

Workshop on Promoting Bioplastic Materials to Reduce Marine Plastic Litter in the Asia Pacific Region

APEC Oceans and Fisheries Working Group

February 2024



**Asia-Pacific
Economic Cooperation**



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I. Introduction of the Project

The three-day Workshop on Promoting Bioplastic Materials to Reduce Marine Plastic Litter in the Asia Pacific Region was successfully held on 5-7 December 2023, in Banten, Indonesia. The severity and impact brought by marine plastic litter in the Asia-Pacific region served to highlight the event. The Ocean and Fisheries Working Group (OFWG) acknowledges the need for improved innovative solutions for marine waste and is working to promote environmentally acceptable alternative materials. The development and innovation of bioplastic materials can play an important role in reducing marine plastic litter. Ongoing institutional development and capacity building are necessary forms of continued support. This will give insight and facilitation to all APEC economies in addressing the problems of identifying the barriers and opportunities faced by APEC economies in promoting bioplastic materials as well as developing strategic recommendations to overcome barriers in the application of bioplastics.

The workshop facilitated related officers, international organizations, business sectors, governments, and stakeholders from APEC economies to come and share experiences, knowledge, and exchange ideas and innovations. The diverse background of participants gathered and enabled thorough conversations about promoting bioplastic materials and formulating strategic recommendations to overcome obstacles in the application of bioplastics. Several recommendations providing valuable insights into strategies and best practices for APEC economies related-stakeholders were produced as the workshop outcome, aiming to identify the barriers and opportunities faced by APEC economies in promoting bioplastic materials to reduce marine plastic litter.

II. Objectives of the Meetings

The workshop aimed to identify barriers and opportunities for APEC economies in promoting bioplastic materials to reduce marine plastic litter. Additionally, it sought to develop recommendations for policy arrangements and capacity-building activities crucial for fostering the use of bioplastic materials in the Asia-Pacific region. This objective aligns with the broader vision outlined in Putrajaya's APEC Vision 2040, emphasizing sustainability in

the marine industry to ensure a resilient Asia-Pacific Community and the prosperity of current and future generations.

On the first day, the workshop focused on elaborating findings related to marine debris and the use of bioplastic in the APEC region. Mentors presented existing bioplastic policies in APEC economies, fostering discussions on bioplastic research and development, future implementation, and identifying barriers and opportunities.

Day two centered on discussions about the challenges and successes of bioplastic products, waste management, and the exchange of best practices and strategies applied in promoting and managing sustainable bioplastic materials within APEC member economies. During the concluding segment, participants from APEC member economies shared perspectives on the workshop's theme, presenting best practices from their respective regions. This wrap-up session fostered interactive and productive discussions, resulting in several findings and policy recommendations aimed at informing policymakers about key insights and actionable steps for promoting bioplastic materials.

The third day facilitated hands-on learning through a field trip to two bioplastics producers, Enviplast and Greenhope. Participants gained firsthand knowledge of bioplastic and biodegradable additive products, witnessing the production process using bio-based polymer compound products derived from cassava, corn, and other natural starches in industrial settings.

III. Briefings of the Presentations in the Workshop

The speakers at the workshop encompassed a diverse range of expertise, including government representatives, fishery-related organizations, and business representatives. The three-day event commenced with a keynote speech delivered by Prof. Dr. Ocky Karna Radjasa, the Chairman of the Research Organization for Earth Sciences and Maritime at the National Research and Innovation Agency of Indonesia.

Opening remarks

Prof. Dr. Ocky Karna Radjasa - The Chairman of the Research Organization for Earth Sciences and Maritime at the National Research and Innovation Agency of Indonesia.

- In his opening remarks, Prof. Dr. Ocky Karna Radjasa emphasizes the integral role the marine industry plays in the economies of APEC members, serving as a lifeline for many who depend on marine ecosystems for sustenance and medicinal resources. However, a concerning issue shadows this vital sector – plastic pollution.
- With over eighteen trillion pounds of plastic globally produced and eighteen billion pounds entering the oceans annually, the environmental repercussions are alarming. The persistent nature of regular plastics poses a severe threat to biodiversity, affecting at least 690 species, with 92% of encounters linked to plastic.
- Recognizing the severity of the issue, a Workshop on Promoting Bioplastic Materials to Reduce Plastic in the Oceans in the Asia Pacific Region has been convened. Bioplastics emerge as a promising solution, being eco-friendlier and more capable of mitigating the harm caused by traditional plastic waste.
- The workshop aims to bring together diverse perspectives to formulate effective strategies in line with Putrajaya's APEC Vision 2040, fostering a resilient Asia-Pacific Community and ensuring the well-being of present and future generations. The collective effort seeks to address the significant challenge of plastic pollution, fostering a healthier ocean, thriving communities, and a flourishing shared environment.

Session 1:

Moderator: Fera Roswita Dewi, PhD – Senior Researcher of Jakarta Technical University of Fisheries

Prof. Dr. Agus Heri Purnomo - Senior Researcher, Research Center for Society and Culture, National Research and Innovation Agency of Indonesia.

