013)

Development strategy for Satun province have the prosperity of the economy has continued to grow, stable, sustainable on the basis of local potential production and the opportunities for future economic growth enhance people's quality of life and solve the problem of sustainable drugs. Development of economic security pathway to ASEAN. (Provincial Development Strategy Group, Satun Province Office, 2015) Public sector, private sector, civil society have focused on and actively address environmental issues, this leads to the definition of holistic environmental management tools and mechanisms. Incorporation of concepts between conservation socio-economic development. The objective is to bring about a balance between the needs of all three sectors: the public sector, private sector and people, the guidelines 7 include : principle 1; people have access to information, principle 2; people participate in problem solving, principle 3; transparency, principle 4; social responsibility, principle 5; the rule of law, principle 6; justice and principle 7; sustainability. (Ministry of Industry, 2010) By the participation of people, this gives the public the right to public policy processes, both in terms of providing and receiving information, provide feedback or suggestions, decision making and environmental and natural resources management.

Also the participation of the people, the opportunity for the parties, show your needs and concerns from the beginning of the project. It reduces the chance of dispute and division. Maintaining credibility and legitimacy, the decision-making process is transparent and allows people to participate. It creates public credibility and legitimacy, especially when it comes to making decisions on the subject of controversy and civil society development including leadership training. And people learn to work together to solve problems effectively in the future. (King Prajadhipok's Institute, 2016)

Therefore, the study of the traditional community and participation in development area of Koh Lipe, Satun of Thailand on environmental good governance is a qualitative research using the integrated research model, documentary research and descriptive research. This is a guide to the development of Koh Lipe that maximizes the use of resources on the island and the impact on natural resources is minimal environmental management is creatively based on ethical and appropriate environmental performance.

Objective: To study were to study the history of the traditional community in Koh Lipe, Satun province, to study the present condition and problems of the traditional community in Koh Lipe, Satun province and to propose the participation in development area of Koh Lipe, Satun province on environmental good governance.

Materials and methods

The study area was Koh Lipe, Moo 7, Koh Sarai sub-district, Muang district, Satun province. The population in this study were people, organization, agencies living in a community Koh Lipe, Koh Sarai sub-district, Muang district, Satun province, 548 households 1,278 people.

The samples used in the study as community leaders, philosopher, head of government and the villagers in Koh Lipe, Koh Sarai sub-district, Muang district, Satun province. It was acquired by specifying an interview.

The instruments were structured interviews, the traditional community and participation in environmental development in Koh Lipe which divided into 3 part, Part 1 : History of the traditional community, Part 2 : The state and problems of traditional communities in Koh Lipe, Satun Province and Part 3 : The participation in development area of Koh Lipe, Satun province.

Data were collected from communication to the community coordination organizations in the area of Koh Lipe, Muang district, Satun province to interview, interviewed using structured interviews on traditional community education and participation in environmental development of Koh Lipe area including history of the traditional community, conditions and problems of the traditional community in Koh Lipe, Satun province to propose the participation in development area, space exploration community Koh Lipe, Muang district, Satun province.



Figure 1. Interview with villager Koh Lipe

Results

History of the traditional community in Koh Lipe, Satun province, people living on Koh Lipe and other Islands. In the Adang – Ravi Islands there are two groups, the two groups are the Urak Lawoi. The first group Urak Lawoi had migrated from Koh Lanta since about decades 2440. This group has settled in Koh Lipe. The island is the most conducive to settlement compared to other Islands, in the Adang - Ravi Islands. The island is flat can house and farming, the abundance of resources, both land and sea is conducive to the livelihood of the traditional uighur people. The pioneers and leaders of Urak Lawoi in this era was Toakeeree, persuaded by family and moved to the Koh Lipe. Later in the 1909, Urak Lawoi another group settled in the area Koh Lipe and other Islands in the Adang - Ravi Islands for political reasons the demarcation. When drafting the borderline between Thailand – Malaysia, The governor of Satun. So the Toakeeree muslims at Urak Lawoi to respect come and persuade chieftains from koh-sirey, Phuket province and Koh Lanta, Krabi province. This is a group of Urak Lawoi settle in the Adang - Ravi Islands. The evidence is that this land belongs to Siam, because the Siam families live. The Urak Lawoi this second group, the settlers on Koh Lipe and spread to other Islands in the Adang – Ravi Islands. Settlements of the Urak Lawoi people in the Adang - Ravi islands, have changed again the establishment of Tarutao National Park in 1974 with the rules of the park. The villagers have settled in the Island in the Adang - Ravi Islands to move to the area allowed by the park is on Koh Lipe and parts of Adang - Ravi Islands. So since 1974 onwards Urak Lawoi live in the area of Koh Lipe and parts of the Koh Adang - Ravi only. The government has designated this area as Village 7 “Ban Koh Lipe” of Koh Sarai sub-district, Muang district, Satun province.

The present condition and problems of the traditional community in Koh Lipe, Satun province.

1) The current state of the Urak Lawoi community on Koh Lipe. The island stretches east long to the west shaped like horseshoes, most areas on Koh Lipe are flat. There are 3 main beaches: Pattaya Beach (Bundayha Beach) Chao Lay Beach or Sunrise Beach and fishing Beach or Sunset Beach. Beach on the island is a beautiful beach, soft white sand, sea water clean and clear. There are coral islands around it is natural to remain fertile. The house of the fishermen will look like a house built simply, a single floor high floor.

There are 548 households living in Koh Lipe and the latent population is 145.59%. Most of the people work in the restaurant, resort, tourist accommodation, trade, taxi driver to tour and send and receive tourists. Chao Lay has a unique tradition and culture: Urak Lawoi language, wedding tradition, floating boat tradition, culture building houses and Paepaegina sweets.



Figure 2. The houses and transportation on Koh Lipe

2) The problems of the Urak Lawoi community, most are caused by capitalists or entrepreneurs thus causing a problem that affects communities, including traditional fishermen living:

- Waste problem this is due to the lack of proper waste management systems and lack of awareness pay attention to the correct management of government and entrepreneurs, with the increase in tourist arrivals. The average amount of waste is 10-15 tons. This results in destruction of the scenery and the source of the vectors happiness to people on the Island, it also affects the image of tourism as well.

- The flood in the rainy season in Koh Lipe caused sudden floods in many areas of the Island such as, community after school, community and many communities by the people, shop was flooded. The construction of houses, hotel, resorts, natural water flow. Villagers and restaurants are affected by flooding Koh Lipe. Koh Lipe has 3 main natural waterways, public roads and local government offices.

- Wastewater problem part of the problem is the flood, slow drainage from the construction of natural water barriers. As a result, the smell of rotten. In addition, solid waste in Koh Lipe is flooded with waste, causing a lot of waste water and smog. In addition, the Island has no drainage and sewage systems when it rains, it flows together with waste water as a result, the amount of wastewater increased.

- A narrow public road, this is due to the claim of landowners or hotel, resort, encroachment on public areas, and land use by lack of land use planning or town planning. There are blocking the corridors and beaches, dividing the area between the villagers and tourists inequality in land use.

- Lack of infrastructure, as the number of tourists continues to increase. It requires a lot of water, but the water resources are not enough. There is a shortage of water especially in the dry season. The water in the well is dry some wastewater is not available.

- Drug problem, Koh Lipe has a lot of drug problems. There is a production and there are illegal drugs category 5 in possession of illegal. In addition to drug problems, there are many problems such as alcohol and gambling.

- Issue of influence, there are influential groups in the area efforts have been made to prevent the local or indigenous communities from combining strong claims to rights such as the exploitation of long-haul passengers some of the speedboat operators.

- Unemployment issues (Migrant workers) unemployment rate of Satun province to increase or decrease according to the factors in the season. Because the province of Satun is an agricultural area. Thus, unemployment rates are indicative of seasonality, labor moves to non-agricultural areas in the rainy season. It will return to the agricultural sector again at the harvest season. For job vacancies by education level, find out, employers and establishments have the lowest employment requirement for primary and lower education graduates. The minimum and minimum job vacancies are available.

- Land dispute with the national park and the community with capitalists. There are also some traditional settlers living in national parks and there are disputes over fishing in the restricted area of the fishermen National Park on Koh Adang. In terms of catching the Gamat, logging and finding the forest in the National Park. It is a traditional area of the lagoon before it is declared a national park, there are also land disputes. There are capitalists invading land, the original Urak Lawoi community.

- Change of settlement, The Urak Lawoi community is a small community. The house is spread over the bay and beach. The house was built in a simple way with materials available locally in 1950- 1983, there was an expansion of the community both the population and the number of households. It has been a culture of outsiders who have come into the community, such as building a house without a platform buy materials from outside the area, such as zinc plank, etc. In 1984 the Urak Lawoi community in Koh Lipe has changed dramatically. It is also home to Lipe Island and Koh Adang. However, it is evident that the community has expanded from the previous beach houses. It began to expand the community into the island and the rise of resorts and bungalows that extend to the beach, making the width of the beach less watery, it is another reason why the Urak Lawoi community has to live in the island instead of setting up the house on the beach.

3) The participation in development area of Koh Lipe, Satun province on environmental good governance.

The participation of communities in developing areas Urak Lawoi, Koh Lipe, Satun province to bring awareness to the public. The guideline of public participation. This is an opportunity for people and all sectors of society to participate, using the 5 levels of participation.

Providing information to open the opportunity for the Urak Lawoi community. Government and entrepreneurs participating in the development of Koh Lipe area, the way to provide information such as promoting tourists. Establishment and community to preserve the environment training to educate tourists. Establishment and the community about the problem in the Urak Lawoi community. Include public awareness and understanding of problems, causes, effects and preventive and corrective measures and to raise awareness and instill public consciousness in the community, and entrepreneurs. The use of internet radio advertising techniques, brochures to set up a campaign in the area of Koh Lipe adverts on facebook, webpage, set point information distribution, make a video to open an exhibition center. Legal, camping, sports, music and arts and recreation.

Consultation, the Urak Lawoi community is involved in the provision of factual information and opinions to decision-makers of government agencies in a variety of ways, including setting up service centers, providing assistance and support for website or online media for guidance and question – answer, the establishment of a call center to advise tourists and entrepreneurs, organizing a forum for government agencies. (Tarutao National Park, local government organization), the private sector (capitalists or entrepreneurs) and the public. (Laurel laureate or tourists) Have a problem analysis cause of problem and the solution that takes place on Koh Lipe and listen to the opinions of the Urak Lawoi community. The technique used in the operation is to provide process trainers. Set up a club to provide information and receive information from the public comments on the website, hotline, direct exchange of ideas public forum group discussion to find ways to contribute to solving problems on Koh Lipe. Individual interviews and the questionnaire evaluation by social media.

Involvement or role play this is an opportunity for the Urak Lawoi community to participate in the work or suggestion that led to the decision, to ensure that the information, opinions and needs of the Urak Lawoi community are taken into account as an alternative to public administration, the problem management plan for the Urak Lawoi community the tourist and entrepreneurs establish a volunteer environmental protection team. Meetings for consultation and exchange ideas and subgroup meetings in intergovernmental planning. (Tarutao National Park, local government organization), the private sector (capitalists or entrepreneurs) and the public. (laurel laureate or tourists) using techniques such as forums, small group discussion, conferences public stage on Koh Lipe brainstorming measures constructing consensus, etc., to create engagement with the government, community leaders and entrepreneurs.

Collaboration co-operative decision making is a common practice for the Urak Lawoi community, including the public, private and public sectors, such as community meetings to provide solutions and solutions to problems together with the local authorities and the national park. Appointment of community committee to encourage people to participate in problem management. Appointment of the Urak Lawoi community committee to encourage participation in problem solving, conducting stakeholder meetings, both public and private, to create community referrals for decision-making. The technical implementation is to prepare a plan to prevent problems, official meetings between government and private sector in operations establishment of the board building referendum.

Empowering the public. The Urak Lawoi community is a decision-making community, solution, creating a platform for the Urak Lawoi community to make a decision on the development of Koh Lipe and the memorandum of understanding between the public, the public and the operators about the benefits and rights that all parties will receive. Using techniques such as voting, public forum, community, building a referendum and the memorandum of understanding. This will lead to the involvement of the private sector, the Urak Lawoi community and tourists.

The participation in development area of Koh Lipe, Satun province on environmental good governance. In order to achieve a balance between the needs of both parties and the public and private sectors, including 7:

People can access information in relation to public policy, by providing accurate incident management information and opening the channel for data disclosure and access, by local authorities entrepreneurs have problems in terms of quality and quantity. Management information is correct. Include the cause of the problem and the agency responsible. (Tarutao National Park or local government organization) By using posters, publicity campaigns on solutions to problems, saving resources, campaigning to reduce pearl abuses, etc., beaches, hotels, resorts, temples, community schools and government agencies. It also publishes information through online media such as facebook or the website of the local government.

People are involved in problem solving, by allowing communities to participate in public policy decisions, by the government establishment of information. When problems or urgent situations arise, provide feedback and suggestions and take part in problem solving. The villagers can inform the villagers through the village leaders. The Urak Lawoi can inform the villagers through the village leaders. Government agencies for help with problem management such as waste water discharge, controversy and waste management. The village leader, government, the informants inform the Urak Lawoi about the situation in the Uruguayan rush, such as sudden floods, etc. The Urak Lawoi have the right to vote, participate in the forum, suggestions for solving problems.

Transparency of public sector operations it should be done openly to the community, and can be checked by the government information should be provided on the issues, sources and management practices in terms of quality, such as type and amount of waste, water quality and disclosure to the public. The relevant agencies were surveyed, measurement of resources and pollution such as changes in the area, flood risk areas type and amount of waste water quality and the source is straightforward. And the right management by publishing information at tourist attractions. establishment, community and government agencies. It also publishes information through online media such as facebook or the website of the local government.

Social responsibility entrepreneurs recognize the right to duty, social responsibility and the enthusiasm for solving the problem by the hotel establishment, resort responsibility towards society and the environment, if the impact and there are channels to listen and there is a movement in response to the call by organizing training and campaigning for the government, entrepreneurs and the private sector to have proper and effective management, state and private enterprises provide adequate facilities to the community sharing public space for mutual benefit with the Urak Lawoi community and comply with the rules of sharing resources with the Urak Lawoi.

State law enforcement practices are fairly legal, law enforcement and compliance with agreed rules strictly. The problem is managed according to the law. Safety management is in line with the law, where public and private sectors have pollution control systems, such as ; waste water treatment systems, waste disposal points, land use, etc. They also have accurate and monitoring environmental quality assurance and accurate documentation of their operations. In the application and environmental and public quality monitoring (Tarutao National Park or local government organizations) are strict in enforcing the law.

Justice, government, private sector and the public should adhere to good justice with appropriate resources on Koh Lipe. To return to the community jointly campaign for the conservation of natural resources and environment. Especially marine resources including tourism and the community of Urak Lawoi has a good environment maintaining a proper tradition hotel operators, resorts, or projects that benefit the Urak Lawoi community and national parks deal fairly with disputes between capitalists, parks and communities.

Sustainability all sectors should manage and use limited resources the public and private sectors operate consciously and do not affect the environment and the community by the government operator. (Tarutao National Park or local government organization) Implementation of good governance principles and entrepreneurs have a conscience in the conservation of resources and the environment. Including the public sector,

the community of Urak Lawoi community. Travelers and preserve environmental resources and to achieve a mutually beneficial and sustainable.

Discussion

History of the traditional community in Koh Lipe, Satun province. Study the history of the traditional community in Koh Lipe, it was found that 1909 was the Toakeeree, Aceh province, Indonesia. The first pioneer living in Koh Lipe and the family of the Urak Lawoi. This is one of the few ethnic fishermen in Thailand settled on Koh Lipe and other Islands in the Adang-Rawi Islands. Which is based on the concept Chonchat (1982). It is said that the tribe through the Straits of Malacca to the Andaman, surfing along the west coast of Thailand. It is divided into smaller Urak Lawoi living in the Lanta Islands. And Moklen live next up to Phuket Island. In 1909, Urak Lawoi from Siree Island, Phuket province and Koh Lanta, Krabi province migrated to Koh Lipe and other Islands in the Adang - Rawi Islands. From the persuasion of the Toakeeree which is revered by fishermen. Later when the establishment of Tarutao National Park in 1974 with the rules of the park, the villagers have settled in the Island in the Adang - Ravi Islands. Have moved to the area where the park is permitted on Koh Lipe and some parts of Koh Adang. Urak Lawoi it is an ethnic group with a distinct social and cultural character, there is a language of dress and identity culture. Which is based on the concept Ngasaman (1991). The biggest Urak Lawoi community lives on Koh Lipe, National Park, Tarutao Island, Satun province. It is a tribal ethnic group with a distinctive lifestyle bound to the sea and the coast. They have a shy and fearful character. Expertise in navigating, diving, harvesting, aquaculture in the sea, living with the sea. Take advantage of the sea and natural resources in the sea. Urak Lawoi will call myself Urak Lawoi or Chao La or Gypsy. Consistent with the research of Jaroonthong (2007) studied on the development of history of Urak Lawoi community on Lipe Island, Satun province, A.D.1950-2006 found that prior to 1950 Urak Lawoi had a simple lifestyle in the subsistence economy until the 1950. Lifestyle and culture of Urak Lawoi, Koh Lipe began to change with the factors of the death of the traditional leader, the arrival of the middleman, and the expansion of state power. These factors affect the traditional way of life of Urak Lawoi in the transition period, such as living in the commercial economy. Changes in the location of houses in the community and religion. So after 1950 it was a period of continuity and change, depending on the way of life of the people of Urak Lawoi, Koh Lipe. And consistent with the research of Amloy (2017) settlement of Urak Lawoi's communities in Ko Lanta Yai, Krabi province found that the Urak Lawoi has local wisdom about choosing the right areas for settlement. Firstly, access to diverse natural resources such as the election of settlements in coastal ecosystems is complete and diverse. The Urak Lawoi has a local wisdom about choosing the right areas for settlement such as: item 1; access to a wide variety of natural resources, such as the election of settlers

in areas with complete and diverse coastal ecosystems. Electoral settlements in freshwater areas or located near fresh water, elevations in coastal plains can accommodate a wide range of activities and coastal slopes and a suitable channel for mooring. Item 2; seasonal livelihoods, such as the selection of areas on the east side of the island. Because it can avoid the severe southwest monsoon and can observe the ships traveling off the coast easily. Item 3; security in settlements, such as the election of settlers in areas with safe havens and other dangers. Choosing areas that are safe from serious epidemics or infectious diseases and can be refugees from the pirates who are fighting the property and resources of the sea or avoid conflicts from other groups in the area. Item 4; social interaction, such as a trip to exchange their goods can not be produced by a group of middlemen or others, trip to visit and stay with relatives. And item 5; beliefs about the settlement, as decided by the spiritual leaders and the belief that all places have you in the way, to build confidence among community members.

The present condition and problems of the traditional community in Koh Lipe, Satun province.

The present condition of the traditional community in Koh Lipe, The house of the Chao Lay is a single storey high rise building, most of the population is employed professionals and buddhists. Chao Lay has a unique tradition and culture: Urak Lawoi language, wedding tradition, floating boat tradition, culture building houses and Paepaegina sweets. Which is based on the concept Satun Provincial Administration Promotion Office (n.d.) said the current land use on the island with a total area of 1.94 square kilometers. The area is mostly forest, 73.46% of the total area. 23.59% of the total area of the community/city, other areas, such as beaches and rocky outcrops. And consistent with the research of Kreuain (2011) study restoration and preservation of Urak Lawoi language, Bo Lon Island found that the Urak Lawoi have accumulated the knowledge of the observation of the nature of the sea, through co-exist with the marine ecosystem for a long time. The local wisdom consists of technical knowledge or the phenomenon that the Urak Lawoi used to define or distinguish the nature of the nature of water, wave, cloud, the wind's direction, the orbit of the moon and the stars. It also has expertise in using boats to travel in remote locations the way of living of the people of Urak Lawoi is based the social support system provides access to common resources. It is a knowledge management of social relationships the Urak Lawoi also created abstract knowledge to control the use of resources to achieve sustainability it is the knowledge, the power, the rules, the relationship, and the management of resources. To have the opportunity to use valuable resources learn to cherish and keep up with the resources available, reflections on ethical systems, moral systems, respect for nature, and a way of life in harmony with nature. And consistent with the research of Aksornjarung (2012) studied restoration and preservation of Urak Lawoi language, Bo Lon Island found that restoration and preservation of Urak Lawoi language Koh

Bulone it is 2 benefits include: 1) help the youth of this group to realize and proud in the culture of the ancestors and 2) to help preserve the language, which is spoken Urak Lawoi fragmentation and the risk of extinction to be held later in the form of a written note.

The problems of the traditional community in Koh Lipe include: waste problem, flood problem, wastewater problem, narrow public road problem, utilities shortage problem, drug problem, influence problem, community problems unemployment and migrant workers, land dispute with the national park and the community with capitalists, change of settlement community and home. Which is based on the concept Satun Provincial Administration Promotion Office. (n.d.) the type of accommodation on Koh Lipe is mostly residential the change occurred from 2004-2010, found the size of the community is smaller, there are new areas open to the community some are on the west side of the Island, establishment, travel business, began to expand into the area and there are a lot since 2004. This is because most of the establishments are located in the sea the problem and conflict of local people. And consistent with the research of Prapruit (2015) studied sustainability study of small Islanders of the Urak Lawoi Island: a case study of Koh Lipe, Thailand found that the dynamics of the Urak Lawoi have changed over time to be classified into 3 main: 1) Settlements of fisherman. 2) Local social and political restructuring. And 3) the flourishing of tourism on Koh Lipe as a result, the livelihood model is determined by the production system, from production to subsistence to productivity and to produce for productivity and service. The things that the fisherman still do not change over time, tribal culture and knowledge and folk practices. Currently, Koh Lipe's economy is reliant on tourism in the form of money and spending time in the occupation. Consistent with the research of Plathong (2011) studied fishery resource uses and management intervention at Adang-Rawi-Lipe Islands, Tarutao National Park, and Bulhon Islands, Mu Ko Phetra National Park found that most households in the community rely on fishing for their livelihoods. However, when the market demands higher volume of marine products, local people are more in touch with the mainland need daily amenities. The higher standard of living, the higher the cost. And consistent with the research of Khunweechauy and Khunweechauy (2010) studied lives and culture of sea Gypsy "Urak Lawoi" in the Andaman sea found that there are rapid changes in both Koh Lanta and Koh Lipe. The arrival of commercial and tourism fishing as a result, the two islands became a tourist city. These important factors have affected the life and culture of the fisherman especially the adaptation of the Urak Lawoi on Koh Lanta. There are quite a few changes. The role of the chieftain, both men and women, is responsible for the work. The ownership of the land was taken over and turned into capitalism. Because the disadvantages of education and the power to negotiate the new land and need to live away from the sea and different.

The participation in development area of Koh Lipe, Satun province on environmental good governance.

The participation of the traditional community in Koh Lipe, Satun province using the principle of participation to build trust with the public. The 5 levels of participation are: level 1 inform, level 2 consult, level 3 involve, level 4 collaborate, level 5 empower. Which is based on the concept Songkorsook (1998) from concept to practice, people's participation means participation in a process of development from the beginning to the end of the process include; research, planning, decision-making, operations, management tracking and evaluation and the allocation of benefits that occur. Consistent with the research of Pratad (2015) studied participation of citizens in community development in fort Mahakan, Rattanakosin Island, Thailand found that the problem of the policy implementation of conservation and community development in the community affected the housing of people in the community. The policy of Bangkok no effects on the public clearly did not fully cooperate with the public consistent with the research of Kongdechadisak (2014) studied the people's participation in environmental conservation at Koh Chang National Park, Koh Chang district, Trad province found that participation in practice is highly participatory, followed by the participation of the beneficiaries are involved to a lesser degree. Participation in participatory evaluation was low and final participation in decision making was low. Consistent with the research of Minakhon (2011) study people participation in community garbage management Tambon Bang Nang Li, Amphawa district, Samut Songkram province found that overall, the level of public participation in waste management In the medium level is to bring bags or other containers to the market to replace the plastic bag do not participate in planning activities or activities. Participate in meetings and be aware of the causes engage with knowledge. Access to solid waste management is at a high level. And consistent with the research of Deachpibal (2010) studied the participation of the local community to manage and conserve the environmental quality of mangrove forest : a study exclusively of the local community in Phuket province found that people in Pa Khlok sub-district are traditional local communities, character is a serious person, group together can combine the activities for the common good all the time. It is a social capital that makes people participate in high-level activities. Along with the community of people in Pa Khlok sub-district is attached to the mangrove forest. Know the importance or benefits of mangrove forests. Consequently, there is a need to preserve mangrove forests in line with sustainable development. Initially, the grouping of people in Ban Pa Khlok community and Ban Bangla community aimed to tackle mangrove intrusion. They share the same thoughts together, analyze the problem and choose a long-term solution to prevent mangrove destruction. The mangrove forest was destroyed planning for conservation activities and protect mangrove forests in the community. The result of the participation of the people is to protect the natural resources of the mangrove

forest from being destroyed, to maintain the ecological system of the mangrove forests to be in perfect condition to the next generations.

The participation in development area of Koh Lipe, Satun province on environmental good governance. In order to achieve a balance between the needs of the three parties is the government and private individuals of the 7 principles of environmental governance: principle 1 people can access information, principle 2 citizens participate in problem solving, principle 3 transparency, principle 4 corporate social responsibility, principle 5 rule of law, principle 6 justice and principle 7 sustainability. Which is based on the concept Chompunth (2013) stated good governance means the environment management of natural resources and environment where people have access to information. Engage in decision-making in defining and implementing strategic policies, plans, projects and activities that will impact on natural resources and the environment transparent being ready, responsible, lawful, expected and fair. And consistent with the research of Sisungnoen (2015). The environmental governance system is implemented in accordance with the good governance principles to ensure that national environmental governance is in compliance with the same standards. And it is a way to enter into environmental governance to increase the understanding of executives and practitioners in both the central and provincial areas and the people involved. Therefore, the sustainable development of the environment must be the relationship of the three main parties. It consists of the private, public and private sectors, which are transparent and fair to achieve sustainability objectives. Consistent with the research of Sirijamor and Poboorn (2010) studied good governance in environmental management of local authority: a case study of Siracha Municipality, Chonburi found that Sriracha Municipality has all the environmental management principles of governance. The internal factors that are the strengths are the personnel management, the strategic plan and the environmental program, budget allocation technology create a culture and values in the organization. And consistent with the research of Haiwattananukool (2015) studied development of good governance in environmental and health organization found that the development model of good governance in environmental and health organizations. The independent environmental and health act should be enacted to certify the status of an independent, environmentally and health organization in order to function more effectively. And based on the 6 principles of good governance by the use of wisdom 3 is a tool for the operation of the function.

Acknowledgement

Thank you to the instructor of the National Institute of Development Administration. Entrepreneurs, businesses, accommodation and hotels In Koh Lipe please provide important information by interview. Responding and thank yo Department of Environmental Quality Promotion and the staff responsible for the environmental governance diploma program for all the senior executives who gave this course the opportunity to produce this valuable thesis.

References

- Aksornjarung, P. (2012). Restoration and preservation of Urak Lawoi language, Bo Lon Island. Department of Languages and Linguistics, Faculty of Liberal Arts, Prince of Songkla University.
- Amloy, A. (2017). Settlement of Urak Lawoi's Communities in Ko Lanta Yai, Krabi Province. Ph.D. Candidate in Vernacular Architecture, Faculty of Architecture, Silpakorn University.
- Chompunth, Ch. (2013). Good Governance and Public Participation in Decision-making Process of Development Project, *Journal of Environmental Management* 9(1): 85-106.
- Chonchat, Ch., (1982). Urak Lawoi independent spirit of the sea. *Osothomagazine* 22(8): 47-53.
- Deachpibal, S., (2010). The participation of the local community to manage and conserve the environmental quality of mangrove forest : A study exclusively of the local community in Phuket Province. Master of Arts (Public Affairs), Faculty of Political Science, Thammasat University.
- Haiwattananukool, K. (2015). Development of Good Governance in Environmental and Health Organization, Mahachulalongkornrajavidyalaya University.
- Jaroonthong, D. (2007). History of Urak Lawoi community on Lipe Island, Satun province, A.D.1950-2006. Master of Arts Department of History Graduate School, Silpakorn university.
- Khunweechaui, N. and Khunweechaui, M. (2010). Lives and Culture of Sea Gypsy "Urak Lawoi" in the Andaman Sea. Office of the National Culture Commission, Ministry of Culture.
- King Prajadhipok's Institute. (2016). Public participation. Retrieved From: <http://wiki.kpi.ac.th/index.php?title=%E0%B8%81%E0%B8%B2%E0%B8%A3%E0%B8%A1%E0>.
- Kongdechadisak, Ph. (2014). The People's Participation in Environmental Conservation at Koh Chang National Park, Koh Chang district, Trad province. Master of Public Administration, Public and Private Management Program, Graduate School of Public Administration, Burapha University.
- Kreuaui, N. (2011). Restoration and preservation of Urak Lawoi language, Bo Lon Island. Faculty of Liberal Arts, Prince of Songkla University, Hat Yai, Songkhla.
- Minakhon, Ch. (2011). People Participation in Community Garbage Management Tambon Bang Nang Li, Amphawa district, Samut Songkram province. Office of the Higher Education Commission, Suansunandha Rajabhat University.
- Ministry of Industry. (2010). Environmental Governance Guidelines. Environmental Governance Promotion Program in Industrial Establishments.
- Ngasaman, Ch. (1991). A study of Chao - Le's folktales in Changwat Satun. Master of Arts Program in Thai Studies, Srinakharinwirot University (Songkhla).
- Plathong, S. (2011). Fishery Resource Uses and Management Intervention at Adang-Rawi-Lipe Islands, Tarutao National Park, and Bulhon Islands, Mu Ko Phetra National Park. *Journal of Social Research* 34(2): 151-195.
- Prapruit, P. (2015). Sustainability Study of Small Islanders of the Urak Lawoi Island: A Case Study of Koh Lipe, Thailand. (Ph.D. thesis). Tropical Agricultural Resource Management, Prince of Songkla University, Hat Yai, Songkhla.
- Pratad, O. (2015). Participation of Citizens in Community Development in Fort Mahakan, Rattanakosin Island, Thailand. Master of Political Science (Public Affairs), Thammasat University.
- Provincial Development Strategy Group, Satun Province Office. (2015). Satun Provincial Development Plan 2014 - 2560 (revision). Satun, Provincial Development Strategy Group.
- Pukkalanun, N., (2013). Sustainable sensitive tourism area management model for quality of life development : Lipe Island, Kho Sarai sub-district, Mueang district, Satun province.

- Doctor of Philosophy Program Environmental Science, Faculty of Environment, Kasetsart University, Bangkok.
- Satun Primary Educational Service Area Office. (1990). The city of Satun 150th anniversary commemoration. Satun, Satun Primary Educational Service Area Office.
- Satun Provincial Administration Promotion Office. (n.d.). General information of Koh Lipe, Moo 7, Koh Sarai sub-district, Muang district, Satun province. Satun, n.p.
- Sirijamorn, S., and Poboorn, Ch. (2010). Good Governance in Environmental Management of Local Authority: A Case Study of Siracha Municipality, Chonburi. *Journal of Environmental Management* 6(1): 52-77.
- Sisungnoen, Ch., (2015). The good governance of the organization. Retrieved from: <https://sites.google.com/site/ajutaratsisungnone/phu-cad-tha>.
- Songkorsook, N., (1998). From concept to practice. Chiang Mai, Thai - German High Land Development Project office.

Effects of Gibberellin from Pseudo-stem of Banana to Increase the Stem Elongation in Marigolds by Cuttings

Puangbanyen, A.^{1*}, Phonpakdee, R.¹, and Anuchai, J.¹

¹Department of Agricultural Education, Faculty of Industrial Education, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand 10520

Abstract Stem elongation in marigold is controlled by gibberellins. The effects of gibberellin from the pseudo-stem of banana to increase the stem elongation in marigolds (*Tagetes erecta* L.) (by cuttings) was investigated. The result was found that the increasing of stem elongation in cutting apical bud of marigold by gibberellin from the pseudo-stem of banana inverted with synthetic gibberellin. The high volume of gibberellin from pseudo-stem of banana and synthetic gibberellin showed less induction of stem elongation. Application of gibberellin from synthetic or pseudo-stem of banana affected the stem stretching of the cutting apical bud in the first pinching better than the second pinching.

Keywords: Gibberellin, Banana pseudo-stem, Marigold

Introduction

Nowadays, Marigold becomes one of the most important economic plant of Thailand. It imported from other country but the crop grew easily on any soil type. In addition, Marigold can be get income approximately 2 billion baths by Thai farmer (Klinnimnuan, 2016). It is a popular plant for Thai farmer because it is easy to grow and invulnerable for insects and diseases. It can be harvested in 60-70 days and marigold flowers. Marigold can be planted in any season and any part of the country, so the farmer can schedule its planting program for harvesting. Poomsuwan) 1999(explained the cost of Marigold seeds are increased in the season. Each plant was removed the apical and lateral buds for well growing branches.

