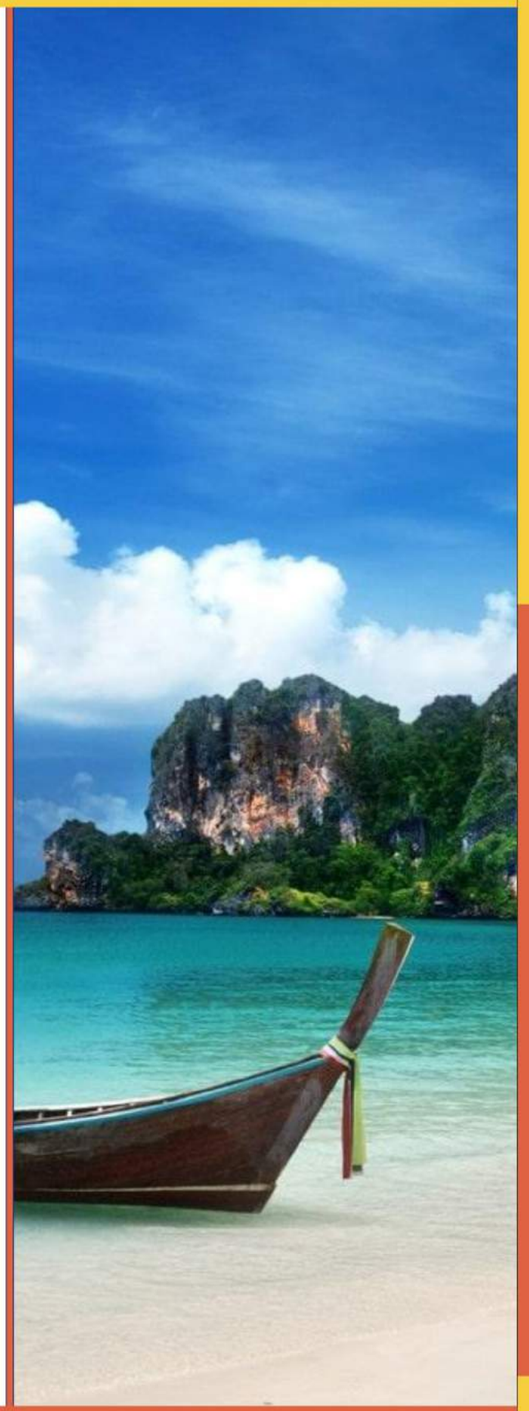
ORGANIZING INSTITUTION

SAFE NETWORK
Asia Pacific Network for Sustainable Agriculture Food and Energy

MEMBERS



7th International Conference Sustainable Agriculture, Food, and Energy

Phuket THAILAND, 2019

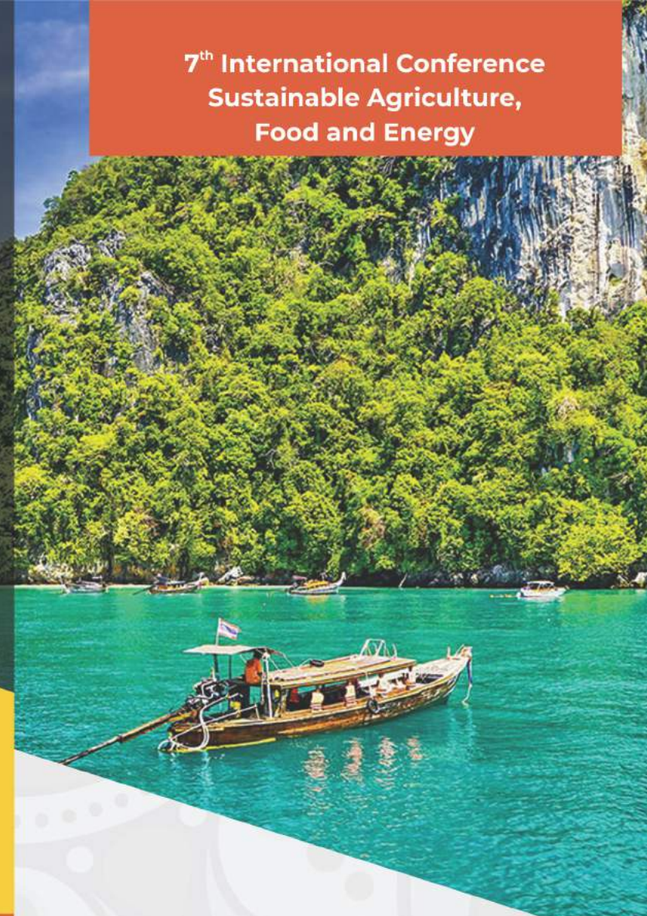
SAFE NETWORK
Asia Pacific Network for Sustainable Agriculture Food and Energy
BECOMING BIGGER TOGETHER

HOME FOR CONNECTING PEOPLE

SAFE 2019 THAILAND

SAFE 2019
International Conference
Sustainable Agriculture,
Food and Energy.
October 18-21, 2019
Phuket. THAILAND.

Conference Programme
Papers Abstracts



7th International Conference
Sustainable Agriculture,
Food and Energy

GREEN AGRI-FOOD ENERGY PRODUCTION FOR A BETTER WORLD IN A CHANGING CLIMATE

SAFE NETWORK
Asia Pacific Network for Sustainable Agriculture, Food and Energy

www.safe-network.org

7th International Conference
Sustainable Agriculture, Food, and Energy
SAFE2019

October 19-21, 2019
Phuket Rajabhat University, Thailand

"Green Agri-food Energy Production for a Better World in a Changing Climate"

CONTENTS

WELCOME MESSAGE FROM SAFE-NETWORK

Welcome to the International Conference on Sustainable Agriculture, Food, and Energy (SAFE 2019)

We are proud to welcome you to the **International Conference on Sustainable Agriculture, Food, and Energy (SAFE2019):** Green Agri-food Energy Production for a Better World in a Changing Climate" which will be held from October 19-21, 2019 in Phuket, Thailand. The host institution are Phuket Rajabhat University, Chiang Mai University and Chiang Mai Rajabhat University. This conference is the 7th annual conference after the 1st International Conference on Sustainable Agriculture, Food, and Energy (**SAFE2013**) in Padang, Indonesia (12-14 May 2014), the 2nd conference **SAFE2014** in Bali, Indonesia (17-19 September 2014). The 3rd conference **SAFE2015** in Ho Chi Minh City, VIETNAM (17-19 November 2015), 4th conference **SAFE2016**, Colombo, Sri Lanka (October 20-22, 2016), the 5th conference **SAFE2017,** Malaysia, August 22-24, 2017 and and 6th SAFE2018 Conference is Makati, Manila. PHILIPPINES

Aside from the conferences, workshops and short course programs, SAFE-Network has expanded to producing **SAFE Rice Project** as an output of organic rice research conducted by Malaysian and Indonesian faculty-researchers. As the Network grows, the Network plans to embark on innovative platforms where "sustainability" can be served best especially to some group of learners who do not have sufficient background in agriculture science. The Network chooses Philippines, particularly CBSUA, to initially host the **Virtual Farm Academy** in collaboration with SAFE Network and eventually with universities from Malaysia, Indonesia, India, Pakistan, Iran, Thailand, Japan, Taiwan, Sri Lanka, Australia and Bangladesh who are also active members of the Network. CBSUA will take the lead in facilitating the modules to online participants and take the necessary actions in expediting the modular classes. The Network Head Coordinator, together with CBSUA President shall issue certificates of program completion to registered participants. We express our deep gratitude for the support given by Dr. ALBERTO N. NAPERI the President of CBSUA. The virtual farm academy will be launched in the opening ceremony of SAFE2019 and we invite all of us to discuss the operational plan of this Virtual Academy on October 19, 2019 in Phuket.

On behalf of SAFE-Network**,** we would like to say thanks and convey our appreciation to the Phuket Rajabhat University, Chiang Mai University and Chiang Mai Rajabhat University for co-hosting this conference.

We would like especially to thank Prof. Dr. Tafdil Husni, *Rector of Andalas University* for his strong support to this event, Assoc.Prof. Sermkiat Jomjunyong, Ph.D, *Local Conference Coordinator*, Dr. Worajit Setthapun, *Conference Secretary* and the members of the local organizing committee who helped with all the preparations required to make the conference a success, as well as the session organizers who worked to ensure a high level of science presented at the meeting. Moreover, of course, we thank all honorable speakers and participants who have agreed to attend and discuss your work! Finally, please understand that while every effort was made to publish this book as the "final" program, we know that unavoidable withdrawals and other changes will occur.

Welcome to SAFE-2019, Phuket! Please enjoy the friendship!
One planet! One happiness! Friendship creates wonders!

Prof. Dr. Novizar Nazir
SAFE-Network Coordinator

MESSAGE FROM THE RECTOR OF ANDALAS UNIVERSITY-INDONESIA

Sawasdi khap,

I would like to congratulate and convey my gratitude to the **SAFE Network** for undertaking the initiative to organize **SAFE2019** (7th International Conference on Sustainable Agriculture, Food, and Energy). Andalas University is delighted to be the organizer of this conference since the 1st International Conference on Sustainable Agriculture, Food, and Energy (**SAFE2013**) in Padang, Indonesia (12-14 May 2014), the 2nd conference of **SAFE2014 in** Bali, Indonesia (17-19 September 2014), the 3rd conference of **SAFE2015** in Ho Chi Minh City, VIETNAM (17-19 November 2015), 4th conference (SAFE2016) in Colombo, Sri Lanka, October 20-22, 2016, the 5th conference **SAFE2017,** Malaysia, August 22-24, 2017 and 6th SAFE2018 Conference is Makati, Manila (Philippines).

The theme of this year's conference is " Green Agri-food Energy Production for a Better World in a Changing Climate". Climate change is one of the most complex problems we face today. This issue involves many dimensions - science, economics, society, politics and morals and ethical questions - and are global problems, felt on a local scale, which will exist for decades and centuries to come. Activities in the agricultural, food and energy sectors are sectors that have an impact on climate change, but on the other hand, that are heavily affected by climate change itself. Therefore, the participation of the scientific community from universities and research institutions to address the problems related to climate change is highly expected.

Through the conference, we hope to generate substantial contributions to create a better solution and new value on sustainability and sustainable development of agriculture, food, and energy. We are confident that valuable innovation that can change or create more efficient processes, products and ideas are forged after attending this conference. Sustainability is a difficult issue and complex. It is not a goal but a process. I would like to thank the organizing committee and the co-organizer institutions for the hard work and full commitment in preparation of this conference.

Finally, we congratulate Phuket Rajabhat University, Chiang Mai University and Chiang Mai Rajabhat University for hosting this conference. My personal respect and thanks go to all participants. Please enjoy the friendship, enjoy the culture of Thailand! I wish you an enjoyable and memorable conference in Phuket.

Khawp khun khap!

Prof. Dr. Tafdil Husni
Rector of Andalas University

OPENING AND WELCOME MESSAGE BY CONFERENCE COORDINATOR

Assoc.Prof. Sermkiat Jomjunyong, Ph.D.,
Country Coordinator of SAFE-Network (THAILAND)
Faculty of Engineering.. Chiang Mai University.

Prof. Dr. Tafdil Husni, Asst.Prof.Dr. Hiran Prasarnkarn, Dr. Alberto N. Naperi and Prof. Dr. Novizar Nazir, Distinguished participants, Ladies and Gentlemen:

It gives me a great pleasure to welcome all of you and chair the Opening Ceremony this morning to the "International Conference on Sustainable Agriculture, Food, and Energy (SAFE 2019)" Green Agri-food Energy Production for a Better World in a Changing Climate" which will be held from October 18th - 21st, 2019, Phuket, Thailand. The host institution is jointly organized by SAFE Network, Chiang Mai University, Chiang Mai Rajabht University, Phuket Rajabhat University, THAILAND and ANDALAS University, INDONESIA.

SAFE Network is an Asia Pacific network of university and college educators, researchers, and activists, who collaborate in analysis, synthesis, connecting and educating the people for a better economy, ecology, and equity in agriculture, food and energy system.

This conference is the seventh conference since the year 2013 to 2018. The SAFE 2019 conference will provide us not only essential knowledge but also a great opportunity to share experiences both technical and regulatory issues.

I would like to take this opportunity to express my sincere thanks to the organizers and in particular our honorable speakers. All of them have been working with us since the beginning of the planning stage and they are still here today for all of us, even though they are both very busy with their responsibilities at their agencies. We truly appreciate your dedication. Again, this conference program could not have been made possible without SAFE Network and Phuket Rajabhat University, THAILAND.

Finally, this is an opportune time for me to declare the official opening of the "SAFE 2019" and I wish all 4 fruitful days of interesting and beneficial program and also that you have a pleasant stay in Phuket.

I warmly welcome you again.

Assoc.Prof. Sermkiat Jomjunyong, Ph.D

WELCOME SPEECH
BY PRESIDENT OF PHUKET RAJABHAT UNIVERSITY

Welcome All delegates,

I am pleased to welcome you to this landmark conference on the International Conference on Sustainable Agriculture, Food, and Energy (SAFE2019): Green Agrifood Energy Production for a Better World in a Changing Climate" which held from October 19-21, 2019 in Phuket, Thailand. Through this conference, we would like to engage with all of you in an open and constructive dialogue about resources and opportunities to interact with prominent leaders in the field of sustainability and greatly expand your global network of scholars and professionals This event aims to bring together people from different areas and interests to share ideas, explore various discussions, maintain existing connections, establish new connections and partnerships, and share the achievements of the work.

I am honored and delighted to greet you all at the 7th International on Conference Sustainable Agriculture, Food, and Energy or SAFE 2019. For this The conference which brings together experts and academics from around the world, especially ASEAN Country. There are many sessions regarding keynote speech, oral presentation, and poster presentation etc. You can network and learn with the professionals in this conference.

I would like to thank you to our partners with the good relationship for long time. I am happy to see all of delegates in this international conference. I am sure that everyone will find the conference and your stay in Phuket both valuable and enjoyable.

Asst. Prof. Hiran Prasankarn, Ph.D.
President of Phuket Rajabhat University.

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Conference Secretary|
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Chiang Mai Rajabhat University-THAILAND
HP:+66 53 885 871. E-mail: worajit@gmail.com

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Virtual Farm Academy

COLLABORATIVE INTEGRATED LEARNING ACADEMY

The SAFE Network

The Asia Pacific Sustainable Agriculture, Food, and Energy (SAFE) Network is a network of university and college educators, researchers and advocates who collaborate in analysis, synthesis, connecting and educating the people for a better economy, ecology and equity. Initially, it organizes scientific international conferences. The 1st International Conference on Sustainable Agriculture, Food, and Energy (SAFE2013) was held in Padang, Indonesia (12-14 May 2014); the 2nd conference SAFE 2014 in Bali, Indonesia; the 3rd conference SAFE 2015 in Ho Chi Minh City, Vietnam, the 4th conference SAFE 2016, Colombo, Sri Lanka, the 5th conference SAFE 2017 in Malaysia; and the 6th conference SAFE 2018 in Manila, Philippines. Also, one of its banner activities is the conduct of an annual short course program for students to address major sustainability challenges in agriculture, food and energy system. In 2016 and 2017, it was held at Warmadewa University in Bali, Indonesia and in 2018 at Central Bicol State University of Agriculture in Camarines Sur, Philippines. This year, the short course program was held in University of Padjadjaran, Bandung Indonesia.

SAFE NETWORK
Asia Pacific Network for Sustainable Agriculture Food and Energy

BECOMING BIGGER TOGETHER

Aside from the conferences and short course programs, the Network has expanded to producing SAFE Rice as an output of organic rice research conducted by Malaysian and Indonesian faculty-researchers. (http://safe2019.safe-network.org) As the Network grows, it plans to embark on innovative platforms where "sustainability" can be served best especially to some group of learners who do not have sufficient background in agriculture science.

SAFE Virtual Farm Academy

As the academe embraces industry 4.0, the next generation of learners is expected to exploit a virtual learning environment in the future. With the fast pace of technology, future learners are no longer interested in a traditional classroom setting. Technology has taught them to become independent learners with a short span of attention, hence, the creation of a virtual school. Minerva project is one classic example (https://www.youtube.com/watch?v=Gk5iiXqh7Tg)

A virtual academy is a learning space, usually online, where courses are taught to participants in the form of a web-based technology classroom. Often referred to as cyber-classroom, virtual schools deliver online learning platform either on a supervised class or an unsupervised education mode. The SAFE Network, through its partner-universitites, will develop a similar model with emphasis on topics that relate to sustainability and happiness. We may be concerned on productivity and regeneration of resources but at the end of the day what counts most is our happiness. We can begin with the most critical issues in food and environment. Experts on certain topics can volunteer to share to a group of 10-15 participants around the Asia Pacific region to start the ball rolling. Then, as a Network, we can expand this to a bigger and more structured discussions including a mini virtual SAFE course.

The Network chooses Philippines, particularly CBSUA, to initially host the virtual academy in collaboration with SAFE Network and eventually with universities from Malaysia, Indonesia, Thailand, Taiwan, Sri Lanka, Australia and Bangladesh who are also active members of the Network. CBSUA will take the lead in facilitating the modules to online participants and take the necessary actions in expediting the modular classes. The Network Head Coordinator, together with CBSUA President shall issue certificates of program completion to registered participants. The virtual academy will be launched in the next international conference which will be held on October 20, 2019 in Thailand.

With the vast network it has, SAFE Network will provide resources and opportunities to interact with prominent leaders in the field of sustainability and greatly expand the global network of scholars and professionals. It shall serve as a collaborative arm of universities such as CBSUA to bring together people from different areas and interests to share ideas, explore various discussions, maintain existing connections, establish new connections and partnerships, and share the achievements of their work.

Module Preparation

The Network is already seven years in active existence and it was founded through volunteerism from senior lecturers and professors who wish to share their knowledge to others. Hence, the preparation and delivery of module will also be a voluntary act of professors, researchers and practitioners according to their field of expertise. The first module will center on "Small-holder family food security". The module, like any other programs, shall consist of learning outcomes, discussion points and games/activities. It will be an activity-based program so it would be a stress-free class eliciting the participants happiness and creativity during the course of their learning.
The outline for this topic is as follows:

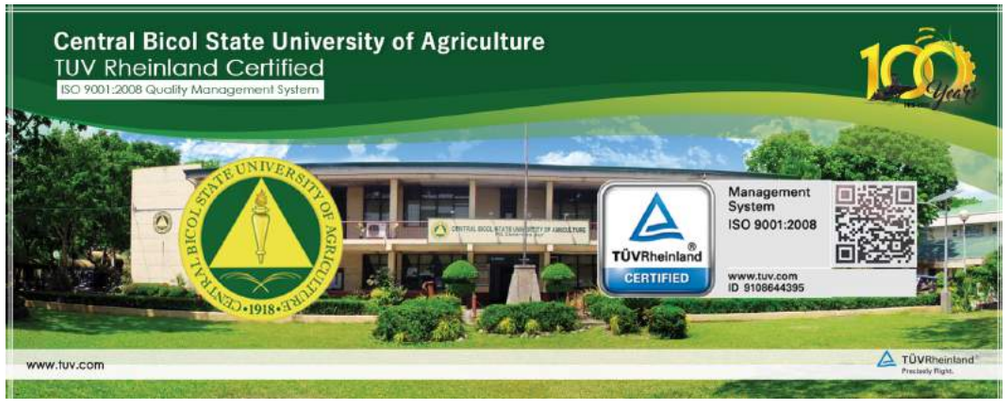
Module A. Concept of Food Security (one week)
Module B. Models of Small-holder farms (three weeks)
Module C. Assessment of small-holder farms in various communities (five weeks)
Module D. Development of a pilot-project (eleven weeks)
Implementation

Initially, this module will be delivered online by Prof. Dr. Helmi and Dr. Ravindra Joshi who are specialists in sustainability and food security in small-holder farms.The succeeding topics are farm tourism and stingless beekeeping which shall be delivered by CBSUA's lecturers and professors.

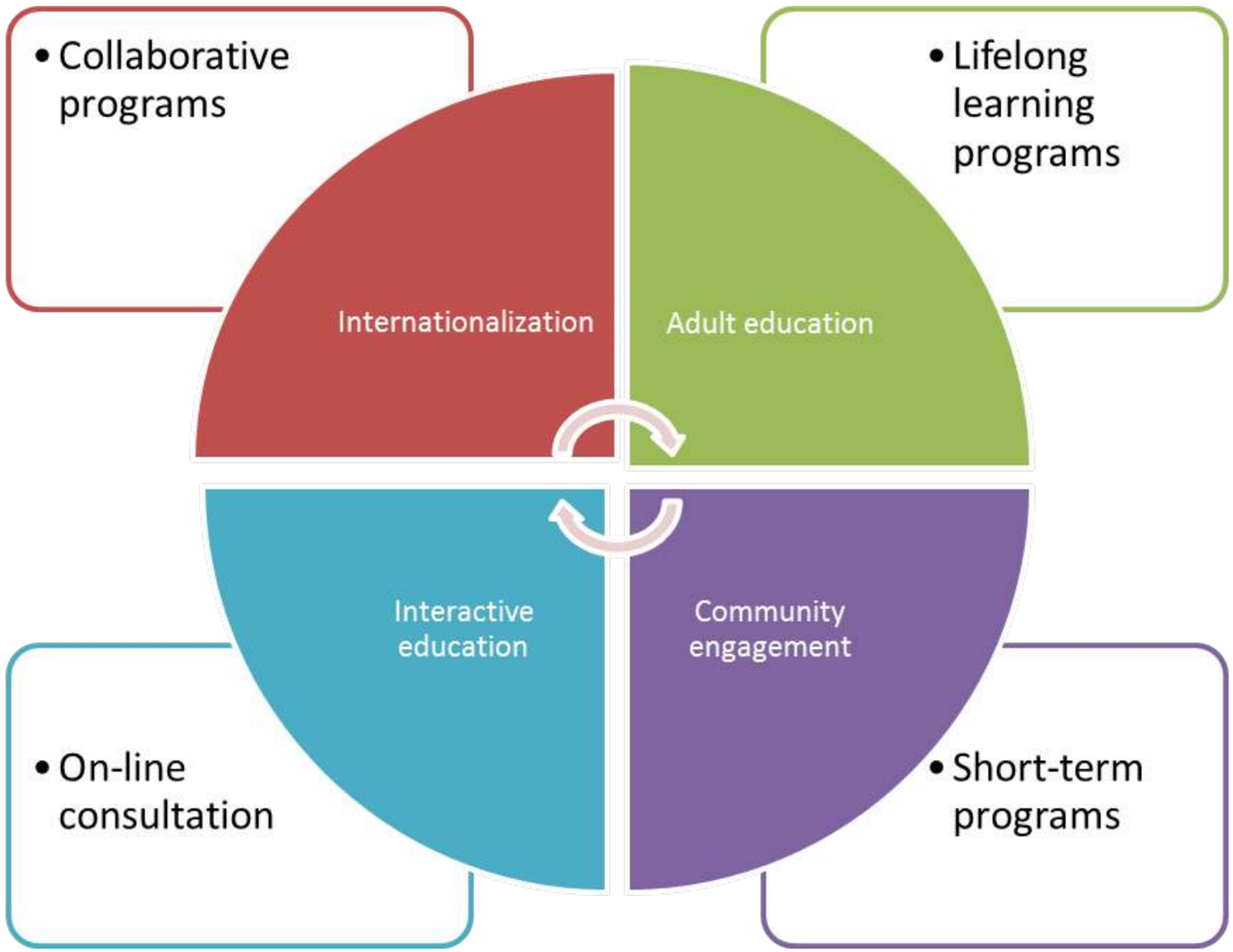
Implementation

The mode of delivery will be made through an online portal. The participants will be assessed to match their profile with the modules being offered. The participants can register any time to start and complete the module. The participants are required to develop an output as a means of measuring whether the learning outcomes have been achieved or not. The module instructor shall determine whether the participant is worthy of a certificate of completion after an evaluation of the output. The target audience of this virtual academy shall be the lifelong learners who are either potential farmers with no experience in farming and practitioners with insufficient educational background in agriculture. The other feature of the VFA is the on-line consultation program where a faculty-specialist is assigned on a specific day to answer the queries of the farmers.

