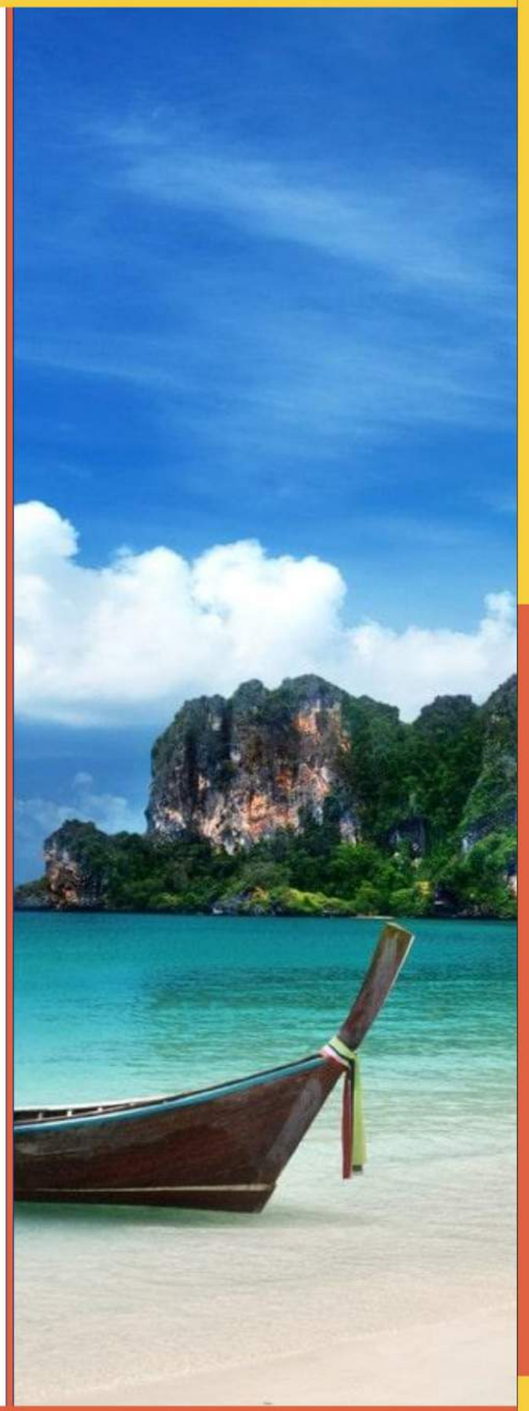
ORGANIZING INSTITUTION

SAFE NETWORK
Asia Pacific Network for Sustainable Agriculture Food and Energy

MEMBERS



7th International Conference Sustainable Agriculture, Food, and Energy

Phuket THAILAND, 2019

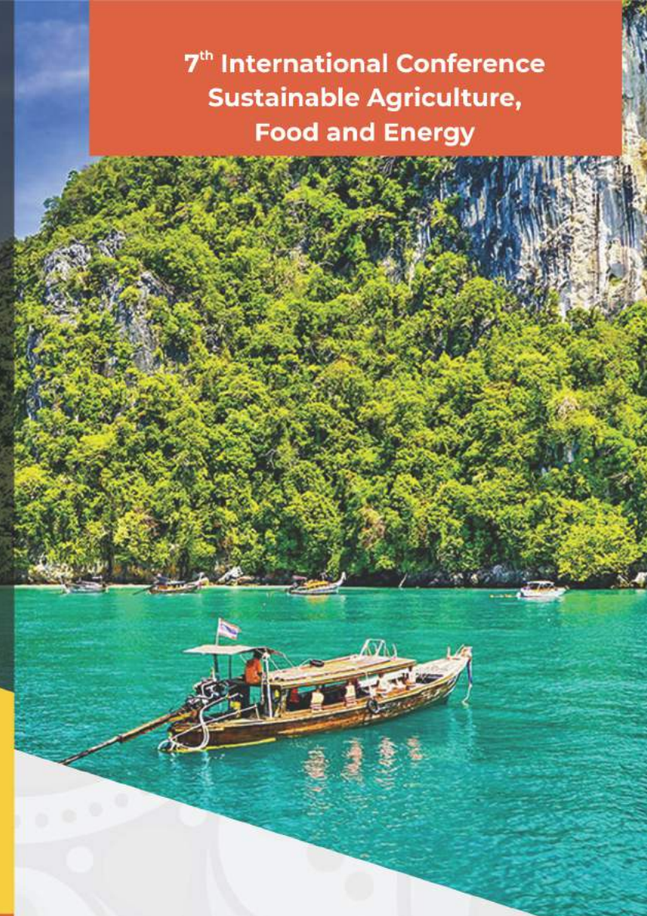
SAFE NETWORK
Asia Pacific Network for Sustainable Agriculture Food and Energy
BECOMING BIGGER TOGETHER

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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Asst.Prof.Dr. Hiran Prasarnkarn, *The President of Phuket Rajabhat University-THAILAND*

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Faculty of Engineering . Chiang Mai University.

