ICBB 2021
INTERNATIONAL CONFERENCE ON BIOMASS AND BIOENERGY

E-PROGRAM BOOK

INTERNATIONAL CONFERENCE ON BIOMASS AND BIOENERGY

"Challenges in Biomass, Bioenergy and Biomaterials Research and Development in a Rapidly Changing World"

Online Conference on Zoom | 9-10 August 2021

Host:

IPB University — Bogor Indonesia

SBRC — Surfactant and Bioenergy Research Center

Co-Host:

ISBB — International Society of Biomass and Bioenergy

Sponsored by:

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Message from Chairman of Organizing Committee

I am delighted and honored to welcome you all to the International Conference on Biomass and Bioenergy (ICBB) 2021 organized by Surfactant and Bioenergy Research Center (SBRC), IPB University, in collaboration with the International Society of Biomass and Bioenergy (ISBB). The conference provides an opportunity to build a network among academicians, researchers, and practitioners for promoting more collaborations and accelerating the development of science and technology in the field of biomass and bioenergy. This year's conference theme is Challenges in Biomass, Bioenergy, and Biomaterials Research and Development in a Rapidly Changing World.

Despite of pandemic, prominent keynote speakers, invited speakers, and participants from 10 countries are enthusiastic to joint this virtual conference and present their research works. We are glad and grateful to have two notable keynote speakers at the conference, namely His Excellency Minister for Energy and Mineral Resources the Republic of Indonesia, Bapak Ir. Arifin Tasrif and Prof. Dr. Yukihiko Matsumura from the Hiroshima University. We hope this conference can fulfill our goals to share technical knowledge, the latest technology developments, policy, and the initiative for collaboration within all stakeholders.

On behalf of the organizing committee, I would like to thank the steering committee, organizing committee, all supporting organizations, all speakers and special thanks also extended to our main sponsor. I hope this conference will succeed with a real contribution to our life.

Bogor, August 2021

Dr. Ir. Edy Hartulistiyoso, MSc.Agr

Milestones of ICBB

Surfactant and Bioenergy Research Center (SBRC)-IPB University has a good reputation in organizing international conferences. On 10-11th October 2016, SBRC-IPB University successfully conducted the 1st International Conference on Biomass with the theme "*Technology, Application and Sustainable Development"*. On 24-25th July 2017, SBRC-IPB University successfully conducted the 2nd International Conference on Biomass with the theme "*Sustainable Development of Biomass Utilization for Industrial Applications"*. On 1-2 August 2018, SBRC-IPB University in collaboration with the International Society of Biomass and Bioenergy (ISBB) successfully conducted the 3rd International Conference on Biomass with the theme "*Accelerating the Technical Development and Commercialization for Sustainable Bio-based Products and Energy"*.

Furthermore, on 19-20 August 2019, SBRC-IPB University in collaboration with the ISBB successfully conducted the International Conference of Biomass and Bioenergy with the theme "*Biomass and Bioenergy: A Pathway for Sustainable Development Goals"*. On 10-11 August 2020, SBRC-IPB University in collaboration with the ISBB successfully conducted the International Conference of Biomass and Bioenergy by online with the theme "*Advanced Technology and Digital Innovations in Biomass, Bioenergy and Agriculture"*. The papers of previous conferences were published in IOP conference series indexed by Scopus: Vol. 65, ICB 2016; Vol. 141, ICB 2017; Vol. 209, ICB 2018; Vol. 460, ICBB 2019; and Vol. 749, ICBB 2020. The documentation of previous conferences is shown below.

Concerning the important issue of sustainable development goals (SDGs) in a rapidly changing world, in this year the International Conference of Biomass and Bioenergy 2021 (ICBB 2021) hosted by SBRC-IPB University in collaboration with the ISBB is continuously held with the theme "*Challenges in Biomass, Bioenergy, and Biomaterials Research and Development in a Rapidly Changing World"*. Due to the COVID-19 pandemic, ICBB 2021 is held as an online conference. Nevertheless, in this big challenge, we have achieved such a milestone in the increasing of participants from ASEAN countries. In this year conference, we received submissions from Indonesia, Japan, Philippines, USA, Chile, France, Germany, Malaysia, China, and Czech.

We are enormously grateful for your kind support and contribution by participating in this year online conference. We are inviting all participants this year to the ICBB 2022 and we hope to see you all in next year conference.

SBRC-IPB University
International Society of Biomass and Bioenergy

Profile of SBRC

Surfactant and Bioenergy Research Center (SBRC) is one of the research centers under IPB University. Surfactant development research consists of processing and technology development research, followed by application of the product in various industries. Bioenergy development research contains integrated upstream to downstream research activities. These activities include processing and technology of bioenergy, role model of institutional development on bioenergy business, and sustainability assessments of Bioenergy development in Indonesia which covers environmental, social and economic aspects.

The recent promising bioenergy to develop is micro/macroalgae as the next alternative environmentally friendly biofuel feedstock. Furthermore SBRC is engaged in the field of biomass and bioproduct. Reseach and development in this field includes biomaterials technology, bioaditives, new biochemicals and green biorefinery. The last SBRC's research area is Advanced computing technology. This research area deals with the advanced digital technology including blockchain, robotics, artificial intelligence, internet of things, drone technology, as well as precision agriculture and agroindustry. The documentation of R&D activities is shown below.

During the last decade, SBRC, IPB University has extensive experiences in collaborating with international partners including collaborations with FAO Rome in 2012-2013, Central Research Institute of Electric Power Industry (CRIEPI) in 2011-2012 and 2014-2015, Research Institute of Industrial Science and Technology (RIIST-POSCO, South Korea) in 2011-2013. Other international cooperation include DFG-CRC990 with University of Goettingen, DE, DK (2012-2017), DANIDA-REDD+ with University of Copenhagen, Denmark (2014-2017), JICA-JSTSATREPS with Nagoya University, Japan (2015-2017), and RISTEKDIKTI AIC with Monash University and University of Sydney, Australia (2015-2017).

Profile of ISBB

The Founder Meetings of International Society of Biomass and Bioenergy (ISBB) was held one day before the ICB 2018 on 31 July 2018 with 18 participants, and the forum ended with a resolution that ISBB, the administrative body of the future conferences of biomass and bioenergy sciences be financially independent by Registration and Review & Publication fees, not seeking for the external funding support, but for the sustainability to keep the high scientific level of papers, as well as providing opportunities to local young generations to work in such an international environment. Current Co-chairs of ISBB are Prof. Dr. Yukihiko Matsumura (Hiroshima University, Japan) and Prof. Dr. Erliza Hambali (IPB University, Indonesia), and the Secretary is Prof. Dr. Haruhiro Fujita (Niigata University of International and Information Studies, Japan).

Figure. Founder Meetings of ISBB in 2018

Objectives of ISBB are to promote academic & industrial development in biomass (and related) fields, by providing opportunity of an international forum of operating international biomass conferences, publishing high level papers, as well as providing professional training programs; to host capacity development of young generation scientists and staff, providing opportunities to work in an international association, of implementing various projects as above.

Activities of ISBB are:

1. To have official publications of ICBB Proceedings and International Journal of Sustainable Biomass and Bioenergy (IJSBB)
2. To have strong network with biomass and bioenergy industries with the participation of their high-ranked official in the society
3. To organize conferences, training and short courses
4. To plan for mobility programs to allow participants or students to have more real-life experience in related industries.
5. To promote research attachment at established labs of its members for research capacity upgrading and expertise sharing
6. To give certain recognition to high-achievers in biomass science and technology

Under the essential collaboration with the Surfactant and Bioenergy Research Center (SBRC) of the IPB University, the ISBB has been taking major roles in:

1. Conference/paper administration in ICB 2018, ICBB 2019 - ICBB 2021
2. Original publication of International Journal of Sustainable Biomass and Biomass, 19 papers in three editions.