The marigold var. "Taewee" is a large flower and gold colour which is more demand in the markets. It has a strong structure and good quality after harvesting which the price was approximately 0.80 to 1.80 bath per flower (Jaimun, 2016). Rinla) 2015(explained that special marigold "Taewee" variety are planted by cutting method that was not success. Therefore, application of Gibberellin helps to increase the internode length, and boarder leaves. Moreover, Boonjarad) 2012(explained that the Gibberellin can stimulate plant growth. Gibberellin was applied high concentration can cause side effects to the plants.

Therefore, it is interested to test Gibberellin treated to marigold plants by cutting method. It can also be tested Gibberellin from pseudo-stem of

* **Coressponding Author:** Puangbanyen A; **E-mail address:** icecooling38053@gmail.com

banana for plant growth. The objective was to improve marigold's internode by cutting method using Gibberellin from pseudo-stem of banana.

Materials and methods

Marigold var Taewee was used in this study. The synthetic Gibberellin, and the natural Gibberellin from upper, middle and lower parts of banana pseudo-stem were used. Marigold seeds were planted in pots with mixture of sand and the coconut coir fiber at the ratio 1: 1. Seedlings were transplanted into black plastic bags which the mixture of sandy soil, rice hull, coconut coir fiber and rice husk at the ratio of 1 :1: 1 :1. The first apical buds were pruned when after four pairs of true leaves and the second axillary buds were pruned after 2 branches come out. Thereafter, the apical and axillary buds were cut and planted to the basket container which the mixture of rice hull and rice husk charcoal at the ratio of 1 :1. The natural Gibberellin from the pseudo-stem of banana was prepared by divided into upper, middle and lower parts. Each part was put in molass and water at ratio of 3:1 then for 7 days to yielded natural GA from upper, middle and lower parts of pseudo-stem gibberellins. The experiment was done using Randomized Complete Block Design) RCBD (with 7 treatments as follows:- T1= non-trated control, T2= synthetic GA 10 mg/L, T3= synthetic GA 20 mg/L, T4 = synthetic GA 30 mg/L, T5= GA from upper part of banana pseudo-stem, T 6= GA from middle part of banana pseudo-stem, T7 = GA from lower part of banana pseudo-stem. Data were collected as internode length (cm) and calculate into the increased percentage.l

Results

Result showed the first pruning of marigold plants that synthetic GA at concentrations 10, 20 and 30 mg/L gave the internode length of 1.50, 3.97, 3.81 cm, respectively, and the natural GA from upper, middle and lower pseudo-stem of banana at the concentration 7.5 cc/10 L resulted to get the internode length of 1.94, 0.87 and 0.79 cm., respectively when compared to the non-treasted control was 0.,04 cm. The synthetic GA at concentrations of 10, 20 andc 30 mg/L increased internode length of 97.33, 98.99, 98.95 %, respectively and the natural GA from upper, middle and lower pseudo-stem of banana at the concentration 7.5 cc/10 L increased internode length of 97.93, 95.40 and 91.13 %, resp[etively.

The second pruning of marigold plants were treated with synthetic GA at concentrations 10, 20 and 30 mg/L which resulted to internode length of 3.99, 2.99, and 2.89 cm., respectively when the non-treated control was 0.43 cm. The natural GA from upper, middle and lower pseudo-stem of banana at the concentration 7.5 cc/10 L showed internode length of 1.64, 0.94 and 0.94 cm, resp[ectively. The synthetic GA at concentrations of 10, 20 andc 30 mg/L increased internode length of 89.22, 85.61 and 85.12 %, respectively. The natural GA from upper, middle and lower pseudo-stem of banana at the

concentration 7.5 cc/10 L increased internode length of 74.39, 54.42 and 54.42 %, resp[etively (Table 1).

Table 1. Internode length (cm) after the first and second prunings

Treatments	1 st pruning	percentage	2 nd pruning	percentage
T1 Non-treated control	0.04	-	0.43	-
T2 synthetic GA 10 mg/L	1.50	97.33	3.99	89.22
T3 synthestic GA 20mg/L	3.97	98.99	2.99	85.61
T4 GA synthestic GA 3 0mg/L	3.81	98.95	2.89	85.12
T5 natural GA (upper pseudo-stem of banana) 7.5 cc/10 L	1.94	97.93	1.64	74.39
T6 GA natural GA (middle pseudo-stem of banana) 7.5 cc/10 L	0.87	95.40	0.94	54.42
T7 natural GA (lower pseudo-stem of banana) 7.5 cc/10 L	0.79	91.13	0.94	54.42

Discussion

The first and second prunings of marigold plants that synthetic GA at concentrations 10, 20 and 30 mg/L and the natural GA from upper, middle and lower pseudo-stem of banana at the concentration 7.5 cc/10 L showed the internode length better than the no-treated fontrol. It is proved thsat the natural GA can be enlarged the internode of marigold which Petchna)2015(stated that the apical meristems produce necessary auxin and transport to the other parts of the plant.

Natural Gibberrellin from pseudo-stem of banana increase the stem elongation of marigold as similar report of Augustyn A. (2012).

However, the length of internode affected by Gibberrellin from pseudo-stem of banana is shorter than synthetic Gibberrellin. This may due to different in tested concentrations Stowe and Yamaki)1957(confirmed that high concentration of Gibberrellin application cause negative effect to the growth rate of plants.

In addition, the Gibberrellin at the concentration of 300 milligrams/litre affated to Marigold flower stem decreased when compared o the concentration of 50, 100, 150, and 250 milligrams/litre (Suhirun, 1992.(

Acknowledgement

This special project has been done successfully due to a significant assistance from Associate Professor Dr .Ratchadakorn Phonpakdee and Dr .Jatuporn Anuchai, Lecturers of Department of Agricultural Education, Faculty of Industrial Education and Technology at King Mongkut's Institute of Technology Ladkrabang.They act as project advisor and co-advisor .I would like to thank them for their time to give me advises and guidelines to achieve the project.

References

- Augustyn, A. (2012). Gibberellin. Retrieved from <https://www.britannica.com/science/gibberellin>
- Boonjarad, M. (2012). Produce Gibberellin hormone. Retrieved from <https://www.gotoknow.org/posts/497868>. 9 August 2012. 12799.html.
- Jaimun, S. (2016). (Sorndang " Marigold. Retrieved from https://www.prachachat.net/news_detail.php?newsid=1467796621.
- Klinnimnuan, W. (2016). "Rich with French Marigold" Kom Chad Luek Newspaper, pp. 4
- Petchna, B. (2015). (Bangkok Agriculture Extension Office: Plant Chemical substances. Retrieved from <https://www.pantown.com/board.php?id=30284>
- Poomsuwan, N. (1999). (Flower Market. Chiang Mai: Faculty of Agriculture, Chiangmai University under His Majesty's Graciousness.
- Rinla, W. (2015). (Cuttings French Marigold. Retrieved from <https://www.nectec.or.th/schoolnet/library/createweb/10000/science/10000->
- Stowe, B. B. and Yamaki, T. (1957). (The History and Physiological Action of the Gibberellins. Annual Review of Plant physiology 8:181-216
- Suhirun, A. (1992). (Using Gibberellin with Sovereign Marigold for growing a potted plant. Bangkok: King Mongkut's Institute of Technology Ladkrabang.

***Emericella* sp. and *Neosartorya* sp. for controlling *Colletotrichum capsici* caused Anthracnose of Chilli**

Thanomwong, A. and Soytong, K.*

Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Abstract The antagonistic fungi, *Emericella* sp. And *Neosartorya* sp. Were proved to be antagonized *Colletotrichum capsici* causing chilli anthracnose in laboratory. The causal agent of chilli anthracnose was isolate from lesion on chilli fruits then morphological identification under bi-nocular compound microscope. Pathogenicity was proved the isolate to be virulent for disease incidence on chilli fruits. Bi-culture antagonistic test were proved that *Emericella* sp. And *Neosartorya* sp. Significantly inhibited *C.capsici* Further research findings are being tested the antagonistic potential in pot experiment.

Keywords: *Emericella* sp., *Neosartorya* sp., *Colletotrichum capsici*, Bi-culture test.

Introduction

Colletotrichum is one of the most important plant pathogens worldwide causing the economically important disease anthracnose in a wide range of hosts including cereals, legumes, vegetables, perennial crops and tree fruits (Bailey and Jeger, 1992). Among these hosts, chilli (*Capsicum* spp.), an important economic crop worldwide (Poulos, 1992), is severely infected by anthracnose which may cause yield losses of up to 50% (Pakdevaraporn *et al.*, 2005). Typical anthracnose symptoms on chilli fruit include sunken necrotic tissues, with concentric rings of acervuli. Fruits showing blemishes have reduced marketability (Manandhar *et al.*, 1995). The health benefits of chili consumption and its active ingredients continue to be investigated using in vitro and in vitro biological models as well as theoretical and experimental models. Capsaicinoids and flavonoids are the determinant compounds of color, flavor, texture and aroma of food prepared with chilis. A common question among health specialists is whether chili consumption improves health or contributes to disease development. The chili fruit contains up to 15 or more capsaicinoid compounds. Among the majority are capsaicin, dihydrocapsaicin and nordihydrocapsaicin; in flavonoid content, quercetin, apigenin and luteolin are notable as well as some catechins and cyanidins. Thus, one does not only ingest vitamins B₁, B₂ and C, minerals, carotenoids and phenols by chili consumption. Chili is an indispensable species and vegetable crops used as a basis of its high consumption. Chili fruits are consumed as fresh, dried or processed products. (Araceli M. Vera-Guzmán). Anthracnose causes extensive pre- and post-harvest damage to chilli fruits causing anthracnose lesions. Even small anthracnose lesions on chilli fruits reduce their marketable value (Manandhar *et al.*, 1995). Many post-harvest diseases of fruit exhibit the phenomenon of quiescence in which symptoms do not develop until the fruit ripens

Chili varieties are severely damaged by anthracnose. Chemical agents cannot completely controlled chili anthracnose caused by *C. capsici*. Biological control of diseases by using microbial antagonists *Emericella* sp. and *Neosartorya* sp. are investigated.

* **Corresponding author:** Soytong, K.; **E-mail** ajkasem@gmail.com

Materials and methods

Isolation and morphological study of chili anthracnose

Isolation of fungal pathogens of anthracnose chili Fungus *Colletotrichum capsici* by tissue transplanting technique. Bring the chili disease cut the infected area into normal tissue into 4 small pieces, soaked in 10% Clorox for 3 minutes. Then wash with sterile water 2 times, dry with sterile filter paper. The leaves were then placed on a plate of water agar (WA) with 4 incubation beds at room temperature. Until the mycelial of the fungus grows out of the plant parts. Then drill at the end of the mycelial with a cork borer and place it at the center of the potato dextrose agar (PDA) at room temperature for full mycelial growth and then examine the specimen under the microscope to see that a disease caused by anthracnose disease Koch's postulation.

Isolation and morphological study of antagonist fungi

Emericella sp. And *Neosartorya* sp. were supported by Associate Professor Kasem Soyong and subculture to PDA media for morphological study.

Pathogenicity test

Make an at the chilli by needle after that agar plug, Agar plug on the wound. Do all 4 repeats, which are defined as sets of inoculated control, do the same, but the underlying cause is agar drill down on wounds instead. Do all 4 repeats, then stored in plastic box clean. Insert a tampon that is drenched in water into the box so that the moisture. Then as the room temperature curing time 7 days to see changes, and size of the lesion is the infection struck. Save the laphon to measure the diameter of the wound. Disease reaction was scored on a 0–4 point scale that was modified from the disease scoring scale described by Dasgupta (1981): 0 = healthy plant; 1= fruit with a necrotic lesion; 2= fruit with a necrotic lesion or a larger water soaked lesion surrounding the infection; 3= fruit showing a necrotic lesion, possibly acervuli, or a water-soaked lesion; 4= fruit covered with a necrotic lesion with acervuli.

Bi culture test

Bi culture test of *Emericella* sp. and *Neosartorya* sp. in the control of anthracnose disease Caused by infection *Colletotrichum capsici*.

Drill at the end of the disease pathogens with a 0.5 mm diameter cork borer onto the PDA media and place it on the left side away from the edge of the plate. Set the control unit to do all 4 repetitions per experiment. Test the efficacy of anti-dual culture by biting at the tip of the cork borer on the left side of the PDA media away from the edge of the dish. *Emericella* sp. Was then placed on the right side at the right side of the plate, away from the edge of the dish *Neosartorya* sp. Did the same. Repeat 4 times at room temperature.

Waiting for the fiber to grow full plate Record the results by measuring the diameter and counting the spores haemacytometer Calculate the percentage restriction as follows:

$$\text{Percentage of inhibition} = [(A - B) / A] \times 100$$

Where A is the mean diameter of the fungal colonies grown on the fungus.

B is the average diameter of the fungal colonies grown on the culture medium. (Plapung, 2004)

Results

Morphological characterization of Colletotrichum capsici

Colony is slow-growing, reaching 9 cm diameter in 12 days at 28-32° C on PDA. The colony colour of *Colletotrichum capsici* was determined on PDA. The colony colour of *C. capsici* is gray to dark gray with producing pigment . Single conidia are curved like a sickle and the spikes are called setae.

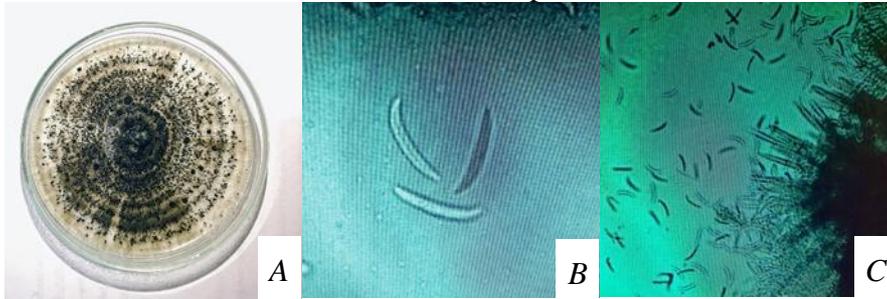


Figure 1. A: Colony of *C. capsici* on PDA ; B: single colony ; C: setae

Morphological characterization of Emericella sp.

Colony is fast-growing, reaching 9 cm diameter in 7 days at 28-32° C on PDA. Ascospores globose or subglobose stellate or appendaged . The colony colour of *Emericella sp.* Is brown in the centre and olive brown in the margins.

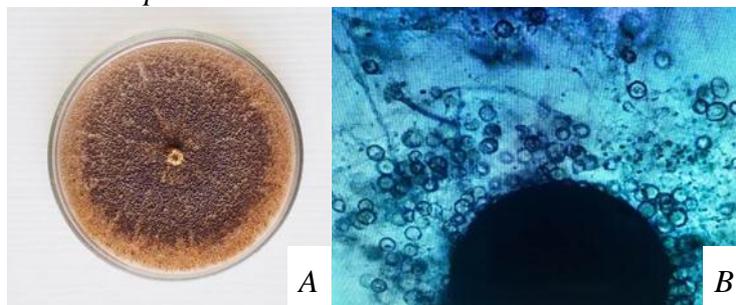


Figure 2. A. Colonies on PDA growing rapidly at room temperature, 55–60 mm diam. in 14 d, granulose, consisting of masses of ascomata surrounded by hyphae and hulle cells ; conidiophores scarcely produced ; reverse dark brown to violet brown; exudate yellowish.(A. M. STCH IG E L, J. CANO AND J. GUARRO), B. product cliestothecium round shape.

Morphological characterization of *Neosartorya* sp.

Colony is slow-growing, reaching 9 cm diameter in 14 days at 28-32° C on PDA. The colony colour of *Neosartorya* sp. is yellow with producing pigment.

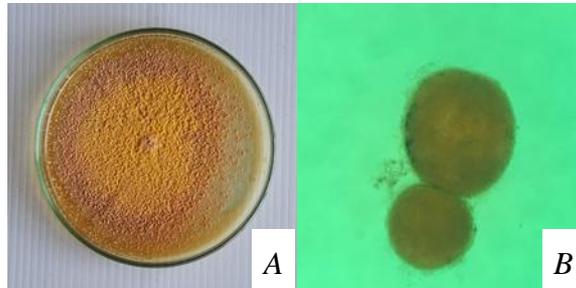


Figure 3. A. Colony *Neosartorya* sp. in PDA media , B. Homothallic, cleistotheca superficial, scattered, white to yellowish white, globose to subglobose, hyaline aerial hyphae; peridium yellow to yellowish brown, thin membranaceous, consisting of angular. (Amnat, 2013)

Pathogenicity test



Table 1. Disease Severity Index of chilli anthracnose

Treatments	Disease Severity Index
Control	0
<i>Colletotrichum capsici</i>	2.50

0 = healthy plant; 1= fruit with a necrotic lesion; 2= fruit with a necrotic lesion or a larger water soaked lesion surrounding the infection; 3= fruit showing a necrotic lesion, possibly acervuli, or a water-soaked lesion; 4= fruit covered with a necrotic lesion with acervuli.

Bi - culture test



Figure 5. A: Bi-culture of *Emericella* sp. Vs. *Colletotrichum capsici* ; B: *Neosartorya* sp Vs. *Colletotrichum capsici* at 30 days.

Table 2 Colony diameter, number of conidia, percent inhibition of colony and conidia of *Emericella* sp. And *Neosartorya* sp. In Bi-culture test at 30 days

Treatments	Colony diameter (cm)	%inhibition of colony growth
control	9.00a	
<i>Emericella</i> sp.	3.95b	58.59%
<i>Neosartorya</i> sp.	4.32bc	51.94%
C.V.	3.53	

Average of four replication, Means followed by the same letters were not significantly different by DMRT at P=0.05,

Discussion

The antagonistic fungi, *Emericella* sp. and *Neosartorya* sp. were proved to be antagonistic *Colletotrichum capsici* causing chilli anthracnose in laboratory. The causal agent of chilli anthracnose was isolate from lesion on chilli fruits then morphological identification under bi-nocular compound microscope. Pathogenicity was proved the isolate to be virulent for disease incidence on chilli fruits. Bi-culture antagonistic test were proved that *Emericella* sp. and *Neosartorya* sp. Traditionally, *Colletotrichum* species have been identified and delimited on morphological characters; several features have been utilized by taxonomists including size and shape of conidia and appressoria; presence or absence of setae, sclerotia, acervuli and teleomorph state and cultural characters such as colony colour, growth rate and texture (Simmonds, 1965; Smith and Black, 1990; Sutton, 1992; TeBeest *et al.*, 1997; Photita *et al.*, 2005; Than *et al.*, 2008a-c; Thaung, 2008). colony diameter formed by *F. oxysporum* f. sp. lycopersici. The pathogen grown in the control plate grew faster and significantly formed larger colony diameter with a mean of 8.97 cm while those in the biculture plate produced smaller colony with a

mean diameter of 6.17 cm. The *E. nidulans*, the fungal antagonist, caused 31.18%. (Sibounnavong, P. 2009)

Acknowledgement

I would like to thank Dr. Kasem Soyong, my adviser, and special thank to KMITL for research fund.

References

- Bailey, J. A, Jeger, M. J. (1992). *Colletotrichum*: Biology, Pathology and Control. Wallingford: Commonwealth Mycological Institute, pp. 388.
- Dasgupta, B. (1981). Sporulation and relative virulence among isolates of *Colletotrichum capsici* causing anthracnose of betelvine. Indian phytopathology.
- Emvijarn, A. (2013). *Neosartorya* species: Diversity, Morphology, Phylogeny, Antagonistic Tests Against Plant Pathogenic Fungi and Secondary Metabolites of *N. pseudofischeri*, Thesis Arpphova Graduate School, Kasetsart University.
- Manandhar, J. B., Hartman, G. L. and Wang, T. C. (1995). Anthracnose development on pepper fruits inoculated with *Colletotrichum gloeosporioides*. Plant Disease 79:380-383.
- Pakdeevaporn, P., Wasee, S., Taylor P. W. J. and Mongkolporn, O. (2005). Inheritance of resistance to anthracnose caused by *Colletotrichum capsici* in *Capsicum*. Plant Breeding 124(2):206-208.
- Photita, W., Taylor, P. W. J., Ford, R., Lumyong, P., McKenzie, H. C. and Hyde, K. D. (2005). Morphological and molecular characterization of *Colletotrichum* species from herbaceous plants in Thailand. Fungal Diversity 18: 117-133.
- Plapung, P. (2004) Improvement of Anthracnose Resistant Strawberry. (Master thesis). Chiang Mai University.
- Poulos, J. M. (1992). Problems and Progress of Chilli Pepper Production in the Tropics. In: Proceedings of the Conference on Chilli Pepper Production in the Tropics. Malaysia: Kuala Lumpur, pp. 98-129
- Sibounnavong, P., Soyong, K. Divina, C. C. and Kalaw, S. P. (2009). In vitro biological activities of *Emericella nidulans*, a new fungal antagonist, against *Fusarium oxysporum* f. sp. lycopersici. Journal of Agricultural Technology 5: 75-84.
- Simmonds, J. H. (1965). A study of species of *Colletotrichum* causing ripe fruit rots in Queensland. Queensland Journal of Agriculture and Animal Science 22: 437-459.
- Smith, B. J. and Black, L. L. (1990). Morphological, cultural, and pathogenic variation among *Colletotrichum* species isolated from strawberry. Plant Disease 74: 69-76.
- Stchigel, A. M., Cano, J. and Guarro, J. (1999). A new species of *Emericella* and a rare morphological variant of *E. quadrilineata*. Mycological research 103(8): 1057-1064.
- Sutton, B. C. (1992). The genus *Glomerella* and its anamorph *Colletotrichum*. In: *Colletotrichum: biology, pathology and control*. CAB International, Wallingford: 1-26.
- TeBeest, D. O., Correll, J. C. and Weidemann, G. J. (1997). Specification and population biology in *Colletotrichum*. In: *The Mycota V, part B*. Springer-Verlag Berlin Heidelberg: 157-168.
- Thaug, M. M. (2008). Coelomycete systematics with special reference to *Colletotrichum*. Mycoscience 49: 345-350.
- Vera-Guzmán, A. M., Aquino-Bolaños, E. N., Heredia-García, E., Carrillo-Rodríguez, J. C., Hernández-Delgado, S., & Chávez-Servia, J. L. (2017). Flavonoid and Capsaicinoid Contents and Consumption of Mexican Chili Pepper (*Capsicum annuum* L.) Landraces. In *Flavonoids-From Biosynthesis to Human Health*. InTech.

Efficacy of *Eurotium* sp. and *Serratia* sp. to control Brown leaf spot disease of rice caused by *Drechslera oryzae*

Unthuraloet, K. and Soyong, K.*

Department of Plant Production Technology, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.

Abstract *Eurotium* sp is antagonistic fungus and *Serratia* sp. is antagonistic bacteria that were proved to be antagonisted *Drechslera oryzae* causing rice brown spot disease in laboratory. The causal agent of rice brown spot disease was isolated from lesion on leaves, then morphological identification under compound microscope. The rice pathogen was proved to be pathogenic isolate by Koch's Postulate method. Dual culture tests between the antagonists and the pathogen were proved that *Eurotium* and *Serratia* sp. significantly inhibited *Drechslera oryzae*. Furt her research findings are being tested the antagonistic potential in pot experiment.

Keywords: Brown leaf spot, *Drechslera oryzae*, *Eurotium*, *Serratia*, Dual cultuer

Introduction

Rice (*Oryza sativa* L.) is one of economically stable crop in the world. During cultivation of rice, weed, pests and diseases are invaded to destroy the plants and low yield (Thawat *et al.*, 1997). Rice crop is frequently affected by about 50 diseases which include 6 bacterial, 21 fungal, 4 nematodes, 12 viral and 7 other diseases and disorders (Hollier *et al.*, 1993; Webster and Gunnell, 1992) However, major diseases are rice blast, brown spot, bacterial leaf blight, sheath blight, sheath rot, Bakanae, stem rot, tungro, false smut and post-harvest diseases (Sharma and Bambawale, 2008). It is estimated that about 14-18% grain yield losses were caused by these diseases worldwide (Mew and Gonzales, 2002). *Drechslera oryzae* (Breda de Haan) Subram and Jain was revised the name from *Helminthosporium oryzae* Breda de Haan (Alcorn, 1988). The fungus causes leaf spot disease of rice seedlings (*Oryza sativa*), the fungus will spread to the internal field and hard and can cause death of seedlings to 10-58%. The output reduced up to 45% in severe infections and infections in 12% of the average level in 1942, has reported losses of 50-90% yield and also causes the death of the population. 2 million peoples with the disease in India, which yielded 14-41 % loss in high-yielding varieties. Under the right environment and the state of Florida in the United States are reported to lose up to 16-40% of the total rice production (IRRI, 1983). Farmers often use chemicals to prevent disease is harm to organisms and environment. We conducted a study on the effectiveness of microorganisms to control plant

* **Corresponding author:** Soyong, K.;**E-mail** ajkasem@gmail.com

diseases, by using *Eurotium* sp. and *Serratia* sp as antagonists to reduce brown leaf spots of rice.

Materials and methods

Isolation of fungal pathogens

Isolation of fungi pathogens of rice brown spot disease by tissue transplanting technique. Bring the rice leaves disease cut the infected area into normal tissue into 4 small pieces, soaked in 10% Clorox for 3 minutes. Then wash with sterile water 2 times, dry with sterile filter paper. The leaves were then placed on a plate of water agar (WA) with 4 incubation beds at room temperature. Until the fiber of the fungus grows out of the plant parts. Then drill at the end of the fiber with a cork borer and place it at the center of the potato dextrose agar (PDA) to cure at room temperature for full fiber growth and then examine the specimen under the microscope to see that a disease caused by anthracnose disease Koch's postulation.

Pathogenicity testing

The spore concentration was standardized to 1×10^5 spores/ml. were inoculated on rice leaves 21 days by spraying 15 to 20 ml of spore suspension for 4 replication at room temperature curing time 5 days to see changes, and size of the lesion is the infection struck. After inoculated measure the disease level.

Disease reaction was scored on a 0–10 point scale for the scoring of brown leaf spot of rice caused by *Drechslera oryzae* given by IRRI (2009)

Study to morphology of fungi

Transferred pure culture of fungi *Drechslera oryzae* and *Eurotium* sp. and check morphology under microscope.

Study to morphology of bacteria

Gram-stained bacteria *Serratia* sp. and check morphology under microscope.

Bi - culture test

Drechslera oryzae and *Eurotium* sp.

Use cork borer drill petri dish of *drechslera oryzae* put on PDA at the left of petri dish (control) and drill petri dish of *Eurotium* sp. put on PDA at the right of petri dish (control) and petri dish of Dual culture use cork borer drill petri dish of *drechslera oryzae* and put on PDA at the left of petri dish and drill of *Eurotium* sp. put on PDA at the right of petri dish.

***Drechslera oryzae* and *Serratia* sp.**

Use cork borer drill petri dish of *drechslera oryzae* put on PDA at the left of petri dish (control) and streak plate *Serratia* sp. one line at the right of

petri dish (control) and petri dish of Dual culture use cork borer drill petri dish of *Drechslera oryzae* and put on PDA at the left of petri dish and streak plate *Serratia* sp. one line at the right of petri dish.

Waiting for the fiber to grow full plate Record the results by measuring the diameter and counting the spore haemocytometer calculated the percentage restriction as follows.

$$\text{Percentage of inhibition} = [(A - B) / A] \times 100$$

By A is the mean diameter of the fungal colonies grown on the fungus. B is the average diameter of the fungal colonies grown on the culture medium (Charkree *et al.*, 2007).

Results

Pathogenicity test

The Disease Incidence of rice is 14.44% at low level. By measure size of the wound for four replication. The dark brown spots are surrounded by yellowish brown leaf edges. The wound oval.

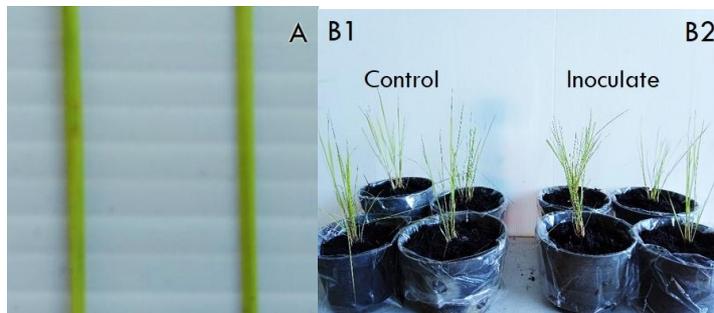


Figure 1. A: lesion of brown spot disease, B1: Control B2: Inoculated with *Drechslera oryzae*.

Table 1. Disease Incidence Index of rice brown leaf spot

Treatments	Disease Infection Index (%)
Control	0.0000 ^b
<i>Drechslera oryzae</i>	2.2750 ^a
CV%	10.6164

Morphology of *Drechslera oryzae*

The fungus produces gray or brown mycelial, Brown conidia with multiple cells, Airborne and can be crossed in the form of conidia and conidiophore on plant debris, *Drechslera oryzae* stick to the seeds is alive without dying (Jiradet, 2531) and showed a gray or brown hyphae and conidia brown color with multiple cell. Colony is growing, reaching 12 cm. diameter in 7 days at 28-32°C on PDA.

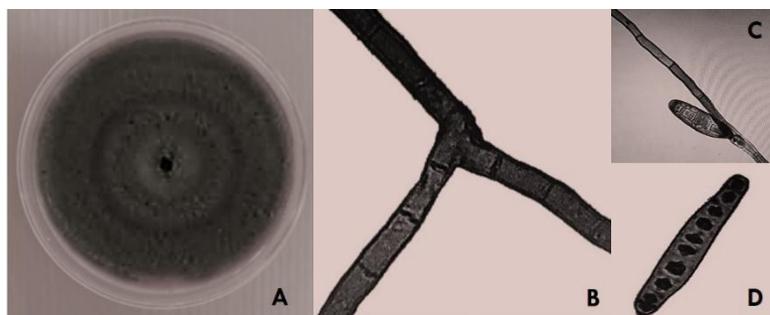


Figure 2. Colony of *Drechslera oryzae*, B: Hyphae of *Drechslera oryzae*, C: Spore on the hyphae of *Drechslera oryzae*, D: Spore of *Drechslera oryzae*.

Morphology of *Eurotium* sp.

Eurotium sp. colony is fast-growing, reaching 9 cm. diameter in 7 days at 28-32°C on PDA. *Eurotium* sp are the teleomorphic stage of *Aspergillus* sp. (Kralj *et al*, 2006) *Eurotium* is common and is most closely related to *Emericella*, another genus with *Aspergillus* anamorphs. *Eurotium* is likely to be present along with related *Aspergilli* if growth has been long term and the nutrients of the substrate are conducive for the conversion to sexual phase. If *Eurotium* spores are isolated on culturable (Andersen) sampling, the *Aspergillus* anamorph is likely to be the identifiable result, at least with primary growth within one week. Occurs on substrates low in moisture (xerophilic). *Eurotium* sp. showed white colony and a white hyphae and 8 ascospores in ascus.

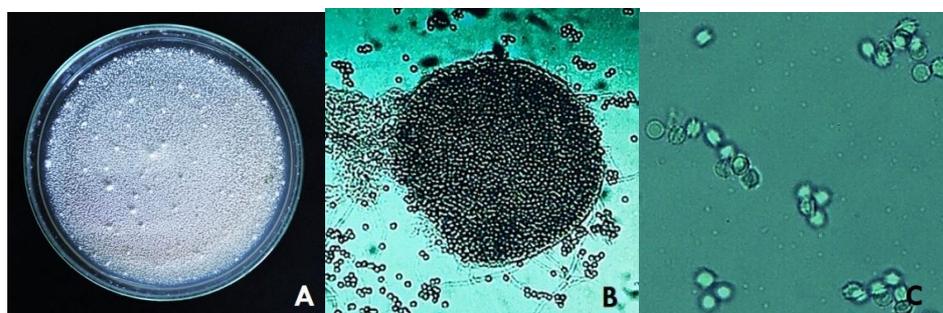


Figure 3. A : Colony of *Eurotium* sp., B : Asci and ascospores of *Eurotium* sp., C : Ascospores of *Eurotium* sp.

Morphology of *Serratia* sp.