Topic: The Findings in the Pre-workshop Research Report

- The urgency of addressing the pervasive issue of plastic pollution, marked by the production of 18 trillion pounds of plastic and an annual inflow of 18 billion pounds into the oceans, has prompted economies worldwide to explore diverse strategies, focusing notably on the adoption of bioplastics. However, challenges abound, with only 1% of global plastic production being bioplastics in 2019. This low adoption rate is attributed to performance concerns, consumer perceptions, regulatory disparities, technological advancements, and resource availability. To comprehensively address these challenges, a pre-workshop research initiative aims to identify existing initiatives taken by APEC economies, particularly focusing on mitigating the damage caused by plastic waste pollution in marine ecosystems.
- To facilitate this research, four distinct methods have been implemented, including a literature database, field observations, in-depth interviews, and an online survey. The literature review reveals a historical trajectory of Bioplastic Development in the Asia Pacific Economy dating back to 1894, peaking in 2002 and continuing to the present. Existing regulations across APEC economies exhibit varying levels of specificity and enforcement. For instance, Canada has specific regulations like the Single-Use Plastics Prohibition, while Viet Nam employs economic instruments in environmental protection, and Malaysia follows a non-binding policy. However, the current implementation of these regulations in these three economies remains passive and involves limited stakeholders, indicating a need for improvement and enforcement.
- Despite a general lack of awareness of bioplastics among respondents, there is universal support for the utilization of eco-friendly plastics. However, challenges persist, particularly regarding the affordability of bioplastics. Respondents emphasize the necessity for comprehensive awareness campaigns, jointly led by the government and private sectors, to address the critical issue of plastic waste.

- In considering potential solutions, a closer look at regulations from other economies offers valuable insights. Improving production technology efficiency to reduce overall production costs, elevating the quality of bioplastic products for performance comparability, and establishing effective regulations emphasizing sustainable practices are identified as crucial steps. Government intervention, including the provision of incentives, is highlighted as essential to encourage widespread adoption of bioplastics and contribute to the broader goal of combatting plastic pollution.

Dra. Heni Agustina, MEM - Associate Environment Impact Mitigation, Ministry of Environment and Forestry of Indonesia

Topic: Existing Policy/Regulation in Indonesia regarding Bioplastic

- Indonesia is confronting a pressing challenge with the massive production and utilization of plastic products, annually generating a staggering 8,113 MMT and consuming 45% of them, resulting in 37% of produced plastic becoming waste.
- A detailed breakdown of plastic usage indicates that 20% is utilized by households, 40% for packaging, 15% for building, 6.5% for shopping bags, and the remaining 18.5% falls under the "other" category.
- Disturbingly, data collected from 310 regencies/cities in 2022 reveals that Indonesia produces a significant 36 million tons of waste each year. However, the capacity for waste reduction is limited to 14.88%, equivalent to 5.3 million tons, leaving a substantial 13 million tons, or 36% of plastic waste, unmanaged. The predominant sources of this unmanaged waste are household refuse and traditional markets.
- To combat this environmental challenge, Indonesia has set an ambitious target to reduce marine plastic waste by 70% economy-wide by the year 2025. To monitor progress and address the issue at the grassroots level, Indonesia has rolled out a comprehensive marine litter monitoring initiative covering all 23 provinces. Additionally, proposed domestic action plans include strategies such as increased stakeholder awareness, effective management of waste from land, coastal, and marina sources, funding mechanisms, institutional strengthening, supervision, law enforcement, research and development, and the introduction of eco-labels for green products. These concerted efforts underscore

Indonesia's commitment to tackling the pervasive issue of plastic waste, striving for significant reductions in marine plastic pollution by 2025.

- In Indonesia, the government also has implemented a comprehensive waste management policy outlined in a specific government regulation, PP No .27 of 2020. This policy focuses on the regulation of specific types of waste, particularly those that pose environmental and health hazards. The categories include waste containing hazardous materials, such as plastic waste, garbage with hazardous components, waste resulting from disasters, building debris, waste that technologically cannot be processed, and irregularly arising waste.
- To address the issue of waste containing hazardous materials, especially plastic waste, the regulation imposes responsibilities on producers. These producers are required to take measures to reduce their waste output, with a specific emphasis on limiting waste generation, promoting waste recycling, and encouraging waste reuse.
- To achieve a reduction in waste generation, there are outlined restrictions and guidelines for waste producers. These include opting for goods and products with environmentally friendly chemical content labels, selecting items with clear instructions for use, storage, and handling, and choosing goods and products that are designed for recycling. By implementing these measures, the policy aims to promote environmentally responsible practices and contribute to the reduction of hazardous waste, with a particular emphasis on plastic waste, in Indonesia.

Jenwit Thammavichan – Ocean and Fishery Working Group of Thailand

Topic: Existing Policy/Regulation in APEC Economies regarding Bioplastic: Thailand

- Thailand has taken significant strides in managing plastic waste through the development of a comprehensive roadmap – the Roadmap on Plastic Waste Management 2018-2030. This strategic plan serves as a guiding framework for various organizations in Thailand to collectively address and prevent the plastic waste issue. The roadmap has two primary targets: firstly, to reduce and replace single-use plastic by promoting eco-friendly alternatives, and secondly, to achieve a 100% target for plastic waste in the circular economy.
- To realize these objectives, three key measures are currently being implemented across different phases. The first phase, initiated in 2019, involved discontinuing the use of cap

seals, oxo-degradable materials, and microbeads. Notably, there were two specific targets for this phase – to eliminate 100% of single-use plastic by 2022 and to recycle 50% of seven types of plastic waste by the same year. The second phase in 2022 focused on phasing out foam food containers, plastic straws, thicker plastic bags, and cups with less than 100 microns in thickness. The third and final phase aims at achieving 100% recycling of targeted plastic wastes by 2027, aligning with the circular economy concept. This phase involves specific targets related to landfill reduction, product recovery, plastic waste leakage into the sea, and the availability of tools for plastic waste management.

