

POPSIG

Greener Future with Palm Oil

A palm oil newsletter brought to you by:

IChemE Palm Oil Processing Special Interest Group

IChemE

Palm Oil Processing
Special Interest Group

***Beyond Palm Oil:
Connecting Life***

WHAT'S IN THIS ISSUE

Palm International Nutra-Cosmeceutical Conference

RSPO-Monash Joint Symposium 2023

Sustainable and Circular Economy in Palm Oil Global
Seminar

POPSIG Research Showcase 2023

POPSIG-MPOC Palm Oil Educational Roadshow @
UKM 2023

MPOC Digital Market Forum—Analyzing Palm Oil
Prospects and Potentials—2023 and Beyond



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Editor's Message

We are excited to bring you the 25th edition of our newsletter, filled with exciting updates and achievements from the world of chemical engineering, palm oil industry, and education. In this issue, we highlight some remarkable events that have taken place, fostering knowledge sharing, and creating pathways for young talents in our industry.

The Palm International Nutra-Cosmeceutical Conference (PINC) featured three sessions covering diverse aspects of the palm oil industry. In Session 1, discussions included health benefits of palm oil bioactives, exploring topics like immune-boosting properties of palm tocotrienols and effects of carotenes on macular degeneration. WH Leong provided insights into legislative updates and market potential. Session 2 delved into palm downstream products in the beauty industry, addressing challenges. Session 3, moderated by MPOC CEO Belvinder Kaur Sron, covered current issues, including palmitic acid and cancer risk, saturates in public health, regulatory preparedness for contaminants, and challenges in palm mixed carotene.

PRSP0-Monash Joint Symposium 2023 aims to provide a platform for researchers and industry practitioners from around the world to share and explore latest and ongoing research findings as well as to discuss future directions for the advancement of a sustainable palm oil industry. The event featured research discussions on focus areas relating to the RSPO and the Monash-Industry Plant Oils Research Laboratory (MIPO) with topics such as assessment of the performance, outcomes and impacts of social and environmental sustainability, highlighting oil palm smallholders, consumer and market demands, palm oil in food and health, as well as new technologies in palm oil processing and waste. This symposium include oral presentations, panel sessions and poster presentation.

POPSIG Research Showcase 2023 highlights of this event consist of plenary forum discussing on the topic of 'Decarbonisation of Palm Oil Value Chain' and also presenting few papers on the topics of CO₂ adsorption performance of char-derived concurrent activated and surface modified (CAM) palm kernel shell derived activated carbon, upcycling lignocellulosic oil palm frond and decanter cake as the substrate for black soldier fly larvae treated with bacteria, mixed cultures resource recovery from glycerin pitch, and biodiesel production from palm oil using barium oxide-reduced graphene oxide (BaO-GO) bifunctional catalyst.

POPSIG has had the pleasure to contribute to POPSIG-MPOC Palm Oil Educational Roadshow at UKM 2023, East-West Technical Exchanges on Palm Oil Global Outlook webinar, and Liquid Biofuel Production from Biogas for Carbon Neutral webinar. POPSIG would like to congratulate the award recipients of POPSIG-KLK palm oil video competition 2023, POPSIG article honorarium, and POPSIG-MPO Palm Oil Infographic Competition 2023.

Thank all our valued POPSIG members and POPSIG sponsors for their continuous support and dedication.

POPSIG gratefully acknowledges our sponsors




Event: Palm International Nutra-Cosmeceutical Conference (PINC) 2023

On Tuesday 22nd August 2023, MPOC hosted the 7th PINC in Le Méridien Putrajaya, Malaysia.

Yang Berbahagia Professor The Chair Professor Ir Dr Chong Mei Fong was represented by the POPSIG team consisting of Ng Wai Lun, Head of Industrial and Corporate Communications Unit, POPSIG; Yap Feng Ming, Vice Secretary, POPSIG; Jocelyn Lim Jean Yi, Vice Treasurer, POPSIG; and Leiu Yu Xuan, Roadshow Coordinator, POPSIG

The delegates of POPSIG Annual Award Ceremony and Research Showcase 2023 & ARPOS Decarbonisation Forum 2023 also participated which consists of Darren Lim Ming Qian, Director; Loi Xuen Ler, Deputy Director; Patrick Tan Yee Siang, Head of Department (Photography & Publicity); and Charlene Ho Yan Weng, Executive at Department of Logistics & Catering.

The plenary session featured two presentations: Dr. Roger Clemens from the University of Southern California discussed the potential replacement of palm oil with synthetic palmitic acid, while Chris de Lavigne from Deloitte APAC in Singapore provided a global overview of oleochemicals and bioactives.

The event featured three sessions covering diverse aspects of the palm oil industry. In Session 1, discussions centered on palm oil bioactives and health benefits, with presentations on topics such as the immune-boosting properties of palm tocotrienols by Professor Dr. Ammu K Radhakrishnan, and the effects of carotenes on age-related macular degeneration by Associate Professor Dr. Mai Chun Wai. WH Leong provided insights into legislative updates, challenges, and market potentials of palm tocotrienols. Session 2 delved into the potential of palm downstream products in the beauty and cosmeceutical industry, featuring talks on palm-based oleochemicals by Norashikin Ahmad and market challenges of palm vitamin E tocotrienols by Marianne Loong. Session 3, a forum on current issues and emerging challenges in the palm oil industry, was moderated by MPOC CEO Ms. Belvinder Kaur Sron and included discussions on palmitic acid and cancer risk by Dr. Roger Clemens, public health perspectives on saturates by Professor Dr. Tilakavati Karupaiah, regulatory preparedness for process contaminants by Ir. Shyam Lakshmanan, and challenges and opportunities related to palm mixed carotene by Bryan See.



Event: RSPO-Monash Joint Symposium 2023

On 25th September 2023, RSPO and Monash University Malaysia had successfully conducted the first joint research symposium. This symposium aims to provide a platform for researchers and industry practitioners from around the world to share and explore latest and ongoing research findings as well as to discuss future directions for the advancement of a sustainable palm oil industry.

The RSPO-Monash Joint Symposium also aims to create awareness and interest among students and young academics, and to support their engagement in the field of palm oil sustainability. Hence, the platform is an opportunity for students to participate and contribute to the symposium by presenting their research projects.

The event featured research discussions on focus areas relating to the RSPO and the Monash-Industry Plant Oils Research Laboratory (MIPO) with topics such as assessment of the performance, outcomes and impacts of social and environmental sustainability, highlighting oil palm smallholders, consumer and market demands, palm oil in food and health, as well as new technologies in palm oil processing and waste. This symposium include oral presentations, panel sessions and poster presentation.

The event featured a diverse array of speakers and topics over the course of two days, covering crucial aspects of the palm oil industry with a strong emphasis on sustainability. Opening remarks on Day 1 were delivered by Professor Ir Chan Eng Seng, Head of Monash-Industry Plant Oils Research Laboratory, and Mr Yen Hun Sung, Head of Impacts Monitoring at the Roundtable on Sustainable Palm Oil (RSPO). The keynote speech was presented by Dr Harikrishna Kulaveerasingam, Chief Research and Development Officer at Sime Darby Plantation Berhad. Day 1 sessions explored downstream processing, conservation of high-value areas, and challenges in labor, RSPO certification, and the roadmap for a resilient palm oil industry. Speakers included experts from Monash University Malaysia, the Malaysian Palm Oil Board, Desmet, Wilmar International Limited, Borneo Futures, and RSPO. Day 2 continued with discussions on achieving a circular economy, empowering smallholders, and shaping the future of sustainable palm oil. Notable speakers included Professor Ir Dr Chong Mei Fong, Dato' Leong Kin Mun, and Ir Hong Wai Onn, addressing topics such as waste reuse, smallholder empowerment, and emerging trends. The event concluded with award and certificate presentations, recognizing outstanding contributions to sustainable practices in the palm oil sector.



Event: POPSIG Research Showcase 2023

On the 18th October 2023, IChemE POPSIG had successfully organized the POPSIG Research Showcase 2023 event. This event provides students a platform to present their research projects about the technological advancement for the palm oil industry. Yang Berbahagia Prof Ir Chong Mei Fong, Chair of POPSIG and Mr Chia Ing Chuk, the Global Refining Technology from Desmet officiated this event. The presenters are the recipients of the 2022 POPSIG Student Research Project Bursary and 2023 POPSIG Student Research Project Bursary.

The highlights of this event consist of plenary forum discussing on the topic of 'Decarbonisation of Palm Oil Value Chain' and also presenting few papers on the topics of CO₂ adsorption performance of char-derived concurrent activated and surface modified (CAM) palm kernel shell derived activated carbon, upcycling lignocellulosic oil palm frond and decanter cake as the substrate for black soldier fly larvae

treated with bacteria, mixed cultures resource recovery from glycerin pitch, and biodiesel production from palm oil using barium oxide-reduced graphene oxide (BaO-rGO) bifunctional catalyst.

The plenary forum consists of speakers, Yang Berbahagia Datuk Dr Ahmad Parveez Haji Ghulam Kadir (Director General of Malaysian Palm Oil Board), Dr Surina Binti Ismail; Group Head of Sustainability (IOI Corporation Berhad), Dr Henry Chan (Conservation Director, WWF Malaysia), and Mr Rashyid Redza Anwarudin (Chief Sustainability Officer, Sime Darby Plantation Berhad).



Event: POPSIG-MPOC Palm Oil Educational Roadshow at UKM 2023

On the 30th October 2023, this University Roadshow was organized by UKM Chemical Engineering Student Club (CheSC) at Auditorium Siber Teknopolis (AST), Universiti Kebangsaan Malaysia. This event was supported by POPSIG in conjunction with MPOC. The roadshow aims to provide an understanding about the upstream and downstream operations of the palm oil industry, and the sustainable development in palm oil industry through a series of interactive events. The theme of this event is Malaysian Youth Drives Change for the Future of Palm Oil Industry which aims to provide an understanding about the ongoing and planned development in palm oil industry through a series of interactive events, to provide a platform to exchange views and suggestions between the students and the professionals, to provide an opportunity for the students to visit the industry to understand applications of the learned knowledge, and to deliver about the latest technological development in palm oil industry to address the challenges during the roundtable discussion.

The presentation on Palm Oil is Nature's Gift was delivered by Yang Berbahagia Academician Tan Sri Emeritus Profesor Datuk Augustine SH Ong from MOSTA. Meanwhile, the presentation on Futureproofing the Palm Oil Industry through Nature-based Solutions was presented by Dr Meilina Ong-Abdullah from MPOB. In her talk, she discussed on the mandatory sustainability compliance imposed on the palm oil industry is perceived as a bane to the industry, on top of other commitments pledged by Malaysia to the international community e.g. net-zero emission by 2050 and reducing CO₂ intensity against GDP by 45% by 2030. Shouldering these commitments require the industry to be agile in changing status quo and adopting new approaches as well as technologies to work within the realms of the environmental, social, and governance (ESG) rating system to guarantee palm oil's future sustainability. Nature-based solutions underpin sustainable development as it leverages natural processes and ecosystems to address the challenges faced by the industry. The talk also touched on the augmenting nature-based solutions with technology for posterity of the palm oil industry.

Besides that, Ms Areej Taufik from MPOC delivered on the talk entitled "Dispelling Misconceptions and Countering Negative Labels Surrounding Palm Oil. She addressed the misconceptions about palm oil is vital for fostering an accurate and informed dialogue on its production and use. Despite being a versatile and widely consumed vegetable oil, palm oil is unfairly associated with concerns such as unhealthy diets, defor-

estation, biodiversity loss, and social issues, leading to the use of discriminatory labels. This paper focuses on dispelling food and nutrition misconceptions about palm oil and highlights the negative impact of discriminatory labelling.

Discriminatory labels, like "no palm oil" or "without palm oil," are misleading, creating an unwarranted perception of palm oil as unsafe for consumption. Scientifically, there is no substantial evidence supporting the notion that palm oil poses health risks. Media claims of palm oil contributing to deforestation and biodiversity loss are countered by the extensive conservation efforts in palm-oil producing countries. The entire palm oil chain undergoes rigorous certification processes, making it the most certified sustainable vegetable oil.

To counter negative labels, collaboration among stakeholders, including producers, environmental organizations, and governments, is crucial. Raising awareness about sustainable palm oil practices through transparent communication channels is essential to combat misinformation. This approach encourages responsible palm oil sourcing by businesses and consumers, contributing to a more balanced and informed perspective on palm oil that recognizes its economic significance while addressing environmental and social challenges.

Prof DDr Lam Hon Loong, the Professor of Department of Chemical and Environmental Engineering and Director in the Centre of Excellent for Green Technology for University of Nottingham Malaysia was the forum chair.



Webinar: East-West Technical Exchanges on Palm Oil Global Outlook

On the 4th October 2023, POPSIG had organized a webinar entitled, 'East-West Technical Exchanges on Palm Oil Global Outlook'. The global palm oil industry has been historically beset by sustainability issues. A sustainable and circular economy approach in the palm oil global outlook aims to tackle these problems, laying a foundation for ethical, environmental, and economic viability.

This seminar aimed to address the pressing challenges that have long plagued palm oil production. We explored innovative ways to integrate sustainable and circular economic principles into the palm oil supply chain. The integration of sustainability and circular economy into the palm oil supply chain, can transform this contentious industry into a paragon of sustainability.

During the event, Mr. Jens Søgaard Jacobsen, Chief Sales Officer of MBP Solutions Limited, Switzerland, highlighted their commitment to transforming by-products from the palm oil industry into raw materials for various sectors, promoting sustainability and economic returns. He emphasized the impact of legislation, such as the EU Renewable Energy Directive (RED) and national blending mandates, on the value of by-products. Mr. Jacobsen also discussed the upcoming EU RED III targets and the certification requirements for palm oil mills. Dr. Nurul Adela Bukhari from the Malaysian Palm Oil Board highlighted the potential of oil palm biomass for biorefinery and the importance of establishing a circular economy using wastewater. Dr. Muhammad Afiq Zubir from Universiti Teknologi Malaysia discussed GHG emissions in the energy and agricultural sectors, presenting organizational-level accounting and efforts to enhance sustainability in the palm oil industry. POPSIG expressed gratitude to supporters, including Desmet Malaysia, MPOC, KLK OLEO, MOMG, and Sime Darby Oils, for their valuable contributions to the event.



East-West Technical Exchanges on Palm Oil Global Outlook POPSIG Seminar. 4th October 2023.



Panelists:

- Jens Søgaard Jacobsen, MBP Solutions Limited, Switzerland.
- Dr Nurul Adela Bukhari, Malaysian Palm Oil Board, Malaysia.
- Dr Muhammad Afiq Zubir, Universiti Teknologi Malaysia, Malaysia.
- Professor DDr Lam Hon Loong, University of Nottingham Malaysia
- Professor Ir Dr Chong Mei Fong, POPSIG
- Ir Dr Wendy Ng Pei Qin, POPSIG
- Melvin Wee Xin Jie, POPSIG

Webinar: MPOC Digital Market Forum – Analyzing Palm Oil Prospect and Potentials – 2023 and Beyond

On the 1st August 2023, the Malaysian Palm Oil Council (MPOC) had organized the second edition of Digital Market Forum. The Digital Market Forum series aims to update the stakeholders on the latest developments and opportunities in some of our key markets. The moderator for this session is Ms Belvinder Sron, the Chief Executive Officer from MPOC. In a series of presentations, key speakers from the Malaysian Palm Oil Council (MPOC) discussed various aspects of the palm oil industry. Karthigayen Kumar, the Regional Manager of Africa, focused on enhancing the presence of Malaysian palm oil in East Africa. Hajar Shamsudin, the Manager of MMD at MPOC, delved into the downstream aspects, specifically charting the export growth of Malaysian palm oil. Rina Mariati, the Regional Manager of Asia Pacific, discussed the role of ASEAN as the primary driver for palm oil demand in the Asia-Pacific (APAC) region. Lastly, Mohd Izham Hassan, the Deputy Director at MMD, provided an analysis of the palm oil market outlook beyond 2023 in his presentation titled "What's Beyond 2023: An Analysis of Palm Oil Market Outlook." The presentations collectively aimed to provide insights into strategies for market expansion, downstream development, regional demand dynamics, and future market trends in the palm oil industry.



MODERATOR

Opening & Introduction of Panellists
Ms Belvinder Sron,
CEO, MPOC



SPEAKERS

Paper 1:
Enhancing Malaysian Palm Oil Presence in East Africa
Ms Fatimah Zaharah,
Assistant Manager, MMD, MPOC



SPEAKERS

Paper 2:
Charting the Export Growth of Malaysian Palm Oil: Downstream Focus
Ms Hajar Shamsudin,
Manager, MMD, MPOC



SPEAKERS

Paper 3:
ASEAN as the Key Driver for Palm Oil Demand from the Asia-Pacific (APAC) Region
Ms Rina Mariati,
Regional Manager of Asia Pacific, MPOC



SPEAKERS

Paper 4:
What's Beyond 2023 : An Analysis of Palm Oil Market Outlook
Mr Mohd Izham Hassan,
Deputy Director, MMD, MPOC

Webinar: Liquid Biofuel Production from Biogas for Carbon Neutral

On the 2nd October 2023, the webinar entitled, 'Liquid Biofuel Production from Biogas for Carbon Neutral' was presented by Professor Dr Kei Ohkubo, the Professor of Institute for Advanced Co-Creation Studies, Osaka University Japan. In his lecture, he shows the chemical reaction that is photochemical oxygenation of methane in biogas to yield methanol and formic acid. A key molecule is chlorine dioxide used as a deodorant. This reaction is an environmentally benign approach towards the photooxidation of organic compounds. The photochemical oxygenation of methane containing biogas using chlorine dioxide reported herein will be generalized to provide novel application for usage of biogas instead of gas electric power generation in biogas plant in dairy sectors in Japan as well as palm oil sectors in Malaysia.

In year 2022, he and his team had designed the biogas oxygenation in 1000L reactor in Okoppe Town. The Okoppe Carbon Neutral Innovation Consortium aims to move towards the realization of zero carbon. In order to achieve this, the conversion from biogas to liquid energy involved the treatment of manure from 560 milk cows of 540,000 m³/year biogas. The biggest plant is situated in Okoppe, Hokkaido. The gas storage from this plant is able to store 200,000 L gas consisting of 60% of methane and 40% of carbon dioxide. The gas stored could be converted into methanol (80 ton/year) for the application of chemicals, fuels, and solvents. In addition, it also can produced 400 ton/year of formic acid which is used as a additive for silage hydrogen carrier. This project is supported by Institute for Open Innovation, Osaka University, New Energy and Industrial Technology Development Organization (NEDO), and many others.

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POPSIG 2023 Theme Beyond Palm Oil: Connecting Life

2

Kei Ohkubo

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POPSIG 2023 Theme Beyond Palm Oil: Connecting Life

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Kei Ohkubo

Article: Beyond Palm Oil: Connecting Life

*Written by Neduran A/L Kaliappan
(Universiti Kebangsaan Malaysia)*

One of the most useful and popular vegetable oils in the world, palm oil has a wide range of uses, from biofuels and industrial items to food and cosmetics. However, due to its negative effects on the environment and society, palm oil extraction has recently come under scrutiny. The production of conventional palm oil is linked to several problems, including habitat damage, deforestation, and violations of human rights. It is essential to look beyond palm oil and investigate additional sustainable options and practices that connect our lives in a positive way as the global community becomes more conscious of the need for sustainability.

Particularly in Southeast Asia, the palm oil business has been a significant contributor to deforestation in tropical areas. By releasing carbon held in forests, this deforestation not only worsens climate change but also leads to the loss of biodiversity. In addition to environmental challenges, there are significant social problems associated with the production of palm oil, such as land disputes, worker exploitation, and the eviction of indigenous populations. Consumers, businesses, and governments are looking for sustainable alternatives to palm oil because of these difficulties. To encourage ethical production methods, sustainable palm oil certification programs like the round table on Sustainable Palm Oil (RSPO) have been formed. These certificates have drawn criticism, meanwhile, for not going far enough to solve the issues facing the sector. There are many reasons why this sustainable palm oil method was introduced into this world.

First, a life cycle analysis (LCA) is a methodical procedure for assessing a product's or process's environmental effects at every stage of its life cycle, from raw material extraction to manufacture, transit, usage, and disposal. Conducting an LCA is essential for determining the sustainability and overall environmental impact of sustainable alternatives to palm oil. Setting the objective and parameters of the study is the first stage in carrying out an LCA for sustainable palm oil substitutes. This comprises defining the system boundaries and defining the functional unit, such as one kilogram of palm oil replacement. The scope should consider any substantial environmental implications and encompass all pertinent phases, from the manufacture of raw materials through end-of-life disposal.