Serratia sp. colony is fast-growing, reaching 9 cm. diameter in 7 days at 28-32°C on NA. *Serratia* sp. is a Gram-negative, facultatively anaerobic, straight rods with rounded ends, size 0.5-0.8 micrometers by 0.9-2.0 micrometers, usually motile by peritrichous flagella and colonies often appear opaque, somewhat iridescent, white, pink, magenta, or red. Cultures can

produce two kinds of odors, a fishy to urinary odor or a musty, potato-like odor (Koneman, *et al.* 1997).

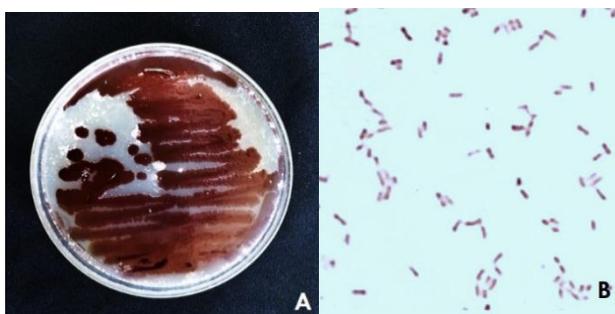


Figure 4. A: Colony of *Serratia* sp., B: Cell of *Serratia* sp.

Bi - culture test



Figure 4. Dual culture A: *Serratia* sp. and *Drechslera oryzae*, B: *Eurotium* sp. and *Drechslera oryzae*

Table 2. Colony diameter, number of conidia, percent inhibition of *Drechslera oryzae* colony and conidia of *Eurotium* sp. and *Serratia* sp. in dual culture test at 30 days.

Antagonist fungi	<i>Drechslera oryzae</i>	
	Colony(cm)	% inhibition of colony
Control	9.00 ^a	100 ^a
<i>Eurotium</i> sp.	5.00 ^b	54.1625 ^b
<i>Serratia</i> sp.	4.00 ^c	37.2175 ^c
CV%	6.68	13.4918

Discussion

The fungus *Drechslera oryzae* morphology is similar to report of Jiradet (2531) as follows the fungus produces gray or brown mycerial, Brown conidia with multiple cells and pathogenicity test showed the dark brown spots are surrounded by yellowish brown leaf edges. The wound oval according to reports of Adul and Saman (1981) and dual culture percent inhibition of *Eurotium* sp. can inhibit *Drechslera oryzae* at 54.16% similar to the report of as follows *Eurotium* sp. can inhibit *Alternaria brassicicola* at 47.70% and

Serratia sp. this research can inhibit *Drechslera oryzae* 37.21% according to reports of Dhar Purkayastha (2018) *Serratia* can inhibit *Lasiodiplodia theobromae* 51.50%.

Acknowledgement

I would like to thanks Dr. Kasem Soyotong, my adviser, and special thanks to KMIITL for research fund.

References

- Abdin, M. Z. and Ilah, A. (2007). Plant regeneration through somatic embryogenesis from stem and petiole explant of chicory (*Cichorium intybus* L). Indian Journal of Biotechnology 6:250-255.
- Abliz, P., Horie, Y., Hui, Y., Nishimura, K. and Li, R. (2001). New and interesting species of Eurotium from Chinese soil. Mycoscience 42: 289-294.
- Holt, J. G. (1986). Bergey's Manual of Systemic Bacteriology, Vol. I & II. Williams & Wilkins, Baltimore, MD.
- Holt, J. G. (1994). Bergey's Manual of Determinative Bacteriology, 9th e d. Williams & Wilkins, Baltimore, MD.
- Khalili, E., Sadravi, M., Naeimi, S., & Khosravi, V. (2012). Biological control of rice brown spot with native isolates of three Trichoderma species. Brazilian Journal of Microbiology 43(1): 297-305.
- Koneman (1997). Color Atlas and Textbook of Diagnostic Microbiology, 5th ed. Lippincott, Philadelphia, PA. Library of Congress subject headings for this publication: Diagnostic microbiology.
- Murray, P. R. (1995). Manual of Clinical Microbiology, 6th ed. American Society for Microbiology, Washington, D.C.
- Mwendo, M. M., Ochwo-Ssemakula, M., Mwale, S. E., Lamo, J., Gibson, P. and Edema, R. (2017). Inheritance of resistance to brown spot disease in upland rice in Uganda. Journal of Plant Breeding and Crop Science 9(4): 37-44.
- Purkayastha, G. D., Mangar, P., Saha, A. and Saha, D. (2018). Evaluation of the biocontrol efficacy of a *Serratia marcescens* strain indigenous to tea rhizosphere for the management of root rot disease in tea. PloS one 13(2), e0191761.
- Soyotong, K. (2014). Bio-Formulation of Chaetomium cochliodes for Controlling Brown Leaf Spot of Rice. International Journal of Agricultural Technology 10(2): 321-337.
- Taboonpong, K. Manoch, L. Chamswarng, C. and Piasai, O. (2014). Diversity of Microfungi in Marine Sediments from the Gulf of Thailand and Andaman Sea and the In Vitro Antagonistic Activity against Plant Pathogenic Fungi. Thai Journal of Agricultural Science 47(2): 99-108.

The application of carbon balance for low carbon society development in Kut Chik sub-district municipality, Sung Noen district, Nakhon Ratchasima province, Thailand.

Banchajarurat P., Viriya, H.* and Kongritti, N.

¹Faculty of Science and Technology, Nakhon Ratchasima Rajabat University, Nakhon Ratchasima, 30000, Thailand.

Abstract The application of carbon balance for low carbon society development was conducted in Kut Chik sub-district municipality Sung-noen district, Nakhon Ratchasima province, Thailand. Total greenhouse gas emission from consumption of food and energy of residence (1,193 households) in Kut Chik sub-district municipality was analyzed to compare with CO₂ absorption efficiency of non-natural plant in 8 public areas (592 hectares) in this municipality. The result showed that the greenhouse gas emissions from consumption was 2,462.4986 ton CO₂eq / year whereas CO₂ absorption was 24.325 ton CO₂eq / year. It showed that the storage of greenhouse gases in biomass form of non-natural plants in public areas. It was not enough to absorb greenhouse gases from consumption of people in Kut Chik sub-district municipality. Therefore, people in Kut Chik should reduce consumption and increase the green space with efficiency economic.

Keywords: Biomass, global warming, greenhouse gas, low carbon society

Introduction

The environment is changed in surrounding ecosystem. The major negative impacts are droughts, floods, landslides, earthquakes, forest fires, tsunamis, tropical cyclones, melting icebergs, extinct animals, and other ecosystems. Life and death are the chain of problems. Human imbalance Make the world warmer Atmosphere is more destroyed. Scientists from various organizations. Trying to find a solution . In 2013, Thailand released 265.9 million tons of greenhouse gases, including emissions from the transition to land use and forestry sectors. The 11th National Economic and Social Development Plan identifies the development and driving of the country to prepare for a low carbon and eco-friendly economy and society. (Office of the National Economic and Social Development Board 2014). The policy was to develop into a low carbon city that lead to mitigate the climate change in the world. From the Brainstorming Documents the direction of the 12th National Economic and Social Development Plan is still important. Natural Resources and Environment to solve the environmental problem. There is a need for research to develop a low carbon society by applying carbon balance processes. In the area of Kut Chik sub-district Municipality, Sungnoen District, Nakhon Ratchasima Province Thailand. By analyzing greenhouse gas emissions from consumption activities and energy

* **Corresponding Author:** Haritsalak ,V.; **E-mail:** Both.Wealth@gmail.com

consumption. In addition, an analysis of the potential for carbon capture in the biomass of non-naturally occurring green areas in Kut Chik sub-district Municipality, Sungnoen District, Nakhon Ratchasima Province. The data were analyzed for carbon balance of the community. This research would benefit urban development, and low carbon society in the eco-city.

Materials and methods

The concept was to prevent and solve the current and future global warming in the area of Kut Chik sub-district municipality, Sungnoen district, Nakhon Ratchasima province. It was a prototype area for research to find patterns in environmental management. The daily use in public was analyzed the amount of greenhouse gases from daily energy consumption and consumption activities compared with the analysis of carbon sequestration in the biomass of non-natural occurring trees in public areas. A total of 120 from 1,193 households were selected from the Program G * Power 3.0.10. The distribution of the area and then data were collected by training. This was a collaboration of volunteer from Kut Chik Health Promotion Hospital and provided data from sample households. The input data with the carbon emission GHGS (emission factor) of each. Information were consumed. Consumption and energy consumption made people in Kut Chik sub-district municipality and greenhouse gas emissions per person per year were calculated. The carbon storage of trees in the public area of Kut Chik sub-district municipality was also studied. Appropriated sizes and kind of trees were selected. The diameters of trees at DBH (diameter at breast height, 1.30 meters) were measured using a tape measure and then algometric equation was applied. Amount of carbon capture and carbon sequestration were investigated. These data used to compare with the same tree in another year. This get the information of carbon sequestration in trees that occur naturally in a year.

Results

The results of The Use of Carbon Balance in Developing Low Carbon Society in Kut Chik sub-district municipality Sungnoen district, Nakhon Ratchasima province, Thailand was reported. From the energy consumption and greenhouse gas emissions income households was recorded. The volume of greenhouse gas emissions in population village 1 averaged to all activities was 530.9228 kgCO₂eq. The amount of greenhouse gas emissions in among a population village 2 averaged to all activities was 436.0415 kgCO₂eq. The volume in greenhouse gas emissions of the population village 4 (district Nakhlang part) included all the activities was 117.8591 kgCO₂eq, which averaged individual as 2.1355 kgCO₂eq. The registration was done as 2,668 people that had the greenhouse gas emissions at the municipal district of Kut Chik liberation was 5,697.514 kgCO₂eq / day and a number of year for the amount of greenhouse gases in Kut Chik sub-district released as 2,079,592.61 kgCO₂eq or 2,079.5926 tonCO₂eq / year.

Table 1. Greenhouse gas emission in study villages.

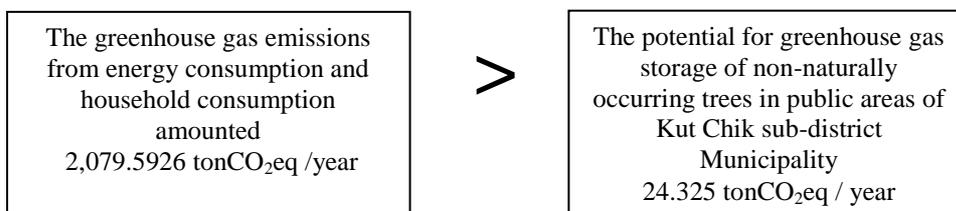
The volume of greenhouse gas emissions	
Village 1	530.9228 kgCO ₂ eq
Village 2	436.0415 kgCO ₂ eq
Village 4	117.8591 kgCO ₂ eq
Average	2.1355 kgCO ₂ eq / person

The potential sequestration of greenhouse gases tree did not occur naturally in the public areas with the number of 930 trees together the trapping greenhouse gases, the entire trees was 98,697.64 kgCO₂eq. It started to storage for 1 year, the amount of greenhouse gas capture and storage of whole trees was 123,022.946 kgCO₂eq. It had information within a year, the trees did not occurred naturally in Kut Chik sub-district Municipality potential sequestration of greenhouse gas was 24,325.31 kgCO₂eq / year or 24.325 tonCO₂eq / year.

Table 2. Greenhouse gas emission from different areas in different times in Kut Chik sub-district.

Location	Number of trees	Time 1 (kgCO ₂ e)	Time 2 (kgCO ₂ e)	difference/year
Kut Chik wittaya school	239	10,434.42	12,061.58	1,627.16
Jaturakram Sarmmakae school	49	5,546.12	8,842.77	3,296.65
Kut Chik sub-district office	58	15,372.97	16,340.04	967.07
Kut Chik Health Promotion Hospital	35	5,823.10	6,722.84	899.74
Bann Kut Chik school	90	27,744.72	34,513.02	6,768.30
Kut Chik temple	156	9,891.35	18,245.84	8,354.49
Santi Silaram temple	82	7,707.03	9,092.79	1,385.76
Public Park	221	16,177.94	17,204.07	1,026.13
Total	930	98,697.64	123,022.95	24,325.31

Comparison of greenhouse gas emissions from energy consumption and household consumption. The potential for greenhouse gas storage of non-naturally occurring trees in public areas of Kut Chik sub-district Municipality, Sung Noen District, Nakhon Ratchasima Province.



Discussion

People in Kut Chik sub-district Municipality Sungnoen District, Nakhon Ratchasima Province. The greenhouse gas emissions of the average consumer, consisting of rice 0.3099 kgCO₂eq / person / day, drinking water 0.0011 kgCO₂eq / person / day, pork 0.3479 kgCO₂eq / person / day , beef 0.0845 kgCO₂eq / person / day, chicken 0.7139 kgCO₂eq / person / day, fish 0.6378 kgCO₂eq / person / day, eggs 5.5874 kgCO₂eq /person/day, oil 0.1194

kgCO₂eq / person / day, tea & coffee 4.2598 kgCO₂eq / person / day and milk 0.5546 kgCO₂eq / person / day . The top three consumption contributes to greenhouse gas emissions are highest. Eggs, tea & coffee and chicken. This is the discharge or emission factor of 6.1316 kgCO₂eq / kg, 7.9600 kgCO₂eq / glass and 5.1935 kgCO₂eq / kg, respectively. And peoples in Kut Chik sub-district Municipality Sungnoen District, Nakhon Ratchasima Province. The greenhouse gas emissions from the average fuel includes diesel, gasohol 91, gas, gasohol 95, NGV, LPG, gasoline E20, fuel E85, and LNG is 2.3721 kgCO₂eq / person /day, 1.0164 kgCO₂eq /person/day, 0.5162 kgCO₂eq /person /day, 0.0365 kgCO₂eq /person /day, 0.1601 kgCO₂eq /person / day, 0.2256 kgCO₂eq /person/day, 0.0087 kgCO₂eq /person /day and 0.0815 kgCO₂eq /person /day and The top three most significant uses of greenhouse gas emissions were diesel, gasohol 91 and gasohol 95, which had 2.7446 kgCO₂eq / liter, 2.1896 kgCO₂eq / liter and 2.1896 kgCO₂eq / liter, respectively.

People in Kut Chik sub-district Municipality Sungnoen District, Nakhon Ratchasima Province. The emissions from the electricity and water supply as per person per day at 1.2327 kgCO₂eq / kWh and 0.1339 kgCO₂eq / m³, which is the discharge or emission factor of 0.5821 kgCO₂eq / kWh and 0.7043 kgCO₂eq / m³. And the carbon storage of trees in the public area of Kut Chik sub-district Municipality.(Kut Chik wittaya school, Jaturakram Sarmmakae school, Kut Chik sub-district office, Kut Chik Health Promotion Hospital, Bann Kut Chik school, Kut Chik temple, Kut Chik temple, Santi Silaram temple and Public Park) That does not happen naturally. The method used to explore each point. What size and what kinds of trees are appropriate. Measure the height and use a tape measure at the height of 1.30 meters of the tree then use the allometric equation by the calculation method of the Greenhouse Gas Management Organization (Public Organization).

From walking get data specific tree with wood and has a height of more than 1.30 meters or more and with a circumference at a height of 1.30 meters, not less than 15 centimeters, keeping in mind the amount of carbon in the form of Biomass is number 930 trees. As the amount of carbon sequestration has many 24,325.31 kgCO₂eq / year or 24.325 tCO₂eq / year.

It is concluded to analyze and assess greenhouse gas emissions from energy consumption and consumption activities of the people in Kut Chik sub-district Municipality Sungnoen District, Nakhon Ratchasima Province, Thailand. The carbon dioxide emission equivalent of 2,079.5926 tonCO₂eq /year was higher than the potential for carbon sequestration in non-naturally occurring carbon stocks in public areas of Kut Chik sub-district Municipality Sungnoen District, Nakhon Ratchasima Province, at 24,325 tCO₂eq / year. It shows that people in Kut Chik sub-district Municipality Sungnoen District, Nakhon Ratchasima Province greenhouse gas emissions more than the amount of greenhouse gas that trees in public spaces has the potential to store up to 2,055.2676 tCO₂eq / year, thus contributing to global warming more greenhouse gases.

From the research on The application of carbon balance for low carbon society development in Kut Chik sub-district Municipality Sung-noen District, Nakhon Ratchasima Province, Thailand. The reason for the global warming, which people in Kut Chik sub-district Municipality. It must be aware of the ways in which to develop a low carbon society. By reducing greenhouse gas emissions and increasing the potential for greenhouse gas capture.

References

- Ashvannanakul, S. (2010). *Capitalism, life. Business has heart* Matichon 1st edition. Bangkok
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). New Jersey: Lawrence Erlbaum Associates, Inc.
- Commentary National Economic and Social Development Board No. 12-2060 Office of the National Economic and Social Development.
- Department of Health. (2014). *Public Participation in Health Department Mission Ministry of Public Health*. Retrieved from <http://psdg.anamai.moph.go.th/news/cpadmin/km/files/chapter2.doc>.
- Global Action Plan, Stockholm Environmental Institute and Eco-Logia. (2006). *UK Schools Carbon Footprint Scoping Study*. Report by Global Action Plan, Stockholm Environmental Institute and Eco-Logia Ltd for the Sustainable Development Commission, London.
- Greenhouse Gas Management Organization. *What is greenhouse gases?*. Retrieved from <http://www.tgo.or.th/index.php?Option=com-content&view=article&id=46:what-is-ghg&catid=35:greenhouse-effect&itemid=55>.
- Greenhouse Gas Management Organization. (2011). *Carbon Footprint Appraisal Guidelines for Carbon Footprint Promoting Organizations* (1 st Edition) Bangkok Ministry of Natural Resources and Environment.
- IPCC (2007). *Climate Change 2007: Synthesis Report*. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Retrieved from http://ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm). [
- Janangkakran, B. (2011). *Carbon footprint of educational organizations: A case study of the Department of Environmental Engineering*. (Master thesis). Chulalongkorn University.
- Office of the National Economic and Social Development Board. (2014). *Economic Development Plan*. Retrieved from <http://www.nesdb.go.th/Default.aspx?tabid=395>.
- Ozawa-Meida, L., Brockway, P., Letten, K., Davies, J. and Fleming, P. (2013). *Measuring carbon performance in a UK University through a consumption-based carbon footprint: De Montfort University case study*. *Journal of Cleaner Production* 56: 185-198
- Pleerux, N. (2012). *Mapping of carbon dioxide emission from human activities: a case study of Saensuk municipality, Mueng district, Chon Buri province*. *Asia-Pacific Journal of Science and Technology*, 17(6): 895-910.
- Poolpatin, T., Sawangpruek, M. and Marcharoen, T. (2011). *Carbon footprint analysis*. Department of Chemical Engineering. Faculty of Engineering: In the meeting International Institute of Chemical and Applied Chemistry, 21st Bangkok, Thailand
- Sripawit, P. (2007). *Let's Protect the Global Warming*. *For Quality* 14: 111-115.
- Suanantan, Ch. (2012). *Carbon Footprint Assessment and GHG Emission Reduction Approach* Kasetsart University. (Master Thesis). Kasetsart University.
- Suranaree University of Technology. (2008). *Enhancement and development of participatory processes. Local communities in the management of water resources and upstream forests*. Retrieved from <http://www.sut.ac.th/im/mun>

Biodiversity of soil macroarthropods and relationship with environmental factors in northeastern Thailand

Krubhachaya, P.^{1,*}, Aroon, S.¹, Sukteeka, S.¹, Paiboon, N.¹, Noinumsai, N.² Tantipanatip, W.³ and Thanee, N.^{1,2}

¹ School of Biology, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand, ² Faculty of Science and Technology, Nakhon Ratchasima Rajabhat University, Nakhon Ratchasima, 30000, Thailand, ³ Faculty of Science and Technology, Phranakhon Si Ayuttaya Rajabhat University, Phranakhon Si Ayuttaya 13000, Thailand.

Abstract The biodiversity and distribution of soil macroarthropods, and relationships between soil macroarthropods and environmental factors were investigated. The research was carried out bimonthly using hand collection and fundamental tools in three forest habitats such as degraded forest, plantation forest and agricultural farm. The results showed that a total of 1,985 insects, 47 genera were found in 6 orders i.e. Blattodea, Coleoptera, Dermaptera, Hymenoptera, Isoptera and Orthoptera. The most diversity and distribution of insects was found in plantation forest (783 individuals) followed by degraded forest (681 individuals) and farm land was the lowest discovered (521 individuals). Order Hymenoptera (family Formicidae) was the most discovered (666 individuals) followed by order Coleoptera (Families Scarabacidae and Staphylinidae) (490 individuals) while order Blattodea (family Blaberidae) was the lowest collection (68 individuals). The correlation between macroarthropods and environmental factors was also studied during the same period. The results revealed that soil pH, available potassium and phosphorus were different while soil organic matter was not significantly different between these three habitats ($P \leq 0.05$).

Keywords: Soil macroarthropods, soil properties, Suranaree University of technology

Introduction

Soil is organic matter from fallen litter return to a mineral state, which show how important soil is in the life of the forest. Conversion of litter into humus and minerals is mainly performed by micro-organisms, soil arthropods and earthworms (Dajoz, 2000, Arim and Jaksic, 2005, Bendano *et al.*, 2005, Allison, 2006). Conversion of litter into humus and minerals is mainly performed by micro-organisms, soil arthropods and earthworms. Soil fauna contains various groups of invertebrates which vary greatly in nature and in number (Dajoz, 2000). Neher and Barberchack (1999) classified soil fauna into 4 groups such as microfauna, meso fauna, macrofauna and megafauna based on biomass and body length. Macrofauna has body length at 2-20 millimeters and biomass of 0.01-10 g per square meter. Soil macroarthropods subsistence in soil and are sensitive on nutrient changes, including dependent on ecological conditions, structure and quality of soil. However, soil macroarthropods play a primary role in organic

*Corresponding Author: Nathawut Thanee; E-mail: nathawut@sut.ac.th.

matter breakdown and they are good bioindicators of soil fertility (Webster *et al.*, 2001, Silvia *et al.*, 2013, Van Vliet and Hendrix, 2007).

Thailand locates in the tropical zone which hosts various types of natural and man-made ecosystems. These different ecosystems are homes of soil, plants and animals resulting in high biodiversity of arthropods (Moreau *et al.*, 2006, Kostenko *et al.*, 2012). However, the study of soil macroarthopods is still in an early stage and information on diversity of soil macroarthopods is actually very sparse with a few studies regarding the patterns of soil biodiversity across the landscape. There is a compelling need for establishing a set of bioindicators and indexes to understand proprieties and monitor changes in the soil macroarthopods.

The purposes of this study were conducted to investigate the biodiversity of soil macroarthopods in three different forests and some environmental factors effecting soil macroarthopods compositions at Suranaree University of Technology (SUT) in Nakhon Ratchasima province during the period September 2014 to August 2015. The information from this study will contribute to our current knowledge and may also help develop methodology of measuring soil fertility by using insect decomposers as the ecological indicator.

Materials and methods

Study region

This research was conducted in three different forests at SUT, Thailand. The study site, (as shown in Figure 1) consisted of three types different of forest, namely degraded forest (DF), plantation forest (PF) and agricultural farm (AF).

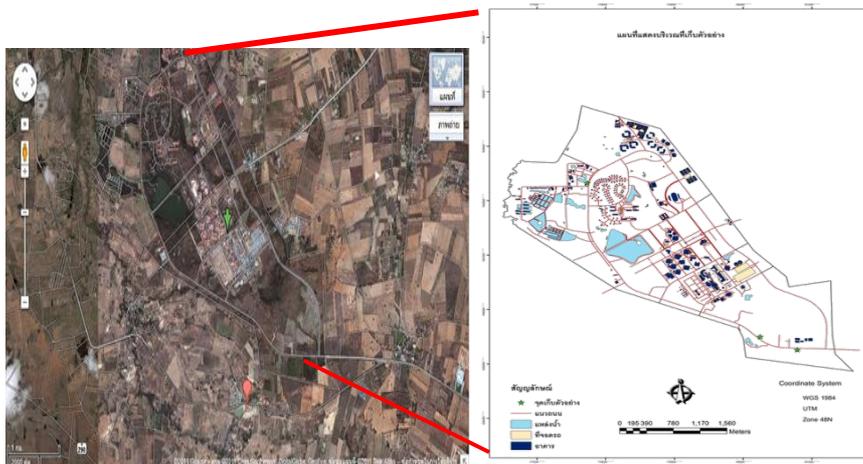


Figure 1. Study region at Suranaree University of Technology (Google earth, 2018).

Soil macroarthopods collection

Soil macroarthopods and soil samples were collected from three different forests, such as DF, PF and AF including establishment of the

permanent plot sized $100 \times 100 \text{ m}^2$. Each permanent plot was divided into 25 sample areas sized $20 \times 20 \text{ m}^2$. A sample area was further divided into 100 sub-plots of $2 \times 2 \text{ m}^2$. Ten sub-plots, each of $2 \times 2 \text{ m}^2$, were chosen after the process of random sampling. The sub-plots was divided into 100 quadrats, each of $20 \times 20 \text{ cm}^2$. Four quadrats in 4 corners and 1 quadrat in the center of a sub-plot were designed for these collection. Soil macroarthropods and soil sample were collected bimonthly. The sample design is illustrated in Figure 2 (Modified from Suriyapong, 2003).

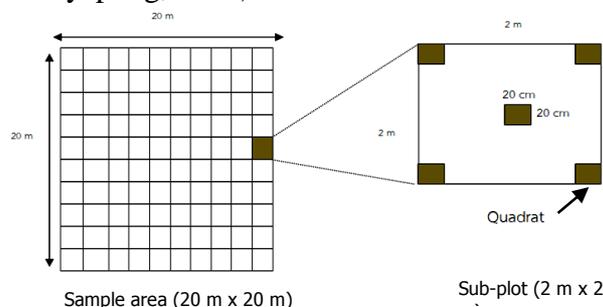


Figure 2 Sampling design for soil macroarthropods collection within each plot.
Source : Modified from Suriyapong, 2003

Moreover, hand collection with forceps and fundamental tools were applied to collect soil macroarthropoda (body length 2-20 mm) in each quadrat. And then, preserved in 70% concentration of alcohol. All soil samples were kept in plastic bags and then brought to laboratory at SUT. The extraction was run using modified berlese funnel. The collected soil macroarthropods were washed by distilled water then counted and identified at the trapped sites. The counted and identified soil macroarthropods were released at the location sites but unidentified soil macroarthropods kept in small vials and identify to families or genera by stereo microscope in the laboratory.

Soil properties

Soil texture, percentages of sand, silt and clay, soil pH, available potassium, available phosphorus and soil organic matter were investigated. Soil pH was measured by pH meter. Furthermore, dried soil samples 200 g were mixed with distilled water in 1,000 ml cylinder and the thickness of layer precipitated was measured for soil texture (Jinu Eo, 2008; Zhao, 2008). In addition, the soil samples were sent to laboratory at The Centre for Scientific and Technological Equipment, SUT for phosphorus and potassium analyses.

Data analysis

Total soil macroarthropods collected from each habitat type were identified to genus level following Morimoto (1973) and Sornnuwat et al. (2004). All statistical tests were performed in SPSS 17.0. Differences between physical and biological factors in the three study areas were analyzed using

one-way ANOVA. Relationships between soil macroarthopods and the physical and biological parameter were tested using Pearson's correlation. Soil macroarthopods diversity was measured and compared using the Shannon-Wiener index, evenness index, species richness (Margalef Index) (Krebs, 1999)

Results and discussion

Physical and Chemical factors

Soil texture was classified as sand in degraded forest (DF) and plantation forest (PF) while the agricultural farm was sandy loam. Significant difference of soil composition among all the study areas ($p < 0.01$) were found (Table 1). Soil pH, available P and K were significantly different between the three habitats while soil organic matter was not significantly different between the three areas ($p < 0.01$). In addition, the phosphorus levels was lower in plantation forest (PF).

Table 1. Physical and chemical factors (mean \pm SE) in degraded forest (DF), plantation forest (PF) and agricultural farm (AF) at SUT from September 2014 to August 2015.

Factor	Study sites		
	DF	PF	AF
Soil texture	Sand	Sand	Sandy loam
Sand (%)	91	94	74
Silt (%)	6	6	19
Clay (%)	3	0	7
Soil pH	7.17 \pm 0.26	6.18 \pm 0.35	7.41 \pm 0.43
Available P (ppm)	158.29 \pm 81.53	59.58 \pm 16.69	454.53 \pm 229.08
Available K (ppm)	33.64 \pm 21.12	20.9 \pm 17.23	90.4 \pm 56.75
Soil organic matter (%)	2.76 \pm 1.08	1.7 \pm 0.89	2.29 \pm 0.75

Soil macroarthropod communities

A total of 1,985 insects, belonging to 47 different genera and 6 orders (Blattodea, Coleoptera, Dermaptera, Hymenoptera, Isoptera and Orthoptera) were recorded during the sampling sites. The most diversity and distributions of soil insects was found in plantation forest (783 individuals) followed by degraded forest (681 individuals) and farm land was the lowest discovered (521 individuals). Formicidae was the most abundant groups (666 individuals) in the three areas, followed by Scarabacidae and Staphylinidae (490 individuals) while Blaberidae was the lowest abundant (68 individuals) (Table 2).

Table 2 Taxonomic classification of soil insects found in study areas in degraded forest (DF), plantation forest (PF) and agricultural farm (AF) at SUT from September 2014 to August 2015.

Order	Family	Genus	DF	PF	AF	Total (individual)		
Blattodea	Blaberidae	<i>Blatta</i>	14	12	14	40		
		<i>Phoetalia</i>	16	6	6	28		
Coleoptera	Carabidae	<i>Chlaenius</i>	12	16	16	44		
		<i>Eucyrtus</i>	12	17	14	43		
		<i>Gonocephalum</i>	10	16	14	40		
		<i>Ophionea</i>	14	16	9	39		
		<i>Pherosophus</i>	8	6	9	23		
		<i>Megopis</i>	6	7	-	13		
		<i>Cylindera</i>	12	7	12	31		
	Lucanidae	<i>Cyclommatus</i>	6	11	6	23		
		<i>Hexarthrius</i>	9	5	-	14		
			<i>Neolucanus</i>	6	6	6	18	
		Lycidae	<i>Lyctus</i>	6	14	8	28	
		Passalidae	<i>Leptaulax</i>	12	6	5	23	
	Scarabaeidae		<i>Anomala</i>	9	12	4	25	
			<i>Copris</i>	6	9	5	20	
				<i>Heliocopris</i>	6	4	4	14
				<i>Popillia</i>	14	7	2	23
				<i>Xylotrupes</i>	9	22	4	35
Dermaptera		Staphylinidae	<i>Paederus</i>	11	17	6	34	
		Anisolabididae	<i>Euborellia</i>	6	9	6	21	
		Chelisochoidea	<i>Adiathetus</i>	9	14	4	27	
		Forficulidae	<i>Hypurgus</i>	6	16	11	33	
Hymenoptera		Formicidae	<i>Aenictus</i>	27	22	19	68	
	<i>Anochetus</i>		24	29	16	69		
	<i>Cerapachys</i>		12	16	14	42		
	<i>Crematogaster</i>		19	22	26	67		
	<i>Diacamma</i>		15	13	10	38		
	<i>Emeryopone</i>		36	24	21	81		
				<i>Harpegnathos</i>	19	12	10	40
				<i>Leptogenys</i>	14	22	17	53
				<i>Lophomyrmex</i>	20	34	16	70
				<i>Pheidole</i>	16	24	11	51
				<i>Polyrhachis</i>	27	31	29	87
	Isoptera		Kalotermitidae	<i>Glyptotermes</i>	42	26	12	80
				<i>Neotermes</i>	26	33	18	77
Rhinotermitidae		<i>Reticulitermes</i>	11	9	24	44		
		<i>Schedorhinotermes</i>	28	35	14	77		
		<i>Hypotermes</i>	11	34	10	55		
		<i>Macrotermes</i>	14	13	16	43		
		<i>Microcerotermes</i>	16	28	19	63		
		<i>Odontotermes</i>	14	12	6	32		
Orthoptera	Gryllidae	<i>Acheta</i>	21	19	10	50		
		<i>Brachytrupes</i>	12	10	5	27		
		<i>Gryllus</i>	7	6	4	17		
		<i>Metioche</i>	8	16	17	41		
	Gryllotalpidae	<i>Gryllotalpa</i>	24	38	12	74		
		Total (individual)	681	783	521	1,985		

Relationship of soil macroarthropod and soil properties

The relationship between physical and chemical properties of soils and biodiversity of macroarthropods (excluding millipedes) was also investigated. The results revealed that phosphorus, pH, organic matter and soil texture showed positive correlation with macroarthropod diversity ($p \leq 0.05$). Some investigators also showed that high soil moisture, other physical and chemical factors of soil affected soil arthropods abundance and diversity (Eaton et al., 2004, Krieb, 1999, Webster et al., 2001, Shao et al., 2015).

significantly different between soil pH, available P and soil organic matter ($p \leq 0.05$). At the same time, *Thyropygus cuisinieri* was positively correlated with available P ($p \leq 0.05$; $r = 0.371$), *Lithostrophus segregatus* was positively correlated with available P ($p \leq 0.05$; $r = 0.423$) and soil pH ($p \leq 0.05$; $r = 0.373$) included *Cylindroiulus* sp. was positively correlated with available P ($r = 0.377$). Nevertheless, *Zephronia siamensis* abundance was negatively reported to be affected by available K. Kime *et al.* (1991) reported that the physical and chemical factors supported the of millipedes. Additionally, (2015) reported that the high soil moisture supported the abundance of soil macroarthropods.