- To support these targets, Thailand has implemented various measures. Certificates on compostable plastic products have been issued to entrepreneurs by the Office of Industrial Economics (OIE), promoting compostable plastic packaging. Tax incentives, including 125% corporate tax deduction, have been applied to encourage the use of compostable plastic products. Investment promotion measures, environmental impact assessments, and skill development initiatives have been implemented to boost businesses aligned with the roadmap. The promotion of compostable plastic industries and awareness campaigns for customers on packaging made from paper and compostable plastics are also key components of Thailand's strategy. These initiatives collectively reflect Thailand's commitment to sustainable plastic waste management, incorporating eco-friendly alternatives and embracing a circular economy model.

Yumei Zhao – The National Ocean Technology Center China

Topic: Development and Prospects of International Marine Plastic Pollution Monitoring Technology and Equipment

- The pervasive issue of marine plastic litter is intricately linked to the substantial increase in global plastic production since 1950. This surge in production has contributed to the spatial distribution of plastic litter, classified into three main categories: beach litter, floating litter, and sea floor litter. Moreover, plastic waste is characterized based on size, dividing into five types: mega (>1 m), macro (25-1000 mm), meso (5-25 mm), micro (<5 mm), and nano (<1 mm).
- Microplastics, a significant component of marine litter, have three primary sources. Firstly, they result from the breakdown of larger plastic debris in the marine environment. Secondly,

synthetic fibers from domestic and production sewage contribute to microplastic pollution. Lastly, particles from personal care products, such as facial cleansers, add to the microplastic load in the oceans.

- The proportion of plastic items in marine litter tends to increase with distance from the source area, primarily due to the movement of plastic waste with seawater and its chemical stability. Microplastics, in particular, exhibit high stability and can be transported over long distances by external forces, leading to their presence in waters far from human activities.
- To effectively monitor marine plastic litter, various methods are employed based on its spatial distribution and type. For beach litter, manual sampling surveys are conducted, while floating litter is monitored through on-site observation, remote sensing, trawl surveys, and visual image recognition. Sea-floor litter is surveyed using manual sampling, diving instruments, and trawl sampling. Microplastics litter is monitored through on-site sampling and subsequent laboratory analysis. These diverse methods allow researchers and environmentalists to gain a comprehensive understanding of the extent and nature of marine plastic litter, facilitating informed conservation and cleanup efforts.

Sally Atika Noor Rahma - Marine Debris Research and Development Staff of the Secretariat of the National Coordination Team for Marine Debris Management

Topic: Indonesia's National Action Plan: Strategy, Implementation, Monitoring

- Since 1950, the global production of plastics has reached a staggering 8.3 billion tons, and Indonesia mirrors this trend with its substantial plastic output and low recycling rates. Unfortunately, this has positioned Indonesia as the second-largest contributor to plastic litter in the world's oceans. In response, President Joko Widodo has initiated a comprehensive action plan to combat marine debris using the 3R approach—Reduce, Reuse, Recycle. The plan encompasses five key strategies aimed at raising awareness, improving waste management, and fostering research and development.
- The first strategy revolves around creating a domestic movement to sensitize stakeholders to the adverse impacts of marine debris. The plan includes training programs on plastic waste sorting and utilization, establishing the Indonesian Maritime School, and recognizing innovation in recycling management through awards. A concurrent effort focuses on

effective land-based waste management, district/city-level plastic waste management, and the development of river waste collection infrastructure.

- Coastal and marine debris management is another crucial aspect, involving the establishment of waste management facilities and infrastructure, implementing SOPs for waste management in marine tourism destinations, achieving ISO 14001 and 14000 certifications, and conducting cleanup actions on beaches and small islands.
- To support these strategies, the plan emphasizes funding mechanisms, institutional strengthening, and law enforcement. It encourages waste management funding schemes through public-private partnerships, corporate social responsibility, community funds, and other sources. Strengthening institutionalization, improving supervision effectiveness, and enforcing laws are essential components.
- Research and development constitute the final strategy, urging the discovery of plastic replacement materials, the development of standards for degradable and recyclable plastic products, the creation of an integrated waste database system, and comprehensive studies on pollution and the impact of marine debris on both the environment and human health.
- Preliminary studies by key institutions estimate that Indonesian oceans hold between 0.201 to 0.620 million tons of marine plastic debris. The implementation of the action plan, coupled with a shift towards biodegradable products, has yielded positive results. According to the Marine Plastic Debris Monitoring Model conducted in 2022, Indonesia has successfully reduced plastic waste in the sea by 217,702 tons, demonstrating progress towards a more sustainable and environmentally friendly future.