Content

Conference Program

Day-1: Monday, 9 August 2021

Jakarta time

Opening Ceremony	Opening and Keynote Session
07.30–08.30	Login and Registration
08.30–08.40	Opening Address (Prof Dr Arif Satria, Rector of IPB University)
08.40–08.50	Opening Address (The Indonesian Oil Palm Plantation Fund Management Agency)
08.50-09.10	Keynote Speech (The Ministry of Energy and Mineral Resources of the Republic of Indonesia) Indonesia's Policy and Contribution to Bioenergy Development
09.10–09.40	Keynote Speech (Prof. Dr. Yukihiko Matsumura, ISBB) Possibility of Biomass as a Carbon Source
Chair Kiyoshi Dowaki	**ICBB 2021 Plenary Session 1**
09.40–10.15	Prof. Dr. Akio Nishijima (The Engineering Academy of Japan) Sustainable Biomass Asia
10.15–10.50	Prof. Dr. David Herak (Czech University of Life Sciences, Czech Republic) Virtual reality and its application in the processing of agricultural products
10.50–11.25	Prof. Dr. Ahmad Zuhairi Abdullah (Universiti Sains Malaysia) Catalytic technologies for depolymerization of oil palm biomass lignin to simple phenolic substances
11.25–12.00	Prof. Dr. Navid Moheimani (Murdoch University, Australia) Saline algal culture for sustainable mass production of high value products
12.00 – 13.00	**Break**
13.00 – 16.30	**Parallel Sessions**

Day-2: Tuesday, 10 August 2021

Jakarta time

Opening Ceremony	Login Session
07.30–08.30	Login and Registration
Chair Justinus Satrio	**ICBB 2021 Plenary Session 2**
08.30–09.00	Prof. Dr. Erliza Hambali (IPB University, Indonesia) Prospects of Palm Oil Based Surfactant for Industrial Applications
09.00–09.30	Prof. Dr. Robert C. Brown (Iowa State University, USA) Heterodoxy in Fast Pyrolysis of Biomass
09.30–10.00	Dr. Oki Muraza (PT Pertamina, Indonesia) Circular Economy in Biofuel Production
10.00 – 12.00	**Parallel Sessions**
12.00 – 13.00	**Break**
13.00 – 16.30	**Parallel Sessions**
	Closing of ICBB 2021 by Conference Secretariat
16.30 - 16.50	Best Student Paper Award by Secretariat ICBB 2021
	Closing Adress by SBRC IPB
	Closing Remarks by ISBB
	Closing Remarks by Organizing Committee ICBB 2021

Day-1: Monday, 9 August 2021: Parallel Session

Time	Parallel 1: Biomass utilization and Bio-materials		Parallel 2: Bioenergy and AI/IT technologies in Biomass/Bioenergy/Agriculture		Parallel 3: Bio-chemicals		Parallel 4: Environment, Economic, Policy, Management/Business related to Biomass or Bioenergy	
	Paper	**Author(s)**	**Paper**	**Author(s)**	**Paper**	**Author(s)**	**Paper**	**Author(s)**
	SESSION 1		**SESSION 1**		**SESSION 1**		**SESSION 1**	
	ROOM A		**ROOM B**		**ROOM C**		**ROOM D**	
	Chair: Prof. Navid Moheimani		**Chair: Dr. Oki Muraza**		**Chair: Prof. Ahmad Zuhairi Abdullah**		**Chair: Assoc. Prof. Nunoura**	
	Operator:		**Operator:**		**Operator:**		**Operator:**	
13.00 - 13.20	Suwarti	[28] Description of maize check genotypes for selection on tidal-swamp land for biomass and grain production	(15.00 JST) Haruka Nakayama, Mitsuo Kameyama, Hisashi Kamiuchi and Kiyoshi Dowaki	[12] Optimization of Temperature Rise of Heat Carriers in Indirect Gasification Hydrogen Production Process Using CFD Simulation	Sang Ayu Made Sri Tandewi and Erliza Hambali	[82] Refining of Fish Oil from Fish Meal Processing By-Product Using Zeolite and Bleaching Earth	(15.00 JST) Kento Torii and Dowaki Kiyoshi	[17] LCA analysis and quantification of adsorption performance of Kanuma clay by simultaneous adsorption of H2S and NH3
13.20 - 13.40	Muhammad Hanifuddin, Riesta Anggarani, Milda Febria, Catur Y Respatiningsih, Rona Malam Karina, Setyo Widodo, Cahyo Setyo Wibowo, May Muchar and Rizkia Malik	[61] The Influence of Gasoline-Bioethanol Blends on Lubrication Characteristic of Motorcycle Engine Oil 4T	Kursehi Falgenti, Yandra Arkeman, Khaswar Syamsu and Erliza Hambali	[2] The design of blockchain network of palm oil FFB supply from certified farms and traceability system of CPO from independent smallholders	Taufik Taufikurahman, Rizka Purnamawati and Andira Rahmawati	[66] Decreased in Paddy Yield (Oryza sativa L.) as a Response to Plant Bioaccumulation of Chromium	(15.20 JST) Akihiro Oki, Takuma Kanemura and Kiyoshi Dowaki	[15] A combined evaluation on quality and eco-burdens of the tomato greenhouse air conditioner using the hydrocarbon refrigerant of GF-08
13.40 - 14.00	(15.40 JST) Shinji Kanehashi	[78] Novel Environmentally-Friendly Biomass-based Polymers	Mohamad Aman	[86] Determination of Diffusion Coefficient of Palm Oil in n-Hexane Using Laser Deflection Method and Image Processing	Evi Triwulandari, Witta K. Restu and Muhammad Ghozali	[14] Characterization and Modification of Starch Using Lactic Acid Oligomer to Decrease the Solubility in Water	Wanda Gustina Utami, Radya Yogautami, Dewi Agustina Iryani, Udin Hasanudin and Puspita Yuliandari	[80] The Potential of Energy Production and Greenhouse Gases Emission Reduction from Households Organic Waste in Bandar Lampung, Indonesia
14.00 - 14.20	Dian Burhani, Athanasia Amanda Septevani, Ruby Setiawan, Luthfia Miftahul Djannah and Muhammad Andrew Putra	[97] The effect of drying process of cellulose nanofiber from oil palm empty fruit bunches on morphology	(09.15 CEST) Sri Murniani Angelina Letsoin, David Herak and Ratna Chrismiari Purwestri	[77] Evaluation Land Use Cover Changes Over 29 Years in Papua Province of Indonesia Using Remote Sensing Data	Berlian Simanjuntak, Helen Julian and M.T.A.P. Kresnowati	[49] Downstream Process of Xylanase Enzyme Production from Oil Palm Empty Fruit Bunches: A Review	May Muchar, Riesta Anggarani, Lies Aisyah, Dimitri Rulianto, Muhammad Hanifuddin, Sylvia Ayu Bethari, Milda Febria, Cahyo Setyo Wibowo, Faqih Supriadi and Emi Yuliarita	[45] The Effect Characteristics Cetane Number of Two Types Commercial High Speed Diesel Fuel with Biodiesel Palm Oil Base Blended in Indonesia
14.20 - 14.40	Ravi Farkhan Pratama, Cahyo Setyo Wibowo, Nur Allif Fathurrahman and Edy Hartulistiyoso	[21] Effect of low percentage methanol blends in gasoline RON 90 on fuel volatility characteristics and spark ignition engine performance					Wildan Q. Salam, Helen Julian and M.T.A.P. Kresnowati	[47] Fermentation Based Sugar-Alcohol Downstream Processing: A Review