Conclusion

A total 2,233 species of soil macroarthropods of three sampling sites belong to 52 genera, 19 families of 11 orders (Sphaerotheriida, Spirostreptida, Spirobolida, Polydesmida, Julida, Blattodea, Coleoptera, Dermaptera, Hymenoptera, Isoptera and Orthoptera). When compared across the difference forests, soil macroarthropods population was highest in plantation forest (866 individuals), followed by degraded forest (740 individuals) and agricultural farm (628 individuals). Soil factors like soil texture, pH, soil organic matter, available P, K and the roles of these edaphic factors of soil on the distribution of soil macroarthropods in three different forests were taken into consideration in the study.

Acknowledgement

The authors are grateful to staff of the Center for Scientific and Technological Equipment, Suranaree University of Technology (SUT) for the use of field site and laboratory facilities. Additionally, authors would like to thank SUT and National Research Council of Thailand for the financial support.

References

- Allison, S. D. (2006). Brown ground: A soil carbon analogue for the green world hypothesis? *The American Naturalist* 167(5): 619-627.
- Arim, M. and Jaksic, F. M. (2005). Productivity and food web structure: Association between productivity and link richness among top predators. *Journal of Animal Ecology*. 74: 31-40.
- Dajoz, R. (2000). *Insects and forests: The role and diversity of insects in the forest environment*. Technique and Documentation. Paris.

- Eaton, R. J., Barbercheck, M., Buford, M., and Smith, W. (2004). Effects of organic matter removal, soil compaction, and vegetation control on collembolan populations. *Pedobiologia* 48: 121-128.
- Jinu, E. and Tomomi, N. (2008). Spatial relationships between roots and soil organisms under different tillage systems. *Soil Biology* 44: 277-282.
- Kime, R. D., Wauthy, G., Delecour, F., and Dufrene, M. (1991). Distribution spatial et preferences ecologique chez les Diplopodes du sol. *Memoires de la Societe Royale Entomologie de Belgique*. 35 (In press).
- Kostenko, O., Van de Voorde, T. F. J., Mulder, P. J., Van der Putten, W. H., and Bezemer, T. M. (2012). Legacy effects of aboveground–belowground interactions. *Ecology Letters* 15: 813-821.
- Krebs, C. J. (1999). *Ecological methodology*. 2nd ed. California: Addison – Educational Publishers.
- Moreau, G., Eveleigh, E. S., Lucarotti, C. J., and Quiring, D. T. (2006). Ecosystem alteration modifies the relative strengths of bottom-up and topdown forces in a herbivore population. *Journal of Animal Ecology*. 75: 853-861.
- Morimoto, K. (1973). Termite from Thailand. *Bulletin of the Government Forest Experiment Station* 257: 57-80.
- Morris, W. F., Hufbauer, R. A., Agrawal, A. A., Bever, J. D., Borowicz, V. A., Gilbert, G. S., Maron, J. L., Mitchell, C. E., Parker, I. M., and Power, A. G. (2007). Direct and interactive effects of enemies and mutualists on plant performance: A meta-analysis. *Ecology* 88: 1021-1029.
- Neher, D.A. and Barbercheck, M. E. (1999). Diversity and function of soil mesotauna. In *Biodiversity in agrosystem*. CRC Pross, Boca Raton. Pp. 27-47.
- Shao, Y., Wang, X., Zhao, J., Wu, J., Zhang, W., Neher, D. A., and Fu, S. (2015). Subordinate plants sustain the complexity and stability of soil micro-food webs in natural bamboo forest ecosystems. *Journal of Applied Ecology*. 10: 1365-2664.
- Silvia, B., Cristina, M., Lorena, B., Federica, D. C., Enrico, P. and Gianluca, P. (2013). Soil microarthropod communities from Mediterranean forest ecosystems in Central Italy under different disturbances. *Environmental Monitoring and Assessment*. 185: 1637-1655.
- Soler, R., Van der Putten, W. H., Harvey, J. A., Vet, L. E. M., Dicke, M., and Bezemer, T. M. (2012). Root herbivore effects on aboveground multitrophic interactions: Patterns, processes and mechanisms. *Journal of Chemical Ecology* 38: 755-767.
- Sornnuwat, Y., Vongkaluang, C., and Yoko, T. (2004). A systematic key to termites of Thailand Retrieved from <http://www.thaiscience.info/Article%20for%20ThaiScience/Article/5/Ts5%20a%20systematic%20key%20to%20termites%20of%20thailand.pdf>.
- Suriyapong, Y. (2003). Study of ground dwelling ant populations and their relationship to some ecological factors in Sakaerat Environmental Research Station, Nakhon Ratchasima. (Ph.D. Thesis). Suranaree University of Technology. Thailand.
- Van Vliet, P. C. J. and Hendrix, P. F. (2007). Role of fauna in soil physical processes, pp. 61–80. In *Soil biological fertility: A key to sustainable land use in agriculture*. Kluwer Academic Publishers, Dordrecht, Netherlands.
- Webster, E. A., Hopkin, D. W., Chudek, J. A., Haslam, S. F. I., Simek, M., and Picek, T. (2001). The relationship between microbial carbon and resource quality of soil carbon. *Journal of Environmental quality* 30: 147-150.
- Zhao, Z. Q., Cai, Y. L., Fu, M. C., and Bai, Z. K. (2008). Response of the soils of different land use types to drought: Eco-physiological characteristics of plants grown on the soils by pot experiment. *Ecological Engineering* 34: 21.

The Effect of Land Use Change on Surface Runoff (A Case Study of Fang Watershed, Northern Thailand)

Songvoot, S.^{1,*} and Duangthip, R.¹

¹Department of Agricultural Engineering, Faculty of Engineering, King Mongkut's Institute of Technology Ladkabung, Bangkok 10520, Thailand.

Abstract The relation of land use change and climate on surface runoff in the Fang watershed, Chiang mai province was examined in Fang watershed has met the natural disaster as floods and droughts. The water deficit has been placed within the watershed influencing the agricultural production and other uses. The collected data based on the land use maps and climate data in watershed area in 2008, 2012 and 2017. The surface runoff was estimated by using SCS curve number method. The result that there were two trends of land use changing during 2008 – 2017 which from forest to cropland and cropland to urban. The meteorological data were collected from the Metrological Department. The surface runoff has gradually decreased from 965.40 mm. in 2008 to 914.25 mm. and 905.14 mm. in 2012 and 2017, respectively. The results in the surface runoff estimation using the lowest, highest and average rainfall showed the relationship of rainfall and surface runoff revealing the amount of rainfall was the major factor influencing a rise of surface runoff. It showed that the land use conversion and surface runoff relation and surface runoff relationship also examined that the transition of land use among 2008, 2012 and 2017 influenced the changes in surface runoff in this watershed.

Keywords : surface runoff, land use change, watershed

Introduction

Water is renewable resource which plays vital role for human and other living-organisms. The major purposes of water use are expressed as domestic, commercial, irrigation, industrial, livestock, mining, rural and thermoelectric power use. Land use change is recognized as factor that influences the change in local, region and global. The understanding of land and water relationship should be addressed in order to be the direction for land and water management.

This study conducted in Fang watershed which located in the Kok river basin in the northern Thailand. In recent years, the area has been affected by both flood and drought. This study utilized the application of Remote Sensing (RS) and Geographic Information System (GIS) to detect land use change, to estimate the surface runoff and to evaluate the relationship among land use change and climate variability on surface runoff.

The watershed hydrology research can be useful for water management as database for water planning and management. In addition, the

* **Corresponding author :** Songvoot S. ; **E-mail :** svsangchan@yahoo.com

land use change detection is useful for land use planning and development to deal with inappropriate and unsuitable land utilization to achieve sustainable development

Obviously, urbanization leads to increase urban temperature which warmer than adjacent countryside because the released heat from industrial, domestic and other activities of urban population is captured by tall building.

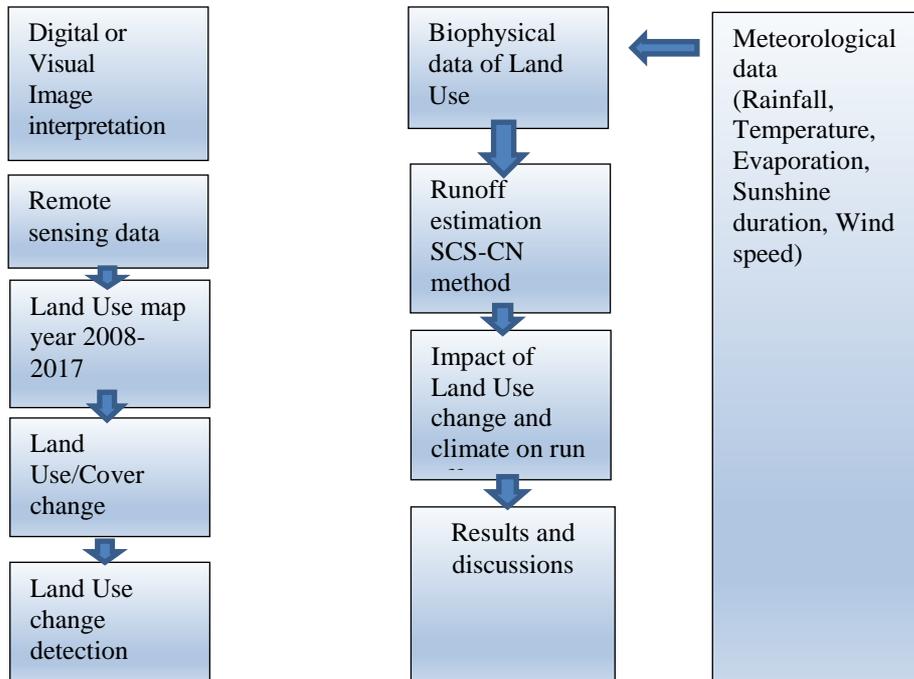


Figure 1 Research methodology

Materials and methods

The land use change and climate using GIS software was investigated. The satellite images of year 2008, 2012 and 2017 were used for land use detection. The seasonal runoff was determined by using SCS curve number method. It was separately estimated in 2008, 2012 and 2017 to access change in effect of land use and climate in the watershed. Meteorological data was collected from Meteorology Department, including rainfall, temperature, evaporation and relative humidity from three climate stations.

Climate Data

The long records of observed data are needed for examining climate variability and change detection. It required sufficient coverage data which was necessary to identify and monitor the signal change. The observed data was consisted of maximum and minimum temperature, precipitation, relative humidity, evaporation, wind velocity which all of those data is observed on daily basis.

Assessment of Seasonal Runoff

The curve number method was used for estimating seasonal runoff of this watershed which is developed by the National Resources Conservation Service (NRCS). The SCS curve number method needs several kinds of data to estimate runoff value which consist of rainfall, soil, and crop data. The estimation of runoff is used the SCS rainfall runoff relation which is expressed as follows:

$$Q = (P - 0.2S)^2 / (P + 0.8S) \quad (1)$$

Where

Q = Runoff depth (cm)

P = Rainfall (cm)

S = Rational parameter (cm) which represents the antecedent moisture, soil moisture condition, land use and conservation practice

$$(2540 / CN) - 25.4$$

Effect of Land Use Change on Surface Runoff

The effect of land use change was determined by using comparison of runoff between 2008, 2012 and 2017. The different of total area of land use among those years were compared. The land use map in 2008 was overlaid with land use map in 2012 and the land use map in 2012 was overlaid with land use map in 2017. Then, both land use change map were conducted.

Results

The results of land use classification, change detection, meteorological analysis and runoff estimation are shown in Figure 2, 3 and 4. The results of runoff calculation depend on rainfall data, soil type and land use types. The different of runoff depth, obviously the runoff increase year to year was shown in Figure 4.

Urban sprawl and expansion of cultivation area played vital factor on the rise of surface runoff within the Fang watershed. Increasing in the residential and agricultural area and decreasing in forest land affected increasing in surface runoff.

From data analysis found that in 2008, 2012 and 2017, the depth of surface runoff in forest areas increased from 46.66 mm. to 97.46 mm. and from 97.46 mm. to 102.82 mm., respectively. The depth of surface runoff in agricultural area increased from 42.10 mm. to 91.37 mm. and from 91.37 mm. to 97.06 mm., respectively. And the depth of surface runoff in residential areas increased from 38.25 mm. to 90.60 mm. and from 90.60 mm. to 96.50 mm., respectively as well.

This study was conducted to examine the relation of land use change and climate variability on surface runoff in Fang watershed. The collected data was based on the satellite images and climate data in 2008, 2012 and 2017. The results of surface runoff estimation indicated that there was positive relationship between rainfall and surface runoff in this watershed. The surface runoff increased in accordance with a rise of annual amount of rainfall since 2008 to 2017. Additionally, the increased surface runoff is also influenced by land use conversion within the watershed.

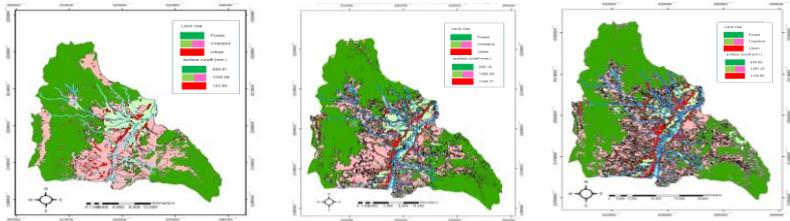


Figure 2 Land use and surface runoff

Figure 4 Comparison of monthly surface runoff

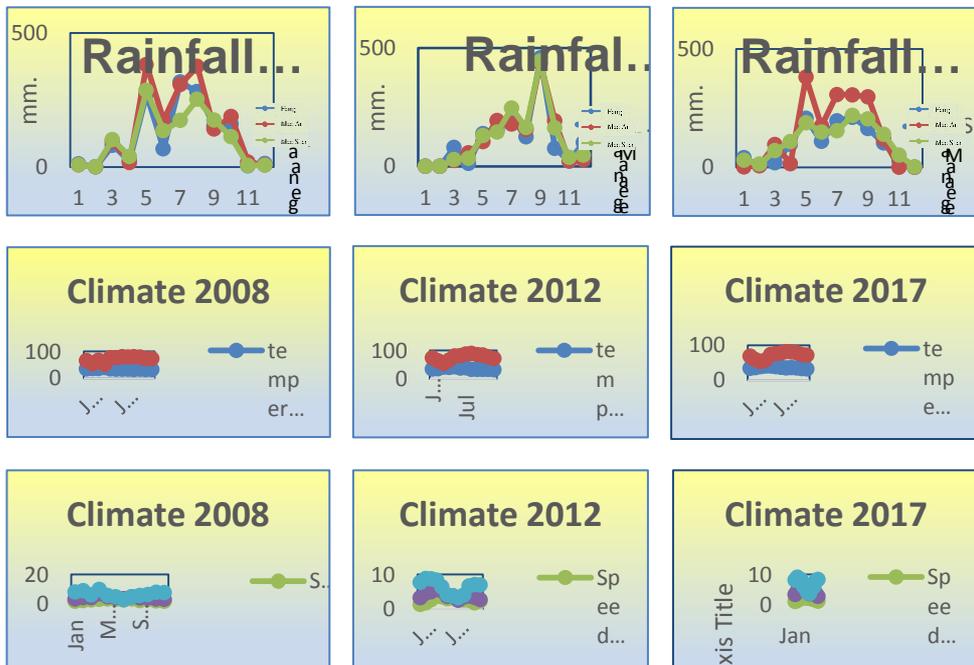


Figure 3 Climate data in 2008, 2012 and 2017

Acknowledgement

The author would like to acknowledge Department of Land Development and Department of Meteorological for supporting data in this research.

References

- Deferies, R. and Eshleman, K. N. (2004). Land use change and hydrologic process : a major focus the futuer”,*Hydrological Process* 18(11): 2183-2186.
- Fengping, L., Guangxin, Z. and Ligin, D. (2013). Study for impact of climate change on hydrology and water resources”, *Scientica Geographica Sinica* 33(4):457-464, 2013

Quality of Life Development and Occupation Opportunity of the Elderly by the Selection of Herbal Plant Using: A Case Study of Nakhon Phanom Province and Neighboring Provinces for the Development of Society and Environment

Hongmaneerat, K.^{*1} and Hongmaneerat, W.²

¹Faculty of Liberal Arts and Science, Nakhon Phanom University, Thailand ²Faculty of Education, Nakhon Phanom University, Thailand.

Abstract This study was conducted to investigate: 1) needs for quality of life development and occupation opportunity of the elderly by the selection of herbal plant using in Nakhon Phanom Province and Neighboring Provinces as well as some parts of Khammoun province, Lao P.D.R. and 2) a guideline for developing quality of life and occupation opportunity of the elderly. The target group consisted of 42 aging people representatives in Nakhon Phanom/neighboring provinces and Kham Muan province of LAO P.D.R. Results of the study revealed the following: 1) Most of the target group members were female, 60-70 year old, farmer, and elementary school graduates. They had their own land received elderly welfare from the public sector for 2,000-5,000 baht per year. Also, all of them received health welfare from the public sector. They use to use local herbs and they joined educational trip on herbs held by the public and private sector twice and above, 2) Local of the study was in Nonghan and Mekhong low land areas. It was rich in bio-diversity including plants. Many ethnic groups lived in this area and they had unique traditions. Most people their used herbal plants for healing and care-taking, 3) the target group needed for the development of quality of life at a highest level, and 4) As a whole, the target group had a high level of their opinions after joining the Career Promotion for the Elderly Center. Based on its details, health was found at a highest level.

Keywords: the elderly, quality of life, herbal plants, the development of society and environment

Introduction

Nakhon Phanom and its neighboring province: Sakonnakhon, Mukdahan and Khammuan of LAOS P.D.R. is about 750 km. to the northeast of Bangkok. Its location is very near to the Mekhong river and Nakhon Phanom has three important things: Thai-Lao friendship bridge, Phra That Phanom pagoda, and beautiful scenery of the banks of the Mekhong river. Importantly, Nakhon Phanom is ranked to be the happiest province in Thailand for the second time. For these reasons, Nakhon Phanom and its neighboring provinces have people aging more than 60 years for about 18.00% of the provinces. Hence, it can be said that develop quality of life of the elderly covering the 4 aspects (health, social life, economy, and

*** Corresponding Author:** Hongmaneerat, K.; **Email:** dr.whmnr@gmail.com

environment), Nakhon Phanom and Ministry of Social Development and Human Security have established the center for the elderly quality of life development and creating careers for the elderly in Nakhon Phanom. This has the following objectives: 1) be a model of social welfare provision for the elderly and people of all ages; 2) be a center for service provision to the elderly based on participation process; 3) to exchange experience among the elderly and for their relaxation; 4) to make the elderly be in the society happily with good quality of life; and 5) to make everyone be aware of the elderly quality. Nevertheless, still needs for good quality of basic factors i.e. food, clothing, residence, and medicine plants or medicinal plants. Therefore, the researchers are interested in the investigation of the elderly quality of life development and career creation for them by the selection of herbal plant using. (Nakhon Phanom Center for the Elderly Quality of Life Development and Creating Careers for the Elderly, 2018)

Objectives of the study

This study aimed to investigate:

1. the context of Nakhon Phanom province/neighborin province and Kham Muan province of Lao P.D.R. in terms of biological/physical appearance, social/economic aspects, traditions, herbal plants, and local wisdoms;
2. needs for the development of quality of life and career creation for the elderly by using herbal pants; and
3. guideline for the developing quality of life of the elderly and career creation for the by using herbalplants.

Conceptual Framework

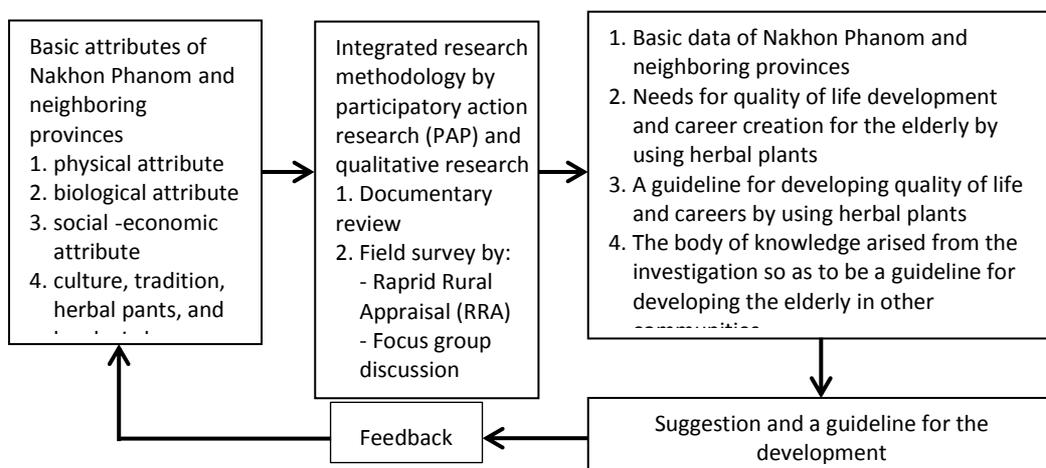


Figure 1. Conceptual framework of the study

Research Methodology

The target group in this study consisted of 42 aging people in Nakhon Phanom/ neighboring provinces and Kham Muan province of LAO P.D.R. out of 420 aging people living in lacale of the study (Nakhon Phanom Provincial Labor Office, 2018)

Research instruments on this study included focus group discussion from, 5 rating-scale questionnaire, and structured-interview schedule. The interpretation criteria were in accordance with that of Roengprapan (2000). Based on the computation the criteria are shown below:

Score	Scale Limits	Description
5	4.21 –5.00	Highest
4	3.41 –4.20	High
3	2.61 –3.40	Moderate
2	1.81 –2.60	Low
1	1.00 –1.80	Lowest

The research instruments in this study were checked by scholars for finding consistency and validity of the content (IOC = .(1.0-0.6Then, it was tried out for finding reliability (.0.84

Data analysis was done by using descriptive statistics i.e. frequency, percentage, mean, and standard deviation

Project Planning

Table 1. The project planning of the study

Date and place	Activities	Outcomes
20 th -30 th January, 2018 Faculty of Liberal Arts, Nakhon Phanom University. The target area was Etheric group community	Coordinated with the target elderly using herbal plants as an alternative for in forming details and making a survey of the target community based on participation process	Gained some aspects of basic data to the elderly in Nakhon Phanom and neighboring province
20 th -30 th March, 2018 Faculty of Liberal Arts, Nakhon Phanom University. The target area was Ethnic group community	Collected data on methods of herbal plants growing and care – taking. Selection of root, stem for healing the elderly (interview and observation)	Gained data in accordance with the objectives together with picture of activities
10 th -20 th April, 2018 Faculty of Liberal Arts, Nakhon Phanom University. The target area was Ethnic group community	Focus group discussion and learning exchange about methods of herbal plants using for healing the elderly	Gained correct data in accordance with the objectives together with picture for completeness of next studies
May, 2018 - June, 2018	Cheeked obtained data a research report	Gained a completed research report for presentation

Results

1. Regarding the general context of local of the study, it was found to be in Nonghan and Mekhong low land areas which was rich in bio-diversity and herbal plants. Most people there were engaged in agriculture such as field crop, vegetable, pineapple, and litchi growing. Besides, they domesticated duck, chicken, pig, ox, and buffalo. Meanwhile some people living on the banks of Mekhong river reared Nile Tilapia in cages. There were two Thai–Lao Friendship bridges connecting Mukdaharn- Savannakhet and Nakron Phanom-Kham Muan facilitating convenience in international trade and tourism. It was found that about 15 percent of people there were aging people. Besides, there were ethnic grouping living in this area and they had unique tradition. Most people there also used herbal plant for healing and care-taking. The herbal plant widely used by the people there most for the development of quality of life was porcupine flower (*Barleria prionitis* L.). The porcupine flower plant is a succulent ahrub plant. It is 1-1.5 m. high and its base has

thorns with the length of 0.5 cm. Its leaves are oval in shape with 0.5-1.0 inch in width and 1.5-2 inches in length. The leaf edge is light green in color and the flower has many colors such as bright yellow, light blue, light purple, pink etc. For its medicinal properties, the leaf, flower, seed, and pollen can heal pain, inflammation, cold, toothache, scurvy, constipation, anaerobic, snake poison, itch, pain in the joints, pneumonia, and indigestion. Besides, it helps purify blood and detoxify.

2. Regarding general data of the target group, it was found that most of them were female (74.1%), 60-70 year old (62.8%) and their main occupation was agriculture (45.0%). About 42 percent of them were elementary school graduates. More than one-half of them (65.6%) had their own land. About one-third of them (36.8%) received elderly welfare from the public sector for 2,000-5,000 baht per year. More than one-half of them (58.6%) joined activities held by the local and private organizations for more than 5 times a year. All of them received health welfare from public sector and all of them joined educational trips held by the public and private sector more than twice.

3. According to needs for the development of quality of life by using herbal plants, as a whole, it was found that the target group had a highest level of needs ($\bar{x} = 62.4$, S.D. = 0.37). Based on its detail, the following were found at a highest level: health ($\bar{x} = 4.45$, S.D. = 0.77); socialization ($\bar{x} = 4.40$, S.D. = 0.76); and environment ($\bar{x} = 4.38$, S.D. = 0.62). Meanwhile, economy was found at a high level ($\bar{x} = 3.80$, S.D. = 0.89) as shown in Table 1.

Table 1 Needs for the development of quality of life by using herbal plants of the target group

Item	\bar{x} (n=42)	S.D.	Description
- Health	4.45	.77	Highest
- Socialization	4.40	.76	Highest
- Economy	3.80	.89	High
- Environment	4.38	.62	Highest
Total	4.26	.37	Highest

4. Regarding guidelines for the development and career creation by using herbal plants of aging people based on interview and focus group discussion, it was found that the target group had a high level of their opinions after joining educational trips and activities of the Quality of Life Development and career Creation for the elderly Center in Nakhon Phanom province ($\bar{x} = 4.00$, S.D. = 0.59). Based on its details, health was

found at a highest level ($\bar{x} = 4.62$, S.D. = 0.37). The following were found at a high level: socialization ($\bar{x} = 3.95$, S.D. = 0.56); environment ($\bar{x} = 3.92$, S.D. = 0.82); and economy ($\bar{x} = 4.00$, S.D. = 0.59) (Table 2).

Table 2 Opinions of the target group after joining educational trips and activities of the Quality of Life Development and Career Promotion for the Elderly Center

Item	\bar{x} (n=42)	S.D.	Discription
Health			
- A source of physical, mental, and emotional health promotion	4.31	.56	Highest
- A learning source on herbal	4.14	.71	High
Total	4.26	.48	Highest
Socialization			
- A place promoting social relationships	3.81	.89	High
- A media for knowledge of community incomes	4.09	.82	High
Total	3.95	.56	High
Econimy			
- A media for learning new careers	3.90	.87	High
- A place for product selling/buying to generate incomes	3.95	.90	High
Total	3.92	.82	High
Environment			
- A good place for learning environment	4.12	.88	High
- Convincing learners to be aware of environment	3.88	.96	High
Total	4.00	.59	High
As a whole	4.03	.36	High

Discussion

1. According to results of the study, Nakhon Phanom/neighboring provinces and Kham Muau province of LAO P.D.R. are located in low land areas. It is rich of bio – diversity having plenty of herbal plant verities. People living their conserve local wisdoms and also use herbal plant for healing and health care as an alternative. This confirms to a study of Hongmaneerat, et al. (2018)which found that aging people in Nakhon Phanom and neighboring provinces conserve their local wisdoms particularly using herbal plants for healing and health care as an alternative. This also conforms to a study of the Quality of life development and Conserve promotion for the Elderly Center

which found that there is exchange on herbal plant local wisdom between I-San local medicine and Lao local medicine. Not only this, it conforms to a study of Hongmaneerat (2016) and Cultural Promotion Department (2018) which claimed that yao-spiritual medicine is in the form of an exchange of wisdom and the body of knowledge on herb medicine. In fact, Yao is a belief and ritual ceremony for healing people in Phu Thai Community since they worship ghosts. This ritual ceremony aims to invite the ghost to heal people suffering from ailment. This may be because the Phu Thai community had hospital in the former time so they needed to do every thing to solve the problem of ailment.

2. The target group use herbal plants for healing as an alternative. They claim that people of all ages can use herbal plants. Importantly, they must have knowledge and understanding of an appropriate amount in using herbal plants of a highest Benefit. It can be said that herbal plants are alexia which can ward off diseases and it is a restorative medicine this conforms to the body of Knowledge on traditional Thai medicine which finds that active ingredients existing in porcupine fliers are free radical enhancing immune for human body. Besides, it can inhibit cancer cells as used with conventional medicine (Anankitpaisan, 2016 and Triratnarong, 2011). In some cases, using porcupine flower as a medicinal plant must consult a medical specialist based on an amount and time span of using it. For example, drinking or eating it consecutively for one week must stop for 2 days to reduce dizziness and anorexia (Herbal Plant club, 2012 and National Library Office, 2014)

3. After the target group has joined educational trips and activities of the Quality of life Development and career Promotion for the Elderly Center. It is found that as a whole they had a high level of opinions about the center. Based on its details, health is found at a highest level which may be because they are aging people who put the importance on health care rather than other aspects. In fact, using herbal plants for the development and promote careers for the elderly is an alternative which can occur in each region of Thailand (Prathantharak and Sornum, 2009). Therefore, aging people should agree to visit the canteen to fulfil the 4 aspects: health, socialization, economy, and environment. This conforms to a study of Hongmaneerat et al., (2018) which found that the development of quality of life and career promotion for the elderly has health promotion as the priority. Thus, results of this study are important to concerned agencies in terms of the adoption and application of results of the study to other communities. Importantly, this under the concept of sufficiency economy philosophy

Suggestions for Development

1. The elderly group must learn and understand about herbal plants like porcupine flower and they should see a Thai traditional medicine personnel for safety before using herbal plants.

2. The elderly group should find an opportunity to visit the center for knowledge and experience exchange and their quality of life development/This is because center at Nakhon Phanom province is regarded as a best pilot model of Thailand.

3. The center should have public relations through various channels about its roles to attract the elderly both inside and outside the country to visit.

4. Public and private agencies should make use of this study for developing the elderly in other communities.

References

- Anankitpaisan, P. (2016). *Herbs Combatting Diseases for Health Care*. Bangkok: Rungroeng Press.
- Cultural Promotion Department. (2018). *Spiritual Medicine*. Culture journal, Ministry of Culture, Bangkok.
- Herbal Plants Club. (2012). *Herbal Plant Garden*. Control Library Printing. Bangkok.
- Hongmaneerat, K. (2016). *The Lifestyle Adjustment of the Agricultural Community to Cope with the Expansion of Urban Community : A Case Study of Baan Noen Sa-ard, Na Rat Khwai Sub-district, Muang District, Nakhon Phanom Province, Thailand*. *Journal of Agricultural Technology* 12(7.2):1947-1954.
- Hongmaneerat, K. et al. (2018). *The Elderly Quality of Life Development and Career Promotion for Social and Environmental in Nakhon Phanom and Neighboring Provinces*. Faculty of liberal Arts, Nakron Phanom University. Nakhom Phanom province.
- Nakhon Phanom Center for the Elderly Quality of Life Development and Creating Careers for the Elderly. (2018). *A manual of the managerial administration for the elderly quality of life development in Nakhon Panom province*. Nakhon Phanom province.
- Nakhon Phanom Provincial Labour Office. (2018). *Workforce Situation in Nakhon Phanom Province*. Nakhon Phanom.
- National Library Office. (2014). *Herb Healing and Health Care*. Bangkok: MIS Printing.
- Prathathurarat, S. and Sornlum, P. (2008). *Herbs: Development for Sustainable Benefits*. Department of Pharmaceutical Botany, Faculty of Pharmaceutical Science. Mahidol University Bangkok.
- Roengprapan, C. (2000). *Basic Statistics and Examples of Analyses by Using Minitab SPSS and SAS Programs*. Khonkaen: Khonkaen University.
- Triatnarong, P. (2011). *Herbal Medicine Scripture*. Bangkok: ONE WORLD Press.