It is also a useful method for evaluating the sustainability and impact on the environment of alternatives to palm oil. LCA assists stakeholders in making knowledgeable decisions to lessen the environmental impact and support more sustainable practices in the palm oil sector by analyzing the whole life cycle of these alternatives, from raw material production through disposal. This research advances our knowledge of how sustainable palm oil substitutes might link people to one another through ethical production and consumption.

Next, the need to lessen the environmental and social problems connected to the production of palm oil is what pushes the search for sustainable alternatives to palm oil. Finding alternative oil sources is important, but it is just as important to use sustainable processing techniques to turn these sources

into oil. Sustainable processing guarantees that the costs of production for the environment and society are kept to a minimum, which helps to create a supply chain that is more responsible and environmentally friendly. The exploration of this idea of sustainable processing in relation to sustainable alternatives to palm oil is very much needed.

Sustainable processing of palm oil substitutes emphasizes making the most effective use of resources possible. This entails maximizing the use of energy, water, and raw materials throughout the production process. Innovative methods may dramatically cut resource usage and leave a reduced ecological impact, such closed-loop systems and energy-efficient equipment. For the processing to be sustainable, there must be transparency across the supply chain. It makes it possible for customers and stakeholders to track the source of raw materials, ensuring that they are sourced ethically. Real-time insight into the production process is made possible by technologies like block chain and digital tracking systems, promoting moral and sustainable practices.

Making educated decisions on behalf of the customer is another aspect of connecting life through sustainability in this life cycle. Consumers may significantly influence the demand for sustainable and ethical products by being informed about the goods they use and the businesses they support. For customers looking for environmentally and morally responsible products, certification labels like RSPO (Round table on Sustainable Palm Oil) and Fair Trade are crucial resources.

The incorporation of renewable energy sources into manufacturing facilities is another important tenet of sustainable processing. Utilizing renewable energy sources like biomass, solar, or wind minimizes processing-related greenhouse gas emissions. Heat recovery systems and LED lighting, for example, are energy-efficient technology and practices that can help minimize the carbon footprint of alternative oil production. Sustainable processing adheres to the principles of a circular economy, which minimizes waste and effectively uses resources. Sustainable processing reduces waste and improves the overall sustainability of the production chain by producing creative ways to use by-products and trash produced during processing, such as turning them into biofuels, animal feed, or bio-based materials.

Moreover, to solve the environmental and social issues related to the production of palm oil, the quest for sustainable alternatives to palm oil is essential. Though promising, this transformation must be made with a commitment to protecting biodiversity. Alternatives to palm oil shouldn't unintentionally cause habitat loss, species extinction, or ecological deterioration. The significance of protecting biodiversity is discussed in this article in relation to sustainable alternatives to palm oil.

The phrase "biodiversity" refers to the variety of life on Earth, including the many species, ecosystems, and genetic resources that make up that life. The Earth is currently experiencing a biodiversity crisis that includes declining species

populations, habitat destruction, and ecosystem degradation. Many species, including orangutans, tigers, and rhinoceroses, have gone extinct because of habitat loss and deforestation caused by the production of palm oil in regions like Southeast Asia and South America.

Making sure that no forests are being destroyed in the process of seeking sustainable palm oil alternatives is one of the most important aspects of protecting biodiversity. Alternative oil crops should be grown instead of removing key forests or important ecosystems, including soy, sunflower, or coconut. Protecting natural ecosystems requires a commitment to supply chains that do not contribute to deforestation and appropriate land use.

The preservation of biodiversity is significantly aided by consumer knowledge and demand. Consumers that are well-informed may help businesses that use ethical and sustainable sourcing methods by purchasing items that have been certified as being favorable to biodiversity. Consumer pressure may force the sector to adopt more ethical manufacturing practices. In the move to alternatives for palm oil, sustainability is essential for satisfying the ethical obligation of maintaining biodiversity. Making ensuring that the development of substitute oils does not unintentionally impact ecosystems, species, and genetic diversity is crucial. The palm oil substitute sector can help create a world that is more biodiverse and linked by implementing responsible sourcing, sustainable agriculture, and biodiversity conservation practices.

Indigenous communities play a crucial role for this topic which is most important. In this case, displacement of land Indigenous groups are routinely evicted from their ancestral grounds as a result of palm oil development. The indigenous people

who have lived in these areas for generations are frequently evicted from their native grounds as businesses destroy forests and build plantations. Their way of life and cultural heritage could suffer greatly as a result of this. Furthermore, loss of employment showing how hunting, fishing, and gathering supplies for food, medicine, and shelter are all common livelihoods practiced by Indigenous cultures who frequently rely on the forests. These traditional lifestyles may be disrupted by the conversion of these forests into palm oil plantations, leaving tribes without a source of income and nutrition.

As a final observation, there are many other ways to connect life through sustainability besides palm oil. This entails supporting ethical sourcing, adopting sustainable agricultural methods, and encouraging the development of alternative oil innovations. Additionally, it calls on consumers to be informed and to make deliberate decisions that support businesses and programs that are in line with sustainable objectives. By doing this, we may forge a future in which the decisions we choose benefit both our planet and its inhabitants. The road towards effective oil extraction serves as a tribute to human development and our commitment to achieving a balance between our energy requirements and the health of the earth. Besides that, there is no denying the impact of the palm oil business on the environment and society, but there is a growing movement to "Go Beyond Palm Oil" and connect life in a more sustainable and ethical manner. Although there are still many obstacles to overcome, the move towards sustainable palm oil production and the investigation of alternatives is an encouraging beginning in the right direction. We can collectively address the intricate problems associated with palm oil production and advance toward a more connected, accountable, and sustainable future by making thoughtful decisions, pushing for change, and supporting businesses dedicated to sustainabil-



Figure 1. Palm Oil Fractions and Their Uses (<https://mpoc.org.my/palm-oil-fractions-and-their-uses/>)

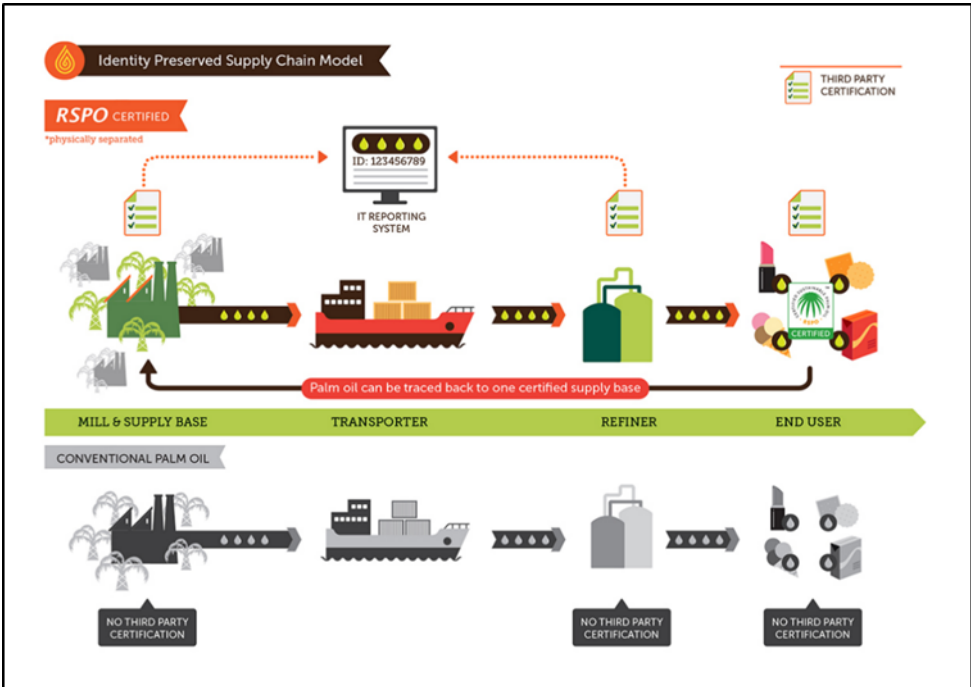


Figure 2. Supply Chain Systems (<https://www.stephensonpersonalcare.com/blog/2016-05-23-knowledge-corner-everything-you-need-to-know-about-sustainable-palm-oil/>)

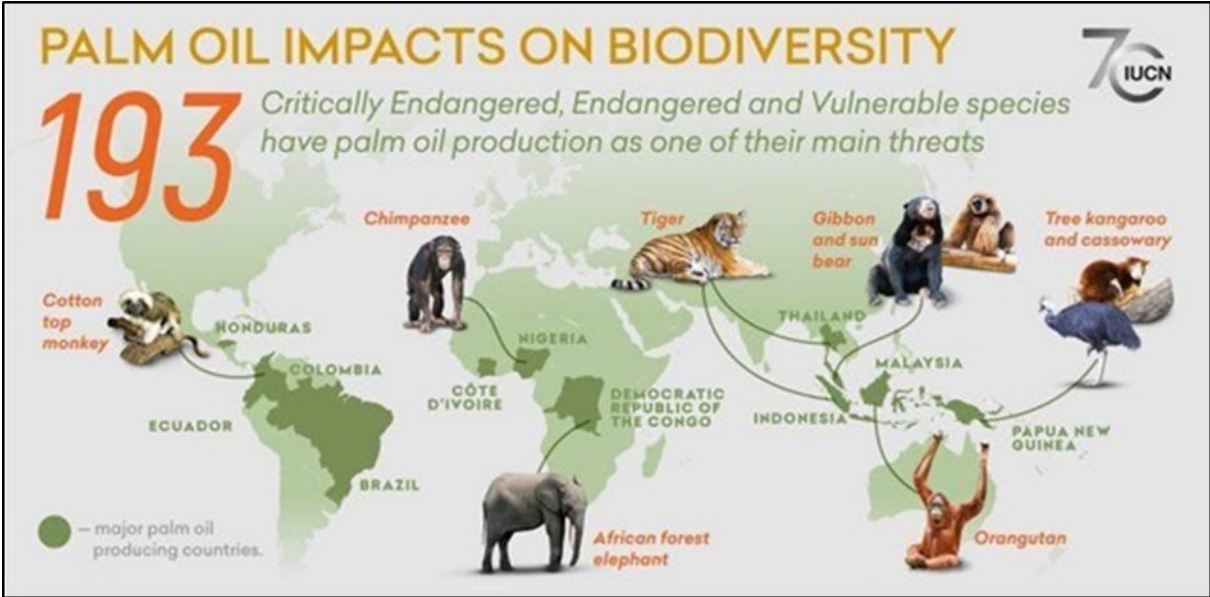


Figure 3. Biodiversity & Palm Oil (<https://www.sustainablepalmoilchoice.eu/biodiversity-palm-oil/>)

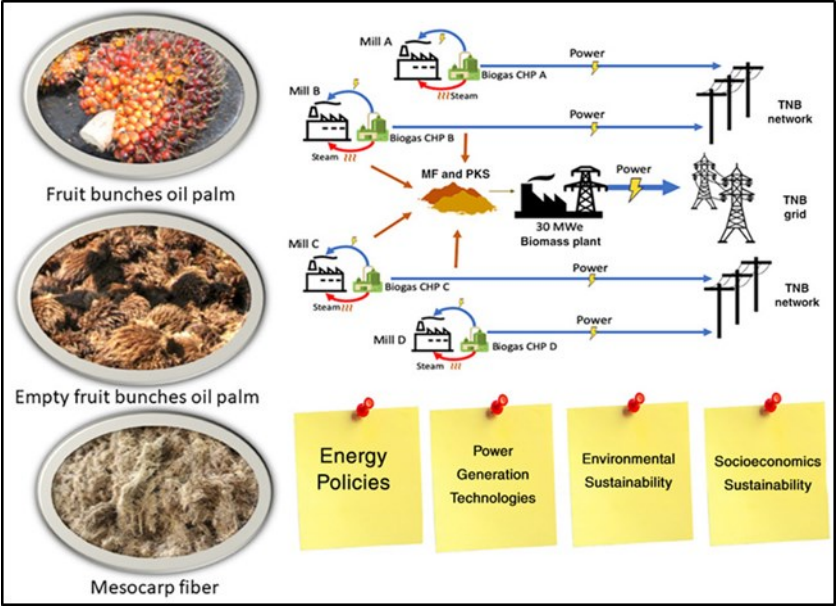


Figure 4. Potential and challenges of palm oil biomass power generation (<https://wires.onlinelibrary.wiley.com/doi/full/10.1002/wene.437>)

Full traceability
to mills: **429**
independent supplier
mills in 2016

88% TTP
for GAR mills in 2016

15 GAR mills
full TTP in 2016

100% TTP
GAR mills end 2017

100% TTP 3rd-party
mills 2020

Figure 5. GAR has achieved 100% TTP for owned mills as of end 2017. (<https://www.goldenagri.com.sg/id/beyond-traceability-responsible-palm-oil-supply-chain/>)

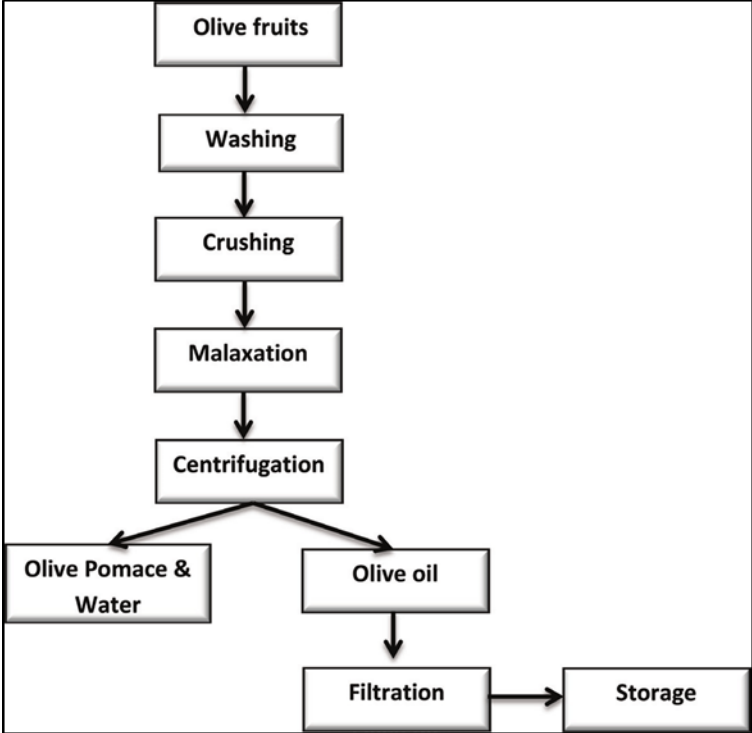


Figure 6. Flow chart of olive oil extraction (https://www.researchgate.net/figure/Flow-chart-of-olive-oil-extraction_fig1_329075431)

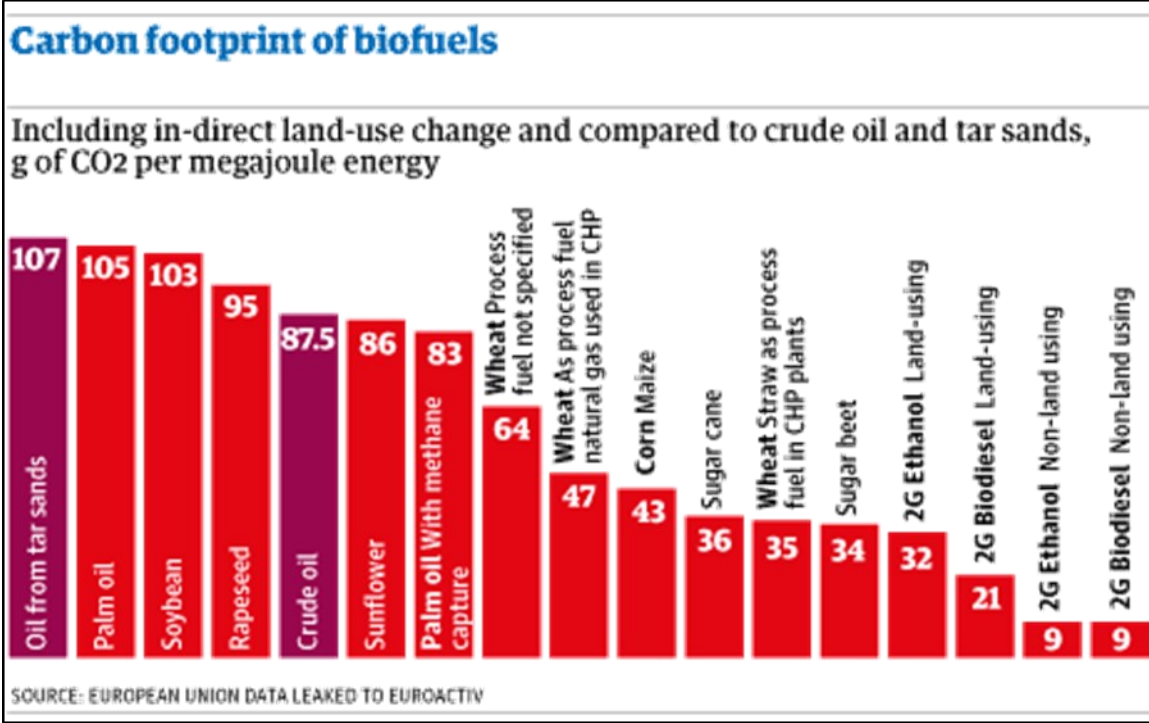


Figure 7. Carbon Footprint of Palm Oil and the Palm Biodiesel Dilemma (<http://rank.com.my/energywise/?p=284#sthash.aBPsztv2.8dhASed2.dpbs>)



Figure 8. Palm Oil and Indigenous Peoples (<https://labelitright.wordpress.com/2016/10/06/palm-oil-and-indigenous-peoples/>)



Figure 9. Impacts of the palm oil industry (<https://www.spott.org/palm-oil-resource-archive/impacts/>)

Article: Sustainable Palm Oil in Malaysia: Smallholders, Certification, and the Path Forward

Written by Chia Jan Feng
(Universiti Kebangsaan Malaysia)

1.0 Introduction

Within the verdant expanses of Malaysia, palm oil cultivation transcends mere agriculture, emerging as a pivotal socio-economic linchpin. Smallholder farmers, who contribute to a staggering 30-40% of palm oil cultivation in the country (Malaysian Palm Oil Certification Council 2022), own approximately 40% of the total area used for oil palm production (Roundtable on Sustainable Palm Oil 2023). While they grapple with challenges like the European Union (EU) boycotts due to sustainability and labor concerns, opportunities arise elsewhere. With India importing 2.89 million tonnes and China 1.76 million tonnes of Malaysian palm oil (Malaysian Palm Oil Certification Council 2022) as shown in appendix A, the market potential is evident. This evolving landscape highlights the need for sustainable growth that balances economic, social, and environmental aspects. The shifting dynamics underscore the pressing need for a sustainable approach that harmonizes economic, social, and environmental objectives. Central to this pursuit is the Malaysian Sustainable Palm Oil (MSPO) Certification Scheme. As a national initiative, the MSPO scheme aims to promote sustainable practices within the palm oil sector, addressing the environmental and social ramifications of the booming demand for palm oil. Its goal is not only to alleviate these concerns but also to optimize yield and productivity. However, even as awareness about certification grows among smallholders, many are still reluctant. Awareness alone doesn't guarantee action, particularly when key decision-making factors aren't addressed. This article, therefore, examines the impact of the Malaysian Sustainable Palm Oil (MSPO) certification on smallholders, government initiatives to support it, and the reasons influencing smallholders' decisions regarding certification.

2.0 Impact of Certification for Smallholder Oil Palm Farmers

The MSPO certification goes beyond a mere label, it embodies a dedication to sustainability. Tailored for the palm oil sector, MSPO covers economic, social, and environmental pillars. Through thorough training and financial aid, it ensures smallholders not only meet standards but truly benefit from them.

2.1 Social Impacts

The social dynamics of smallholders is deeply impacted by MSPO certification. With this certification, they receive thorough training in Good Agricultural Practices (GAP), safety, environmental conservation, and MSPO principles. A notable initiative is the Smallholders Organized Cluster (SPOC), where participants are equipped with Personal Protective Equipment (PPE) and trained on its proper usage (Senawi, R. et al. 2019). This not only elevates safety standards but also instills a sense of professionalism among smallholders. Moreover, MSPO serves as a connector, linking smallholders with other key players. This interconnectedness has given birth to a robust platform for dialogue, grievance redressal, and stakeholder consultation, weaving a tight-knit community where

everyone's voice is valued.

2.2 Environmental Impacts

The MSPO certification gives the environment, often overshadowed by industrial growth, a much-needed voice. Guided by this certification, smallholders adopt best practices—from efficient fertilizer use to advanced harvesting methods. These aren't just theoretical; they yield tangible environmental benefits. A comparative study highlighted that RSPO certified sustainable palm oil has a significantly lower global warming footprint, reduced by 35% (Roundtable on Sustainable Palm Oil 2019). Additionally, the certification mandates the protection of High Conservation Value (HCV) areas, promotes the restoration of degraded lands, and establishes wildlife corridors, ensuring a balanced ecosystem where wildlife flourishes.

