

# 2015 3<sup>rd</sup> International Conference on Adaptive and Intelligent Agroindustry (ICAIA)

## ICAIA 2015



August 3<sup>rd</sup> - 4<sup>th</sup>, 2015

IPB International Convention Center  
Bogor, Indonesia

ISBN : 978-1-4673-7404-0

IEEE Catalog Number : CFP15C67-CDR





**Proceedings of**  
**2015 3<sup>rd</sup> International Conference on**  
**Adaptive and Intelligent Agroindustry (ICAIA)**

IPB International Convention Center, Bogor, Indonesia  
August 3<sup>rd</sup> – 4<sup>th</sup>, 2015

Published by :



Department of Agroindustrial Technology  
Bogor Agricultural University  
Bogor, Indonesia

## **Welcome Message from The General Chairs of ICAIA 2015**

On behalf of the organizing committee, it is our pleasure to welcome you to International Conference on Adaptive and Intelligent Agroindustry, Bogor, Indonesia. This is the 3rd conference on the topic that is held by the Department of Agroindustrial Technology, Bogor Agricultural University, Indonesia.

The conference is expected to provide excellent opportunity to meet experts, to exchange information, and to strengthen the collaboration among researchers, engineers, and scholars from academia, government, and industry. In addition, the conference committee invited five renowned keynote speakers, i.e. Prof Irawadi from Bogor Agricultural University; Prof Kenneth De Jong from George Mason University, USA; Dr Yandra Arkeman from Bogor Agricultural University; and Dr Guillermo Baigorria from University of Nebraska-Lincoln, USA.

The conference committee also invited Prof Noel Lindsay from University of Adelaide, Australia; Kiyotada Hayashi from National Agricultural Research Center-Tsukuba, Japan; Prof Margareth Gfrerer from Islamic State University of Jakarta, Indonesia; Dr Barry Elsey from University of Adelaide, Australia; Dr Gajendran Kandasamy from Melbourne University, Australia; and Imperial College London-British, Prof Allan O'Connor from University of Adelaide, Australia; Dr Wisnu Ananta Kusuma from Bogor Agricultural University, Indonesia; and Dr Frank Neumann from University of Adelaide, Australia, as invited speakers.

This conference was organized by Department of Agroindustrial Technology, Bogor Agricultural University and Asosiasi Agroindustri Indonesia, and technically sponsored by IEEE Indonesia Section. Furthermore, it was supported by Department of Computer Science, Bogor Agricultural University; Surfactant and Bionergy Research Center; PT Bogor Life Science and Technology; Indonesian Ministry of Industry; PT Pachira Distrinusa; and PT Kelola Mina Laut.

I would like to take this opportunity to express my deep appreciation to the conference's committee members for their hard work and contribution throughout this conference. I would like to thank authors, reviewers, speakers, and session chairs for their support to participate in the Conference. Lastly, I would like to welcome you to join ICAIA 2015 and wish you all an enjoyable stay in Bogor.

Sincerely,  
Dr Yandra Arkeman  
General Chairs, ICAIA 2015

## WELCOMING ADDRESS

**Prof. Dr. Ir. Nastiti Siswi Indrasti**

Head of Agroindustrial Technology Department  
Faculty of Agricultural Engineering and Technology  
Bogor Agricultural University

on

**3<sup>rd</sup> International Conference on Adaptive and Intelligence Agroindustry (3<sup>rd</sup>  
ICAIA)**

Bogor, August, 3 – 4, 2015

Assalamu'alaikum Warohmatullahi Wabarokatuh  
In the name of Allah, the beneficent and the merciful,

Distinguish Guest, Ladies and Gentlemen

Let me first thank you all for accepting the invitation to participate in this 3<sup>rd</sup> International Conference on Adaptive and Intelligence Agroindustry (ICAIA). In particular I would like to thank Rector of IPB (Institut Pertanian Bogor/Bogor Agricultural University) Prof. Herry Suhardiyanto for supporting this event as part of the series academic event in celebrating the 52<sup>nd</sup> Anniversary of Bogor Agricultural University.

We are certainly proud to have been able to assemble this event in IPB, Bogor. The range of participants and audience at this conference is precisely something I would like to stress. Participants who followed the event more than 150 people, coming from various countries including the USA, Australia, Japan, Vietnam, Philippine, Germany and Indonesia. The main goal of the conference is to provide an effective forum for distinguished speakers, academicians, professional and practitioners coming from universities, research institutions, government agencies and industries to share or exchange their ideas, experience and recent progress in Adaptive and Intelligent Agroindustry.

The 2015 3<sup>rd</sup> International Conference on Adaptive and Intelligent Agro-industry (ICAIA) is the third forum for the presentation of new advances and research results on various topics in all aspects of innovative agro-industry that highlights the development and improvement for today and tomorrow's global need for food, energy, water and medicine. The aim of the conference is to stimulate interaction and cohesiveness among researchers in the vast areas of innovative agro-industry. Innovative Agro-industry has the ability to adapt intelligently to future global challenges, i.e. food, energy, water, and medical. Global challenges needs a new breed of Agroindustry which could produce innovative products to fulfill the needs through advanced processing technology, production systems and business strategy supported by cutting-edge information and communication technology.

The topic for this event is "Empowering Innovative Agroindustry for Natural Resources, Bioenergy and Food Sovereignty". The topics clustered into four main parts:

Track 1 : Innovative Agroindustrial and Business System Engineering

Track 2 : Frontier Approaches in Process and Bioprocess Engineering  
Track 3 : Frontier Approaches in Industrial Environmental Engineering  
Track 4 : Intelligent Information and Communication Technology for Adaptive  
Agroindustry of the Future

This event also hosts four (4) workshops: (1) Strategies for Agroindustry Development (2) LCA for Agroindustry (3) Innovation and Technopreneurship for Agroindustry and (4) Agroindustry Informatics.

Distinguish Guest, Ladies and Gentlement,  
Agroindustry transforms agricultural commodities into high value-added products. Agroindustry is industry that process agricultural products to increase their value added significantly by using technology and by considering environmental aspect and sustainability. However, with changing global demand and technology advancement, innovative agroindustry is needed in order to be competitive as well as sustainable. The challenge of future agroindustry is not merely efficiency and productivity anymore, but also the challenge to appropriately apply frontier technology as well as meeting future global demands.