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:

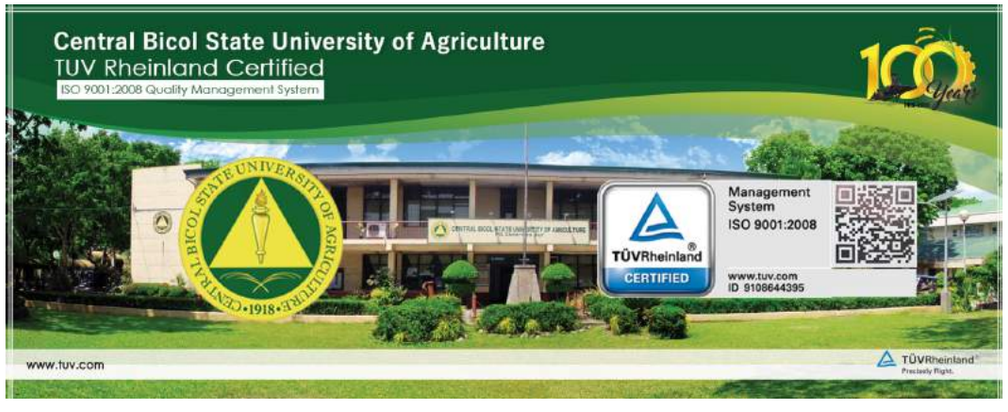
Module A. Concept of Food Security (one week)
Module B. Models of Small-holder farms (three weeks)
Module C. Assessment of small-holder farms in various communities (five weeks)
Module D. Development of a pilot-project (eleven weeks)
Implementation

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.