The SAFE Network and its partner universities, including CBSUA, shall help in promoting the virtual academy program to its target participants. The virtual academy shall be under the Office of the External and International Linkages of CBSUA. It shall coordinate with the university's Lifelong Learning Center, College of Information and Technology (Sipocot campus), Information and Communication Center and Extension Division since its purpose traverse through the programs of the said offices. In order to reach the small farmers in the countryside, CBSUA, particular, will team up with the Local Government Units to facilitate the setting up of a virtual program in their municipalities.



VFA Framework



Project Team within CBSUA

Since the project is a partnership with Asia-Pacific SAFE Network, the **Office of the External and International Linkages** will supervise the implementation of the program. While the nature of the project cuts across our mandate on community engagement, the **Extension Office** will take the lead in facilitating and monitoring the implementation of the farm sustainability modules. As the University embarks on developing adult education programs, this project will be integrated in the **Lifelong Learning Center** of the University. The Center will assist in the development of modules and craft strategies on how they can be delivered effectively to the target market. On the technical side, the **College of Information and Technology** will develop the web platform that will enable the VFA to function as an online learning system. In order to maintain the connectivity, the **Information and Communication Office** will develop, implement and support Information Systems and Applications that support the academic and administrative processes of the VFA.

SAFE2019 PROGRAM

DAY 0: Thursday, October 17 2019

ARRIVAL OF PARTICIPANTS AND SECRETARIAT MEMBER & CHECK IN HOTEL: METROPOLE PHUKET HOTEL

DAY 1: Friday October 18 2019

PHI PHI ISLAND TOUR

SAFE Secretariat arrange Phi Phi Island Tour/participants should pay)

DAY 2: Saturday, October 19, 2019

10.00-12.00 AM | NETWORKING DISCUSSION

Agenda: Virtual Farm Academy, Conference, Workshop, Summer Course, Collboration

Venue: METROPOLE PHUKET Hotel, THAILAND

01.00-09.00 PM PRE-CONFERENCE TOUR (FREE FOR PARTICIPANTS)

Starting Point: METROPOLE PHUKET Hotel, THAILAND

DESTINATION: Phuket Old Town, Karon View Point, Big Budda, Wat Chalong Temple, Promtep Sunset, Chilva Market

07.30-09.45 PM | WELCOME DINNER:

SAFE Network will provide food and drink

Registration: OC will provide conference kits

Venue: METROPOLE PHUKET Hotel, THAILAND

08.15-08.30 PM | INVITED SPEAKER

AGRICULTURE, FOOD, ENERGY, AND SUSTAINABILITY IN NEPAL

Prof. Dr. Megh Raj Pokhrel

Central Department of Chemistry, Tribhuvan University, Kirtipur, Kathmandu. Nepal

Venue: METROPOLE PHUKET Hotel, THAILAND

VENUE: PHUKET RAJABHAT UNIVERSITY, PHUKET-THAILAND

		Opening Ceremony **Venue: PKRU CONVENTION HALL** **Person in Charge/MC:** **Dr. Worajit Setthapun, AdiCET, Chiang Mai Rajabhat University, THAILAND**

	7.30-8.00 AM	**Registration**	
8.15-8.25	**Thailand National Anthem** **Indonesia National Anthem**		
8.25-8.30	Conference Program Introduction by Local Conference Coordinator**, Dr. Serkiyat Jomjunyong,** SAFE-Network National Co-ordinator (THAILAND). CHIANG MAI UNIVERSITY (CMU). THAILAND		
8.30-8.35	Welcome Remark from Rector of Andalas University**, Prof. Dr. Tafdil Husni**		
8.35-8.40	Opening Remark from President of Phuket Rajabhat University, THAILAND. **Asst.Prof.Dr. Hiran Prasarnkarn**		
8.40-9.00	Book Launching on *The Miracle Tree of Moringa* l, Co-writers: **Dr. Ravindra Joshi and Dr. MC. Palada** Presentation of Certificate of Appreciation and Special Gift from **Prof. Dr. Novizar Nazir (SAFE-Network**) to the host of SAFE2019: Andalas University, Chiang Mai University (CMU), Phuket Rajabhat University (PRU). , Special Gift for Local Conference Coordinator **Assoc. Prof. Dr. Sermkiyat Jomjunyong**, and Local Conference Secretary, **Dr. Worajit Setthapun,** Official Photo Session.		
	KEY NOTE ADDRESS: **Session Chair: Dr. Norman de Jesus,** *(Country Coordinator, Philippines). Pampanga State Agricultural University, Philippines*		
9.00-9.30	**The Concept of Virtual Farm Academy** **Prof. Dr. Helmi,** *Andalas University-Indonesia* **Dr. Hanilyn Hidalgo,** *Central Bicol State Agricultural University (CBSUA). Philippines*		
9.30-9.40	Discussion		
9.40-9.45	Signing Ceremony of Letter of Intent on the Establishment of Virtual Farm Academy between SAFE-Network and CBSUA, Philippines		
9.45-10.00	COFFEE BREAK		
	Plenary Session I Venue: Main Conference Room Emerging Technology in Agriculture and Food	**Plenary Session II** Venue: **Asian Workshop on Sustainable Energy**	

	Session Chair: Prof. Dr. Manggala de Chatura, *(Country Coordinator, Sri Lanka). University of Ruhuna, Sri Lanka*	**Session Chair: Dr. Worajit Setthapun, AdiCET. Chiang Mai University, Thailand** ***Note: The time allocated for each speaker is 20 minutes, consisting of 15 minutes for presentation and 5 minutes for question and answer***
10.10-10.30	**INVITED SPEAKER 1**: EMERGING PLASMA TECHNOLOGY FOR NEXT GENERATION AGRICULTURE AND FOOD PROCESSES **Prof. Jeon Geon Han** Thai-Korea Collaboration Research Center,Chiang mai University, Thailand Center for Advanced Plasma Surface Technology, Sungkyunkwan University, Republic of Korea	**INVITED SPEAKER 5**: TOWARD SUSTAINABLE TRANSPORT VIA ASEAN FUEL ECONOMY ROADMAP **Dr. Nuwong Chollacoop** Lab Head, Renewable Energy Laboratory National Metal and Materials Technology Center (MTEC),National Science and Technology Development Agency, Thailand
10.30-10.50	**INVITED SPEAKER 2**: SUSTAINABLE DRYING SYSTEMS FOR AGRICULTURAL CROPS IN RURAL COMMUNITIES **Romualdo C. Martinez, Ph.D.** Chief Science Research Specialist Philippine Center for Postharvest Development and Mechanization (PHilMech) Munoz, Nueva Ecija, Philippines	**INVITED SPEAKER 6:** CONVERSION OF AGRI-WASTE INTO BIOMASS ENERGY INTEGRATED WITH MICROGRIDS **Assoc.Prof. Keng-Tung Wu, PhD** Director, Industry Promotion Office for Southeastern Asia (IPOSA) Head, Planning & Marketing Division, International College of Innovation and Industry Liaison (ICIIL). National Chung Hsing University, Taichung, Taiwan (ROC)
10.50-11.10	**INVITED SPEAKER 3**: ENABLING ENVIRONMENT FOR ENTREPRENEURSHIP & DISRUPTIVE TECHNOLOGY **Dr. Wibool Piyawattanametha** Director, Advanced Imaging Research Center Department of Biomedical Engineering, Faculty of Engineering King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand	**10.50-11.00 Presenter 1:** AN OVERVIEW OF COMMUNITY EMPOWERMENT BY SOLAR ENERGY **Dr Vivek Mandot** V. K. B. Government Girls' College, Dungarpur, Rajassthan 314001, India **11.00-11.20 Presenter 2:** COMPOSITIONAL ANALYSES OF SELECTED LIGNOCELLULOSIC BIOMASS FROM MALAYSIA AGRO-WASTE USING VAN SOEST METHOD **Dr. Masita Mohammad** Solar Energy Research Institute, SERI, UKM, Malaysia **11.20-11.30 Presenter 3:** PRODUCTION OF BIOGAS FROM PALM OIL MILL EFFLUENT WITH INDIGENOUS BACTERIA **Prof. Dr. Muhammad Said** Chemical Engineering Department, Faculty of Engineering, Universitas Sriwijaya
11.10-11.30	**INVITED SPEAKER 4**:	

	TRANSFORMATION OF GADONG TUBER STARCH INTO SOPHISTICATED MATERIAL Assoc. Prof.Dr. Azwani Mat Lazim Universiti Kebangsaan Malaysia. Malaysia	
11.30-12.00	DISCUSSION	**11.30-13.00** **Venue: Room1** **Presentation:** Energy-005 Energy 06 Energy 07 Energy 08 Energy 09 Energy-011 Energy 013 Energy 014 Energy 015 Energy 010 Energy 017 Energy 019 Energy 020 Energy 021 Energy 023 Energy 024 Energy 025 GPI-97
12.10-13.30	BREAKOUT SESSION 1 Venue: Room 1-8	
13.00-14.00	**LUNCH BREAK**	

DAY 3: Sunday, October 20, 2018

VENUE: PHUKET RAJABHAT UNIVERSITY, PHUKET-THAILAND

12.05-13.00 **Breakout Session 1 (***Previous Speaker will invite the next speaker to present, etc)*
CHAIR: Dr. Ravindra Joshi, *Country Coordinator (Fiji and Pacific Island)*)
Secretary: Dr. Rahmanta Setiahadi (Merdeka University of Madiun, Indonesia)

Paralllel Session	**Room 1**	**Room 2**	**Room 3**	**Room 4**	**Room 5**	**Room 6**	**Room 7**	**Room 8**
12.05-12.15	Energy	THE REGIONAL LAND USE CONTROL FOR SUSTAINABLE AGRICULTURE. **Melinda Noer,** Andalas University. Indonesia	BIOFERTILIZERS INCREASES THE GROWTH AND YIELD OF EDAMAME SOYBEANS ON THE COASTAL SOIL OF BENGKULU, INDONESIA **Abimanyu Dipo Nusantara.** Univ. Bengkulu. Indonesia	CATECHIN, EPICATECHIN AND EPIGALLOCATECHIN GALLATE OF GAMBIR TEA WITH TELANG PIGMENT. **Tuty Anggraini.** Andalas University. Indonesia	THE HOLISTIC COMPONENTS OF CATTLE PRODUCTION FOR SOLVING THE HAZE IN CHIANG MAI **Sermkiat Jomjunyong.** CMU-Thailand	ISOLATION AND CHARACTERIZATION OF POTENTIAL PROBIOTIC YEAST FROM FISH FERMENTED **Yetti Marlida,** Andalas University. Indonesia	VOLUME AND AVAILABILITY OF BANANA AND WATER LILY AND THEIR UTILIZATION AS FEED INGREDIENTS FOR GOATS IN LUZON-PHILIPPINES. **Norman de Jesus**, PSAU. Philippines	**EFFECTS OF *BACILLUS THURINGIENSIS*-BASED BIO-INSECTICIDES ON THE PRESENCE OF INSECTS AND THEIR LEVEL OF ATTACK ON MELON FRUIT CULTIVATION IN POLYBAGS** **Yulia Pujiastuti.** Unsri. Indonesia
12.15-12.20	Energy	GPI-01	AST-01	PD-02	Environment-15	FST-02	GPI-11	AST-11
12.20-12.25	Energy	GPI-02	AST-02	PD-03	Environment-16	FST-05	GPI-12	AST-12
12.25-12.30	Energy	GPI-03	AST-03	PD-06	Environment-17	FST-06	GPI-12	AST-13
12.30-12.35	Energy	GPI-04	AST-04	PD-08	Environment-18	FST-07	GPI-14	AST-14
12.35-12.40	Energy	GPI-06	AST-06	PD-10	Environment-19	FST-08	GPI-17	AST-15
12.40-12.45	Energy	GPI-07	AST-09	PD-12	Environment-20	FST-09	GPI-18	AST-16
12.45-12.50	Energy	GPI-08	AST-10	PD-14	Environment-21	FST-10	GPI-20	AST-17
12.50-13.00	**Q&A**	**Q&A**	**Q&A**	**Q&A**	**Q&A**	**Q&A**	**Q&A**	**Q&A**

14.00-15.35 **Breakout Session 2 (***Previous Speaker will invite the next speaker to present, etc)*
Chair: Assoc,Prof.Dr. Nurul Huda, *Country Coordinator (Malaysia)*
Secretary: **Dr. Leily Nurul Komariah** (Sriwijaya University, Indonesia)

Paralllel Session	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6 .	Room 7	Room 8
14.00-14.10	**MODELING VISCOELASTIC PROPERTIES OF GLUTEN-FREE RED KIDNEY BEAN NOODLE** **Pavalee Chompoorat** **Postharvest program in Faculty of Engineering and Agro-Industry. Maejo University. Thailand**	THE MORPHOLOGY OF CILEMBU SWEET POTATO AFTER COOKED BY BOILING IN WATER, BAKED AND MICROWAVE IRRADIATION. **Bohari M. Yamin.** UKM. Malaysia	WATER RAINFALL HARVESTING QUALITY AS A FERTIGATION RESOURCES USING AUTOPOT TOMATO CHERRY (SOLANUM L. VAR CERASIFORME) QUALITY. **Nurpilihan,** Unpad. Indonesia	THE EFFECT OF PROBIOTIC SUPPLEMENTATION ON LIVER BIOCHEMISTRY AND COLON MORPHOMETRIC IN BROILER CARCASS AT POST TRANSPORTATION **Roostita L. Balia,** Universitas Padjadjaran. Indonesia	O MOTHER EARTH-IS THE SOIL IN YOU IS SAFE FOR AGRICULTURE-? : AN EASY METHOD TO FIND IT SAFE! **G.R. Rajakumar,** AICRP for Dryland Agriculture. India	FRACTIONATION, ISOLATION AND CHARACTERISATION OF OIL PALM FRONDS XYLOOLIGOSACCHARIDES : A POTENTIAL SOURCE OF PREBIOTICS. **Sabiha Hanim Saleh**, UiTM. Malaysia	THE HALAL FOOD PROFILE IN THAI CONSUMER ATTITUDE BY USING FLASH PROFILE METHOD. **Kallayanee Tengpongsathon .** King Mongkut's Institute of Technology Ladkrabang, Thailand	IMPROVEMENT of MANGO PRODUCTION through SCIENCE and TECHNOLOGY INNOVATIONS and SUPPORT MECHANISMS for CAPACITY DEVELOPMENT in BATAAN and ZAMBALES **Hermogenes M.Paguia,** Bataan Peninsula State University. Philippines
14.10-14.15	GPI-21	GPI-40	AST-18	PD-15	Environment-02	FST-11	GPI-59	AST-36
14.15-14.20	GPI-22	GPI-41	AST-19	PD-16	Environment-03	FST-12	GPI-60	AST-37
14.20-14.25	GPI-23	GPI-43	AST-20	PD-17	Environment-04	FST-13	GPI-61	AST-38
14.25-14.30	GPI-24	GPI-44	AST-21	PD-18	Environment-05	FST-14	GPI-62	AST-39
14.30-14.35	GPI-25	GPI-45	AST-23	PD-19	Environment-06	FST-15	GPI-63	AST-40
14.35-14.40	GPI-26	GPI-46	AST-24	PD-20	Environment-07a	FST-16	GPI-64	AST-41
14.40-14.45	GPI-28	GPI-47	AST-25	PD-21	Environment-08	FST-17	GPI-65	AST-42
14.45-14.50	GPI-29	GPI-48	AST-26	PD-22	Environment-11	FST-18	GPI-67	AST-43
14.50-14.55	GPI-30	GPI-49	AST-27	PD-23	Environment-12	FST-19	GPI-68	AST-45
14.55-15.00	GPI-31	GPI-50	AST-28	PD-25	Environment-13	FST-20	GPI-69	AST-46
15.00-15.05	GPI-32	GPI-51	AST-29	PD-26	Environment-22	FST-21	GPI-70	AST-47
15.05-15.10	GPI-33	GPI-52	AST-30	PD-27	AST-53	FST-22	GPI-71	AST-48
15.10-15.15	GPI-34	GPI-53	AST-31	PD-28	AST-54	FST-25	GPI-73	AST-49
15.15-15.20	GPI-35	GPI-56	AST-33	PD-29	AST-55	FST-26	GPI-73	AST-50
15.20-15.25	**GPI-38**	**GPI-57**	AST-34	PD-30	**AST-56**	FST-27	**GPI-74**	AST-51
15.25-15.30	**GPI-39**	**GPI-58**	AST-35	PD-31	**AST-57**	FST-28	**GPI-75**	AST-52
15.20-16.00	**Q&A**	**Q&A**	**Q&A**	**Q&A**	**Q&A**	**Q&A**	**Q&A**	**Q&A**

16.00-17.20	**Breakout Session 3 (***Previous Speaker will invite the next speaker to present, etc)* **Chair: Dr. Norashikin Ab. Azis (Universiti Putra Malaysia, Malaysia)** **Secretary: Dr. Addion Nizori (University of Jambi, Indonesia)**							
Paralllel Session	**Room 1**	**Room 2**	**Room 3**	**Room 4**	**Room 5**	**Room 6**	**Room 7**	**Room 8**
16.00-16.10	ISOLATION OF HALO-TOLERANT BACTERIA WITH PLANT GROWTH-PROMOTING TRAITS. **Jaliaman Sipayung**. National Pingtung University of Science and Technology, Taiwan	IMPLICATIONS OF SOIL BULK DENSITY ON THE WATER UPTAKE PATTERN OF SOYBEAN PLANT UNDER DIFFERENT SOIL MOISTURE CONDITIONS **Mizanur Rahman Bhuiyan**. Khulna UNIVERSITY. Bangladesh	FFAGPI, FUTURE FARMERS OF ASIA GROWING PROGRAM INITIATIVE. **Nobutaka Ito.** Chiang Mai University. Thailand	PREPARATION AND CHARACTERIZATION OF POLYVINYL ALCOHOL/MICROBIAL CELLULOSE/CHITOSAN COMPOSITE. **Henny Purwaningsih.** IPB University. Indonesia	EFFECT OF EXTRACTION SOLVENTS ON PHENOLIC COMPOUNDS OF THEOBROMA CACAO L. BY-PRODUCTS USING ULTRASOUND-ASSISTED EXTRACTION. **Raseetha V S Manikam.** UiTM. Malaysia	GRAIN YIELD EVALUATION and AGRONOMIC CHARACTERIZATION of 10 NEW HYBRID MAIZE PROSPECTIVE GENOTYPES. **Irfan Suliansyah.** Andalas University. Indonesia	THE APPLICATION OF CLAY POT FOR MOISTURE REDUCTION OF GENIOTRIGONA THORACICA STINGLESS BEE HONEY, **Yus Aniza Yusof.** UPM. Malaysia	GREEN CHEMISTRY: APPROACH FOR HEALTHY ENVIRONMENT AND SUSTAINABILITY **Manoj K S Chhangani** Government Meera Girls College, Udaipur-(Rajasthan), INDIA
16.10-16.15	AST-58	AST-83	AST-105	**PD-32**	**PD-55**	**PD-75**	**GPI-76**	**GPI-93**
16.15-16.20	AST-60	AST-84	AST-106	**PD-33**	**PD-56**	**PD-76**	**GPI-77**	**GPI-94**
16.20-16.25	AST-61	AST-85	AST-107	**PD-34**	**PD-57**	**PD-77**	**GPI-78**	**GPI-95**
16.25-16.30	AST-62	AST-87	AST-108	**PD-35**	**PD-59**	**PD-79**	**GPI-79**	**GPI-96**
16.30-16.35	AST-63a	AST-88	AST-109	**PD-36**	**PD-59**	**PD-80**	**GPI-80**	**GPI-98**
16.35-16.40	AST-64	AST-89	AST-110	**PD-37**	**PD-60**	**PD-81**	**GPI-82**	**GPI-100**
16.40-16.45	AST-65	AST-90	AST-111	**PD-38**	**PD-61**	AST-125	**GPI-83**	**GPI-101**
16.45-16.50	AST-66	AST-91	AST-112	**PD-39**	**PD-62**	AST-126	**GPI-84**	**GPI-103**
16.50-16.55	AST-69	AST-94	AST-113	**PD-41**	**PD-63**	AST-127	**GPI-85**	**GPI-104**
16.55-17.00	AST-70	AST-95	AST-114	**PD-42**	**PD-64**	AST-128	**GPI-86**	**GPI-105**
17.00-17.05	AST-71	AST-96	AST-116	**PD-43**	**PD-65**	AST-129	**GPI-87**	**GPI-106**
17.05-17.10	AST-72	AST-97	AST-117	**PD-45**	**PD-66**	AST-130	**GPI-88**	**GPI-107**
17.10-17.15	AST-73	AST-98	AST-118	**PD-47**	**PD-67**	**AST-131**	**GPI-89**	**GPI-108**
17.15-17.20	AST-74	AST-99	AST-119	**PD-48**	**PD-68**	**AST-132**	**GPI-92**	**GPI-109**
17.20-17.35	AST-75	AST-100	AST-120	**PD-49**	**PD-69**	**AST-133**	**GPI-116**	**GPI-111**
17.35-17.40	AST-76	AST-101	AST-121	**PD-50**	**PD-70**	**AST-134**	**GPI-121**	**GPI-112**
17.40-17.45	AST-79	AST-102	AST-122	**PD-51**	**PD-71**	**AST-135**	**GPI-122**	**GPI-113**