Session 2:

Moderator: Witta Kartika Restu Ph.D. - Senior Researcher for the Research Centre of Chemistry, National Research and Innovation

Prof. Dr. K. Sudesh Kumar, FASc – Professor of Applied Microbiology, School of Biological Sciences, University Sains Malaysia

Topic: The Current Status of Bioplastic Research and Development

- PHA (Polyhydroxyalkanoates) is a biodegradable and bio-based product. Since 1988, academic scientists have been working on developing the PHA platform. In 1992, Zeneca even built the first manufacturing plant to produce and develop the PHA platform. However,

the project was discontinued due to high manufacturing costs. Over time, the development of the PHA market was slow but gained tremendous speed in 2019.

- In tropical economies like Indonesia and Malaysia, where there is abundant palm oil, there is a significant opportunity since PHA can be produced using various palm oil by-products and wastes generated by the palm oil industry.
- For non-tropical economies, PHA can be produced using sources other than palm oil. For example, in Oman, date seeds have been used, and in Germany, researchers have utilized low-fat animals to produce PHA.
- Multiple steps of washing and centrifugation are necessary to obtain the final purified PHA, and this process might be costly. To reduce the cost of producing PHA, the use of mealworms is considered, with an estimated 50% reduction in costs.

Prof. Mochamad Chalid – President of Indonesia Polymer Association

Topic: Polymer Sustainability: Biodegradable Plastics Implementation in the Future

- There are three primary categories of materials: metals, polymers, and ceramics, each with its own set of strengths and weaknesses. Among these, the widespread use of plastic products, comprising polymers and additives, has experienced rapid growth in human life due to their ease of production, practicality, and cost-effectiveness.
- While plastics designed for recycling pose no issues, the challenge lies in waste management, leading to the creation of plastic cycles. Conventional plastics, though not easily degradable, break down over an exceptionally long period. This realization has prompted a shift toward biodegradable polymers.
- The implementation of biodegradable plastics requires comprehensive feasibility studies, considering technical, resource, and cultural factors as part of the main scenario. This involves adherence to legal and ethical requirements, operational compatibility within the organization, cost analysis, technological support, resource availability, and the potential impact on local/general culture or the time needed to change community behavior.
- Biodegradable polymers emerge as a promising solution to address plastic waste problems, necessitating dedicated development efforts. The development of biodegradable polymers requires a holistic approach, taking into account technical aspects, ecosystems, socio-

cultural factors, and regulatory frameworks as integral components of an integrated waste management strategy.

Eric Sander Setiawan, MM - Business Development Manager of PT Intera Lestari Polimer

Topic: Barriers and Opportunities in Promoting Bioplastics

Adopting bioplastics on a massive scale in the economy presents various challenges and opportunities across different dimensions.

- Economic Dimension:
 - Challenges:
 - Higher unit cost attributed to production scale and costs compared to conventional plastics.
 - Opportunities:
 - Reduced dependence on oil costs.
 - Increased investment in the circular bio-economy.
 - Growing expectations from agriculture industries to support non-food and non-agriculture sectors.
 - High growth potential in the global bioplastics market.
- Regulatory Dimension:
 - Challenges:
 - Absence of policies for the separate collection of bioplastics.
 - Lack of a legislative framework for bioplastics.
 - Non-harmonized and unclear terminology and labels.
 - Opportunities:
 - Implementation of taxes for non-bioplasic goods.
 - Subsidies and tax incentives for bioplasic manufacturers.
 - Prohibition of non-bioplasic goods.
 - Development of a supportive policy framework for the circular bio-economy.
 - Implementation of standardized labels and terminology to minimize confusion.
- Technology Barrier:
 - Challenges:
 - Low levels of bioplastics production.
 - Lack of a bioplastics identification system.

- Limited separate collection of bioplastics and waste management systems.
- Inferior performance compared to conventional packaging in terms of mechanical strength, thermal stability, and barrier performance.
- Opportunities:
 - Increased volume of bioplastic production.
 - Additional waste management options.
 - Effective sorting for bioplastics waste.
 - Opportunities for producing bioenergy and biofuel from organic waste.
 - Anticipated increase in biodegradability with the use of starch.
- Social Barrier:
 - Challenges:
 - Low levels of information and knowledge leading to misconceptions and expectations.
 - Varied preferences in packaging: Reusable, recyclable, or no packaging.
 - Doubt towards the environmental impact of bioplastic usage.
 - Opportunities:
 - Increased customer awareness and preference for bioplastic products.
 - Growing concern about environmental well-being and the accumulation of plastic waste in natural environments.
 - Expectations for a more positive environmental impact from the usage of bioplastics.

Session 3:

Moderator: Dr. Yeyen Nurhamiyah - Junior Researcher, Research Center for Biomass and Bioproducts, National Research and Innovation Agency of Indonesia

Nhan Nguyen MBA, Grad Cert. TTL - Lecturer at The Business School, RMIT Viet Nam

Topic: The Challenges and Successes of Bioplastic Products: The Case of Galaxy Biotech in a Nascent Bioplastics Sector

- Galaxy Biotech, a Vietnamese startup, is currently engaged in the development of bioplastics, with their flagship product being the Breathable Biobag. This innovative Biobag is designed to maintain the freshness of fruits and vegetables for an extended period. The nano-sized pores in the bags facilitate the expulsion of ethylene gas and heat generated

by the food while preventing oxygen from entering, thereby preserving the quality of the food. These Biobags decompose entirely within 6 to 24 months, depending on the environmental conditions.