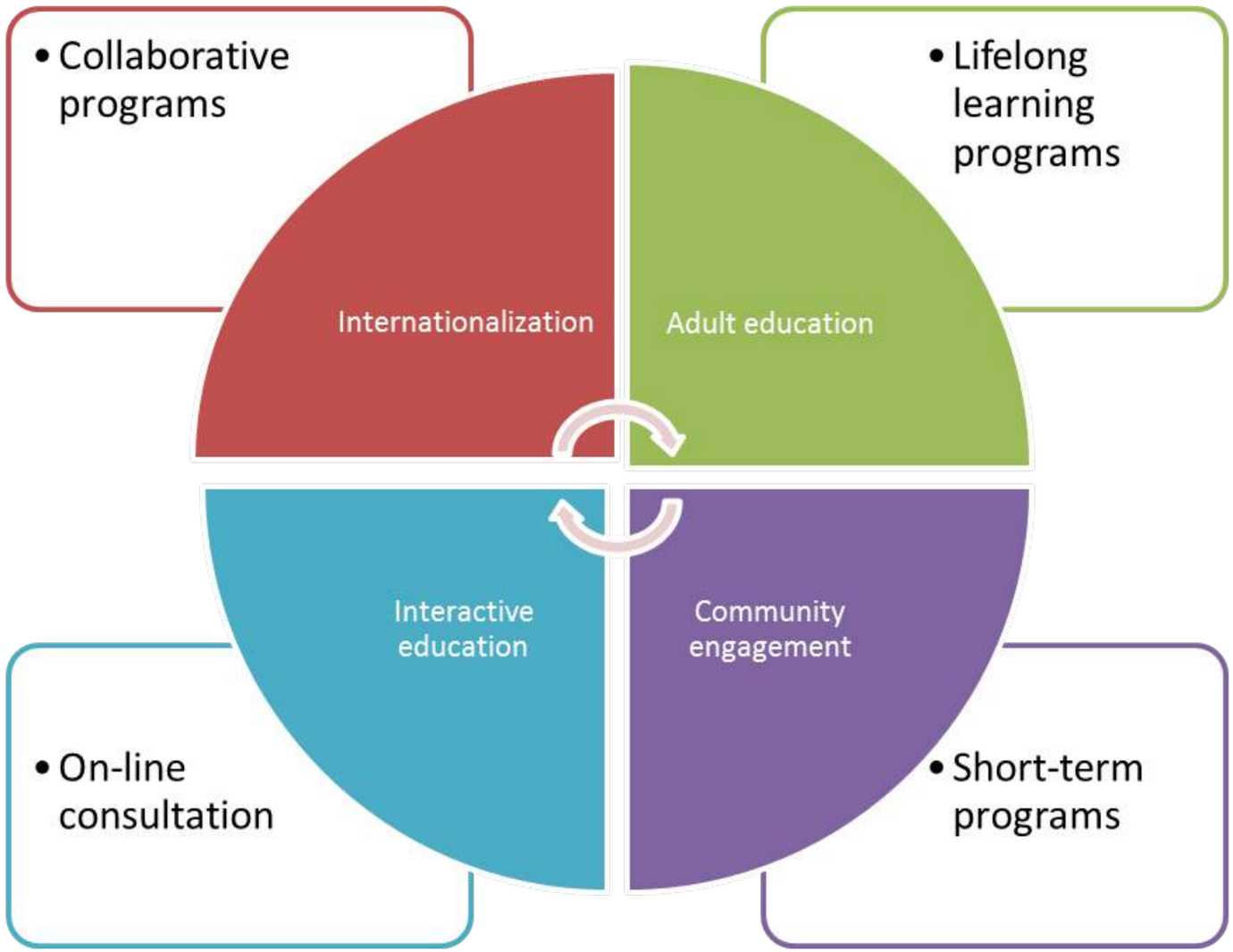
Implementation

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|

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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
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Performance Comparison Analysis of Fixed and Solar-Tracker Installed Panel at PV System

Performance Comparison Analysis of Fixed and Solar-Tracker Installed Panel at PV System

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Abstract. Energy generation by conventional energy has been an issue in many countries due to more demands and less supply and getting lesser by the years. This condition urges all the countries in the world to search for other alternatives of energy generation and the desired one is the one with unlimited sources. This unlimited source or self-renewable is called renewable energy. PT. Pertamina (Persero) RU-III Plaju as a state-owned enterprise is committed taking the active role in supporting the government in the campaign of using renewable energy in generating electricity. PT. Pertamina (Persero) RU-III Plaju installed a 3 x 3000 WP PV system to supply the managerial building, and this PV system is considered a research device to develop the possibility of substituting the conventional energy with renewable energy. This paper discussed the performance comparison of the fixed panel and solar-tracking solar panel application for the PV system in PT. Pertamina (Persero) RU-III Plaju. The performance analysis is including final yield, reference yield and performance ratio. Experiment results show that the fixed panel has more energy production with the average percentage of final yield is 3.3% and capacity factor is 13.6%, while the PV panels with solar-tracker have the average final yield of 2.3% and capacity factor of 9.6%. Therefore, this study shows that the application of solar-tracker is not necessary for PV panels in Palembang, due to the average maximal power achieved from 11 AM to 02 PM every day.

1. Introduction

The energy demand in Indonesia is projected to increase by 4.27% per year in 2011-2030 [1, 2]. This energy growth is directly proportional to the increase in population and the rate of economic growth. The depletion of petroleum and coal, which currently are the primary energy resource insist people and government find the alternatives to meet the energy demand. Energy consumption is including electricity generation that relies heavily on fossil fuel, and although Indonesia has a deposit amount of coal of 2.1 billion tons, it will run out in 50 years [3, 4].

The source of energy is divided into non-renewable energy or known as conventional energy and renewable energy. Non-renewable energy is defined as an energy source that cannot be recreated in a short period of time, such as coal, natural gas, and oil. Renewable energy is another type of energy that has unlimited sources, such as hydropower, solar energy, biomass energy, etc.

People started to look for energy alternatives, and one of them comes from above, the sun, which can be the inexhaustible source of energy. The earth only receives the energy emitted by the sun at 69% of the total emission of the sun. The supply of solar energy to the earth reaches 3x1024 joules/year. This energy is equivalent to 2 x 1017 W. This amount of energy is equivalent to 10,000 times the energy consumption in the entire world today [2, 5]. In other words, only by utilizing 0.1% of the solar energy received on the surface of the earth by using PV system and with the efficiency of

10% alone can cover the needs of the world today. As a tropical country located in the equatorial region, Indonesia has a great potential in developing renewable energy sourced from solar energy of 4.8 kWh/m^2 per day. The other feature of this type of renewable energy is that it is free of CO emission and environmental friendly [6].