17.45-17.50	AST-80	AST-103	AST-123	**PD-52**	**PD-72**		**GPI-123**	**GPI-114**
17.50-17.55	AST-81	AST-104		**PD-53**	**PD-74**		**GPI-124**	**GPI-115**
17.55-18.10	**Q&A**	**Q&A**	**Q&A**	**Q&A**	**Q&A**	**Q&A**	**Q&A**	**Q&A**

18.10 –18.20	**CLOSING CEREMONY**
	KEY POINTS/HIGHLIGHT FROM THE SESSIONS **Dr. Worajit Setthapun (CMRU, Thailand), Local Conference Secretary** **Dr. Helen Martinez,** *SAFE2019 Networking Meeting Secretary, PhilMech, Philippines* **Dr.Irawati Chaniago**, *SAFE-Network Secretary, Andalas University-INDONESIA* **Closing Message: Dr. Sermkiat Jonjumnyong,** *Local Conference Coordinator. CMU, Thailand*

AST-Agricultural Science and Technology|
FST-Food Science and Technology|
PD-Product Development|
GPI-Green Production and Innovation|
Energy-Energy|
Environment-Environment|

LIST OF PAPER BASED ON SUB-THEME

Name	Affiliation	Title	Code
		Agricultural Science and Technology (AST)	
Wan Arfiani Barus	Universitas Muhammadiyah Sumatera Utara	Morphophysiology Characteristics and Production of Some Varieties of Paddy on Saline Soil by Antioxidant Application	AST-01
Made Deviani Duaja	Faculty of Agriculture, University of Jambi	ORGANIC FERTLIZERS FOR SUSTAINABLE AGRICULTURE AND SOYBEAN (GLYCINE MAX .L) GROWTH AND YIELD	AST-02
Wilyus	Faculty of Agriculture, Universitas Jambi	MODEL of AGROECOSYSTEM MANAGEMENT as RESERVOIR (BANK) NATURAL ENEMY in RICE AGROECOSYSTEM	AST-03
Edison	Universitas Jambi	SUPPLY RESPONSIVENESS MODEL OF CORN IN TANJAB TIMUR DISTRICT: APLICATION WITH META RESPONSE FUNCTION	AST-04
Aryunis	Faculty of Agriculture, Universitas Jambi	IDENTIFICATION OF GENETIC CHARACTERISTICS OF LOCAL RICE FIELDS OF ORIGIN JAMBI	AST-05
Ardhiyan Saputra	Faculty of Agriculture, Universitas Jambi	Influencing Factors of potatoes Production in Merangin Regency	AST-06
Enita	Sekolah Tinggi Ilmu Pertanian, Graha Karya (STIP- GK) Jambi	The effect of goat urine liquid as organic fertilizer on the growth of oil palm seedlings in ultisol soil	AST-07
Abimanyu Dipo Nusantara	Faculty of Agriculture, Universitas Bengkulu	BIOFERTILIZERS INCREASES THE GROWTH AND YIELD OF EDAMAME SOYBEANS ON THE COASTAL SOIL OF BENGKULU, INDONESIA	AST-08
Yudhy Harini Bertham	Faculty of Agriculture, Universitas Bengkulu	USING BIOFERTILIZER TO INCREASE PEANUT GROWTH AND YIELD ON COASTAL SOIL OF BENGKULU, INDONESIA	AST-09
Usman Kris Joko Suharjo	Faculty of Agriculture, Universitas Bengkulu	BREAKING THE DORMANCY OF POTATO SEEDS AND PROMOTING SEEDLING GROWTH BY NATURAL PGR EXTRACTED FROM SHALLOT (Allium ascalonicum L.)	AST-10
Rustikawati	Faculty of Agriculture, Universitas Bengkulu	EFFECTIVENESS OF MYCORRHIZAL APPLICATION IN SALINE SOIL TO IMPROVE GROWTH AND YIELD OF MAIZE	AST-11
Catur Herison	Universitas Bengkulu	GROWTH AND YIELD RESPONSE OF FOUR CHILI PEPPER (Capsicum annuum L.) HYBRIDS TO NPK FERTIGATION IN ULTISOL	AST-12
Reny Herawati	Universitas Bengkulu	CORRELATIONS and PATH ANALYSIS to DETERMINE the SELECTION CHARACTERS on NEW-TYPE UPLAND RICE	AST-13
Bandi Hermawan	Universitas Bengkulu	TEMPORAL AND VERTICAL CHANGES IN VOLUMETRIC WATER CONTENT AT FOUR CONTRASTING-TEXTURED SOILS	AST-14
Tunjung Pamekas	Faculty of Agriculture, Universitas Bengkulu	Pre Nursery Palm Oil Resistance Response to Stem Rot using Culture Filtrate of Trichoderma sp.	AST-15
SEMPURNA GINTING	Faculty of Agriculture, Universitas Bengkulu	New Invasive Pest, Spodoptera frugiperda (Lepidoptera: Noctuidae) and Its Natural Enemies Attacks on Corn In Bengkulu	AST-16
Dwinardi Apriyanto	Faculty of Agriculture, Universitas Bengkulu	EFFECTIVENESS OF TWO BIOPESTICIDES TO CONTROL TWO LEPIDOPTERAN SPECIES OF CITRUS PESTS IN BENGKULU, INDONESIA	AST-17
Hendri Bustamam	Faculty of Agriculture, Universitas Bengkulu	INFLUENCE OF MEDIA PROPAGATION AND EFFECTIVENESS OF SELECTED STREPTOMYCES TO CONTROL BACTERIAL WILT DISEASE IN PEANUTS	AST-18
Mimi Sutrawati	Faculty of Agriculture, Universitas Bengkulu	Seed-transmitted Potency of Cowpea mild mottle virus (CPMMV) on 10 Varieties of Soybean in Indonesia	AST-19
Priyono Prawito	Faculty of Agriculture, Universitas Bengkulu	SOIL BIOPHYSICAL PROPERTIES IN OIL PALM PLANTATION OF VARIOUS AGES IN ULTISOL BENGKULU	AST-20
Sofia Sandi	Universitas Sriwijaya	THE EFFECTS OF PROBIOTIC FROM *Hymenache acutigluma* SILAGE TO THE LENGHT OF SMALL INTESTINE AND CAECA IN PEGAGAN DUCKS	AST-21

Yulia Pujiastuti	Universitas Sriwijaya	Effects Of *Bacillus Thuringiensis*-Based Bio-Insecticides On The Presence Of Insects And Their Level Of Attack On Melon Fruit Cultivation In Polybags	AST-22
Mery Hasmeda	Universitas Sriwijaya	MOLECULAR ANALYSIS OF CROSSING BETWEEN BLACK RICE ACCESION AND IMPARA 5 VARIETY	AST-23
Laila Hanum	Universitas Sriwijaya	GENETIC DIVERSITY OF LOCAL RED RICE FROM SOUTH SUMATRA USING SPECIFIC MOLECULAR MARKERS FOR ENCODE PROANTHOCYANIDIN PROTEIN	AST-24
Meisji Liana Sari	Universitas Sriwijaya	The Effect Of Provision Wuluh Star Fruit Solution (Averrhoa Blimbi L.) To Carcass Weight And Commercial Carcass Slices Of Pegagan Ducks	AST-25
Yuanita Windusari	Faculty of Agriculture, Universitas Sriwijaya	Genetic variability Of Swamp Buffalo (Bubalis bubalis Linn.) South Sumatera Based On Polymerase Chain Reaction-Random Amplified Polymorphic DNA (PCR-RAPD)	AST-26
Yuanita Windusari	Faculty of Agriculture, Universitas Sriwijaya	PREFERENCE FOR LANDING AND BITTING OF MOSQUITOES BASED ON BLOOD TYPE: Case study in the Kemelak Bindung Langit Village, Ogan Komering Ulu District, South Sumatra	AST-27
Weri Herlin	Universitas Sriwijaya	Antifeedant and mortality activity of Ageratum conyzoides, Tithonia diversifolia and Cuscuta australis on Crocidolomia pavonana Fabricius (Lepidoptera: Pyralidae)	AST-28
Aptriansyah Susanda Nurdin	Universitas Sriwijaya	THE COMPARISONS OF Hymenachne acutigluma SILAGE QUALITY INOCULATED WITH EM-4, RUMEN FLUID AND RICE RINSED WATER	AST-29
Suparman Suparman	Department of Plant Protection, Faculty of Agricultue, Universitas Sriwijaya	Transmission of Pepper Yellow Leaf Curl Virus in Different Varieties of Pepper	AST-30
Warmanti Mildaryani	Universitas Mercu Buana Yogyakarta, Doctoral Student, UNS Surakarta	RELATIONS OF PLANTS AGE WITH PHYSICAL AND CHEMICAL PROPERTIES OF MATERIAL DEPOSITS IN OIL PALM LEAF AXILL.	AST-31
Ir. Nurpilihan Bafdal,M.Sc	Universitas Padjadjaran	Water Rainfall Harvesting Quality as a Fertigation Resources Using Autopot Tomato Cherry (Solanum L. Var Cerasiforme) Quality	AST-32
Betty Natalie Fitriatin	Universitas Padjadjaran Indonesia	Effects of biofertilizers (N-fixers and P-solubilizers) and organic ameliorants on yiled of upland rice	AST-33
Stefina Liana Sari	Faculty of Agriculture, Universitas Padjadjaran	Utilization of CuSO4 in Liquid Fertilizer Formula to Prevent a Decrease in Red Chili Production	AST-34
Fardian Khairul Hakim	Faculty of Agriculture, Universitas Padjadjaran	Effect of N, P, K and Ca, Mg Fertilizers, on pH, Ca-dd, Mg-dd, Ca, Mg Uptake, Growth and Yield of Sweet Corn (Zea mays saccharata L) on Inceptisols	AST-35
Bambang Pujiasmanto	FP, Universitas Sebelas Maret, Surakarta	The effect of colchicine on the performance of Sambiloto plants (Andrographis paniculata Nees.)	AST-36
Etty Handayani	Doctoral Program of Agricultural Science, Universitas Sebelas Maret, Surakarta	Analysis Diversity of Indigenous Kepel (Stelechocarpus burahol (Bl.) Hook.F & Thomson) in Yogyakarta Based on Morphological Characters	AST-37
Paulus Chadikun	Doctoral Program of Agricultural Science, Universitas Sebelas Maret, Surakarta	DIOSCOREA spp. EXPLORATION AT MANOKWARI REGENCY, WEST PAPUA, INDONESIA	AST-38
Bambang Heri Isnawan	Universitas Muhammadiyah Yogyakarta; Doctoral Program of Agricultural Science, Universitas Sebelas Maret, Surakarta	Nutrient uptake, root development, and crop growth analysis of several local rice varieties with intermittent irrigation	AST-39
Sri Gunawan	Doctoral Program of Agricultural Science, Universitas Sebelas Maret, Surakarta	THE PERFORMANCE OF OIL PALM PRODUCTIVITY AND MANAGEMENT OF ORGANIC MATERIALS AT VARIOUS RAIN INTENSITY IN SANDY LAND	AST-40
Idum Satia Santi	Institut Pertanian Stiper Yogyakarta; Doctoral Program of Agricultural Science, Universitas Sebelas Maret, Surakarta	The study of plants as hosts of the natural enemies to control Darna trima and Stora nitens in Oil Palm Plantation	AST-41

Anggun Cinditya Putri	Laboratory of Genetics and Breeding, Faculty of Biology, Universitas Gadjah Mada	MOLECULAR DETECTION OF BEGOMOVIRUS CAUSING YELLOW CURLY LEAF DISEASE ON PEPPERS (*Capsicum frutescens* L. 'cempluk')	AST-42
Cindy Gresyllia Permadani	Universitas Gadjah Mada	DETECTION OF RESISTANCE GENE TO BEGOMOVIRUS IN CHILI PEPPER (Capsicum frutescens L. 'CEMPLUK')	AST-43
Anggun Cinditya Putri	Laboratory of Genetics and Breeding, Faculty of Biology, Universitas Gadjah Mada	ASSEMBLY OF ORANGE HYBRID WATERMELON (Citrullus lanatus (Thunberg.) Matsum&Nakai) RESULT OF CROSSING BETWEEN 'Putri Delima' AND 'Maduri' CULTIVARS	AST-44
Yacobus Sunaryo	University of Sarjanawiyata Tamansiswa, Yogyakarta	The Dynamic of Paddy Plantation in Banjararum, Kalibawang, Kulonprogo, Yogyakarta: from Inorganic to Organic	AST-45
Maria Theresia Darini	University of Sarjanawiyata Tamansiswa, Yogyakarta	The Correlation Between Nodule Population with Component Growth of Jackbean (Canavalia ensiformis L.) in intercropping with aloe (Aloe vera L.) plant in the lime soil	AST-46
Maria Theresia Darini	Universitas Sarjanawiyata Tamansiswa, Yogyakarta	Endophytic Root Population Dynamics and Agronomic Characteristics of Aloe vera L. Plants by Application of Nitrogen Fertilizer Dosage and Biofertilizers Sources in Sandy Soil	AST-47
Endah Puspitojati	Politeknik Pembangunan Pertanian Yogyakarta Magelang	Effect of fermentation time on the molecular weight distribution of ACE inhibitory peptides from jack bean (Canavalia ensiformis)	AST-48
Yoyanda Bait	Faculty of Agricultural Technology, Universitas Gadjah Mada	FREE-RADICAL SCAVENGING ACTIVITY OF RICE WITH CHERRY (MUNTINGIA CALABURA) LEAF EXTRACT	AST-49
Susila Herlambang	Prodi Ilmu Tanah UPN Veteran Yogyakarta	EFFECT RESIDUE of BIOCHAR and ORGANIC WASTE to SOIL IMPROVING for PRESERVE FOOD SECURITY in PADDY SOIL	AST-50
Parawita Dewanti	Faculty of Agriculture, Universitas Jember	Encapsulation and Regeneration through somatic embryogenesis from spindle leaf segments of sugarcane (Saccharum officinarum L).	AST-51
Tri Candra Setiawati	Faculty of Agriculture, Universitas Jember	The Changes of Some Soil Nutrient Concentration and Nutrient Uptake By Aromatic Pendok Tuban Rice Applied By Mixed Organic Matter, Agro-mineral and Microorganisms	AST-52
Dwi Erwin Kusbianto	Faculty of Agriculture, Universitas Jemberxl	The growth and crystallization in aromatic Pendok Tuban rice cultivated by applying mixed organic matter, agromineral and microorganisms in Jember, Indonesia	AST-53
Sri Hartatik	Faculty of Agriculture, Universitas Jember	SHOOT PRUNING AND POTTASIUM APPLICATION EFFECT ON CUCUMBER (Cucumis sativus L.) SEEDS PRODUCTION AND QUALITY	AST-54
Sugeng Winarso	Faculty of Agriculture, Universitas Jember	THE DECOMPOSITION AND EFFICIENCY OF NPK-ENRICHED BIOCHAR ADDITION ON ULTISOL WITH SOYBEAN	AST-55
Praptiningsih Gamawati Adinurani	Faculty of Agriculture, Universitas Merdeka Madiun	OPTIMIZATION OF ROOT NODULES AND NPK UPTAKE WITH THE APPLICATION OF RHIZOBIUM AND MYCORRHIZAE IN PEANUT PLANTS (Arachis hypogaea L.)	AST-56
Wahidin Nuriana	Universitas Merdeka Madiun	UTILIZATION OF MIDRIBS OF PISANG KEPOK LEAVES SAP, TEAK LEAF SAP, PURPLE YAM SAP WITH SOXCHLET EXTRACTION AS A ENVIRONMENTALLY FRIENDLY TEXTILE DYE	AST-57
Ni Luh Suriani	FMIPA Biologi, Univ Udayana	ANTAGONISM TRICHODERMA SP FOR PRESSING BLAST DISEASE ON RED BALI RICE PLANTS (ORYZA SATIVA)	AST-58
Ni Luh Suriani	FMIPA Biologi, Univ Udayana	INHIBITORY ACTIVITY OF PIPER CANINUM LEAF EXTRACT AGAINST CURVULARIA SPOTTING DISEASE ON RICE PLANTS	AST-59
Dwi Ariani Yulihastuti	Departmenet of Biology FMIPA, Universitas Udayana	CONDITIONS OF HEMATOLOGY AND DIGESTIVE SYSTEM HISTOPATHOLOGICAL DESCRIPTION FROM DUCK AFTER GIVING BACTERIA Salmonella sp, WHICH HAS BEEN EXPOSED TO ULTRAVIOLET	AST-60
Ngurah Intan Wiratmini	FMIPA Biologi, Universitas Udayana	WATER-SOAKED Leucaena leucocephala LEAF MEAL AS FEED FOR RABBITS: EFFECT OF INCLUSION ON PERFORMANCE	AST-61
Made Pharmawati	Departmenet of Biology FMIPA, Universitas Udayana	ISSR AND RAPD PRIMERS SELECTION OR ASSESMENT OF GENETIC DIVERSITY OF SEAGRASS Enhalus acoroides	AST-62
Deny Suhernawan Yusup	Universitas Udayana	COPEPEODS AS NATURAL FEED FOR FISH HATCHERY: Formulated diet for Copepods, Acartia spp., mass culture	AST-63a

Deny Suhernawan Yusup	Universitas Udayana	THE FEEDING RESPONSE OF SEATURTLE *Lepidochelys olivacea* : The Inclusion Of Dried Seaweed And Seagrass On The Fish Pellet	AST-63b
Ni Gusti Ayu Manik Ermayanti	Universitas Udayana	Effect of Cod Liver Oil Supplementation in Feed on the Haematological Values and Concentration of Epididymis Spermatozoa of Local Rabbits	AST-64
Ida Bagus Made Suaskara	Department of Biology FMIPA, Universitas Udayana	SPECIES OF BIRDS BASED ON FOOD TYPE IN RICE FIELD SUBAK MAMBAL, BADUNG REGENCY.	AST-65
Rai Suarni	Universitas Udayana	SUBSTITUTION OF COMMERCIAL FEED WITH MORINGA LEAF MEAL TO IMPROVE THE SPERM QUALITY OF MALE RABBIT	AST-66
Putu Anom Sulistyawati	Universitas Warmadewa	THE ROLE OF CARBOHYDRATES AND THE C / N RATIO OF LEAVES IN THE BUDDING TYPES AND PHASE OF FLOWERING DEVELOPMENT IN THE FRAMEWORK OF HARVEST FORMED IN PLANTS	AST-67
Anak Agung Sagung Putri Risa Andriani	Universitas Warmadewa	Locally Isolated Trichoderma spp. From the Soil of Conventional and Organic Cultivated Rice	AST-68
Yohanes Parlindungan Situmeang	Universitas Warmadewa	UTILIZATION OF MANURE FROM COWS, GOATS, AND CHICKENS AS BIOCHAR AND COMPOST TO INCREASE THE YIELD OF RED CHILI	AST-69
Ida Bagus Komang Mahardika	Universitas Warmadewa	Application of Rabbit Manure Compost and Lateral Buds Pruning on Growth and Yield of Chili (Capsicum annuum L.)	AST-70
Zauzah Abdullatif	Lecturer of Faculty of Agriculture, Khairun University, Ternate, North Maluku, Indonesia	Identification of Gofu Tafure (*Piper sarmentosum* Roxb ex W. Hunter) Weed Associations and Its Status Enhancement to Become Cultivated Plant	AST-71
Ramli Hadun	[1)]Postgraduate Study Program in Agricultural Sciences, Khairun University	LAND CHARACTERISTICS ANALYSIS FOR FOOD PLANT DEVELOPMENT IN EAST SAHU DISTRICT WEST HALMAHERA DISTRICT	AST-72
Lily Ishak	Soil Science Department, Faculty of Agriculture, University of Khairun, Ternate	DISTRIBUTION AND EDAPHIC CONDITIONS BETWEEN PROVENANCE OF CAPILONG - BEAUTY LEAF TREE IN TERNATE ISLAND	AST-73
Tri Mulya Hartati	Department of Soil Science, Faculty of Agriculture, Khairun University, Ternate	Study of Morphological Properties of Cassava Plants in Local Varieties of Tobelo, North Maluku, Indonesia	AST-74
Karmila Ibrahim	Faculty of Agriculture, Universitas Khairun, Ternate	analysis of the determination of growth centers and hinterland areas in the ternate city	AST-75
Betty Kadir Lahati	Faculty of Agriculture, Universitas Khairun, Ternate	BIODIVERSITY OF INSECTS ON ORGANIC AND CONVENTIONAL CHILI (Calsicum annum) PLANTATIONS IN THE TERNATE CITY OF NORTH MALUKU PROVINCE	AST-76
Hermogenes M.Paguia	Bataan Peninsula State University, City of Balanga, Bataan, Philippines	IMPROVEMENT of MANGO PRODUCTION through SCIENCE and TECHNOLOGY INNOVATIONS and SUPPORT MECHANISMS for CAPACITY DEVELOPMENT in BATAAN and ZAMBALES	AST-77
Riaz Shah	Sultan Qaboos University, Oman	BASELINE SUSCEPTIBILITY of WHITEFLY ADULTS (Bemisia tabaci) (HEMIPTERA: ALEYRODIDAE) from OMAN	AST-78
Rethinasamy Velazhahan	Sultan Qaboos University, Muscat, Oman	Efficacy of native microbial antagonists in the ecofriendly management of Monosporascus root rot and vine decline disease of muskmelon in Oman	AST-79
Ghazi Al-Karaki	Jordan University of Science & Technology	Nursery pre-inoculation of marigold with mycorrhizal fungi improves seedling quality and subsequent growth under drought	AST-80
Jaliaman Sipayung	National Pingtung University of Science and Technology, Taiwan	Isolation of halo-tolerant bacteria with plant growth-promoting traits	AST-81
Muhsanati	Agriculture Faculty of Andalas University. Indonesia. Email :	"GANDASIL D" FOLIAR FERTILIZER APPLICATION ON VANILLA (VANILLA PLANIFOLIA) IN ULTISOL	AST-82