- To assess the market conditions, a PESTEL analysis is employed, considering the Political, Economic, Social, Technological, Environmental, and Legal aspects.
 - Political Analysis: In Viet Nam, with a one-party system, decisions on critical issues can be swift and effective. Recognizing the magnitude of plastic pollution, the government has taken steps, including laws aligned with international initiatives on plastic waste reduction.
 - Economic Analysis: Viet Nam has experienced significant GDP growth, resulting in a growing middle class. However, the market remains price-sensitive, and the importation of scrap plastic, though steady, is expected to decline due to recent laws. The production of bioplastics in Viet Nam is relatively low compared to conventional plastics.
 - Social Dynamics Analysis: Bioplastics are currently considered a niche product, appealing mainly to higher-educated and wealthier segments of society. The general population in Viet Nam lacks awareness of the negative impacts of single-use plastics, leading to weak social pressures for behavior change.
 - Technology Analysis: While the knowledge and technology for manufacturing bioplastics are emerging in Viet Nam, the expertise is still limited to a few key players. Post-consumption technology for bioplastics is lacking, presenting an opportunity for further development.
 - Environment Analysis: Viet Nam, like many Southeast Asian economies, faces environmental challenges due to plastic pollution. The harm caused by single-use plastics is well-established, with plastic waste littering various areas, including marine environments.
 - Legal Analysis: Viet Nam has enacted laws focusing on environmentally friendly packaging, waste collection, reuse, recycling, and treatment of plastic waste. The introduction of Extended Producer Responsibility (EPR) laws and specific mentions of the bio-plastic industry in strategic decisions indicate a growing regulatory emphasis on sustainable practices.

- This comprehensive PESTEL analysis provides insights into the market conditions and potential challenges and opportunities for Galaxy Biotech and the bioplastics industry in Viet Nam.

Prof. George Z. Kyzas – Head of Department of Chemistry, International Hellenic University

Topic: Waste Management of Bioplastic

- Plastics, derived mainly from petroleum sources, are polymers that can be molded when hot and retain their shape when cooled. The global focus on environmental plastic pollution has prompted major entities such as the UN, World Economic Forum, World Health Organization, and the European Union to prioritize this issue. The degradation of plastics is influenced by their physical and chemical characteristics, including molecular weight, crystallinity, hydrophobicity, and solubility in water.
- In 2014, approximately 311 million tonnes of plastic were produced globally, consuming 6% of the worldwide oil production. Despite increased awareness, plastic production reached 368 million tonnes in 2019.
- Degradable plastics, breaking down under specific conditions or after a predetermined time, include bio-degradable and photodegradable plastics. Concerns about degradable plastics include proper disposal conditions, potential methane emissions, complications in sorting systems, and the misconception that these plastics will simply disappear.
- Advantages of bioplastics include cost-effectiveness, energy efficiency, easier recycling, reduced CO₂ emissions, and non-toxicity. However, disadvantages include variable decomposition rates, potential toxic residues, land use for plant-based materials, genetic modification concerns, and challenges in recycling.
- Waste management efforts for plastics involve various methods such as chemical recycling, mechanical recycling, biotechnological processes, and integrated upgrading options. Bio-based and biodegradable plastics require specific waste management practices. Source separation, collection, transport, sorting, and subsequent reuse, recycling, energy recovery, treatment, and disposal are integral elements of an effective waste management system.
- Three key factors influencing effective plastic waste management include high collection rates, effective sorting of commingled waste, and efficient waste treatment systems,

especially for biodegradable plastics. Despite existing standards for certification, universal acceptance of these standards in organic waste treatment facilities is still a challenge.

- Policies, legal actions, and regulations on bioplastics in various economies:
 - Japan: The Japanese government aims to have 20% of all plastics consumed in the economy derived from renewable sources by the year 2022.
 - Netherlands: The Netherlands has implemented a tax of 40 euro cents/kg on PET (polyethylene terephthalate) compared to a tax of 8 euro cents/kg on PLA (polylactic acid).
 - USA: Every federal agency in the United States is mandated to devise a plan focused on purchasing as many biobased plastics as practically feasible. The criteria for the federal procurement plan include biobased content, price, and performance.
 - European Union (EU): Production Capacity: As of 2020, EU Bioplastic Agency reported that the production capacity of biopolymers is projected to reach 2.87 million tonnes by 2025. However, this capacity is considered insufficient to meet the market demand, which is estimated at 360 million tonnes. The significant gap underscores the necessity for alternative feedstock.

Nuha Siddiqui - CEO Erthos Inc, Canada

Topic: The solutions and Strategies Applied in Promoting Bioplastic and Sustainable Bioplastic Material Management

- Erthos, a biomaterial company based in Canada, distinguishes itself by leveraging diverse material sources from agriculture products and fibers. Through the integration of artificial intelligence (AI), Erthos specializes in creating tailor-made functional biomaterials for the plastics industry.
- Common Misconceptions in the Bioplastic Industry:
 - All Bioplastics Result in Microplastics:
Clarification: Addressing the misconception that all bioplastics lead to microplastics is crucial. Bioplastics, when designed and managed appropriately, can offer solutions that minimize or eliminate microplastic pollution.
 - All Bioplastics Compete with Food Sources:

Clarification: Dispelling the notion that bioplastics compete with food sources is important. Bioplastics can be sourced from non-food agricultural products and waste, contributing to a more sustainable and ethical industry.