Agroindustry needs to deal with the application of advance technologies and cope future global issues. Current global issues which arise and expected to exist in the future are food sovereignty, renewable energy, sustainable water management and pharmacy. The ability of agro-industry to respond the future global issues and the undoubtedly substantial increase in demand in future decades will be highly dependent on the increased application of existing technologies as well as the exploitation of new and innovative technologies.

The emergence of high technology could be applied in the agro-industry are: nanotechnology, biotechnology, bioinformatics, food processing, food packaging-waste, state-of-the-art computation and many others. The aforementioned high-technology along with computation technology could greatly advance agro-industry from a traditional system into a smart-intelligent and innovative technology. Therefore, in the new millennia, adaptive-intelligent and innovative agro-industry will contribute to solutions to global problems and brings agriculture into perfection.

Hope this conference will also discuss this issue in more detail as it is an important matter for all of us. We should no more think just how to produce high value product but it is also necessarily important how to keep our live in good quality by understanding following old saying... “You do not live at once. You only die once and live every day”.

I do not to take up any more of your time with these opening remarks. Let me simply thank you once again for sharing your thoughts with us. Here’s wishing every success for the conference. May Allah bless all of us.

Thank you for your kind attention,  
Wassalamu’alaikum Warohmatullahi Wabarokatuh

## COMMITTEE

### **Condescendent**

Prof. Dr. Ir. Herry Suhardiyanto,  
M.Sc (IPB's Rector)

### **Steering Committee**

#### **Chairman**

Prof. Dr. Ir. Nastiti Siswi Indrasti

#### **Vice**

Dr. Ir. Yandra Arkeman, M.Eng

### **Board member**

Prof. Dr. Ir. Aziz Darwis  
Prof. Dr. Ir. Irawadi Djamaran  
Prof. Dr. Ir. Eriyatno, MSAE  
Prof. Dr. Ir. Anas M. Fauzi  
Prof. Dr. Ir. Syamsul Maarif, M.Eng  
Prof. Dr. Ir. Machfud, MS  
Prof. Dr. Ir. Djumali Mangunwidjaja

### **Organizing Committee**

#### **Chairman**

Dr. Ir. Yandra Arkeman, M.Eng

Co-chairs :

Prof. Dr. Ir. Suprihatin  
Prof. Dr. Ono Suparno, S.TP, MT

#### **Treasury**

Dr. Indah Yuliasih, S.TP, M.Si  
Dr. Elisa Anggraeni, S.TP, MSc

### **Programs**

Dr. Hartrisari Hardjomidjojo, DEA  
Dr. Endang Warsiki  
Ir. Lien Herlina, MSc  
Dr. Ika Amalia Kartika

### **Funding**

Dr. Meika Syahbana Rusli  
Dr. Dwi Setyaningsih  
Prof. Erliza Hambali  
Dr. Mulyorini Rahayuningsih

### **Secretariat**

Dr. Titi Candra Sunarti  
Dr. Prayoga Suryadharma  
Dr. Sugiarto, MS  
Dr. Faqih Uddin  
Niken Ayu Permatasari, STP, MSi  
Angga Yuhistira, STP, MSi  
Luthfa Jamilah, STP  
Yulianti  
Elvin Septiana

### **Paper & Proceedings**

Prof. M. Romli  
Prof. Marimin  
Prof. Ani Suryani  
Prof. Erliza Noor  
Dr. Liesbetini Hartoto  
Dr. Moch Yani

### **Accommodation dan Logistics**

Dr. Andes Ismayana  
Dr. Ade Iskandar  
Dr. Muslich  
Dr. Sapta Raharja

### **Design, Web and Publication**

Dr. Taufik Djatna  
Dr. Aji Hermawan  
M. Arif Darmawan, MT  
Teguh Adi Setia, AMd

## AGENDA

Time	Activities
<b>Monday, August 3<sup>rd</sup> 2015</b>	
08.00 - 09.00	Registration
09.00 - 10.00	Opening Ceremony <ul style="list-style-type: none"> <li>• Welcoming Address: Prof. Nastiti Siswi Indrasti (Head of DAT, Fateta, IPB)</li> <li>• Welcoming Speech Head of Bogor Regency</li> <li>• Conference Opening: Prof. Herry Suhardiyanto (Rector of IPB)</li> <li>• Opening Speech and Conference Opening : Minister of Industry Indonesia *</li> <li>• Launching Expose International program DAT</li> </ul>
10.00 – 10.05	<i>Photo Session</i>
10.05 - 10.15	<i>Coffee break</i>
10.15 - 10.45	Keynote Speech :
10. 45 - 11.30	1. Prof Irawadi (Bogor Agricultural University, Indonesia)
11.30 – 12.00	2. Prof. Kenneth De Jong (George Mason University, USA)
12.00 – 12.30	3. Dr. Yandra Arkeman (Bogor Agricultural University, Indonesia)
	4. Dr. Guillermo Baigorria (University of Nebraska, Lincoln, USA)
12.30 – 13.30	Lunch break
13.30 – 13.50	Plenary Session 1 :
13.50 – 14.10	Prof. Noel Lindsay (University of Adelaide, Australia)
14.10 – 14.30	Dr. Kiyotada Hayashi (National Agricultural Research Center, Tsukuba, Japan)
14.30 – 14.50	Prof. Margareth Gfrerer (Islamic State University of Jakarta, Indonesia)
14.50 – 15.10	Dr. Barry Elsey (University of Adelaide, Australia)
15.10 – 15.45	Ir. M. Novi Saputra (Marketing Director KML Food Group)
	<i>Discussion</i>
15.30 – 15.45	<i>Coffee break</i>
15.45 – 18.00	Parallel session A, B and C
18.00 – 21.00	Welcome Dinner