Meng-Jie,LYU	National Pingtung University of Science and Technology, Taiwan	Isolation of halo-tolerant bacteria with antifungal activity against Botrytis cinerea	AST-83
Satria Prima Budi Utama	Department of Biological Science and Technology, National Pingtung University of Science and Technology, Taiwan ROC	Characterization of Plant Growth Promoting Rhizobacteria (PGPR) from Saline Soil in Taiwan	AST-84
Wichidtra Sudjarid	Sakon Nakhon Rajabhat University, Thailand	HEXACHLOROBENZENE PESTICIDES PERSISTENCE IN AGRICULTURAL CHEMICAL USAGE AREA	AST-85
Ahmed Khairul Hasan	Bangladesh Agricultural University, Mymensingh, Bangladesh	Response of wheat plant under system of wheat intensification	AST-86
Ahmed Khairul Hasan	Bangladesh Agricultural University, Mymensingh, Bangladesh	Evaluation of the Local, High Yielding and Hybrid Rice Varieties for Grain Morphology and Grain Yield	AST-87
Zulfatri	Faculty of Agriculture, Universitas Riau	ISOLATION AND IDENTIFICATION OF PHOSPHATE SOLUBILIZING BACTERIA PROM ULTISOL SOIL IN KAMPAR DISTRICT, RIAU PROVINCE INDONESIA	AST-88
Zulkarnain	Faculty of Agriculture, University of Jambi	DEVELOPMENT OF SOMATIC EMBRYOGENESIS IN THE PROPAGATION OF PALM OIL (Elaeis guineensis Jacq.) BY TISSUE CULTURE	AST-89
Elis Kartika	Faculty of Agriculture, Universitas Jambi	EFFECTIVENESS and COMPATIBILITY of ARBUSCULAR MYCORRHIZAL FUNGI with ANTAGONISTIC RHIZOSPHERE FUNGI on LIBERIKA TUNGKAL JAMBI COFFEE SEEDLINGS in PEAT SOIL	AST-90
Lizawati	Faculty of Agriculture, University of Jambi	THE INDUCTION of EMBRYOGENIC CALLUS USING YOUNG LEAF EXPLANTS of COFFEA (*Coffea liberica* L. cv. Liberika Tungkal Jambi)	AST-91
Lizawati	Faculty of Agriculture, University of Jambi	IN VITRO CALLUS DEVELOPMENT ON IMMATURE LEAF EXPLANTS OF LIBERICA COFFEE (Coffea liberica L. cv Liberika Tungkal Jambi) BY THE APPLICATION OF 2,4-D AND BAP	AST-92
Made Deviani Duaja	Faculty of Agriculture, University of Jambi	Organic Fertlizers for Sustainable Agriculture in Tidal Area and Soybean (Glycine max.) Growth and Yield	AST-93
Dotti Syuryati	[1]Dept. of Crop Science - University of Bengkulu. Jl. Wr. Supratman Kandang Limun, Bengkulu, 38371, Indonesia	YIELD POTENTIAL AND RESISTANCE PERFORMANCE OF SOYBEAN GENOTYPES TO POD SUCKER (Riptorsus linearis)	AST-94
Irawati Chaniago	Universitas Andalas	The Introduction of Indigenous Rhizobacteria to Promote the Growth and Yield of Potato var. Granola at Alahan Panjang, West Sumatra	AST-95
Khasrad	Universitas Andalas	THE EFFECT OF ELECTRICAL STIMULATION ON MEAT QUALITY OF INDONESIAN LOCAL AND CROSSBREED CATTLE	AST-96
Rusdimansyah	Universitas Andalas	THE EFFECT OF ELECTRICAL STIMULATION ON MEAT QUALITY OF INDONESIAN LOCAL AND CROSSBREED CATTLE	AST-96
Indra Dwipa	Universitas Andalas	EFFECT OF INDIGENOUS RHIZOBACTERIA AND MANURE ON THE GROWTH AND YIELD OF RED POTATOES (Solanum tuberosum L.)	AST-97
Irfan Suliansyah	Universitas Andalas	GRAIN YIELD EVALUATION and AGRONOMIC CHARACTERIZATION of 10 NEW HYBRID MAIZE PROSPECTIVE GENOTYPES	AST-98
Bujang Rusman	Universitas Andalas	Improvement of the chemical characteristics of Andisols on Oil Palm Plantation Using the Implementation of Biochar	AST-99
Ezi Masdia Putri	Faculty of Animal Science, Universitas Andalas	EFFECT OF VARYING RUMEN DEGRADABLE AND DEGRADABLE PROTEIN OF RATION ON NUTRIENT DIGESTIBILITY, IN VITRO RUMEN FERMENTATION CHARACTERISTICS AND MICROBIAL PROTEIN TOTAL	AST-100
Harnentis	Faculty of Animal Science, Universitas Andalas	The Use of Different Binders to Improve Physical Quality and Performance of Native Chicken Ration in Pellet Form Based on Coconut Meat Waste Supplemented with Mannanolytic Thermophilic Bacteria and Thermostable Mannanase	AST-101
Silvia Permata Sari	Faperta Universitas Andalas	BIOLOGICAL AGENT OF PREDATOR AND PARASITOID DIVERSITY IN HYBRID MAIZE	AST-102

Yulmira Yanti	Faperta Universitas Andalas	Development of the PGPR and Cyanobacteria Consortium for Growth Promotion and Control Ralstonia syzigii subsp. indonesiensis of Tomato	AST-103
Tertia Delia Nova	Fakultas Peternakan Universitas Andalas	The Optimization Ginger (Curcuma xanthorriza Roxb) and Zink Minerals in Feed to Preventing Heat Pressure at Tropical Temperatures in Sikumbang janti Local Ducks	AST-104
My Syahrawati	Faperta Universitas Andalas	Predation of Phidippus sp at difference density of Nilaparvata lugens Stal 1854 (Hemiptera : Delphacidae) in laboratory	AST-105
Haliatur Rahma	Faperta Universitas Andalas	Plant Growth Promoting Rhizobacteria (PGPR): as a Biocontrol of Curvularia oryzae in Invitro	AST-106
Tinda Afriani	Faculty of Animal Science, Universitas Andalas	SUPEROVULATION RESPONSE TO GIVING FOLLICLE STIMULATING HORMONE (FSH) AND GONADOTROPH IN REALIZING HORMONE (GNRH) IN BUFFALO (Bubalus Bubalis)	AST-107
Yusmarni	Faculty of Agriculture, Universitas Andalas	Financial feasibility and farmers' response to citronella grass farming and processing in Simawang village Tanah Datar district	AST-108
Gita Ciptaan	Faculty of Animal Science, Universitas Andalas	Utilization of Fermented Soybean Meal Waste with Aspergillums ficuum in Broiler Ration	AST-109
Arief	Faculty of Animal Science, Universitas Andalas	Milk Quality of Etawa Dairy Goat Fed Palm Kernel Cake, Tithonia (Tithonia diversifolia) and Sweet Potato Leaves (Ipomoea batatas L.)	AST-110
Arief	Faculty of Animal Science, Universitas Andalas	MILK QUALITY, RATION CONSUMTION AND DIGESTIBILITY RATION OF ETAWA CROSSBRED DAIRY GOAT FED VARIOUS PALM KERNEL CAKE, TITHONIA (Tithonia difersifolia) AND CORN WASTE	AST-111
Yurnalis	Faculty of Animal Science, Universitas Andalas	Single nucleotide polymorphism of GHR gene and its association with body weight in Bayang duck, local duck from west sumatera, Indonesia	AST-112
Mardiati Zain	Faculty of Animal Science, Universitas Andalas	The effects of legumes (Gliricidia sepium, Leucaena leucocephala and Indigofera zollingeriana) as substitute for Concentrate in ammoniated rice straw-based rations on rumen characteristics and in vitro methane production	AST-113
Zaituni Udin	Faculty of Animal Science, Universitas Andalas	Effect Of Different Techniques And Storage Time Of Ovarium On Quantity And Quality Of Buffalo Oocyte As Agenetic Material Resources	AST-114
Masrizal	Faculty of Animal Science, Universitas Andalas	Effect Of Different Techniques And Storage Time Of Ovarium On Quantity And Quality Of Buffalo Oocyte As Agenetic Material Resources	AST-114
Suci Rahmawati	Faculty of Animal Science, Universitas Andalas	Effect Of Different Techniques And Storage Time Of Ovarium On Quantity And Quality Of Buffalo Oocyte As Agenetic Material Resources	AST-114
Syafri Nanda	Faculty of Animal Science, Universitas Andalas	Effect Of Different Techniques And Storage Time Of Ovarium On Quantity And Quality Of Buffalo Oocyte As Agenetic Material Resources	AST-114
Nobutaka Ito	Faculty of Engineering, Chiang Mai University	FFAGPI, Future Farmers of Asia Growing Program Initiative	AST-115
Choncharoen Sawangrat	Faculty of Engineering, Chiang Mai University	FFAGPI, Future Farmers of Asia Growing Program Initiative	AST-115
Latifa Hanum	Politeknik Pertanian Negeri Payakumbuh	Socioeconomic Characteristics of Breeder Against Adoption of Artificial Insemination Technology	AST-116
Mizanur Rahman Bhuiyan	Soil, Water and Environment Discipline. Khulna University, Khulna, Bangladesh	IMPLICATIONS OF SOIL BULK DENSITY ON THE WATER UPTAKE PATTERN OF SOYBEAN PLANT UNDER DIFFERENT SOIL MOISTURE CONDITIONS	AST-117
Malik Makmur	Faculty of Animal Science, Universitas Andalas	Evaluation of Ratio Grass-Legume on Inhibition of Biohydrogenation in Rumen In Vitro System	AST-118
Novirman Jamarun	Faculty of Animal Science, Universitas Andalas	EFFECT OF FERMENTATION OF TITONIA (Tithonia diversifolia) WITH Lactobaccilus plantarum BACTERIA ON THE pH, TOTAL BACTERIA COLONI AND PHYTASE ENZYME ACTIVITIES	AST-119
Hendri	Faculty of Animal Science, Universitas Andalas	THE EFFECT OF FSH DOSES ON LITTER SIZE, SEX RATIO AND BIRTH WEIGHT IN DIFFERENT PARITIES OF GOAT	AST-120

Rusmana Wijaya Setianingrat	Faculty of Animal Science, Universitas Andalas	The effects of legumes (Gliricidia sepium, Leucaena leucocephala and Indigofera zollingeriana) as substitute for Concentrate in ammoniated rice straw-based rations on rumen characteristics and in vitro methane production	AST-121
Nurbailis	Faculty of Agriculture, Universitas Andalas	EXPLORATION OF FUNGI THAT ASSOCIATED WITH BRANDH DIEBACK DISEASES IN COCOA (Theobromae cacao L.) PLANTS IN PADANG CITY	AST-122
Yulensri	Politeknik Pertanian Negeri Payakumbuh	POTENTIAL OF BACTERIA ISOLATED FROM LOCAL MICROORGANISM (LMO) OF BANANA STEM BUD AS A PEST BIOCONTROL AGENT Spodoptera litura F	AST-123
Yulensri	Politeknik Pertanian Negeri Payakumbuh	COMPATIBILITY OF SOME BACTERIA AS PESTICIDES AND BIOLOGICAL FERTILIZERS AND THE FORMULATIONS ON VARIOUS ORGANIC MATERIALS	AST-124
Kresna Murti	Politeknik Pertanian Negeri Payakumbuh	ROLE OF BIO-LIQUID ORGANIC FERTILIZERS (BIO-LOF) ON SOIL FERTILITY AND NUTRIENTS UPTAKE ON MAIZE (Zea mays L)	AST-125
Misfit Putrina	Politeknik Pertanian Negeri Payakumbuh	APPLICATIONS OF VARIOUS TYPES AND DOSAGE OF BIO-COMPOSTS ON GINGER PLANT (Zingiber officinale L)	AST-126
Noveri	Politeknik Pertanian Negeri Payakumbuh	POTENTIAL OF BACTERIA OF BANANA STEM BUD LOCAL MICRO ORGANISM (LMO) AS A BIO-FERTILIZER TO INCREASE THE GROWTH OF PADDY IN SRI METHOD	AST-127
Nelson Elita	Politeknik Pertanian Negeri Payakumbuh	THE APPLICATION BIOFERTILIZER CONTAINING Azotobacter BACTERIA AND Pseudomonas fluorescents Indigenous FORMULATION OF ORGANIC COMPOS WITH VARIOUS SUBSITUTION MATERIALS ON RICE PRODUCTION SRI METHOD	AST-128
Rita Erlinda	Politeknik Pertanian Negeri Payakumbuh	The Test of Storage Time for Azotobacter Bacteria Isolate Formulation, Indigenous Pseudomonas fluorescents as Biofertilizer on the Number of Bacterial Colonies	AST-129
Yun Sondang	Food Crops Department, Politeknik Pertanian Negeri Payakumbuh	ISOLATION AND IDENTIFICATION OF EFFECTIVE MICROORGANISMS FROM WATER HYACINTH BIOFERTILIZERS	AST-130
Fardedi	Department of Water System of Agriculture , Politeknik Pertanian Negeri Payakumbuh	Trips (Thysanoptera: Thripidae) Population Monitoring At Mangosteen Planting Area	AST-131
Deswani Panggabean	Politeknik Pertanian Negeri Payakumbuh	Making Organic Fertilizers from Orok-orok (Crotalaria juncea.) as a nutrient for chicory (Brassica juncea.) that are grown fertigately	AST-132
Sri Nofianti	Politeknik Pertanian Negeri Payakumbuh	Effect of Breeder Knowledge Against Adoption of Artificial Insemination Technology	AST-133
Jaswandi	Faculty of Animal Science, Universitas Andalas	THE USE OF STRAW FOR INVITRO MATURATION OF CATTLE OOCYTES DURING TRANSPORTATION	AST-134
Made Deviani Duaja	Agriculture Faculty, Jambi University	REDUCE THE USE OF MINERAL FERTILIZERS IN CHINESE KALE (Brassica alboglabra Bailey)	AST-135
Anak Agung Ketut Darmadi	Biology Study Program Faculty of Mathematics and Natural Sciences Udayana University Bali-Indonesia	ANTIFUNGAL ACTIVITIES OF CINNAMON LEAF EXTRACTS AGAINST SIGATOKA FUNGUS (PSEUDOCERCOSPORA FIJIENSIS)	AST-136
			Energy
Firmansyah	Politeknik Negeri Sriwijaya	Study of the Supply Water Discharge at the Micro Hydro Power Installation in the Sarwan Village South Sumatera	Energy-01
Tresna Dewi	Politeknik Negeri Sriwijaya	ACTIVE AND PASSIVE COOLING COMPARISON OF PV PANELS APPLIED IN TROPICAL CITY; CASE STUDY PALEMBANG, SOUTH SUMATRA	Energy-02
Dentri Irtas	Politeknik Negeri Sriwijaya	The Effect of Electric Current on the Production of Brown's Gas using Hydrogen Fuel Generator with Seawater Electrolytes	Energy-03
Tri Hidayat	Politeknik Negeri Sriwijaya	Modification of Fuel Input on Oil Fuel Electric Generator to Gas Fuel Engine	Energy-04

Feni Alvionita	Chemical Engineering Department, Faculty of Engineering, Universitas Sriwijaya	Production of Biogas from Palm Oil Mill Effluent With Indigenous Bacteria	Energy-05
Muhammad Said	Chemical Engineering Department, Faculty of Engineering, Universitas Sriwijaya	Conversion Of Palm Oil Mill Effluent To Produce Biogas With Consortium Bacteria	Energy-06
Muhammad Said	Chemical Engineering Department, Faculty of Engineering, Universitas Sriwijaya	Synthesis of Epoxide and Polyol Compounds as Intermediates for Biolubricant from Soybean Oil	Energy-07
Yohandri Bow	Politeknik Negeri Sriwijaya	Effect of Air Flow Rate on Thermal Efficiency in the Process of Drying Crackers with Dryer using Photovoltaic Solar Panels	Energy-08
Herdian Wibowo	Politeknik Negeri Sriwijaya	Performance Comparison Analysis of Fixed and Solar-Tracker Installed Panel at PV System in PT. Pertamina (Persero) RU-III Plaju	Energy-09
Aisman	Universitas Andalas	ANALYSIS OF BIOMASS CHARACTERISTICS AND CALORIES VALUE FROM VARIOUS BAMBOO TYPES AROUND GUMANTI RIVER LEMBAH GUMANTI SUB-DISTRICT OF SOLOK DISTRICT	Energy-10
Muhaji	Department of Mechanical Engineering, Universitas Negeri Surabaya	Flame Caracteristics Difusion Cumbostion Jatropha Curcas Linn Oil Biodiesel and Diesel Fuel Oil Blend	Energy-11
Nasrul Ilminnafik	Department of Mechanical Engineering, Universitas Jember	Improving the Quality of Biogas with the Addition of Liquefied Petroleum Gas (LPG)	Energy-12
Weiwei LUO	Chiang Mai Rajabhat University/Yunnan Academy of Scientific and Technical Information, P.R.China	DETERMINANTS OF CHINESE SMES' ENTRY TO ASEAN RENEWABLE ENERGY MARKET	Energy-13
Vivek Mandot	V. K. B. Government Girls' College, Dungarpur, Rajassthan 314001, India	An Overview of Community Empowerment by Solar Energy	Energy-14
Chayanoo Sawatdeenarunat,	Asian Development College for Community Economy and Technology, Chiang Mai Rajabhat University, Thailand	The combustion characteristic of biomass stove with air-preheated by porous medium	Energy-15
Chayanon Sawatdeenarunat,	Asian Development College for Community Economy and Technology, Chiangmai Rajabhat University , Chiang Mai, Thailand	ENERGY POTENTIAL OF ELEPHANT CAMP : THE PERLIMINARY STUDY OF TUMBON MAEWIN, APMPHOE MAEWANG, CHIANG MAI, THAILAND	Energy-16
Masita Mohammad	Solar Energy Research Institute, SERI, UKM, Malaysia	COMPOSITIONAL ANALYSES OF SELECTED LIGNOCELLULOSIC BIOMASS FROM MALAYSIA AGRO-WASTE USING VAN SOEST METHOD	Energy-17
Giang Van Tran	Maejo University, Chiang Mai, Thailand	EFFECTS OF CO-SUBSTRATE CONCENTRATIONS ON THE ANAEROBIC CO-DIGESTION OF COMMON REED AND COW DUNG	Energy-18
Marwan Asrof	Mining Department of Engineering Faculty, Universitas Sriwijaya, Palembang 30662,Chemical Department of Engineering Faculty, Universitas Sriwijaya, Palembang 30662, Indonesia.	THE CHARACTERISTICS ANALYSIS OF CHAR RESULTED FROM LOW RANK COAL GASIFICATION	Energy-19
Hathaithip Sintuya	Asian Development College for Community Economy and Technology, Chiang Mai Rajabhat University, Thailand	LOW COST ONLINE MONITORING DEVICES FOR HOME ENERGY MANAGEMENT SYSTEMS THROUGH WIFI NETWORK	Energy-20