- Circular Packaging Goals Cannot Be Achieved with Bioplastic Solutions:
Clarification: Challenging the idea that circular packaging goals are unattainable with bioplastics is essential. Strategic design and recycling practices can align bioplastics with circular economy objectives.

- Four Key Areas of Opportunity for Global Bioplastic Management:

- Holistic Design Principles:

Considerations: Tailor bioplastics based on end-use requirements, considering factors such as single-use or long-term applications, the use of mixed plastics, and adherence to unique shapes and sizes.

- Looking Beyond "Biodegradable":

Emphasis: Recognize that being "biodegradable" is insufficient; practicality and affordability are equally critical for successful bioplastic adoption.

- Inclusive Policies & Infrastructure:

Recommendation: Advocate for policies and infrastructure that support and accelerate next-generation bioplastic technologies rather than impeding their progress.

- B2C Communication Tactics:

Strategy: Promote open and transparent communication to address misconceptions surrounding bioplastics. Use consumer-friendly terms to enhance understanding and acceptance.

Sugianto Tandio, M.Sc - Chief Innovation Officer Greenhope, Indonesia

Topic: The solutions and Strategies Applied in Promoting Bioplastic and Sustainable Bioplastic Material Management

- In 2017, a profound transformation swept through the conventional plastic industry, representing one of its most impactful disruptions. This pivotal period witnessed the emergence of critical developments, including plastic waste crises, the rise of new technologies, the advent of innovative business models, and the substantial upheaval of conventional plastic practices.

- Amidst this backdrop, the plastic demand by sector indicated a rising trend, particularly in medical products and packaging. The fate of plastic waste was predominantly directed towards landfills and incineration, with notable disparities in waste management practices across economies, such as Indonesia.
- While developed economies like the Netherlands and the United States heavily relied on incinerators for plastic waste management, Indonesia faced challenges due to limited resources for incinerator infrastructure. Consequently, there was a heightened urgency for Indonesia to embrace bioplastic alternatives.
- Recognizing the complexity of the issue, the call for a holistic and complementary Circular Economy approach was emphasized, focusing on reduction, reuse, and recycling. End-of-life designs, such as returning certain items to the earth and implementing recovery methods, were proposed based on economic viability.
- Greenhope, a global green technology social enterprise based in Indonesia, positioned itself as a pivotal player in addressing plastic consumption and waste pollution. By developing proprietary bioresins and collaborating with downstream producers, Greenhope targeted diverse market segments, offering eco-friendly solutions. Their technology portfolio, aligned with global trends, addressed different affordability points.
- Since 2017, Greenhope's impactful efforts have resulted in the conversion of plastic items equivalent to 12 billion plastic bags or 125,000 tons, showcasing tangible progress in the pursuit of a sustainable and eco-conscious plastic industry.

Session 4

Moderator: Prof. Dr. Hari Eko Irianto - Professor at Sahid University

Topic: A Compendium of Recommendations for Problem Solving: Practical Implementation in the Unique Contexts of Economies and the Development of Concrete Plans to Promote Bioplastic Materials

Australia:

- Australia has collaborated with the Indonesian government and investors since 2020 to reduce plastic waste.
- Every economy has its own program to address the plastic issue, depending on its geographical location.

- There's hope for future collaboration between Australia and ASEAN economies within Australia's program.

Chile:

- There's a need for collective action from society and the government to develop bioplastics.
- The workshop/event is helpful in bringing different ideas for bioplastic implementation from different economies.
- Communication of bioplastics needs to be done to ensure society is aware of bioplastics.

People's Republic of China:

- Technological improvement is crucial for monitoring plastic litter in the ocean.
- It is also important to develop bioplastics to make them more competitive than conventional plastics.

Indonesia:

- There are two major challenges to adopting bioplastics: prices and awareness.
- We need technology that allows enterprises to produce affordable bioplastics.
- There's a need to find suitable materials that enable bioplastics to compete with conventional plastics in terms of prices.
- Regarding awareness, social media can be the channel to inform the general public about bioplastics.

Malaysia:

- Bioplastics are an alternative material that can be a long-term solution to address the plastic pollution issue.
- We need to find bioplastic materials that are durable and affordable, comparable to conventional plastics.
- Awareness about bioplastics also needs to be improved.

Peru:

- Peru has regulations to encourage people to use single-use bioplastics.
- Peru also monitors the utilization of bioplastics in economies and the concentration of plastic litter in the ocean.

The Russian Federation:

- Plastic pollution has had negative effects on many economies, including Russia.
- To address this, Russia has a domestic program to reduce plastic waste.

Thailand:

- Collaboration with local companies is crucial to developing bioplastic products.

Viet Nam:

- Viet Nam has several regulations to reduce plastic pollution and usage, especially in the fishery sector.
- Viet Nam also has investment and research initiatives to find biodegradable plastic materials.