Solar Power Plant or PV system at PT. Pertamina (Persero) RU-III Plaju is a manifestation of state-own enterprises campaign for supporting government regulation or Regulation of the Minister of Energy and Mineral Resources (ESDM) No.49 of 2018 in shifting from utilizing fossil fuel into renewable energy, and Regulation of ESDM No. 17 of 2013 regarding State Electricity regulation in purchasing electricity produced by customer's PV system.

PV system based on place of installation is divided into two; roof top and ground installation. PV system is also divided into On-Grid or connected to utility and Off-Grid or stand-alone system. The PV system installed in PT. Pertamina (Persero) RU-III Plaju is an on-grid system used to supply the managerial building with a capacity of 9 kWp and established since 2016 [7].

There are two types of solar panel commonly used; fixed and solar tracker installed panel [6-10]. Fixed panel is the PV system panel that is installed within a certain angle facing the sun. Solar tracker installed panel is made so that the panel can receive sunlight optimally by following the direction of the arrival of sunlight [13-15]. PV system panel with a solar tracker system is expected to produce more power than the fixed panel type. However, in fact, tracker usage on solar panels reduces the electrical energy produced by the panel.

The objective of PV system installation in PT. Pertamina (Persero) RU-III Plaju is a research device in renewable energy in line with government regulation regarding renewable energy for electric generation. Due to this objective, PT. Pertamina (Persero) RU-III Plaju installed both fixed and solar tracker installed PV panel. This paper investigates the performance of both fixed and solar tracker installed PV panel. The performance measurement will be conducted to both types of PV panel installation and compare the result to obtain the optimum generated electricity for the PV system in PT. Pertamina (Persero) RU-III Plaju [16-18]. The result will show the best method to apply in Palembang. The fixed tilt angle is 15^o, and solar tracker keeps on rotating based on the detection of the highest intensity of irradiance.

2. Materials and Method

This study is to show the comparison of output power produced by the fixed and solar-tracker installed panel. The research is conducted at the PV system installed in PT. Pertamina (Persero) RU-III Plaju, a state-owned company engaged in energy processing and production. Figure 1 shows the complete installation plan of the fixed and solar-tracker panel considered in this study, and Figure 2 shows the single line diagram of the installed PV system.

Table 1 presents the specification technique of installed PV system, where P_{max} is maximum power, P_{Total} is total power, V_{mp} is voltage at maximum power, I_{mp} is current in maximum power, I_{sc} is current in short circuit, and V_{oc} is the voltage in open circuit.

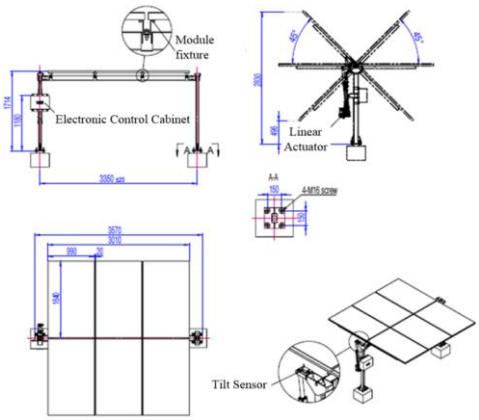

Figure 1. Installation plan of fixed and solar tracker installed PV system

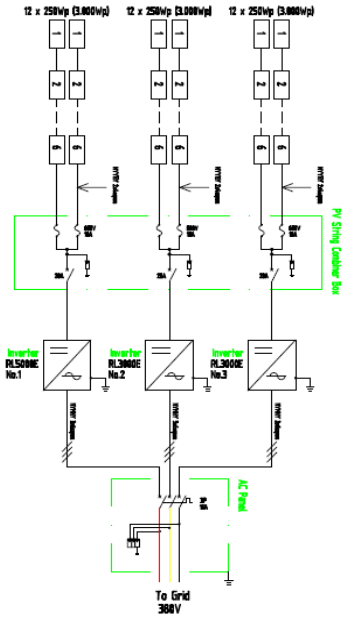

Fig 2. Single line diagram of installed PV System

Table 1. Specification technique of installed PV system

Specification technique	Solar Cell	
	Fixed Mounting	solar Tracker
P_{max}	250 Wp	250 Wp
P_{Total}	3000 Wp	3000 Wp
V_{mp}	30.9 Volt	30.9 Volt
I_{mp}	8.12 Amp	8.12 Amp
I_{sc}	8.47 Amp	8.47 Amp
V_{oc}	37.8 Volt	37.8 Volt
PV cell	36 cell	36 cell
Cell	17.12 %	17.12 %
Efficiency	1640 x 992 x 40 mm	1640 x 992 x 40 mm
Dimension	19.00 kg	19.00 kg
Weight	*Monocrystalline*	*Monocrystalline*
Type	*Silicon*	*Silicon*