Time	Parallel 1: Biomass utilization and Bio-materials		Parallel 2: Bioenergy and AI/IT technologies in Biomass/Bioenergy/Agriculture		Parallel 3: Bio-chemicals		Parallel 4: Environment, Economic, Policy, Management/Business related to Biomass or Bioenergy	
	Paper	**Author(s)**	**Paper**	**Author(s)**	**Paper**	**Author(s)**	**Paper**	**Author(s)**
14.40 - 14.55	**BREAK**							
	SESSION 2		**SESSION 2**		**SESSION 2**		**SESSION 2**	
	ROOM A		**ROOM B**		**ROOM C**		**ROOM D**	
	Chair: Assoc Prof. Kanehashi		**Chair: Dr. Oki Muraza**		**Chair: Prof. Lee Keat Teong**		**Chair: Dr. Darmono Taniwiryono**	
	Operator:		**Operator:**		**Operator:**		**Operator:**	
14.55 - 15.15	Okta Amelia, Illah Sailah, Ika Amalia Kartika, Ono Suparno and Yazid Bindar	[62] Study on Effectivity and Efficiency of Various Drying Methods of Nyamplung Fruits (Callophyllum Inophyllum)	Erni Krisnaningsih, Yandra Arkeman, Marimin Marimin and Erliza Hambali	[36] Decision Model for Determining the Feasibility of Rice-Based Bioenergy Supply Chain Development Area with Fuzzy Logic-AHP Approach	Rossy Dwi Devitasari, Nur Allif Fathurrahman, Marsha Katilli, Cahyo Setyo Wibowo, Sylvia Ayu Bethari, Riesta Anggarani, Lies Aisyah and Maymuchar	[24] Determination of Oxidation Stability of Palm-Oil Biodiesel and Biodiesel-Diesel Blends by Rancimat and RSSOT Methods	Alfa Firdaus	[72] Strategies on the Development of Palm Oil-Based Biodiesel Agroindustry for Energy Security in Indonesia
15.15 - 15.35	(16.15 MYT) Mahmud Hakim, Muhammad Khairul Afdhol, Fiki Hidayat, Yuliusman Yuliusman, Razif Muhammed Nordin, Rosdanelli Hasibuan and Fadilul Fadly	[39] The Utilization Pineapple Skin Waste and Additive Xylene used As A Wax Inhibitors	Lukman Haris, Irman Hermadi, Ganjar Saefurahman, Dhani S. Wibawa and Yandra Arkeman	[94] Cellular Automata Machine Modeling with Probabilistic Cellular Automata to Obtain Optimal Conditions and Productivity of Microalgae Biomass	Taufik Taufikurahman, Deby Anindya Rizkyani and Andira Rahmawati	[83] Phytotoxicity of chromium-containing wastewater on germination and growth of Oryza sativa L.	Meika Syahbana Rusli, Obie Farobie and Muhammad Adi Septyan	[35] Effect of Bio-additive Derived from Essential Oils on Particulate Matter and Water Content of B30 (30% of Biodiesel Blended Fuel)
15.35 - 15.55	Fadilul Fadly, Muhammad Khairul Afdhol, Fiki Hidayat, Yuliusman Yuliusman, Razif Muhammed Nordin, Rosdanelli Hasibuan and Mahmud Hakim	[38] Bioethanol Formulation from Waste Pineapple and Additive Toluene as Wax Inhibitor	Totok Soehartanto, I Putu Eka Widya Pratama and Alvin Daviza Putra	[50] The Design of Fuel Dryer in Palm Oil Processing Industries by Utilizing the Heat Product of Boiler Based on Computational Fluid Dynamic	Salsabila Posmaryana Utami, Andre Fahriz Perdana Harahap, Muhammad Arif Darmawan, Misri Gozan and Muhammad Yusuf Arya Ramadhan	[70] Liquid-Liquid Extraction (LLE) of Furfural Purification from Oil Palm Empty Bunch with Toluene Solvent	Adil Fajar Widrian, Budiawan Sidik Arifianto, Nur Baiti and Nugroho Adi Sasongko	[63] Review Biodiesel Policy in Indonesia
15.55 - 16.15	Endang Warsiki and Kamilia Melinggawati Manan	[37] Application of Modified Atmosphere Packaging to Extend Pineapple (Ananas comosus L.) Shelf Life	Arty Dwi Januari and Haruki Agustina	[25] Palm Oil Empty Fruit Bunches and The Implementation of Zero Waste and Renewable Energy Technologies	Fabio Carisma Handita, Andre Fahriz Perdana Harahap and Misri Gozan	[56] Vapor-Liquid Equilibrium (VLE) Curve for Furfural Purification from Oil Palm Empty Fruit Bunch Hydrolysate Solution with the UNIQUAC Model	(04.55 EDT) Justinus Satrio and Maria Nydia Lynch	[26] Utilization of Grassy Biomass Grown in Heavy-Metal Contaminated Soil as Feedstock for Bioenergy Production - An LCA Study

Day-2: Tuesday 10 August 2021: Parallel Session

Time	Parallel 1: Biomass utilization and Bio-materials		Parallel 2: Bioenergy and AI/IT technologies in Biomass/Bioenergy/Agriculture		Parallel 3: Bio-chemicals		Parallel 4: Environment, Economic, Policy, Management/Business related to Biomass or Bioenergy	
	Paper	**Author(s)**	**Paper**	**Author(s)**	**Paper**	**Author(s)**	**Paper**	**Author(s)**
	SESSION 1		**SESSION 1**		**SESSION 1**		**SESSION 1**	
	ROOM A		**ROOM B**		**ROOM C**		**ROOM D**	
	Chair : Assoc. Prof. Kanehashi		**Chair: Prof. Navid Moheimani**		**Chair: Prof. Ahmad Zuhairi Abdullah**		**Chair: Assoc. Prof. Nunoura**	
	Operator:		**Operator:**		**Operator:**		**Operator:**	
10.00 - 10.20	(11.00 MYT) Basuki Wirjosentono, Darwin Yunus Nasution and Diana Adnanda Nasution	[89] Plastisisation of Polyvinilchloride Biofilms with Palm Oil Oleine and Methylmethacrylate as Comonomer	Widiatmini Sih Winanti, Wahyu Purwanta and Wiharja	[10] Utilization of Municipal Solid Waste into electricity energy: A performance study of the PLTSa Bantargebang Pilot Project	Herdhata Agusta, Dwi Guntoro, Mercy Bientri Yunindanova and Mei Nita Sari	[9] Thermal Hydrolysate of Coconut Trunk, Coir, and Shell as Bioherbicide	Abeth Novria Sonjaya and Adi Surjosatyo	[99] An Investigation on Gasification Conversions of Municipal Solid Waste Using Fixed Bed Downdraft: Study Case of Final Processing Site TPA Putri Cempo Surakarta Indonesia
10.20 - 10.40	Made Tri Ari Penia Kresnowati, Dianika Lestari, Ervina Desiviola Tommy, Mien Shavero Purba and Mustofa Anshori	[27] Carotene Production from Solid State Fermentation on Oil Palm Empty Fruit Bunches (OPEFB)	Muhammad Syukur Sarfat, Dwi Setyaningsih, Farah Fahma, Nastiti Siswi Indrasti and Sudirman	[51] Characterization of mono-diacylglycerols, cellulose nanocrystals, polypropylene, and supporting materials as raw materials for synthesis of antistatic bionanocomposites	Siti Nikmatin, Irmansyah Irmansyah, Muhammad Nur Indro, Gito Heryan and Mirna Mariani Sholikhah	[20] Thermal study of Ca(OH)2 coated OPEFB fibers from limestone through the calcination-hydration process	Ati Atul Quddus, Erliza Hambali, Mulyorini Rahayuningsih, Ika Amalia Kartika and Slamet Budijanto	[91] Bibliometric Mapping of Glucomannan Flour from Porang (Amorphophallus muelleri Blume) Tubers as Future Crops in Agriculture: Review and Future Research agenda
10.40 - 11.00	Mashur Mashur	[13] The Effect of Nest Box Types and Stocking Density on Multilevel of Shelf Cultivation System on Increasing Biomass Production of Eisenia foetida Savigny	Agung Nugroho, Amin Padil, Udiantoro Udiantoro and Wiwin Tyas Istikowati	[69] Characteristics and Performance of Charcoal Briquette from the Sawdust of Sungkai (Peronema canescens Jack)	Hablinur Al Kindi, Armansyah H Tambunan, Edy Hartulistiyoso, Salundik, Achmad Kemal Fadillah and Iyan Yuliana	[55] Equilibrium Behaviour of CO_2 Adsorption from Biogas Onto Zeolites	Dwi Setyaningsih, Farah Fahma, Purwoko, Aria Tri Wahyudi, Cyntia Humaira, Ellis Natalita Sitepu, Ikhrahmatul Shindy, Ilham Bintang Mahendra, Sindy Pratiwi Putri	[92] Technology Innovation and Business Model of Palm Oil Miniplant for Food and Energy
11.00 - 11.20	Gita Syarifah Ali, Erliza Hambali and Farah Fahma	[84] Potential of nanoemulsion process and method using agro-industrial based materials in skincare formulations: A review	Nur Suhascaryo and Angga Sirait	[60] Implementation of New Material "CCO" for Mud Drilling to Prevent Swelling Problem with Geonor As.	(13.00 JST) (12.00 CST) Daisuke Hara, Miao Shan, Junnosuke Shimogawa, Noboru Katayama and Kiyoshi Dowaki	[58] A Suitable Design of Metal Hydride Cartridge for a Fuel Cell Assisted Bicycle in Consideration of Heat Transfer Performace	Yogi Pramudito, Cahyo Setyo Wibowo, Nur Allif Fathurrahman, Riesta Anggarani, Faqih Supriadi, Sylvia Ayu Bethari, Dimaz Wirahadi, May Muchar, Emi Yuliarita and Dimitri Rulianto	[43] Comparison Performance CI Engine of Used fuel High Speed Diesel Fuel-Biodiesel Blend (B30) with B40 on Diesel Engine Dyno test
11.20 - 11.40	Nopia Cahyani, Andi Detti Yunianti and Suhasman Suhasman	[33] The Potential of Nano Bio Briquette from Coffee Ground and Pine Wood Waste	Alifiana Permata Sari, Rinaldi Medali Rachman, Mega Mutiara Sari and Eduardus Budi Nursanto	[52] The Utilization of Chicken Slaughter Waste for Organic Fertilizer	Sri Wahyono, Firman Laili Sahwan and Feddy Suryanto	[6] Characterization of Municipal Solid Waste for Waste to Energy Option in Jakarta	Reza Fathurahman and Adi Surjosatyo	[96] Utilization of rice husks as a fuel for gasification – A review