Speakers:

- Regulatory and social awareness are two important aspects of developing bioplastics.
- By 2025, limit the usage of single-use plastics.
- Not all bioplastics are biodegradable in marine environments. To address this, there's a PHA that can be degraded in marine environments.
- Other issues include religious matters, such as whether the usage of bioplastics is halal or not.
- The primary focus is to educate the public about littering. The government should play a significant role in promoting such campaigns.
- Considering microplastics issues, there are three agendas to consider:
 - Mapping, making every stakeholder work together to address common issues.
 - Roadmap, creating an implementation plan.
 - Promoting synergic programs between stakeholders.
 - Policy and Certification, having CPG aligned with biomaterial targets and marine litter, and proposing standardized regulations.
 - Command and control system, creating an incentivized system to give benefits to industries that use and promote bioplastics.

IV. Briefings on Discussions at the Workshop

In this session, participants were actively participating in the discussion.

Q&A / Discussion

Session 1

- A participant inquired about the possibility of using drones to monitor land-based litter. Yumei Zhao mentioned that drones haven't been used for monitoring marine litter in China. The common practice involves using satellites to monitor marine litter on water surfaces and sensors to monitor litter concentrated in deeper waters.
- A participant inquired about the public perception and government targets regarding bioplastic usage in Thailand and China.
Jenwit, representing Thailand, explained that Thailand currently lacks specific policies or regulations for bioplastics. However, the government encourages the public sector to shift from conventional plastics to bioplastics. In Thailand's National Plan, certificates for compostable plastic products have been issued to entrepreneurs, promoting compostable plastic packaging with a 125% corporate tax deduction. Approximately 10,000 tons of compostable plastic resin per year are accounted for by 70 issued certificates.
Yumei Zhao mentioned that she is not from a government agency regulating bioplastics in China. However, the focus in China is on monitoring and cleaning the oceans from plastic litter.
- A participant asked about specific regulations or policies to prevent microplastic pollution from water waste treatment entering the marine environment.
Sally highlighted the importance of regulating manufacturer activities producing wastewater to install wastewater treatment, especially in the plastic industry. While microplastic reduction technologies exist, Indonesia and the global community currently lack standardized regulations for microplastics.

- A participant raised a question concerning the factors contributing to the elevated pollution of plastic litter in the ocean. They inquired whether the issue is linked to the extensive disposal of plastic waste and if it is influenced by the non-degradable nature of plastics.

Heni highlighted that plastics, notably from households and traditional markets, constitute the predominant litter in oceans. The lack of awareness among people results in inappropriate disposal practices in rivers and oceans. This situation is further exacerbated by the non-degradable nature of plastics.

- A participant inquired about the most effective approach to address the issue of plastic waste, questioning whether emphasis should be placed on promoting a social-cultural shift first, prioritizing technological solutions first, or implementing both approaches in parallel.

Agus pointed out that the pre-workshop study indicates a lack of awareness among some individuals regarding bioplastics. Consequently, there is a need to enhance awareness of bioplastic usage through a social-cultural approach. On the other hand, individuals who are aware of bioplastics often hesitate to use them due to perceived higher costs and impracticality compared to conventional plastics. Hence, Agus suggested that a technology-driven approach is essential for research and development, aiming to make bioplastics more competitive and practical than conventional plastics.

- The moderator asked about the effectiveness of Indonesia's programs to encourage people to use eco-friendly product, including bioplastic.

Sally emphasized that the current focus in Indonesia revolves around policies aimed at reducing plastic leakage into the ocean. Although there isn't a specific policy in place to encourage the use of bioplastics, there are plans to conduct studies to explore effective strategies for encouraging people to adopt bioplastics.

- A participant asked about the techniques China uses to accurately measure marine plastics pollution in the sea.

Zhao mentioned that China uses various methods based on the type and concentration of marine plastics. The chosen method depends on the nature of the plastics litter being investigated, whether on surfaces or in deep water. The goal is to select the most appropriate method for accurate measurements.

Session 2

- Participants asked about whether the PHA developed by Sudesh is available in the market since she needs the PHA to develop her bio-styrofoam.
Sudesh mentioned that he is currently working with a Japanese company to develop this PHA. The estimated timeline for his product to be available in Indonesia starts next year. The first company that will use their PHA product as packaging material is Marugame Udon.
- A participant asked about the challenges that speakers face when selling bioplastic to the industry.
Eric mentioned that the prices of bioplastic, which are more expensive than conventional plastic, are indeed the main challenges when selling bioplastic products. He suggests the government provide subsidies and tax incentives to the bioplastics industry so that bioplastic prices can be reduced and made competitive with conventional ones.
- A participant asked about the type of microorganisms Sudesh uses in developing PHA, specifically whether it involves oil-type bacteria or if they are modified by genes. The participant also inquired about the substrate used in PHA production and whether the speaker employs any special treatment for the substrate.
Sudesh mentioned that microbacteria are indeed able to produce PHA, but the efficiency is not good. Therefore, they modified the genes of bacteria for industrial purposes. They use palm oil waste from the industry as a substrate.
- A participant raised the point that bioplastic tends to degrade easily upon contact with water and questioned the feasibility of utilizing bioplastic for fishing gears. Sudesh mentioned that the PHA he developed is intended for single-use only, so it's not

designed to have high durability/strength. He knows that some of his collaborators in Japan have developed ultra-high molecular weight PHA, with a molecular weight almost 10 billion, which is 10 times higher than the molecular weight of conventional plastic. People can produce fishing gears using this material, but currently, the production efficiency of this strong PHA is not as good as normal plastic, so the cost will be higher. Chalid mentioned that when we want to build a product, we need to determine the properties of the product. The properties of the product can be classified into two categories: functional properties and aesthetic properties. Designing fishing gears using biodegradable products is not practical in nature, so it will remain an issue to be solved.