2.3 Economic Impacts

The MSPO certification offers significant economic benefits to smallholder farmers. It boosts the potential for increased Fresh Fruit Bunch (FFB) yield, with data from 2017 indicating that Malaysian smallholders could achieve over 30 tons per hectare annually (Herdiansyah et al. 2020), rivaling larger estates. Moreover, certified smallholders in East Malaysia reportedly earn about 25% more than uncertified ones (Malaysian Palm Oil Certification Council 2022). Rooted in Good Agricultural Practice (GAP), the MSPO enhances productivity and offers cost savings on inputs like pesticides and fertilizers. It also provides financial incentives including audit fee claims and preparation cost claims, directly cutting costs and boosting profit margins. Furthermore, MSPO-certified farmers enjoy a competitive advantage in local and global markets, heightening the global appeal of Malaysian palm oil. In summary, MSPO certification equips smallholders with increased productivity, reduced costs, greater income, and broader market reach.

3.0 Governments' Efforts in Sustainable Certification of Smallholders

While certification indeed offers numerous advantages to smallholders, encompassing environmental, social, and economic benefits, a significant portion of these smallholders remain uncertified despite being aware of these benefits. Recognizing this gap, the government has initiated several measures to bolster the certification rates among smallholders.

Financial support has been a cornerstone of these efforts. The Malaysian government, understanding the financial constraints faced by smallholders, has rolled out substantial financial incentives to facilitate their participation in the sustainable certification scheme. A notable initiative in this regard is the allocation of USD 35 million as subsidies (Food and Agriculture Organization of the United Nations 2019), specifically earmarked to aid smallholders in obtaining their certification.

In addition to financial backing, the government has also emphasized the importance of knowledge dissemination and capacity building. Extension services and training programs have been launched to enhance smallholders' understanding of the certification process, its inherent benefits, and the best practices required to achieve it. For instance: TUNAS officers, part of the extension services, educate smallholders about sustainability and guide them towards sustainable certification. Additionally, specialized training programs are provided:

Awareness of Malaysia Sustainable Palm Oil Course: An introduction to the MSPO Standard, designed for business owners, consultants, government officials, and palm oil industry professionals.

Interpretation and Implementation Course: Focused on practical techniques for sustainable practices, aiding participants in system development and management.

Internal Auditor Training Course: Equips participants with skills for auditing, covering planning, execution, and reporting of audit findings.

These endeavors are designed to arm smallholders with the insights and tools essential for a smooth certification application process.

Recognizing the challenges individual smallholders might face, the government introduced the concept of Group certification. Under the MSPO certification, the Sustainable Palm Oil Clusters (SPOC) model was adopted. This model clusters smallholders based on their geographical proximity, enabling them to pool resources, share knowledge, and collectively work towards certification, thereby simplifying the process (Aziz et al. 2021).

Collaborative efforts have also been a significant part of the government's strategy. By forging partnerships with NGOs and the private sector, the government aims to tap into a broader resource pool and expertise. Collaborations with entities like the Malaysian Palm Oil Certification Council (MPOCC) and corporate giants like Wilmar International are testament to this approach. These partnerships focus on assisting suppliers in Malaysia to align with MSPO certification standards, ensuring a cohesive approach to sustainable palm oil production.

Lastly, to underscore the importance of certification and ensure industry-wide adherence, the Ministry of Primary Industries (MPI) took a decisive step by announcing the mandatory implementation of MSPO certification from January 1st, 2020 (Aziz et al. 2021). This mandate ensures that all stakeholders, including the smallholders, align with the MSPO standards, marking a significant stride towards a sustainable palm oil industry in Malaysia.

4.0 Factors Influencing Smallholders' Participation in Palm Oil Sustainable Certification

Despite government incentives and efforts, many smallholders are still reluctant to seek sustainable certification for palm oil. This hesitation indicates some key decision-making factors might have been missing (Ahmad Rizal et al. 2021). Ammar Redza's research highlights this, pinpointing four crucial elements influencing smallholders' stance on certification: "Perceived Economic Benefit," "Social Interaction," "Shared Identity," and "Communication Discourse."

The "Perceived Economic Benefit" encompasses the tangible financial advantages smallholders anticipate from certification, such as augmented profits and diminished operational costs. Smallholders' rational choice does not entirely rely on awareness; instead, they also evaluate the benefits and risks before making any decision. Upfront commitments, both in terms of finances for equipment and time for training, can act as barriers. Therefore, promotional campaigns should spotlight the enduring financial rewards and present tangible solutions, such as subsidies or grants, to alleviate these immediate burdens. Clearly communicating these benefits can instill confidence in smallholders, making the scheme psychologically more appealing to smallholders.

"Social Interaction" also significantly influences smallholders' participation. Social interaction bonds reflect the intensity of connections among community members and foster the growth of a healthy society. Smallholders, who often live within close-knit communities, depend on each other for communication, exchange of information, and assistance. They interact in public spaces, such as coffee shops, religious halls, and municipal halls, where they exchange information about their plantations business and management. A single negative experience or misconception about the certification can lead an entire community to skepticism. To counteract this, the presence of positive testimonials within the community is crucial. For example, presentations by successfully certified smallholder farmers, supported by empirical data highlighting enhanced profits and market access, can effectively inspire and persuade others to consider the certification. Additionally, social interaction has been proven to expand a person's network structure and reduce structural holes, allowing information to be widely disseminated. Such interactions not only bridge information gaps, bolster knowledge but also strengthen their beliefs, fostering greater participation in sustainable certification.

"Shared Identity", described as a set of beliefs shared by the members about the central, enduring, and distinctive characteristics of a society, significantly affects smallholders' willingness to pursue certification. Being part of a community instills this shared identity, which then influences sustainable certification decisions. A study from Kenya illustrates this point, showing that farmers, through united efforts, can access essential information - a significant barrier in many southern nations. This collaborative approach facilitated greater market access and elevated their income (Kirui and Njiraini, 2013). However, even with the Sustainable Palm Oil Cluster (SPOC) model in place, certain smallholders within the cluster might not resonate with this shared identity, highlighting the importance of reinforcing this bond to attract other uncertified smallholders.

"Communication Discourse" is another linchpin in this equation. It represents ongoing engagement between parties, echoing Habermas's theory of communicative action and deliberative democracy. This concept emphasizes well-founded arguments over simple statements (Habermas, 1994). Smallholders, who have an intrinsic connection to their lands, sometimes feel their concerns are dismissed or overlooked. They need a platform where their voices and experiences are not just heard but respected and valued. Without this, there's a risk of them feeling marginalized and disrespected, leading to reluctance to adopt new innovations, or joining sustainable initiatives. To address this, it's imperative to integrate communication discourse more deeply into policy and decision-making processes. By fostering an environment of mutual respect and open dialogue, smallholders become active con-

tributors, critically assessing, and shaping new policies. One thing that is certain is that smallholders are increasingly examining the impact of new practices and policies on their well-being. (Ahmad Rizal et al. 2021).

5.0 Conclusion

The journey of palm oil cultivation in Malaysia is marked by both challenges and opportunities. With the MSPO certification, the country is taking significant strides towards ensuring sustainability in the sector. This certification, while symbolizing a commitment to eco-friendly practices, also brings tangible benefits across economic, social, and environmental dimensions. However, the reluctance of some smallholders to adopt this certification, despite its evident advantages, underscores the complexities involved in decision-making processes. Factors such as perceived economic benefits, the strength of social interactions, shared community identity, and the quality of communication play pivotal roles in influencing these decisions. Thus, a holistic understanding of these factors is crucial for policymakers and industry stakeholders. As the palm oil industry continues to evolve, it is imperative to ensure that the voices of smallholders are heard, their concerns addressed, and their well-being prioritized. Only then can the industry truly move towards a sustainable future where both the environment and the people thrive.

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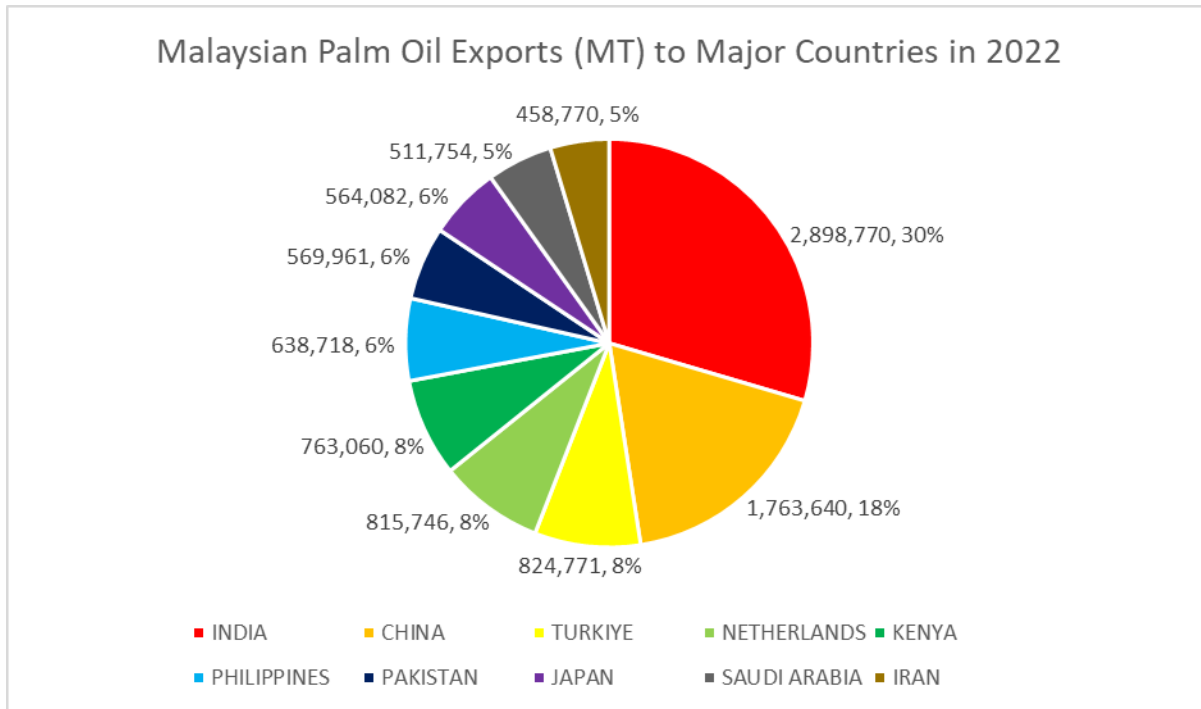


Figure 1. Malaysian Palm Oil Exports (MT) to Major Countries in 2022 (Source: Malaysian Palm Oil Council 2023)

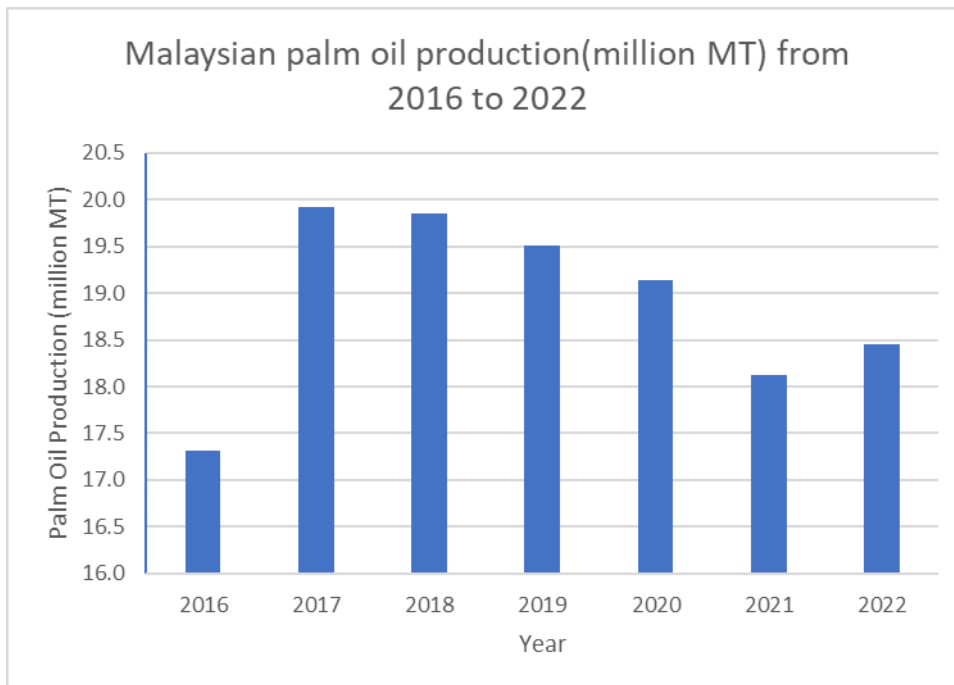


Figure 2. Malaysian palm oil production (million MT) from 2016 to 2022 (Source: Malaysian Palm Oil Council 2023)

Article: Sustainable Palm Oil Industry: Water Footprint Assessment & Reduction

*Written by Tan Kah Huat
(Universiti Sains Malaysia)*

Are you aware that palm oil, scientifically known as "Elaeis guineensis", stands out as the most efficient crop globally, yielding a higher oil output per land area compared to any other equivalent vegetable crop? Do you know that it is versatile, oxidation-resistant, and heat-stable, which make it attractive for grower and consumer? Globally, Indonesia and Malaysia collectively contribute more than 85% to the global palm oil supply, in which palm oil becomes one of the major revenue generators for them [1]. According to the latest information of year 2023, the current world production of palm oil is around 79.464 million MT with the market size of 68.14 billion USD, proving the popularity of palm oil [2, 3]. In order to boost awareness regarding environmental and societal impacts of palm oil, Roundtable on Sustainable Palm Oil (RSPO) has been established. It instituted production standards for growers, delineating best practices in the production and sourcing of palm oil. With widespread industry acceptance, it has garnered support from a majority of global stakeholders [1].

Nonetheless, recently, there is a misperception from the public that palm oil production has a high water footprint, which is not environmental-friendly and threatening the water availability. This article is going to discuss about the water footprint of palm oil plantation and the innovative solutions to effectively reduce the water footprint. First and foremost, let's define what is water footprint. Water footprint of palm oil is defined as the total volume of freshwater used to produce one ton of Fresh Fruit Bunch (FFB), measured in m³/yield. It is further categorized into three fractions, which are green (rainwater), blue (surface water and groundwater) and grey (chemical compounds' dilution water) [4]. In overall, during the 1996-2005 period, the global water footprint for agricultural crop production was highest for wheat (15%), rice & paddy (13%), and maize (10%). In contrast, the water footprint attributable to oil palm globally was comparatively low, accounting for only 2% as in Figure 1 [5].

The study carried out by Research Centre & Community Development (LPPM) of Stiper Institute of Agriculture (Instiper) Yogyakarta, Indonesia in collaboration with the Indonesia Oil Palm Plantation Fund Management Agency (BPDPKS) proves the assertion that palm oil does not present a risk to water source. The assessment of water usage and root length density revealed that oil palm predominantly extracts water from the upper root zone. This implies that oil palm relies primarily on rainwater and surface water for its water needs. For evidence, the study in Central Kalimantan, Indonesia depicts that the water footprint of palm oil plantation at the area level was 1,002.1 m³/ton, compared to sunflower seed (3,366 m³/ton), rapeseed (2,271 m³/ton), and olives (3,015 m³/ton) [4].

Looking into the details of water usage, for evapotranspiration level, another result shows that the water requirement in palm oil plantation was only 1,104 mm/year, compared to bamboo and lamtoro plants (3,000 mm/year), followed by acacia plants (2,400 mm/year), sengon tree (2,300 mm/year), pine and rubber (1,300 mm/year) as depicted in Figure 2 [6]. Moreover, according to another research, as illustrated in Figure 3, it is

evident that oil palm emerged as one of the most water-efficient plants for bioenergy production (75 m³/GJ). Notably, the major water-wasteful plants include rapeseed (184 m³/GJ), coconut (126 m³/GJ), and cassava (118 m³/GJ) [7]. These findings indicate that palm oil plants have lower water requirements, signifying greater efficiency and water conservation compared to other commodities. This observation effectively refutes the concern that the water footprint of oil palm poses a threat to the availability of water resources.

For further enhancement of palm oil sustainability, advanced smart technologies, especially those related with Industry Revolution (IR) 4.0, could be utilized to improve the production efficiency. The adaptation of smart irrigation system stands out as a promising strategy to monitor soil conditions and regulate irrigation levels to optimize water and fertilizer usage. For example, this is accomplished through the utilization of a network comprising sensors, controllers, and servers designed to ascertain the necessary irrigation and fertilization levels. By referring to Figure 4, the system operates by analysing moisture content and transmitting the data to central server. A comprehensive assessment of the economic viability of smart irrigation has been executed to examine its effectiveness. It indicates that, even with a substantial initial Capital Expenditure (CAPEX), a positive Return on Investment (ROI) could be attained in 5 years, provided the plantation size is a minimum of 1.5 ha. Besides, it demonstrates a notable decrease in both water footprint and expenses required to achieve optimal moisture conditions [8]. Presently, Malaysian Palm Oil Board (MPOB) is integrating the Internet of Things (IoT) technology, a component of IR 4.0, into the palm oil industry. This involves the implementation of geospatial and drone technology, alongside the utilization of Geographic Information System (GIS) and Oil Palm Resource Information System (OPRIS). OPRIS is designed to identify and furnish geospatial information concerning oil palm plantations, soil types, agro-climatic conditions, and areas deemed suitable and prospective for oil palm cultivation [9].

Let's examine its feasibility via successful applications supported by data. A pilot precision irrigation system in Malaysia that applies IR 4.0 concepts powered by solar energy is applied for nurturing palm oil seedlings at the estate of YP Plantation Holdings in Rompin, Pahang. Figure 5 illustrates its application of a water dripping technique to irrigate each seedling tray directly. The system is controlled by a microcontroller equipped with a timer and soil moisture sensors for monitoring functions. According to the results, this innovative system successfully reduced water wastage by 30% compared to the previous manual watering approach. Additionally, it effectively monitors the essential moisture content required for optimal seedling growth, contributing to the production of high-quality yields [10]. Moving forward to Uumbal oil palm plantation in Tabasco, Mexico where internet coverage is constrained, it currently boasts an information network encompassing real-time data on historical climate, weather forecasts, and irrigation monitoring by applying LoRaWAN network. This data is accessible through the mobile application

"Fieldclimate" from any location and at any time. The weather forecast has proven instrumental in aiding farmers to optimize daily operations, enabling them to plan activities such as harvesting, spraying, or any tasks involving personnel more effectively. The availability of such information has significantly enhanced the company's decision-making response time, mitigating potential crop-related stress [11].

Through the assessment and effective reduction of water footprint in palm oil industry, undeniably, palm oil plantation actually aligns with the Sustainable Development Goals (SDG). Firstly, it is SDG 6 – Clean Water and Sanitation. As aforementioned, palm oil is one of the most efficient crops in terms of water usage naturally. It could effectively optimize water usage, easing the reliance on water sources and reducing water wastage. As a result, sufficient and reliable water supply are always guaranteed [12]. Moreover, it also complies with SDG 12 – Responsible Consumption and Production. Through precise agricultural techniques in smart irrigation system, water consumption could be optimized and minimized. Consequently, sustainable management and use of water resources could be achieved [13]. Next, for Environmental, Social and Governance (ESG) aspects, palm oil plantation meets the environmental objectives by optimizing water usage, contributing to environmental conservation. For social target, it actively engages with local communities and stakeholders to address issues and incorporate strategies into water management. Regarding governance goal, it upholds transparency and accountability in responsible water management practices [14].

In essence, palm oil plantation plays a pivotal role in global agriculture, boasting efficiency and versatility in oil production. By debunking misconceptions, palm oil could positively contribute to environmental conservation, societal well-being, and governance responsibility. Through embracing technological innovations and aligning with SDG for palm oil industry, the future viability of palm oil could be safeguarded to connect life, bringing increased benefits to the world. It is imperative that the youth, as the driving force shaping the future of the palm oil industry, contribute innovative technologies and solutions as aligned with IR 4.0 principles. Palm oil industry holds significant development potential, and the active involvement of the younger generation is crucial for its continued improvement and sustainable growth.