<b>Time</b>	<b>Activities</b>
<b>Tuesday, August 4<sup>rd</sup> 2015</b>	
08.30 – 09.00	Registration
09.00 – 09.20	Plenary Session 2 : Dr. Gajendran Kandasamy (PhD in Physic, Melbourne University ; PhD in Innovation Imperial Collage, London)
09.20 – 09.40	Prof. Allan O'Connor (University of Adelaide, Australia)
09.40 – 10.00	Dr. Eng. Wisnu Ananta Kusuma, ST, MT (Bogor Agricultural University, Indonesia)
10.00 – 10.20	Dr. Frank Neumann (University of Adelaide, Australia)
10.20 – 10.45	<i>Discussion</i>
10.45 – 13.00	Parallel Session A, B and C
13.00 – 14.00	Lunch break
14.00 – 15.30	Parallel Workshop <ul style="list-style-type: none"> <li>• Strategies for Agroindustry Development</li> <li>• LCA for Agroindustry</li> <li>• Innovation and Technopreneurship for Agroindustry</li> <li>• Agroindustrial Informatics</li> </ul>
15.30 – 15.45	Coffee Break
15.45 – 16.15	Closing remark



## TABLE OF CONTENTS

Welcoming address from general chairs	i
Welcoming address from head of Agroindustrial Technology Departement Bogor Agricultural University	ii
Committee	iv
Agenda	v
Table of Content	vii
<b>Abstract of Invited Speakers</b>	
Noel Lindsay	1
Kiyotada Hayashi	2
Barry Elsey	3
Frank Neumann	4
Yandra Arkeman	5
Wisnu Ananta Kusuma	6
<b>Innovative Agroindustrial and Business System Engineering</b>	
The Feasibility Study of Establishment of Biodiesel And Paving Block Industry From Spent Bleaching Earth	7
Febriani Purba, Ani Suryani and Sukardi	
Green Supply Chain Management Innovation Diffusion in Crumb Rubber Factories: Designing Strategies towards Implementation	13
Tri Susanto, Marimin Marimin and Suprihatin	
Mobile Business Analytics System for Service Level Analysis of Customer Relationship Decision	19
Taufik Djatna and Yudhistira Chandra Bayu	
Exploring an Innovative Approach to Address Non-Tariff Barriers Experienced by Small to Medium Enterprises in Downstream Coffee Production in Indonesia	26
Andar Hermawan, Yandra Arkeman, Titi Candra Sunarti	
Innovation on Guardrail Press Tool with Simple Technology for Highway Road Business	33
Bambang Suhardi Waluyo and M.Syamsul Ma'Arif	
An Analysis of Innovation Network Performance on the Palm Oil Industry in North Sumatera	34
Danang Krisna Yudha, Aji Hermawan and Machfud	
Application of Nanotechnology to Improve Physical Properties of Red Fruit Emulsion in order to Increase Its Industrial Use	41
Murti Ningrum and Syamsul Maarif	
Exploring the Internationalization Process Model of an Indonesian Product – Case study : Fruit Chips SME's	47
Dickie Sulistya Apriliyanto, Hartrisari Hardjomidjojo, Titi C Sunarti	
Innovation Management in Indonesian Palm Oil Industry	53
Karim Abdullah, Aji Hermawan and Yandra Arkeman	

Innovation Design Process for Gayo’s Coffee Quality Improvement Rahmat Pramulya, M Syamsul Ma'Arif and Tajuddin Bantacut	59
Technology Innovation Adoption to Improve the Performance of Dairy Small-Medium Enterprises (SME): Case study in Pangalengan-Bandung Regency, West Java, Indonesia Nuni Novitasari, Titi Candra Sunarti and Nastiti Siwi Indrasti	67
Process Innovation for Producing Bioethanol from Oil Palm Empty Fruit Bunches by Improving Fermentation Conditions Fitriani Kasim, Novizar Nazir and Syamsul Ma'Arif	76
Managing Innovation through Knowledge Sharing in An Indonesia Coconut SME Muchammad Kodiyat P, Machfud, Nastiti S Indrasti	82
Increasing Added Value of Banana by Producing Synbiotic Banana “Sale” Using Innovation & Technology Strategy Approach Eka Ruriani	88
Innovation Palm Fronds Briquettes Through Noncarbonization Process Petir Papilo, Syamsul Ma'Arif and Yandra Arkeman	93
Graphic Design Innovation As Brand Identity For “Mahlzeit N 'Das Brot “ Bread Packaging Zulkarnain, Deny Dwi Lestari and M. Syamsul Ma'Arif	100
An AHP Application for Selecting A Business Innovation Strategy of Chocolate SMEs in East Java Yani Kartika Pertiwi, M. Syamsul Maarif and Machfud	104
Understanding local food consumers and their motivations: A case study in Padang city Poppy Arsil	110
Spatial Model Design for Competitive Improvement of Small Medium Scales Enterprises (Case Study: Bogor City) Hartrisari Hardjomidjojo, Harry Imantho and Armaiki Yusmur	116
System Analysis and Design for Selecting Chitin and Chitosan Industry Location by Using Comparative Performance Index (CPI) Method Dena Sismaraini, Nastiti S. Indrasti and Taufik Djatna	121
Arduino-Based Temperature Monitoring Device for Cold Chain Transportation Delmar Zakaria Firdaus and Endang Warsiki	129
Development of Downstream Cocoa Industry: Exploring the Role of Government and Small and Medium Industry in Partnership Farda Eka Kusumawardana, Yandra Arkeman, Titi C Sunarti	134
The Role of Communication in the Technology Transfer (A Case Study at the Center for Agro-based Industry) Anindita Dibyono, Sukardi, Machfud	140
The Center for Pulp and Paper Appraising its Productivity in Generating Industry-Applicable Research: A Best Practice Illustration Ahmad Rudh Firdausi, Anas M Fauzi, Machfud	147
<b>Frontier Approaches in Process and Bioprocess Engineering</b>	
Identification of Flavor Compounds In Cemcem ( <i>Spondiazpinata</i> (L.F) Kurz) Leaf Extra	156