Leily Nurul Komariah	Department of Chemical Engineering, Universitas Sriwijaya, Jl Srijaya Negara, Palembang, 30119, Indonesia.	Best Tank Materials for Biodiesel Storage; a Comparative Study on Corrosion Profile	Energy-21
Manoch Kumpanalaisatit	Asian Development Colleg for Community Economy and Technology, Thailand	THE EFFECT OF SPACE UTILIZATION UNDER THE GROUND-MOUNTED SOLAR FARM ON POWER GENERATION	ENERGY-22
Hathaithip Sintuya	Asian Development College for Community Economy and Technology, Chiang Mai Rajabhat University, Thailand	LOW COST ONLINE MONITORING DEVICES FOR HOME ENERGY MANAGEMENT SYSTEMS THROUGH WIFI NETWORK	Energy-23
Rungnapa Chulasak	Asian Development College for Community Economy and Technology, Chiang Mai Rajabhat University, Thailand	ECONOMIC ANALYSIS OF APPLYING HYBRID BIOMASS STOVE TO PRODUCE HOT WATER SERVING CHILD DEVELOPMENT CENTER IN OMKOI DISTRICT, CHIANG MAI, THAILAND	Energy-24
Surachai Narrat Jansri	Asian Development Colleg for Community Economy and Technology, Thailand	HOUSEHOLD BIOMASS GAS STOVE PERFORMANCE AND EXHAUST GAS EMISSIONS	ENERGY-25
			Environment
Sermkiat Jomjunyong	1Industrial Engineering Department, Faculty of Engineering, Chiang Mai University, Thailand 50200	THE HOLISTIC COMPONENTS OF CATTLE PRODUCTION FOR SOLVING THE HAZE IN CHIANG MAI	Environment-01
Nita Kusumawati	Universitas Negeri Surabaya	Utilization of Teak Leaf Waste as an Environmentally Friendly Batik Dyes	Environment-02
Elida Novita	Faculty of Agricultural Technology, Universitas Jember	BEDADUNG RIVER POLLUTION LOAD CHANGES STUDY IN SUSTAINABLE WATER QUALITY MANAGEMENT AT JEMBER REGENCY, EAST JAVA, INDONESIA	Environment-03
Rahmanta Setiahadi	Faculty of Agriculture, Universitas Merdeka Madiun	STRATEGY ACTION OF LAND-BASED CLIMATE CHANGE MITIGATION IN GEOPARK AREA OF GUNUNG SEWU, JOGJAKARTA	Environment-04
Asihing Kustanti	Faculty of Agriculture, University of Brawijaya	FARMERS ROLE ON SUSTAINABLE UB FOREST MANAGEMENT-A Case From Indonesia	Environment-05
Dina Novia	Faculty of Agriculture, University of Brawijaya	The Development Strategy of Dampit Coffee Ecotourism To Improve the Rural Economy (A Case Study in Amadanom Village, Malang Regency, East Java)	Environment-06
Meitini Wahyuni Proborini	Department of Biology, Basic Science and Math Faculty, University of Udayana	Diversity of Arbuscular Mycorrhizal Fungi (AMF) in Rhizosphere Plants at the West Bali National Park (TNBB)	Environment-07a
Meitini Wahyuni Proborini	Department of Biology, Basic Science and Math Faculty, University of Udayana	Fungus species that change the Blood Type of Blood Stains on Iron, Aluminum, Ceramics, Wood and the Length of Change as Evidence for Forensics	Environment-07b
Mary Grace DP. Rodriguez	Da Compound, San Agustin, Pili, Camarines Sur, PHILIPPINES	INTEGRATED VULNERABILITY ASSESSMENT of WATER-ENERGY-FOOD NEXUS SECURITY of WARAS-LALO SUBWATERSHED, BICOL RIVER BASIN PHILIPPINES	Environment-08
Melody Morano Guimary	Block 18, Lot 7, Ideal Homes Subdivision, Barangay Libertad, Butuan City, Agusan Del Norte 8600, PHILIPPINES	ASSESSMENT of the RIVERBANK STABILIZATION PROJECT in NASIPIT, AGUSAN DEL NORTE, PHILIPPINES	Environment-09
G.R. Rajakumar	AICRP for Dryland Agriculture, Regional Agricultural Research Station Vijayapura, Karnataka, University of Agricultural Sciences, Dharwad, India	O MOTHER EARTH-IS THE SOIL IN YOU IS SAFE FOR AGRICULTURE-? : AN EASY METHOD TO FIND IT SAFE!	Environment-10

Sukanya Vongtanaboon	Phuket Rajabhat University, Thailand	FLOOD RISK AREA ASSESSMENT IN PATONG MUNICIPALITY, KATHU DISTRICT, PHUKET PROVINCE	Environment-11
Sakollawat Sawetrattanakul	Chiang Mai Rajabhat University	APPROPRIATE GUIDELINES OF WASTE MANAGEMENT FOR KEUDCHANG SUB-DISTRICT, MAETANG DISTRICT, CHIANG MAI PROVINCE, THAILAND	Environment-12
Wiskandar	Universitas Jambi	RECLAMATION of the PHYSICAL PROPERTIES of EX-COAL MINE LAND by USING BIOCHAR and MANURE	Environment-13
Wiskandar	Universitas Jambi	The EFFECT of BIOCHAR and COMPOST of TITONIA on the PHYSICAL PROPERTIES of SOIL in POST-MINNING LAND of COAL	Environment-14
Agus Susatya	Dept of Forestry, University Bengkulu	VULNERABILITY AND ITS INFLUENCING FACTORS TO CLIMATE CHANGE OF THE VILLAGES AROUND KERINCI SEBLAT NATIONAL PARK: A CASE STUDY ON PINANG BERLAPIS DISTRICT, LEBONG REGENCY, INDONESIA	Environment-15
Rusdianasari	Jurusan Teknik Kimia, Politeknik Negeri Sriwijaya	The Effectiveness of Electrocoagulation Process in Rubber Wastewater Treatment using Combination Electrodes	Environment-16
Gita Mulyasari	Faculty of Agriculture, Universitas Bengkulu	How Climate Change Affects the Livelihood Vulnerability of Marine Capture Fishermen in Bengkulu Province, Indonesia	Environment-17
Dwi Probowati Sulistyani	Universitas Sriwijaya	LAND SUITABILITY ASSESSMENT FOR TEAK PLANT (Tectona grandis) IN THE AREA OF COAL MINE RECLAMATION PT. BUKIT ASAM, TBK. TANJUNG ENIM SOUTH SUMATRA	Environment-18
Rita Tri Puspitasari	IPB University	BIOAUGMENTATION IN DOMESTIC AND ORGANIC WASTEWATER FOR PLANT FERTILIZERS	Environment-19
Wiji Tuhu Utami	Student, Universitas Sebelas Maret, Surakarta	AN EVALUATION ON THE IMPLEMENTATION OF SURAKARTA LOCAL REGULATION NO. 3/2010 ABOUT RUBBISH MANAGEMENT	Environment-20
Raden Roro Ilma Kusuma Wardani	Faculty of Agriculture, Universitas Sebelas Maret, Surakarta	The Dynamic of Rubbish Bank Management in Solo City, Indonesia	Environment-21
Widyatmani Sih Dewi	Faculty of Agriculture, Universitas Sebelas Maret, Surakarta	Increasing Soil C Sequestration as Key Point Facing Climate Change	Environment-22
		Food Science and Technology	
Fauzan Azima	Fateta Universitas Andalas	Evaluation of Oily Food Product Quality at the Market	FST-01
Wenny Surya Murtius	Universitas Andalas	Isolation and Characterization of Lipid Degraded Bacteria from Galamai Leftovers	FST-02
Yetti Marlida	Faculty of Animal Science, Universitas Andalas	NEW POULTRY PROBIOTIC OF LACTIC ACID BACTERIA ORIGIN FROM FOOD FERMENTED WEST SUMATERA, INDONESIA	FST-03
Yetti Marlida	Faculty of Animal Science, Universitas Andalas	Isolation and Characterization of Potential Probiotic Yeast from Fish Fermented	FST-04
Novelina	Faculty of Agricultural Technology, Universitas Andalas	The Microbiological Characteristic of Grinded Fresh Chili (*Capsicum annum* L.) with Addition of Cooking Oil on Storage	FST-05
Susi Desminarti	Politeknik Pertanian Negeri Payakumbuh	GLYCEMIC RESPONSE OF INSTANT YELLOW CORNMEAL AND TEMPE FLOUR PORRIDGE AND THE FACTORS AFFECTING THE RESPONSE	FST-06
Usman Pato	Faculty of Agriculture, Universitas Riau	ANTIMICROBIAL ACTIVITY OF LACTIC ACID BACTERIA STRAINS ISOLATED FROM DADIH AGAINST ESCHERICHIA COLI	FST-07
Evy Rossi	Faculty of Agriculture, Universitas Riau	Characterization of Bacteriocin produced by Lactobacillus plantarum isolated from solid waste of soymilk production	FST-08
Dewi Fortuna Ayu	Universitas Riau	Addition Of Red Palm Oil On Chemical And Sensory Characteristics Of Mayonnaise From Patin Fish Oil	FST-09
Agus Slamet	Faculty of Agroindustry, Univ. Mercu Buana Yogyakarta	YOGURT POWDER ISOLATE OF WINGED BEAN PROTEIN AS FUNCTIONAL FOOD HYPOCHOLESTEROL	FST-10
Abubakar Ahmad	Universitas Padjadjaran Indonesia	DETERMINATION STANDARD LEVEL OF PUNGENCY IN SAMBAL TERASI (CASE OF STUDY MSME RUMAH MAKAN BETAWI)	FST-11

In-In Hanidah	Fakultas Teknologi Industri Pertanian, Universitas Padjadjaran	CHARACTERIZATION OF PROBIOTIC BACTERIAL CANDIDATES FROM JATINANGOR-INDONESIA BREAST MILK	FST-12
Endah Wulandari	Faculty of Industrial Agriculture Technology, Universitas Padjadjaran	Functional characteristics of white and red sorghum (Sorghum bicolor (L.) Moench) proteins from local bandung cultivar	FST-13
Debby Moody Sumanti	Universitas Padjadjaran Indonesia	SYNBOTIC BISCUIT POTENTIAL REDUCING BLOOD SUGAR LEVELS IN WISTAR WHITE RATS	FST-14
S.Rosalinda	Universitas Padjadjaran Indonesia	Physico-chemical Characteristic of Corn Varieties Based on Starch Properties	FST-15
Gusti Setiavani	IPB University	RHEOLOGICAL CHARACTERISTICS OF DODOL ULAME DURING STORAGE IN DIFFERENT TEMPERATURES	FST-16
Dandy Yusuf	IPB University	HYPOCHOLESTEROLEMIC PROPERTIES OF LACTOBACILLI ISOLATED FROM INDONESIAN KEFIR GRAINS	FST-17
Yuliana Tandi Rubak	IPB University	ANGIOTENSIN CONVERTING ENZYM INHIBITORY (ACE-I) ACTIVITY AND NOVEL ACE-I PEPTIDES IN FERMENTED GOAT MILK BY INDIGENOUS LACTIC ACID BACTERIA	FST-18
Fenny Amilia Mahara	Department of Food Science and Technology, Faculty of Agricultural Engineering and Technology, IPB University	Growth and Folate Production of Lactic Acid Bacteria in Folate-Free Culture Medium	FST-19
Mentari Larashinda	Agricultural Technology, Andalas University, Padang, West Sumatera, Indonesia, 25613	Identification of Purine Content in Various Processed Foods of Chicken as Specialty Food of West Sumatra	FST-20
Luh Suriati	Food Science and Technology, Universitas Warmadewa, Bali	CHARACTERISTICS of the PHYSICOCHEMICAL *Aloe vera* GEL TREATMENT of FILLER as EDIBLE COATING on STRAWBERRY FRUIT	FST-21
Surya Aulia H	Department of Food Science and Technology, Faculty of Agricultural Engineering and Technology, IPB University	DIETARY FIBER PROFILE OF WINGED BEAN (PSOPHOCARPUS TETRAGONOLOBUS)	FST-22
Novizar Nazir	Faculty of Agricultural Technology.Universitas Andalas	PHYSICAL-CHEMICAL PROPERTIES, GLYCEMIC INDEX AND SENSORY PROFILE OF PRABOILED PURPLE RICE GROWN IN WEST SUMATRA	FST-23
Sabiha Hanim Saleh	Universiti Teknologi Mara	Fractionation, isolation and characterisation of oil palm fronds xylooligosaccharides: A potential source of prebiotics	FST-24
Wiwit Amrinola	Department of Food Science and Technology, Faculty of Agricultural Engineering and Technology, IPB University	Studies on Characteristics Of Developed Pigmented Ampiang : Flaked Glutinous Rice From West Sumatra, Indonesia	FST-25
Yusma Yennie	Department of Food Science and Technology, Faculty of Agricultural Engineering and Technology, IPB University	EFFECT OF DIFFERENT DRYING METHODS ON CHARACTERISTICS OF DRIED SALTED NOMEI (Harpodon nehereus) FISH	FST-26
Sakina Yeti Kiptiyah	Food Science, Faculty of Agricutural Technology, Universitas Gadjah Mada, Yogyakarta	THE EFFECT OF BLANCHING AND EXTRACTION ON TOTAL PHENOLIC AND FLAVANOID CONTENT OF KENCUR (Kaempferia galanga. L).	FST-27
Rita Ismawati	Department of Home Economic, Faculty of Engineering, Universitas Negeri Surabaya	Effect of Soybean sorts on Chemical Characteristics and Sensory of Tempeh Sausage	FST-28
Aqshan Shadikin Nurdin	Faculty of Agriculture, Universitas Khairun, Ternate	Composition and nutrition content in honey Trigona sp. in the production forest management area Tidore islands	FST-29
Lucia Tri Pangesthi	Jurusan PKK, Faculty of Engineering, Universitas Negeri Surabaya	DEVELOPMENT ABILITY OF SWEET BREAD MADE FROM LIQUID AND DRY RAISIN YEAST	FST-30
Puspita Sari	Universitas Jember	Antioxidative Properties of Arabica, Liberica, and Robusta Coffees Grown in Jember District, Indonesia	FST-31

Ni Made Suaniti	Department of Chemistry, FMIPA, Universitas Udayana	Analysis Fatty Acid Ethyl Ester dan α-Tocopherol as Antioxidants in Virgin Coconut Oil Synthesis and commercial	FST-32
Novi Safriani	[1] Department of Food Science and Technology, Faculty of Agricultural Technology, IPB University	Antioxidative and immunomodulatory effect of selected edible plants from Indonesia *in vitro*	FST-33
Green Production and Innovation			
Sri Widayanti	Universitas Pembangunan Nasional "Veteran" Jawa Timur	Analysis of Rice Supply Chains In Rice Mills In Kedungpring District, Lamongan	GPI-01
Endang Yektiningsih	Universitas Pembangunan Nasional "Veteran" Jawa Timur	RISK ANALYSIS OF RED CHILLI FARMING	GPI-02
Ira Wahyuni Syarfi	Faperta Universitas Andalas	THE REVITALIZATION OF THE FARMER COOPERATIVE IN SMALLHOLDERS PALM OIL REPLANTATION IN DHARMASRAYA DISTRICT, WEST SUMATERA PROVINCE, INDONESIA	GPI-03
Dwi Evaliza	Faperta Universitas Andalas	INCOME ANALYSIS AND WORK TIME ALLOCATION OF NUTMEG PLANT PRODUCTS IN PADANG SELATAN DISTRICT, PADANG CITY OF WEST SUMATRA	GPI-04
Melinda Noer	Faperta Universitas Andalas	The Regional Land Use Control for Sustainable Agriculture	GPI-05
Basril Basyar	Faculty of Agriculture, Universitas Muhammadiyah Sumatera Barat, Padang	LPHN Member Participation in Nagari Pasir Talang Timur Forest in the Empowerment Program through Beef Cattle Fattening	GPI-06
Muhamad Reza	Faculty of Agriculture, Universitas Muhammadiyah Sumatera Barat, Padang	LPHN Member Participation in Nagari Pasir Talang Timur Forest in the Empowerment Program through Beef Cattle Fattening	GPI-06
Hery Bachrizal Tanjung	Faculty of Agriculture, Universitas Andalas	TOWARDS TRANSFORMATION OF DISTRICT AGRICULTURAL EXTENSION INSTITUTION (BPP) IN DIGITAL ERA	GPI-07
Dedet Deperiky	PhD Student of Agricultural Science, Universitas Andalas	Development of Agriculture Area Based On Community Supply Chain With Local Wisdom Perspective	GPI-08
Candrianto	Politeknik ATI Padang	THE FINANCING MODEL FOR WASTE MANAGEMENT IN LUBUK ALUNG SUB-DISTRICT, PADANG PARIAMAN REGENCY THROUGH THE USE OF VILLAGE FUNDS	GPI-09
Desniorita	Politeknik ATI Padang	VALIDATION OF OPTIMIZATION OF pH, TEMPERATURE AND LONG PECTIN EXTRACTION OF COCOA POD WITH RESPONSE SURFACE METHODOLOGY (RSM)	GPI-10
Ameilia Zuliyanti Siregar	Faculty of Agriculture, Universitas Sumatera Utara	POTENTIAL USE OF NATURAL PESTICIDE TO CONTROL OF ORSEOLIA ORYZAE AND LEPTOCORISA ORATORIUS IN PADDY ECOSYSTEM IN PERCUT OF PESTS IN SALINE PADDY OF PERCUT, NORTHERN SUMATERA	GPI-11
Dini Wahyuni	Universitas Sumatera Utara	MODELLING OPERATION OF LOGISTICS MANAGEMENT IN MODERN MARKET: A CASE STUDY IN INDONESIAN RETAIL COMPANY	GPI-12
Dini Wahyuni	Universitas Sumatera Utara	The Effect of Illumination on Work Result in Sorting Department	GPI-13
Meilita Tryana Sembiring	Industrial Engineering Department, Faculty of Engineering, Universitas Sumatera Utara	Redesigning Distribution Routes of Smartphone X in North Sumatra	GPI-14
Meilita Tryana Sembiring	Industrial Engineering Department, Faculty of Engineering, Universitas Sumatera Utara	REDUCTION BULLWHIP EFFECT IN THE SUPPLY CHAIN SINGLE VENDOR AND MULTI RETAILER USING METHOD VENDOR MANAGED INVENTORY (VMI) IN PT. XYZ	GPI-15
Nurhayati Sembiring	Universitas Sumatera Utara	Organization and Management Review related to Sustainable Supply Chain Management	GPI-16

Nurhayati Sembiring	Universitas Sumatera Utara	Increasing Company's Achievement by Sustainable Supply Chain Management	GPI-17
Lusiana Andriani Lubis	Universitas Sumatera Utara	Effectiveness of Communication, Information and Education (CIE) in Implementing the Family Planning Programme on the Peasant Community in Muaratais District, South of Tapanuli	GPI-18
Juliza Hidayati	Department of Industrial Engineering , Universitas Sumatera Utara	REDESIGN THE DISTRIBUTION FACILITIES AND ROUTES TO ENSURE THE SUSTAINABILITY OF LIQUIFIED PETROLEUM GAS SUPPLY IN NORTH SUMATERA	GPI-19
Siti Zahara Nasution	Faculty of Nursing, Universitas Sumatera Utara	KNOWLEDGE AND NUTRITIONAL STATUS OF ELDERLY	GPI-20
Lufthiani	Faculty of Nursing, Universitas Sumatera Utara	The Correlation between Food Consumption Pattern and Nutritional Status among Street Children in Shelter Home, Medan City	GPI-21
Reni Asmara Ariga	Faculty of Nursing, Universitas Sumatera Utara	Effectiveness of Demonstration and Video Media Methodin the Examination of Vital Sign on Clinical Skill in the Nursing Students of USU	GPI-22
Cholina Trisa Sire	Faculty of Nursing, Universitas Sumatera Utara	PATIENTS 'ABILITY TO MAKE NUTRITIONAL NEEDS DURING HEMODIALYSIS IN MEDAN, INDONESIA	GPI-23
Nunung F.Sitepu	Faculty of Nursing, Universitas Sumatera Utara	Correlation between Sleep Quality and Spirituality Level in Cancer Patients undergoing Chemotherapy at Hospital Medan, Indonesia	GPI-24
Evawany Yunita Aritonang	Faculty of Nursing, Universitas Sumatera Utara	Behavior of TB-DM Patients in Medan City Health Center in Controlling Blood Sugar Levels	GPI-25
Syarifah	Faculty of Nursing, Universitas Sumatera Utara	THE BEHAVIOUR OF FORMAL COMMUNITY LEADERS IN TUBERCULOSIS (TB) CONTROL FOR THE FORMATION OF TB FREE VILLAGES IN MEDAN	GPI-26
Sori Muda Sarumpaet	Faculty of Nursing, Universitas Sumatera Utara	Model Application Of Kantong SOSA, Abon Fish Lele, And SMS In The Discussion Of The Lung Tb Transmission Chain In Medan 2018-2020	GPI-27
Tukiman	Faculty of Nursing, Universitas Sumatera Utara	Community Behavior in Preventing Pulmonary Tuberculosis in Bandar Klippa Health Center in 2019	GPI-28
Andriasan Sudarso	STIE IBBI, Medan	WarPLS Approach for Modelling Relationship Between Brand Image and Service Quality on Customer Loyalty Through Customer Satisfaction	GPI-29
Lili Suryati	STIE IBBI, Medan	Variance-Based SEM Approach for Modelling Customer Satisfaction Mediating of Product Quality and Service Quality on Customer Loyalty	GPI-30
Firman Raydav Lamtorang Silalahi	Politeknik Pembangunan Pertanian Medan	FINANCIAL ANALYSIS OF INTEGRATION OF BEEF CATTLE LIVESTOCK AND OIL PALM IN KOTA WARINGIN REGENCY	GPI-31
Mawar Indah Peranginangin	Politeknik Pembangunan Pertanian, Medan	LEVEL OF APPLICATION OF POST-HARVEST COCOA (THEOBROMA CACAO L.) TECHNOLOGY BY FARMERS IN STABAT SUB DISTRICT, LANGKAT REGENCY	GPI-32
Yeni Kusumawaty	Faculty of Agriculture, Universitas Riau	COMPARATIVE ANALYSIS OF INCOME ON PALM OIL PRODUCTION BETWEEN THE LAND APPLICATION (LA) AND NON LAND APPLICATION (NLA) WASTE MANAGEMENT IN LUBUK DALAM ESTATE OF PTPN V, SIAK DISTRICT, RIAU PROVINCE, INDONESIA	GPI-33
Hermiza Mardesci	Universitas Islam Indragiri (UNISI), Tembilahan - Riau	DETERMINATION of VALUE-ADDED and CONTRIBUTING ORGANIZATION in the DEVELOPMENT of COCONUT WATER-BASED AGRO INDUSTRY	GPI-34
Ujang Paman Ismail	Faculty of Agriculture, Universitas Islam Riau	FARM MACHINES DENSITY AND APPLICATION LEVEL ON SMALL-SCALE RICE FARMING IN REGENCIES OF RIAU PROVINCE	GPI-35
Satria Putra Utama	Faculty of Agriculture, Universitas Bengkulu	THE ROLE OF FARMERS CONTACTS RESOURCES AND FIELD AGRICULTURE EXTENSION IN INCREASING THE EFFECTIVITY OF FARMERS GROUPS IN SELUMA DISTRICT, BENGKULU PROVINCE	GPI-36
Indra Cahyadinata	Universitas Bengkulu	Management Model of Mud Crab Fisheries on The Outermost Small Island (Case Study: Enggano Island, Bengkulu Province, Indonesia)	GPI-37
Teguh Adiprasetyo	Faculty of Agriculture, Universitas Bengkulu	Developing Strategy for Increasing the Adoption of Indonesia Sustainable Palm Oil Production System by Smallholder Farmers	GPI-38