2.1 Solar Power Plant or PV System

PV system is an electric power plant that uses sunlight through the photovoltaic effect to convert solar radiation into electrical energy [19-20]. In simple terms, solar cells consist of a connection between p and n semiconductor materials (p-n junction semiconductor), which is exposed to sunlight, will occur electron flow, and this electron flow is referred to as electric current flow [21]. Figure 3 is the process of converting solar energy into electrical energy.

Many studies have been carried out to develop this renewable energy and give effort in finding the optimum method to harness the energy, one of them is discussing the effect of tilt angle on PV panels [22-27]. The ability of solar power plants to produce electrical energy is very dependent on the intensity of irradiance and duration of the sun's rays exposal on the PV panel [26]. The current technology for a PV system is installing actuators on the panel to direct PV panels to follow the direction of sunlight. This device is called a solar tracker.

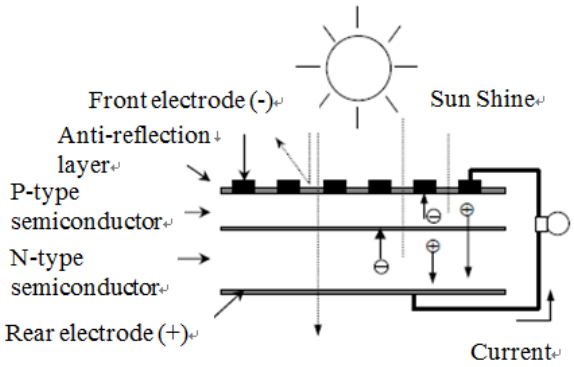

Fig 3. Process of converting solar's ray into electricity

Some research discussing the application of solar tracker for PV system has been simulated and experimentally measured on the produced energy output [27]. The efficiency comparison on single axis sun tracker and dual axis solar tracker was also applied [10][30][6].

2.2 Fixed Panel System

The fixed panel system is solar power plant whose panel installed within certain tilt angle based on the position of the sun or the location of installed PV system relative to the position of the sun during the highest intensity of irradiance of a day. Figure 4 shows the installation of fixed PV panels in PT. Pertamina (Persero) RU-III Plaju. The panels are installed with a 15º tilt angle, and this angle is due to the position of Indonesia. The position of Indonesia is 5º. However, this angle does not have enough cleaning power, therefore, the angle adjusted into 15º to accommodate the possibility of self-cleaning by falling rain that carries dust and dirt on the surface of the PV panel. The solar panels used in PT. Pertamina (Persero) RU-III Plaju are Solar Panel 3000 WP (12 x 250WP) Monocrystalline Type. The number of solar cells per module is 60 cells, with module size (972x1640x40) mm, one solar panel consists of 6 solar modules, with the size of a solar panel (3280x2976x40) mm, and one PV system has two solar panels (3x6 solar modules) with a capacity of 12 x 250WP or 3000WP.

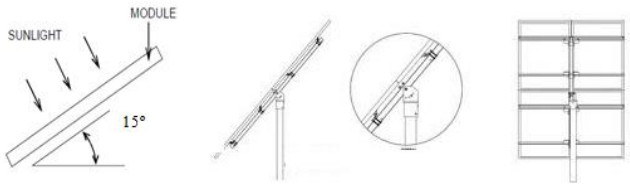

Fig 4. Design of fixed panel system

All three sets of solar generating systems are installed in parallel with a capacity of 3 x 3000WP. The advantage of using the fixed panel system when compared to the sun tracker system is that the installation price is relatively cheaper because it does not require an actuator to drive the PV panel, but it is not optimal in receiving sunlight because it cannot follow the direction of the light.