Luh Putu Wrasiasi, Ni Made Wartini and Ni Putu Eny Sulistyadewi Synthesis and Characterization of Nanosilica from Boiler Ash with Co- Precipitation Method	160
Wahyu Kamal Setiawan, NastitiSiswiIndrasti and Suprihatin The Comparison Of Media on the Microalgae <i>Nannochloropsis</i> sp. Culture	165
Anak Agung Made Dewi Anggreni, I Wayan Arnata and I B Wayan Gunam	
Identification of Media and Indicator Liquid as A Recorder Smart Label	169
Endang Warsiki and Riris Octaviasari	
The Effect of Consentration of Mes Surfactant From Palm Oil and Consentrasion of Inorganic Salt to Interfacial Tension Value	174
Rista Fitria, Ani Suryani, Mira Rivai and Ari Imam	
Effect of Nano Zinc Oxide On Bionanocomposite	180
Siti Agustina, Nastiti Siswi Indrasti, Suprihatin and Nurul Taufiqu Rohman	
The Effects of Molar Ratio Between 80% Glycerol And Palm Oil Oleic Acid on the Synthesis Process of Ester Glycerol	186
Mira Rivai, Erliza Hambali, Giovanni Nurpratiwi Putri, Ani Suryani, Pudji Permadi, Bonar T.H Marbun and Ari Imam Sutanto	
Selecting Part of Natural Fiber EFB which has Best Mechanical Strength through Tensile Test Analysis for Composite Reinforced Material	192
Farkhan, Yohanes Aris Purwanto, Erliza Hambali and Wawan Hermawan	
Effect Of Ethyl Methane Sulfonate (EMS) On Growth Rate, Cell Size, Fatty Acid Content And Antioxidant Activities Of <i>Dunaliella</i> sp.	199
Mujizat Kawaroe and Amelia Gustini	
Identification of phenol red as Staphylococcus aureus indicator label Dunaliella sp.	206
Melati Pratama, Endang Warsiki and Liesbetini Hartoto	
Enhancing Ethanol Tolerant of <i>Escherichia coli</i> Recombinant by Glutamate Addition under Aerobic Conditions	211
Indra Kurniawan Saputra, Prayoga Suryadarma and Ari Permana Putra	
In Vitro Potentifal of Antibacterial Marine Microalgae Extract <i>Chaetocerosgracilis</i> Toward <i>Staphylococcus epidermidis</i> Bacteria	216
Ardhi Novrialdi Ginting, Liesbetini Haditjaroko and Iriani Setyaningsih	
The Potential Applications of Modified Nagara Bean Flour through Fermentation for Innovation of High Protein Analog Rice	221
Susi, Lya Agustina and Chondro Wibowo	
Studies on the Characteristics of Pasayu (Pasta of Waste-Cassava) Fortification as a New Product Development	226
Marleen Sunyoto, Roni Kastaman, Tati Nurmala and Dedi Muhtadi	
Optical And Particle Size Properties Of <i>Sargassum</i> Sp Chlorophyll As Dye- Sensitized Solar Cell (DSSC)	234
Makkulawu Andi Ridwan and Erliza Noor	
Alkaline Pre-Treatment of <i>Gelidium latifolium</i> and <i>Caulerpa racemosa</i> for Bioethanol Production	239

Dwi Setyaningsih, Neli Muna, Elisabeth Yan Vivi Aryanti and Anastasya Hidayat

<b>New Trends in Industrial Environmental Engineering &amp; Management</b>	
Formulating a Long Term Strategy for Sustainable Palm Oil Biodiesel Development In Indonesia: Learning From the Stakeholder Perspective	247
Beny Adi Purwanto, Erliza Hambali and Yandra Arkeman	
Quality Improvement of Polluted River Water Used as Raw Water in Clean Water Supply by Using Biofiltration	253
Suprihatin, Muhammad Romli and Mohamad Yani	
An Empirical Investigation of the Barriers to Green Practices in Yogyakarta Leather Tanning SMEs	260
Dwi Ningsih, Ono Suparno, Suprihatin and Noel Lindsay	
Preliminary Study For CO <sub>2</sub> Monitoring System	267
Farhan Syakir, Rindra Wiska, Irvi Firqotul Aini, Wisnu Jatmiko and Ari Wibisono	
Designing a Collaboration Form to Overcome Innovation Resistance in Waste Management Practices in Lampung Tapioca Industry	273
Nur Aini Adinda, Suprihatin, Nastiti Siswi Indrasti	
Pollution Reducing Opportunities for a Natural Rubber Processing Industry: A Case Study	280
Syarifah Arum Kusumastuti, Suprihatin and Nastiti Siswi Indrasti	
Creating the Standard for Specific Energy Consumption at Palm Oil Industry	286
Alfa Firdaus and M Syamsul Ma'Arif	
Effects of Palm-Dea Non-Ionic Surfactant as an Additive in Buprofezin Insecticide on the Efficacy of it in Controlling Brown Planthopper Rice Pest	290
Fifin Nisya, Rahmini, Mira Rivai, Nobel Cristian Siregar, Ari Imam Sutanto and Ainun Nurkania	
<b>Intelligent Information &amp; Communication Technology for Adaptive Agroindustry of the Future</b>	
Design of Web-Based Information System With Green House Gas Analysis for Palm Oil Biodiesel Agroindustry	294
Yandra Arkeman, Hafizd Adityo Utomo and Dhani S. Wibawa	
Sequential Patterns for Hotspots Occurrence Based Weather Data using Clospan algorithm	301
Tria Agustina and Imas S. Sitanggang	
How to Deal with Diversity in Cultivation Practices using Scenario Generation Techniques: Lessons from the Asian rice LCI Initiative	306
Kiyotada Hayashi, Yandra Arkeman, Elmer Bautista, Marlia Mohd Hanafiah, Jong Sik Lee, Masanori Saito, Dhani Satria, Koichi Shobatake, Suprihatin, Tien Tran Minh and Van Vu	
Development of Life Cycle Inventories for Palm Oil in North Sumatra: Modelling Site-Specific Activities and Conditions	309
Vita D Lelyana, Erwinsyah and Kiyotada Hayashi	
Sequential Pattern Mining on Hotspot Data using PrefixSpan Algorithm	313
Nida Zakiya Nurulhaq and Imas S. Sitanggang	