Damres Uker	Faculty of Agriculture, Universitas Bengkulu	POTENTIAL AVAILABILITY OF RAW MATERIALS AND BUSINESS PERCEPTIONS IN THE DEVELOPMENT OF PEABERRY COFFEE IN KEPAHIANG DISTRICT, BENGKULU	GPI-39
Irnad Ardenis	Faculty of Agriculture, Universitas Bengkulu	EXPLORING FACTORS AFFECTING SUSTAINABILITY OF COFFEE FARMING: A STRUCTURAL EQUATION MODELING STUDY	GPI-40
Nusril	Faculty of Agriculture, Universitas Bengkulu	POTENCY OF AGRICULTURAL SUBSECTORS IN PROVINCE ECONOMY ON THE SUMATERA REGION, INDONESIA	GPI-41
Ketut Sukiyono	Faculty of Agriculture, Universitas Bengkulu	Husband's And Wife's Housework Time Allocation among Fishery Households In Bengkulu City: Does Working Wife Have an Impact?	GPI-42
Eliza	Dept. of Chemistry FMIPA, Universitas Sriwijaya	GREEN SYNTHESIS SILVER NANOPARTICLE USING EXTRACT OF KECAPI (Sandoricum koetjape) TO INHIBIT FUNGAL GROWTH Neofusicoccum parvum	GPI-43
Mirza Antoni	Faculty of Agriculture, Universitas Sriwijaya	DETERMINANT FOR SOURCES OF PRODUCTION COSTS CHOICE BY RICE FARMERS IN INDONESIA	GPI-44
Sawarni Hasibuan	Master of Industrial Engineering Program, Universitas Mercu Buana, Jakarta	FRAMEWORK OF SUSTAINABILITY PERFORMANCE MEASUREMENT FOR PALM BIOMASS POWER PLANT	GPI-45
Dian Astriani	Department of Agrotechnology, Universitas Mercu Buana Yogyakarta	THE EFFECT OF CNSL CONCENTRATION AND THE ADDITION OF NATURAL DYES IN BOTANICAL PESTICIDE FORMULATION ON SITOPHILUS ZEAMAIS AND CORN SEED QUALITY	GPI-46
Indira Lanti Kayaputri	Faculty of Agriculture Industrial Technology, Universitas Padjadjaran	REVIEW : THE POTENCY OF BEE POLLEN FROM STINGLESS BEES AS FUNCTIONAL FOODS	GPI-47
Ratu Safitri	Study Program of Biotechnology, Postgraduate Study, Universitas Padjadjaran	Biodegradation Of Black And Red Remazol textile Dyes By Bacterial Strains Isolated From River Contaminated Dyewaste Effluent	GPI-48
Ririn Regiana Dwi Satya	IPB University	A DIGITAL BUSINESS MODELLING FOR GREEN SUPPLIER SELECTION OF POTATO CHIPS AGROINDUSTRY	GPI-49
Lely Herlina	Departement of Agro-Industrial Technology, Faculty of Agricultural Technology, IPB University	Business Process in Production and Distribution Planning: A case of shrimp agro-industry supply chain	GPI-50
Nuraeni Dwi Dharmawati	Doctoral Program of Agricultural Science, Universitas Sebelas Maret, Surakarta	ANALYSIS OF SOFTENER EFFECTIVENESS IN REDUCING HARDNESS OF BOILER FEED WATER IN CRUDE PALM OIL MIL	GPI-51
Ari Astuti	Universitas Sarjanawiyata Tamansiswa, Yogyakarta	PROSPECTS FOR RED ONION (Allium cepa L.) FARMING DEVELOPMENT IN THE LIME FIELD	GPI-52
Nita Kusumawati	Universitas Negeri Surabaya	Exploration and Standarization of Coconut Fiber Waste Utilization in Batik Dyeing Process	GPI-53
Asrul Bahar	Universitas Negeri Surabaya	Strengths and Weaknesses of Halal Gelatin Based on Bovine and Goat Skin Gelatin as Alternative Substitute for Pig Skin	GPI-54
A. Shalihin	Industrial Engineering Department, Faculty of Engineering, Universitas Sumatera Utara.	LEAN APPROACH ON HALAL CERTIFICATION SERVICE SYSTEM USING INTEGRATED COST VALUE STREAM MAPPING	GPI-55
A. Shalihin	Industrial Engineering Department, Faculty of Engineering, Universitas Sumatera Utara.	THE POINT OF CRITICAL HALAL SUPPLY CHAIN MANAGEMENT IN INDUSTRY MANUFACTURING	GPI-56
Ummi Sholikhah	Faperta Universitas Jember	ANTHOCYANIN CONTENT IN SOME BLACK RICE CULTIVARS	GPI-57
Dwi Erwin Kusbianto	Universitas Jember	THE GROWTH AND CRYSTALLIZATION IN AROMATIC PENDOK TUBAN RICE CULTIVATED BY APPLYING MIXED ORGANIC MATTER, AGROMINERAL AND MICROORGANISMS IN JEMBER, INDONESIA	GPI-58

Nita Kuswardhani	Agriculture Industrial Technology Department, Agricultural Technology Faculty, Universitas Jember	BUILDING A DEVELOPMENT STRATEGY FOR ROBUSTA COFFEE AGROINDUSTRY IN ARGOPURO MOUNTAIN AREA, JEMBER REGENCY, EAST JAVA, INDONESIA	GPI-59
Silvana Maulidah	Faculty of Agriculture, University of Brawijaya	SUSTAINABLE BUSINESS MODELS: CHALLENGES ON POTATO AGRO-INDUSTRY SMES	GPI-60
Andan Linggar Rucitra	Faculty of Agricultural Technolog, Universitas Brawijaya	Integration of Statistical Quality Control (SQC) and Failure Mode Effect Analysis (FMEA) Method of Tea Product Packaging	GPI-61
Ardaneswari Dyah Pitaloka Citraresmi	Universitas Brawijaya	RISK ANALYSIS IN THE DISTRIBUTION PROCESS OF FROZEN SHRIMP	GPI-62
Azimmatul Ihwah	Faculty of Agricultural Technology, Universitas Brawijaya	CONSUMER PREFERENCES TOWARD INOVATION OF HANDMADE ART-PAPER FROM ARECA-PALM FIBER USING CONJOINT METHOD	GPI-63
Andy Kurniawan	Faculty of Agriculture, University of Brawijaya	Sustainable Community Livelihood Strategy Around the Ternate-Tidore Protected Forest Management Area North Maluku Province	GPI-64
Retno Kawuri	Departmenet of Biology FMIPA, Universitas Udayana	Molecular Identification and Determination of Chemical Components in Extract of Streptomyces KCM2 by GC-MS spectrometry	GPI-64
Made Antara	Universitas Udayana	STRATEGY TO MAINTAIN OF THE REGIONAL FOOD SECURITY IN BALI PROVINCE, INDONESIA	GPI-65
Ni Made Ayu Gemuh Rasa Astiti	Universitas Warmadewa	Impact of marketing of Bali cattle calf to the income of farmers	GPI-66
Mardiyani Sidayat	Faculty of Agriculture, Universitas Khairun, Ternate	Sustainable Practices: the role of farmer in maintaining the sustainabillity of terubuk (Sacharum Edule) vegetable in Tidore-North Maluku-Indonesia	GPI-67
Mila Fatmawati	Faculty of Agriculture, Universitas Khairun, Ternate	DETERMINANT OF CHICKEN INCOME IN TERNATE CITY	GPI-68
Fatmawati Kaddas	Faculty of Agriculture, Universitas Khairun, Ternate	DETERMINANT OF CHICKEN INCOME IN TERNATE CITY	GPI-68
Norman de Jesus	Pampanga State Agricultural Universality (PSAU), Magalang, Pampanga-Philippines	VOLUME AND AVAILABILITY OF BANANA AND WATER LILY AND THEIR UTILIZATION AS FEED INGREDIENTS FOR GOATS IN LUZON-PHILIPPINES	GPI-69
Reta	Politani Negeri Pangkep, Sulawesi Selatan	The Fermentation Of Parchment Ohmic Technology Used To Process Coffee Beans (A Wet Black Coffee) Aroma	GPI-70
Wan Haniza	Universitas Medan Area	SUSTAINABILITY MODEL FOR PRIVATE HIGHER EDUCATION OF NORTH SUMATERA, INDONESIA	GPI-71
Mohamad Sazuan B Sahrom	University Kebangsaan Malaysia	CRYSTALLINITY OF SOME RICE GROWN IN ASEAN COUNTRIES BY XRD TECHNIQUE	GPI-72
Sri Desfita	STIKes Hang Tuah Pekanbaru	CHARACTERISTIC OF FOREST HONEY FROM SEVERAL AREAS IN RIAU PROVINCE	GPI-73
Bohari M Yamin	Publication Enhancement Unit, UKM	THE MORPHOLOGY OF CILEMBU SWEET POTATO AFTER COOKED BY BOILING IN WATER, BAKED AND MICROWAVE IRRADIATION	GPI-74
Mohamad Hasnul Naim Abd Hamid	University Kebangsaan Malaysia	MORPHOLOGY AND ELEMENTAL DISTRIBUTION OF MANDOTI SALUNKANAN GELATINOUS RICE CULTIVATED IN SOUTH SULAWESI, INDONESIA	GPI-75
Irma Lisa Sridanti	STIPER Rejang Lebong	Genetic Variability Of Quality Properties Of Arabican Coffee Breeds In Highland Jang-Hiang-Bong	GPI-76
Mohd Noorsyakir Saipol Yazan	Center for Research and Instrumentation Management, Universiti Kebangsaan Malaysia	THE SYNTHESIS OF NANO CALCIUM OXIDE AND HYDROXYAPATITE FROM THE SHELLS OF INDONESIAN CUTTLEFISH (Sepia sp)	GPI-77
Idris Sharif	Universiti Kebangsaan Malaysia	MORPHOLOGICAL STUDY of RHIZOBACTERIA TREATED and UNTREATED POTATOES by SCANNING ELECTRON MICROSCOPY	GPI-78
Siti Halimah Bt Sarijo	Fakulti Sains Gunaan, Universiti Teknologi MARA	Synthesis and Controlled Release study of 4-Chloro-2-Methylphenoxyacetic Acid And 3,4-Dichlorophenoxyacetic Acid intercalated in Zinc Layered Hydroxide Host Carrier	GPI-79

Siti Norasmah Surip	Universiti Teknologi Mara, Malaysia	Pineapple Leaf Fibers (PALF)/ Polyethylene Terephthalate (PET) Electrospun Nanofibers: Effect of Ratio on Wetting, Structural & Thermal Properties	GPI-80
Hermogenes M.Paguia	Bataan Peninsula State University, Philippines	Improvement of Mango Production Through Science Andtechnology Innovations and Support Mechanisms Forcapacity Development in Bataan and Zambales	GPI-81
Hanilyn Hidalgo	Central Bicol State University of Agriculture	LIVELIHOODS OF MOUNTAINOUS SITES IN VIETNAM AND PHILIPPINES: ARE THEY THREATENED FROM COLD SPELL AND TYPHOON?	GPI-82
Phatnawatch Aimkum	King Mongkut's University of North Bangkok (KMUTNB)	Using IoT based Technology for Monitoring Sustainable IBC Aquaponics System in Raising Malayan Kelah Fish	GPI-83
MA. TERESA B. LIRAG	CENTRAL BICOL STATE UNIVERSITY OF AGRICULTURE	Economic Analysis of Cacao (Theobroma cacao) Production in Camarines Sur, Philippines	GPI-84
Md Aminul Islam	Agronomy and Soil Science, University of New England, Armidale, Australia	THE ROLE OF FARMERS' PERCEPTION OF SALINITY AND ADAPTATION STRATEGIES FOR ENSURING FOOD SECURITY: EVIDENCE FROM COASTAL RICE GROWING AREAS OF BANGLADESH	GPI-85
Prapatsorn Kittimanorom	Rajapruk University, Thailand	The relationship between internal control and Creative Accounting risk management of SMEs entrepreneurs in Bangkok Metropolitans	GPI-86
Ma Cresilda M. Caning	Central Bicol State University of Agriculture	Innovation management and practices of agri-based SMEs in Camarines Sur, Philippines	GPI-87
Ramona Isabel S. Ramirez	Central Bicol State University of Agriculture	CAPACITATING FARMING FAMILIES IN FARMING COMMUNITIES FOR RESILIENCY AND POVERTY ALLEVIATION	GPI-88
Manoj K S Chhangani	Government Meera Girls College, Udaipur-(Rajasthan), INDIA	GREEN CHEMISTRY: APPROACH FOR HEALTHY ENVIRONMENT AND SUSTAINABILITY	GPI-89
Kallayanee Tengpongsathon	King Mongkut's Institute of Technology Ladkrabang, Thailand	THE HALAL FOOD PROFILE IN THAI CONSUMER ATTITUDE BY USING FLASH PROFILE METHOD	GPI-90
Inanpi Hidayati Sumiasih	Universitas Trilogi, Jakarta	DESIGN AND CONCEPT OF AGRIEDUTOURISM PARK USING SUSTAINABLE AGRICULTURE PRINCIPLE AT ATTAQIE FARM f	GPI-91
Nerisa Paladan	Partido State University, Philippines	Uplifting Farmer's Association's Communities: A Training Needs Assessment	GPI-92
Nathitakarn Pinthukas	Faculty of Agriculture, Chiang Mai University, Thailand	Livestock Raising following the sufficiency economy philosophy in the area Mae Chaem district Chiang Mai Province	GPI-93
Mae S.A. Lustre	Central Bicol State University of Agriculture, Philippines	Production and Marketing Practices of Agritourism Farms in the Bicol Region, Philippines	GPI-94
Maria Victoria P. Balderas	Central Bicol State University of Agriculture, Philippines	Resource Inventory of Organic Diversified Crop Farms with Meliponiculture in Camarines Sur	GPI-95
Suwattanarwong Phanphet	Department of Industrial Technology, Faculty of Science and Technology, Chiang Mai Rajabhat University, Thailand	The Building a Brand and Participation in Decreased Tackling Haze effects and Particulate matter Less Than 2.5 Micron (PM2.5) A Case Study: A Group of Students of Yupparaj Wittayalai School, Chiang Mai Province, Thailand	GPI-96
Zangta Sang	Energy Research and Development Institute-Nakornping, Chiang Mai University	ANAEROBIC DIGESTION OF STARCH WASTEWATER: THE EFFECT OF PH AND OXIDATION REDUCTION POTENTIAL ON THE REACTOR PERFORMANCE	GPI-97
Prapatsorn Kittimanorom	Rajapruk University, Thailand	COMPENSATION MANAGEMENT AND EMPLOYEE MOTIVATION OF KUNMING HAITIAN HOTEL	GPI-98
Suratman Sudjud	1)Postgraduate Study Program in Agricultural Sciences, Khairun University, Ternate, Indonesia	ANALYSIS OF POTENTIAL AND STRATEGY FOR DEVELOPMENT OF FOOD PLANTS IN EAST HALMAHERA DISTRICT	GPI-99
Pritteshkumar K Patel	C G Bhakta Institute of Biotechnology, Uka Tarsadia University, India	Pathogenic variability of red rot pathogen Colletotrichum falcatum under South Gujarat condition	GPI-100

Yong Soon Kong	Faculty of Applied Sciences, Universiti Teknologi MARA	Growth and metal uptake of spinach grown from soil amended with co-compost of cat manure and spent coffee ground	GPI-101
Yus Aniza Yusof	Department of Process and Food Engineering, Faculty of Engineering, Universiti Putra Malaysia	THE APPLICATION OF CLAY POT FOR MOISTURE REDUCTION OF GENIOTRIGONA THORACICA STINGLESS BEE HONEY	GPI-102
Bambang Herry Purnomo	Agroindustrial Technology Study Program, Faculty of Agricultural Technology, Jember University, Indonesia	Diagnosis Model of Production Risk in Sugar Agroindustry	GPI-103
Mohamad Hasnul Naim A Hamid	Research and Instrumentation Center, Universiti Kebangsaan Malaysia	MORPHOLOGY AND ELEMENTAL DISTRIBUTION OF MANDOTI SALUNKANAN GELATINOUS RICE CULTIVATED IN SOUTH SULAWESI, INDONESIA	GPI-104
Nurul Athirah Mohamad Adam	Universiti Teknologi Mara, Shah Alam, Selangor, Malaysia	Direct and indirect regeneration of Melastoma decemfidum from nodal explants	GPI-105
Rohaya Ahmad	Universiti Teknologi MARA, Shah Alam, Selangor 40450, Malaysia	The potential of areca nut of Areca catechu Linn. as a functional food ingredient based on its antidiabetic properties	GPI-106
Nesamalar Kantasamy	Faculty of Applied Sciences, Universiti Teknologi MARA, Malaysia	Congo Red Dye Removal from Aqueous Solutions using Palm Oil Empty Fruit Bunch	GPI-107
Rashidah Sukor	Department of Food Science, Faculty of Food Science and Technology, Universiti Putra Malaysia	ISOLATION, IDENTIFICATION AND ANTIBIOTIC SUSCEPTIBILITY OF BACTERIA FROM HUMAN BREAST MILK	GPI-108
Aida Firdaus Bt Muhammad Nurul Azmi	Universiti Teknologi MARA, Malaysia	Physico-chemical and sensory characteristic of functional coffee - A case study of UNACOFFEE	GPI-109
Norashikin Ab Aziz	Universiti Putra Malaysia	PERFORMANCE EVALUATION OF PORTABLE HOT WATER JET FOR FROZEN MEAT INDUSTRY APPLICATION	GPI-110
Melliana	Sekolah Tinggi Teknologi Dumai	THE ROLE OF HUMAN RESOURCE COMPETENCY IN IMPROVING LOGISTIC PERFORMANCE	GPI-111
YUSMA YENNIE	Research Center For Marine and Fisheries Product Processing and Biotechnology, PhD Student of IPB Universiaty	EFFECT OF DIFFERENT DRYING METHODS ON CHARACTERISTICS OF DRIED SALTED NOMEI (Harpodon nehereus) FISH	GPI-112
Akas Pinaringan Sujalu	Department of Agrotechnology, Universitas 17 Agustus 1945, Samarinda	A CORRELATION BETWEEN the INCREASED TEMPERATURES and the PRODUCTIVITY of LADANG in KUTAI BARAT REGENCY, the PROVINCE of EAST KALIMANTAN, INDONESIA	GPI-113
Akas Pinaringan Sujalu	Department of Agrotechnology, Universitas 17 Agustus 1945, Samarinda	Study of Changes in Forest Cover and Temperature at West Kutai Regency	GPI-114
Harissatria	Universitas Mahaputra Muhammad Yamin Solok	The Preservation Epididymis Spermatozoa of Buffalo Into Talp Diluent With Addition of Serum Level	GPI-115
Tri Astuti	Universitas Mahaputra Muhammad Yamin Solok	EFFECT FERMENTATION OF SUGARCANE TOPS WITH Phanerochaete chrysosoporium ON THE ACTIVITY OF LACCASE, LIGNIN PEROXIDASE AND MANGANESE PEROXIDASE ENZYMESEFFECT FERMENTATION OF SUGARCANE TOPS WITH Phanerochaete chrysosoporium ON THE ACTIVITY OF LACCASE, LIGNIN PEROXIDASE AND MANGANESE PEROXIDASE ENZYMES	GPI-116
Rica Mega Sari	Faculty of Agriculture, Universitas Mahaputra Muhammad Yamin Solok	THE INFLUENCE OF SOME TYPE OF MANURE ON THE GROWTH AND PRODUCTION OF ELEPHANT GRASS (Pennisetum Purpureum) CV. TAIWAN IN ACID SOIL	GPI-117
Delsi Afrini	Faculty of Agriculture, Universitas Mahaputra Muhammad Yamin Solok	PARTNERSHIP PATTERN BETWEEN FARMERS DEVELOPMENT WITH COOPERATIVE SOLOK RADJO COFFEE IN LEMBAH GUMANTI SUBDISTRICT SOLOK REGENCY	GPI-118

Helty Andriani	Universitas Mahaputra Muhammad Yamin Solok	Adaptation Tests of Some Shallots Varieties on Lowlands Area In the Pesisir Selatan District West Sumatera	GPI-119
Rohmatulloh	Kemeterian ESDM Jakarta	CHARACTER EDUCATION of FOOD LOCAL CULTURE VALUES in the PEOPLE of KAMPUNG ADAT CIRENDEU THROUGH EXEMPLARY	GPI-120
Ghazalie Ghazalie	Indonesian Defense University	STRATEGY to REALIZE NATIONAL ENERGY SECURITY in MASELA BLOCK	GPI-121
Mutiara Dewi Pupsitawati	Universitas Trilogi, Jakarta	ORGANIC FERTILIZER FROM WASTE OF STARFRUIT AS SUSTAINABLE AGRICULTURE SOLUTION	GPI-122
Agoes Thony Ak	STIPER Sriwigama-Palembang, Indonesia. Agribisnis Building, South Sumatera Palembang. Indonesia	ANALYSIS OF FACTORS AFFECTING THE PRODUCTIVITY OF SWAMPY LOWLAND RICE FARMING AND ITS CONTRIBUTION TO HOUSEHOLD INCOME IN OGAN KOMERING ILIR SOUTH SUMATERA	GPI-123
Agus Susatya	[1]Dept of Forestry, University Bengkulu, Bengkulu Indonesia	VULNERABILITY AND ITS INFLUENCING FACTORS TO CLIMATE CHANGE OF THE VILLAGES AROUND KERINCI SEBLAT NATIONAL PARK: A CASE STUDY ON PINANG BERLAPIS DISTRICT, LEBONG REGENCY, INDONESIA	GPI-124
Made Antara	Study Program of Agribusiness, Faculty of Agriculture, University of Udayana, Bali, Indonesia	STRATEGY TO MAINTAIN OF THE REGIONAL FOOD SECURITY IN BALI PROVINCE, INDONESIA	GPI-125
			Product Development
Nurjanna Albaar	Khairun University, Ternate 97719, Indonesia	Characterization Carrot Quality Using Packaging Primary and Secondary During Transportation Simulation	PD-01
Rina Yenrina	Fateta Universitas Andalas	Antioxidant Activity and Poliphenols Content of Red Ginger Powder with Various Drying Methods	PD-02
Kesuma Sayuti	Fateta Universitas Andalas	The Effect of Addition of “Senduduk” Leaves (Melastoma malabathricum L.) on the Characteristics of Crackers	PD-03
Rini Bahar	Fateta Universitas Andalas	CHARACTERIZATION OF PROTEIN IN DENDENG LAMBOK AS A TRADITIONAL MINANGKABAU FOOD - INFLUENCED BY COOKING METHODS	PD-04
Tuty Anggraeni	Fateta Universitas Andalas	Catechin, Epicatechin and Epigallocatechin Gallate of Gambir Tea With Telang Pigment	PD-05
Tuty Anggraeni	Fateta Universitas Andalas	Effect of Green and Black Tea Processing : The DPPH Radical Scavenging Activity, IC50 Value, Total Polyphenols, Catechin and Epigallocatechin Gallate	PD-06
Mirnawati	Faculty of Animal Science, Universitas Andalas	The Effect of Fermented Palm Oil sludge with combination Phanerochaete crysosporium and Neurospora crassa on Broiler Performance	PD-07
Mirnawati	Faculty of Animal Science, Universitas Andalas	Broiler Performance on Utilization of Fermented Palm Kernel Cake with Bacillus subtilis in Ration	PD-08
I Ketut Budaraga	Faculty of Agriculture, Universitas Ekasakti, Padang	The Antioxidant Characteristics of The Liquid Smoke of Cocoa Shell (Theobroma Cacao, L) In Different Water Content Variations	PD-09
I Ketut Budaraga	Faperta Univ. Ekasakti, Padang	Antimicrobial Activity and Minimum Killing Concentration of Liquid Smoke of Cocoa Fruit Skin on Growth of Fungus *Lasiodiplodia Theobromae*	PD-10
SALVIA. S	Politeknik Pertanian Negeri Payakumbuh	THE QUALITY OF PE GOAT MILK SUPPLEMENTED WITH Chlorella vulgaris	PD-11
SALVIA. S	Politeknik Pertanian Negeri Payakumbuh	PRODUCTIVITY OF PE DAIRY GOATS FED DIET WITH TOFU PULP AND SOYBEAN SHELLS	PD-12
Rince Alfia Fadri	Department of Food Technology, Politeknik Pertanian Negeri Payakumbuh	EVALUATION of THE VALUE of DEFECTS AND TASTE OF arabica COFFEE (Coffea arabica L) MANUFACTURED BY WEST SUMATRAN COFFEE PROCESSING UNIT	PD-13