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Article: Recent Applications and Strategies for Sustainability of Palm Oil in the Food Industry

Written by Zhao Tianhui, and Nur Farhana Abd Rahman

(Universiti Kebangsaan Malaysia and Luzhou Vocational and Technical College)

1. Introduction

Oil palm (*Elaeis guineensis*) is predominantly grown in southeast Asia. Palm oil, extracted from the mesocarp of the oil palm (Choudhary & Grover 2019), is the largest producer and consumer of vegetable oil worldwide (Azman et al. 2023; Shahbandeh 2022). Malaysia ranks second in global production (Absalome et al. 2020; Sulaiman et al. 2022). Not only is palm oil used in the feed, cosmetics, textiles, and daily necessities industries, but also extensively applied in the food industry due to its stability and abundant nutrients (Mancini et al. 2015; Sati 2023). As in cooking, interestingly, palm oil is considered as high-quality frying oil, due to lower oxidation and high thermal stability (Dian et al. 2017; Izuddin et al. 2023). Furthermore, palm oil is rich in various bioactive ingredients, such as palmitic acid, β -carotene and vitamin E (Amri et al. 2021; Baldassarre et al. 2023).

However, recent studies have indicated that production of palm oil has led to destruction in ecological environment (Mukherjee & Sovacool 2014; Pirker et al. 2016). In some degree, the sustainability of palm oil is in serious doubt (Wassmann et al. 2023). Recently, some sustainable strategies for palm oil application in the food industry, such as developing new palm oil formulations and improving the extraction process of palm oil have been applied. Blending of palm oil, palm kernel oil and their fractions with sunflower oil in different ratio can be used to formulate various types of reduced fat spread (Dian et al. 2017). The extraction process of palm oil without refining and bleaching can help to retain carotenoid, vitamin E and sterol in red palm oil (Tan et al. 2021). These strategies could be beneficial for products to obtain better textural and storage properties, and even be commercialized. Although these strategies can improve product quality, more sustainable strategies need to be proposed from different aspects to facilitate the development of the palm oil industry. Subsequently, this article compressed the extraction process of palm oil and reviewed some applications of palm oil in food products. Five sustainable strategies for palm oil applied in the food industry are proposed based on various aspects. These efficient strategies can contribute to further progression of the palm oil industry.

2. The extraction process of palm oil and its applications in food products

2.1 The extraction process of palm oil (Corley & Tinker 2008)

Pre-treatment was conducted prior to the extraction process. The fruits were selected based on the standardized grade and the dust, mildew and damaged fruits were removed. Next, a sterilization process was applied with high pressure steam resulting in separation process of kernel from its branch and shell. After that, the fruits were pressed, and the oil was extracted from the fruits. Post-extraction, the impurities from the crude oil were removed and the oil undergone drying process. Then, the fiber was separated from the cake and dry nut was produced, graded and cracked. At last, the dry kernel was packed and stored. The extraction process of palm oil is summarized in Figure 1.

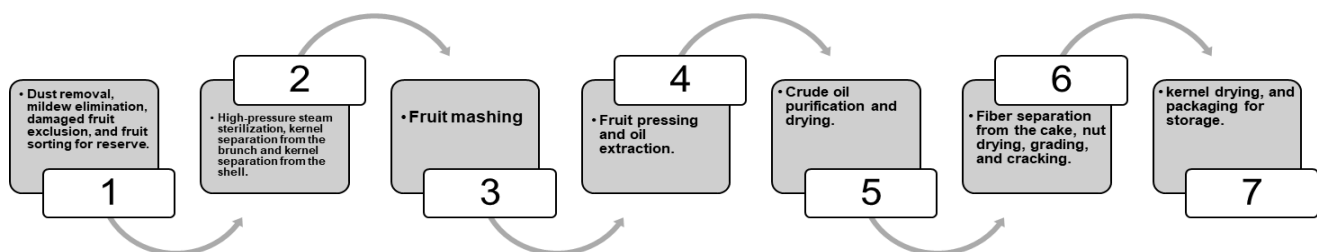


Figure 1. The extraction process of palm oil

2.2 Palm oil applications in food products

2.2.1 Bakery products

Palm oil is one of the primary baking oils. Palm stearin enabled bakery products to remain pliable even without hydrogenation, thereby significantly reducing trans-fat intake in diets (Kellens et al. 2007). When approximately 10% of palm oil shortening was added during the bread baking process, the bread's volume was increased to the optimum level of 4% (Chin et al. 2010). It displayed that palm oil positively impacted the texture and filling capacity of bakery products, and their commercial value could be improved.

2.2.2 Fried food

Palm oil is the preferred frying oil due to its high stability. Palm oil was evaluated by the score for taste of the product that had been fried five times. The fried product in palm oil and soybean oil received similar high score (8.5 and 8.6), but low score (7.8) in mustard oil. Sensory evaluation revealed that the palatability of food items fried in palm oil was comparable to soybean oil, while food items fried in mustard oil exhibited poor palatability (Rashid et al. 2023). Nile tilapia is typically fried before consumption, with palm oil being the usual choice (Tadesse Zula et al. 2021). It is common that palm oil is used in fried food.

2.2.3 Chocolate

Palm oil is frequently used as a substitute for cocoa butter in chocolate products. Substituting palm oil for cocoa butter in the chocolate bar-making process resulted in an increase of unsaturated fats content and a decrease in the melting point and hardness of chocolate bars (Limbarido et al. 2017). Chocolate products derived from a blend of coconut fat and palm oil shortening exhibited physical properties similar to those from cocoa butter (Limphapayom 2013).

2.2.4 Plant protein drinks

In addition, palm oil-based soy milk can enhance the emulsion stability of vegetable protein drinks. Higher storage stability in palm oil-based compared to traditional plant protein drinks (Pan et al. 2017). Better viscosity, stability and sensory of red palm oil emulsion drink can be obtained by adding different concentrations of Carbon Methyl Cellulose (CMC) and mango flavor (Silsia et al. 2021).

3. Sustainable strategies for palm oil applied in the food industry

3.1 Sustainability in strengthening institutions and systems improvement.

Roundtable on Sustainable Palm Oil (RSPO) has been developing and implementing global standards for sustainable palm oil. Numerous regions have also established organizations and robust systems to drive the uptake of more sustainable palm oil in the world. Malaysian Sustainable Palm Oil (MSPO) was established in 2013, launching a certification scheme for sustainable oil palm. Food safety requirements of palm oil products can be reasonably addressed by the Malaysian Palm Oil Board (MPOB). European Sustainable Palm Oil (ESPO) was established in 2015 and the Indonesia Sustainable Palm Oil (ISPO) standard was introduced in 2011. All of them are committed to sustainable economic, social and environmental objectives. Furthermore, promoting sustainability necessitates the development of market mechanisms, particularly in the oil palm sector (Omar et al. 2012).

3.2 Sustainability on innovative palm oil applications in food products

Development on the sustainability of palm oil in the food industry is possible by improving the quality of palm oil-used food products and devoting to its diversification and innovation. The pendawa chocolate with mixing ratio of palm oil and coconut oil had the same nutrition as the original and better texture (Harahap et al. 2023). In addition, palm oil and monoglyceride stearate were used as a base oil and oleogelator separately, and produced oleogels which can partially substitute for cocoa butter (30% w/w) to make chocolate with heat-stable and bloom-resistant (Chen et al. 2022). Hence, focusing on innovation to improve nutritional and practical value could inspire larger production capacity of palm oil-used food products.

3.3 Sustainability in valorization of biomass waste from palm oil

Biomass production from empty fruit bunch (EFB) after extraction of palm oil can be reduced and utilized into gas fuel production which can be considered as a renewable energy resource by gasification technology (Aktawan et al. 2020). Converting biomass waste into energy not only solved energy crisis, but also benefited environmental conservation. Furthermore, oil palm male inflorescence organic waste can be used to synthesis carboxymethyl cellulose, which is regarded as an ice cream stabilizer (Jainal et al. 2023). Therefore, it is possible that the sustainability of oil palm can be realized by converting biomass waste into energy and making new food additives.

3.4 Sustainability in optimization process and equipment advancement

Optimization of palm oil extraction process and advancing equipment for its production can improve its security in the food industry. Converging on lower production costs could significantly improve economic returns. Both aluminum and 316 stainless steel were chosen as storage tank for palm oil in terms of equipment advancement (Nizam & Mahmud 2021). Prior to

palm oil extraction, fresh fruit bunches undergone sterilization process in boiler and sterilizer. An integrated design combined the boiler and sterilizer for fresh fruit bunches, resulting in significantly reduced specific water consumption compared to conventional methods(Wae-Hayee et al. 2022). Consequently, enhancement of security and lower production costs from palm oil applications can be applied to promote the sustainability of palm oil in food products.

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Infographic: IR 4.0 Efforts In Digitalising Malaysia's Palm Oil Industry

Prepared by Muhammad Fakhru Radzi Bin Ridwan
(Universiti Teknologi PETRONAS)



CHALLENGES IN PALM OIL COMMERCE

PESTS & DISEASES [1] [2] [14]

Basal Stem Rot (BSR)
Economic loss

80% Yield Reduced

43% economic loss

Located mainly in Peninsular and Sabah

Within 6 Months the Fungal Disease can cause of palm plantation to suffer

Field Symptoms
FDE progress in the xylem
Dry leaves skirt-like shape

Fusarium Wilt
Native strain could infect palm oil vitro

Bred materials from Africa

CLIMATE CHANGE [1] [2] [7]

Mapping of Plant Distribution

5.74 Millions Hectars Plantation in 2020's

11 out of 14 Ecosystem function has been depleted due to Deforestation

Influencing Factors: Rainfall, World Temperature, Bio-Screening

Greenhouse Gases (GHG) Emissions in Industry

Contribute towards 6 - 17% anthropogenic global release

Carbon Emissions (CO2)

Top 3 palm oil export country in carbon emission: BRAZIL, INDIA, MALAYSIA

SOCIAL RIGHTS [2] [6]

Employment Abuse

Market Value of US \$20 Billions

Problem become very serious post pandemic Covid 19 era, restriction of physical labour

Strong desire to digitalise operations

Increase Efficiency, Evidence Traceability

METHODOLOGIES IN INDUSTRIAL REVOLUTION 4.0

SATELLITE IMAGING [9] [12] [13]

Plantation Remote Sensing

Land Use Land Cover (LULC) Analysis

60% Population Increment

Digital Classification: Visual Classification, Object-oriented technique

Mapping Accuracy: 89.78%

94.50% Accuracy Comparison

Palm Oil Plant Management [4]

Forest Monitoring, Illegal Logging & Illegal Deforestation

Benefits of Mapping Sensing: Observation of Air Pollution, Urban Heat Island Detection, Evolution Demographic

ARTIFICIAL INTELLIGENCE [14]

Palm Tree Identification

Convolutional Neural Network (CNN)

- Sliding Window Technique
- Sample Merging

NDVI Analysis on Tree Health & Height

Factors: Moisture Content, Pigmentation, Leaf Size, Stem Arrangement

Threshold Value: 31 Broadsleaf tree (deciduous), 30 Broadleaf Evergreen, 24 Palm & Conifer

> 30% projected by 2024

Vegetations are homogeneous

LeNet neural Network: Fully Connected Layer

IMAGE PROCESSING [2] [11] [15]

Disease Detection Assessment

Detection using RGB Color Intensity

- Pixel Color Identification
- Image Filtering
- Feature Extraction

Hue-Saturation Intensity (HSI) Colorspace

Leaf Bring & Tattering Analysis

Detection Accuracy using Different Colorspace

VIRTUAL AUTOMATION [7] [8]

Plantation Control Software

Unmanned Aerial Vehicle (UAV)

- Yield Monitoring
- Image Collecting Maps
- Mobile Robots Sensors

Mechanized Fertilization Monitoring

60-70% significant monetary losses due to Overfertilization & Decreased Harvest

Machine Vision Algorithm

Method to Control Fertilizers

'3P' OF SUSTAINABLE DEVELOPMENT APPROACHES

PEOPLE [18] [19]

Improve Food Security Livelihood

2 ZERO HURGER

Malaysia's Palm Oil Benefits: Staple food ingredients, enriched with Vitamins

Smallest Land Highest Yield

PROSPERITY [19] [20]

MPO Contribution Significant for >51% Export Revenue Increment

RM36 Billions Palm oil industry contribution to Malaysia's GDP (2020)

Competitive & Innovative Stable Sector

PLANET [7] [8]

Conservation & Enhanced Ecosystem

15 LIFE ON LAND

Minimal Land Utilisation Committed For 50% Forest Conservation

National Resources Conservation Foundation (MPOGCF) ~24 Millions (RM) investment for Wildlife, Biodiversity & Environmental Research & Studies

MUHAMMAD FAKHRUL RADZI BIN RIDZWAN
CHEMICAL ENGINEERING | UNIVERSITI TEKNOLOGI PETRONAS

References

Further Reading



Infographic: Shaping A Sustainable Tomorrow—Innovating The Malaysian Palm Oil Industry

Prepared by Tashwin A/L Sandra Segeran
(Universiti Kebangsaan Malaysia)



ECONOMIC CONTRIBUTION⁽¹⁾

reduces country's poverty rate

50% in 1960 → **<5%** today

EXPORT COMPETITIVENESS⁽²⁾

Contribute up to **2.5%** of Malaysia GDP in 2021

the leading global producers and exporters of PO anticipate increased production in the second half of the year.

EMPLOYMENT⁽³⁾

18.6% Crude Palm Oil (CPO) exports rate in Malaysia

provides direct and indirect employment to over 3 million Malaysians, out of which nearly 500,000 are smallholders.

CONTRIBUTIONS

CURRENT CHALLENGES

NO PALM OIL LABELLING⁽⁴⁾

Misleading labels in Belgium and France,

affect Malaysian PO trade in the EU.

ENVIRONMENTAL⁽⁵⁾

Rising temperatures and sea level have a significant negative relationship with PO production in Malaysia

Increasing temperature level **1-4°C** → **10-41%** PO production

LABOR SHORTAGES⁽⁶⁾

150,608 foreign plantation workers- Sep,2022

With 2.6 million hectares of PO, this is a **1:17 labor-to-land ratio**. Sustainability requires a ratio of 1:14 or lower.

led to thousands of tonnes of fruits rotting

the output is forecast to decline or remain unchanged from last year's 18.1 million tonnes

DEFORESTATION AND HABITAT LOSS⁽⁷⁾

Rapid expansion of PO plantations has led to significant deforestation.

↑ 2.5-FOLD 2001-2016

leads to endangering species like orangutans and pygmy elephants.

INTENSE COMPETITION⁽⁸⁾

Increasing stocks may potentially exert pressure on PO prices.

CPO price

US\$600/tonne (2023) vs USD200/tonne (2022)

Competition in the crude palm oil (CPO) market is anticipated to stay intense, further impacting PO prices.

STOCK INCREASE By Aug 2022, **↑13.5%** due to Indonesian competition.

REVOLUTIONIZING MPO: INNOVATIVE INDUSTRY TRANSFORMATIONS

BLOCKCHAIN TRACEABILITY⁽⁹⁾

Malaysian Palm Oil Council (MPOC) develops a blockchain app to increase trust within the industry.

Collaboration with:

Build trust with consumers

Promote sustainable PO production practices

Improve transparency and immutable supply chain record.

CERTIFICATIONS

To prevent deceptive labeling, MPO industry has established comprehensive certification programs to verify sustainable palm oil production.

Malaysian Sustainable Palm Oil (MSPO)⁽¹⁰⁾

The national scheme in Malaysia for PO plantations.

Supports the Sustainable Development Goals (SDG) 2030.

Roundtable on Sustainable Palm Oil (RSPO)⁽¹¹⁾

Global certification system for certified sustainable PO.

Helps halt deforestation, limits carbon emissions, and prohibits planting on peat.

MECHANIZATION⁽¹²⁾

Mechanization of PO farms through robotics automation.

Reduce reliance on manual labor.

Mechanisation and Automation Research Consortium of PO

Realtime Alert Supervision (IoT Remote Monitoring) System

Automated drone monitoring

AI Preventive Maintenance

SATELLITE MONITORING⁽¹³⁾

Utilize satellite technology to monitor PO plantations and detect illegal deforestation activities in real-time.

Dabeo Inc. signed an MOU with Saba Legend Sdn Bhd.

Analyze palm tree growth using high-resolution satellite images

CIRCULAR BIOECONOMY METHOD⁽¹⁴⁾

A biomass method used in the MPO industry using waste products from the PO milling process to create renewable energy.

Collect palm oil waste → Convert to renewable energy, like biogas → Use it to power mill/facilities as electricity and heat source → Reusing waste as fertilizer or animal feed

NOVEL IDEAS AND FUTURISTIC INNOVATIONS IN MALAYSIAN PALM OIL

BIOTECHNOLOGY⁽¹⁵⁾

Can significantly impact the PO industry, enhancing sustainability, productivity, and environmental sustainability.

- Climate-Resilient Varieties
- Improved Varieties
- Nutritional Enhancement

Climate-Resilient Varieties: PO can thrive in high temperature and changing climate without compromising the yields.

Improved Palm Varieties: Genetic modification or selective breeding to achieve these goals.

Nutritional Enhancement: Creating PO trees that are resistant to diseases, reducing the need for chemical treatments.

AI FOR YIELD PREDICTION⁽¹⁶⁾

AI-based yield prediction uses algorithms and data to forecast PO fruit yields.

Data Collection → Machine Learning Models → Yield Forecasting → Real-Time Data Integration

EXPANDING THE DOWNSTREAM⁽¹⁷⁾

DOWNSTREAM SECTOR By 2022, **18.6%** contributions to exports compared to CPO

Explore more on the downstream sector, which includes the production of oleochemicals and processed PO products.

Oleochemical products

edible oil

REMOTE TRAINING AND EDUCATION⁽¹⁸⁾

Develop virtual reality (VR) and augmented reality (AR) training modules for plantation workers, providing training on sustainable practices and safety measures in PO industry.

CARBON FARMING⁽¹⁹⁾

Agricultural practices that sequester carbon dioxide from the atmosphere into the soil and vegetation within PO plantations, effectively acting as a carbon sink.

- ACROFORESTRY: which combines agro-forestry with other crops and trees
- FERTILIZERS: using organic compost and nutrients to limit soil disturbance.
- CARBON SEQUESTRATION: agro-forestry and soil conservation CDO technologies.

ADVANCING AHEAD⁽²⁰⁾

The MPO industry is increasingly aligning its activities to support the UN's Sustainable Development Goals (SDGs).

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Infographic: The Future of Palm Oil Industry: Technological Milestones in Palm Oil Industry

Prepared by Thiranai Thongchan, Koh Jia Ee Penny, and Kang Li Qian
(Universiti Sains Malaysia)



KANG LIQ QIAN | KOH JIA EE PENNY | THIRANAI THONGCHAN
Bachelor of Engineering (Chemical Engineering) with Honours
School of Chemical Engineering
Universiti Sains Malaysia

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THE FUTURE OF PALM OIL INDUSTRY: TECHNOLOGICAL MILESTONES IN PALM OIL INDUSTRY

DID YOU KNOW?

Malaysia, boasting approximately 5.08 million hectares of oil palm plantations, ranks as the world's second-largest palm oil exporter, following Indonesia.

Malaysian Palm Oil Export Market in 2022

Country	Percentage	Export Volume (Million Tonnes)
India	18.4%	2.89
China	11.2%	1.76
EU	9.4%	0.82

Malaysia also engages in the export of palm oil to various countries, including Turkey, Kenya, the Philippines, and Pakistan.

Applications of Palm Oil Across Industries

- Distilled fatty acids of palm kernel oil is used to manufacture detergents through direct saponification.
- Utilized as a feedstock for biodiesel production due to its high energy content and favorable combustion properties.
- Palm oil derivatives are used as excipients in drug formulations, including capsules, ointments, and suppositories.
- In the food sector, parts of the palm fruit such as palm stearin to produce margarine which provides good plasticity and non-sticky surface.

TECHNOLOGY INNOVATIONS IN PALM OIL INDUSTRY

DRONES

WHY DRONES?

Drones advances the oil palm cultivation through high-resolution aerial photography. They monitor vast plantations, optimize yields, and ensure sustainability by assessing crop health. Drones provide real-time data via various sensors with imagery as detailed as less than one centimeter per pixel.

Palm Oil Surveillance

- A single human can capture images of oil palm up to 5 hectares.
- A single drone can capture images of about 2,500 hectares.

500 TIMES MORE EFFICIENT

TYPE OF DRONE SENSORS

- Multispectral
- Near Infrared Reflectance
- LIDAR

3D MAPPING

Drone technology can capture high-resolution images that can be transformed into 3D surface models, which are valuable for tasks like topographic mapping, volume calculations, and presenting the site in a 3D format which is obtained via photogrammetry method.

CROP MONITORING

Drone technology, equipped with high-resolution sensors, enables the precise mapping of critical crop data, including crop height, canopy coverage, and crop distribution. This data serves as a foundation for accurate crop yield forecasts.

INTERNET OF THINGS (IoT)

IRRIGATION SYSTEM

The optimization of irrigation strategies through the analysis of real-time field data represents a viable prospect, driven by the IoT and sensor systems. When harnessed in conjunction with economies of scale, these innovations hold the promise of becoming a pragmatic solution for the precise management of water resources in plantations, ultimately contributing to the stabilization of production outcomes.