Time	Parallel 1: Biomass utilization and Bio-materials		Parallel 2: Bioenergy and AI/IT technologies in Biomass/Bioenergy/Agriculture		Parallel 3: Bio-chemicals		Parallel 4: Environment, Economic, Policy, Management/Business related to Biomass or Bioenergy	
	Paper	**Author(s)**	**Paper**	**Author(s)**	**Paper**	**Author(s)**	**Paper**	**Author(s)**
11.40 - 12.40	**BREAK**							
	SESSION 2		**SESSION 2**		**SESSION 2**		**SESSION 2**	
	ROOM A		**ROOM B**		**ROOM C**		**ROOM D**	
	Chair: Dr. Farah Fahma		**Chair: Dr. Dwi Setyaningsih**		**Chair: Prof. Lee Keat Teong**		**Chair: Dr. Ir. Udin Hasanudin, M.T.**	
			Operator:		**Operator:**		**Operator:**	
12.40 - 13.00	Reno Susanto, Ilman Azhari and Komalasari Komalasari	[98] Utilization of Palm Frond Waste to Control Corrosion in Industrial Piping Systems	Muhammad Fuad Fuad and Muhammad Kurniawan Kuniawan	[32] Producing biodiesel distillate with low monoglyceride for B40 Component by 1 plate and 30 plate (TBP distillation)	Siti Suharyatun, Agus Haryanto, Winda Rahmawati and Muhammad Naufal F.	[8] Valorization of Corncob Through Torrefation Process	Rizal Alamsyah, Susi Heryani, Dedi Darmawan Samid and Nobel Cristian Siregar	[64] Production of Fuel pellet From Agricultural and Plantation Estate Crops Biomass
13.00 - 13.20	Harapin Hafid and Peni Patriani	[4] Utilization of industrial waste banana chips in feed towards morphometrics and characteristics of thin-tailed sheep carcass	(14.00 MYT) Tengku Rachmi Hidayani, Basuki Wirjosentono, Darwin Yunus Nasution and Diana Adnanda Nasution	[88] Processing of Primary Sludge of Pulp Industry As Microfillers for Polystyrene foam Composites	Muhammad Fuad Fuad and Ishenny Mohd. Noor Mohd. Noor	[29] Effect addition of bioadditive in Biosolar properties	Harummi Sekar Amarilies, Iwan Sukarno, Alifiana Permata Sari and Eduardus Budi Nursanto	[54] Selection of Liquid Organic Fertilizer Packaging by Applying the Concept of Reverse Logistics Using Quality Function Deployment (QFD) Method DEPLOYMENT (QFD) METHOD
13.20 - 13.40	Ziedal Mafaaz Fafaaza Emha, Erliza Hambali and Dwi Setyaningsih	[79] Solid Alcohol Formulation as a Lighters in Charcoal Bio-Briquettes	Joko Prayitno, Rahmania Admirasari, Siti Jamilah and Agus Rifai	[30] Alternative source of nutrients for microalgae biomass production in a photobioreactor system	Ika Amalia Kartika, Satriyo Dibyo Sumbogo, Ikbal Fataya, Wega Trisunaryanti, Hartati Hartati and Illah Sailah	[7] Optimization of Calophyllum oil extraction and its application for biogasoline	(09.00 CEST) Resa Martha, Istie Sekartining Rahayu, Irmanida Batubara, Wayan Darmawan and Philippe Gérardin	[11] The promising future of tropical marine microalgae: culture, biomass production, potency, and challenges in food and health applications.
13.40 - 14.00	Muliadi Ramli, Nurdin Saidi, Muniana Murniana and Minna ti Maisarah	[41] Aceh Local Dolomite Modified Alkali Metals as Low-Cost Solid Inorganic Catalyst for Biodiesel Synthesis	Peni Patriani, Harapin Hafid, T. V Wahyuni and T V Sari	[5] The Effectiveness of Honje (Etlingera elatior) Biomass on improving the physical quality of native chicken meat	Abdul Salam, Distra Rizki, I Santa, S Supriatin, Liska Septiana, Sarno and Ainin Niswati	[46] The Biochar-Improved Growth-Characteristics of Corn (Zea mays L.) in a 22-Years Old Heavy-Metal Contaminated Tropical Soil	Diah Noerdjito, Debora Purbani, Asep Bayu, Kusmiati, Gede Suantika, I Made Sudiana and Serly Sapulete	[81] Improvement of Short Rotation Teak Wood by Glycerol-Maleic Anhydride Treatment
14.00 - 14.20	(09.00 CEST) Britta Brands and Matthias Kleinke	[57] Astaxanthin production in Xanthophyllomyces dendrorhous grown in medium containing watery extracts from vegetable residue streams	Tengku Dahril and Aras Mulyadi	[3] Applied Technology to produce Chlorella Jelly Genki to Increase Human Body Immunity from Covid-19 Illness.	(15.00 PHST) Artbellson Mamuri, Nathaniel Ericson Mateo, Thomas Ubiña and Shirley Agrupis	[22] Optimization of a 10 Liter Full Electric Reflux Distiller		
14.20 - 14.35	**BREAK**							

Time	Parallel 1: Biomass utilization and Bio-materials		Parallel 2: Bioenergy and AI/IT technologies in Biomass/Bioenergy/Agriculture		Parallel 3: Bio-chemicals		Parallel 4: Environment, Economic, Policy, Management/Business related to Biomass or Bioenergy	
	Paper	**Author(s)**	**Paper**	**Author(s)**	**Paper**	**Author(s)**	**Paper**	**Author(s)**
	SESSION 3		**SESSION 3**		**SESSION 3**		**SESSION 3**	
	ROOM A		**ROOM B**		**ROOM C**		**ROOM D**	
	Chair : Dr. Tatang Hernas Soerawidjaja		**Chair : Dr. Farah Fahma**		**Chair : Dr. Herdhata Agusta**			
	Operator:							
14.35 - 14.55	I Made Sudiana, Tri Ratna Sulistiyani and Ikhsan Guswenrivo	[87] Application of Compost, fertilizer and beneficial microbes to support Sorghum's Growth in Ultisol	Karnita Yuniarti, Efrida Basri and Lisna Efiyanti	[59] INTERMITTENT DRYING OF DRAGON BLOOD'S RESIN	Dwi Setyaningsih, Crisman Arianto Siagian, Neli Muna and Purwoko	[95] Synthesis of Bio Hydrocarbon from Palm Olein Through Pyrolysis at Various Temperature		
14.55 - 15.15	Nur Akmalia Hidayati, Septhian Marno, Irika Devi Anggraini, Rijal Ali Fikri, Wihdhatul Latifah, Nelliza Putri, Irma Nur Fitriani, Bayu Prabowo and Rachma Fitriani	[23] Development of fertilizer-based medium for the growth rate improvement of Chlorella sp. in the laboratory scale	Edy Hartulistiyoso, Obie Farobie and Suandireza Rholanjiba	[42] A Comparative Study on the Effect of Catalysts on the Yield of Biodiesel from Kemiri Sunan (Reutealis trisperma) Oil	Maharani Dewi Solikhah, Andrias Rahman Wimada, Anisa Galuh Arisanti, Feri Karuana, Hafizh Ghazidin, Hanafi Prida Putra, Fatimah Tresna Pratiwi and Bina Restituta Barus	[68] Influence of B30 palm based biodiesel blends upon degradation of elastomers		
15.15 - 15.35	Ahmad Nurul Muttaqin, Hairul Arsyad and Onny Sutresman	[1] Characteristics of Corn Cobs from the Ball Mill Process	Dedi Suntoro, Paber Sinaga, Radityo Cahyo Yudanto and Faridha Faridha	[73] Energy Efficiency and Energy Saving Potential Analysis of Biomass Boiler at the PT Greenfields Indonesia Milk Processing Plant	Nyoman Puspa Asri, Rahayu Saraswati, Rachmad Ramadhan Yogaswara, Suprapto Suprapto and Nadya Errys Restyani	[74] Converting of kesambi (Schleichera oleosa l.) oil into biodiesel using ZnO-based solid acid catalyst		
15.35 - 15.55	Siti Nikmatin, Irmansyah Irmansyah, Muhammad Nur Indro, Adi Cifriadi, Muhammad Farhan and Yulisa Aviani Nurwinda	[19] The Effect of Woven Oil Palm Empty Fruit Bunches (OPEFB) Filler Fiber on the Mechanical Properties of Natural and Synthetic Rubber	Hurun Iin, Sugiarto Sugiarto and Farah Fahma	[93] Production of zeolite-cellulose nanocomposites with garlic essential oil for antimicrobial tablets	Diini Fithriani and Susiana Melanie	[40] Vitamin and mineral content of microalgae Phorpyridium and Chlorella and development prospects for food raw materials		
15.55 - 16.15	Eduardus Budi Nursanto, Rinaldi Medali Rachman, Mega Mutiara Sari and Alifiana Permata Sari	[53] The Utilization of Fruit Peels as Carbon Source for Production of Organic Fertilizer			(04.35 CLT/EDT) (10.35 CEST) Rene Garrido, Joseph Reckamp, Philipp Bastian, Nicole Rumore, Charles Coe and Justinus Satrio	[34] Influences of Zinc Chloride on Fast Pyrolysis of Pinewood		
16.15 - 16.30	**BREAK**							