Adaptation of Aging Farmer Life Style by Practice Teaching Media and Media Related to Health

Hongmaneerat, W.^{1*}, Hongmaneerat, K.², and Pongsuk, P.³

¹ Faculty of Education, Nakhon Phanom University, Thailand, ² Faculty of Liberal Arts and Sciences, Nakhon Phanom University, Thailand, ³ Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Thailand.

Abstract The objectives of this study were to: 1) construct knowledge about health by using media 20/80; 2) investigate effectiveness index of media related to health; 3) compare learning outcome of aging farmers about health before and after media using; and 4) explore aging farmers satisfaction with media using. The target group consisted of 120 aging farmers in Baan Nongpladuk community. Research instruments in this study were: 1) a tool used for the experiment was a media related to health: animation on tumbling of the elderly; computer assorted instruction on quality of life and family relationships of the elderly; website on quality of life planning of the elderly; and video on emotion of the elderly and 2) a tool used for data collection-test paper measuring knowledge gained from the media and a questionnaire on satisfaction with each type of media using. Percentage, mean, standard deviation, and t-test (Dependent) were used for data analysis. Results of the study were as follows: 1) The aging farmers gained knowledge about health through a type of media with the efficiency of 83.0/088.30, 83.33/98.66, 83.33/85.33, and 92.00/88.66, respectively which were higher than the criteria as set. 2) Effectiveness index value of the media the aging farmers gained increased knowledge for 81.00, 52.00, 69.00, and 58.00 percent. 3) knowledge of the aging farmers about health after using the media was more than before with a statistical significance level at .05, and 4) The aging farmers had a high level of satisfaction with media using (\bar{x} = 4.01, S.D. = 0.86; \bar{x} = 4.39, S.D. = 0.57; \bar{x} = 3.99, S.D. = 0.44; \bar{x} = 4.18, S.D. = 1.06, respectively).

Keywords : aging farmer, farmer life style, practice teaching media, health media

Introduction

Nowadays, Thailand has a rapid increased number of the elderly. According to the National Statistics Office and the proportion of population based on age, childhood, working age, and the elderly during 2007 – 2016, There are 6,705,061 aging people (10.64%) of the total population in 2007 but it reached 9,302,080 (14.87%) in 2016 (National Statistics Office 2016). There is a high Tendency to have a continual increased number of the elderly. According to the estimation of Thai population, it is found that Thailand will become to be a complete aging society with in the year 2022 and the elderly

*Corresponding Author: Hongmaneerat, W.; Email: dr.whmnr@gmail.com

group will be a majority group in the near future. Actually, an increase in a proportion of the elderly is mainly due to a decreased birth rate while an average age of the population increases on the mortality rate decreases (Peak, Imem, and Tangthanaset, 2017). The said data clearly show that the Thai society is becoming to be an aging society which will lead to be a problem of the country. Also, concerned public agencies have to provide social welfare to the elderly.

The Thai government, the Ministry of social Development and Human Security, and the National Elderly committee have prepared the second National Elderly Plan (2002-2021) having the formulation of clear strategies, measures, goals, and indicators. Also, there is an outcome on the elderly. Many countries across the world are becoming to be aging society and have to take care of the elderly property for their good physical and mental health. This is on the basis of the following: 1) food which is an important factor for health care of the elderly; 2) physical exercise which the elderly needs to do for about 3-4 times per week for good movement; 3) sanitary which the elderly must avoid things which are hazardous to their health such as alcoholic beverage and cigarette ; 4) urinary and defecation of the elderly must be well taken care; 5) weather and sunlight which the elderly should stay in a good environment with fresh air; 6) emotion, 7) hobbies, 8) future, 9) warmth, and 10) accidents which occur any time and it must be prevented (Office of Support Fund for Health Promotion, 2018).

The teaching-learning facilitation of Educational research subject for Third year college students focuses on learner centered (Khaemane, 2013). This aims to make the learner practice media creation and develop learning performance of learner of each level such as extension of knowledge about health to the elderly. Hence, media are means to convey data to the receiver. In face, meaning conveyance is like a vehicle bringing message to the receiver and it can refer to “teaching media” in terms of teaching/learning activities. (Piriyasurawong, 1207). This can be done through computer comprising message, data base, figure graphic, pictur, sound, and V.D.O. Romiszowki (1999) proposed a simple guideline to consider in the selection of teaching media. There are many factors leaving an effect on media selection such as teaching method, learning style, learner attribute and learning must be through actual practice.

According to the afore concepts as mentioned, the team of researchers wish to develop learning by using a teaching style to make the learner practice media creation. This aims to extend knowledge about health care to the elderly. Efficiency of the created media must be found and the elderly satisfaction with the media must be measured. Besides, it can be a guideline of

planning the elderly to make use of their free time. As a matter of fact, hobbies of the elderly play important roles making them have useful activities which are beneficial to them. This also makes the elderly be happy, strong, and healthy.

Objectives of the Study

Specifically, the objectives of this study were to: 1) construct knowledge about health by using media (80/80); 2) investigate effectiveness index of the media related to health; 3) compare learning achievement of aging farmers about health before and after using the media; and 4) explore aging farmer Satisfaction with media using.

Conceptual Framework

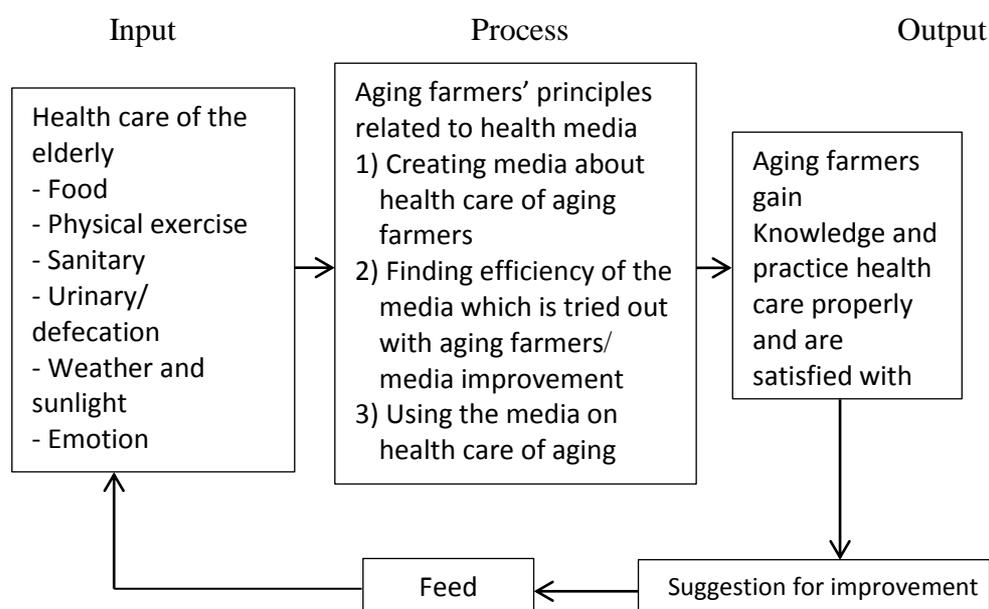


Figure 1. Conceptual framework of the study

Hypothesis of the study

Learning achievement the aging farmers after using the media is higher than before.

Research Methodology

This study was a semi-experimental research classified into 3 periods:

Period 1 - Students created media based on the principles of the elderly self-health care of the Support Fund for Health Promotion: food, physical exercise, sanitary, urinary/defecation are and sunlight, emotion, hobbies, future, warmth and accident.

Period 2 - The students tried out the created media twice

Period 3 - Extension of knowledge about health care to the elderly by using the effective media.

Population and Sample Group

Population

Period 1 - Students registered or were enrolled in second semester, academic year 2017 (Educational Research subject). They were third year college students majoring in computer of the Faculty of Education (3 classes, 72 students).

Period 2 - Aging farmers who were 60 years old and above in Baan Nongpladuk, Baan Phueng sub-district, Mueang district, Nakhon Phanom University (250 persons).

Target group

Period 1 - Students registered on were enrolled in second semester, academic year 2017 (Educational Research subject). They were Third year college students majoring in Computer of the Faculty of Education (A classroom of 20 students and they were classified into 4 groups).

Period 2 - Aging farmers who were 60 years old and above in Baan Nangpladuk, Baan Phueng sub-district, Mueang district, Nakhon Phanom province (120 persons).

Period 3 - Extension of knowledge about health through the effective media (120 aging farmers).

Research Instrument

There were 2 types of research instrument in this study: 1) 4 kinds of the experimental health media - animation on fall of the elderly, computer assisted in teaching about quality of life and family relationships of the elderly, website on planning quality of life of the elderly, and video on emotion of the elderly, and 2) research instruments for data collection: learning achievement test each media and questionnaire about aging farmer satisfaction with each media kind.

Finding Efficiency of the Research Instrument

1. Media related to health (4 kinds, 4 topics)

1.1 Examining efficiency by individuals or one-to-one testing. The innovation created for the first time was tried out with 1 - 3 learners together with inquiry about their opinions and problems in the innovation using, language, and additional requirement. Obtained data were used for the innovation improvement related to diagram, illustrated picture, language, etc. According to the experiment, it was found that the letter size, letter colour, and V.D.O. screen size were inappropriate with the elderly.

1.2 Finding efficiency of the innovation with a small group (small group testing). The improved innovation was tried out with a group of 5-10 persons and inquired them about their opinions towards the innovation, needs, and problems encountered. Obtained data were used for improvement (graphic). According to the experiment, it was found that sound and some test items were inappropriate with the elderly.

1.3 Finding efficiency of the innovation with a big group or field testing. The improved innovation was tried out with a group of 30 persons who were not the target group.

2. The research instrument used for data collection were a learning achievement test for each topic and questionnaire asking satisfaction with each media type.

The learning achievement test of each media or topic had been checked and improved to gain content validity, Item - objective congruence Index (IOC) which must be 0.50 and above. The reliability value of the 4 topics was 0.60-0.72. The reliability value of the questionnaire about satisfaction with each of the media was 0.75 - 0.83.

Data Collection

1. Pre-test on knowledge about media of each topic related to health (4 media types, 4 topics).

2. Preparation of activities for aging people to learn data from the improved media.

3. Preparation of a practice form during learning activities.

4. Conducting testing after finishing the activities by using a learning achievement test for each media on topic.

5. Collected the questionnaire on aging farmer satisfaction.

Data Analyses

1. Descriptive statistics i.e. percentage, mean, and standard deviation for the computation of knowledge about health, efficiency of the media, and aging farmer satisfaction with the media using.

2. t-test (Dependent) was employed for comparing learning achievement about health of aging farmers before and after using.

Results

1) The aging farmers gained knowledge about health through the 4 kinds of media (4 topics) with the efficiency value at 83.00/88.30, 83.32/98.66, 83.33/85.33 and 92.00/88.66, respectively which were higher than the criteria as set (Table 2).

Table 1. Media providing knowledge about health of the aging farmers

Rank	Media	Topic
1	Animation	Fall of the elderly
2	Computer ass it instruction	Quality of life and family relationship of the elderly
3	Web site	Planning quality of lite of the elderly
4	Video	Emotion of the elderly

Table 2. Efficiency of the media related to health of the aging farmers

Topic	Efficiency in accordance with the 80/80 criterion		Description
	E1	E2	
1	83.00	88.30	Higher
2	83.33	98.66	Higher
3	83.33	85.33	Higher
4	92.00	88.66	Higher

2) Electiveness indicators of the media related to health of the aging farmers made them gain increased knowledge for 81.00, 52.00, 69.00, and 58.00 percent in Table 3.

Table 3. Effectiveness indicators of the media related to health of the elderly

Topic	Score before and after using the media		Effectiveness indicator	Description
1	67	159	0.81	Increased knowledge (80%)
2	114	118	0.52	Increased knowledge (52%)
3	49	98	0.69	Increased knowledge (69%)
4	131	117	0.58	Increased knowledge (58%)

2) A comparison of learning achievement about health of the aging farmers before and after using the media.

According to Table 4, it shows that learning achievement about health of the aging farmer was higher after using each type of the media with a statistical significance level at .05.

Table 4. A comparison of learning achievement about health of the aging farmers before and after using the media

Topic	Achievement of the media using	N	\bar{x}	S.D.	t	Sig.
1. Animation	Before	30	3.20	1.04	14.19*	.000
	After	30	6.10	0.80		
2. CAI	Before	30	5.43	1.25	10.95*	.000
	After	30	8.23	1.10		
3. Wed side	Before	30	2.33	0.55	11.56*	.000
	After	30	4.33	0.66		
4. Video	Before	30	5.80	1.27	3.89*	.001
	After	30	6.60	0.72		

*a statistical significance level at .05

4) The aging farmer satisfaction with the media using

According to Tables 5, it was found that, as a whole, the aging farmers were satisfied with their media using at a high level (\bar{x} = 4.01, S.D.=0.86; \bar{x} =4.39, S.D.=0.57; \bar{x} =3.99, S.D.=0.44; and \bar{x} =4.18, S.D.=1.06, respectively).

Table 5. The aging farmer satisfaction with the media using

Topic	Satisfaction	\bar{x}	S.D.	Description
1	Animation watching	4.01	0.86	High
2	CAI using	4.39	0.57	High
3	Web site using	3.99	0.44	High
4	Video watching	4.18	1.06	High

Discussion

In this study, the extension of knowledge to the aging farmers through a types of media (4 topics): 1) animation on gall of the elderly; 2) CAI about quality of life and family relationship of the elderly; 3) web site about quality life planning of the elderly; and 4) video on emotion of aging farmers. It was found that the aging farmers gained increased knowledge after learning through the media and they were satisfied with it at a high level. This might be because it was knowledge related to health care which could interest them and it was beneficial to them. This conformed to a study of Puangklin and Panratsami (2013) chick found that physical potency of the elderly joining the study had positive change in terms of decreased body size. Hengsukho (2014) had conducted a steady on potential of the community in health enhancement

by physical exercise and found to have a high level. Booranasanpasit (2012) had conducted a study on outcomes of core muscle practice towards the strength and balance of the elderly. It was found that an average mean score of core muscle and the ability of balance before the practice of the control and the experimental groups was not different. After the fourth to the eighth week of practicing, it was found to leave statistically significant difference at .05 and the ability of balance in the experimental group was better than before.

The computer assisted instruction (CAI) lesson entitled quality of life and family relationship of the elderly had the efficiency which conformed to a study of Inthanin and Sopirak (2014) on developing computer assisted instruction entitled health enhancement of golden age males and females and it was used together with internet network system. The following were found the computer assisted instruction lesson used together with internet network system had the efficiency at 83.05/85.11 which was in accordance with the criterion as set (85.0/85.2). The effectiveness indicator of the progress in learning increased (0.71) or 71.0 percent. This implied that the learner had progress in learning development for 71.0 percent. Besides, the learners were satisfied with the lesson at a high level (\bar{x} = 4.26, S.D. = 0.42).

Quality of life planning of the elderly and emotion of the elderly conformed to a study of Choeysonbat et.al. (2016) on recreational activities handicraft arts for enhancing self-value awareness of the elderly in Tatcha villa communing, Bangkok, The following were found: 1) The recreational activities (handicraft arts) of Tatcha villa community comprised 4 activity groups which were selected by brainstorming among the elderly their included the following: wood carving, cooking, wickerwork, and sculpture (once a week, six hours – 4 weeks); 2) perception of self-value of the elderly was higher than before in terms of the following; success value importance and capability, respectively For hobbies the elderly there were interested in handicraft arts and wanted to do it. This conformed to a study of Siriro (2016) which found that the elderly sample group had a high level of satisfaction with arts and crafts (\bar{x} -3.94), steps of arts and crafts (\bar{x} -3.67), and packaging (\bar{x} -4.00). It was also found that recreational activities for the elderly could enhance knowledge to them. This conformed to a study of Techatherapreda (2014) on the managerial administration of recreational activities for the elderly and consistency between needs of the elderly about social recreation and the managerial administration of recreational activities of the community. It was found that the elderly sample group was satisfied with recreational activities offered by the community at a high level in terms of social recreation (such as traditional fairs), physical exercise, tourism activities, hobbies, etc.

Suggestions

Durability in knowledge and practice of the elderly should be investigated so as to be data on the development of the quality of life management system of the elderly. Results of the study can be proposed to concerned agencies at the national level.

References

- Booranasanpasit, S. (2012). Outcomes of Core Muscle. Practice towards Strength and Balance of the Elderly. Retrieved from <http://cuir.car.chula.ac.th/handle/123456789/52351>. (26th March 2018).
- Choeysonbat, M. et al. (2016). Recreational Activities on Handicraft Arts. Enhancing Self-value of the Elderly in Thatcha Villa Community, Bangkok. [Online] <http://www.dtc.ac.th/images/journal/Sep-2017/17.pdf>)9th February, 2018).
- Department of Social Development and Human Security. (2009). National Elderly Development Plan (2002-2021). Retrieved from <http://www.dop.go.th/th/laws/4/22/766>. 5th February 2018.
- Heinich, R. and others). 1996. (Instructional Media and Technologies for Learning. New Jersey :Prentice-Hall, Inc.
- Hengasukho, E. (2014). Potential of the Community in Health Enhancement by Physical Exercised the Elderly. Retrieved from <https://sites.google.com/site/healthgrade6/hnwy-kar-reiyn-ru-thi-1/hnwy-kar-reiyn-ru-thi-6>. (26th Mach 2018).
- Inthanin, T. and Sopirak, S. (2014). Developing Computer Assisted Instruction entitled Health Enhancement of Golden Age Males and Females together with Internet Network System. AL-NUR journal. 9(17), Graduate School Ladorni University. Retrieved from <http://www.kmutt.ac.th/jif/public-html/article-detail.php?>.
- Khaemane, T. (2013). Teaching Science. Bangkok: Chulalongkorn University.
- Kitrakarn, P. (2003). Effectiveness Indicators. Instruction material. Mahasarakham: Department of Educational Technology, Faculty of Education, Mahasarakham University.
- Maslow, A. H. (1970). Motivation and Personality. New York :Harper and Row.
- National Statistics office. (2016). Statistical data of a number of the elderly in Thailand, 2016. [Online]. <http://www.dop.go.th/th/know/1/51> (5th February, 2018).
- Office of National Social and Economic Development Committee. (2017). 12th National Social and Economic Development Plan. Retrieved from <http://www.dop.go.th/threat-news.php?nit=6420>. (5th February, 2018).
- Office of supportter Health Promotions. (2018). Self-health care of the Elderly. Retrieved from <http://www.thaihealth.or.th./content/40229.html> (4th February, 2018).
- Peak, k. Imem, W., and Tangthanaset, R. (2017). Report on Situations of Thai Population, Bangkok: Population Fund of the United Nation and Office of National Social and Economic Committee. Text and General Publication Ltd.
- Piriyasuwong, P. (1997). Application of Mixed Media. Retrieved from <http://siravitoo1.blogspot.com> // 2016/08 (1st April, 2018).
- Promwong, C. (2013). Efficiency of Media on Teaching Module Testing. Silpakorn Journal on Educational Research. 5(1) p. 7-19.

- Puangklin, U. and Panratsami, C. (2013). Outcomes of Xi kong Physical Exercise towards Physical competency of the Elderly in Huay Yai Sub-district, Chonburi Province, Nonthaburi: Kanchanabhishek Institute of Medical and Public Health Technology. Retrieved from wtc.ac.th/reseacrh/56/m7-56.pdf .(26th March, 2018).
- Romiszowski, J. (1999). Theory and Principle of instructional Media Selection [Online] <https://khanittakuldee.wordpress.com> (1st April, 2018).
- Siriro, P. (2016), Arts and Crafts Product for Hobby of the Elderly. Retrieved from <https://www.tci-tharjo.org/index.php/ajnu/article/view/73250>. 9th February, 2018), (9th February, 2018).
- Techatheraprida, S. (2014). Managerial Administration of Recreational Activities of the Elderly by Nong Nam Sai Municipality, Si Khiew District, Nakhon Ratchasima bovin. Retrieved from <http://laverotch-thaijo.org/index.php/eapheitveyarticle/view/as18/74315> (9th Ebruary, 2018).

Digestive Enzymes in Hybrid Catfish Fed with *Spirulina* (*Arthrospira*) Additive Feed

Tippayakraisri, K., Saikaew, P., Chukwannuan, W., Suwan, N., and Tongsiri, S.*

Faculty of Fisheries Technology and Aquatic Resources, Maejo University, Chiang Mai, Thailand.

Abstract Digestive enzymes in Hybrid Catfish fed with *Spirulina* (*Arthrospira*) additive feeds at the percentages of 0(T0), 5 (T5), 10 (T10), 15 (T15) compared with commercial floating diet (CF) were investigated. The CRD (Completely Randomized Design) was applied. An average initial body weight of 12.83 g of hybrid catfish was used. Four experimental diets were isonitrogenous (30%). Fish were fed twice a day with 5% of body weight. They were randomly weight and length measured every 30 days for a 120-day experimental period. Results showed that the increased weight and average daily gain were significantly higher in the T10 group than other experimental and control groups ($P < 0.05$). Amylase activity from fish intestine was the highest in the T10 group while amylase activity from fish intestine was the highest in the T5 group. Protease activity from intestine was the highest in the T5 group followed by the one in T10 group. Trypsin activity from intestine was the highest in the T0 group followed by the one in T10 group. Chymotrypsin activity from intestine was the lowest in the T5 group followed by the one in T10 group. Referring to the Trypsin enzyme per Chymotrypsin enzyme (T/C ratio) from intestine of catfish fed with different diets and their growth rates, there was a positive relationship in a T10 group. These results suggest that fish feed mixed with 10% *Spirulina* (*Arthrospira*)(T10) provided the best growth rate and suitable for a hybrid catfish culture to get the highest production.

Keywords: Hybrid catfish, Digestive Enzyme, Growth

Introduction

Hybrid Catfish is the offspring of a male Maekong Giant Catfish (*Pangasianodon gigas*) and a female Striped Catfish (*Pangasianodon hypophthalmus*). It is white flesh catfish which is popular among consumers as it is considered healthy food and rich in valuable nutrition. It is very good in growth and disease resistance. It can be reared in either earthen ponds or cages (Mengamphan, 2016). Although the growth of hybrid catfish is very good, the cost of feed is very high. *Spirulina* (*Arthrospira*) is a cyanobacterium containing high nutritional content, e.g. protein, amino acid, vitamin and minerals (Vonshak, 1997) and improved the immune and the innate immune system of carp (Watakuni et. al, 2006). The 5% *Spirulina*

*Corresponding Author: Tongsiri, S.; Email: sudap2515@gmail.com

(*Arthrospira*) used as a feed supplement for *P. sutchi* provided the highest survival rate (Jana *et al.*, 2014). However, so far, there is no available report on the digestive enzymes in a hybrid catfish fed with *S. platensis*. This information could be used to investigate the suitable ratio of *S. platensis* in hybrid catfish diet in order to make it practically and cost affordable.

Objectives: The objective of this study was to determine the characteristics of pectinase, trypsin, chymotrypsin and amylase enzyme from the intestine of hybrid catfish fed with *Spirulina* (*Arthrospira*) additive feed.

Materials and methods

The experimental unit

Twelve nets of 1 x 1 x 1 m (width x length x depth) were used in this study. The fish were received from the Faculty of Fisheries Technology and Aquatic Resource, Maejo University. A total of 120 fish were separated into 4 treatments, 3 replicate each. The average weight of each fish before the experiment was 12.83 g.

Experimental design and proximate composition

Statistical analysis had been performed on the data obtained from CRD. The different feeding combinations (4 formulas of isonitrogenous, 30%) were prepared as follows:

Diet 1 The combination of feed with 0% *Spirulina* (*Arthrospira*) (T0).

Diet 2 The combination of feed with 5% *Spirulina* (*Arthrospira*) (T5).

Diet 3 The combination of feed with 10% *Spirulina* (*Arthrospira*) (T10).

Diet 4 The combination of feed with 15% *Spirulina* (*Arthrospira*) (T15).

Diet 5 The commercial floating diet (CF) (Table 1)

Table 1. Ingredients of the experimental diets for hybrid catfish

Parameter (%)	T0	T5	T10	T15	CF
Moisture	10.75±0.01 ^{ab1/}	14.94±2.67 ^b	11.00±0.68 ^b	12.57±0.69 ^b	8.88±0.02 ^a
Ash	8.02±0.72 ^a	8.49±2.11 ^a	12.58±1.22 ^b	7.98±0.19 ^a	10.44±2.09 ^{ab}
Protein	29.50±0.25 ^a	28.34±0.11 ^a	28.64±0.25 ^a	29.99±0.40 ^a	30.05±0.48 ^a
Lipid	4.76±1.40 ^a	3.52±1.36 ^a	4.76±0.36 ^a	4.48±0.60 ^a	5.81±1.70 ^a
Fiber	4.63±0.70 ^b	2.82±1.27 ^a	3.26±0.28 ^a	4.26±0.28 ^b	5.04±0.70 ^b

^{1/}Values are mean + SE. Values in the same row with different superscripts are significantly different (P<0.05)

The diets were packed in plastic bags and kept in the refrigerator at -18 °C throughout the experiment. The diets were dried at 105 °C for 24 h before analyzing protein, lipid, fiber, and ash, as described by the AOAC (2005).

Fish were fed formula two times each day at 5% of body weight, for a 120-day experimental period. The feeding rates were adjusted every 2 weeks. Weight and length of the fish were measured individually. Growth performance parameters were calculated as the following formulae.

- a. The increased weight (g) = total final weight- total initial weight / number of fish
- b. Average daily gain /day (g/d) = total final weight- total initial weight / days
- c. Feed conversion rate (FCR) = feeding weight in grams/ weight gain of fish in grams

Statistic analysis

Data were expressed as mean±standard error of mean in triplicate observations. One-Way Analysis of Variance was used for evaluating growth performance parameters. Significant differences between means were ranked using Turkey's multiple range test at 95% significance level.

Digestive enzyme studies

Enzyme extraction

Fish were washed and immediately frozen at -20 °C. The digestive systems of individual fish were removed using a glass plate maintained at 4 °C. The intestine was weighed and length measured. The intestine was put in

dry ice immediately and cut into small pieces and added into a centrifuge tube containing phosphate buffer pH 7 for homogenization. The homogenate was centrifuged at 10,000 x g at 4 °C for 10 min. and the supernatant was collected and stored at -80 °C. Three replicates were used for each sample. The method to measurement protein content was using the method described by Lowry *et al.* (1951)

Purified enzyme by dialysis enzyme

Dialysis by using membrane brand Cellucep®. The membrane was soak in the distilled water for 15 minutes and then put the membrane into 10 mM sodium bicarbonate at 80 °C, for 30 minutes. After that, transfer the membrane into 10 mM Na₂ EDTA for 30 minutes. Finally remove the membrane into 80 °C distilled water (Stirred all the time) for 30 minutes and waited for room temperature. Keep in the 50% ethanol solution. The membrane was used by using clamp in the end and put the enzyme in the membrane and close the other end by clamp. The sample was soak into the phosphate buffer pH 8 at 4 °C for 12 hours and then keep the supernatant of enzyme at -80 °C.

The digestive enzyme assay

Amylase specific activity

Amylase activity was measured by using 1% (w/v) starch solution in pH 7 of phosphate buffer as substrate. The method was used the Areekjseree et al. (2004) with some modified method. Maltose was used for the preparation of standard curve. The amylase specific activity was defined as μmol of maltose produce per min per mg protein. The pH profile study was measured at room temperature and pH 2-12. The temperature profile study was measured at temperatures 25 – 80 oC in either the neutral or alkaline condition.

Protease specific activity

Total protease activity was measure by using 2% azocasein as substrate. The method was used the Areekjseree et al. (2004) modified method. Total proteinase specific activity was expressed as the number of proteinase units per mg of protein. One unit of proteinase activity was defined as the amount of enzyme giving an increase of per min per mg protein. The pH profile study was measured at room temperature and pH 2-12. The

temperature profile study was measured at temperatures 25 – 80 °C in either the acidic or the alkaline condition.

Trypsin and Chymotrypsin activity

Trypsin activity and chymotrypsin activity were assayed by initial reactions based on Rungruangsak-Torrissen (2007) using BAPNA (benzoyl-L-arginine-p-nitroanilide) and SAPNA (N-succinyl-ala-ala-pro-phep-nitroanilide) as specific substrates, respectively. The specific activities of trypsin and chymotrypsin were expressed as $\mu\text{mol pnitroaniline produced h}^{-1} \text{mg protein}^{-1}$.

Protein measurement

The method to measurement protein content was using the method described by Lowry *et al.* (1951)

Results

The Survival rate and growth performances

In this experiment, the feed consisted of isonitrogenous and isocaloric feed in all treatments (Table1). The results of this experiment were found that the survival rate of the hybrid catfish were significantly higher in the T10 group than TO group ($P < 0.05$). The growth rate of the hybrid catfish were shown in table 2. The increased weight and average daily gain were significantly higher in the T10 group than T5 group ($P < 0.05$). (Table2) Feed conversion rate was significantly lower in T10 group than other experimental and CF groups ($P < 0.05$). The growth performances of hybrid catfish fed with 10% *Spirulina* (*Arthrospira*) were shown the highest the increased weight and average daily gain. (Table2)

Table 2. The Survival rate and growth performances of hybrid catfish fed with various ratios of *Spirulina* additive diets

Treatment	T0	T5	T10	T15	CF
The increased weight (g)	248.33± 9.49 ^{b1/}	185.12± 9.24 ^a	260.21± 2.51 ^b	230.33± 8.01 ^b	242.70± 2.31 ^b
FCR	2.56±0.9 ^a	3.38±0.17 ^a	2.45±0.02 ^b	2.74±0.9 ^a	2.60±0.02 ^a
ADG	2.17±0.08 ^b	1.65±0.08 ^a	2.28±0.02 ^b	2.03±0.07 ^b	2.13±0.02 ^b
Survival rate (%)	44.44±0.0 ^a	61.11±9.62 ^{ab}	77.77±0.0 ^b	55.55±9.62 ^{ab}	66.66±9.62 ^{ab}

^{1/}Values are mean + SE. Values in the same row with different superscripts are significantly different (P<0.05)

The digestive enzyme specific activities

The amylase specific activity

The amylase activity was measured in pH 2-12, the profiles were similar in both the stomach and the intestine. The amylase activities of the stomach showed the pH optima for hydrolysis of the substrate such as T10 were highest with the amylase activity at pH 8 and 7. The amylase activities of the intestine showed the pH optima for hydrolysis the substrate, the highest amylase activity were T5, CF and T10 at pH 8 and 7, respectively. All of the amylase activities of the stomach and the intestine were shown to be alkaline amylase. The conclusion were showed that amylase activity from fish stomach was the highest in the T10 group while amylase activity from fish intestine was the highest in the T5 group. (Figure1)

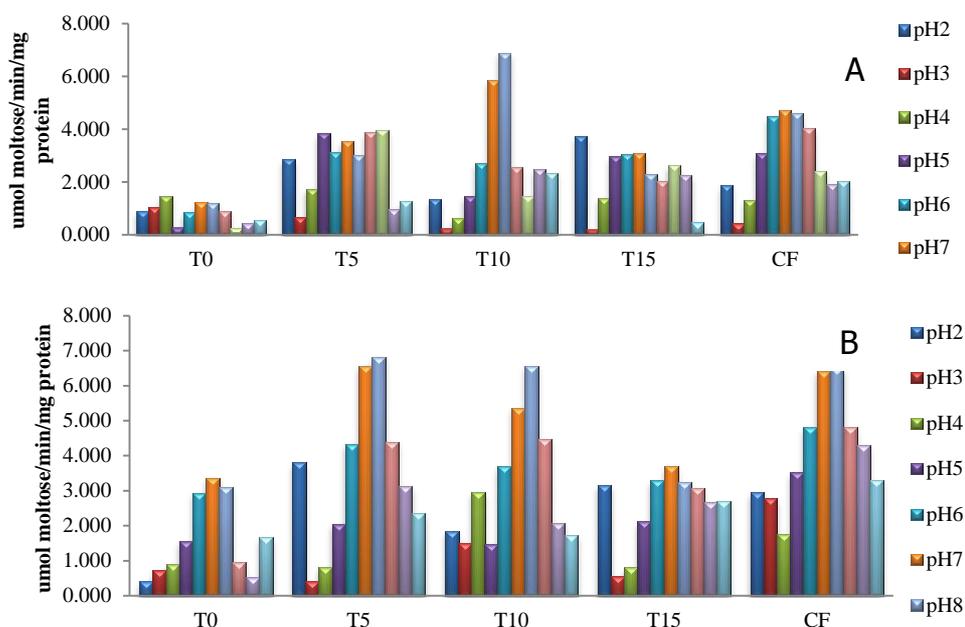


Figure 1. Amylase activity from stomach of hybrid catfish(A) and intestine of hybrid catfish (B)

Protease specific activity

The protease activity was studied in pH 2-12 (Figure2). In the stomach, we found the alkaline protease (pH 8-10) in T10, pH 9-11 in T5 and pH 8-11 in CF groups. The intestine, we found that alkaline proteinase (pH 10-12) in T5, pH 10-11 in T10 and pH 9 and 11 in T0 (Figure 2A and B). Protease activity from intestine was the highest in the T5 group followed by the one in T10 group.