SOIL MONITORING SYSTEM

The importance of maintaining good soil quality cannot be overstated when aiming to produce high-quality palm oil. Without sufficient soil information, farmers may struggle to ensure the proper nutrition for their oil palm trees. Thus a real-time palm oil soil monitoring system has been developed for smart agriculture, measuring pH, moisture, and soil tilt. These parameters are crucial for assessing soil alkalinity, tilt, and moisture content.

Soil Monitoring System Process

- The sensors are placed in the soil sample.
- The readings are sent to the Arduino microcontroller.
- The microcontroller captures, processes and analyses the data.
- Captured data will be transmitted via WiFi to a cloud database for recording.
- Real-time readings will be graphically displayed on ThingSpeak.
- Using the obtained data, the farmer will assess soil quality and decide on further actions.

PALM OIL MILL MAINTENANCE

IoT implementation in palm oil mills, particularly for water treatment and boiler maintenance enhances operational efficiency by streamlining work orders and maintenance scheduling, reducing time consumption. IoT-driven predictive maintenance, with its data analytics and machine learning capabilities, can predict equipment failures. The Complex Proportional Assessment (COPRAS) method can then consider these predictions as factors to prioritize maintenance actions based on urgency.

Advantages of Implementing IoT For Predictive Maintenance

- 40%** REDUCTION OF MAINTENANCE COST
- 50%** DECREASE OF EQUIPMENT DOWNTIME
- 5%** DECREASE OF CAPITAL INVESTMENT

FUN FACT

In 2022, Malaysia boasted 450 operational palm oil mills for fresh fruit bunches (FFB), with a significant concentration of these mills located in Peninsular Malaysia.

ROBOTICS IN PALM OIL MILLS

COLLABORATIVE ROBOTS

Collaborative robots, or cobots, can work alongside palm oil mill operators. They excel at handling tasks that are dirty, unsafe, repetitive, or require quick action. For instance, cobots can autonomously control steam and temperature in the Digester using robotic arms and sensors, as well as automatically manage crude oil-water dilution to enhance oil separation efficiency and reduce losses during the Clarification process.

REALTIME ALERT SUPERVISION

Deployed at critical operational points, IoT sensors continuously monitor operating conditions, comparing them to set control limits. When a parameter deviates beyond these limits, an alert is immediately generated and sent to the mobile devices of mill supervisors for notification.

ADVANTAGES

- Withstand Harsh Conditions
- Able to Work For Longer Duration
- Capable of expanding their knowledge
- Offers More Transparency

Infographic: Navigating Sustainability Challenges for a Thriving Future

Prepared by Lum Wai Hong
(Universiti Malaya)

Malaysian Palm Oil Revolution:

Navigating Sustainability Challenges for a Thriving Future

LUM WAI HONG

DEPARTMENT OF CHEMICAL ENGINEERING, FACULTY OF ENGINEERING, UNIVERSITI MALAYA.

SDG Sustainable Development Goals

The Malaysian palm oil industry struggles to align with the Sustainable Development Goals (SDGs) due to its past environmental and social issues, sparking concerns and criticism locally and globally.



Addressing the Malaysian palm oil industry's Challenges

Despite its early focus on sustainability and meeting ESG demands since the early 2000s, the Malaysian palm oil industry continues to face intense scrutiny and misconceptions, particularly in the plantation sector.

Supply and Demand

Palm oil is highly sensitive to price volatility due to factors like regional supply and demand, competition with other oils, and stock levels in exporting and importing countries.

Price Volatility
Malaysia's palm oil process hit a record high of **\$1,586** per tonne in March 2023 but have since tumbled by about **40%**



EU European Union's Protectionist Policies

Adoption of various protectionist policies by European Union affects Malaysian palm oil trade in the EU.

EU Renewable Energy Sources Directive (RED)
The EU's classification of palm oil as a high IUC-risk (Indirect Land Use Change) feedstock has both constrained market entry for the Malaysian palm oil industry and added a layer of complexity to exports destined for the EU.

EU Policy on Forests and Deforestation
European Commission (EC) estimates palm oil to drive 60% of global deforestation highlights the importance of the issue to Malaysia.

Process Contaminants 3-MCPD
Starting from 2020, it is the ILO option for a split-level approach to 3-MCPD, dividing oils into lower and higher maximum levels.

Types of oil	Concentration of 3-MCPD
Coconut, Rapeseed, Sunflower, soybean, oil etc.	100 mg/kg
Refined palm oil	10 mg/kg

Low Mechanization Rate

According to Malaysian Palm Oil Board (MPOB), the adoption of mechanization in Malaysian palm oil's plantation is low, which will persistently hamper the sector's overall productivity and growth.

<50% for overall field activities **<15%** for harvesting

Labour Shortage

Malaysia's palm oil industry heavily depends on foreign labour. Even after easing pandemic-related movement restrictions, the industry faced delays in securing more workers, resulting in crop losses, despite government promises to expedite worker approvals.

Only **22%** of foreign worker entries against the total approved applications.⁽¹⁾

Reduced productivity
Difficult to meet international demand

Sustainability Concerns

The expansion of the Malaysian palm oil industry has indeed raised significant sustainability concerns, encompassing issues like deforestation, water pollution, soil pollution, and greenhouse gas emissions.

Water Pollution⁽²⁾
2.5 MT effluent per MT palm oil

GHG Emissions⁽³⁾
637-1131 kg CO₂e per tonne CPO

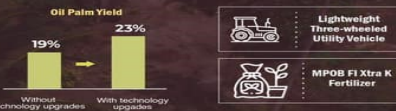
Deforestation⁽¹¹⁾
63% tree cover loss occurred within plantations

Way Forward for the Advancement & Development of the Malaysian Palm Oil Industry

Technological Advancement and Commercialization

With the Malaysian government limiting the expansion of oil palm plantations, the primary avenue for industry growth lies in technological advancements and increasing yields.

MPOB's technologies for commercialization



Certification and Sustainability

The Malaysian palm oil industry should ensure sustainability and traceability throughout its supply chain by following MSPO and FPOC guidelines, enhancing productivity, and cutting carbon emissions.



Circular Economy

Implementing a circular economy approach in the Malaysian palm oil industry can offer innovative solutions to address sustainability challenges while simultaneously creating economic opportunities.



Zero-Deforestation

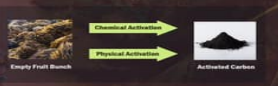
Malaysian palm oil industry shall commit to zero-deforestation practices to ensure long-term sustainability and environmental responsibility of the sector.

Sustainable Sourcing
Companies in palm oil supply chain are suggested to source palm oil from plantations and smallholders that strictly adhere to no-deforestation policies.

Planting Location
Malaysian palm oil industries are recommended to locate plantations only on agricultural and fallow lands, not at the cost of forest cuts.

Net Zero Waste

Activated carbon (AC) from oil palm biomass is potential adsorbent for palm oil mill effluent (POME) treatment.



AC for POME Treatment⁽¹¹⁾
Reduce organic compounds & coloured pigments with low dosage and short treatment time.

9% (w/v) **24 HR**

With this innovation -
Reduced carbon footprint
Cost-effective

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Infographic: Malaysia's Palm Oil Industry: Facing the Challenges and Seizing the Opportunities

Prepared by Viknish A/L Arumugam, and Thurgashiny A/P Veeramani, (Universiti Kebangsaan Malaysia)



THURGASHINY A/P VEERAMANI | VIKNISH A/L ARUMUGAM DEPARTMENT OF CHEMICAL ENGINEERING, FACULTY OF ENGINEERING AND BUILT ENVIRONMENT, NATIONAL UNIVERSITY OF MALAYSIA

Malaysia's Palm Oil Industry: Facing the Challenges and Seizing the Opportunities

RISING PRODUCTION AND EXPORTS
 Malaysia's palm oil production was estimated at **19 Million Tonnes** in 2023, a significant increase from 18.45 million tonnes in 2022.
 Malaysian palm oil exports are forecasted to rise by **3.7%** in 2023, compared to 15.72 million tonnes in 2022.

DIVERSIFIED PRODUCTS AND MARKETS
MARKET INSIGHTS
 Cooking oil, Cosmetics, Biodiesel
EXPORT GROWTH
 Exports in 2023 are set to grow to **16.44 Million Tonnes** from **15.73 Million Tonnes** in 2022.
EXPORT VALUE
137.89 BILLION MYR
 Strong demand for Malaysia palm oil and palm based products in 2022.

DEMAND
 Demand for Malaysia's palm oil is forecasted to increase to **19.85 Million Tonnes** in 2023 from **19.01 Million Tonnes** in 2022.

SUPPORTIVE GOVERNMENT POLICIES AND INCENTIVES
70 MILLION MYR
 Allocation by Malaysian Government to support the Malaysian Sustainable Palm Oil Certification programme.
MPIC
 Oil Palm Integrated Farming Scheme (iTa)
 Agro Bank-MPOB Easy Financing Scheme
 Ensure the sustainability of smallholders' income sources.

6.5 MILLION HECTARES
 Cultivation of capping the total oil palm which included in government policies on Environmental, Social and Governance (ESG).

SWOT Analysis:
Strengths: S
Weaknesses: W
Opportunities: O
Threats: T

HIGH DEPENDANCE ON FOREIGN LABOR
391,000 Total Workers in palm oil plantation sector
74% Foreigners
 with additional labor shortage of **63,000 Foreign Workers** resulted in estimated loss of **20 BILLION IN REVENUE**

AGING OIL PALM TREES
 Nearly **27%** of Malaysia's total planted area of **5.67 MILLION HECTARES** consisted of oil palms trees that are more than 20 years old.
FGV
 Malaysia's FGV Holdings Aims to replant 19,549 hectares in 2023
KLK
 Kuala Lumpur Kepong Bhd Plans to replant 10,000 hectares in 2023.

GROWING DEMAND FOR PALM OIL IN EMERGING MARKETS
India: Largest Malaysian palm oil export market **18.4%** of total Malaysian palm oil exports in 2022. Palm Oil consumption **↑ 26% to 10 MILLION TONNES** expected to increase by 26% to 10 million tonnes in 2023.
China: **↑ 12.9%** export, **↑ 0.3%** volume. Malaysia's palm oil export value and volume to China in 2022. Palm Oil consumption **6.65 MILLION METRIC TONS**. China's estimated palm oil domestic consumption volume in 2023.

EMPLOYMENT OPPORTUNITIES
 The palm oil industry, including downstream sectors employs close to **1 million people** making it second biggest employer after the government. Job openings in Malaysian palm oil industry. Ranging from marketing executives to process engineers, mill managers and sustainability officers.

UNFAVORABLE WEATHER CONDITIONS AND NATURAL DISASTERS
The El Nino weather pattern is expected to cause in Malaysia crude oil production in 2024. The Malaysian Palm Oil Board (MPOB) has projected a decrease of between 1 and 3 million tonnes.

NEGATIVE CAMPAIGNS AND BOYCOTTS BY NGOS AND CONSUMERS
European Union's Protectionist Policies
 European Union Deforestation-free Regulation (EUDR)
 The implementation of the EUDR is expected to have significant impact on the use of palm oil in the EU
10:1 Ideal land-labour ratio. This indicates a high demand for labour in the palm oil industry.
10.1% Significant decrease in Malaysian palm oil exports to the EU by

THE STRATEGIES AND ACTIONS THAT THE MALAYSIAN PALM OIL INDUSTRY HAS TAKEN

MPOC
 Organized the Malaysian Palm Oil Forum (MPOF) in Nairobi, Kenya.
 To foster the relationships
 Increase business opportunities with key industry stakeholders in the East African region.
 Introduced the Palm International Nutra-Cosmeceutical Conference 2023
 To update stakeholders in food, health and cosmetics on palm oil's health benefits.

CPTPP
 The United Kingdom's accession to the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) in March 2023.
 Removes tariffs on Malaysian palm oil imports.
 Enabling industry growth through expanded market access.
 Increased exports to the UK and CPTPP member nations.
 Carries strategic significance.

Ministry of Plantation and Commodities (KPK)
 drafting the National Biomass Action Plan 2022-2030 in line with the National Energy Transition Roadmap.
 Plans to set up one-stop centres to collect oil palm biomass and the raw material will be processed into
 Animal feed, Energy generation, Bio fertilizer

REFERENCES



Infographic: Charting The Future—Malaysia's Palm Oil Industry

Prepared by Kong Li Jing and Winnie Wong yong Xin
(Universiti Teknologi PETRONAS)

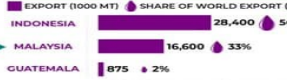
Charting the Future: Malaysia's Palm Oil Industry

CURRENT PALM OIL MARKET

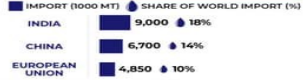


“ Malaysia is the **second largest producer and exporter of palm oil in the world.** ”

TOP PALM OIL EXPORTERS



TOP PALM OIL IMPORTERS



* Statistics in year 2023 from U.S. DEPARTMENT OF AGRICULTURE [1]

CHALLENGES & THE WAY FORWARD

01 LABOR SHORTAGE DUE TO OVERRELIANCE ON FOREIGN WORKERS



80% of workers are Indonesian [4]
Delayed government approvals on the entry of migrant workers during MCO border closures affected yield
Malaysia lose out on an estimated **RM 20 BILLION** in 2022's revenue [2,3]

SHORTAGE OF 63,000 FOREIGN WORKERS [4]

Solutions

1 MECHANIZATION

CANTAS TECHNIQUE [6]
Introduced by Malaysian Palm Oil Board (MPOB)
PROVEN TO BOOST PRODUCTIVITY **2.5 TONS / DAY**
REDUCES LABOR CONSUMPTION **50%**

USE MACHINES: [5]
Hydra-Porter
Sensor-based spraying vehicles
Beluga
The Grabber
FFB Mobile Lifter

2 USE OF LOCAL LABOR

Improving:
Wage
Bonuses
Working condition

MINIMUM WAGE
2013 → 2019
RM 900 → RM 1100

02 PLANT INFECTIONS: BATTLING GANODERMA DISEASE

BASAL STEM ROT (BSR) DISEASE [7]

Caused by the fungus *Ganoderma boninense*

7.4% incidence in Malaysia	9.2% smallholders affected	Estimated yield losses RM 1.5 Billion
221,000 ha affected area (out of 2,883,871 ha surveyed)	3,450.70 ha affected (out of 37,359.81 ha surveyed)	

Solutions

Until 2021, MPOB has developed and disseminated:

8 TECHNOLOGIES ON GANODERMA ON BIOLOGY	7 TECHNOLOGIES ON EARLY DETECTION	32 TECHNOLOGIES ON CONTROL & MANAGEMENT
---	--	--

e.g.,

- Use of endophytic bacteria that possess the characteristics of effective biological control agents
- Drilling & Ganoderma Selective Medium (GSM)
- Polymerase Chain Reaction
- GanoSken tomography
- True-to-Type Version 2 - High Resolution Genotyping Platform for Parental Identification

03 DECLINE IN EXPORTS TO THE EUROPEAN UNION (EU)

MALAYSIAN TOTAL PALM OIL EXPORTS TO THE EU DECLINED **↓4%** (2017: 1.99 Million Tonne → 2018: 1.91 Million Tonne) [13]

EU'S RENEWABLE ENERGY DIRECTIVE (RED II)	EU STANDARDS ON 3-MCPD LEVELS
RED II phased out palm oil as biofuel due to: 1 Risk of causing Indirect Land Use Change (ILUC) 2 Environmental impacts such as CO ₂ emissions	Different maximum levels for 3-MCPD: 1.25 ppm Palm kernel oil 2.50 ppm Refined palm oil

Solutions

WTO legal action against the EU [12]

Explore new markets in the Middle East, Central Asia, China & North Africa [14]

Solutions

Reduces chlorine content of CPO: [11]

Liquid-liquid extraction with polar solvents	Segregating Sterilizer Condensate (SC) & Empty Fruit Bunch (EFB) oils
↓50%	↓30%

04 CLIMATE CHANGE IMPACT ON PALM OIL PRODUCTION

EL-NINO EFFECT: In 2015/2016, El-Nino caused a drop in production: [15]

Before El-Nino	After El-Nino
1986: 22.15 tonnes per hectare	2016: 15.91 tonnes per hectare
1986: 4.41 tonnes per hectare	2016: 3.21 tonnes per hectare

EFFECT OF TEMPERATURE INCREMENT: [13]

Temperature ↑ 1-4°C → Palm oil production ↓ 10-41%

Solutions

MITIGATION STRATEGIES	ADAPTATION STRATEGIES
Afforestation Organic soil Restoration (FAO 2011) Cropland Management	Develop Climate-Resilient Palm Varieties Mulching, Weed, & Cover Crop Management

IMPORTANT VALUES FOR ADVANCING THE MPO INDUSTRY

<h4>QUALITY DEVELOPMENT</h4> [16] <p>3 GOOD HEALTH AND WELL-BEING</p> <p>Code of Practice (COP) E.g. CXC 79-2019 in refined oils & food products</p> <p>Palm Oil Nutrition Research water-soluble phytonutrients (treatment of Alzheimer's disease)</p>	<h4>INNOVATION & TECHNOLOGY</h4> [12] <p>9 ROBUST INFRASTRUCTURE AND INFRASTRUCTURE</p> <p>According to MPOB, oil palm yield & by-products can be enhanced from current 19% → 23% through advanced technology</p> <p>Recording of crop production with GPS location tagging improves traceability</p>	<h4>ENVIRONMENTAL SUSTAINABILITY</h4> <p>13 CLIMATE ACTION</p> <p>The recently-revised MSPO 2022 includes: [17]</p> <ul style="list-style-type: none"> Biogas capture (POME) Limiting deforestation <p>Biomass & biogas as a fuel source for energy generation</p>
--	--	---

“ The oil palm is the most efficient oil-bearing crop in the world, requiring only 0.26 hectares of land to produce one tonne of oil while soybean, sunflower and rapeseed require 2.22, 2.00 & 1.52 hectares, respectively, to produce the same. — Malaysian Palm Oil Council (MPOC) [18] ”



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UNIVERSITI TEKNOLOGI PETRONAS
KONG LI JING | WINNIE WONG YONG XIN

Infographic: Innovation in the Palm Oil Industry

Prepared by Grayson Pan Kee Hao
(Universiti Teknologi PETRONAS)

Innovations in the Palm Oil Industry.

What is Palm Oil?

Oil Palm (*Elaeis guineensis*) is a plant that originates from the tropical rain forest regions of West Africa. Oil palm produces two distinct types of oils: **crude palm oil** from mesocarp and **crude palm kernel oil** from kernels. Today, palm oil is among the **most widely-used** and **cheapest** vegetable oils in the world. It is one of the main feedstocks for oleo-chemical industries, and is found in approximately **60%** of all packaged products in supermarkets.

[1][3][5][10]

As of September 2023

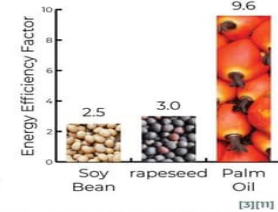
32% Production share of global oil & fats market.

and

53% of worldwide vegetable oil exports.

using only

6% of agricultural land intended for oil production.



Challenges Faced by the Industry

Malaysia is the second largest producer of palm oil worldwide, and has thus been on the receiving end of various critiques from NGOs for unsustainable agricultural practices for palm oil production.

2.3% of Global Deforestation

Deforestation & Climate Change Issues

Palm Oil Mill Effluent (POME) Pollution

54% affects endangered mammals

Habitat destruction of Endangered Species

More Than 100% Price Increase During the COVID-19 Pandemic

Unpredictable Global Scenarios

[1][8][9][10]

So, whats next?

Development of more efficient and sustainable methods of Palm Oil production should be the priority for the industry. Here are just some of the many possible optimisations

A study showed engines running on biodiesel were able to complete **30,000km** of mileage with no technical problems.



Biodiesel Production using Palm Oil

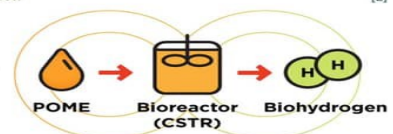
Biodiesel has sparked much interest due to its similarities with conventional petroleum based diesel in terms of energy content and chemical structure, while reducing net CO₂ emissions by **78.45%**. This is commonly done through homogenous catalysis of the transesterification processes, or alternatively through heterogenous, enzymatic, and supercritical technologies. It has been reported that pure palm biodiesel can be directly used as fuel in a diesel engine without prior modification.

[2]

Biohydrogen Production from Palm Oil Mill Effluent (POME)

Biohydrogen is hydrogen produced by algae, bacteria, and other biomass materials; Hydrogen is well regarded as a clean fuel that is seen as highly integral to a greener energy landscape. The highly polluting POME wastewater can be treated using **anaerobic dark fermentation (DF)** systems to produce biohydrogen. Further modifications to the DF method, such as dilute acid pre-treatment of the POME wastewater with HNO₃ and H₃PO₄ to breakdown the complex carbohydrates in POME to more fermentable sugars.