Abstract of Papers

Preface

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PREFACE

The International Conference on Biomass and Bioenergy (ICBB) 2021 was successfully conducted as a fully online conference by the Surfactant and Bioenergy Research Center (SBRC)-IPB University, Indonesia in cooperation with the International Society of Biomass and Bioenergy (ISBB); College of Engineering, Villanova University, USA; and Biomass Project Research Center, Hiroshima University, Japan. ICBB 2021 was sponsored by The Palm Oil Fund Management Agency (BPDP Sawit) and IPB University. ICBB 2021 with the theme of **Challenges in Biomass, Bioenergy, and Biomaterials Research and Development in a Rapidly Changing World** was the sixth international scientific conference on biomass and bioenergy hosted in Indonesia. This conference is conducted annually to raise current global issues in biomass and bioenergy fields.

Due to COVID-19 related real conference and travel restrictions, ICBB 2021 was held as an online conference on 9-10 August 2021 by Zoom Video Conference platform. ICBB 2021 was organized by SBRC-IPB University and hosted from IPB International Convention Center, Bogor, Indonesia. To maintain the continuity of the annual conference and the intention of scientists to disseminate and publish their research, as well as the uncertainty of the end time for COVID-19, the ICBB 2021 associates and stakeholders decided to hold a virtual conference and not postpone the conference.

ICBB 2021 main program consisted of seven plenary sessions and four thematic parallel sessions. ICBB 2021 successfully delivered 30 minutes-plenary lectures (20 minutes lecture, and 10 minutes discussion and Q&A sessions) of some prominent scientists in biomass and bioenergy sciences from 5 different countries, i.e., Prof. Dr. Akio Nishijima (The Engineering Academy of Japan), Prof. Dr. David Herak (Czech University of Life Sciences, Czech Republic), Prof. Dr. Ahmad Zuhairi Abdullah (Universiti Sains Malaysia), Prof. Dr. Erliza Hambali (IPB University, Indonesia), Prof. Dr. Robert C. Brown (Iowa State University, USA), Dr. Oki Muraza (PT Pertamina, Indonesia) and 78 parallel presentations (20 minutes presentation and Q&A for each presenter). ICBB 2021 thematically discussed four key topics as follows:

1. Biomass utilization and Bio-materials,
2. Bioenergy and AI/IT Technologies in Biomass/Bioenergy/Agriculture,
3. Bio-chemicals,
4. Environment, Economics, Policy, Management/Business related to Biomass or Bioenergy

The paper committee received 99 submissions and finally accepted 70 full papers of over 78 presentations which were delivered in the conference and published in this ICBB 2021 proceedings after the peer reviewing process. There were more than 151 participants who attended online ICBB 2020 from 8 countries (Japan, Czech Republic, Malaysia, USA, Germany, Philippines, Chile, and Indonesia). The differences in time zones and the quality of the participants' internet networks posed a challenge to the implementation of this online conference. However, this was resolved by conducting preparatory Zoom video meetings with session chairs and presenters before the conference was taken place. Therefore, the technical quality and delivery success of the conference as a whole were very good.

Acknowledgments and appreciations are given to the Rector and Vice Rector of IPB University for their support to the conference, to the reviewers and editorial board members, committee members, and event partners who worked hard to make the conference and the publication of this proceeding successful. The conference committee acknowledged the support and sponsorship from The Palm Oil Fund Management Agency (BPDP Sawit) and IPB University.

The paper committee did their best to accomplish manuscript reviewing and editing by following the best scientific standards in the IOP Conference Series: Earth and Environmental Science. However, there might be some shortcomings found in this proceeding. Therefore, suggestions from readers are greatly appreciated, so that the quality of the ICBB conference proceeding will be

improved in the future. We hope this ICBB 2021 proceedings will provide knowledge and benefits to academics, scientists, industrial stakeholders, and policy makers, especially in the field of biomass and bioenergy. Thank you for your kind attention.

Bogor, March 2022
The International Conference of Biomass and Bioenergy 2021
Organizing Committee

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The design of blockchain network of palm oil FFB supply from certified farms and traceability system of CPO from independent smallholders

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The design of blockchain network of palm oil FFB supply from certified farms and traceability system of CPO from independent smallholders

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Abstract. Mills produce Crude Palm Oil (CPO) from procurement channels of their plantation, plasma farm, and independent smallholders' farm. The mill manufactures Fruit Fresh Bunch FFB from all channels and sells CPO with low Free Fatty Acid (FFA) CPO for foods and CPO for industrial. CPO with low FFA for export consists of premium-grade CPO with FFA level < 2% and super-grade CPO with FFA level <3.5%. This Low FFA CPO is exported for food to developed countries. The food industry as a CPO customer needs a lot of information about the origin of the CPO commodity and information about sustainable oil palm agriculture governance. The challenges of building low FFA CPO traceability system raw material of CPO come from three-channel of FFB procurement and produce the various quality of CPO. This study aims to map the FFB supply at PT. RSI from Roundtable on Sustainability Palm Oil (RSPO) certificate farm in independent smallholders groups channel in the Hyperledger Fabric blockchain network and smart contract. The interaction of entities with smart contracts is described in the ERD diagram, and the form of collaboration between entities is illustrated in the sequence diagram. The design of blockchain network of FFB supply and traceability of FFB from independent smallholders group procurement channel was based on CPO sales data from the exporter. The contribution of independent smallholders group channels to produce low FFA CPO was calculated. By presenting the CPO supply system on a map, independent smallholders' farms' source of low FFA CPO can be identified. Finally, various sustainable information in the farms can be shared.

1. Introduction

Low Free Fatty Acid (FFA) of CPO is an essential vegetable oil for the food industry due to its high calory content and affordable price compared to other vegetable oil. Therefore, the global CPO industry keeps growing, including in Europe. The increase in CPO consumption occurs because most people are eager to change their consumption pattern and avoid consuming hydrogenated fat and solid fat derived from the animal [1]. Low FFA of CPO for export commodity coming from the plantation owned by big enterprises. Meanwhile, Indonesia's smallholder only contributes about 3% of 9% of the export value of smallholders worldwide [2]. Low FFA of CPO for export comprises premium-grade with less than 2% of FFA content and super-grade with less than 3.5% of FFA content.

European Union (EU) is the world's 3rd highest importer CPO from Indonesia, and the EU ensures only import of CPO from sustainable sources [1]. A few parties in Europe and CPO producer countries

are now trying to increase smallholders and independent smallholders contributions to CPOs for export. Such as done by the *terpercaya* initiative in Indonesia, which is a part of the CPO sustainable program between Malaysia and Indonesia, a collaboration of stakeholders in developing sustainable agriculture commodities [3]. *Terpercaya* initiative has aided smallholder's and local farmers in CPO centres, such as in Seruyan and Kotawaringin Barat, Central Kalimantan. There, they have achieved RSPO/ISPO certificate through jurisdiction approach [4]. Owning Roundtable on Sustainability Palm Oil (RSPO) certificate, smallholders united in a group of farmers can access the international market and achieve an added value by trading off their RSPO certificates credit through virtual trading or book claim GreenPlatform. The book and claim system use supports the sustainable production of palm oil. The importer only claims it through virtual trade.

For instance, Nissin, a Japanese food company, highlights more on the rights of independent smallholders in the CPO supply chain. They identify and evaluate the default that may occur in the CPO supply chain in Asia. Working along with Serikat Petani Kelapa Sawit (SPKS) and Kredit Petani Primer Anggota (KKPA), Nissin surveys the independent smallholders' life who domicile 25 km in the distance from mills. The survey purpose of strengthen human rights and the sustainability issues in the CPO supply chain [5].