An Intelligent Optimization Model Analysis and Design of Bio-filtration in Raw Water Quality Improvement	317
Ramiza Lauda and Taufik Djatna	
Development Of People Food Consumption Patterns Information System Based On Webmobile Application.	323
Fadly Maulana Shiddieq, Roni Kastaman and Irfan Ardiansah	
Association Rules Mining on Forest Fires Data using FP-Growth and ECLAT Algorithm	330
Nuke Arincy and Imas S. Sitanggang	
Development Of Expert System For Selecting Tomato ( <i>Solanum Lycopersicon</i> ) Varieties	334
Erlin Cahya Rizki Amanda, Kudang Boro Seminar, Muhamad Syukur and Noguchi Ryoza	
Developing Life Cycle Inventories for Rice Production Systems in Philippines: How to Establish Site-specific Data within the General Framework	340
Elmer Bautista, Kiyotada Hayashi and Masanori Saito	
Construction of Site-specific Life Cycle Inventories for Rice Production Systems in Vietnam	343
Tran Minh Tien, Bui Hai An, Vu ThiKhanh Van and Kiyotada Hayashi	
Study on Life Cycle Benefit Assessment as a tool for promoting the solution of Environmental Problems	346
Tetsuo Nishi	
Real Time Monitoring Glycerol Esterification Process with Mid IR Sensors using Support Vector Machine Classification	350
Iwan Aang Soenandi, Taufik Djatna, Irzaman Husein and Ani Suryani	
Extraction of Multi-Dimensional Research Knowledge Model from Scientific Articles for Technology Monitoring	356
Arif R. Hakim and Taufik Djatna	
Performance of Artificial Lighting Using Genetics Algorithms	362
Limbran Sampebatu	
The Application of Fuzzy-Neuro Approach for ERP System Selection: Case Study on an Agro-industrial Enterprise	367
Joko Ratonu, Kudang Boro Seminar, Yandra Arkeman and Arif Imam Suroso	

# Innovation Management in Indonesian Palm Oil Industry

Karim Abdullah<sup>1</sup>, Aji Hermawan<sup>2</sup>, and Yandra Arkemen<sup>3</sup>

*Institut Pertanian Bogor*

*E-mail: karim.abdullah@yahoo.com, [ajiher@gmail.com](mailto:ajiher@gmail.com), yandra.arkeman@gmail.com*

**Abstract-** Indonesia is the biggest producer of palm oil in the world with 31.5 million tons of Crude Palm Oil (CPO) in 2014 and had export value almost 21 million USD. On the other hand, the economic value of Indonesian palm oil is lower than Malaysia. It happened because the palm oil industry is less developed and depend on the large area of plantation. However, the development of palm oil industry is not only increasing the economic value but also creating new jobs for Indonesian. But, many problems happen in the developing process, one of them is the lack of Innovation. Therefore, the aim of the study is formulating innovation management for the palm oil industry. The research is using a case study strategy, with an inductive approach and interpretive philosophy. Data collection is using in-depth interviews with an expert from Industry, a researcher from University, and a researcher from research institution. The data is analyzed by a triangulation method. The result showed that the innovation management in upstream industry and downstream industry has different stage. The development of innovation in downstream area needs more stage called as a demonstration plant stage. Furthermore, the availability of the market becomes the main factor for enterprises to develop innovation. There are two types of market internal and external. Moreover, before conducting research, the industry categorizes their problems into four sections urgent-direct, urgent-indirect, less urgent-direct, and less urgent-indirect. Based on that, they can prepare a short-term and a long-term strategy. Finally, the industry can develop innovation by their own resources, but the government, research institution and university can help the industry to accelerate the process, by conducting collaboration among them.

Key Words : Innovation Management, Palm oil, Industry, Indonesia

<sup>1</sup>Karim Abdullah is a master student in double degree program between Institut Pertanian Bogor and University of Adelaide (corresponding author to +6285624772170)

<sup>2</sup>Dr Aji Hermawan is a Lecturer in Institut Pertanian Bogor, Jl. Raya Darmaga, Kampus IPB Darmaga, Bogor, Jawa Barat 16680, Indonesia

<sup>3</sup>Dr Yandra Arkeman a Lecturer in Institut Pertanian Bogor, Jl. Raya Darmaga, Kampus IPB Darmaga, Bogor, Jawa Barat 16680, Indonesia

## I. Introduction

### A. Background

Palm oil (*Elaeis guineensis Jacq*) is one kind of hard plant that comes from Africa. It grows inland location 500 meters above the sea surface. The plant produces a first fruit after three years that can be harvested for 25 until 30 years (Pahan 2011). The palm oil fruit, called fresh fruit bunch (FFB), produces crude palm oil (CPO) with yield between 20 and 24 % and palm kernel oil (PKO) with yield from 3 to 4% [1]

Moreover, the production cost of CPO is approximately 300 USD/ton, much lower than compared with the cost to produce one ton of soybean and rapeseed oil which are 400-800 USD and 500-700 USD respectively [2]. Furthermore, palm oil is the most economic commodity compared to other oil and fat resources. It is not only because of the price competitiveness but also the techno-economic superior attributes (both physical and chemical) of the palm oil. The superior attributes mean palm oil can be processed into different types of products on a wider area [3].

Palm Oil is the biggest and most important commodity in global trade, and it contributes more than 32% of the total volume of oil and fat produced in the worldwide [4, 5] [6].

CPO can be processed into several kind of product that can be categorized into two groups: edible products and non-edible products. There are several edible products such as margarine, vegetable oil, shortening, cocoa butter substitute, and coffee whitener. There are also many non-edible products like soap, detergent, plasticizer, and biodiesel [7]. So, the significant function of the commodity leads to the demand of palm oil in the world market rising significantly every year [5].

The palm oil is also one of the most important commodities for the Indonesian economy because it contributes high income and can empower many workers both in the upstream and the downstream industry [8]. Furthermore, the production cost of Indonesian's palm oil is the lowest when compared with other palm oil producers in the world [9].

In the last three decades, Indonesian palm oil industry has been growing rapidly supported by a large area of suitable land, good weather and availability of labor [10]. They make Indonesia become the world largest producer of crude palm oil

(CPO) in 2014, with total productions of approximately 31.5 million tons. For the coming years, CPO production in Indonesia is expected to increase gradually affected by the opening of new plantations in several areas [11, 12].

Furthermore, innovation is one of the key factors for developing the palm oil industry. It can help enterprises to expand their market segment, increase the quality of product and decrease the production cost [13]. Developing innovation is not easy for enterprises because they should have a good management to reach their goal.

### B. Research Question

Q1: What kind of innovation management uses by enterprises in developing innovation in Indonesian Palm Oil Industry?

Q2: What kind of strategy can be used to accelerate the development of innovation in palm oil downstream industry?

### C. Limitation

The research has been conducted in Indonesia and Australia from June 2014 until March 2015. The innovation management is based on the best practice in PT SMART Tbk, one of the biggest palm oil enterprises in Indonesia. Moreover, the Innovation management is also based on the researcher's interpretation of expert's opinion. The result of the research cannot be generalized for other palm oil enterprises in Indonesia because the sample was just only one. But the result can be used as a base for further research to create a new model to develop innovation in the palm oil downstream industry.