[4][7]



24% Increased Economic Yield

40% Reduction in GHG emissions

Optimisations for Sustainable Palm Plantation Development

Various optimisations can be done towards palm oil plantations, a 2019 study using an input-output optimisation model (IOM) showed that a combined mix of inorganic & organic fertilisation can improve fresh fruit bunch productivity, giving maximum economic yield while reducing land usage by **24%**. From the same study, a reduction in greenhouse gas emissions from **282.95 kt CO₂ eq / year** to **200.73 kt CO₂ eq / year** was achieved.

[6]

Breeding and Biotechnology to Improve Oil Palm as a Crop

Genomics-based strategies such as marker-assisted selection are already generating several useful advances for a variety of important traits that include oil yield, fatty acid composition and crop morphology. Through a genomics-based programme called 'Genome Select' carried out by Sime Darby, the yield of the produced plants is reported to be **9.9 ton/ hectare** over 5 years in field trials with optimum conditions, this is **more than double** of the current average palm oil yields of around **4 ton/ hectare**.

[8]



Made by
Grayson Pan Kee Hao,
Chemical Engineering Department,
Universiti Teknologi PETRONAS



Infographic: Young Palm's Triple-P Future

Prepared by Lim Jia Yang, Ng Chiu Hwi, and Adam Loh Ee Xian
(Universiti Malaya)

YOUR PALM'S TRIPLE-P FUTURE





DEPARTMENT OF CHEMISTRY
LIM JIA YANG - NG CHIU HWI - ADAM LOH EE XIAN



People

Challenge:
Plantation Labour Shortages^[1]

Pandemic causes **shortfall** in labor:
About **120,000** workers in 2022

Hiring of labor is increasingly expensive, especially after pandemic

BOX OF MALAYSIA'S OIL PALM PLANTATION WORKERS ARE MIGRANTS

SOLUTION: DIGITAL TRANSFORMATION OF PLANTATION

THE RISE OF AUTOMATION AND MECHANISATION^[2]

Oil Palm Plantation Inventory

- Tree counting by remote sensing
- 3D mapping for visualization using satellite

Biomass estimation

Forecasting plantation production

Weed Mapping and Management

Map to differentiate between soil from grass and forest by NDVI index

Pest and Disease Detection

Machine Learning Algorithms (SVM) for accurate diagnosis of diseases and bacterial blight

Drone to spray pesticide and fertilizers

Non-destructive method: Colour Vision^[3]

Detection of Ripeness of FFB

Recommended

RGB CAMERA

Low cost
No expensive equipment
Commercially available
Easy to handle

FRESH FRUIT BUNCH (FFB)

CNN CLASSIFIER ALGORITHM

6 LABORERS = 1 DRONE WITH AI

Planet

Challenge 1: Palm Oil Mill Effluent (POME)^[4]

1 ton Crude Palm Oil → 0.5-0.6 ton POME

GREENHOUSE GAS EMISSION

POME IS 94-96% OF WATER

NEAR-FUTURE SOLUTION: THERMAL TREATMENT OF POME^[5]

Enhanced biogas production

Water reclamation and onsite reuse

SUSTAINABLE SOLUTION: ELIMINATION OF POME^[6]

Microwave heating + solvent extraction

ZERO WATER DISCHARGE & HIGH YIELD

Challenge 2: Oil Palm Biomass^[7]

68.6 ton per hectare per year

An oil palm tree contributes 1 oil : 9 biomass

NOVEL SOLUTION: HYDROCHAR FROM BIOMASS

ULTRASOUND TREATMENT OF BIOMASS

HYDROTHERMAL CARBONIZATION (HTC)

Carbon

Soil amendment

Mitigate pollution

Hydrochar (high-value)^[7]

Chemical catalyst

Energy production & Storage

Prosperity

SOLUTION: PUBLIC EDUCATION

Challenge 1: Public Misconception^[8]

Consuming palm oil = Risk of getting cardiovascular diseases

The study could be too general!

sp-2 Hypothesis^[9]

Stereospecific lipase hydrolyses fatty acids at sn-1 and sn-3 in TAG

PALM OIL DESIGNER LIPID (PODL)^[9]

sn-1 & 3 long / medium chain saturated FA
palmitic acid
stearic acid

sn-2 mono- / poly-unsaturated FA
oleic acid
linoleic acid

POOL VS COMMERCIAL PALM OIL BLEND

- ✓ Lighter colour
- ✓ Lower acid value
- ✓ Oxidative stability even higher!

STRONG POTENTIAL CANDIDATE OF COMPLEMENTING TRADITIONAL COOKING OIL

SOLUTION: SUPPORT SUSTAINABLE PALM OIL^[10]

Challenge 2: EU Protectionary Principle & US Customs and Border Protection^[10]

Bending will by the public → Anti-palm oil lobby

DIETARY SUPPLEMENT MARKET^[11]

>69,000 articles published through PubMed between 2012 and 2022

expected global market by 2028 = USD 300 billion

Palm Mixed-Carotenes
66% beta carotene

- Antioxidant
- Lower the risk of getting age macular degeneration (AMD)

PALM OIL AS NUTRIENT^[12] SOURCE

Tocotrienol-Rich Fraction (TRF)

- Anti-cancer
- Antioxidant
- Antidiabetic
- Neuroprotection
- Anti-inflammatory
- Immune enhancement
- Chemotherapeutic agent

US = GREATEST ECONOMIC BY GDP IN 2022^[13]

How could we lose such a huge market because of anti-palm oil lobby?

UPSTREAM: MODERN OIL PALM PLANTATION

MIDSTREAM: SUSTAINABLE PALM OIL PRODUCTION

DOWNSTREAM: INTERSECTION OF PALM OIL AND PUBLIC HEALTH

Infographic: The Rise of Malaysian Palm Oil as a Phytonutrient Powerhouse

Prepared by Sharvani A/P Karthigesu, Chang Jia Heng, and Tee Qiao Er (Universiti Malaya)



The Rise of Malaysian Palm Oil as a PHYTONUTRIENT POWERHOUSE



UNIVERSITY OF MALAYA
Department of Chemistry,
Faculty of Science, UM

SHARVANI A/P KARTHIGESU | CHANG JIA HENG | TEE QIAO ER

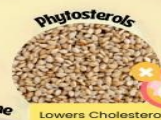
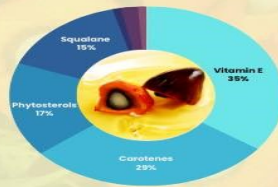


Scan me to get the references links

What are palm-based Phytonutrients?



Percentage of Phytonutrients in 1% weight of crude palm oil



Economy Aspect

Vitamin E

"Malaysia's annual RM70 MILLION palm oil VITAMIN E EXPORT to the global pharmaceutical industry are set to expand"

Market is expected to register a **CAGR of 7.54% 2019-2026**

Market is expected to register a **CAGR of 3.4% 2020-2027**

Provitamin A

Higher preference for natural carotenoid over synthetic products

DEMAND for PALM PHYTONUTRIENTS in the nutraceutical segment is **INCREASING** but is still in its infancy.

Vitamin E can **IMPROVE** the quality of the **IMMUNE RESPONSE** and the **EFFECTIVENESS OF VACCINES** in young pets

Largest market share of **CAGR of 38.90% in 2022**

Vitamin deficiency in pets and livestock animals
Production of specialized Vitamin E supplements

Free radical damage in the body
Used as antioxidants and anti-inflammatory agents

Premature aging of skin caused by UV exposure
Carotenoid increase skin density, elasticity and firmness

Largest market share of **CAGR of 46.50% in 2022**

Carotenoid is added to **animal feed** as **PIGMENT** and to **increase its OXIDATIVE STABILITY**



MPOB has announced that **Palm Tocotrienol-Rich Fraction (TRF)** as an **ADDITIONAL NUTRITION ALLOWED** for food products.

Vitamin A deficiency (VAD) is prevalent in **primary school children** living in due to low socioeconomic status

Possible Applications of palm-based phytonutrients

Challenges & Solutions

1 Deforestation & CO2 emission

Solutions:

i. Stricter regulations on the applications of RSPO and MSPD Certifications by oil palm producers

A global certification system for certified sustainable palm oil.

ii. Oil Palm industry commit to 'NO DEFORESTATION, NO PEAT AND NO EXPLOITATION' development policy.

iii. License withdrawal for non-certified estates



Malaysia produces the **MOST SUSTAINABLE** palm oil

Oil palm plantation requires only **9%** of the 322 million hectares of land used to produce oil crops globally, yet it **PRODUCES 36%** of total vegetable oils produced.

Worldwide palm oil cultivation only accounts for **<5%** of **GLOBAL DEFORESTATION** from 1995-2015

2 Research and Development

Solution:

i. Application of high-precision DNA fingerprinting platform

Planting palms in breeding trials and commercial plantations having the desired genetic lineage to increase phytonutrient composition

ii. R&D in producing chewable tocotrienol tablets

"Consumers were willing to pay an additional RM23.30 per bottle for tocotrienols in the form of a flavoured chewable tablet compared to capsule form."

iii. Development of tocotrienols and carotene based local skincare

TOCOVID's SupraBio™ technology



3 Lack of Consumer Awareness



"Love Malaysian Palm Oil Campaign"

Solutions:

i. Collaboration with Healthcare Professional

Encourage doctors, nurses to prescribe palm based vitamins to patients in need

ii. Conduct Educational Talks and Competitions

Ministry of education collaborate with industries to conduct **SEMINARS, TALKS and COMPETITIONS** related to palm-based phytonutrients

iii. Label food packaging with TRF as additional nutrition



4 Marketing Issue

Solutions:

i. Collaboration with influencer

Collaborate with the influencer to promote palm based products in social medias.

ii. Getting HALAL certification

Certification to let the public to trust the products and willing to buy and consume the products

iii. Advertisement

Billboards, Television, Instagram and Youtube Ads on palm-based phytonutrient containing products

5 Food Safety Issue

Process Contaminants

Trans Fats Glycidyl esters (GE)
3-monochloropropanediol esters

Solutions:

Reduction in process contaminants

Trans fat should be limited to less than 1% to protect Malaysian consumers

Simple water washing to remove most precursors to trace contaminants

Deodorization at lower temperature followed by neutralization.

Infographic: Future of Palm Oil Industry Overcoming Hurdles for a Sustainable Future: Labour Issues and Solutions on Upstream

Prepared by Lee Khai Jin and Loh Wen Han
(Universiti Malaya)

Organised by:



Participated by:

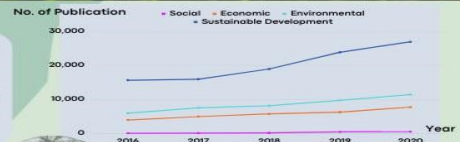
1. Lee Khai Jin (BEng in Chemical Engineering)
2. Loh Wen Han (BEng in Chemical Engineering)



Future of Palm Oil Industry Overcoming Hurdles For A Sustainable Future: Labour Issues and Solutions on Upstream

Introduction

The importance of achieving sustainable development has gained significant prominence worldwide in the last twenty years. It has emerged as a crucial approach to tackle and alleviate global issues like climate change, resources scarcities as well as social concerns. Approaches such as bioeconomy, green economy and circular economy tend to focus more on economic growth, cleaner production, and environmental protection, while not giving enough attention to the social aspect. However, the measurements of social impacts and indicators or effectiveness of efforts towards social sustainable are complicated and impractical.



4-D's situation

(Dirty, Difficult, Dangerous, Demeaning)
A perpetual issue in the palm oil sector as this sector is labour-intensive by nature.



Mechanization and Technology Adoption

- Invest in research and development of technologies for mechanized harvesting and processing of palm oil.

In 2022, the Malaysia oil palm plantation sector's total labor requirement was 437,212. However, the number of workers in the sector was 382,582, recording a shortage of 54,630. Hence, resulting in revenue loss of RM 20 billion (\$ 4.6 billion).

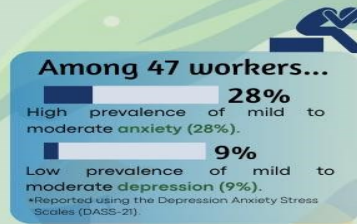
Labour shortage

- 4D and restrictions from source countries
- Huge amount of Fresh Fruit Bunches (FFB) are left unharvested and spoiled
- Causing countless revenue lost



Efficient Workers Recruitment Practices

- Seeking collaboration with the source countries to simplify the migration procedure.
- "Borrow" workers from India, which has large population as the exchange of skills by sending back the skilled workers afterwards.



Forced labour

11 Indicators of ILO Forced Labour

- Abuse of Vulnerability
- Deception
- Restriction of Movement
- Isolation
- Physical and Sexual Violence
- Intimidation and Threats
- Retention of Identity Documents
- Withholding of Wages
- Debt Bondage
- Abusive Working and Living Conditions
- Excessive Overtime

8 out of 1000 workers of Malaysian oil palm plantation are in forced labour, including private estate & government scheme workers.

*Data from Human Rights Commission of Malaysia

70% of the workers in Sabah are undocumented and dependent on plantation operations for their working permits.

Child labour

- Undocumented Indonesian migrants who born in Malaysia, have neither Malaysian nor Indonesian citizenship (stateless children)
- Informally working on plantations to meet the high production

72000 stateless children are estimated to work on oil palm plantations in Sabah without minimum education.

Strengthen Labour Regulations and Enforcement

- Ensure the protection of workers' rights, by implementing stringent monitoring and enforcement mechanisms to prevent and penalize instances of child labor, forced labor, and abusive treatments.

Producers' Education and Training

- Provide education and training to palm oil plantation owners and workers on labor rights and self-awareness.
- Ensure the producers to comply the RSPO standards and advocate the benefits of RSPO certification.

Transparency and Accountability

- Require producers to disclose their labor standards, recruitment practices, and working conditions.
- Whistleblowing policy: channel the grievances raised to the dedicated team where the complainants will be guaranteed with protection.



Important Values for Advancing Malaysian Palm Oil (MPO) Industry

8 DECENT WORK AND ECONOMIC GROWTH

Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Stronger commitment to the well-being and advancement of the workforce by implementing policies that prioritize decent job prospects, fair wages, safe work conditions, and skill development.

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

Renovation of harvesting technologies fosters the sustainable practices within MPO industry by optimizing production efficiency, promoting well-being of workers and reducing environmental footprints.

17 PARTNERSHIPS FOR THE GOALS

Strengthen the means of implementation and revitalize the global partnership for sustainable development

Collaboration with other countries promotes sustainable practices, policy coherence, and innovation while fostering transparency, accountability, and conflict resolution with the same goals.

Infographic: Malaysian Palm Oil: Nurturing The Golden Future

Prepared by Kelvin Chuah Jing Lee and Wan Jia Wei
(Universiti Tunku Abdul Rahman (UTAR))

MALAYSIAN PALM OIL: NURTURING THE GOLDEN FUTURE

PROBLEMS, SOLUTIONS AND IMPORTANT VALUES

Social

High Dependence on Foreign Workers

- Face a shortage of **200,000** foreign workers in 2023^[11]
 - At least **70 %** of workforce contributed by foreigner^[2]
- Fresh fruit bunches production reduced by **3.33 million** tonnes in 2021 due to labour shortage affected by COVID-19^[3]

Adoption of Mechanisation & Automation

Reduce the workload of labour to operate the harvesting pole^[4]

Exoskeleton

Drone

- Spray fertiliser and pesticide
- Collect data from^[4] heterogeneous sources^[5]

Fluctuation in Demand

- European Union's protectionist policies restrict the import of palm oil products^[6]
- **10 %** Decline in palm oil export to EU in 2022^[7]
- Decrease in demand from India and China in 2022^[8]

Value Addition and Market Development

- Explore more new applications to diversify the market through research and development
- Used cooking palm oil processed into bio-lubricant^[8]



- Palm kernel cake as feed for laying hens without affecting the egg quality^[8]

Environmental

Destruction of Biodiversity^[9]

- Conversion of land to oil palm plantations displaces pristine tropical habitats
- Considerable **habitat loss** and **biodiversity decline** as complex ecosystem are replaced with species-poor plantation system^[10]

Emission of Green House Gases^[11]

- **Peatlands** contain globally significant levels of carbon below ground
- Planting oil palm on drained peatland lead to high emissions of CO₂ to the atmosphere
- Habitat fragmentation and increased pollution can further increase emissions of GHG^[10]

Cultivation on Degraded Land^[10]

Several studies imply that on already degraded land, modest oil palm expansion would be feasible

Reducing Unnecessary Expansion^[9]

Limiting the development of cultivation on peatlands and enforcing the moratorium on new concessions in primary forest

Enhancing Plantation Management Measures^[9]

Employing cover crops, mulch, and compost, as well as avoiding peat drainage and illegal land clearance with fire

IMPORTANT VALUES

Sustainability^[12]

- Certification scheme was introduced to ensure the sustainability of oil palm cultivation
- The certified company had met the standard to **produce, process and distribute** palm oil sustainably in terms of environmental and social

Traceability^[15]

- The end consumer is able to trace the supply chain from the **origin plantation** to the **manufacturer**
- Ensure the supply chain is sustainable

97.88 % MSPO-Certified Oil Palm Plantation Area^[13]

441 MSPO-Certified Mills^[14]



Contributed to **66.1 %** of the total export earnings which amounted to **RM44.63 billion** in 2022^[16]



Methane capture from Palm Oil Mill Effluent (POME) is burned to provide consistent & reliable energy^[18]



Oil palm trees with a **5.6** leaf area index raise the photosynthetic efficiency. Produce more oxygen to the air and absorb more carbon dioxide from the atmosphere^[17]



Malaysia Palm Oil industry reduced poverty from **50 %** in 1960 to less than **5 %** today by providing various employment^[18]

Infographic: Why & How to Sustain Palm Oil Industry?

Prepared by Cindy Lau Jen Ding
(Universiti Teknologi PETRONAS (UTP))



Prepared by Cindy Lau Jen Ding
Department of Chemical Engineering, Universiti Teknologi PETRONAS



Malaysia is the world's Top 2 producer & exporter of palm oil [3], [4].



The palm oil industry, being the 4th largest contributor to the Malaysian economy [6].

Why & How to Sustain Palm Oil Industry?



Current Problems Faced in Malaysian Palm Oil (MPO) Industry

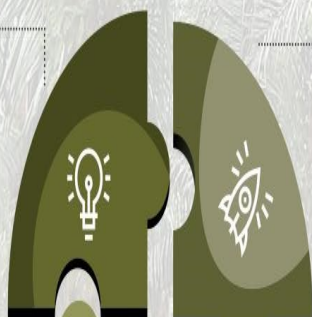
- Ongoing environmental and sustainability issues including deforestation, biodiversity loss and GHG emissions due to crop expansion.
- Serious production issues related to plantation management, labour shortages, and a slow pace of mechanization.
- High degree of price volatility caused by the unpredictable S&D scenarios in the edible oil and oilseed market.
- Palm oils are globally traded commodities with lengthy and complex supply chains, which can impede implementation of sustainability criteria.

SOLUTIONS

01

Reduce GHG Emission

- To limit oil palm expansion to areas with moderate or low carbon stocks.
- To execute pragmatic replanting programme with best practices.



02

Technological Advancement for Higher Output

- Use modern molecular breeding approaches to modify crop architecture.
- MPOB reported that upgrading the technology at the plantation and production level can increase the oil palm yield and by-products from 19% to 23% [1].

04

Market Expansion

To further strengthen its position in the global market, the Malaysian industry will have to expand and establish markets by leveraging global supply chains.



03

Implementation of transparent and effective certification schemes

To achieve 100% sustainability and traceability throughout its supply chain.
e.g. Malaysian Sustainable Palm Oil (MSPO) and Roundtable on Sustainable Palm Oil (RSPO)

4 Market Diversification

Reducing dependency on a few key export markets can help stabilize the industry and mitigate the impact of market fluctuations.

1 Environmental Responsibility & Sustainability

Sustainable practices are vital to ensure the long-term viability of the MPO industry. This includes environmentally responsible cultivation and production methods that minimize deforestation, protect biodiversity, and reduce greenhouse gas emissions.

Important Values for Advancing the MPO Industry

2 Research & Innovation

Investing in research and innovation can lead to more sustainable and efficient palm oil production methods, including disease-resistant varieties, efficient harvesting techniques, and improved waste management.

3 Certifications

Encouraging the adoption of certifications like RSPO and MSPO can promote sustainable practices and provide consumers with confidence in the industry's sustainability efforts.

Infographic: A Zero Waste Crop

Prepared by Muhammad Fakhru Radzi Bin Ridzwan
(Universiti Teknologi PETRONAS (UTP))

A ZERO WASTE CROP

Circular Economy for Sustainability of Palm Oil Industry



What is Happening?