Rince Alfia Fadri	Department of Food Technology, Politeknik Pertanian Negeri Payakumbuh	AROMA INTENSITY ACIDITY, ACIDITY, AND FAVORITE STRAWBERRY DRINK TYPE	PD-14
Andi Eviza	Politeknik Pertanian Negeri Payakumbuh	Performance Test Of West Sumatera Kahwa Daun's Roaster	PD-15
Evawati	Politeknik Pertanian Negeri Payakumbuh	Study on Making Instant Mangostahurt of Encapsulation with Varying Concentrations and Type of Coating Material	PD-16
Mutia Elida	Politeknik Pertanian Negeri Payakumbuh	THE VIABILITY OF PROBIOTIC LB PARACASEI SSP PARACASEI ML3 IN BIO-CAPSULES CARRAGEENAN-SKIM MILK	PD-17
N M R Suarni	Study Program of Biology, Faculty of Mathematic and Natural Sciences	Substitution of commercial feed with moringa leaf meal to improve the sperm quality of male rabbit	PD-18
Bahlina Mohd Nur	Faculty of Agriculture, Universitas Syiah Kuala	THE EFFECTS OF DIFFERENT SOURCES OF CARBOHYDRATE AND FERMENTATION TIME ON QUALITY OF MAMAN'S VEGETABLE (Cleome gynandra L.)	PD-19
Fachrul Razi	Faculty of Engineering, Universitas Syiah Kuala	THE ANTIOXIDANT RECOVERY OF Syzygium cumini L. FRUIT JUICE USING COMBINATION OF ULTRAFILTRATION/NANOFILTRATION MEMBRANE	PD-20
Novia Mehra Erfiza	Faculty of Agriculture, Universitas Syiah Kuala	DEVELOPMENT OF COCONUT WATER – BASED KEFIR AS A FUNCTIONAL BEVERAGE	PD-21
Hafidh Hasan	Faculty of Engineering, Universitas Syiah Kuala	Numerical modeling of heat transfer to gain insight in the fish canning sterilization process for various filling medium	PD-22
Murna Muzaifa	Faculty of Agriculture, Universitas Syiah Kuala	PHENOTYPIC IDENTIFICATION OF LACTIC ACID BACTERIA FROM CIVET (Paradoxorus hermaphroditus)	PD-23
Murna Muzaifa	Faculty of Agriculture, Universitas Syiah Kuala	Study of Pectin Production from Coffee Pulp under Different Time and Temperature	PD-24
Herman Fithra	Department of Civil Engineering, Universitas Malikussaleh, Lhokseumawe, Aceh	Mass Evacuation Transportation Model using Hybrid Genetic Algorithm	PD-25
Dahlan Abdullah	Department of Civil Engineering, Universitas Malikussaleh, Lhokseumawe, Aceh	Model Slack Super Efficiency and Reverse Efficiency for Activity Benchmarking	PD-26
Ismail Sulaiman	Faculty of Agriculture, Universitas Syiah Kuala	Effect of Fermentation Media on The Quality of Arabica Wine Coffee	PD-27
Fahrizal	Faculty of Agriculture, Universitas Syiah Kuala	EFFECTS OF CHITOSAN AND GLYCEROL ON THE PROPERTIES OF BIOFILM MADE OF COMPLEX FISH SKIN GELATIN AND CHITOSAN	PD-28
Normalina Arpi	Faculty of Agriculture, Universitas Syiah Kuala	CHEMICAL CHARACTERISTICS OF CASCARA, COFFEE CHERRY TEA, MADE OF VARIOUS COFFEE PULP TREATMENTS	PD-29
Addion Nizori	Universitas Jambi	DESIGN, DEVELOP AND PERFORMANCE TEST OF DRYING RACK FOR KERINCI ARABICA COFFEE BEANS QUALITY	PD-30
Addion Nizori	Universitas Jambi	Influence of Coconut Oil composition as Cocoa Butter Replacers in The Development of Dark Chocolates Products as Functional Foods from Jambi Cocoa Bean Origins	PD-31
Miksusanti	Dept. of Chemistry FMIPA, Universitas Sriwijaya	THE INCORPORATION OF SAPPAN WOOD EXTRACTS IN AREN STARCH TO MAKE THE ANTIBACTERIAL AND ANTIOXIDANTS FILM	PD-32
Elfita	Dept. of Chemistry FMIPA, Universitas Sriwijaya	CHEMICAL COMPOUNDS FROM THE ANTIBACTERIAL ACTIVE FRACTION OF Cordyline fruticosa (L)	PD-33
Eli Sahara	Universitas Sriwijaya	THE EFFECT OF GIVING CHITOSAN TO THE ACCESSORIES ORGAN (HEART AND PANCREAS) AND REPRODUCTIVE ORGAN (OVARIY AND OVIDUC) ITIK TEGAL	PD-34
Rizki Palupi	Faculty of Agriculture, Universitas Sriwijaya	The effect of added biomass by Fermented of pineapple waste and Indigofera zollingeriana leafs to nutrient digestibility as in vitro	PD-35
Fitri Nova Liya Lubis	Faculty of Agriculture, Universitas Sriwijaya	Effect of supplementation of natural antioxidant in feed on the performance of locally grown chicken	PD-36
Sefti Heza Dwinanti	Universitas Sriwijaya	PHARMACOVIGILANS ASPECT OF BILIMBI (AVERRHOA BILIMBI) FOR FISH	PD-37

Afnur Imsya	Faperta Universitas Sriwijaya	OPTIMIZATION OF TOTAL MIXED FIBER AMMONIZATION WITH DIFFERENT UREA LEVELS ON CHANGE OF NUTRITION AND FIBER CONTENTS	PD-38
Heni Radiani Arifin	Faculty of Agricultural Industrial Technology, Universitas Padjadjaran	NANOCRYSTALLINE CELLULOSE PROPERTIES FROM DIFFERENT EXTRACTION METHODS AS REINFORCEMENT BIONANOCOMPOSITE FILM : A REVIEW	PD-39
Roostita L. Balia	Faculty of Animal Husbandry, Universitas Padjadjaran	THE EFFECT OF PROBIOTIC SUPPLEMENTATION ON LIVER BIOCHEMISTRY AND COLON MORPHOMETRIC IN BROILER CARCASS AT POST TRANSPORTATION	PD-40
Herlina Marta	Universitas Padjadjaran Indonesia	EFFECT OF HEAT-MOISTURE TREATMENT ON PASTING, TEXTURAL, AND PHYSICOCHEMICAL PROPERTIES OF BANANA (Musa spp.) STARCH	PD-41
Nia Boru Ritonga	Faculty of Agricultural Technology, Andalas University, Padang Indonesia	FORMULATION AND EVALUATION OF SKIN LOTION WITH VCO RAW MATERIAL WITH ADDITION OF SECANG TIMBER (Caesalpinia sappan) AS NATURAL COLORS	PD-42
Tuti Widjastuti	Faculty of Animal Husbandry, Universitas Padjadjaran, Indonesia	Application of Mangosteen Peel Extract (Garcinia mangostana L) As Feed Additive in Ration for Performance production and Egg Quality of Sentul Chickens	PD-43
Akhmad Endang Zainal Hasan	Department of Biochemistry, Faculty of Mathematics and Natural Sciences, IPB University, Jl. Lingkar Akademik, Kampus IPB Darmaga, Bogor, Indonesia	Diversity of Secondary Metabolites Produced by a Pilot Plant Scale from Endophytic Fungi Isolated from Soursop Leaves (Annona muricata L.)	PD-44
Akhmad Endang Zainal Hasan	Department of Biochemistry, Faculty of Mathematics and Natural Sciences, IPB University, Jl. Lingkar Akademik, Kampus IPB Darmaga, Bogor, Indonesia	GLUCOSE, CHOLESTEROL AND TRIGLYCERIDES CONCENTRATION FROM RAT BLOOD AS A SUBCHRONIC TOXICITY PARAMETERS OF 70% ETHANOL EXTRACT OF PROPOLIS	PD-45
Henny Purwaningsih	# Chemistry Department, Faculty of Mathematics and Science, IPB University, Darmaga Campus, Chemistry Building, Tanjung Street, Bogor, 16680, Indonesia	Preparation and Characterization of Polyvinyl Alcohol/Microbial Cellulose/Chitosan Composite	PD-46
Adi Ruswanto	Universitas Sebelas Maret, Surakarta	THE STUDY OF CAROTENE CONTENT AND IODINE VALUE OF OIL FROM DIFFERENT RIPENING LEVELS AND STORAGE DURATION OF PALM FRESH FRUIT BUNCHES	PD-47
Hamidin Rasulu	Post Graduate Student of Agricultural Doctor Program Sebelas Maret University (UNS)	Mechanical and Barrier Properties of Kappa Carrageenan-Based Biocompiste Film Incorporated with Coconut Crabs Chitosan Nano Fiber	PD-48
Ngatirah	Institut Pertanian Stiper Yogyakarta; Doctoral Student of Food Science, Universitas Gadjah Mada	Glycerolysis of palm kernel oil catalized by MgO on mono and diglyceride composition and its antibacterial activity	PD-49
Haslina	Fakultas Teknologi Pertanian, Universitas Semarang	Optimation of Corn Silk Powder Extracts from Three Indonesian Local Varieties	PD-50
Hamidah Hendrarini	Universitas Pembangunan Nasional "Veteran" Jawa Timur	THE IDENTIFICATION OF READY-TO-EAT BANANAS' SUPERIOR ATTRIBUTES THROUGH THE FISHBEIN MULTI-ATTRIBUTE APPROACH	PD-51
Sudiyarto	Universitas Pembangunan Nasional "Veteran" Jawa Timur	CUSTOMER SATISFACTION IN PURCHASING ONLINE VEGETABLE PRODUCTS IN SURABAYA CITY	PD-52
Pawana Nur Indah	Universitas Pembangunan Nasional "Veteran" Jawa Timur	EFFECT OF TASTE, PRICE, LOCATION, AND SERVICE ON PURCHASE DECISIONS (CASE STUDY TAHU KOPECI KECAMATAN KUNINGAN, KUNINGAN DISTRICT)	PD-53

Pawana Nur Indah	Universitas Pembangunan Nasional "Veteran" Jawa Timur	SAVOR, LOCATION, PRICE AND SERVICE INFLUENCED TOWARDS PURCHASE DECISION (TAHU KOPECI STUDY CASE IN KUNINGAN SUB-DISTRICT, KUNINGAN DISTRICT)	PD-54
Rahayu Kuswardani	Universitas Negeri Surabaya	SEMPRIT COOKIES USING SUBSTITUTE INGREDIENTS RAMBUTAN-SEED FLOUR and FAT-TYPE PROPORTION	PD-55
Mauren Gita Miranti	Universitas Negeri Surabaya	NUTRITIONAL VALUE AND CONSUMER ACCEPTABILITY OF BISCOTTI MADE FROM RAMBUTAN SEED FLOUR	PD-56
Meda Wahini	Universitas Negeri Surabaya	Rambutan Seed Flour as Substitute Ingredient in Semprit Biscuit with Different Fat Type	PD-57
Sri Wahjuni	Fakultas MIPA Universitas Udayana	ADMINISTRATION OF ETHANOL MUSTARD GREEN (Brassica rapa L) LEAVES DECREASES 8-OHdG (8-Hydroxi-2-Deoxiguanosine) LEVELS IN HYPERGLYCEMIC WISTAR RATS	PD-58
Wiwik Susanah Rita	FMIPA Universitas Udayana	Antibacterial Activity of Milk Banana (Musa paradisiaca L.) Peel Methanol Extract and Its Total Flavonoid and Phenolic Contents	PD-59
IDA AYU RAKA ASTITI ASIH	Universitas Udayana	IN VIVO EVALUATION OF ANTIOXIDANT ACTIVITY OF FLAVONOID GLYCOSIDE EXTRACT FROM TAMARILLO (Solanum betaceum Cav)	PD-60
Sang Ketut Sudirga	Department of Biology FMIPA, Universitas Udayana	Bioactive Compounds of Mansoa alliacea Leaf Extract has Potential as Botanical Pesticides to Control Colletotrichum acutatum Against Anthracnose Disease on Chili Peppe	PD-61
Sri Soenarsih	Faculty of Agriculture, Universitas Khairun, Ternate	DETERMINATION ON DIVERSITY OF ESSENSIAL OIL FROM NUTMEG (*Myristica* sp.) NORTH MALUKU	PD-62
Yusnaini	Faculty of Agriculture, Universitas Khairun, Ternate	The Characteristics of Volatile Compounds of Kenari (Canarium indicum L.) Shell Liquid Smoke	PD-63
Erna Rusliana Muhamad Saleh	Department of Agricultural Product Technology, Universitas Khairun, Ternate	THE EFFECT OF BLEACHED SAGO PULP CONCENTRATION ON PHYSICAL AND BIODEGRADABILITY CHARACTERISTICS OF BIOFOAM	PD-64
Indah Rodianawati	Faculty of Agriculture, Universitas Khairun, Ternate	Chemical Physical Characteristics of Essential Oils from Seeds, Mace, Fruit and Leaf nutmeg (Myristica sp.) Varieties Ternate 1 and Tidore 1.	PD-65
Mulyati M. Tahir	Universitas Hasanuddin Makassar	Study of Making Dark Chocolate with Addition of Ginger Extraction (Zingiber officinale) As Filler Material	PD-66
Andi Sukainah	Agricultural Technology Education Study Program, Faculty of Engineering, Universitas Negeri Makassar	ANALYSIS QUALITY OF SOFT CHEESE COTTAGE WITH ADDITIONAL OF PINEAPPLE JUICE (ANANAS COMUSUS (L.) MERR) AND LACTOBACILLUS FABIFERMENTANS	PD-67
Ratnawaty Fadilah	Politeknik Pertanian Negeri Pangkep	EFFECT OF COMBINE RAW MATERIALS AND FERMENTATION TIME ON QUALITY AND THE NUMBER OF MICROBES OF ORGANIC LIQUID FERTILIZER	PD-68
Shariff Ibrahim	Universiti Teknologi Mara, Malaysia	APPLICATION OF CATIONIC SURFACTANT MODIFIED MENGKUANG LEAVES (PANDANUS ATROCAPUS) FOR THE REMOVAL OF REACTIVE ORANGE 16 DYE IN WASTEWATER: A COLUMN STUDY	PD-69
Latifa Aini	Faculty Of Agricultural Technology. Andalas University	Technology Of Environmentally Friendly Catechin Extraction Process From Gambir Asalan With Ultrasonic Bath In West Sumatra	Pd-70
Noorlaila Ahmad	Universiti Teknologi MARA	Optimisation of pectin extraction from Roselle (Hibiscus sabdariffa L.) calyces using Response Surface Methodology	PD-71
Leslie R. Jorge	Bataan Peninsula State University, Philippines	Marketability of Mango- based Products: Input to Product Development of Locally Farm Produced Mangoes in Central Luzon	PD-72
Raseetha V S Manikam	Universiti Teknologi MARA	Effect of Extraction Solvents on Phenolic Compounds of Theobroma Cacao L. By-products using Ultrasound-Assisted Extraction	PD-73
MOHAMMAD SYARIL RAMLI	Faculty of Applied Sciences, Universiti Teknologi MARA	Tannase Production In Selected Agri-Industrial By-products by Aspergillus niger PN1	PD-74
Norrizah Jaafar Sidik	Faculty of Applies Sciences, Universiti Teknologi MARA, Malaysia	TOTAL PHENOLIC CONTENT OF Typhonium flagelliforme LEAVES EXTRACT FROM DIFFERENT GROWTH CONDITIONS	PD-75

Aida Safina Aridi	Universiti Putra Malaysia	PHYSICOCHEMICAL PROPERTIES OF CHITOSAN EXTRACTED FROM LEUCAENA LEUCOCEPHALA PODS USING DEPROTENIZATION AND DECOLORIZATION STEPS	PD-76
SITI NOOR HAJJAR BINTI MD LATIP	Universiti Teknologi Mara	ANTIFEEDANT AND FEEDING DETERRENT ACTIVITIES OF THE Curcuma longa AND Cymbopogon citratus EXTRACT ON THE APPLE SNAIL	PD-77
Masita Mohammad	Solar Energy Research Institute, SERI, UKM, Malaysia	ISOLATION OF NANOCRYSTALLINE CELLULOSE (NCC) FROM POTENTIAL AGRICULTURAL WASTE RESOURCES (PINEAPPLE LEAVES AND SUGAR CANE) IN MALAYSIA	PD-78
Elsa Carla Azizi	Universitas Airlangga	The Effect of Tempe Substitution and Addition of Carrot Puree on The Acceptability and Nutritional Value of Sausages for Snacks for School Children	PD-79
Yuli Wibowo	Faculty of Agricultural Technology Universitas Jember	Effect of Seed Type and Harvest Time of Seaweed (Eucheuma Cottonii) on The Quality of Alkali Treated Cottonii	PD-80
Abdul Kadir Kamaluddin	Faculty of Agriculture, Khairun University, Ternate 97719, Indonesia	The Use Of Fishing Tuna Flour Fortification Modified Tapioca Starch In Emergency Food Product	PD-81
Zulfa Fitri Ikatrinasari	Master of Industrial Engineering Program, Universitas Mercu Buana. Corresponding	PROCESS DESIGN OF PUREE COOLING IN SMALL MEDIUM INDUSTRY PROCESSING FRUIT	PD-82
			INVITED SPEAKER
Ir. Helmi	Faperta Universitas Andalas	The Concept of Virtual Farm Academy	INVITED SPEAKER
Azwani Mat Lazim	University Kebangsaan Malaysia	TRANSFORMATION GADONG TUBER STARCH INTO SOPHISTICATED MATERIAL	INVITED SPEAKER
Nuwong Chollacoop	Lab Head, Renewable Energy Laboratory. National Metal and Materials Technology Center (MTEC),National Science and Technology Development Agency, Thailand	Toward sustainable transport via ASEAN fuel economy roadmap	INVITED SPEAKER
Assoc. Keng-Tung Wu, PhD	Director, Industry Promotion Office for Southeastern Asia (IPOSA) Head, Planning & Marketing Division, International College of Innovation and Industry Liaison (ICIIL). National Chung Hsing University, Taichung, Taiwan (ROC)	Conversion of Agri-waste Into Biomass Energy Integrated With Microgrids	INVITED SPEAKER
Hanilyn Hidalgo	Central Bicol State University of Agriculture (CBSUA). Philippines	The Concept of Virtual Farm Academy	INVITED SPEAKER
Jeon Geon Han	Thai-Korea Collaboration Research Center,Chiang mai University, Thailand Center for Advanced Plasma Surface Technology, Sungkyunkwan University, Republic of Korea	Emerging plasma technology for next generation agriculture and food processes	INVITED SPEAKER
ROMUALDO C. MARTINEZ, PhD.C	Philippine Center for Postharvest Development and Mechanization (PHilMech). Munoz, Nueva Ecija, Philippines	Sustainable Drying Systems for Agricultural Crops in Rural Communities	INVITED SPEAKER
Wibool Piyawattanametha	Director, Advanced Imaging Research CenterDepartment of Biomedical Engineering, Faculty of Engineering King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand	Enabling Environment for Entrepreneurship & Disruptive Technology	INVITED SPEAKER
Megh Raj Pokhrel	Central Department of Chemistry, Tribhuvan University. Kirtipur, Kathmandu. Nepal	Agriculture, Food, Energy, and Sustainability in Nepal	INVITED SPEAKER

The Effectiveness of Electrocoagulation Process in Rubber Wastewater Treatment using Combination Electrodes

The Effectiveness of Electrocoagulation Process in Rubber Wastewater Treatment using Combination Electrodes

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Abstract. Industrial wastewater is one of the types of waste that can pollute the water environment. Almost the entire industry has one wastewater effluent owned rubber industry. Many of the rubber industry is less concerned about the quality of water and dispose of waste directly into the environment. Whereas in the rubber industry wastewater content, there are many pollutants that can harm the environment, especially the marine environment, such contaminants as metals, organic substances, and inorganic substances. For that, we need a method that can be used in treating wastewater of this rubber industry that is by electrocoagulation method. Electrocoagulation is a method of coagulation by using electric current through electrochemical events. Rubber wastewater treatment by electrocoagulation method is done by varying the voltage and process time, that is with variations of 12V, 15V, and 18V and with variation of process time 30 minutes, 60 minutes, 90 minutes, 120 minutes and 150 minutes to find out pH values, Total Suspended Solid (TSS), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD_5), and Ammonia levels. From the research results obtained, optimum conditions are at a voltage of 18 volts with a processing time of 150 minutes. The effectiveness electrocoagulation of rubber wastewater was for TSS 85.39%, COD56.14%, BOD_5 57.18%, and NH_3 73.5%, respectively. These results have fulfilled the environmental standards of rubber wastewater.