Like other supply chains of agriculture commonly, the safety and the quality of CPO are highly required to ensure the health and safety of the end-users. As a producer, the mill is necessary to consider about how to sell CPO. The mill is also required to offer added value to its customers. Consequently, the mill is required to provide an information service to convey the source of its low FFA of CPO through a traceability system. The market is eager to ensure a sustainable CPO, especially the European Union market that accepts imported CPO from a reputable source [1]. CPO certification is a prerequisite to be accomplished to make CPO acceptable in Europe and other developed countries. To ensure sustainable CPO, RSPO owns the principles and the criteria on the CPO production that significantly impacts the environment and the society, including the direct production input in the plantation, starting from the seeds, chemical, water, and the social impact regarding the connection between the workers and the society around the farm. The farm as a producer of FFB and mill as a producer of CPO become the essential objects of RSPO certification. The sustainable information service from the plantation and mills is easier to share with their end-users through a traceability system.

The government, mills, and smallholders are obliged to work side by side in building the traceability system for both downstream and upstream. Mill may start identifying and building the database of the certified farm as the source raw material to produce CPO for export purposes. The government through its plantation service owns Surat Tanda Daftar Budidaya Perkebunan (STDB) data, source of palm oil farm data. STDB comprises the farm owned by independent smallholders and plasma smallholders, particularly those who own less than 25 hectares of land. Despite not all the independent smallholders listed, the STDB data of palm oil farms can be used to classify and build a valid database of farms with valid legality, good productivity, and a supply system that can support low FFA of CPO production. Besides ensuring an accurate source, the traceability system may also benefit for enhancing people's trust in the product and the company [6]. On the other hand, RSPO lacks because RSPO cannot ensure a sustainable CPO supply chain [6], especially downstream.

The long supply chain, a complicated network, and dynamic information make it uneasy about being traceable. A strategy used in developing a traceability system is decomposing the CPO supply chain into sub-network FFB procurement and production low FFA CPO and sub-network delivery of CPO from the factory to food companies in exported countries. In each sub-network, numerous parties interact with one another based on an agreement made. In sub-network FFB procurement and CPO production, core plantation farmers, a group of plasma smallholders, and a group of independent smallholders interact with mills in the business process of FFB procurement. At the same time, in sub-network delivery of CPO, exporters interact with mills in CPO trade transactions.

The raw materials for CPO production come from three channels of FFB procurement. They are the channel of procurement from core farmers in the land of a plantation owned by mills, the channel of procurement from plasma smallholders, and the channel of procurement from independent smallholders. Interaction among the parties in a separate channel with the other channels and FFB

procurement transactions is varied from one to another. The procurement from the core farmer's plantation without a trade process and the plasma smallholders procurement is more accessible because they are guided and bound with the mill. In contrast, the procurement from the independent smallholders consists of two types: smallholders with no partnership and group of smallholders who own RSPO certificate and collaborate with mills (Fig.1). The partnership can be in the form of a procurement contract or MoU of procurement only. The more independent smallholders who partner with the mill, the bigger their opportunity to produce low FFA of CPO for export purposes. Consumers from developed countries wish to receive low FFA of CPO coming from the smallholders. The farm information and their contributions are shared with the consumers, making the traceability system of low FFA of CPO more informative.

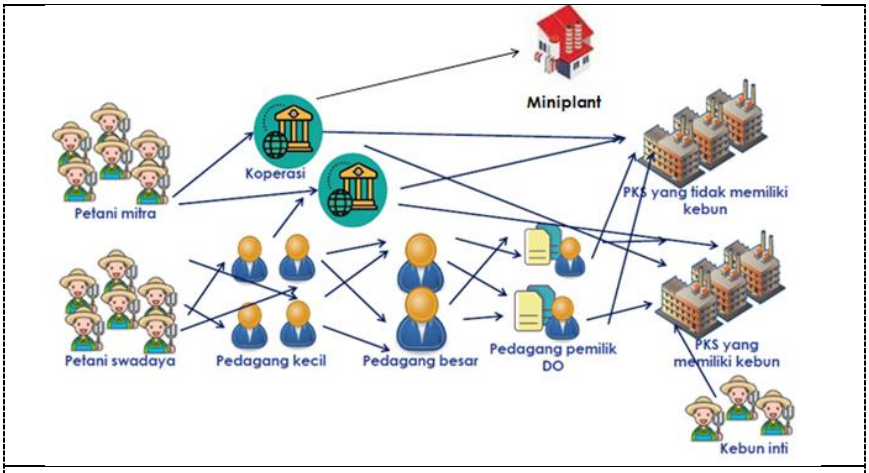

Figure 1. Independent smallholder FFB supply chain

To ensure information needed can be shared in the traceability system of low FFA of CPO from the different channels of FFB procurement, so it needs the support of advanced technology. Blockchain and smart contracts are the combinations of advanced technology that can develop a Distributed Application (DApp) to support the FFB traceability system. Public blockchain technology becomes popular in developing bitcoin, a digital currency. The characteristic of traceability, immutability, audit ability, and provenance are equipped by blockchain that disrupts the supply chain [7]. The consortium chain is developed to facilitate the supply chain [8], a particular blockchain type requiring registration and permission. The participants are restricted and verified through the determined node. The Consensus algorithm on the consortium chain only validates data and blocks through a previously selected node, not all nodes. By this work pattern, consensus and data validation can be promptly achieved. A consortium chain is only accessible in a particular organization. Data access of transactions in the consortium chain is manageable and viewable by certain interested parties, based on the authority given. Consortium chain technology and smart contract can be used in developing DApp FFB supply system. The FFB supply chain characteristic consists of numerous procurement channels, and each channel owns a varied business process. Consortium blockchain is a suitable technology to use develop a traceability system in the supply chain.

This research aims to design a DApp of FFB supply and traceability system for low FFA CPO production from independent smallholders using a consortium blockchain. From the sale data of low FFA CPO by a mill, the contributions of each channel of FFB producing low FFA CPO can be defined. Food companies in exported countries can identify FFB supplier farms and mills that produce low FFA CPO they import through the traceability system. Besides information on farm location, it can also share detailed information on the sustainable farm with InterPlanetary File System (IPFS) support.

2. Blockchain and Smart Contract

Blockchain is renowned as the internet of value and is the third generation of the internet. Previously, we know the internet of things (IoT) as the second generation and the internet of people as the first generation [9]. Blockchain technology is a part of advanced technology for industry 4.0 [10]. Blockchain can be applied to develop a traceability system on the supply chain. All actors are connected in one network and can operate numerous rules and groups of business processes in the blockchain platform. Blockchain technology encourages all parties to be involved in a more spacious business process, more effective and efficient without involving third parties and centralized authority. As a credible digital network [11], all parties connected in the blockchain network may do their transaction automatically and safely without a reconciliation process that makes ineffective operation. The main issue highlighted in the supply chain is eliminating asymmetric information and inefficient process among the partners. The causes of inefficiency are infrastructure and incompatibility issues. The more application used, the more companies become inefficient and uneconomical to reconcile both data and process continually.

The difference of the information system applied makes an ineffective connection and makes end-to-end traceability difficult among the parties [12]. On the other hand, blockchain offers immutability, audit ability, and provenance. All these capabilities have not been found in the previous technology. Decentralization is another superiority of blockchain. Blockchain technology is an important technology in the supply chain transformation, It makes it more powerful, and several parties collaborate in a transparent ecosystem [13]. The transaction is stored in a block, starting from its production process to its distribution and sale. Transparency and visibility are essential to increase product traceability and ensure product originality and validity [14]; [15].

Smart contracts and blockchain integration can increase the business process of supply chain operation to be more accurate, more valid, more transparent, more secure, and more efficient. The smart contract is a small program stored in the blockchain, and it works when information conditions in a determined contract are fulfilled. Automatically, the smart contract sends a determined data source, including the cause (the trigger) of the occurrence. Smart contract receives the transaction and causes the occurrence in the form of a function call, enabling the entity and node to monitor, track, and receive a relevant warning once a violation occurred. Node is a component inside the blockchain and an entity that participated in the supply chain. Nodes function gathers, validates, executes the transaction, stores the data, and all transaction results in the ledger. This ledger is then replicated and synced by all nodes. FFB procurement that consists of numerous channels is more suitable when using a consortium chain. The transaction in the consortium chain supported by smart contracts does not require a central institution and mediator. This enhances the integrity, reliability, and security of the transaction.