Fast-Growing Industry

Contribute towards
5.74 Millions
Hectars Plantation in 2020's

Contribute towards
87%
HIGH VOLUME SOLID WASTE

11 Ecosystem function has been depleted out of 14 due to



Year	Solid Biomass Waste	POME
2010s	75.61 M tons / year	65.35 M tons / year
2020s	85 – 100 M tons / year	70 – 110 M tons / year

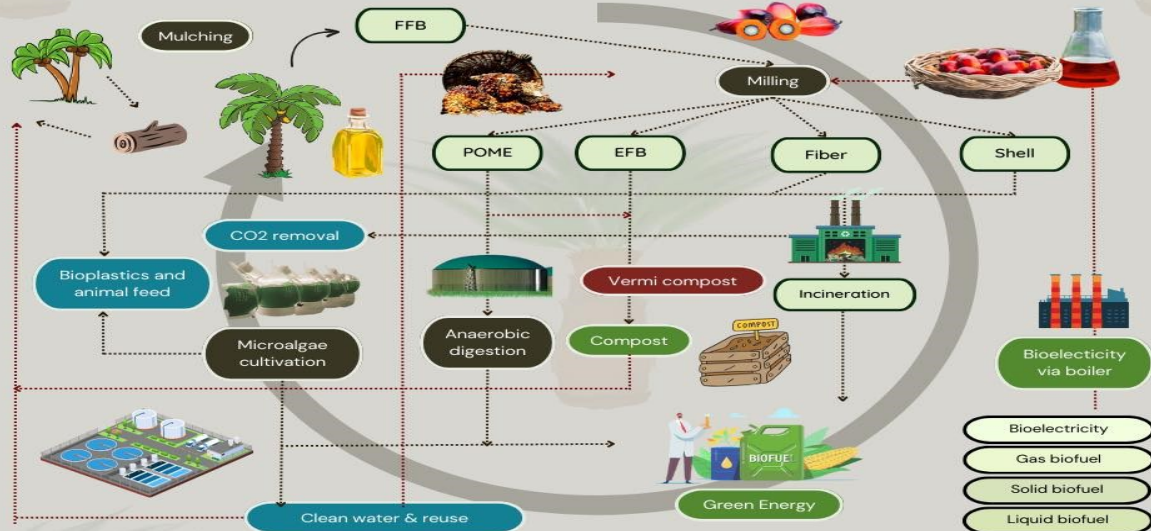
PALM OIL INDUSTRY IN MALAYSIA

Waste-to-Energy Facility

2010s ~ 300MW
2020s ~ 800MW

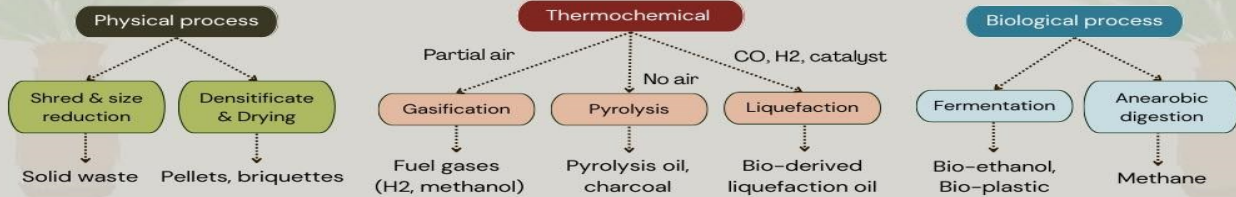
LIFE CYCLE ASSESSMENT (LCA)

Efforts in Circular Industrial Ecology



Palm Oil Waste Management

METHODOLOGY : BIOMASS REACTIONS



SUSTAINABILITY APPROACHES

PEOPLE

Sustainable livelihood and poverty reduction

PROSPERITY

Competitive, resilient and sustainable sector

PLANET

Conserved, protected and enhanced ecosystem

What's Up Next?

Malaysia's palm oil board, Petronas to study use of palm waste as aviation fuel

Reuters August 16, 2023 10:58 PM GMT+8 · Updated a month ago



"In line with National Energy Policy 2022-2040 to reduce CO2 emissions. It acts as catalyst for Malaysia socio-economic development."

Malaysian Palm Oil Board, MPOB, (Aug 16, 2023)

MUHAMMAD FAKHRUL RADZI BIN RIDZWAN
CHEMICAL ENGINEERING | UNIVERSITI TEKNOLOGI PETRONAS



References



Further Reading



Infographic: The Future of Malaysia Oil Palm Industry

Prepared by Kenneth Chong Yih Haur
(Universiti Teknologi PETRONAS (UTP))

CURRENT STATUS

3.7%
Increase of Malaysian palm oil exports

97% Oil palm cultivated areas

Palm oil mills **98%**
MSPO Certified!

MAIN DISTRIBUTOR

SABAH

SARAWAK

THE FUTURE OF MALAYSIA OIL PALM INDUSTRY

Land for palm oil expansion is limited in availability as most areas have already been planted and urban development is prioritised.

Cannot compete with the volume of Indonesia's palm oil production.

Current Issues

Malaysia lacks the infrastructure to retain any market share it gains in the short term

Heavy reliance on manual labour for palm oil production

PALM OIL CONSUMPTION

Year	Food and Industry	Electricity	Biodiesel
2010	~3.8	~0.2	~0.0
2012	~3.5	~0.3	~0.2
2014	~3.2	~0.4	~0.4
2016	~3.0	~0.5	~0.5
2018	~2.8	~0.6	~0.6

As many countries seeking to replace all carbon-based fuels by 2050. The demand of electricity production will be expected to raise due to the recent advances in electric vehicles (EVs) technologies.

CONCLUSION

The future of the Malaysian palm oil industry hinges on a commitment to several crucial values. Sustainable cultivation practices, responsible environmental stewardship, and ethical labor standards are paramount. Furthermore, embracing innovation and technological advancements will drive efficiency and competitiveness. By upholding these values, the Malaysian palm oil industry can not only thrive but also serve as a global model for sustainable and responsible agricultural practices.

1 "Smart" Oil Palm Mill

Use of digital technologies, such as blockchain and AI, to enhance the performance and transparency of supply chains

2 MSPO Standard

Achieve goals where all states produce palm oil outputs to RSPO standards for sustainable oil palm production.

3 Electricity for EV

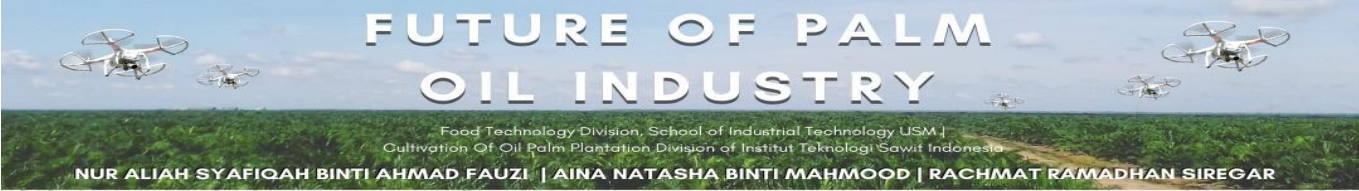
Divert from biodiesel to electricity production purpose to address demand of EVs in the future.

FUTURE SOLUTION

KENNETH CHONG YIH HAUR
CHEMICAL ENGINEERING DEPARTMENT
UNIVERSITI TEKNOLOGI PETRONAS

Infographic: Future of Palm Oil Industry

Prepared by Nur Allah Syafiqah Binti Ahmad Fauzi, Aina Natasha Binti Mahmood and Rachmat Ramadhan Siregar
(Universiti Sains Malaysia (USM))



Current Challenges in MPO Industry

- High Demand of Palm Oil**
Globally increase in 2050
50 → **77**
Million Tonne
- Market Access Issues**
Trade restrictions & boycotts due to sustainability concerns
- Labour Shortages**
Shortage of skilled labor in remote plantation areas affects productivity
- Environmental Concerns**
Deforestation, biodiversity losses
2.3% Palm oil contributes for global deforestation

1 Genetic Modified Organism (GMO)

- Reduce trunk height
- To enhanced yield & ease of harvesting

2 Digital Agriculture

- Using drones & IOT Sensors to enable precise intervention

Advancing Palm Oil for Future

- 3 Research & Development**
Genomic Analysis
Accelerate breeding of disease resistant
Accelerate climate-resilient palm oil
- 4 Agroforestry Integration**
Combine diverse tree crops to enhance biodiversity & carbon sequestration
- 5 Blockchain Traceability**
Blockchain technology
Ensure transparency & traceability throughout the supply chain

Genetic Modified Organism (GMO)

- Reduce trunk height
- To enhanced yield & ease of harvesting

Digital Agriculture

- Assess nutrient level
- Analyze plant health
- Detect diseases
- Monitor plantation

Budget 2023 - recently has proposed

- Allocation of **70** Million
- In order to improve the level of sustainability in the palm oil industry
- Encouraging the recycling of palm waste materials

Recommendation in Advancing MPO Industry

Moving forward

- With advancements in technology, Malaysia has potential to further drive its palm oil industry into the future.

References in QR Code

Infographic: The Future of Palm Oil Industry

Prepared by Lo Ming Eirwen and Helena Tan Hui Fang
(Heriot Watt University Malaysia campus)

THE FUTURE OF PALM OIL INDUSTRY

Lo Ming Eirwen
College of Engineering
Universiti Tenaga Nasional
(UNITEN)

Helena Tan Hui Fang
School of Engineering and Physical Sciences
Heriot-Watt University Malaysia
(HWUM)



CHALLENGES IN THE MALAYSIAN PALM OIL INDUSTRY.

LABOUR SHORTAGE

Only **21,000** foreign workers returned to the plantation sector.

Locals refuse to work in MPO industry as they consider the job the **4D's**.^[1]


Dirty

Difficult

Dangerous

Demeaning

Limited approval on recruitment from source countries besides **Indonesia**.^[2]



BANGLADESH 1% **INDONESIA 51%**
NEPAL 5% **INDIA 42%**

potential revenue of **RM20 billion** in 2022 is lost from unrealised crop & palm products.^[3]

ESG CONCERNS

Large-scale conversion of tropical forests to oil palm plantations.^[4]

BIODIVERSITY LOSSES

193 Critically Endangered, Endangered & Vulnerable species lost their natural habitat.^[5]

SOIL & WATER POLLUTION


2.5 metric tons of effluent is generated for every metric ton of palm oil produced.

CLIMATE CHANGE


0.8% of total GHG emissions is contributed by the conversion of peat swamps into palm oil plantations in Southeast Asia.^[6]

EUROPEAN UNION'S PROTECTION POLICIES

European Union Deforestation-free Regulation (EUDR)



reduction in exports of MPO to EU, with **25%** year-to-year reduction in the import value.^[7]



products cannot originate from deforested land or contribute to forest degradation.^[8]

“No Palm Oil” Labels

80/251 outlets in Klang Valley were found to carry products with “No Palm Oil” labels in 2021.^[9]

The discriminatory label has **mised the consumers & undermined the credibility of Malaysia's golden oil**.^[10]

VALUES IN ADVANCING MALAYSIAN PALM OIL INDUSTRY.

TECHNOLOGY TRANSFER

New fertilizer formulations^[11]

increase nutrient uptake efficiency

increase the yield

raise the income of growers

upgrades **biomass** like

- oil palm trunks
- empty fruit bunch
- palm kernel cake (PKC)

into **bioethanol** a clean-burning fuel that reduces GHG emissions by **86%** compared to gasoline.^[12]

Biorefinery technology

ENVIRONMENTAL BENEFITS

By complying with RSPO standards & incorporating the HCSA,

Identifying, maintaining and enhancing High Conservation Value (HCV) areas & High Carbon Stock (HCS) forests.^[13]

Halt deforestation

Habitat Conservation


RSPO: Roundtable on Sustainable Palm Oil
HCSA: High Carbon Stock Approach



renewable palm-based polyurethane from palm oil-based polyol

protect stitched artificial grass at the back of the carpet

RESPONSIBLE LABOUR PRACTICES



Lightweight three-wheeled utility vehicle equipped with a hybrid-powered pesticide spray system.

reduce plantation operating costs

reduce the workload for chemical spraying

ergonomic design for comfort and safety

INNOVATION AND RESEARCH

Machine to collect oil palm loose fruits in the plantations.

- loose fruits have the highest oil content
- to reduce the dependency on foreign workers
- collection of loose fruits is more efficient

New Fertilizer technology GanoCare®^[14]

This technology improves

- Oil Palm Growth
- Resistance against Ganoderma Basal Stem Rot Disease

Infographic: Navigating the Future: Palm Oil Industry Insights

Prepared by Ong Jun Du
(Universiti Sains Malaysia (USM))



Navigating the Future: Palm Oil Industry Insights

OVERVIEW

The future of Malaysia's palm oil industry relies on technology advancements, with a focus on **precision agriculture** in the upstream sector to increase crude palm oil (CPO) yield per hectare, while the downstream sector explores **innovative oleochemical processes** to expand value-added products, all aimed at ensuring **sustainable production** and competitiveness.

Current Challenges :-

- Deforestation & Habitat Destruction**
- Market Uncertainty**
- Technical Inefficient**
- Labor Practices & Concerns**

Innovation Drivers :-

- Export Opportunities**
- Environmental & Sustainability Concerns**
- Technological Advancements**
- Market Demand & Consumer Awareness**

- SMART ROBOTIC ARMS**
Robotic arms, often combined with AI and IoT, are employed in the upstream palm oil plantation phase to automate tasks like harvesting and pruning, enhancing efficiency and reducing reliance on manual labor.
- REMOTE MONITORING**
Remote sensing technologies and data analytics for real-time monitoring of plantations, helping detect diseases and pest infestations early, and optimizing resource allocation.
- AGRICULTURE DRONE TECHNOLOGY**
Drones are utilized in the plantation phase in conjunction with aerial mapping and surveillance, to monitor large plantation areas efficiently, gather crucial data, and enhance sustainability management.
- AUTOMOTIVE VEHICLES**
Automotive vehicles and tractors are employed in the upstream palm oil plantation phase for tasks such as transportation of harvested palm fruit bunches, contributing to efficient operations.
- BLOCKCHAIN TECHNOLOGY**
Blockchain technology is used in palm oil production, from plantation to refinery, to improve supply chain traceability and transparency, supported by emerging technologies for sustainable & accountable production.



- RENEWABLE ENERGIES**
Integrating renewable energy sources, like solar and biomass power generation, into palm oil plantation and mills to reduce greenhouse gas emissions and dependence on fossil fuels.
- WASTE UTILIZATION**
Implementing technologies to convert palm oil waste, such as empty fruit bunches, palm kernel shells, and mill effluent into value-added products like biochar and biogas, with achievement of resource conservation.
- SUSTAINABLE PRACTICES**
Implementing technology-driven sustainable practices, such as zero-burning policies, precision fertilization, and water management systems, to mitigate deforestation & environmental concerns.
- SUSTAINABLE PALM OIL CERTIFICATION**
Roundtable on Sustainable Palm Oil (RSPO)-certified sustainable palm oil ensures transparency and traceability by verifying responsible sourcing and production practices.
- HEALTH, INNOVATION AND REGULATION**
Consumer health consciousness may drive palm oil industry innovation for healthier alternatives with reduced saturated fat, while stricter regulations and labeling could affect consumer choices.

ECONOMICS IMPACTS

SOCIAL IMPACTS

IMPACTS

- Trade & Market Expansion**
- National Economic Growth**
- Reduced Poverty**
- Environmental Conservation**
- Social Inclusion & Job Creation**
- Health & Well-Being**

Scan Me!!



REFERENCES

Do you know?
On September 18, 2023, China would double its imports of Malaysian palm oil to **500,000 tonnes per year** from the previous 250,000 tonnes.
In June 2023, Malaysia and Indonesia underscored their collaborative effort to **protect shared palm oil interests**.

This infographic is designed for the competition organized by IChemE's Palm Oil Processing Special Interest Group (POPSIG), known as the Palm Oil Infographic Competition.



School of Chemical Engineering, USM ENGINEERING CAMPUS

Created by: ONG JUN DU

Infographic: Potential of Empty Fruit Bunches (EFB) From Palm Oil Waste in Malaysia

Prepared by Low Ru Yi and Teh Chin Man
(Universiti Malaya)



Infographic: Future of Palm Oil Industry

Prepared by Nur Aisyah Syahirah Binti Ahmad Fauzi, Nurul Izzati Izzah Binti Izani, and Wan Nurbalqis Faalihah Binti Wan Bukhari (Universiti Putra Malaysia)



• NUR AISYAH SYAHIRAH BINTI AHMAD FAUZI • NURUL IZZATI IZZAH BINTI IZANI •
• WAN NURBALQIS FAALIAH BINTI WAN BUKHARI •
Food Science and Technology, Faculty of Food Science and Technology, UPM

FUTURE OF PALM OIL INDUSTRY

Palm Oil Production



Global market for palm oil was valued at **\$67.3 billion** in 2022 (8)



MALAYSIA

5.9 million hectares of plantation area (9)

SABAH



has **largest** plantation area

CURRENT CHALLENGES IN THE MALAYSIAN PALM OIL INDUSTRY

12% of Malaysia's population are indigenous ethnic groups (5)



SOCIALS

The indigenous communities, The Orang Asli of Malaysia have lost their ancestral grounds and are more prone to fatal diseases, due to polluted water from deforestation. (10)

2018 Deforestation from plant oil palm plantations disrupted the Temiar people's Sewang ceremony, and the traditional medicines and food availability in jungles. (3)

2021 Despite successful legal action, the land of the Temiar tribe of Orang Asli was invaded and encroached from deforestation by timber and plantation corporations. (4)

2022 State officials rejected the relation between deforestation and an increase in human-wildlife contact, from tiger attack on an indigenous Temiar man. (4)

2010

Over 87% of Malaysia's total land area, 20.3 Mha were covered in natural forest. (11)



ENVIRONMENTAL

Palm oil is responsible for an estimated 5% of deforestation in tropical regions (FAO) and 2.3% of worldwide deforestation (The European Commission). (2)

Mammals and birds, including orangutans, tigers, and hornbills, are severely threatened by the loss and fragmentation of habitats, which is bringing them closer to extinction. (2)

Deforestation & Biodiversity Loss



ECONOMICS

Currently, palm oil cultivated almost **52%** of total agriculture land (**10.94 million hectares**) (7)

Malaysia has **limited arable land**

Government cannot afford to expand the plantation area (7)



Labor shortage

Shortage of 12,000 workers can lose income to the government about (3)

RM2.8 billion to RM3.9 billion

Palm oil is the largest produced and traded edible oil globally. **Unpredictable supply & demand scenarios** cause price volatility (1)

Deforestation & Human Rights

IDEAS IN ADVANCING MALAYSIAN PALM OIL INDUSTRY

Sustainable Oil Extraction

Spend in **technology** that can produce oil of a higher quality while having **less negative impact** on the environment, eg: supercritical fluid extraction or enzymatic extraction. Greener solvents or mechanical extraction techniques that use less energy and produce less waste. (6)

Implement IoT (Internet of Things)

Real-time monitoring of soil conditions, weather and plant health.

Circular Economy Approach

Producing **value-added goods** from waste oil palm products.

Community involvement fair trade initiatives

Applying **practise fair trade principles**, offering **employment opportunities**, and assisting **local community development initiatives**.

IMPORTANT IN ADVANCING MALAYSIAN PALM OIL INDUSTRY



Sustainability



Environmental Responsibility

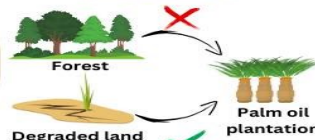


Ethical Labor Practices



Research and Innovation

The POTICO concept: Shift to degraded land




POTICO's goal: Prevent deforestation by diverting oil palm plantations away from forests and on to already degraded areas.



Scan for references.




Infographic: Future of Palm Oil Industry in Malaysia

Prepared by Hani and Yi Xun
(Universiti Teknologi PETRONAS)



FUTURE OF PALM OIL INDUSTRY

in Malaysia

An infographic by
Hani Yi Xun
Business Management &
Chemical Engineering
Universiti Teknologi PETRONAS



From a tropical climate, 25-28°C



Harvested every 10 days

A tree can be productive for 25 years




Each fruit contains **30-35% oil**




40 kg of oil is produced by a palm tree every year


CHALLENGES AND SOLUTIONS



8 of 10 Foreign Labours with right skills to harvest have returned home causing a labour shortage in the industry


Provide **SPECIALISED TRAININGS** for industry labour to improve competency

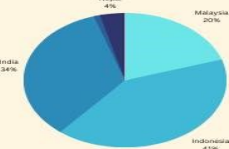




10-41% Reduction in palm oil production due to changing weather patterns

- PROMOTION and development of climate resilient varieties
- SOIL and water conservation
- AFFORESTATION
- INSURANCE and risk transfer mechanisms
- EMISSION reduction technology
- PROTECTION of coastal flooding







Country	Percentage
Indonesia	41%
Malaysia	20%
Nepal	4%
India	3%

Struggle with increasing dependence on foreign labour and a slow pace of mechanization

Adoption of multiple tools to allow for mechanization of palm oil harvesting to improve productivity.