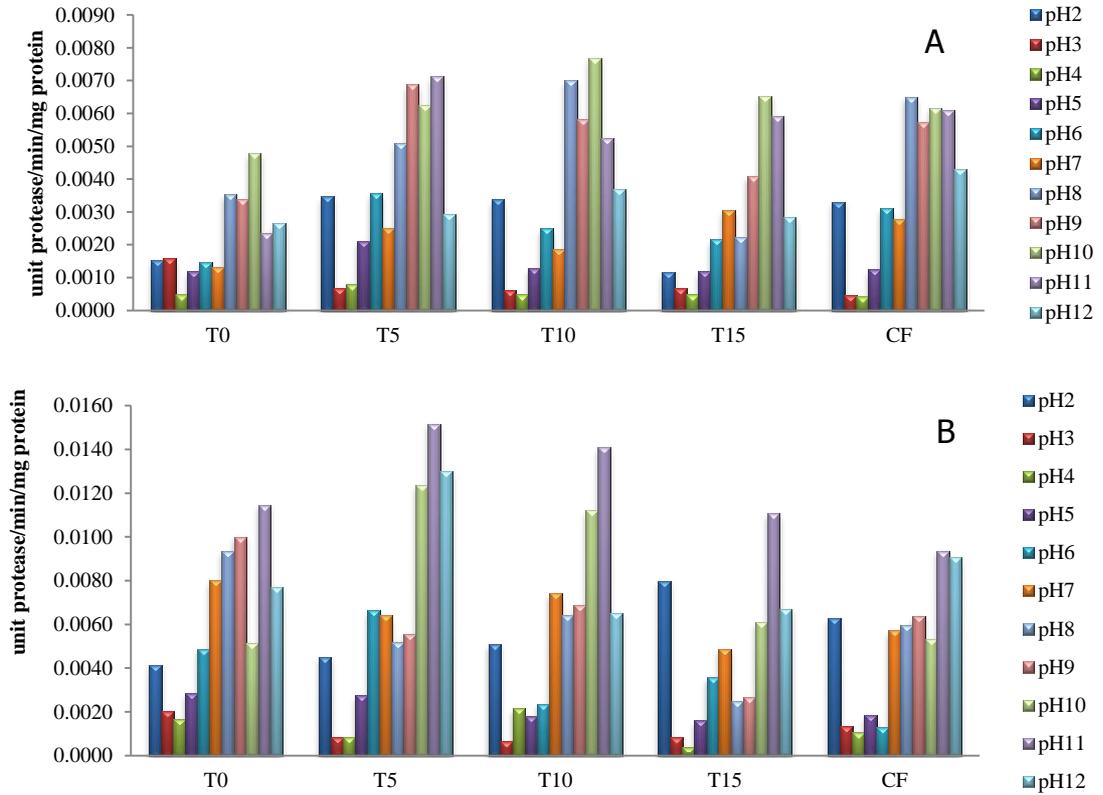


Figure 2. Protease activity from stomach of hybrid catfish(A) and intestine of hybrid catfish (B)

Trypsin and Chymotrypsin activity

Trypsin activity from intestine was the highest in the T0 group followed by the one in T10 group. Chymotrypsin activity from intestine was the lowest in the T5 group followed by the one in T10 group. (Figure 3)

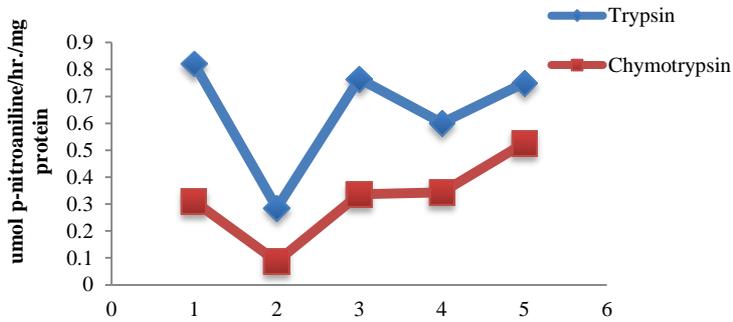


Figure 3. Trypsin and Chymotrypsin activity from the intestine

The highest value of Trypsin enzyme per Chymotrypsin enzyme (T/C ratio) from intestine of hybrid catfish was observed in a T10 fish group. According to the relationship between digestive enzymes specific activities and growth, we found that average daily gain was highest in T10 group which was positive relationship with T/C ratio as the highest activity or trypsin activity as well. (Figure 4)

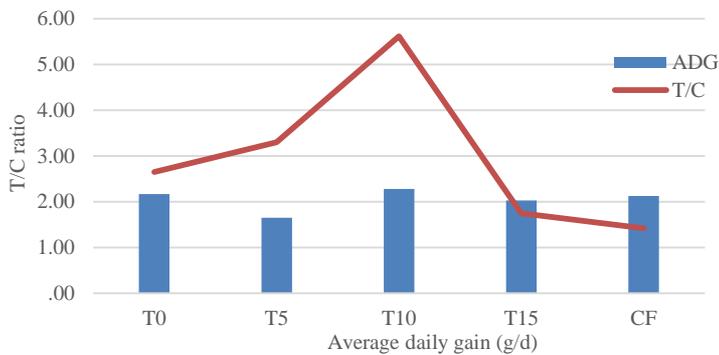


Figure 4. The comparison of average daily weight gain and the digestive enzyme ratio from intestine fish fed with *Spirulina (Arthrospira)* Additive Feed for 120 days

Discussion

The Survival rate and growth performance

The hybrid catfish fed with 10% *Spirulina* (*Arthrospira*) (T10) gained highest survival rate 77.7% ($P < 0.05$). Growth performances of hybrid catfish fed with *Spirulina* (*Arthrospira*) additive feed including average daily gain and the increased weight were significantly higher in T10 than other experimental and control groups ($P < 0.05$). The results showed that *Spirulina* (*Arthrospira*) feeding could improve the survival rate, growth and brightness of skin color as well as improving the cost/performance ratio of the fish (Vonshak, 1997). Similar results were found in hybrid catfish, *Clarias macrocephalus* x *Clarias gariepinus* (Burchell) indicating 10% *Spirulina* sp. provided the best performances on weight gain, specific growth rate, and feed conversion ratio (Phromkunthong and Pipattanawattanakul, 2005) Feeding *Spirulina* to fish and other animals could improve their survival rate and growth rate (Belay *et al.*, 1996 and Hayashi *et al.*, 1998).

The digestive enzyme specific activities

The amylase activity was measured in pH 2-12; however, the amylase activities of the stomach showed the optimum pH at 7-8 and the amylase activity of the intestine showed the optimum pH 7-8, respectively. All of the amylase activities of the stomach and the intestine were shown to be alkaline amylase. The results was similar to the reported by Klahan *et al.* (2009) indicating that the amylase activity levels from the liver, pseudostomach, upper and lower intestines of different sizes of fish were highest at pH 6-8. The optimal pH for amylase activity varied depending on the sources of the enzyme, such as amylase in mammals suitable at pH 6.0–7.0 (Wong, 1995). The carbohydrate is thus digested at a non-acidic pH (Klahan *et al.*, 2009). The effects of four modified diets (gamma-irradiated, microwave-irradiated, probiotic-supplemented and carbohydrase-supplemented diets) on digestive enzyme specific activities and growth performance quality of juvenile Siamese fighting fish were investigated and found that amylase specific activity showing highest levels in microwave-irradiated dietary group and lowest levels in carbohydrase-supplemented dietary group. (Thongprajukaew *et al.*, 2011). In this study, the amylase activity from fish stomach was the highest in the T10 group while amylase activity from fish intestine was the highest in the T5 group.

The protease activity was measured in pH 2-12 and found that the protease activities of the stomach showed the optimal pH 8-11 and the protease activity of the intestine showed the optimal pH 8-12. All of the protease activities of the stomach and the intestine were shown to be alkaline protease. Klahan *et al.*, (2009) also reported that the activity of protease from the pseudostomach, upper and lower intestines and liver was highest at pH of 9-12. Thongprajukaew *et al.* (2011) also reported that the protease activity showed the pH optimal at pH 8 and that the alkaline protease activity of Siamese fighting fish. Areekijserree *et al.*, (2004) reported the optimal activity of protease in the intestine of adult freshwater pearl mussel was showed that pH range of 6–8 (alkaline proteinase).

Trypsin and chymotrypsin specific activity from the intestine were showed that trypsin activity was the highest in the T0 group followed by the one in T10 group. Chymotrypsin activity was the lowest in the T5 group followed by the one in T10 group. The resulted in the highest T/C ratio from intestine was a positive relationship in a T10 group. According to the relationship between digestive enzymes specific activities and growth, the highest average daily gain growth in T10 group, the highest positive relationship with T/C ratio was observed as the highest activity or trypsin activity as well. The specific activities of the alkaline proteases trypsin and chymotrypsin including T/C ratio are important for understanding growth performance relationship and feed utilization efficiency in different fish species (Rungruangsak-Torrissen, 2007; Rungruangsak-Torrissen and Fosseidengen, 2007; Rungruangsak-Torrissen *et al.*, 2009; Sunde *et al.*, 2001, 2004). As the same reported by Rungruangsak-Torrissen (2007) trypsin specific activity and ratio of trypsin to chymotrypsin (T/C ratio) were the inverse relationship between a result of increased chymotrypsin specific activity (C) in the pyloric ceca indicating a reduction in fish growth rate. Unajak *et al.* (2012) reported that one of the most important processes for predicting fish growth was the efficiency of the digestive enzyme trypsin and the activity ratio of trypsin to chymotrypsin, which influenced the conversion of feed to nutrients for utilisation.

Referring to this study, the increased weight and average daily gain were significantly higher in the T10 group than other experimental and control groups ($P < 0.05$). Amylase activity, protease activity and trypsin activity from intestine were highest T10 group. There was a positive relationship between T/C ratio from intestine and their growth rates in a T10 group. These results suggest that fish feed mixed with 10% *Spirulina* (*Arthrospira*)

provided the best growth rate and suitable for a hybrid catfish culture to get the highest production.

References

- AOAC. (2005). Official Methods of Analysis of AOAC International, 18th ed. Association of Official Analytical Chemists, Maryland, USA.
- Areekijseeree, M., Engkagul, A., Kovitvadhi, U., Thongpan, A., Mingmuang M., Pakkong, P. and Rungruangsak-Torrissen K. (2004). Temperature and pH characteristics of amylase and proteinase of adult freshwater pearl mussel, *Hyriopsis (Hyriopsis) bialatus* Simpson 1900. *Aquaculture* 234:575-587.
- Belay, A., Kato, T. and Ota, Y. (1996). *Spirulina (Arthrospira)*: potential application as an animal feed supplement. International Association of Applied Algology 7th International Conference Abstract p. 23.
- Hayashi, O., Hirahashi, T., Katoh, T., Miyajima, H., Hirano, T. and Okuwaki, Y. (1998). Class specific influence of dietary *Spirulina platensis* on antibody production in mice. *J. Nutr. Sci. Vitaminol.* 44:841-851.
- Jana, A., Saroch, J.D., and Borana, K. (2014). Effect of spirulina as a feed supplement on survival and growth of *pangasius sutchi*. *International Journal of Fisheries and Aquatic Studies* 1(5): 77-79.
- Klahan, R., Areechon, N., Yoonpundh, R., and Engkagul, A., (2009). Characterization and Activity of Digestive Enzymes in Different Sizes of Nile Tilapia (*Oreochromis niloticus* L.). *Kasetsart J. (Nat. Sci.)* 43: 143 – 153.
- Lowry, O.H., Rosebrough, N.J., Farr, A.L. and Randall, R.J. (1951). Protein measurement with the Folin phenol reagent. *J. Biol. Chem.* 193: 265-275.
- Mengamphan, K. (2016). Mekong Giand Caffish for Comercial and Community (in Thai). Maejo University.
- Phromkunthong, W. and Pipattanawattanakul, A. (2005). Effects of *Spirulina* sp. on growth performance and antibody levels in hybrid catfish, *Clarias macrocephalus* x *Clarias gariepinus* (Burchell) Songklanakarin *J. Sci. Technol.*, 2005, 27(Suppl. 1) : 115-132
- Rungruangsak-Torrissen, K., (2007). Digestive efficiency, growth and qualities of muscle and oocyte in Atlantic salmon (*Salmo salar* L.) fed on diets with krill meal as an alternative protein source. *Journal of Food Biochemistry* 31:509–540.
- Rungruangsak-Torrissen, K., and Fosseidengen, J.E., (2007). Effect of artificial feeding on digestive efficiency, growth and qualities of muscle and oocyte of maturing Atlantic mackerel (*Scomber scombrus* L.). *Journal of Food Biochemistry* 31:726–747.
- Rungruangsak-Torrissen, K., Stien, L.H., Daae, B.S., Vågseth, T., Thorsheim, G.B., Tobin, D. and Ritola, O. (2009). Different dietary levels of protein to lipid ratio affected digestive efficiency, skeletal growth, and muscle protein in rainbow trout families. *Scholarly Research Exchange* 2009. doi:10.3814/2009/709529 Article ID 709529.
- Sunde, J., Eiane, S.A., Rustad, A., Jensen, H.B., Opstvedt, J., Nygard, E., Venturini, G. and Rungruangsak-Torrissen, K. (2004). Effect of fish feed processing conditions on digestive protease activities, free amino acid pools, feed conversion efficiency and growth in Atlantic salmon (*Salmo salar* L.). *Aquaculture Nutrition* 10: 261–277.

- Thongprajukaew, K., Kovitvadhi, U., Kovitvadhi, S., Somsueb, P. and Rungruangsak-Torrissen, K. (2011). Effects of different modified diets on growth, digestive enzyme activities and muscle compositions in juvenile Siamese fighting fish (*Betta splendens* Regan, 1910). *Aquaculture* 322–323(1): 1–9.
- Unajak, S., Meesawat, P., Paemanee, A., Areechon, N., Engkagul, A., Kovitvadhi, U., Kovitvadhi, S., Rungruangsak-Torrissen, K., and Choowongkamon, K., (2012). Characterisation of thermostable trypsin and determination of trypsin isozymes from intestine of Nile tilapia (*Oreochromis niloticus* L.). *Food Chemistry* 134:1533–1541.
- Vonshak, A. (1997). Appendices. In Vonshak, A. (Ed.) *Spirulina platensis (Arthrospira): physiology cell-biology and biotechnology*. 214 pp. Taylor and Francis Ltd. London.
- Watanuki, H., Ota, K., Tassakka, A.C.M., Kato, T., and Sakai, M. (2006). Immunostimulant effects of dietary *Spirulina platensis* on carp, *Cyprinus carpio*. *Aquaculture* 285(1-4):157-163
- Wong, D.W.S. (1995). *Food Enzyme: Structure and Mechanism*. Chapman and Hall. New York. 390 p.

The Use of Bioreactor System and Aquatic Plants (Water Hyacinth) for Aquaculture Wastewater Treatment

Panyada, M.¹, Whangchai, N.¹, Pholchan, M.² and Sompong, U.^{1*}

¹ Faculty of Fisheries Technology and Aquatic Resources, Maejo University, Thailand.

² Division of Biotechnology, Faculty of Science, Maejo University, Thailand

Abstract The bioreactor (volcanic rock) and aquatic plants (Water Hyacinth) were applied in the wastewater treatment in aquaculture pond. Complete randomized design (CRD) of five treatments was assigned in this experiment; Control, 5% Water Hyacinth with 5% bioreactor (WH5%, RA5%), 5% Water Hyacinth with 15% bioreactor (WH5%, RA15%), 15% Water Hyacinth with 5% bioreactor (WH15%, RA5%) and 15% Water Hyacinth with 15% bioreactor (WH15%, RA15%) in 9×9×1.2 m pond, contained with aquaculture wastewater, for 30 days. Fifteen percent of Water Hyacinth with 15% of bioreactor (WH15%, RA15%) had highest efficiency in the reducing ammonia-N, nitrite-N, nitrate-N, phosphate-P, total phosphorus, COD and chlorophyll- a content; the reduced efficiency were 91.94 ± 2.45, 64.75 ± 5.36, 95.99 ± .27, 86.19 ± .94, 88.24 ± .10, 77.95 ± 0.62, 91.70 ± 1.54 %, respectively. The bioreactor made from volcanic rock and Water Hyacinth was effective to wastewater treatment and was environmental friendly and utilization of invasive plants can certainly assist for their sustainable management in treating wastewater.

Keywords: Bioreactor, Water Hyacinth, Wastewater treatment

Introduction

Water is the most important element for aquaculture. Selection of source water should be based on its suitability for efficient production of a high quality aquaculture product. Poor water quality may affect aquatic animal health through impairment of development and growth or may degrade the quality of the product by tainting its flavor or by causing accumulation of high concentrations of toxic substances which could endanger human health (Zweig *et al.*, 1999).

The intensive development of the aquaculture industry has been accompanied by an increase in environmental impacts. The production process generates substantial amounts of polluted effluent, containing uneaten feed and feces (Miller and Semmens, 2002; Read and Fernandes, 2003). Discharges from aquaculture into the aquatic environment contain nutrients, various organic and inorganic compounds such as ammonium, phosphorus, dissolved organic carbon and organic matter (Piedrahita, 2003; Sugiura *et al.*,

* **Corresponding Author:** Sompong, U.; **Email:** udomluk.sompong@gmail.com

2006). The high levels of nutrients cause environmental deterioration of the receiving water bodies. In addition, the drained water may increase the occurrence of pathogenic microorganisms and introduce invading pathogen species (Thompson *et al.*, 2002).

The water quality parameters which affect fish are the basic characteristics of natural water otherwise referred to as its physio-chemical properties. Fish have a limited range in which they can grow optimally. Fish health can also be affected by pollutants typical of anthropogenic (as a result of human activity) discharges. It is possible for these discharges to also come from natural causes. These pollutants can cause deleterious behavioral and reproductive changes in fish.

Physical and chemical processes are employed in conjunction with biological process in order to achieve better and stable removal of pollutants from pond water (Losordo *et al.*, 1992). Phytoremediation is considered to be a possible method for the removal of pollutants present in wastewater and recognized as a better green remediation technology. Water hyacinth, *Eichhornia crassipes* (Mart.) Solms, is one of the technologies that have been still used.

The water hyacinth, a floating plant found in river, has been successfully used to treat wastewater from the community (Chirnsirikul, 1990). Water hyacinths can remove 68-75% of COD depending on initial concentration (Pavithra and Kousar, 2016). Similarly with the research of Gamage and Yapa (2001), water hyacinth was used for treating the textile wastewater, 81.4% of COD, 60% of dissolved solids, 72.6% of volatile solids and 46.6% of suspended solids were removed.

Bioreactors are also used in the water treatment (Itayama *et al.*, 2008; Bi *et al.*, 2013 and Gutierrez, 2014). They developed a method for cyanobacterial (blue-green algae) control involving a bioreactor inhabited by microfauna species. The charcoal bioreactor effectively suppressed the proliferation of cyanobacteria in pond by the continuous removal of cyanobacterial cells from the waters. The charcoal bioreactor can be effective to decompose cyanobacteria and cyanotoxin in an aquaculture pond in northern Thailand. The volcanic rock or pumice has been used to apply in water treatment. The use of pumice as an adsorbent to remove metals from wastewater treatment at low cost is a well-established process, porous material suitable for the effective bacteria. Pumice has been found to be effective for the removal of phosphate ions from water (Onar *et al.*, 1996).

Therefore, the researcher has the idea to apply the aquatic plants and the bioreactor system to increase the efficiency of water treatment with high organic content by applying volcanic rock or pumice into the bioreactor

system. The purpose of this study was to evaluate the feasibility of reducing water nutrient parameters and phytoplankton content in aquaculture ponds using volcanic rock bioreactor and aquatic plant.

Materials and Methods

Preparation of bioreactor system

Two sizes of plastic baskets (height 42 and 32 cm) were prepared for bioreactor. Crushed volcanic rock was filled between 2 baskets. The air pump (600 L / hr.) was installed inside the basket as shown in Figure 1. The water pump attached to a transparent plastic hose via a t-connector which serves as the effluent output lines outside and inside cage effluent output lines) was placed inside the smaller basket. Four 0.6 L empty round PET containers were attached sideways to each bioreactor to serve as floats. The bioreactors were subjected to non-stop operation for a month.

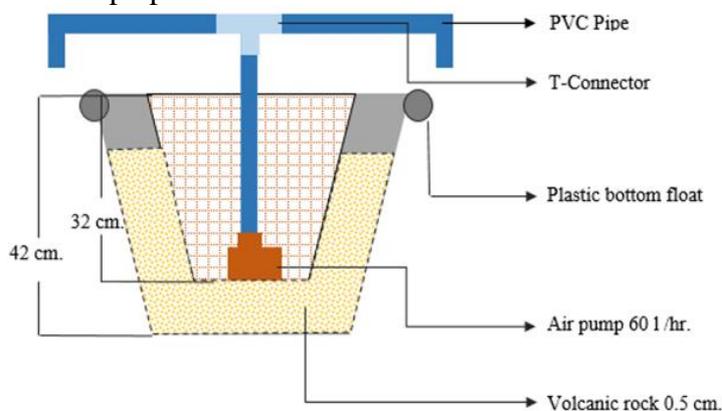


Figure 1. The bioreactor system model (modified from Gutierrez, 2014)

Pond management

The aquaculture pond size was approximate 9×9×1.2 meters. The water was filled up and adjusted by adding nutrients (fertilizer 16: 16: 16).

Aquatic Plant

Aquatic plant (water hyacinth) was collected from stream ecosystem nearby Maejo University, Chiang Mai, Thailand. The same size of water hyacinth was selected and weighed to use in this experiment. The quadrat

made from Polyvinyl chloride (PVC) pipe (0.5 m × 0.5 m) was maintained in a floating state with bubble float being fixed on both sides of the sink (Figure 2).

Experimental design

CRD (Complete Randomized Design) was chosen to divide experiment into 5 treatments with 3 replications: Control (without bioreactor and water hyacinth), 5% of water hyacinth and 5% of bioreactor (WH5%, RA5%), 5% of water hyacinth and 15% of bioreactor (WH5%, RA15%), 15% of water hyacinth and 5% of bioreactor (WH15%, RA5%) and 15% of water hyacinth and 15% of bioreactor (WH15%, RA15%). The percent of water hyacinth and bioreactor was calculated from surface area of the pond.

The quadrats filled with water hyacinth and volcanic rock bioreactors were placed in experimental area (approximately 5-15% of pond area) in this study (Fig. 2).



Figure 2. The volcanic rock bioreactors and quadrats filled with water hyacinth were placed into each aquaculture pond.

Water sampling

Water samples from aquaculture ponds were collected every 3 days for 30 days to analyze the chemical water quality parameters such as ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, orthophosphate, total phosphorus, chemical oxygen demand (COD), biochemical oxygen demand (BOD) and chlorophyll-a content (APHA, 2005)

Statistics analysis

Duncan's Multiple Comparison test and one way analysis of variance (ANOVA) were used for analyzing by SPSS program Ver. 24.0 at 95% difference.

Results

The physical parameters of experiment ponds were shown in Table 1. From the start of experiment, the pH of the water was ranged from 9.70-7.70. The water temperature was ranged from 24.33-29.00 °C and air temperature was ranged from 30-36 °C. The water transparency was 17.35-21.06 cm and increased to 25.5-27.33 cm at the end experiment. The data shown the effect of bioreactor with aquatic plant clarify the water inside the aquaculture pond. Phytoplankton and sediment concentrations were decreased.

Table 1. The physical parameters of experiment ponds (before and end of the experiment)

Treatment	Parameter					
	Transparency (cm)		Water temperature (°C)		pH	
	Before	End	Before	End	Before	End
Control	18.33	26.67	24.33	27.83	9.62	7.94
WH 5%,RA.5%	17.35	25.75	24.00	27.50	9.14	8.02
WH 5%, RA.15%	20.28	25.50	25.13	28.50	9.00	7.85
WH 15%, RA.5%	21.07	26.00	26.00	29.00	8.78	7.79
WH15%,RA.15%	17.97	27.33	23.33	27.33	9.40	7.82

Dissolved oxygen concentration of this experiment was significantly increased (Figure 3). Highest dissolved oxygen content was 15% of water hyacinth and 15% of bioreactor system (WH15%, RA15%) (9.35 ± 0.11 mg /l). The lowest dissolved oxygen concentration was shown in the control treatment because of without air pump. The difference was significant at the 95 % confidence ($p < 0.05$).

Ammonia, nitrite and nitrate nitrogen concentrations had trend to decrease from the beginning. The best effective experiment was 15% of water hyacinth with 15% of bioreactor system (WH15%, RA15%). Ammonia, nitrite

and nitrate nitrogen concentrations were 0.11 ± 0.03 , 6.43 ± 0.44 , 0.56 ± 0.27 mg/l, respectively (Table 5). The amount of inorganic nitrogen compounds were reduced to 92.56%, 66.12% and 95.98% (Table 2).

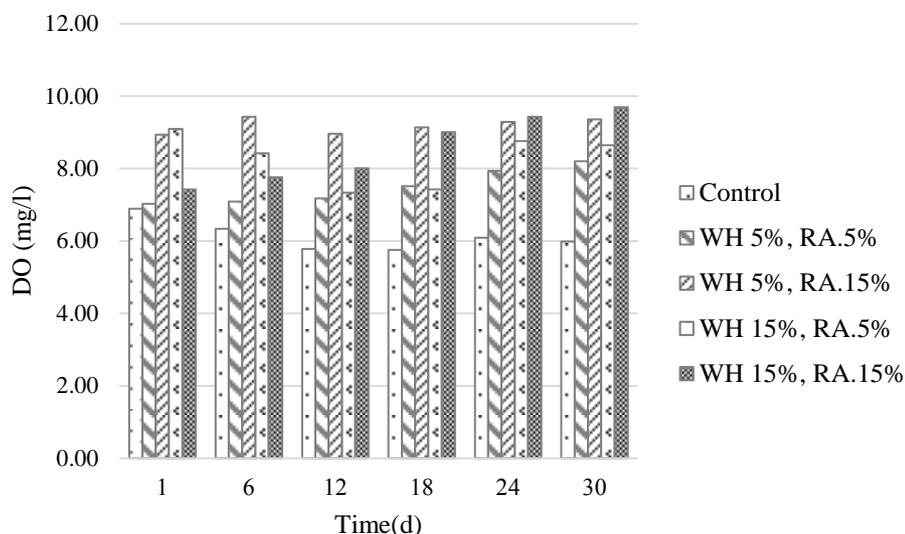


Figure 3. Dissolved oxygen concentrations in aquaculture pond water.

The phosphate and total phosphorus concentrations were decreased. The most effective experiment in phosphorus removal was 15% of water hyacinth and 15% of bioreactor system (WH15%, RA15%), Phosphate-P was decreased from 13.23 ± 0.82 mg /l. to 1.71 ± 0.02 mg /l after 30 days trial. The total phosphorus content was decreased from 6.45 ± 0.71 mg /l. to 0.75 ± 0.08 mg /l. (Table 6). The removal percentages were 86.19% and 88.24%, respectively (Table 3). The difference was significant at the 95 % confidence ($p < 0.05$).

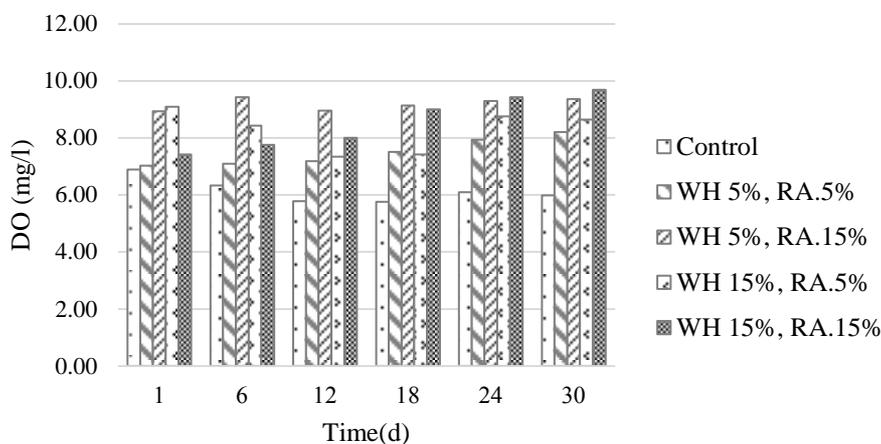


Figure 4. Dissolved oxygen concentrations in aquaculture pond water.

The phosphate and total phosphorus concentrations were decreased. The most effective experiment in phosphorus removal was 15% of water hyacinth and 15% of bioreactor system (WH15%, RA15%), Phosphate-P was decreased from 13.23 ± 0.82 mg /l. to 1.71 ± 0.02 mg /l after 30 days trial. The total phosphorus content was decreased from 6.45 ± 0.71 mg /l. to 0.75 ± 0.08 mg /l. (Table 6). The removal percentages were 86.19% and 88.24%, respectively (Table 3). The difference was significant at the 95 % confidence ($p < 0.05$).

Chlorophyll- a content in aquaculture pond water was also decreased. It implied that phytoplankton concentration in water was decreased by using bioreactor with water hyacinth. The highest efficacy was 15% of Water Hyacinth and 15% of Bioreactor system treatment (WH15%, RA15%). The percentage of reduction was 91.75% ($p < 0.05$) (Table 4). The COD removal percentage was significantly decreased. The most effective of experiments in COD removal were 15% of Water Hyacinth and 15 % Bioreactor system (WH15%, RA15%) and 15% of Water Hyacinth and 5% of Bioreactor system treatment (WH15%, RA5%). The removal percentages were 77.92 and 74.78 %, respectively. Meanwhile, the COD removal in control treatment was decreased 55.81 % (Table 4).