1. Introduction

Wastewater treatment technology is vital to preserving the environment. Whatever type of domestic and industrial wastewater treatment technology is built, it must be operated and maintained by the local community. So the processing technology chosen must be following the technological capabilities of the people concerned. Various wastewater treatment techniques for removing pollutantshave been tried and developed so far [1-3].

Development of new industries at this time can increase prosperity for the community, but bring negative impacts on the environment. These effects need to be considered several effect, such as waste produced. One industry that produces liquid waste is the rubber industry. Liquid waste produced by the rubber industry contains relatively high organic compounds. The existence of these organicmaterials causes the value of BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand) in the liquid waste of the rubber industry to be high [4-8].

One of the chemical wastewater treatment without coagulant is electrocoagulation. The electrocoagulation method is a cheap and effective method for treating industrial waste. Electrocoagulation is an electrochemical method for waste treatment where an anode occurs in the release of active coagulant in the form of metal ions (usually aluminum or iron) into a solution, whereas in the cathode an electrolysis reaction occurs in the form of hydrogen gas release [9-12]. The electrocoagulation technique has several advantages, namely simple equipment, easy operation, short reaction time. Also, during the electrocoagulation process, the salt content does not increase

significantly as it occurs in chemical processing, so the pH tends to be constant. The basic principle of electrocoagulation is the reduction and oxidation (redox) reaction. In an electrocoagulation cell, the oxidation event occurs at the electrode (+), which is the anode, while the reduction occurs at the electrode (-), which is the cathode. What is involved in electrocoagulation reactions other than electrodes is treated water, which functions as an electrolyte solution. Electrocoagulation is capable of removing various types of pollutants in water, namely suspended particles, heavy metals, colors in dyes, and various other harmful substances [13-17].

2. Materials and Method

The materials used in this study were rubber liquid waste, concentrated H_2SO_4, KIO_3, $FeSO_4.6H_2O$, ferroin indicator, starch indicator, HCl, $AgSO_4$, potassium dichromate, and $Na_2S_2O_3$. The equipment used in this research is a set of electrocoagulation, which is equipped with aluminum and stainless steel electrodes, electrode cells, regulators, digital multimeters, and anode and cathode connecting cables. During the processing of this rubber liquid waste, the processing time is varied The electrodes used were 11 cm long, 11 cm wide, the distance between the electrodes was 1 cm, and the thickness of the aluminum electrode was 0.25 cm, and the thickness of the stainless steel electrodes was 0.33 cm.

After the electrode cell is filled with rubber liquid waste, the anode and cathode connecting cables are connected, then the voltage flow is turned on by using voltage variations of 12 volts, 15 volts, 18 volts and the operating time of each process is 30 minutes, 60 minutes, 90 minutes, 120 minutes, and 150 minutes. The results of the electrocoagulation process were precipitated for 2 hours, then filtered from the results of the precipitate. The characteristics of the electrocoagulation process were determined by measuring the pH, BOD, COD, TSS, and ammonia levels in the filtered cell. The rubber waste treatment equipment using the electrocoagulation method is shown in Figure 1.

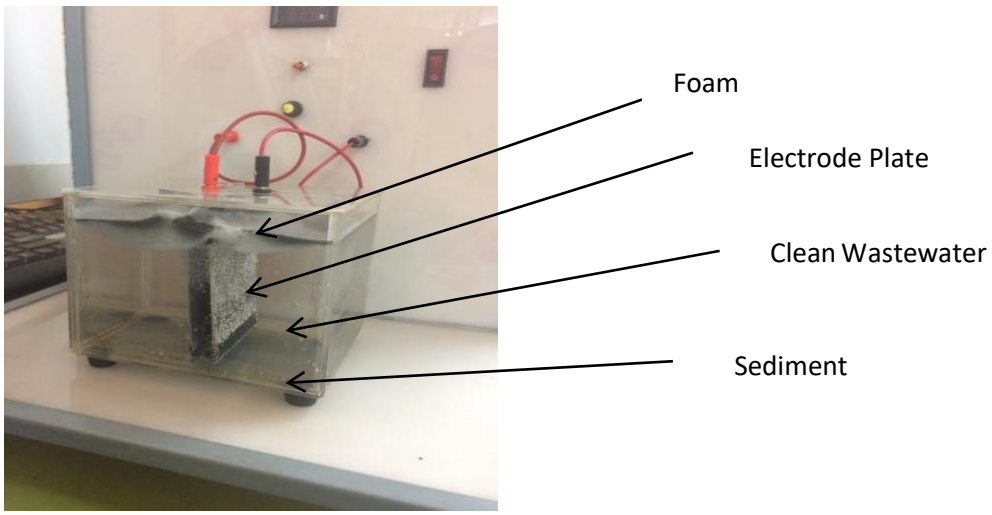

Figure 1. Rubber waste treatment by electrocoagulation method

3. Result and Discussion

3.1 Initial Characterization of Rubber Liquid Waste

Initial analysis was carried out on rubber industry liquid waste taken from a rubber processing plant in Kalidoni, Palembang City, South Sumatra. The initial characterization of rubber wastewater was carried out by electrocoagulation methods to analyze pH values, TSS levels, BOD5, COD, and Ammonia. The results of the analysis can be seen in Table 1.

Table 1. Initial Characterization of Rubber Liquid Waste

No	Parameter	Units	Results	Standards*
1	pH	-	6,79	6 – 9
2	TSS	mg/L	48,2	100
3	BOD_5	mg/L	39,7	100
4	COD	mg/L	114	250
5	NH_3	mg/L	2,00	15

**Source: Pergub Sumsel No.08 Tahun 2012[25]*

3.2 Effect of Voltage and Processing Time on pH

The pH value is an expression and concentration of hydrogen ions (H^+) in water. pH is very important as a parameter of water quality because it controls the type and rate of reaction of several substances in water.

The pH value of rubber wastewater before being processed by the electrocoagulation method has met the environmental quality standard requirements. In Figure 2, it can be seen that the pH value after processing is obtained the pH value, which reaches 7.04, which is very close to neutral pH, where the environmental quality standard pH value for rubber liquid waste is between 6-9. The ongoing process of electrolysis reaction results in changes in the composition of the electrolyte, especially the increase in pH due to the release of OH^- and H_2 gas.

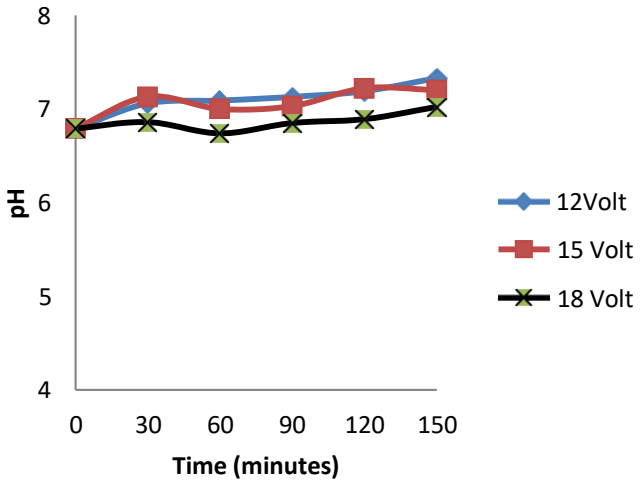

Figure 2. Effect of voltage and processing time on increase in pH

The optimum conditions for increasing the pH are at a voltage of 18 volts with a processing time of 150 minutes. This result was chosen because at a voltage of 18 volts with a processing time of 150 minutes produces a pH of 7.04, which is close to the neutral pH of water.

3.3 Effect of Voltage and Processing Time on TSS

TSS is a solid that is suspended in water in the form of organic and inorganic materials. TSS values that are too high can cause turbidity in water. The turbidity of the water is not expected in waters because if it is too turbid, it can reduce or inhibit the sun's rays entering the water so that it can interfere with the development of aquatic biota. If wastewater contains high TSS, it can be concluded that the waste is of poor quality. In the initial analysis, TSS levels did not exceed environmental quality standards. This is due to good waste sampling and also the condition of waste that is still good when analyzed [18-21].

Figure 3 shows that the TSS values obtained are not stable. This is caused by electrodes decaying during the processing process and unstable voltage resulting in an increase and decrease in the results obtained.

At the anode, an oxidation reaction occurs to the anion (negative ion), an anode made of metals such as stainless steel will undergo an oxidation reaction to form Fe_3^+. Hydrogen gas from the cathode helps floc $Fe(OH)_3$ in solution raised to the surface. The mechanism of precipitation of $Fe(OH)_3$ floc in the electrocoagulation bath follows the coagulation-flocculation principle because of the growth of the floc mass so that the specific gravity of the floc becomes large and eventually settles. This is very related to the magnitude of the electric current and voltage are given during the electrocoagulation process [22-24].

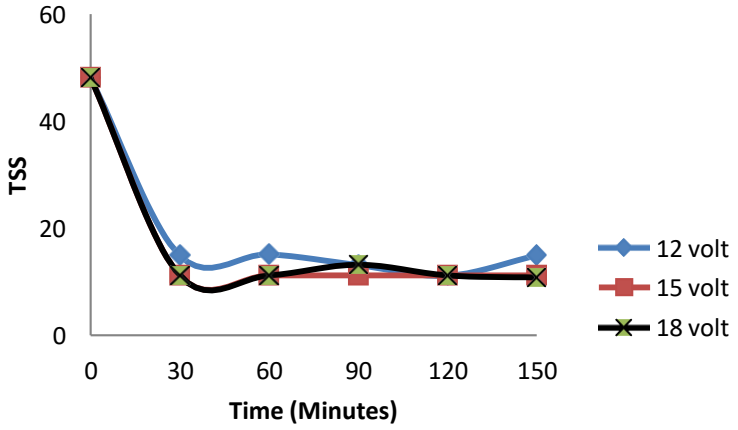

Figure 3. Effect of voltage and processing time on TSS

The optimum conditions for the decrease in TSS values are at the 18 volt voltage and 150 minutes processing time, where the value drops from 48.2 mg/L to 10.8 mg/L. Requirements for the environmental quality standard permitted TSS levels of 100 mg/L.

3.4. Effect of Voltage and Processing Time on BOD_5

BOD_5 is the amount of oxygen needed by bacteria during the breakdown of organic compounds under aerobic conditions for five days. BOD measurements were carried out for five days because, for five days, the number of organic compounds described had reached 70%. High levels of BOD5 indicate that there are many organic compounds in the waste, so that much oxygen is needed by microorganisms to break down these organic compounds. The principle of checking BOD parameters is based on the oxidation reaction of organic substances with oxygen in the water, and the process takes place due to the presence of aerobic bacteria. In Figure 4, the results are decreased with BOD5 levels. In the initial analysis of the BOD5 content, the BOD5 content obtained meets the environmental quality standard requirements of rubber liquid waste [25].

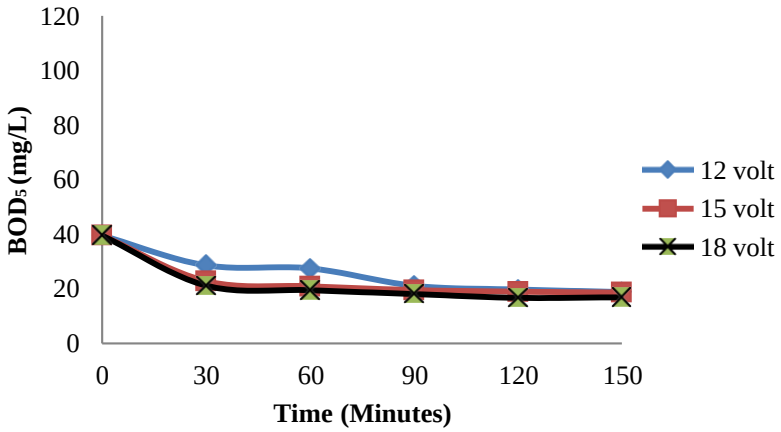

Figure 4. Effect of voltage and processing time on BOD_5

The optimum conditions obtained from the BOD5 value are 18 volt voltage and 150 minutes processing time, where the value is from 39.7 mg/L to 17 mg/L.

3.5 Effect of Voltage and Processing Time on COD

COD (Chemical oxygen demand) is the total amount of oxygen needed to oxidize all organic matter contained in waters. COD is the amount of oxidant that reacts with the sample under certain conditions. The amount of oxidant used is proportional to oxygen demand. Organic and inorganic compounds in the sample are oxidized subjects, but organic compounds are more dominant. COD is often used as a measure of the number of pollutants in water. In the initial analysis, the COD level did not exceed the environmental quality standard. This is due to good waste sampling.

In Figure 5, after processing by the electrocoagulation method, the treated waste has decreased. The decrease in concentration is due to the oxidation and reduction processes in the electrocoagulation process. Gas electrodes are formed, such as oxygen and hydrogen, which will influence the reduction of COD. This decrease is also due to the floc formed by organic compound ions, which bind to positive coagulant ions [26].

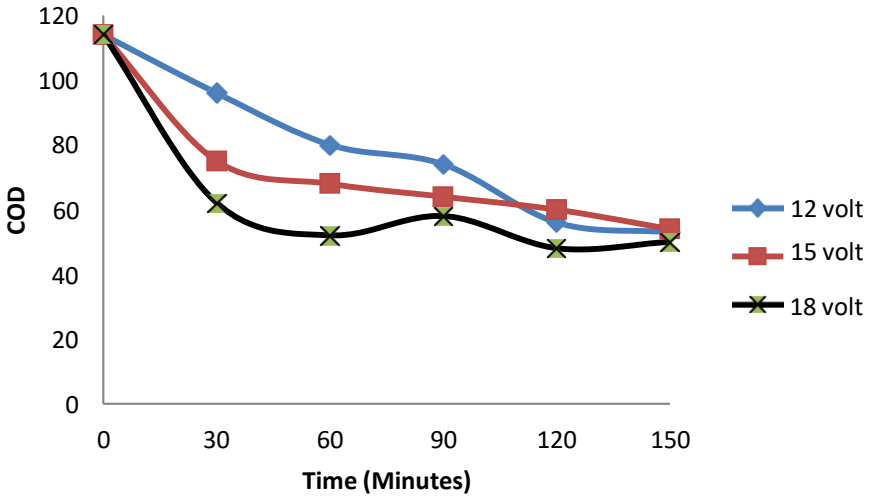

Figure 5. Effect of voltage and processing time on COD

The optimum conditions obtained from the variation of voltage and processing time in reducing COD levels are with a voltage of 18 volts with a processing time of 150 minutes that is 50 mg/L. This indicates that the higher the voltage and processing time, the COD concentration will decrease.

3.6 Effect of Voltage and Processing Time on NH_3

NH_3 levels are important to analyze because high NH3 levels can damage the environment and endanger the health of living things in them. In the initial analysis results, NH_3 levels from rubber liquid waste before being processed by the electrocoagulation method have met the environmental quality standard requirements. High ammonia levels will cause the death of living things found in these waters. High ammonia levels in river water indicate pollution. Consequently the taste of river water is less pleasant and smelly [26].

From Figure 6, the ammonia level obtained is decreased. The greater the voltage applied, the ammonia levels obtained decreases. Ammonia levels obtained meet the environmental quality standard requirements.

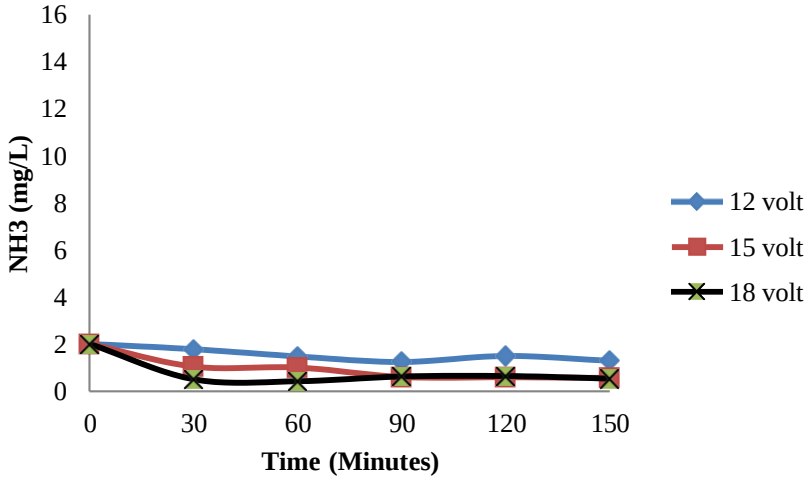

Figure 6. Effect of voltage and processing time on NH_3

The optimum conditions obtained from the variation of voltage and processing time in reducing NH_3 levels are at 18 volts with a processing time of 150 minutes, 0.53 mg/L.

3.7 Currents Efficiency

In experiments that can be determined, current efficiency (η) calculated gravimetrically by weighing the electrode weight before treatment and after treatment. The difference from initial weight and the final weight is the weight of electrodes dissolved in the experiment (wd), for the theoretically dissolved weight is calculated using the Faraday formula using the current and time data used.

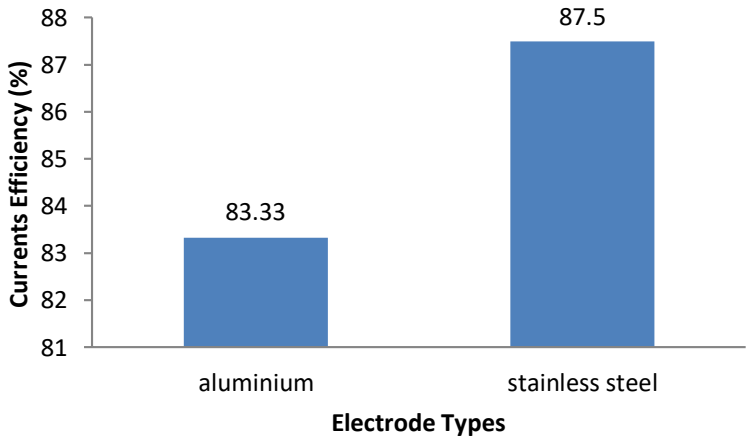

Figure 7. Currents efficiency of the electrocoagulation method for electrode types

From the calculation, it is known that the weight of the electrolyzed metal (w_d) is 0.2 grams and the weight of the electrolyzed metal theoretically (w_t) is 0.24 grams, the current efficiency for the aluminum electrode is 83.33%, and the stainless steel electrode is known (w_d) namely 0.42 grams and (w_t), i.e. 0.48 grams, the current efficiency is 87.5%. With a current efficiency value of less than 100%, this shows the current loss in the electrocoagulation system.

3.8 Dissolved Metals

In the electrocoagulation process, the use of metals as electrodes electrocuted will cause some of the metal contents to be released from liquid waste and even will be dissolved in liquid waste.

At the cathode surface, absorption occurs, while at the anode, there is a decrease in positive ions. Anode will release positive ions so that positive ions will continue to decrease when electrified, while the cathode will produce a new layer on the surface of the plate. This happens because of the absorption of interactions between the ions present in wastewater. The released ions will cause erosion on the electrode surface.

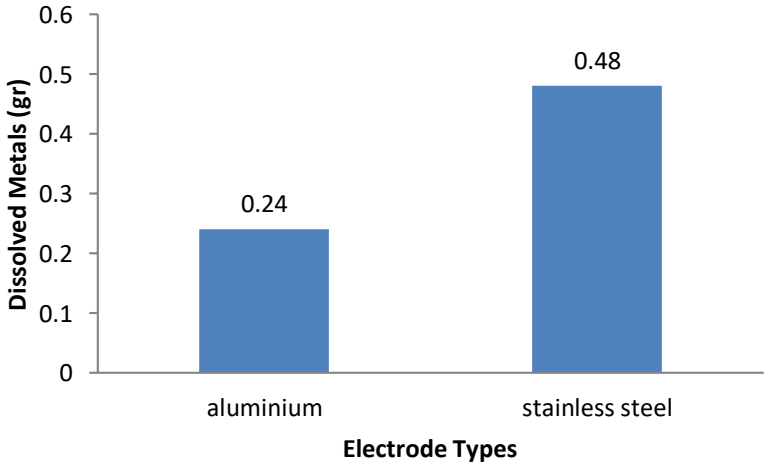

Figure 8. Dissolved metals to electrode types

From the results of this study, it was found that the weight of the dissolved metal using aluminum electrodes was 0.24 grams, and stainless steel electrodes were 0.48 grams (Figure 8).

4. Conclusions

The electrocoagulation process using aluminum-stainless steel electrodes effectively reduces the value of TSS, BOD5, COD, and also NH_3 and can significantly increase the pH value in rubber liquid waste. After the electrocoagulation process the pH value increased to near neutral pH 7.04 and decreased TSS levels (10.8 mg/L), BOD (5 17 mg/L), COD (50 mg/L), and NH_3 (0.53 mg/L). The results obtained show that the electrocoagulation method is able to reduce levels of pollutants in rubber liquidwaste and is below the environmental quality standard which means the liquid waste does not pollute the surrounding environment. The optimum condition for this electrocoagulation method is at 18 volts,with a processing time of 150 minutes. From the results of this study also found that metal dissolved using aluminum electrodes of 0.24 g and stainless steel electrodes of 0.48 grams. Furthermore, obtained current efficiency using aluminum electrodes that are 83.33% and stainless steel electrodes, which are 87.5%.

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