## II. Managing Innovation

There are three types of innovation which contribute to business development market innovation, product innovation, and process innovation. Market innovation focuses identifying new markets and how to provide a best service. Product innovation is concerned with the identification of new products and how these are best developed. Process innovation is tried to identify new internal operations and how these are best performed [14]. However, the term of innovation used in this thesis is concerned with two types of innovation which are product and process innovation.

Furthermore, Rothwel [15] Suggested five generations of the innovation process, and the characters of each generation can be seen in Table 1

Moreover, innovation is very important for a firm to survive in their business, both by creating new products or by improving the existing products. With innovation, they can maintain or increase market share of products or drive new markets [13]. Furthermore, Innovation also can give impact to the social and economic Change [16]. In addition, innovation can increase economic growth and decrease a poverty rate. It will involve complex inter-linkages among industry,

academician, and government within multiple overlapping "innovation ecosystems". The innovation can create new ways for the production process, more, better or previously unavailable products can be produced at prices that people can afford

TABLE 1  
Five Generations of Innovation

Generation	Period	Characteristics
First- The Technology push	1950s – 1960s	Innovation to develop new products and production technique
Second - the market pull	1960s – Early 1970s	Providing new products based on market and customers needed.
Third - the coupling model	Early 1970s – mid-1980s	The process of innovation represents the confluence of technological capabilities and market needs within the framework of the innovating firm
Fourth – The integrated model	Early 1980s – Early 1990s	Integrating suppliers into the new product development process at an early stage while at the same time integrating the activities of the different in-house departments involved, who work on the project simultaneously (in parallel) rather than sequentially (in series)
The fifth – The System integration and network Model	Early 1990s - now	Integration among strategic partner, supplier and customers with the strong system and has collaboration between marketing and R&D. Emphasis on flexibility and speed, and also focus on the quality

In the beginning, innovation development used a closed innovation paradigm, it means every activity to develop innovation in the firm just uses their own resource and do not involve an external party. However, there is a new paradigm for developing innovation in the firms, called an open innovation paradigm. The new paradigm suggests a firm should collaborate with other parties to develop their innovation. The principles of the paradigms are not all smart people work for us, but the firms need to work with smart people inside and outside the company; we do not have to develop new research to profit from it, a better business model is better than entering to

market first and we should gain profit from others who use our IP and we can gain profit by buying other IP [17].

Based on this open innovation paradigm, when a firm wants to develop innovation they should collaborate with other institutions. It can help them to optimize the process, reduce the cost and gain more benefit. Moreover, this study aims to formulate innovation management that including collaboration among companies, government and research institution in terms of developing innovation.

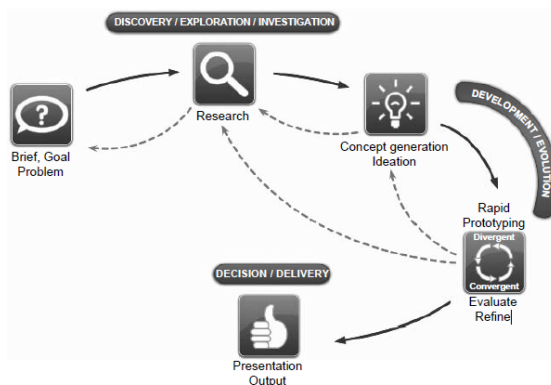


Figure 1. A Model of the Design Process (Carlopio 2010)

Moreover, to explain every stage in developing innovation, the paper is using an approach from Carlopio (2010). It is called as a model of design process. The model is developed from traditional strategic planning. The model of design process has five steps, the first is briefing; followed with research, after that is concept generation ideation, continued with developing a prototype, and the last is delivering the output. The model can be showed in figure 1.

### III. Research Methodology

#### A. Introduction

The study is using a case study strategy because the research aims to find a phenomenon occurring in a Palm Oil Industry. Furthermore, PT SMART Tbk is chosen as a sample for the study, we will learn from them how the company manages their strategy in order to develop innovation. Moreover, the respondents of the research also include researchers from university and research center, who will explain the innovation climate in palm oil industry based on their expertise. The results of the interview will be analyzed by a triangulation method to see the innovation condition in palm oil industry comprehensively [18]. Furthermore, the research will formulate a strategy to develop innovation in the palm oil industry based on the best practice in PT SMART Tbk (one of the biggest palm oil company). Finally, the research will suggest a collaboration management among stakeholders to accelerate the process of developing innovation in the palm oil Industry

#### B. Case Study

A case study research is a study to understand a phenomenon in its real world context. Robson defines case study as a strategy for doing research that involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence [18]). The case is based on best practice in PT SMART Tbk, a one of the biggest palm oil companies in Indonesia.

#### C. Validity

In qualitative study, researcher effects and bias are well acknowledged and become part of the study itself. As a consequence, the concept of validity within qualitative studies cannot be seen as fixed but is dependent on how the research process itself unfolds [19]. A qualitative approach may be considered valid if it retains a level of integrity and quality and is an accurate and truthful account of an individual's experience

Furthermore Maxwell [20] offers seven techniques to validate the result of qualitative research, there are: Intensive long-term [field] involvement; Rich data; Respondent validation; Search for discrepant evidence and negative case; Triangulation; Quasi- statistics; and Comparison. In this research, I validate my findings using two technique; Respondent validation and Triangulation method.

Triangulation is a method to see a point from the different point of views. The principle of the method is seeking at least three ways of verifying or corroborating a particular event, description, or fact being reported by a study. Such corroboration serves as another way of strengthening the validity of a study. The ideal triangulation would not only seek confirmation from three sources but would try to find three different kinds of sources. [21]

#### D. Participant

There are three respondents for the research, one from Industry, one from Research Institution and one from University. All of them are experts in developing innovation in palm oil industry

### IV. Result and Discussion

Research Question 1: *What kind of innovation management uses by enterprises in developing innovation in Indonesian Palm Oil Industry?*

The model of the design process from Carlopio (2010) is suitable to describe innovation management in the palm oil industry. Even though, the research also made several adjustments to the model especially about the name of steps.