Table 2. Percent removal of inorganic nitrogen compounds. (Mean ± SE)

Parameter		Time (days)					
		1	6	12	18	24	30
NH₃-N	Control	0.00±0.00	29.18±6.27 ^{Cd}	48.92±2.14 ^{Bb}	58.09±2.79 ^{ABb}	62.73±1.82 ^{Ac}	65.14±1.11 ^{Ac}
	WH5%, RA.5%	0.00±0.00	63.55±0.06 ^{Db}	71.66±1.28 ^{Ca}	75.41±3.73 ^{BCa}	76.85±2.14 ^{Bb}	85.45±1.61 ^{Ab}
	WH15%, RA.15%	0.00±0.00	76.47±0.99 ^{Ba}	71.36±8.77 ^{Ba}	75.89±3.18 ^{ABa}	83.96±2.65 ^{ABa}	92.56±2.45 ^{Aa}
	WH5%, RA.15%	0.00±0.00	46.52±3.00 ^{Dc}	59.27±0.63 ^{Cab}	70.74±1.53 ^{Ba}	75.03±0.60 ^{Bb}	87.94±0.48 ^{ABb}
	WH15%, RA.5%	0.00±0.00	52.61±1.16 ^{Dc}	64.35±2.74 ^{Ca}	78.21±5.87 ^{Ba}	80.92±1.50 ^{ABab}	88.86±0.45 ^{ABb}
NO₂-N	Control	0.00±0.00	-10.71±6.16 ^{EDab}	22.13±6.89 ^{Cb}	39.97±5.82 ^{Bc}	52.10±2.93 ^{Aab}	55.41±3.30 ^{Aa}
	WH5%, RA.5%	0.00±0.00	-28.82±8.49 ^{Cb}	21.37±12.07 ^{Bb}	42.27±3.67 ^{ABbc}	42.50±8.38 ^{Aab}	51.21±4.15 ^{Aa}
	WH15%, RA.15%	0.00±0.00	19.04±9.67 ^{Ba}	54.22±6.39 ^{Aa}	56.47±6.01 ^{Aab}	61.32±5.72 ^{Aa}	66.12±5.36 ^{Aa}
	WH5%, RA.15%	0.00±0.00	16.72±5.58 ^{Ca}	42.90±6.78 ^{Bab}	57.09±3.36 ^{ABab}	61.11±6.31 ^{Aa}	62.06±6.50 ^{Aa}
	WH15%, RA.5%	0.00±0.00	10.74±11.11 ^{Cab}	49.36±3.36 ^{Ba}	62.79±2.53 ^{Aa}	63.45±2.51 ^{Aa}	64.12±2.83 ^{Aa}
NO₃-N	Control	0.00±0.00	-27.97±30.80 ^{Da}	30.82±7.68 ^{Ca}	56.29±13.91 ^{Bab}	70.01±12.84 ^{ABac}	78.80±5.75 ^{Ac}
	WH5%, RA.5%	0.00±0.00	-19.12±14.64 ^{Ca}	41.85±33.56 ^{ABa}	83.07±6.27 ^{Aa}	84.30±3.91 ^{Aab}	84.30±2.57 ^{Abc}
	WH15%, RA.15%	0.00±0.00	-22.33±19.40 ^{Ca}	71.22±1.47 ^{ABa}	80.07±2.91 ^{ABa}	94.61±1.98 ^{Aa}	95.98±.27 ^{Aa}
	WH5%, RA.15%	0.00±0.00	-0.53±17.58 ^{Da}	23.96±17.49 ^{Ca}	47.81±11.20 ^{BCb}	59.62±7.55 ^{Bc}	86.23±2.48 ^{Aabc}
	WH15%, RA.5%	0.00±0.00	-10.58±7.85 ^{Da}	22.17±7.93 ^{Ca}	62.45±2.02 ^{BCab}	77.25±1.14 ^{Babc}	90.66±.33 ^{ABb}

** A-F = The difference was significant on each day of the experiment. (p <0.05)

a-f = The difference was significant on treatment. (p <0.05)

Table 3. Percent removal of phosphate and total phosphorus (Mean ± SE)

Parameter		Time (days)					
		1	6	12	18	24	30
TP	Control	0.00±0.00	17.01±4.92 ^{Dc}	33.12±8.88 ^{Cb}	47.91±4.07 ^{Bc}	56.06±1.91 ^{ABc}	60.80±2.66 ^{Ac}
	WH5%, RA.5%	0.00±0.00	31.26±4.21 ^{Db}	51.58±6.86 ^{Cab}	64.42±6.09 ^{BCb}	69.06±4.31 ^{ABb}	75.17±3.94 ^{Ab}
	WH15%, RA.15%	0.00±0.00	49.88±3.88 ^{Da}	68.71±1.20 ^{Ca}	80.12±0.72 ^{BCa}	83.75±.82 ^{ABa}	88.24±0.10 ^{Aa}
	WH5%, RA.15%	0.00±0.00	36.38±5.04 ^{Cab}	55.21±10.38 ^{BCab}	66.73±6.65 ^{ABab}	73.95±5.79 ^{ABab}	77.79±4.71 ^{Ab}
	WH15%, RA.5%	0.00±0.00	35.32±4.15 ^{FDab}	54.40±3.48 ^{Cab}	64.37±3.15 ^{BCb}	73.75±2.55 ^{ABab}	81.00±3.45 ^{Ab}
PO₄³⁻-P	Control	0.00±0.00	19.14±7.53 ^{Db}	28.64±6.88 ^{Cb}	35.57±8.99 ^{BCc}	42.49±6.94 ^{Bb}	56.83±10.16 ^{Ab}
	WH5%, RA.5%	0.00±0.00	29.78±2.08 ^{Cb}	47.95±5.18 ^{Bab}	68.38±2.89 ^{ABab}	75.88±3.18 ^{Aa}	78.17±2.90 ^{Aa}
	WH15%, RA.15%	0.00±0.00	50.22±8.71 ^{BCb}	65.75±3.63 ^{Ba}	82.05±1.50 ^{Aa}	86.51±0.74 ^{Aa}	86.19±0.94 ^{Aa}
	WH5%, RA.15%	0.00±0.00	12.48±3.96 ^{Db}	52.57±5.34 ^{Ca}	63.34±1.24 ^{BCb}	79.10±5.21 ^{Aa}	82.25±3.98 ^{Aa}
	WH15%, RA.5%	0.00±0.00	12.08±5.01 ^{Db}	60.11±6.11 ^{BCa}	74.02±1.76 ^{ABab}	84.12±1.32 ^{Aa}	86.79±0.45 ^{Aa}

** A-F = The difference was significant on each day of the experiment. (p <0.05)

a-f = The difference was significant on treatment. (p <0.05)

Table 4. Percent removal of Chlorophyll a and COD (Mean ± SE)

Parameter		Time (days)					
		1	6	12	18	24	30
Chlorophyll a	Control	0.00±0.00	14.10±1.77 ^{CDc}	21.40±3.92 ^{Cc}	54.40±3.87 ^{Bd}	69.60±5.28 ^{Ab}	71.80±4.30 ^{Ac}
	WH5%, RA.5%	0.00±0.00	17.50±2.25 ^{Dc}	47.80±2.55 ^{Cb}	66.50±1.24 ^{Bc}	76.00±0.75 ^{ABab}	81.80±1.93 ^{Ab}
	WH15%, RA.15%	0.00±0.00	44.90±3.57 ^{Cab}	61.80±2.48 ^{BCa}	78.70±2.58 ^{Bab}	87.70±2.45 ^{Aa}	91.75±1.54 ^{Aa}
	WH5%, RA.15%	0.00±0.00	32.50±4.28 ^{Cb}	58.3±0.57 ^{BCa}	75.40±1.58 ^{ABb}	80.30±2.46 ^{ABab}	83.00±1.49 ^{Ab}
	WH15%, RA.5%	0.00±0.00	53.20±8.10 ^{Ba}	65.30±4.23 ^{Ba}	84.30±0.18 ^{Aa}	81.50±4.99 ^{Ab}	83.50±3.16 ^{Ab}
COD	Control	0.00±0.00	13.97±5.86 ^{Dc}	39.05±4.05 ^{Cbc}	43.39±1.74 ^{ABc}	48.43±2.08 ^{ABd}	55.81±4.09 ^{Ab}
	WH5%, RA.5%	0.00±0.00	28.88±3.23 ^{Db}	52.81±7.08 ^{BCab}	61.92±5.98 ^{ABb}	66.46±5.20 ^{ABbc}	71.04±2.47 ^{Aa}
	WH15%, RA.15%	0.00±0.00	54.62±1.12 ^{Ca}	63.50±1.97 ^{Ba}	74.86±0.48 ^{ABa}	77.37±2.34 ^{ABa}	77.95±0.62 ^{Aa}
	WH5%, RA.15%	0.00±0.00	28.28±1.80 ^{Db}	35.85±0.97 ^{CDc}	49.09±1.87 ^{Cc}	59.18±2.85 ^{Bc}	71.22±2.08 ^{Aa}
	WH15%, RA.5%	0.00±0.00	29.38±3.65 ^{Db}	47.63±3.00 ^{Ccb}	60.01±1.58 ^{ABb}	69.55±2.12 ^{Ab}	74.78±2.10 ^{Aa}

** A-F = The difference was significant on each day of the experiment. (p <0.05)

a-f = The difference was significant on treatment. (p <0.05)

Table 5. The ammonia, nitrite and nitrate- nitrogen concentrations (Mean ± SE)

Parameter		Days			
		1	9	18	30
● (0.0-0.05 mg/l)	NH ₃ -N Control	0.82±0.053 ^{aC}	0.46±0.034 ^{cB}	0.33±0.007 ^{bAB}	0.28±.026 ^{bA}
	WH5%, RA.5%	0.80±0.102 ^{aB}	0.26±0.025 ^{abA}	0.19±0.029 ^{aA}	0.11±.017 ^{aA}
	WH15%, RA.15%	0.78±0.109 ^{aB}	0.17±0.032 ^{aA}	0.15±0.006 ^{aA}	0.05±.013 ^{aA}
	WH5%, RA.15%	0.84±0.088 ^{aA}	0.41±0.014 ^{cC}	0.24±0.010 ^{abB}	0.10±.003 ^{aA}
	WH15%, RA.5%	0.85±0.076 ^{aC}	0.35±0.022 ^{bcB}	0.18±0.049 ^{aA}	0.09±.004 ^{aA}
● (0.0-50 mg/l)	NO ₂ -N Control	21.23±1.059 ^{aC}	16.91±2.175 ^{bBC}	12.82±1.755 ^{bAB}	9.53±1.184 ^{bA}
	WH5%, RA.5%	14.21±1.262 ^{aB}	11.29±1.457 ^{aB}	8.11±0.221 ^{aA}	6.82±0.105 ^{aA}
	WH15%, RA.15%	19.00±2.422 ^{aB}	9.11±0.364 ^{aA}	7.98±0.137 ^{aA}	6.43±0.044 ^{aA}
	WH5%, RA.15%	20.34±4.256 ^{aC}	14.06±1.983 ^{aAB}	8.44±1.013 ^{aA}	7.16±0.108 ^{aA}
	WH15%, RA.5%	18.69±1.644 ^{aC}	12.02±0.194 ^{aB}	6.87±0.105 ^{aA}	6.61±0.022 ^{aA}
● (0.0-2.0 mg/l)	NO ₃ -N Control	15.13±2.137 ^{bB}	10.63±1.969 ^{bcAB}	6.96±2.982 ^{bA}	3.45±1.419 ^{bA}
	WH5%, RA.5%	10.39±1.814 ^{aB}	5.66±1.995 ^{abA}	3.45±0.319 ^{abA}	1.53±0.079 ^{abA}
	WH15%, RA.15%	8.97±1.276 ^{aC}	3.29±0.385 ^{aB}	1.76±0.310 ^{aAB}	0.36±0.062 ^{aA}
	WH5%, RA.15%	11.38±0.103 ^{abC}	9.84±1.865 ^{bcC}	5.92±1.216 ^{abB}	1.56±0.272 ^{abA}
	WH15%, RA.5%	12.20±0.332 ^{abC}	11.35±0.325 ^{cC}	4.58±0.314 ^{abB}	1.14±0.071 ^{aA}

** A-F = The difference was significant on each day of the experiment. (p <0.05)

a-f = The difference was significant on treatment. (p <0.05)

● = Standard of each water quality parameter

Table 6. The phosphate phosphorus, total phosphorus COD and Chlorophyll a concentration (Mean ± SE)

Parameter		Days			
		1	9	18	30
● (0.03-2.0 mg/l)	PO ₄ ³⁻ P Control	15.77±2.219 ^{aC}	11.63±1.632 ^{bBC}	9.90±.988 ^{cAB}	6.42±0.862 ^{bA}
	WH5%, RA.5%	11.60±3.552 ^{aB}	7.01±1.879 ^{abAB}	3.50±0.783 ^{abA}	2.32±0.336 ^{aA}
	WH15%, RA.15%	13.23±0.824 ^{aC}	6.08±1.383 ^{aB}	2.37±0.260 ^{aA}	1.71±0.026 ^{aA}
	WH5%, RA.15%	14.01±0.450 ^{aD}	7.80±0.852 ^{abC}	5.12±0.149 ^{bB}	2.45±0.463 ^{aA}
	WH15%, RA.5%	14.18±0.441 ^{aD}	7.92±0.759 ^{abC}	3.66±0.144 ^{abB}	1.86±0.010 ^{aA}
TP	Control	7.27±0.140 ^{aC}	5.25±0.572 ^{cB}	3.80±0.357 ^{cA}	2.85±0.228 ^{bA}
	WH5%, RA.5%	5.45±1.514 ^{aB}	2.86±0.627 ^{bAB}	1.77±0.176 ^{abA}	1.24±0.124 ^{aA}
	WH15%, RA.15%	6.45±0.716 ^{aC}	2.24±0.267 ^{aB}	1.27±0.113 ^{aAB}	0.75±0.087 ^{aA}
	WH5%, RA.15%	6.92±0.173 ^{aC}	4.09±0.434 ^{bcB}	2.32±0.520 ^{abA}	1.55±0.369 ^{aA}
	WH15%, RA.5%	7.01±0.225 ^{aD}	3.91±0.269 ^{bcC}	2.51±0.297 ^{bB}	1.33±0.255 ^{aA}
● (<120 mg/l)	COD Control	305.77±6.506 ^{bA}	204.44±47.136 ^{abA}	170.66±37.333 ^{bA}	135.11±20.959 ^{dA}
	WH5%, RA.5%	430.11±3.612 ^{cC}	259.55±26.547 ^{bB}	163.55±24.888 ^{bA}	124.44±9.898 ^{cdA}
	WH15%, RA.15%	410.66±14.110 ^{bcC}	170.66±5.333 ^{abB}	103.11±1.778 ^{abA}	90.66±5.333 ^{bcA}
	WH5%, RA.15%	213.33±3.079 ^{aD}	151.11±1.778 ^{aC}	108.66±4.914 ^{abB}	61.33±4.163 ^{abA}
	WH15%, RA.5%	204.44±7.749 ^{aD}	129.77±4.703 ^{aC}	81.77±4.703 ^{aB}	51.55±4.703 ^{aA}
Chlo- a	Control	246.89±32.615 ^{bB}	195.28±25.102 ^{cB}	110.82±12.326 ^{cdA}	71.94±18.524 ^{bA}
	WH5%, RA.5%	263.78±8.661 ^{bD}	143.92±6.954 ^{bc}	88.39±5.119 ^{cB}	47.72±4.494 ^{abA}
	WH15%, RA.15%	277.48±5.718 ^{bD}	124.88±4.450 ^{bc}	58.60±6.028 ^{bB}	22.88±4.100 ^{aA}
	WH5%, RA.15%	151.60±6.767 ^{aC}	80.12±15.422 ^{abB}	37.39±3.628 ^{abA}	25.72±2.908 ^{aA}
	WH15%, RA.5%	148.25±2.138 ^{aC}	57.89±8.084 ^{aB}	23.28±.611 ^{aA}	24.34±4.333 ^{aA}

** A-F = The difference was significant on each day of the experiment. (p <0.05)

a-f = The difference was significant on treatment. (p <0.05)

● = Standard of each water quality parameter

Discussion

The application of wastewater treatment by using volcanic rock bioreactor and water hyacinth was evaluated in aquaculture ponds. They were effective to treat inorganic nitrogen and also phosphorus. The experimental data shown high nitrogen and phosphorus removal efficiencies. From the study of Qin *et al.* (2016), the potential of the water hyacinth (*Eichornia crassipes*) and water lettuce (*Pistia stratiotes* L.) as phytoremediation aquatic macrophytes for nutrients (nitrogen and phosphorus) removal and algal interception from domestic sewage contaminated pond. The water hyacinth, which exhibited hyperactive accumulating capacity for nitrogen (58.64% of total reductions), was more suitable than water lettuce for the intensive purification of domestic sewage with high nitrogen concentrations. This result may be attributed to the larger total root surface area, active absorption area, and leaf area and higher root activity and root biomass of water hyacinth. It exhibited a higher total phosphorus removal efficiency, which benefitted higher P accumulation, adsorption, and precipitation because of its larger roots with higher rhizofiltration capacity.

Water hyacinth can be used to reduce the amount of organic, inorganic and heavy metals wastewater (Rezania *et al.*, 2015). Moreover, the bioreactor improved water quality and decreased the amount of cyanobacterial phytoplankton (*Microcystis*) 4.3×10^{11} cells per day (Itayama *et al.*, 2008). Our experiments obtained similar results with Itayama *et al.* (2008) that the volcanic rock bioreactor reduced the amount of phytoplankton in pond water. The water transparency was higher than the beginning of the experiment (Table 1).

The water temperature in aquaculture ponds was ranged between 23.33 and 28.63°C, while the appropriate temperature was 23.00 - 32.00°C. The daily pH variation was ranged between 7.9 and 9.6. The pH value remained within the standard of aquaculture (6.5-9) (Water Quality Management Division Pollution Control Department, 2002). This bioreactor likely provided the biological filtration from bacteria living in the water. Highly porous on the rock particle surface, was a source of habitat and attached of bacteria. The nutrients for bacteria living in biofilm were provided in the aquaculture water and from the organic decomposition, which contained compounds that bacteria consume. Biofilm bacteria attached volcanic rock particles could be reduced inorganic nutrients (N and P compounds). Nitrifying and denitrifying bacteria can live inside the particles and water. The optimum pH for denitrification process was ranged from pH 6 to 8 and the optimum pH for

ammonia removal was in the range of 7 - 8 (Paul and Clark, 1996; Yangan, 2003).

Ammonia nitrogen ($\text{NH}_3\text{-N}$) content in pond water was reduced because nitrogen in form of ammonia was oxidized to nitrite and nitrate from the nitrification process. The pore size of the synthesized medium was used as a fixative for nitrifying bacteria to produce nitrification. Nitrifying bacteria, which are *Nitrosomonas*, can use ammonia to be nitrite and *Nitrobacter* use nitrite and then convert it into nitrate. Ammonia may be removed through assimilation by bacteria during growth, aquatic plant and phytoplankton. This experiment ammonia nitrogen was uptake by water hyacinths, nitrification and volatilization of ammonia gas into the atmosphere (Mayo *et al.*, 2017). The use of water hyacinth can reduce the amount of ammonia nitrogen 72% (Ismail *et al.*, 2015). In addition, Yangan (2003) studied the efficiency of ammonia removal of different volcanic rocks. It was found that more volcanic rocks were more effective in ammonia removal and at all filtration rates, the efficiency of ammonia removal was higher.

Nitrite nitrogen in water can occur when break down organic matter and release ammonia. In the presence of oxygen, ammonia is converted to nitrite and, if pH is higher than 8.00, the efficiency of nitrite conversion to nitrate will be greater. It reduces the nitrite accumulation in water which is toxic to aquatic animals (Chantawong, 2008). Changes in ammonia, nitrite and nitrate in the aquarium at the first stage of ammonia concentration are high. Nitrite and nitrate concentrations are lower. When the concentration of ammonia decreased, the concentration of nitrite and nitrate was high (Charoencharoen, 2006).

Phosphate and total phosphorus in each experiment more decreased with time during the experiment period. The highest efficacy was 15% of water hyacinth and 15% of bioreactor treatment (WH15%, RA15%). Rock particle have much porous surface. The volcanic rocks composed of silica, iron, calcium, aluminum, titanium, potassium and manganese, respectively. The volcanic rock with the smaller particle size used to have a larger cation exchange capacity and higher surface area. Zhang *et al.* (2014) showed the strong capacity and capability of volcanic rock as absorbent for phosphorus wastewater. Poonchaisin *et al.* (2012) used various shape of absorbents to remove nitrogen and phosphorus in wastewater. It had the potential to absorb high phosphorus.

The COD in the experimental pond water was found to be lower when treated with the use of bioreactors and water hyacinth. The COD decreased significantly during the experiment period because the water hyacinth roots

were fully developed and the filtration capacity of the roots of suspended solids increased as well as the absorption of dissolved nutrients. Gloger *et al.* (1995) compared the COD removal rate of hydroponic tanks that had lettuce plants with aerated tanks that had no plants in treating fish wastewater. They reported 54% higher COD removal rate for lettuce tanks compared with tanks with no plants. In the present study, the plant, water hyacinth, and bioreactor were able to remove the COD in the wastewater during the experiment period ($77.95 \pm 0.62\%$). Krishna (2016) used water hyacinth in the chromium contaminated wastewater treatment. Seventy four percent of the COD was decreased

Conclusions

The application of aquatic plant and bioreactor system in nutrient removal from aquaculture wastewater was estimated. The high nutrient removal efficiency of the experiment was 15% of water hyacinth and 15% of volcanic rock bioreactor system (WH15%, RA5%). This method was environmental friendly and utilization of invasive plants can certainly assist for their sustainable management in treating wastewater.

Acknowledgements

This research was supported by grants from the National Research Council of Thailand: NRCT. The authors thank the Faculty of Fisheries Technology and Aquatic Resources, Maejo University for the research facilities.

References

- APHA. (2005). Standard Methods for Examinations of Water and Wastewater, 21st ed. APHA, AWWA and WEF DC, Washington.
- Boyd, C. E., Romaine, R. P. and Johnston, E. (1979). Water quality in channel catfish production ponds. *J. Environ. Qual.* 18(3): 423–429.
- Chantawong, A. (2008). Water quality for aquaculture. Songkhla: aquaculture. Fisheries College Tinsulanonda.
- Charoencharoen, S. (2006). Treatment of Biological Waste Water by Aquaculture. Master Thesis Prince of Songkla University, Songkhla.
- Chirnsirikul, A. (1990). Treatment of Wastewater with Water Hyacinth. Chulalongkorn University.
- Gamage, N.S. and Yapa, P.A.J., 2001. Use of water hyacinth (*Eichhornia crassipes* (Mart.) solms) in treatment systems for textile mill effluents - a case study. *J. Natl. Sci. Found. Sri Lanka* 29 (1&2): 15–28.

- Gloger, K.C., Rakocy, J.E., Conter, J.B., Bailey, D.S., Cole, W.M. and Shultz, K.A. (1995). Contribution of lettuce to wastewater treatment capacity of raft hydroponics in a closed recirculating fish culture system. In: Timmons MB, editor. Aquacultural engineering and waste management. Proceedings from the Aquaculture Expo VIII and Aquaculture in the Mid-Atlantic Conference, Washington DC: 272–300.
- Gutierrez, R.L. (2014). Remediation and Mitigation of Off-Flavor and Odor Compounds Geosmin and 2-Methylisoborneol) in Water for Aquaculture. Ph. D. Dissertation. Maejo University, Chiang Mai, Thailand.
- Itayama, T., Iwami, N., Koike, M., Kuwabara, T., Whangchai, N. and Inamori, Y. (2008). Measuring the effectiveness of a pilot scale bioreactor for removing *Microcystis* in an outdoor pond system. Environ. Sci. Technology 42: 8498–8503.
- Liu, F.K. (1993). Development of technology of recirculating water in eel ponds. In Fisheries Special Publication, Agriculture Council, Taipei, Taiwan. 52: 101–125.
- Losordo, T. M., Masser, M. and Rakocy, J. (1992). Recirculating aquaculture tank systems. Southern Regional Aquaculture Center (SRAC) Pub. 51: 1–8.
- Mayo, A.W. and Hanai, E.E. (2017). Modeling phytoremediation of nitrogen-polluted water using water hyacinth (*Eichhornia crassipes*). Physics and Chemistry of the Earth, Parts A/B/C 100:170–180.
- Meske, C. (1976). Fish culture in recirculation system with water treatment by activated sludge. Adv. Aquaculture 54: 527–531.
- Miller, D. and Semmens, K. (2002). Waste Management in Aquaculture. Aquaculture Information Series Publication #AQ02-1. Aquaculture Extension Specialist, West Virginia University, Morgantown, West Virginia.
- Onar, A.N. Balkaya, N. and Akyüz, T. (1996). Phosphate removal by adsorption. Environmental Technology 17(2) : 207–213.
- Paul, E.A. and Clark, F.E. (1996). Soil Microbiology and Biochemistry (second ed.), Academic Press, San Diego, California (1996). 340 p.
- Pavithra, M. and Kousar, H. (2016). Efficiency of water hyacinth (*Eichhornia crassipes*) in reduction of chemical oxygen demand (COD) from textile industry effluent. Imp. J. Interdiscip. Res. (IJIR) 2 (7): 1071-1073.
- Piedrahita, R.H. (2003). Reducing the potential environmental impact of tank aquaculture effluents through intensification and recirculation. Aquaculture 226: 35–44.
- Poonchaisin, N., Wangchaichai, M., Lardkitchavorn, S., and Noopan., P. (2012). Efficiency of nitrogen and phosphorus removal on various shape intermediates. Bangkok: National Conference on Kasetsart University. (9th to 9th of December) : 403–410.
- Qin, H., Zhang, Z., Liu, M., Liu, H., Wang, Y., Wen, X., Zhang, Y. and Yan, S. (2016). Site test of phytoremediation of an open pond contaminated with domestic sewage using water hyacinth and water lettuce. Ecological Engineering 95: 753–762.
- Rattanachai, C. (1996). Water quality management. Bangkok: Chulalongkorn Printing.
- Read, P. and Fernandes, T. (2003). Management of environmental impacts of marine aquaculture in Europe. Aquaculture 226: 139–163.
- Rezania, S., Ponraj, M., Talaiekhosani, A., Mohamad, S.E., Din, M.F.M., Taib, S.M., Sabbagh, F. and Sairan, F.M. 2015. Perspectives of phytoremediation using water hyacinth for removal of heavy metals, organic and inorganic pollutants in wastewater. J. Environ. Manag. 163: 125–133.
- Sugiura, S.H., Marchant, D.D., Wiggins, T., and Ferraris, R.P. (2006). Effluent profile of commercially used low-phosphorus fish feeds. Environ. Pollut. 140: 95–101.

- Thompson, F.L., Abreu, P.C., and Wasielesky, W. (2002). Importance of biofilm for water quality and nourishment in intensive shrimp culture. *Aquaculture* 203: 263–278.
- Water Quality Management Division Pollution Control Department. (2002). *Community wastewater and wastewater treatment*. Kurusapa Printing.
- Yangan, S. (2003). *Removal of Ammonia in Wastewater from Aquariums by Filtration with Volcanic Rocks*. Master Thesis Engineering (Environmental Engineering), Kasetsart University, Bangkok.
- Zhang, C., Zhong, Z., Feng, Y., Sun, L. and Qi, L. (2014). Potential for phosphorus removal in wastewater using volcanic rock as adsorbent. *Advanced Materials Research* 1010–1012 : 202–206.
- Zweig, R. D., Morton, J.D. and Stewart, M.M. (1999). *Source Water Quality for Aquaculture: A Guide for Assessment. Environmentally and Socially Sustainable Development: Rural Development*. The International Bank for Reconstruction and Development/ The World Bank, Washington D.C. pp.

Assessment of the Project for Supplementary Incomes of Small Scale Farmers Raising Silver Barb in Baan Doong District, Udon Thani Province, Thailand

Wangkhat, S.^{1*} Pongsuk, P.¹, Hongmaneerat, K.², and Sashiyo, M.³

¹Department of Agricultural Education, Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Thailand, ²Faculty of Liberal Arts and Science, Nakhon Phanom University, Thailand, ³Director, Baan Khaen School, Hora sub-district, Atsamart district, Roi Et province, Thailand

Abstract The assessment of the project for supplementary incomes of small scale farmers raising Silver Barb in Baan Doong District, Udon Thani Province, Thailand in 2018 was the project assessment by using CIPP model. It aimed to assess the project based on environmental condition, input factor, process and yields as well as problems encountered. Questionnaire, interview, and training achievement test were used for data collection conducted with the population of 225 persons. The sample group consisted of 142 persons and another 5 persons provided in-depth data. Findings showed that the project was successful. Most of the informants (67.2%) could earn an income for more than 30,000 bath after finishing the project and they had a high level of quality of life. They had highly level of satisfaction with the project ($\bar{x} = 4.80$). The training on silver barb raising met needs of the informants and it was consistent with way of life of local people. Their silver barb raising was found at a very high level. This implied that they had learned they had learned techniques of silver barb raising. About 41 percent of them wanted to rear silver barb as their main occupation and 30.5 percent wanted to do to for supplementary incomes. However, the expectation: 1) an amount and quality of water; 2) part of the yields was for household consumption; and 3) some of them took some feed of the project for their own fish raising. Appropriateness of environmental condition, input factors, and process of the project were found at a moderate level. Adequate budgets and the establishment of technology transfer on silver barb raising center were advantage of the project. However, there were problems in lack of personnel monitor the project and operation plan.

Keywords: assessment, supplementary income project, silver barb raising, small scale farmers

Introduction

Udon Thani Provincial Agriculture office prepares the “Sustainable Thaism” project in accordance with the Thai government policy on the promotion of small scale farmers to have additional incomes aside from their main accusation. It fact, there is financial support provided by Udon Thani Provincial Agriculture office as the representative of the Department of

* **Coressponding Author:** Songsak Wangkhat; **E-mail:** songsak_09@hotmail.com

Agricultural Extension. This financial support is given to the committee head at the community level (20 districts 195 communities, 300,000 baht each). This is in accordance with the project for additional income generating of small scale farmers (Udon Thani Provincial Agriculture Office, 2018). A guideline for the project implementation of the Ministry of Agriculture and Cooperatives can help small scale farmers in the installation of intellectual weapon, construction of good immunity, and self-reliance as follow of the Philosophy Sufficiency Economy (Wangkhahat, *et al.*, 2016; Kaewnimit, 2009; wongboonsin, 2015; Thandee, 2010, Kaewri *et al.*, 2007; and Innupat, 2007). In this respect, the small-scale farmers will gain knowledge through training group forming, analysis and presentation, and project implementation of the community This project emphasizes on farmer and community development. The 195 projects proposed by farmer groups will be implemented by them self with continual utilization plans and it can be topped up to be agricultural entrepreneur group. These projects include production and selling to generate incomes but It must-have a clear business plan. It also should have a plan on working capital of sub-groups candle community. This in accordance written criteria quid conditions of the project which the project must be beneficial to the society, sustainable and additional incomes (Thanathanyapit, 2018). In addition, this project must be the converted form of decreased expenses/increased incomes/ increased yields/ high standard products. This is under the project framework comprising: plant/animal domestication organic fertilizer production and soil fertility nourishment pesticide/herbicide, community farm, food production, yield processing, agricultural product linstocks'is fisheries/aquaculture, economic insect production, and other agricultural aspects. The supplementary income generating project for small scale farmers raising silver barb in Baan Doong district, Udon Thani province is successful in the project implementation producing adequate protein for the community consumption. In addition, it is the conservation and rehabilitation of local fish species and there is value-added of the fields (Koprajim, 2018). Therefore, the monitoring and assessment of this project can be a case study so as to be a model or guideline for the development other projects.

Objectives of the study

Specifically, this study aimed to: 1) assess the supplementary income generating project for small scale farmers raising silver barb in Baan Doong district, Udon Thani province; and 2) explore problems encountered in the project.

Conceptual Framework

This study anchored on CIPP model of Stufflebean (Stufflebean and Shinkfield, 2007) comprising the assessment of context or environment input process and product. These four components are preferred to be applied to the assessment of the project for agricultural care promotion (Suksaen, 2002). In Mis study, components used for the assessment are shown in Figure 1.

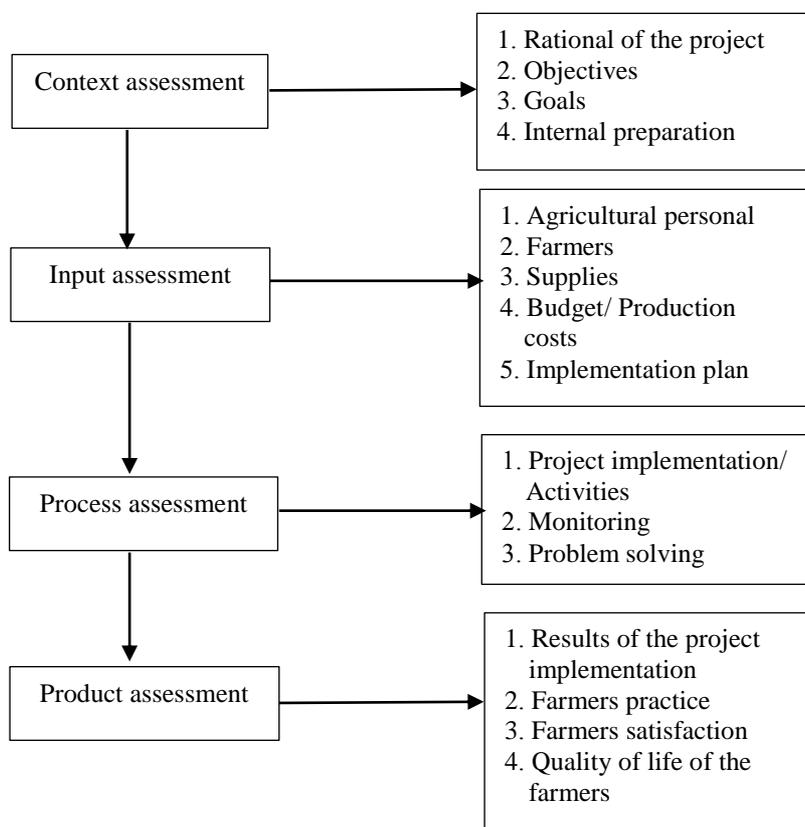


Figure 1. Conceptual framework of the study

Research Methodology

This study focused on the assessment of the project for supplementary income generating for small scale farmers nearing silver barb. It was an evaluation research with the following details:

Scope and delimitation

1. Population and locale of the study-A group of farmers attending a training center the project for supplementary income generating for small scale farmers raising silver barb (225 persons) and I don Thani Provincial Agriculture Office personnel project proponents (5 persons).

2. Content- Four aspects of components:

2.1 Context- Environmental conditions of the project before and article implementing the project i.e. rationale and background of the project, objectives, goals, and internal preparation.

2.2 Input- Basic factors of the project i.e. agricultural personnel, farmers, equipment tools budget production costs, and implementation plan.

2.3 Process-Steps of the project implementation and activities i.e. project implementation activities relevant the project plan and objectives, monitoring, and problem solving while implementing the project.