3. Research Methods

Independent smallholders FFB supply system to produce low FFA CPO and the traceability system of low FFA CPO are supported by DApp. This application is developed using consortium chain technology and smart contract. The blockchain platform used in this research is Hyperledger Fabric. DApp development method of FFB supply and low FFA CPO traceability with system approach [16], developing input and output diagram, identifying system components in diagrams, starting the involved actors and their roles. Input and output rules data and resources are needed (Fig.2). Next, analyzing and designing DApp using UML. The diagram to be developed is the Entity-Relationship Diagram (ERD) and sequence diagram. Blockchain network design in this research only uses one channel of FFB procurement from independent smallholders. This blockchain network design will then be developed by integrating FFB procurement channels of groups of plasma smallholders and core farmers' plantations.

The implementation of advanced technology 4.0 like blockchain was tested on a small-scale pilot project to grasp the requirements [17]. The user and system requirements for developing FFB supply and low FFA CPO DApp in this research were obtained through the case-study process at PT. RSI located in Suka Damai village, Ujung Batu district, Rokan Hulu regency, Riau province. The capacity of CPO production of PT. RSI was 90 tons/hour. Two weighing terminals support the FFB

procurement, one terminal is for FFB trucks from its farm, and another is for weighing the trucks from outside the mill, so PT. RSI also receives FFB from outside. A group of independent smallholders fostered has received RSPO certification with a plantation area of 250 ha has established an MoU on the supply of FFB to PT. RSI. At the end of this year, two more farmer groups joined so that the area of the plantation that already has RSPO certification and cooperates with PT RSI was 800 ha of land owned by about 200 independent smallholders.

CPO product coming from fostered smallholder's farms is processed to be part of low FFA CPO for export purposes. As one of a mill that owns RSPO certification, PT. RSI would like to maximize the low FFA of CPO for export purposes. Only FFB procurement from independent smallholders who own RSPO certification was supported by the DApp of blockchain. DApp of FFB supply and low FFA CPO traceability system are parts of the company's effort to enhance their service to their customer's food industries in developed countries. DApp of FFB supply and low FFA CPO traceability system will be developed on delivery network, starting from the farm to the food industries in exported countries.

This research only focused on a group of independent smallholders, a mill, and an exporter. With the coordination of the local industry office, the blockchain network can be scaled up by integrating many farmer groups and mills in the Rokan Hulu district that archives RSPO certificates.

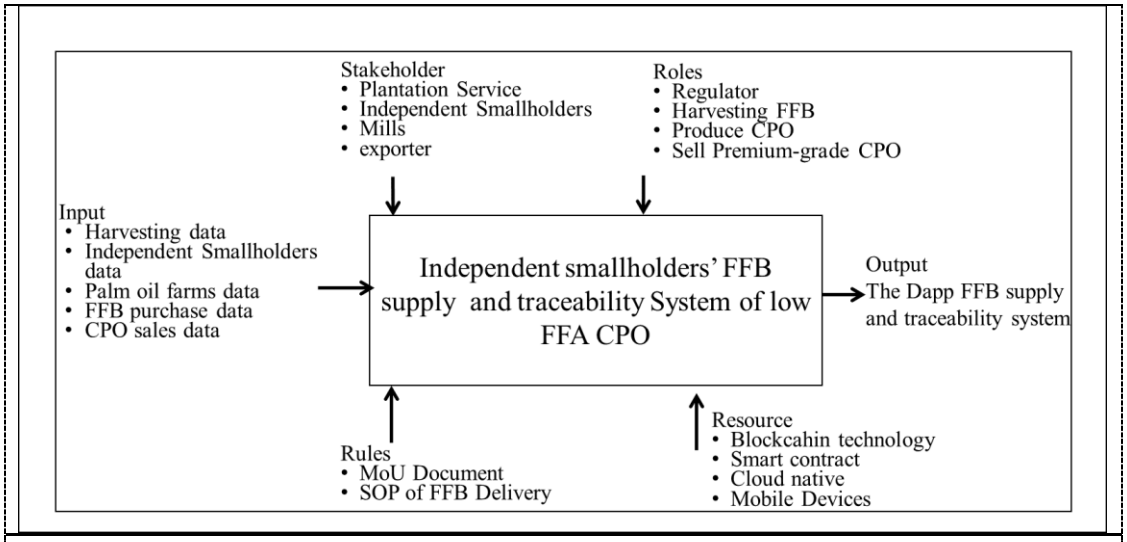

Figure 2. Component analyst of independent smallholders' FFB supply and traceability system for low FFA CPO.

4. Results and Discussion

4.1. The design of consortium chain and smart contract

The FFB supply system from the independent smallholders' procurement channel to produce low FFA CPO is equipped with information recording and adding unique identity and lot numbers once each transaction gets started. They were noting hash values to ensure the validity of the transaction. Batch is a unique identifier for identifying the material originality of CPO. Hash data was stored in Hyperledger, and data of transactions was stored in IPFS. Consortium chain provides a function of access control on all transactions. The access control policy aims to restrict user reading and writing to the ledger, ensuring that the transaction is executed by authorized users and optimizing data safety. Certain entities can run smart contracts. These certain entities comprise registered entities in the system, and those authorized can interact through smart contracts. Each entity is described as follow (Fig.3)

Independent smallholders: The independent smallholders who become a part of the blockchain network of FFB supply and low FFA CPO traceability are selected. They are responsible for planting

and determining harvest rotation and harvesting. The condition of farms is in pictures or video stored in IPFS. Those who can access these media are given the authority to access them. For the system of harvest time, traceability and the venue are recorded on the blockchain.

Mills: Processes FFB becoming CPO. Mill stores batch information, quantity, and inspection information of CPO comprising the level of FFA, water content, and CPO purify in IPFS. Hash data is stored in the blockchain, and label data, including a batch number, is brought together once CPO is delivered. Mills also store GPS farm coordinate location that supplies FFB for low FFA CPO production. The map of the farms that harvest raw material of low FFA CPO is stored in IPFS. Consumers who use and process low FFA CPO obtain information about the low FFA CPO source.

Exporter: Exporter is responsible for storing CPO and selling it to the importers in batch. The company information, time of selling product, price, and other information are kept in IPFS. The hash value is stored in the blockchain to ensure the following data cannot be disturbed.

Regulator: The regulator is a representative of the government who manages STDB data of farms. The regional farm's service receives and processes the registration of farm STDB from the group of Farmers. The farm service can only view selling transactions from smallholders to Mills, monitor and ensure whether the farms of FFB source that produce low FFA CPO have owned update STDB or not.
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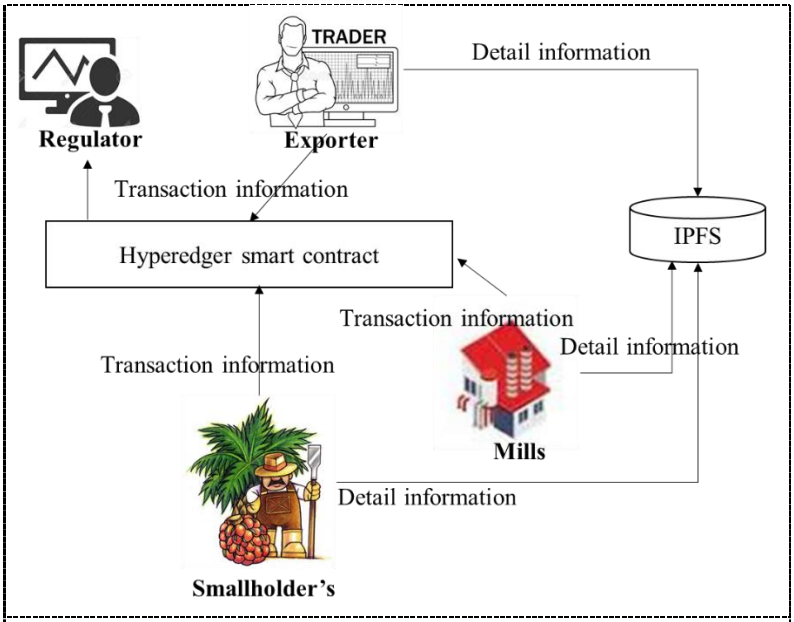

Figure 3. Consortium chain and smart contract for traceability system of low FFA CPO

4.2. Entity Relationship Diagram (ERD) and Sequence Diagram

ERD displays several main entities and the connection between several entities with smart contracts (fig.4). Each entity works on the blockchain network of the Low FFA CPO supply system by calling function in the smart contract. Smallholders start smart contracts by uploading harvest rotation data. FFB harvest information retrieves from renewing *UpdateCropInfo()* until harvest rotation can be reached. The selling FFB transaction between the smallholders and mills is based on an agreed price by both parties. Each CPO production from independent smallholders has a batch number so that CPO production from independent smallholders can be traced.