#### A. Idea Generation

The first step of developing innovation is idea generation, which defining the problem and questioning the basic assumptions which surround it [22]. The Company generates ideas to solve problems



or to improve their system or products. In this study, ideas are generated from problems in the market. Moreover, there are two types of market; Internal and external market. Innovation for Internal market includes reducing production cost and improving product quality. Innovation for external market usually provides new products that have high demand in the market. Liwang [23] Says that he already identified the problems in their company, and he knows what kind of research needed to solve the problems. For example is how to use fertilizer as low as possible with productivity as high as possible. So there are several solutions for the problem (a) Change the plant, (b) Change the application, and (C) Change the time.”

Liwang [23] also says about the External market: before develop innovation, we should know where we will sell the product. Because a company always calculates the profit aspect before develop a new product, has it profit or not? If it gives profit, the company will try to provide that product.

After that, the research team will make a list of problem and also solution possibility based on their discussion. It will be used as a basis for the second step of innovation management.

### B. Idea Selection

There are many problems collected in idea generation stage, but they also have many ideas to solve it. So, to make it more manageable, they divide the problems into four categories based on priority, urgent-less urgent and direct - indirect. It can be seen in figure 1

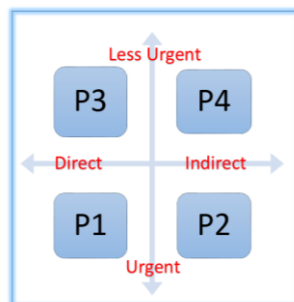


Figure 1. Research Priority Matrix (Based on the interview)

- P1: Direct and Urgent,
- P2: Indirect but urgent
- P3: Direct but Less Urgent
- P4: Indirect and less Urgent

The ideas in group P1 are a high priority research because the solution will give direct impact to the problems in the short term. The example of this type of research is a fertilizing scheme such as timing for giving the fertilizer, how much the dosage, and type of fertilizer

Furthermore, in Group P2 the solution has not direct interaction with the problem but it can solve the problem in different way. An example of this case is a

research about microbe that has effect to the absorption of fertilizer in the plant.

And in group P3 and P4, that research needs more time to gain a result, cannot finish just in a year. Even the research takes long time, but it is important for the company because it can solve the fundamental problems. For example is a research to develop a new seed which resists to fungus.

The research priority is used as a base for the R&D department to conduct their research. Which problems must be solved in the short term and which one for the long term. What kind of resources needed for the research, are they already having it? Or they need to make collaboration with other parties to solve the problems. So, the matrix priority is very important for the company to optimize their resources.

### C. Research and Development

The research and development activities are conducted in laboratory and plantation. The company also can make research collaboration with other parties such as universities and research institutions, it depends on the situations. Nowadays, the company already collaborates with University, and University student does a part of research. However, the focus of research is selected by the company, and it is usually a part of research that contained in P3 or P4 group of Research Priority. With this strategy, the result of research can be used by company to develop their innovation.

However, the collaboration with other parties is very important especially to develop innovation in downstream industry. Because it needs a lot money to be conducted

### D. Prototype Creation

There are two types of research based on the industrial area: upstream and downstream. There are several example of research in upstream area such as efficiency in fertilizer, pesticide, and human resource. The palm oil industry is already established in this area of research because they already have a site to develop prototype from their research. However, the industry is still struggling in developing innovation for the downstream industry, such as developing equipment to process CPO become oleochemical or other downstream products. The problems happen because creating that kind of equipment need a lot of money.

Hambali [25] from IPB says about the problem in creating a demonstration plant for palm oil downstream industry:

“Biodiesel, we are starting from industrial scale, but it must be observed. For example, we want to make 100.000 ton a year. It is big, isn't it? Who want to finance it? Industry does not want to do that, so government should finance it.

Finally, Liwang [23] from PT SMART Tbk argues about the innovation in the palm oil downstream industry

"After produces CPO and other downstream product; we just buy the technology because the technology does not change a lot of. If we want to change it, which research institution can do that? If we want to make a prototype, how much the budget needed? It is impossible."

Both respondents have similar think about developing innovation in the palm oil downstream industry. The main problem is lack of budget to scale up the research.

#### E. Implementation

The research result in upstream area can be implemented directly in the company especially in their plantation. For example research in developing a new seed. They will use the new seed for re-planting their old tree; so it can reduce the cost of planting. When they already fulfill the internal market, they will start to sell their seed to other companies or to farmers by creating a subsidiary company.

Furthermore, combining a short and long term research is a good strategy for the enterprises. It will produce innovation to solve their urgent and less urgent problem. Based on Rothwel [15], their research strategy is already in the third generation of Innovation.

However, even their strategy is already success implemented in upstream area, but the strategy does not work well in downstream area. There are many challenges in developing innovation in the downstream area, such as financial aspect, market demand, human resource and regulation.

Furthermore, research in the downstream industry needs a different strategy with research in upstream industry. Because, research in the downstream industry cannot just use a small scale capacity but needs to use a demonstration plant that has the similar capacity with the real plant. It means the research not only needs a lot of money but also has a high risk.

The development of innovation in the palm oil downstream industry needs one more step compare with the innovation management in the upstream industry, the additional stage is called as demonstration plant stage. In that stage, the industry should optimize their collaboration with other parties, the University and Research Institutions. The collaboration can help the company reduces the research cost and also divides the risk to other stakeholders.

**Research Question 2:** What kind of strategy can be used to accelerate the development of innovation in palm oil downstream industry?

There are many strategies to develop innovation for the palm oil industry. The most important thing is the

government should use their power to support the development process. Hambali [25] Suggests several strategies to accelerate the development process:

- a. Government should provide sufficient fund for university to buy new equipment. So the university can help companies to develop their innovation in downstream industry
- b. Government should reduce the tax for a company who has a research in downstream industry. .

In other hand, Susetyo [24], a researcher from BPPT, suggests government should implement a regulation that Private Company should participate in the research activity; venture and insurance also should enter the process. Moreover, government should reduce a tax for companies who do a research in developing innovation.

Liwang [23], Director of Research and Development of PT SMART Tbk, argues that the research depends on the availability of industry (market demand) and industry will grow up when the money (Incentive) is available, because it can reduce their cost so will increase their profit. However, the incentive is depend on the government regulation.