2.4 Product - Outcomes of the project implementation, practice of the farmers, quality of life of the farmers, and farmer satisfaction. Population and sample group.

The population in this study consisted of 225 persons and the sample group consisted of 142 persons obtained by a method of Krejcie & Morgan. In depth interview was conducted with 5 Udon Thani Provincial Agriculture office personnel the project proponents.

Research instrument

1. Learning achievement test (20 items) with the following criteria

Score		Level of knowledge
13.34 - 20.00	=	High
6.67 - 13.33	=	Moderate
0.00 - 6.66	=	Low

2. Questionnaire and semi-structure interview schedule. This covered an aspects; context input, process and product as well as the farmers quality of life and satisfaction. The questionnaire was in the form of 5-rating-scale and the interpretation criteria were in accordance with that of Roengprapan (2000, p.30).

$$\frac{\text{Highest criterion} - \text{Lowest criterion}}{\text{All criteria}} = \frac{5-1}{5} = 0.80$$

Based on the computation, the criteria are shown below:

Score	Scale limits	Descriptive
5	4.21-5.00	Highest
4	3.41-4.20	High
3	2.61-3.40	Moderate
2	1.81-2.60	Low
1	1.50-1.80	Lowest

Examining quality of the research instrument- Specialists involved in examining quality of the research instrument based on consistency and validity and objectives of the training program (Index of Item - Objective congruence). The consistency vales range was found at 0.6 – 1.0 and the reliability value was found at 0.86.

Data analyses

An analysis of data from learning achievement test, wore and semi-structure interview schedule was done by using the statistical Package. Results were posseted in the form of Table. Descriptive statistics was also employed i.e. frequency, percentage, mean, and standard deviation

Results of the Study

General data of the sample group

findings showed that most of the respondents were male (64.1%) and their age range was 41-50 years old (33.3%). Most of the respondents' main occupation was agriculture and 40.1% of them were elementary school graduates. Less than one-half of the respondents had their family's land (38.7%) and 35.9 percent had their own land. Their annual family income range 59,000 - 100,000 baht. About one forth (27.5%) of the respondents perceived agricultural knowledge and data of the project through neighbors most. This was followed by smart phone (22.5%) community leaders (16.9%), and other media (33.1%). Most of the respondents (80.3%) had joined educational trip once and had attended a training once (73.9%).

All of the respondents applied to the participants of the project by themselves and they expected to use knowledge and experience gained from the project in their occupational development for increased family incomes. In other words, their families encouraged and supported them to join the project and They had a place ready for silver barb culture. Findings showed that the respondents had a high lived knowledge after they had attended the training (13.34-20) which accounted for (69.0%).

The project assessment

Based on environmental conditions of the project it was at a high level of appropriates (\bar{x} = 4.08). The respondents claimed that the training venue was convenient to access most (\bar{x} = 4.25), followed by the training had adequate media and instruments (\bar{x} = 4.17). Besides it was found that there was a high level of the following: clear project goals interesting content and it was consistent with objectives and appropriacies of project management.

Table 1. An assessment of context (environment)

Item	\bar{x}	S.D.	Description
1. The training venue is convenient to visit	4.25	0.667	high
2. The training venue is appropriate with the project and area	4.12	0.842	high
3. Training content is interesting and easy to understand	4.15	0.587	high
4. Objectives and goals of the project is clear	3.84	0.880	high
5. There are adequate media and equipment	4.17	0.595	high
6. The place after the training of participants is appropriate	4.12	0.619	high
7. There is the preparation of tools equipment for the project implementation	4.15	0.587	high
8. Production factors are enough and appropriate with the placed the participants	4.02	0.719	high
9. There is continual and systematic preparation of the project	4.13	0.672	high
On average	4.08	0.308	high

Regarding an assessment of the supplementary income generating project for small scale farmers raising silver barb based on input factor it was found that as a whole, there was a moderate level appropriateness (\bar{x} = 3.37); The following were found at a high level: The participants can rear silver barb based on the objective as set (\bar{x} = 3.89); Obtained budget is enough (\bar{x} = 4.30); and An amount of feed and fish is consistent with the yields as set (\bar{x} = 3.94).

However, the agriculture personnel have a low level of adequateness towards the training project ($\bar{x} = 2.29$) as shown in Table 2.

Table 2. An assessment of input factors of the project

Item	\bar{x}	S.D.	Description
1. Agriculture personnel have adequateness towards the training project	2.29	0.957	Low
2. The participants can rear silver barb based on the objective as set	3.89	0.896	high
3. Equipment and tools are enough and consistent with the project	3.15	0.908	Moderate
4. Obtained budget is enough	4.03	0.693	high
5. A guideline and operational plan in the area are appropriate and consistent the situations and the province policy	2.96	1.044	Moderate
6. An amount feed and fish is consistent with the yields as set	3.94	0.873	high
On average	3.37	0.384	Moderate

In the case of process factors, as a whole, it was found data high level of appropriateness. Based on its details the following were found at a high level: 1) provision of productid fact as is rapid, convenient and adequate ($\bar{x} = 4.06$); 2) delivery of fish breed follows her schedule. ($\bar{x} = 4.15$), and 3) there is immediate consultation for problem solving ($\bar{x} = 3.99$). However, the project implementation is difficult was found at a low level. (Table 3.)

Table 3. An assessment of process of the project

Item	\bar{x}	S.D.	Description
1. The project implementation is difficult	2.19	0.984	Low
2. provision of production factors is convenient rapid, and adequate	4.06	0.736	high
3. Communication between the agriculture personnel and the participants is rapid and convenient	3.38	0.928	Moderate
4. Delivery of fish breed follows the schedule	4.15	0.792	high
5. Immediate consultation for problem solving	3.99	0.646	high
6. Processing and marketing follows the plan schedule	3.10	1.49	Moderate
On average	3.48	0.399	high

Regarding an assessment of satisfaction with the project as a whole, it was found at a highest level of 4.24). Based on its details the following were found data highest level: training operation ($\bar{x} = 4.23$), knowledge gained from the training ($\bar{x} = 4.30$); experience training and educational trip experience ($\bar{x} = 4.10$); educational trip at a business place ($\bar{x} = 4.48$); resource persons and personnel the project ($\bar{x} = 4.33$); training venue or place

($\bar{x} = 4.14$), suggestions of the agriculture personnel ($\bar{x} = 4.28$); supervision monitoring and suggestion alter the training ($\bar{x} = 4.39$); additional training for knowledge/experience exchange ($\bar{x} = 4.28$); and extension of processing and marketing of the silver barb raising project ($\bar{x} = 4.31$) as shown in Table 4.

Table 4. An assessment of the participant satisfaction

Item	\bar{x}	S.D.	Description
1. Training operation	4.23	0.733	Highest
2. Knowledge gained from the training	4.30	0.641	Highest
3. Training and educational trip experience	4.30	0.647	Highest
4. Educational trip at organization	4.48	0.380	Highest
5. Resource persons and personnel of the project	4.33	0.661	Highest
6. Factors supporting the project implementations	3.68	0.925	high
7. Training venue or place	4.44	0.613	Highest
8. Suggestions of the agriculture personnel	4.28	0.636	Highest
9. Knowledge exchange between the resource person and the participants	4.02	0.794	high
10. Supervision monitoring, and suggestions after the training	4.39	0.673	Highest
11. Additional training for knowledge experience exchange	4.28	0.634	Highest
12. Water quality checking and standards the silver barb pond	4.02	0.862	high
13. Extension of processing and marketing the silver barb raising project	4.31	0.654	Highest
On average	4.08	0.308	high

According to an assessment of quality of life as viewed by the participants, it was found that as a whole the participants had a high level of quality d life ($\bar{x} = 3.93$). Based on its details the Following were found at a high level: mind ($\bar{x} = 4.17$), social relationship ($\bar{x} = 4.10$), environment ($\bar{x} = 3.82$), and health ($\bar{x} = 4.15$). Only family economy was found at a moderate level. (Table 5)

Table 5. An assessment d quality of lite of the participants

Item	\bar{x}	S.D.	Description
1. Mind	4.17	0.704	high
2. Social relationship	4.10	0.943	high
3. Family economy	3.39	0.865	Moderate
4. Environment	3.82	0.869	high
5. Health	4.15	0.723	high
On average	3.93	0.331	high

Time span of silver barb raising and harvesting time span of silver barb raising. Based on the questionnaire it was found that there were 83

participants (58.45%) spent the time for raising silver based 4 months; As participants (31.69%) spent the time for y months; and 14 participants (9.86%) spent the time for 6-8 months.

Yields of the silver barb raising project

Based on the questionnaire, it was found that all of the participants caught the fish cherishing 1-3 fish per kilogram. Most of the fish weighed 500 grams and above which consumers preferred fresh fish and dried fish whereas the fish weighing 700 grams up to 1 kilogram was preferred to be processed as fermented fish and it took 6-8 months to reach this size. The following are reasons with the 1-3 fish per kilogram were harvested: 1) the farmer did not have an increased burden on feed; a long time of raising was risky to have a deficit due to quality of the water; and 3) The Provincial Fisheries Office encourages the farmers to sell their fish due to a good price of fish during that time.

Income after joining the project

According to the questionnaire and interview it was found that the participants had prepared an account for the first round of the project implementation Findings showed that more than one-half of them. (67.2%) had an increased income for 30,000 baht white 32.8 percent had an increased income for 5.000 - 29.999 baht. They revealed that fresh fish and processed fish at that time care needed by the mark and it had a high price. There was the promotion fish processing as fermented fish artic was a famous product of Udon Thani province. Besides, some participants - expanded the production by using their can capital.

Participation in the project implementation of family members.

Results of the sturdy revealed that family members of the participants participated and supported activities of the project. Interestingly, 41.6 percent of the participants reared silver barb as their main occupation. Almost one-third of the participants (30.57) reared silver barb as a supplementary career whereas 27.9 percent had not yet made a decision for the next project.

Problems encountered in the project implementation. Findings showed that the participants had good attitudes towards the agriculture personnel. As a whole, there was a low level of problem encountered in the participation in the project implementation ($\bar{x} = 1.53$), Based on its details there was a low level of the problems in participation and working with the community ($\bar{x} = 2.05$). Most of the participants had a problem in water shortage during dry season (80%) followed by processing and packaging (75%) selling or distribution (66.5%) and quality of water (56.50%), respectively.

Table 6. Conclusions of CIPP analysis in each aspect

Aspects to be analyzed	Level of appropriateness	Remarks
Environmental conditions	High	Water shortage during the dry season
Input factors	Moderate	Adequacy of the agriculture personnel towards the training and project promotion
Process	High	-
Yields	Increased incomes, a better quality of life, most satisfaction	An amount of yields was lower than expected colon compared with the budget allocation but there was an increase in production size by a personal budget

According to CIPP analysis of each aspect, it could be concluded as show in Table 6. As a whole, these projections supplementary income generating for small scale farmers raising saver barb was successful making them had a better quality of life. Findings showed that factors on environmental condition and process of the project are sound at a high level of appropriateness whereas input factors were found at a moderate level. It was found that silver barbering was consistent with objectives of the project and ways of life of people in the area. It could be said that this project caused the occasioned learning about selver barb raising techniques. Moreover, some of the participants would rear sliver barb as the main and supplementary career.

Discussion

According to the process assessment et was found that the project was successful because it helped increase incomes and quality of life of the participants. The project a high level of appropriateness of environmental conditions whereas the input factors were found at a moderate level. The silver barb raising activities were consistent with objectives of the project and ways of life of people in the area. This conformed to a study of Pachonchai et al. (2013, p.62) which found that the farmers joining the project for promotion and development of aqua culture occupant (giant seaperch reining in cages) in Naradiwas province was successful because it helped increase incomes and quality of life at the farmers and they wanted to rear giant seaperch to supplement their incomes. Regarding the input factors it was found that most of the participants were male 41-50 years old elementary school graduates and their occupation was agriculture. Fifty participants had their own land for farming, and an annual income range was 50,000 – 100,000 baht. They perceived agricultural knowledge and data of the project through neighbors,

smart phones and community leaders. It could be seen that current farmers could acquire knowledge by themselves particularly through smart phone, YouTube, and Facebook. The participants expected that they would apply knowledge gained from the training to their occupation. They were supported by their family members, and they prepare a place for silver barb raising after they had attended the training. Besides, the participants had a high level of knowledge after the training.

An assessment of the context or environmental conditions of the project showed a high level of appropriateness. This included the following: it was convenient to go to the training place leaving adequate tools, equipment, and medias objectives and goals of the project were clear, the content was interesting and easy to understand; and the project preparation was appropriate. This conformed to a study of Duangsuwan (2008) on an assessment of the project for the promotion and development of catfish culture in a plastic pond in Lamphun province. It was found that this project was successful due to clear objectives and appropriate preparation. This also conformed to a study of Amporn et.al. (2003) on the economy of sea fish culture in Puyu sub-district, Mueang district, Satun province. It was found that the project was successful because there were external stimulation and environmental factors such as food source household workforce, and nearby groupers source.

Regarding an assessment of input factors, as a whole, it was found at a moderate level of appropriateness. Although there were not enough agriculture personnel on the training but there was an appropriate guideline and operational plan which was consistent with the situations and policy of the province. The allocated budget for the training was enough and needs for training of the participants made the project be successful. This conformed to a study of Drangswan (2008), Amporn et al. (2003), and Nuan-anong (2001) which found that the success of the project was due to enough number of personnel, supporting budget, and clear operational plan. For an assessment of process factors, as a whole, it was found at a high level of appropriateness. The sample group perceived that the project process was not complicated, the deliverance and fish breed followed the schedule, the provision of production factors was enough, rapid, and convenient, and there was immediate consultation for solving problems through smart phone.

Regarding an assessment of product, it was found that the project was successful. The participants could rear silver barb as determined (4-8 months). The fish of 2-3 fish per kilogram was easy for processing and we had a high price because it was popular among summers (Fresh Water Fisheries Research and Development Office, 2006), In terms of the project implementation, gained

knowledge training and educational trip experience, resource persons, consultation of the agriculture personnel supervision and monitoring after training extension and additional training, and consistency with results of a quality of life assessment, it was found that the participants had an increase in their quality of life on the basis of mind, social relationship environment and health. However, family economy was found at a moderate level. This conformed to a study of Pachunchai P., et al. (2012, p=63) which found that the farmers parties patting in the project for promotion and development of aquaculture (sea bass) in Naradiwas province had a high level of quality of life on the basis of mind, social relationship, and environment excepted household economy found in a moderate level.

Recommendations

Environmental conditions - Practitioners should have enough operational time and an agency at the area level must have its own operational plan to be ready for the operation. The formulation of objectives must be clear which will result in good practice. The selection of participants must be on the basis of voluntary and interest.

Input Factors - It should have improvement on budget production costs of the farmers, it is too much they may.

Be less interested in the project as it should be. Thus, the farmers should be encouraged to take part in the investment. Developing personnel in the area should be considered for morale of the personnel.

Process - It should be improved by determining the operational plan and the budgeting plan. Also, the supervision process should have some more which will make concerned personnel have a better understanding and can solve problem correctly and accurately.

Product – It an agency wants to develop silver barb raising it needs to improve the environmental conditions. This includes rationale and background of the project, policy of the target organization, objectives of the project, and clear internal preparation of the project. In addition, it should have systematic support on processing and marketing channels for the participants.

References

- Dangsuwan, R. (2008). An Assessment of the Project for Promotion and Development of Catfisk Culture in a Plastic pond, Lamphun province. Independent study, Graduate School, Chiang Mai University.
- Fresh Water Fisheries Research and Development Office. (2006). White Silver Barb Culture. Bangkok: Agricultural Cooperative club of Thailand Printing.

- Innupat, N. (2007). *Manual Community Development*. Bangkok: North Andaman Friends Group.
- Kaewri, N., et al. (2007). *A Promotion Model of Sufficiency Economy Way of Life in Udonthani Province*. Udonthani: The Assistance Center on Community Development Academy Region 4.
- Kaiwnimit, C. (2009). *Roles of Community Leaders in Community Economy Development*. Unpublic thesis, Master of Arts in Community Development. Khonkaen University.
- Kotprajim, T. (2018). Interview of the president of supplementary income generating project for small scale farmers raising silver barb at Thon Na Lab community, Baan Doong district, Udon Thani provinces.
- Nuan-Anong, P. (2001). *An Assessment of the Project for Tilapia Culture in a Cage Lampang Province*. Independent study, Graduate School, Chiang Mai University.
- Pachunchai, P., Zhoerjtham, T. and Panasri, S. (2013). *Evaluation of Extension of Aquaculture in Cage and Pond Occupation Project, A Case Study of Sea Bass Culture in Cage, Narathiwat Province, 2010-2011*. Fisheries Technology Transfer and Development Bureau, Department of Fisheries, Ministry of Agriculture and Cooperatives.
- Roengprapan, C. (2000). *Basic Statistic together with Specimen by Minitab SPSS and SAS*. Khonkaen: Khonkaen University.
- Stufflebeam and Shinkfield. (2007). *Evaluation Theory, Models and Applications*. John Wiley and Son, Inc.
- Suksaen, S. (2002). *CIPP Model: Form of Project Assessment*. A lecture document on Planning and Assessment Techniques. Phras Provincial Public Health Office.
- Thanatanyapit, T. (2017). Interview on supplementary income generating project for small scale farmers at Thon Na Lab community, Baan Doong district, Udon Thani province.
- Thandee, D. (2005). *State and Development*. Bangkok: Chulalongorn University Press.
- Udon Thani Provincial Agriculture Office. (2017). *Sustainable Thaism Projects: Supplementary Income Generating Project for Small Scale Farmers*. Udon Thani Provincial Agriculture Extension office. Thailand Ministry of Agriculture and Cooperatives.
- Wangkhaat, S., Pongsuk, P., Intorrathed, S., and Hongmaneerat, K. (2016). *Context, Understanding, and the Sufficiency Economy Philosophy Practice of Baan Thon Na Lab Community Members, Baan Doong Distric, Udonthani Province*. *Journal of Agricultural Technology*. 12(7.2): 2001-2010.
- Wiboonsri Y. (1999). *An Assessment of Concept and Practice Project*. Bangkok: Chulalongkorn University.
- Wongboonsin, K. (2015). *Population and Development 2nd edition*. Bangkok: Chulalongkon University press.

Utilization and Protection Buffalo Welfare in Phuket Province

Mungkhun S.^{1*}, Pongsuk, P.¹, Intorrathed, S.¹, and Sittijinda, P.²

¹Department of Agricultural Education, KMITL, Bangkok, Thailand. ²Faculty of Agricultural Technology, Rambhi barni Rajabhat University, Thailand.

Abstract The utilization and protection of Buffalo welfare in Phuket province was explored by interview with 27 Jurors Hearing beefaloes. Results revealed that most of the informants reared buffaloes for supplementary income generating which aimed to spend it for household agricultural activities and for agro-tourism promotion. It was found that the informants wished to make their buffaloes be part of agro-tourism promotion such as rice growing activities, wonder buffalo show, and buffalo riding. Besides, they wanted to have a buffalo museum in the area so as to be the center for learning buffalo rearing. Buffalo contest was also needed in order to develop Buffalo strains or breeds to be beef buffaloes. Regarding measures for buffalo protection, its must be careful to avoid buffaloes eating wastes or garbages littered by tourists and danger caused by passby vehicles and tourists. In addition, tourist activities made some buffalo farmers chieft to other occupations. Also, the informants concerned public agencies to hold a training on buffalo rearing as part of agro-tourism in Phuket province.

Keywords: buffalo rearing, utilization, buffalo welfare, agro-tourism

Introduction

Tourist activities in Phuket province are diverse and very popular particularly on seatourism which is very important to the economic system of the province and the country. There are a lot of tourism activities together with a rapid growth rate of tourist attractions and tourists. Besides, there are a lot of foreigner running business in the area such as the eatery, hotel, spa, and tour company. Thus, tourism is an important component making local people have incomes earned from tourism activities. Actually, it is observed that some tourist attractions are too crowded until there are environmental problems. Hence, new tourism activities such as agro-tourism and community way of life tourism can be alternatives for interested persons. This helps reduce overcrowded income tourist attractions.

An activity supporting sustainable tourism to the community is community way of life tourism related to farming (Sudchookiat *et al.* 2007) such as buffalo rearing in the area for income generating (Thabutr and Sripawong, 2016 and Sanghuaipai, 2009). Some tourist attractions have buffalo services for tourists. At present, however, there is a decreased number

* **Corresponding author:** Mungkhun, S.; **Email:** mungkhuns@hotmail.com

in buffaloes due to the expansion of tourism activities and some buffaloes grower in hotel's area. Also, heavy traffic is dangerous to tourists and buffaloes along the edges of the road (Chaniwanitkul, 2014 and Phuket Provincial Livestock office, 2017). Therefore, to put the importance on buffalo welfare is essential and appropriate for sustainable buffalo rearing and is consistent with tourism in the area.

The conceptual framework in this study was the investigation of buffalo rearing, direct/indirect buffalo utilization, and measures on buffalo welfare protection due to the community expansion and tourism activities. Scope and delimitation of the steady was the population in this study which consisted of 27 framers rearing buffalo was in Phuket province and the content included general traits, utilization of buffalo rearing of the farmers, and buffalo welfare protection such as care-taking, tourist spot on buffalo rearing showed the problems encountered in buffalo rearing.

Specifically, this study aimed to explore the conditions and problems in buffalo rearing of famers in Phuket province and utilization and protection of buffalo welfare

Materails and methods

The qualitative and quantitative research, interview, and observation were employed as follows: population, it consisted of 27 farmers rearing buffaloes and they were obtained by snowball sampling, the research instrument was a set of five-rating-scale questionnaires where used for data collection. It was based on the general data of the farmers rearing buffaloes and utilization and protection of buffalo welfare. Data were collected during March-June 2018. Data were analysed a descriptive statistic i.e. frequency, percentage, mean, and standard deviation. The determination of interpretation criterion score of a problem level was in accordance with that of Leekitwattana (2012) as shown below:

Score	Scale Limits	Level of problem
5	4.50 – 5.00	Highest
4	3.50 – 4.49	High
3	2.50 – 3.49	Moderate
2	1.50 – 2.49	Low
1	1.00 – 1.49	Lowest

Results

General data of the farmers reining buffalo

Results revealed that most of the farmers reared 17.5 buffaloes on average and they had been rearing for about 12 years and it was in the form of free ranching. Ninety percent of the farmers built a pen for their buffaloes. One-half of the farmers had a grass plot) 4 rai(for their buffaloes. Most of them 75.)8%(reared buffaloes for supplementary incomes. They reared buffaloes from generations to generations in the area where there was no epidemic.

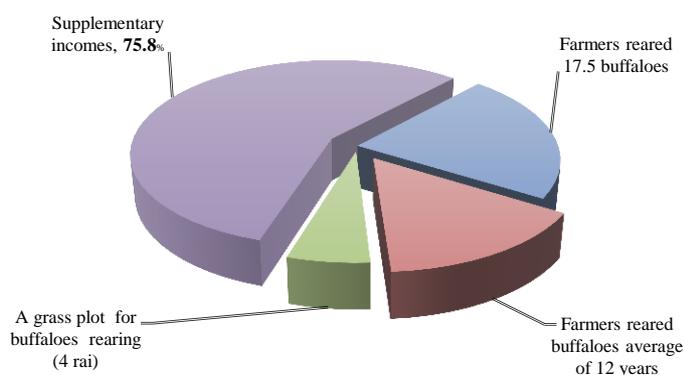


Figure 1. A graph showing buffalo rearing of the farmers.

Utilization of beefalo rearing of the farmers

It was found that the farmers mostly reared buffaloes as a draft animal and a hobby which they had knowledge exchange about buffalo rearing. The farmers put the importance on the conservation of buffalo rearing for the local ecology systems. Results of the study on the utilization of beefalo rearing were shown in Table 1.

Table 1. Utilization of buffalo rearing of the formers in Phuket province

Item	\bar{x}	S.D.	Description
1. Promotion of agro-tourism in the area	4.35	0.74	Highest
2. A tourist place on buffalo rearing activities	4.35	0.74	Highest
3. Selling manure for supplementary incomes	3.40	0.75	Highest
4. A learning source about agricultural community way of life	4.20	0.69	Highest
5. Buffalo contest and conservation	4.15	0.74	High
6. Buffalo selling	3.12	0.72	High
7. Keeping the ecology system in the area	3.81	0.79	High

According to Table 1, it was found that the farmers utilized buffalo rearing at a highest level in terms of the following: selling manure for supplementary incomes; promotion of agro-tourism in the area; a tourist place or buffalo rearing activities; and a leaning source about agricultural community way of life, respectively.

Impacts of tourism activities on buffalo rearing of the farmers

Results showed negative impacts of tourism activities on buffalo rearing of the farmers in Phuket province duce to a decrease income; public grazing land; buffaloes could not encroach private areas for grazing such as neighbors' residential area, hotels/resorts, and cultivated area.

Table 2. Impacts of tourism activities on buffalo rearing of the farmers in Phuket province

Item	\bar{x}	S.D.	Description
1. Farmers have less income from buffalo rearing	4.21	0.67	High
2. Increased expenses on buffalo feed	4.02	0.69	High
3. Expense on buffalo confinement	3.52	0.73	High
4. Wage for buffalo rearing workforce	3.10	0.71	High
5. Expenses on medical supplies for buffalo healing	2.85	0.87	Moderate

Regarding impacts of tourism activities on incomes and buffalo rearing of the farmers as shown in Table 2, it was found that following were found at a high level; a decreased income eared from buffalo rearing; increased expenses on buffalo feed; expense on buffalo confinement; wage for buffalo rearing workforce ; and expenses on medical supplies for buffalo healing.

Protection of buffalo welfare of the farmers rearing buffaloes in Phuket province

Protection of buffalo welfare of the farmers rearing buffaloes was essential since the buffaloes were used in various activities such as agricultural proposes and tourism activities In addition; there were an increase in an amount of vehicles tourism activities, and the expansion of the community. All of there had a negative impact on the buffalo welfare which needed to be solved.

Table 3. Impacts of tourism actives on buffalo welfare in Phuket province

Item	\bar{x}	S.D.	Description
1. In adequate grazing areas of the buffaloes	3.63	0.76	High
2. Shortage of clean natural water sources	3.25	0.55	Moderate
3. Natural grazing land area is contaminated due to waste water from the community	3.00	0.72	Moderate
4. The buffalo domestication areas have garbage form the community	2.97	0.95	Moderate
5. Expansion of the community area and structure	3.60	0.72	High
6. The buffalo domestication areas are close to the road which may have an accident	3.58	0.63	High

Impacts of tourism activities on buffalo welfare were found at a high level on average. This included inadequate natural foot sources; expansion of the community area and tourist services; inadequate clean water sources; garbags, and chemical contamination.

Measures on buffalo welfare protection

Most of the farmers rearing buffaloes in Phuket province reared buffaloes in the form of free ranching in public areas where there was no utilization. However, it was found that the buffaloes were domesticated in risky areas. This was due to the following: the community expansion, garbage littering, confinement of entrepreneur places, heavy traffic, etc. (Table 4)

Table 4. Measures on buffalo protection

Item	\bar{x}	S.D.	Description
1. Medical checking of the buffaloes	4.75	0.44	Highest
2. Buffalo rearing extension and training	4.60	0.50	Highest
3. Buffalo conservation and commercial value added	3.62	0.83	High
4. Provision of food sources for the buffaloes	4.70	0.47	Highest
5. Promotion of buffalo breeds and strain improvement	4.65	0.48	Highest
6. Having networks for knowledge exchange about buffalo rearing	3.71	0.57	High
7. Enforcement of animal welfare protection Act	3.68	0.79	High

The medical checking of the buffaloes, provision of food sources for the buffaloes, promotion of buffalo breeds and strain improvement and buffalo rearing extension and training needed to be done (Table 4).

Discussion

Buffalo domestication in Phuleet province is inherited from ancestors for supplementary income generating. Normally farmer there keep buffaloes in a pen and free ranching every day. According to results of the study, there are many problems encountered in buffalo domestication. This includes: inappropriate sanitary, inadequate grazing areas and natural water sources, accidents on the road, etc. This also conforms to a study of Chaniwanitkul (2014) which revealed buffalo injury due to the accident while crossing the road. This also conforms to a study of Ngertkip (2011) and Intawicha *et al* (2017) which revealed that some buffaloes eat garbages and were injured from sharp materials. These problems mostly occur from impacts of the expansion of tourism and other business such as the construction of residential area, commercial buildings, tourist spots, and para rubber plantation. All of these make some farmers sell their buffaloes. Nevertheless, buffalo utilization is still necessary in Phuket province. Although buffaloes are not mainly used for agricultural purposes by it can be used in other activities such as agro-tourism and a buffalo learning source.

According to results of the study, most of the farmers in the sample group domesticated buffaloes in the form of free ranching in public areas where there was no ceterization. However, there where prolems there such as dung on the road, footpath, and in the fields. Meanwhile, some of the farmers domesticated buffaloes in their own land (3-5 rai) but there was inadequate feed particularly in the dry season.

The domestication and utilization of buffaloes of farmers in Phuket province was in the synergistic form such as manure for selling, ritual

ceremonies, buffalo contest, etc. Buffaloes were also used for tourist service which began to be popular. Besides, the farmers also wished to have a buffalo museum in the area as well as a learning center about the community way of life. This conformed to a study of Somboonpong (2010) which revealed a buffalo contest for promoting tourism activities and farmers wanted concerned public agencies to assist in buffalo domestication.

Regarding impacts of tourism activities on buffalo domestication, it was found that there was inadequate natural water sources. This conformed to a study of Songscerm *et al.* (2013) which claimed that the existing of buffalo domestication depends on public area use and obligation between man and buffalo. For buffalo welfare, it tended to be worse since there was a decrease in buffalo domestication area and there was danger from eating garbages construction materials or staying in a dirty swamp making them buffaloes have skin disease. This conformed to a study of Sompan (2013) which cited that buffaloes like to stay in a swamp for heat releasing but is was risky to have skin disease, In addition free ranching buffaloes had a possibility to have accident on the rood due to heavy traffic.



Housing estate expand in buffalos area



The wall diagonal block grazing of buffaloes



Waste from the community and tourist



The dangerous of traffic



A sign to beware of buffaloes



A sing promoting tourism

It is suggested the buffalo free ranching needed to be more careful than keeping it in open. Farmers should be careful which harmful to buffaloes because it may result in illness. The domestication of buffaloes must be appropriated. The topographic area and a fence should be built to prevent the buffaloes go out of the safe area. Entrepreneurs who uses buffaloes for tourist service must pay attention to the importance on sanitary, avoiding stress and animal welfare.

References

- Sanghuaipai, N. (2009). Production of Thai Buffaloes leading to Sustainable Development and Conservation. Department of Livestocks, Office of Agriculture and Agricultural Cooperatives. Bangkok, Thailand.
- Ngertkip, P. (2011). Legal Measures for Animal Protection in Accordance with Animal Welfare. Unpublished thesis. Thammasat University, Thailand.
- Intawicha, P., Tana, S., Krueasan, S., Saengwong, S., Sorachakula, C., Danmek, K., Attabhanyo, R., Dongpaleethun, C., and Teepatimakorn, S (2017). Conditions of Buffalo Domestication and Satisfaction with Academic Services of Phayao Provincial Agriculture Office, Phrachomklao. Agriculture journal. 35(3) pp. 64-78.
- Leekitwattana, P. (2012). Educational Research Methodology Bangkok: Faculty of Industrial Education, King Mongleut's Institute of Technelogy Ladkrabang.
- Sompan, P. (2013). Importance of a Wallow towards Safety of Swamp Buffaloes. Department of Agricultural Technology, Faculty of Science and Technelony. Thammasat University.
- Somboonpong, M. (2010). Land Use of Farmers for Agro-tourism in Wang Nam Khieo District Nakhon Ratchasima Province. unpublsh thesis. Kasetsat University.
- Chaniwanitkul, S. (2014). Animal Welfare Protection, Faculty of Law, Assumption University.
- Sudchookiat, S. Nakviboonwong, V., and Tanon, S. (2007). Protection and Sustainable Utilizatilise of Agricultural Area, National Research Council of Bangkok Thailand
- Songscerm, S., Homhual, S., Kotedok, U., and Chanthabut, L. (2013). Thai Buffalo Conservation Strategies of Nongtherng Community, Nong waeng Sub-district, Musing District, Roi Et Province. Division of Inovation for Local Development, Mahasarakham Rajabhat University.

- Thabutr, A. and Sipawong, S. (2016). Factors Effecting the Sustainability in Buffalo Domestication of Farmers in Lower Songkhram watershed, Mahasarakham Provincial Livestock Office. Mahasarakham province.
- Phuket Provincial Livestock Office. (2017). Buffalo Numbers of Farmer Households. Phuket province.