2.3 Solar Tracker System

Fig 4 and 5 show the design of the solar tracker system. solar tracker system is a further development of finding the best way to harnest solar energy and convert it into electrical energy. This system is designed to overcome the problems found in fixed panel systems, which are less optimal reception of sunlight by PV panels; therefore, it does not produce optimum electrical energy. The solar tracker system has an actuator that can move the PV panel in accordance with the direction of sunlight, and solar sensor to sense the direction of the sun. The PV system in PT. Pertamina (Persero) RU-III Plaju has a solar Panel 3000 WP (12 x 250WP) with Monocrystalline type. The number of solar cells per module is 60 cells, with module size (972x1640x40) mm. One solar panel consists of 6 solar modules,

with the size of a solar panel (3280x2976x40) mm. One system has two solar panels (2x6 solar modules) with a capacity of 12 x 250WP or 3000WP. All three sets of solar generating systems are installed in parallel with a capacity of 3 x 3000WP.

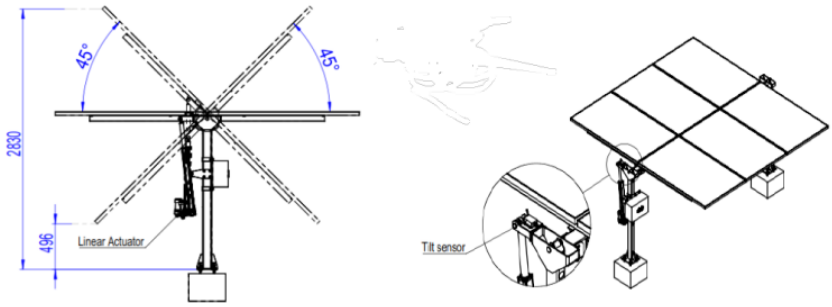

Fig 5. Design of Solar Tracker System

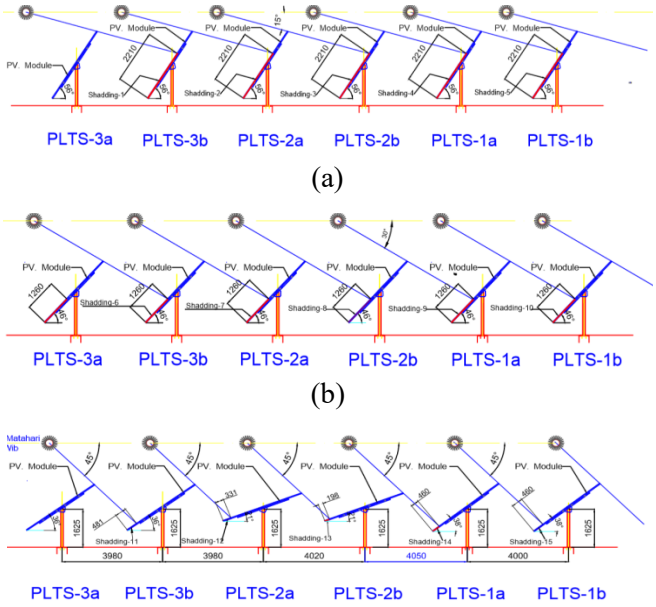

Fig 6. PV panel position at (a) 07.00 AM, (b) 08.00 AM and (c) 09.00 AM.

(a) Solar tracker sensor

(b) Installed solar tracker and actuator in PV system

Fig 7. Solar trackern and the nstalled solar tracker with actuator in PV system

Fig 7 shows the solar tracker sensor and the installed solar tracker along with the actuator used to move the panel.

2.4 Performance Analysis of PV System

Based on IEC 61724: Photovoltaic system performance monitoring-guidelines for measurement, data exchange and analysis, and performance parameter of the PV system is represented by [21]:

2.4.1 Final Yield

Final yield (YF) is set in the annual, month, or daily period of the AC energy output on the system divided by the peak power of the PV array installed at standard test conditions (STC) on solar irradiation 1000W/m^2 and cell temperature 25ºC.

$$Y_F = \frac{E_{PV}}{P_O} \ldots (1)$$

where
EPV = power given to network (kWhAC)
PO = peak power (kWpDC)

2.4.2 Reference Yield

The Reference Yield (YR) is the total of the insulation in a field divided by the iridation array installed under standard test conditions (STC).

$$\boldsymbol{Y_R = \frac{H_T}{G_{STC}} \ldots (2)}$$

where
HT = irradiance falls on array (kWh/m2)
GSTC = irradiance reference STC (1kW/m2)

2.4.3 Performance Ratio

The Performance Ratio (PR) can determine the quality of a PV system. PR is expressed as a percentage, this percentage shows the total ratio of the system when converting from DC to AC output.