Based on the opinions from three points of views, the development of innovation in downstream industry depends on incentive from government to research institutions, university and Industry. The government can give incentive to research institutions and university in forms of additional budget to upgrade the research facilities such as machinery and laboratory equipment. For the Industry who has research to develop innovation in the palm oil downstream industry, the government can give incentive for them such as reducing tax.

However, the government also has a role to provide a wider market for the palm oil downstream industry. So the investor will interest to invest their money to develop innovation. Moreover, there are two types of market based on the location, local and export market. In Local market, government should stimulate Indonesian people to increase consumption of palm oil product, so it will increase the palm oil demand. For overseas market, Indonesian government should promote about the palm oil products to the market in other countries, so the demand of the palm oil products can increase.

Furthermore, Liwang [23] also suggests the government to lead the process of innovation development in downstream industry by creating an institution which deals with the activity.

"But if we are reckless, there should be an institution that deal with the development of palm oil downstream industry. I saw Malaysia, and it is simple. The important thing is working together. For example, there is a budget, 10 trillion, for five years. So we use students. Developing from University, LIPI and BPPT is also support. [23]

Furthermore, collaboration among government, research institution and industry can accelerate the

process of developing innovation in the palm oil downstream industry.

### V. Conclusion:

Based on the research, the model of design process from Carlopio is suitable to describe the innovation management in the palm oil upstream industry. However, the development of innovation in the palm oil downstream industry has a different stage; it needs one more step after the prototype creation stage which called as the demonstration plant stage.

The research also shows the industry generates ideas based on market demand both internal and external, and they also tries to provide a new technology for their customer. It shows that the industry already in the third generation of innovation. Moreover the industry categories their ideas into four groups: direct-urgent, direct- less urgent, indirect-urgent and indirect-less urgent. This strategy can optimize their resources, which one the priority and which one for the long term research.

In the research and development stage, industry can do the research with their resources or make collaboration with other parties, it depends on the situation such as the availability of human resources, machinery or laboratory instruments. Furthermore, the research in upstream area is easy to be implemented by company because the company already has their own market. In contrast, research in downstream area needs more support from the government and other research institution because the development of innovation in that area has a high risk and also needs more budgets.

### VII. Bibliography

- Sunaroko, *Petunjuk Praktis Budidaya dan Pengolahan Kelapa Sawit*. 2008, Jakarta: Agromedia Pustaka.
- Zimmer, Y., *Competitiveness of rapeseed, soybeans and palm oil*. Journal of Oilseed Brassica, 2010. **1**(2): p. 84-90.
- Basiron, Y. and M.A. Simeh, *Vision 2020 – The Palm Oil Phenomenon*. OIL PALM INDUSTRY ECONOMIC JOURNAL, 2005. **5**(3).
- (SDP), S.D.P., *Palm Oil Facts and Figures*. 2014.
- Abdullah, R. and M.B. Wahid, *World Palm Oil Supply, Demand, Price And Prospects: Focus On Malaysian And Indonesian Palm Oil Industry*. 2010, Malaysian Palm Oil Board (MPOB).
- Basiron, Y., N. Balu, and D. Chandramohan, *Palm Oil: The Driving Force of World Oils and Fats Economy*. OIL PALM INDUSTRY ECONOMIC JOURNAL, 2005. **5**(3).
- Team, *ROADMAP Industri pengolahan CPO*. 2009, Direktorat Jenderal Industri Agro dan Kimia- Kementerian Perindustrian: Jakarta.
- Sa'id, E.G., *Review Of Agroindustrial Strategic Studies, Researches And Development In Indonesia: The Case Of Oil Palm, Cacao And Gambir*. J. Tek. Ind. Pert, 2009. **19**(1): p. 45-55.
- Rifin, A., *Export Competitiveness of Indonesia's Palm Oil Product*. Trends in Agricultural Economics, 2009.
- Bangun, D., *Indonesian Palm Oil Industry*, in *The National Institute of Oilseed Products Annual Convention*. 2006: Arizona.
- (GAPKI), G.P.K.S.I. *Refleksi Industri Kelapa Sawit 2014 Dan Prospek 2015*. 2015 [cited 2015 03/03]; Available from: <http://www.gapki.or.id/Page/PressReleaseDetail?guid=dd997bd7-efbe-4ef7-aace-192e71eac097>.
- (MPOB), M.P.O.B. *MONTHLY PRODUCTION OF OIL PALM PRODUCTS SUMMARY FOR THE MONTH OF DECEMBER 2014 2015* [cited 2015 03/03]; Available from: <http://bepi.mpob.gov.my/index.php/statistics/production/125-production-2014/660-production-of-oil-palm-products-2014.html>.
- Datta, A., L. Jessup, and R. Reed, *Corporate Reputation and the Commercialization of Innovation- Does Reputation Match Reality, and Does Innovation Matter?* Technology and Investment, 2011. **2011**(2): p. 256-272.
- Johne, A., *Using market vision to steer innovation*. Technovation, 1999. **19**: p. 203-207.
- Rothwel, R., *Towards the Fifth-generation Innovation Process*. International Marketing Review, 1994. **11**(1): p. 7-31.
- Sang-Hoon Kim a and K.-H. Huarng, *Winning strategies for innovation and high-technology products management*. Journal of Business Research, 2011. **64**: p. 1147–1150.
- Chesbrough, H.W., *Open Innovation "The New Imperative for Creating and Profiting from Technology"*. 2003, Boston: Harvard Business School Press.
- Saunders, M., P. Levis, and A. Thornhill, *Research Methods for Business Students* ed. 5th. 2009, England: Prentice Hall.
- Golafshani, N., *Understanding Reliability and Validity in Qualitative Research*. The Qualitative Report, 2003. **8**(4): p. 597-607.
- Maxwell, J.A., *Qualitative Research Design: An Interactive Approach*. 1996, Thousand Oaks: CA.
- Yin, R.K., *Qualitative Research from Start to Finish*. 2011, New York: The Guilford Press.
- Carlopio, J., *Strategy By Design "A Process of Strategy Innovation"*. 2010, New York: PALGRAVE MACMILLAN.
- Liwang, T., *Expert's Opinion*, K. Abdullah, Editor. 2015.
- Susetyo, I.B., *Expert's Opinion*, K. Abdullah, Editor. 2015.
- Hambali, E., *Expert's Opinion*, K. Abdullah, Editor. 2015.