- Motorized harvesting pole, Cantas™
- Buffalo-assisted collection of FFBs





European Comission (EC) estimates Palm Oil, Soybean & Beef to drive **80%** of Global Deforestation in Malaysia

Set robust policies to remove deforestation, conversion of other natural ecosystems, such as peatlands, and human rights abuses from their supply chains



FUTURE OF PALM OIL INDUSTRY



Eco-processed pozzolan (EPP) is expected to generate an additional RM 3.3 billion (USD 1 billion) in GNI and create 1,000 jobs



Market Expansion

Establishing more food and health based downstream segments. Will increase the value of Malaysian palm oil to domestic industry and increase the value of palm oil related exports.





Leveraging global supply chains.

Reference



News: POPSIG Management Paid A Courtesy Visit to Malaysia Palm Oil Board (MPOB) Headquarter

The Chairlady Yang Berbahagia Professor The Chair Professor Ir Dr Chong Mei Fong led POPSIG management to pay a courtesy visit to the headquarter of Malaysian Palm Oil Board (MPOB) in Bandar Baru Bangi on Friday 11 August 2023.

POPSIG management team were represented by Yang Berbahagia Professor The Chair Professor Ir Dr Chong Mei Fong, Chairlady of POPSIG; Mr Ng Wai Lun, Head of Industrial and Corporate Communications Unit, POPSIG; Ms Jocelyn Lim Jean Yi, Vice Treasurer at POPSIG; and Ms Leiu Yu Xuan, Roadshow Coordinator at POPSIG.

MPOB team attending the meeting were Yang Berbahagia Datuk Dr Ahmad Parveez Haji Ghulam Kadir, Director General of MPOB; Dr Loh Soh Kheang, Head of Energy and Environment Unit, Engineering and Processing Research Division, MPOB; Mr Nik Aznizan Nik Ibrahim, Head of Corporate Communications Unit, Information Technology and Corporate Service Division, MPOB; Mr Nasrin Abu Bakar, Group Leader of Milling and Waste Management Technology Group, Milling and Processing Unit, Engineering and Processing Research Division, MPOB; and Ms Nor Asliza Semiran, Corporate Communications Unit, Information Technology and Corporate Service Division, MPOB.

POPSIG expressed a warm welcome to the collaboration with the Malaysian Palm Oil Board (MPOB), emphasizing its commitment to engaging in joint technical activities benefiting both industrial players and university students. The discussions between POPSIG and MPOB extended to exploring the potential for technical collaborations specifically within the con-

text of the POPSIG University Roadshow, underscoring the shared interest in advancing awareness and understanding of the intricacies of the biodiesel industry. As part of this collaborative effort, a learning visit to the MPOB Gallery was undertaken, providing a valuable opportunity for participants to gain firsthand insights into the advancements and innovations within the palm oil sector. This multifaceted collaboration between POPSIG and MPOB underscores a concerted effort to bridge industry and academia, fostering knowledge exchange and facilitating a deeper understanding of the technical aspects crucial to the biodiesel landscape.

Malaysian Palm Oil Board (MPOB) is the government agency entrusted to serve the country's oil palm industry. Its main role is to promote and develop national objectives, policies and priorities for the wellbeing of the Malaysian oil palm industry. It was incorporated by an Act of Parliament (Act 582) and established on 1 May 2000, taking over, through a merger, the functions of the Palm Oil Research Institute of Malaysia (PORIM) and the Palm Oil Registration and Licensing Authority (PORLA). Each of these respective organisations has been involved in the oil palm industry for more than 20 years and it is to render more effective services as well as to give greater national and international focus to the industry that MPOB was instituted.

POPSIG management gratefully acknowledges the support provided by Desmet Malaysia Sdn Bhd, Malaysian Palm Oil Council (MPOC), Kuala Lumpur-Kepong Oleomas Sdn Bhd (KLK OLEO), Malaysian Oleochemical Manufacturers Group (MOMG), and Sime Darby Oils (SDO) to our activities.



News: POPSIG Management Paid A Courtesy Visit to Malaysian Biodiesel Association (MBA)

The Chairlady Yang Berbahagia Professor The Chair Professor Ir Dr Chong Mei Fong led POPSIG management to pay a courtesy visit to Wilma FMM and greeted the President of Malaysian Biodiesel Association (MBA) in Kuala Lumpur on Monday 21 August 2023.

POPSIG management team was represented by Yang Berbahagia Professor The Chair Professor Ir Dr Chong Mei Fong, Chairlady of POPSIG, Mr Oscar Ting Teo Wei, Chief Manager of Information, Communications and Technology & Head of UK, EU, Swiss and Norwegian Affairs, POPSIG, and Mr Ng Wai Lun, Head of Industrial and Corporate Communications Unit, POPSIG.

MBA team attending the meeting were Mr Unnikrishnan R Unnithan, President of MBA; Mr Tee Lip Teng, Deputy President of MBA; Mr Eric Kiu Kwong Seng, Committee Member, MBA; Mr Long Tian Ching, Committee Member, MBA; and Ms Chan Pek Wan, Secretariat of MBA.

POPSIG expressed enthusiasm for the collaboration with MBA, particularly in engaging in technical activities beneficial to industrial stakeholders. The Chairlady extended a warm welcome to MBA representatives, encouraging their participation in the POPSIG University Roadshow aimed at increasing awareness about advancements in the biodiesel industry. Mr. Ting highlighted POPSIG's past initiatives, including a univer-

sity roadshow featuring representatives from Genting Biorefinery Sdn Bhd and Sime Darby Oils Biodiesel. Additionally, Mr. Unnithan invited university students to take part in the upcoming 4th Biodiesel Conference in October. Mr. Ting provided insights into the latest developments in palm-derived biodiesel within the EU region. Mr. Unnithan expressed hope for POPSIG's management team to organize events addressing Indirect Land Use Change (ILUC) risks on a global scale. The Chairlady discussed the potential to support postgraduate students pursuing studies in biodiesel development. Finally, Mr. Long explored the prospect of recruiting students and graduates to contribute to the biodiesel sector, reflecting a collaborative effort between POPSIG and MBA across various facets of the biodiesel landscape.

Malaysian Biodiesel Association (MBA) was established on September 2, 2008 and consist of members, located in Peninsular Malaysia, Sabah and Sarawak. MBA was primarily established to represent the interest of the biodiesel industry in Malaysia. The association works closely and represents the industry in government dialogues, forums and committees.

POPSIG management gratefully acknowledges the support provided by Desmet Malaysia Sdn Bhd, Malaysian Palm Oil Council (MPOC), Kuala Lumpur-Kepong Oleomas Sdn Bhd (KLK OLEO), Malaysian Oleochemical Manufacturers Group (MOMG), and Sime Darby Oils (SDO) to our activities.

POPSIG gratefully acknowledges our sponsors and partners

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MBA

News: Harikrishna Addressed at the Opening of RSPO-Monash Symposium

Dr. Harikrishna Kulaveerasingam, Senior Vice President I and Chief Research & Development Officer of Sime Darby Plantation Berhad delivered the Keynote Address titled "Plantation 4.0: Challenges & Opportunities in the Oil Palm Industry" in Plenary Theatre in Monash University Malaysia on 25 September 2023.

In his keynote, Dr. Harikrishna shared some of Sime Darby Plantation's (SDP) research and development initiatives as well as SDP's plans for the future.

Dr. Harikrishna talked about SDP's pursuit for higher-yielding palms through genomics and the remarkable results of GenomeSelect™, which has proven to outperform the current best planting materials in the market. He also shared videos of machines that have been rolled out in our operations, and SDP's vision for the future of palm oil through mechanisation, automation and digitalisation. Our aim is to transform the palm oil industry into a less labour intensive industry.

One of the key takeaways from Prof. Ir. Chan Eng Seng, Head of Monash-Industry Plant Oils Research Laboratory (MIPO) at Monash University, and Mr. Yen Hun Sung, Head of Impacts Monitoring, Evaluation, and Learning (IMEL) at the Roundtable on Sustainable Palm Oil (RSPO), is that the power of partnerships and collaborations is the way forward for the oil palm industry.

Dr. Harikrishna completed his first degree (B.Sc.) in Plant Sciences at the University of London (Wye College), UK, and his Ph.D. in Plant Developmental and Molecular Biology at the University of Leicester in the UK.

Dr. Harikrishna joined the Sime Darby Technology Centre Sdn. Bhd. an R&D company within the Sime Darby R&D Centre in July of 2003. Currently, he is the Senior Vice President I and Chief Research and Development Officer of Sime Darby Plantation Bhd. Over his career, Dr. Harikrishna has been a post-doctoral Fellow of University of California, Davis, USA; a lecturer in biotechnology at Universiti Putra Malaysia and a visiting scientist at the Massachusetts Institute of Technology, Cambridge, USA. He has over 30 years postgraduate experience in biotechnology and is a co-author on numerous publications and patents. In 2012 he was inducted into the Malaysian Academy of Science as a fellow. He is currently a member of the Scientific Advisory Council of the Institute of Systems Biology (INBIOSIS), Universiti Kebangsaan Malaysia since 2016 and a visiting Professor to the School of Biological Sciences, University of Nottingham, Malaysia.

Dr. Harikrishna spearheaded the effort to sequence the oil palm genome at Sime Darby and in May 2009, Sime Darby announced that it had successfully sequenced, assembled, and annotated the oil palm genome exclusively using second generation sequencing technology. In April 2016 Sime Darby announced the first commercial planting of genome select oil palm seedlings – making Sime Darby the world's first company to achieve this scientific break-through using this technology. In April 2017 Sime Darby Plantation's Genome Select was announced as a winner for the Edison Best New Product Awards™ under the Sustainability Category.

RSPO-Monash Joint Symposium 2023 was proudly supported by POPSIG.



News: Oscar Visited Industriepark Höchst in Germany



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KLK OLEO
KORPORASI PETILAN KELAPA

MOMG
Malaysian Oleochemical Manufacturers Group

Sime Darby Oils
Realising possibilities, together

Oscar Visited Industriepark Höchst in Germany
20th July 2023, Frankfurt am Main, Germany



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Upon the invitation, Oscar Ting paid a visit to Industriepark Höchst in Frankfurt am Main, Germany on 20th July 2023.

He was presented the production of biodiesel and pharmaceutical-grade glycerin from vegetable oils and waste fuel at Industriepark Höchst. At the meeting, the project leaders informed Oscar that palm oil, which was previously used in manufacturing, has then been replaced by other vegetable oils.

Walking down the Industriepark equivalent to the size of 644 soccer fields, he also observed the significant investment in implementing large-scale green technologies in edible oil industry in Germany.

Oscar also visited Rheinland-Pfalz and Hessen to observe the sustainable development, circular economy and hydrogen projects in Germany.

During the visit, he has taken note about the views of the firms and organisations in Europe on palm oil. At the same time, he also shared about the work done by companies and institutions in other countries, such as: Japan and Malaysia.

He also shared to the leaders in Frankfurt a.M. about the great support to POPSIG by its sponsors and partners, namely Desmet, MPOC, KLK OLEO, MOMG and Sime Darby Oils.

Oscar, who leads the EU, UK, Switzerland and Norwegian Affairs, has made POPSIG the first palm oil group in the world to be recognised by the EU as the top performed organisation on the sustainable youth development project in recent year.

Oscar, speaking in German, expressed his sincere appreciation to the companies in the European Union for hosting him a

News: MPOB Meterai In Collaboration with PETRONAS, Explore the Potential of Aviation Fuel from Palm Waste



On the 14th August 2023, MPOB signed a Memorandum of Understanding (MoU) with PETRONAS as an effort to maximize the application of used palm oil and palm waste materials such as palm factory effluent or POME to produce sustainable aviation fuel (SAF), the agreement was signed by Datuk Datuk Dr. Ahmad Parveez Ghulam Kadir, Director General of MPOB and representing Petronas is Mr. Ahmad Adly Alias, Vice President of Filtering, Marketing and Trade, Milliran Business, PETRONAS. The ceremony was witnessed by Datuk Mohamad Helmy Othman Basha, Chairman of MPOB and Datuk Sazali Hamzah, Executive Vice President and CEO of PETRONAS Hilaran Business. The idea of SAF production arose after seeing used palm oil and palm residue potential brightened as an important raw material for the production of such value added products at the same time reducing the country's dependence on fossil fuels.

News: MPOB is Proud to be One of the Supporters at the Palm Oil Milling Exhibition & Conference (POMtec)



On the 8th-9th August 2023, MPOB is proud to be one of the supporters at the Palm Oil Milling Technology Exhibition & Conference (POMtec) from 8 – 9 August 2023. Director General of MPOB, Datuk Dr. Ahmad Parveez has been invited to chair the second session along with other panel members- Assoc. Prof. Dr. Ir. Viknesh Andiappan from Swinburne, Dr. Jibrail Kansedo, from Curtin University Malaysia, Assoc. Prof. Dr. Brigidid Chin Lai Fui, from Curtin University Malaysia and Dr. Sivasangar Seeni-vasagam, from UPM.

News: Winners of POPSIG-MPO Palm Oil Infographic Competition 2023

A total of 42 submissions from 73 students across 11 universities has been received on 01 October 2023. On 19 October 2023, the Judging Committee have unanimously made the final decision on the Top 20 infographics. The list of Top 20 winning teams is presented as follow according to their ascending rank, as shown in the Appendix. The Top 20 infographics will be displayed during the POPSIG-MPOC Palm Oil Educational Roadshow at Universiti Kebangsaan Malaysia (UKM) on 30 October 2023. Congratulations to the Top 20 winning teams. The Organising and Judging Committees would like to appreciate the excellent contributions of all participants in this competition.

The list of Top 20 winning teams, according to the rank order:

1. **Muhammad Fakhru Radzi Bin Ridzwan (Universiti Teknologi PETRONAS)**
2. **Tashwin A/L Sandra Segeran (Universiti Kebangsaan Malaysia), and Arvin A/L Saravanan (Universiti Kebangsaan Malaysia)**
3. **Thiranai Thongchan (Universiti Sains Malaysia), Koh Jia Ee Penny (Universiti Sains Malaysia), and Kang Li Qian (Universiti Sains Malaysia)**
4. **Lum Wai Hong (Universiti Malaya)**
5. **Viknish A/L Arumugam (Universiti Kebangsaan Malaysia), and Thurgashiny A/P Veeramani (Universiti Kebangsaan Malaysia)**
6. **Kong Li Jing (Universiti Teknologi PETRONAS), and Winnie Wong Yong Xin (Universiti Teknologi PETRONAS)**
7. **Grayson Pan Kee Hao (Universiti Teknologi PETRONAS)**
8. **Lim Jia Yang (Universiti Malaya), Ng Chiu Hwi (Universiti Malaya), and Adam Loh Ee Xian (Universiti Malaya)**
9. **Sharvani A/P Karthigesu (Universiti Malaya), Chang Jia Heng (Universiti Malaya), and Tee Qiao Er (Universiti Malaya)**
10. **Lee Khai Jin (Universiti Malaya), and Loh Wen Han (Universiti Malaya)**
11. **Kelvin Chuah Jing Le (Universiti Tunku Abdul Rahman), and Wan Jia Wei (Universiti Tunku Abdul Rahman)**
12. **Cindy Lau Jen Ding (Universiti Teknologi PETRONAS)**
13. **Muhammad Fakhru Radzi Bin Ridzwan (Universiti Teknologi PETRONAS)**
14. **Kenneth Chong Yih Haur (Universiti Teknologi PETRONAS)**
15. **Nur Aliah Syafiqah binti Ahmad Fauzi (Universiti Sains Malaysia), Aina Natasha binti Mahmood (Universiti Sains Malaysia), and Rachmat Ramadhan Siregar (Institut Teknologi Sawit Indonesia)**
16. **Helena Tan Hui Fang (Heriot-Watt University Malaysia), and Lo Ming Eirwen (Universiti Tenaga Nasional)**
17. **Ong Jun Du (Universiti Sains Malaysia)**
18. **Low Ru Yi (Universiti Malaya) Teh Chin Man (Universiti Malaya)**
19. **Nur Aisyah Syahirah Binti Ahmad Fauzi (Universiti Putra Malaysia) Nurul Izzati Izah Binti Izani (Universiti Putra Malaysia) Wan Nurbaqis Faalihah Binti Wan Bukhari (Universiti Putra Malaysia)**
20. **Nur Hani Idris (Universiti Teknologi PETRONAS), and Low Yi Xun (Universiti Teknologi PETRONAS)**

News: From Zero to Eight



News: Congratulations to Award Recipients of POPSIG-KLK Palm Oil Video Competition 2023



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**POPSIG-KLK
PALM OIL VIDEO
COMPETITION 2023**



Congratulations to Andersson T'ng Khai Shern, Yeow Teck Ann, Wong Man Kei, Bachelor of Engineering (Honours) Chemical Engineering, Xiamen University Malaysia. Their video is titled "Overview of Palm Oil Process in the Coming Hundred Years". Their video is awarded for comprehensively presenting the future possibilities and advanced technologies in the palm oil industry, in addition to the detailed areas on catalysis, digitalisation and safety topics.

View the video at: <https://youtu.be/xjY8gzXecpw>

News: Congratulations to Award Recipients of POPSIG-KLK Palm Oil Video Competition 2023



Sponsored by:



POPSIG-KLK PALM OIL VIDEO COMPETITION 2023



Congratulations to Ng Wai Hoong, Bachelor of Engineering (Honours) Chemical Engineering, Universiti Malaya. Wai Hoong's video is titled "Impact of Generation Z Towards the Palm Oil Industry". His video is awarded for showcasing a broad connection between Generation Z and the oils and fats sector. This connection encompasses specific aspects relevant to the palm oil industry. The video underscores the potential impacts of Generation Z on the advancement of the palm oil sector.

View the video at: <https://youtu.be/qkgUEjwlziw>

News: Congratulations to Award Recipients of POPSIG-KLK Palm Oil Video Competition 2023



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POPSIG-KLK PALM OIL VIDEO COMPETITION 2023



Congratulations to Yiek Siew Teck, Bachelor of Engineering (Honours) Chemical Engineering (Year 3), Curtin University Malaysia. Siew Teck's video is titled "Tomorrow's Green Gold: The Palm Oil Process Plant of the Future". His video is awarded for connecting advanced technology into palm oil processing and subtly link to diversity and sustainability, in which these elements envision a futuristic palm oil industry.

View the video at: <https://youtu.be/75lJIX-tqWk>

News: Thank You to Our 34 Participants Who Showed Their Hard Work and Dedicated Contributions at the Palm Oil Video Competition

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Palm Oil Processing
Special Interest Group
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PALM OIL VIDEO COMPETITION

Thank you

16 submissions
34 participants
10 universities/organisations
7 disciplines/courses



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News: Malaysia Independence Day

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Palm Oil Processing
Special Interest Group

MALAYSIA

INDEPENDENCE DAY

31ST AUGUST



Organised by:



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UKM-YSD CHAIR FOR SUSTAINABILITY
KURSI KELESTARIAN UKM-YSD

POPSIG-MPOC PALM OIL INFOGRAPHIC COMPETITION

Theme

1st Announcement

Future of Palm Oil Industry

Participation

1. Individual; or,
2. Group of two (2) to three (3)

Registration & Submission

1. Submission opens from 21 August 2023 until 01 October 2023.
2. Participants only need to complete one online form for participation.

✉ For more enquires, email to popsigmalaysia@gmail.com

🌐 Information available at www.icheme.org/palm-awards

🌐 WWW.ICHEME.ORG/PALM



ICHEMEPOPSIG

Champion

RM1,000
cash prize



GIVEAWAY

Total value up to
RM4,800 cash prize

UPCOMING EVENTS

DATES	EVENTS
9 November 2023	Event: International Palm Oil Congress and Exhibition 2023
20 November 2023	Event: POPSIG-MPOC Palm Oil Educational Roadshow at Swinburne 2023
22 December 2023	Event: Palm Oil Processing Special Interest Group Annual Meeting

IChemE offices

Global headquarters

UK

Tel: +44(0) 1788 578214

Email: membersupport@icheme.org

Australia

Tel: +61(0) 3 9642 4494

Email: austmembers@icheme.org

Malaysia

Tel: +603 2283 1381

Email: malaysianmembers@icheme.org

New Zealand

Tel: +64 (4) 473 4398

Email: nzmembers@icheme.org

Singapore

Tel: +65 6250 0385

Email: singaporemembers@icheme.org