$$PR = \frac{Y_F}{Y_R} \dots (3)$$

where

PR = performance ratio (%)

2.4.4 Capacity factor

The capacity factor of a PV system is also expressed as a percentage. The capacity factor is the final result of YF in a three-month period with output if it operates at nominal power for three months.

$$CF = \frac{Y_F}{1464} \dots (4)$$

where

CF = capacity factor (%)

3. Results and Discussion

The installed PV system in PT. Pertamina (Persero) RU-III Plaju solar power plants is monitored via Ethernet as shown in Figure 8. Electric power output data from the PV system can be read via Ethernet. However, in the research, direct measurements were carried out for several parameters. The solar tracker consider in this study is single axis solar tracking at PT Pertamina (Persero) RU 3 Plaju as shown in Figure 9.

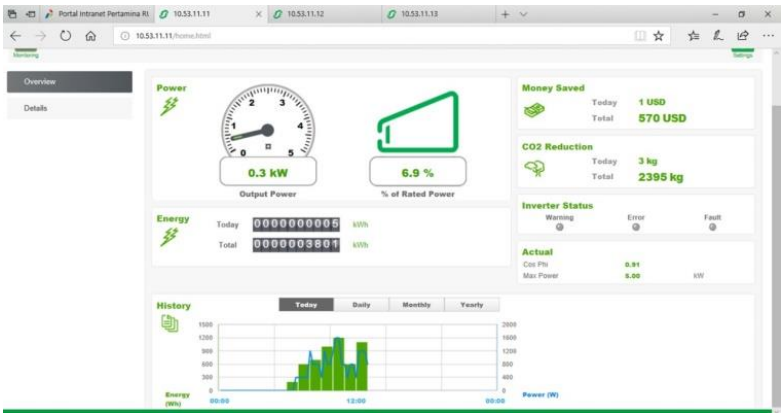

Fig 8. The monitoring of PV system in PT. Pertamina (Persero) RU-III Plaju

Fig 9. PV system installed at PT Pertamina (Persero) RU 3 Plaju

3.1 Data Output PV System in PT. Pertamina (Persero) RU III Plaju

PV system installed at PT. Pertamina (Persero) RU III Plaju uses modules with materials made of monocrystalline. The solar panel consists of 12 modules with each producing power of 250 Wp, or 3000 WP per PV system. Overall, three sets of solar generating systems are installed in parallel with a capacity of 3 x 3000WP. Table 2 is the PV systemproduced power within 3 months.

Table 2. Data produced within 3 months

Date	Output Power (kWh)	Rate of Irradiance/day (w/m2)
May 29 – Jun 17, 2017	150.1	4,620.99
Jun 18 – Jul 7, 2017	133.4	4,595.10
Jul 8 – Jul 27, 2017	132.2	4,636.35
Jul 29 –Aug 17, 2017	188.1	5,966.54
Aug 18 – Sep 6, 2017	190.3	5,882.30
Sep 7 – Sep 26, 2017	210.3	6,387.30

Fig 10 shows the power output comparison between fixed and solar tracker installed panel. Based on data in table 2 and Figure 10, fixed panel produces more power than solar tracker installed panel.

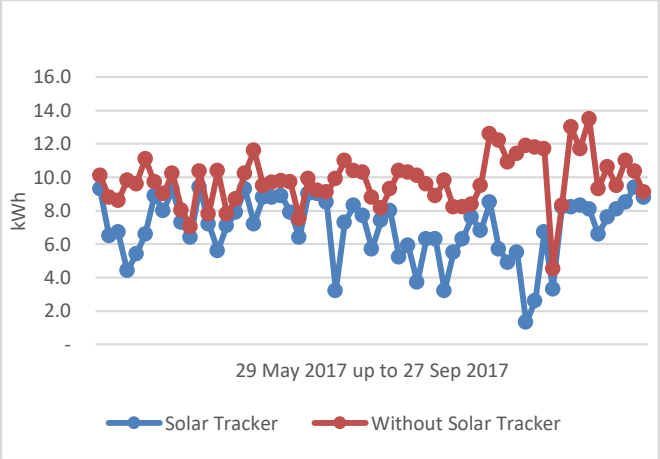

Fig 10. The power output comparison between fixed and solar tracker installed panel

This condition is due to the use of PV system with a solar tracker system that has a one-axis drive actuator that moves the PV panel to follow the direction of sunlight direction. This actuator consume electricity as its source, and the electricity consumed comes from solar panels that are driven by actuators which causes a reduction in the energy produced by the solar panel. In the end when compared to fixed panel systems, PV system with a solar tracker system is less efficient to use as a power plant at PT. Pertamina (Persero) RU-III Plaju.