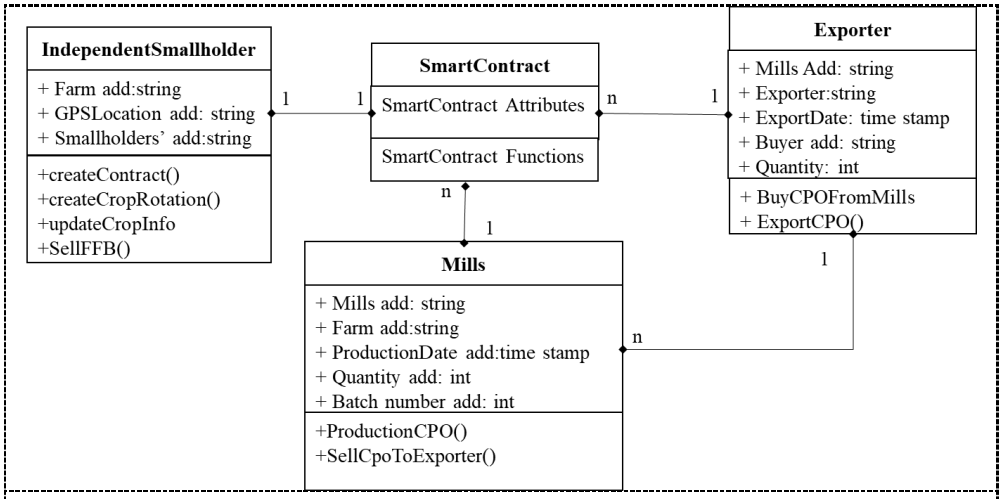

Figure 4. Entity Relationship Diagram.

Fig. 5 is a sequence diagram of collaboration between smallholders and Mills. The event of *SellFFB*() records harvest data and the *ProductionCPO()* event record of CPO production from an Independent smallholder farm. At first, *SellFFB()* active after they harvest and receive price information of FFB from the mill. The function of *SellFFB()* forwards the addresses of smallholders, mills, and time of harvest to activate smart contrast that triggers an event. *SellFFB()* informs the participants and forwards and records quantity parameters and weighing time with the smart contract triggers the event. Afterwards, the function of *ProductionCPO()* informs Mills address, quantity, batch number, farm and date of production. *CPOProduce()* informs the transaction CPO production time, batch number, forwards, and records the parameter

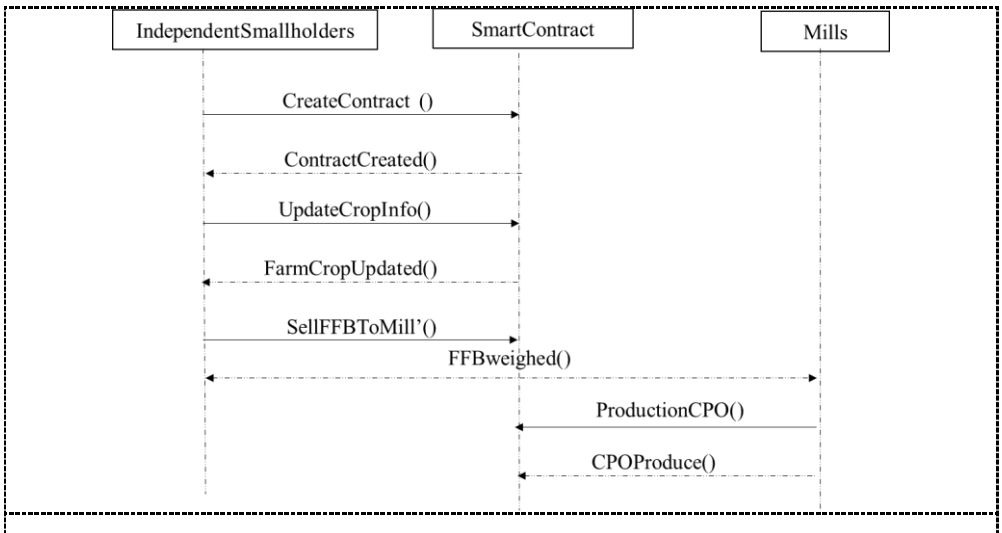

Figure 5. Sequence diagram of interaction among independent smallholders, smart contract and mills

Fig. 6 is a sequence diagram between Mills and exporter. Exporter purchases low FFA CPO on a big scale from various Mills to be exported. First, the exporter triggers the event of *BuyCPOFromMill()*, forwards the address of exporter, the address of mills, quantity, batch number, and the parameter of selling date to inform Mills who sells CPO to them. The mill runs the function of *SellCPOToExporter()*, forwards the address of Mills, the address of exporter, the quantity of sale, batch number and the parameter of selling date to activate the event *CPOSoldToExporter()* to inform the interaction among entities.

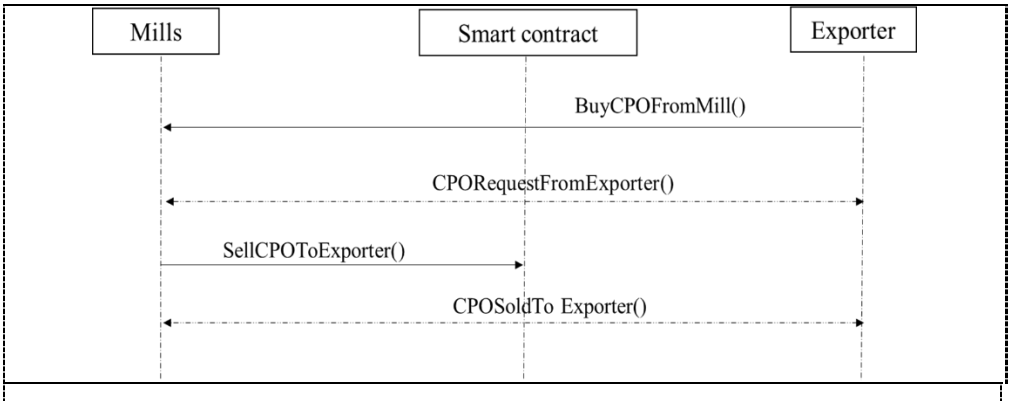

Figure 6. Sequence diagram of interaction among mills smart contract and exporter

The design of decentralization application in the consortium chain for FFB supply is developed from certified farms of independent smallholders. This system requires a database of independent smallholders to supply FFB to PT. RSI and database of independent smallholders who own STDB issued by plantation service and RSPO certified. It is crucial to ensure whether the farms which supply FFB for low FFA CPO production already have a valid database. The blockchain network of the FFB supply from the certified farm from the FFB procurement channel of plasma farmers should be applied for the next stage. Decentralization Application is more effective to be used by massive users. In this research, the only mill involved was PT. RSI. Once it is applied in the future, the other RSPO certified mills and farms may also be involved with this DApp FFB supply and low FFA CPO traceability system.

5. Conclusion

The contribution of independent smallholders of Indonesia for exported CPO is so small, approximately 3% of 9% of all smallholders worldwide. It cannot be preconcerted whether the farms owned by independent smallholders can contribute more to the production of low FFA CPO for export purposes. RSPO traceability system only aids smallholders in selling RSPO credit through virtual trading. By supporting the FFB supply from the certified farms and the CPO for export traceability system designed in this research, smallholders become active actors in this supply chain. They are not only active in virtual trading. The contribution of independent smallholder groups channels to produce low FFA CPO can be calculated. By presenting the FFB supply system on a map, independent smallholder farms are contributing to producing low FFA CPO can be identified. The increased number of smallholders who register RSPO can increase their contribution in making low FFA CPO for export purposes. The active role of independent smallholders gives the added value of income and the environment. The farms are objects of RSPO certification. Therefore various sustainable information in the farms can be shared.

With the coordination of the District of Industry office as the regulator, the blockchain network can be scaled up by integrating many farmer groups and mills in the Rokan Hulu district that archives RSPO certificates. Decentralization of government in Indonesia has given district governments the authority to manage their industries. FFA low CPO traceability blockchain network managed by the Rokan Hulu district government will increase the trust of CPO production from Rokan Hulu district consumed by the food industry in developed countries. The increase of DApp users from RSPO certified farms of Independent smallholders in the Rokan Hulu district make it possible to integrate the blockchain network with the traceability system of RSPO.

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Judul :

The design of blockchain network of palm oil FFB supply from certified farms and traceability system of CPO from independent smallholders

Menimbang :
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