3.2 Performance Analysis of PV System installed in PT. Pertamina (Persero) RU-III Plaju

From the data results of electricity production output comparison in PV system with a fixed and solar tracker installed panel during the period of May 29, 2017 to September 26, 2017, it can be seen that electricity production in PV system PT. Pertamina (Persero) RU-III Plaju with an average fixed panel system is 9.8 kWh, this value is greater than PV system with a solar tracker system where the average production of electricity produced is only 7.0 kWh. Table 2 shows the specific performance and factors of the PV system capacity of PT. Pertamina (Persero) RU-III Plaju. By using two solar panels installed in a Solar tracker system and a fixed panel system PT. Pertamina (Persero) RU-III Plaju

produces 1,022 MWh of electricity for three months, with a performance ratio (PR) of 51.9% with production details can be seen in Table 2.

Table 3. Specific performance and capacity factor of PV system in PT. Pertamina (Persero) RU-III Plaju

Date	Output Power (kWh)	YF (%)	CF (%)	YR (%)	PR (%)
May 29 – Jun 17, 2017	150.1	2.5	10.4	4.6	54.1
Jun 18 – Jul 7, 2017	133.4	2.2	9.3	4.6	48.4
Jul 8 – Ju 27, 2017	132.2	2.2	9.2	4.6	47.5
Jul 29 –Aug 17, 2017	188.1	3.1	13.1	6.0	52.5
Aug 18 – Sep 6, 2017	190.3	3.2	13.2	5.9	53.9
Sep 7 – Sep 26, 2017	210.3	3.5	14.6	6.4	54.9

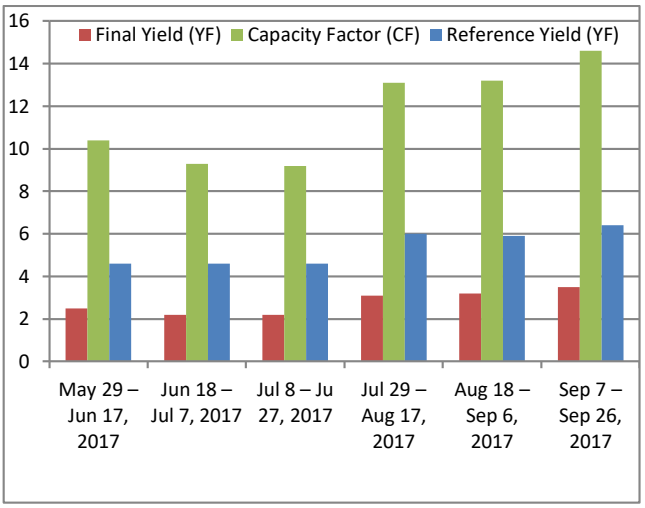

Figure 11. Specific performance and capacity factor of PV system in PT. Pertamina (Persero) RU-III Plaju

The data in Table 3 shows that there is an increase in specific performance and capacity factors in PV system PT. Pertamina (Persero) RU-III Plaju. Figure 11 shows the comparison of specific performance and capacity factor of PV system in PT. Pertamina (Persero) RU-III Plaju. The increase occurred when implementing the fixed panel system in PV system starting on 29 July - 27 September 2017. The final yield or the final result of PLTS with a fixed panel system on 29 July - 27 September 2017 the average percentage is 3.3%. This result is greater than the PV system with solar tracker system where the average percentage of final results (YF) is 2.3% in vulnerable time 29 May - 28 July 2017. Figure 11shows the specific performance and PV system capacity factors of PT. Pertamina (Persero) RU-III Plaju for three months.

4. Conclusion

Experiment results shows that the characteristics of changes in output power data that are not affected by tracker or static usage. Ouput power data shows the setup of solar panels with solar tracker, does

not increase the output of electrical power produced compared to fixed panel. This is because, among other things: the use of an actuatorreduces the output of electrical energy for external loads. Solar tracker does not increase the efficiency of solar panel electrical power output. Specific performance and capacity factor in PLTS with fixed panel system average percentage yield (YF) is 3.23% and the average percentage capacity factor (CF) is 13.6% which is greater than PV syatem with a solar tracker system that only has an average. The final yield percentage (YF) is 2.37% and the average capacity factor (CF) percentage is 9.6%.

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