- A participant asked if bioplastics can replace conventional plastics.
Eric mentioned that Bioplastics are very moisture-sensitive, so it would be quite impossible to replace conventional plastics completely with biodegradable plastics.
- A moderator asked how long the speaker developed the PHA product until it is ready to launch in the market.
Sudesh mentioned that PHA was already invented 100 years ago, but it did not get developed massively until the 1980s. Sudesh has worked on PHA for 30-50 years to make it ready to launch in the market.
- A moderator asked about the implementation of the scenario of the circular economy.
Chalid mentioned that it's not easy to shift the paradigm from a linear economy to a circular economy. We should build an ecosystem and a system for a circular economy by using a network between researchers, academics, businesses, and the government.

Session 3

- A participant shared that he manufactures polyethylene seeds and expressed interest in using Ethos materials in his factory. The participant sought details about Ethos' products and the technology employed in their production.
Nuha clarified that Ethos primarily focuses on Polypropylene and polyethylene but can customize materials based on customer demands. Ethos utilizes a diverse range of bio-materials sourced globally and employs chemical engineering to convert these materials

into their final products. She suggested having a more detailed discussion after the workshop to go over the participant's materials requirements and specifics.

- Another participant inquired about whether Ecoplas and Natureloop still incorporate fossil fuel-based plastics and, if so, the proportion used.

Sugianto explained that their products are compostable, making it challenging to achieve a 100% plant-based composition. For instance, in Ecoplas, 60% of the materials are plant-based, with the remaining portion being regular plastic. However, Sugianto highlighted that they modify the regular plastic during the process, eliminating conventional plastic properties.

- A participant raised concerns about the disparity between the life cycle of a product and the life cycle of its ingredients/materials.

Nhan mentioned that he worked on a Unilever project to develop packaging for a detergent product with the intention of making it reusable, allowing customers to refill the detergent once it's empty. However, a challenge arose when the product's quality would diminish if left unused for a specific period. In response, they faced the challenge of needing to sell all detergent products with refill packaging within a designated timeframe. George acknowledged the participant's concerns, noting that each economy approaches this issue differently. He emphasized the need for collaboration and cited Greece's substantial investment in building a circular economy.

Nuha mentioned the gathering of a database on bioplastic materials to research the life cycle of products and their ingredients/materials.

Sugianto stressed the importance of life cycle analysis for achieving net-zero emissions and his company has shared collaboration with BRIN to assess the life cycle analysis of Ecoplas, estimating a 30% reduction in greenhouse gases. He emphasized the need for the adoption of circular economy practices at the local level.

- A participant asked the possibility of the bio Polypropylene and bio Polyethylene can be recycled as conventional plastics.

George mentioned that he doesn't have the answer since he has not researched this matter. There's an issue of funding to research on this matter in Greece. However, he

emphasized that every material needs to be managed according to the product characteristics. George recommends having more research on this matter.

- A participant asked the speaker's opinion on the holistic approach to address the plastic issue based on PESTER analysis.

Nhan mentioned that PESTER looks at the environment where the business exists. Nhan mentioned that he comes from Viet Nam where there is no bioplastics association, and there are only a few players in Viet Nam. So Nhan recommends the participant ask this to the stakeholders of the bioplastics industry in their corresponding economies.

Sugianto mentioned that currently is the disruption period. When there's a disruption, it's likely to have a conflict, for example, a conflict between conventional taxis and online taxis when the online taxi platform was introduced. In this case, he mentioned that it's quite challenging to transition from conventional plastic to bioplastic completely, and it will take a longer time.

V. Summary of the Workshop

Marine plastic pollution is a global environmental concern, exacerbated by the staggering 18 trillion pounds of plastic manufactured annually, with 18 billion pounds entering oceans. Contributing significantly to this crisis is East Asia and the Pacific, responsible for 23% of the world's waste production, yet facing challenges of inadequate waste collection coverage. The persistence of conventional plastics poses environmental hazards, necessitating a shift towards exploring alternatives like bioplastics.

Bioplastics, derived from renewable sources, present a potential solution to the escalating issue of single-use plastic waste. Materials such as those from vegetable oil, potatoes, and cornstarch naturally degrade, offering promise. However, they constitute only 1% of global plastic production, grappling with durability and cost challenges when compared to traditional plastics. Ongoing research aims to address these issues, projecting a 30% growth rate by 2025. The Asia-Pacific region dominates bioplastics production, aligning with global efforts to combat single-use plastics, especially in the packaging sector, which contributes significantly to solid waste generation.

The adoption of bioplastics is fueled by factors such as performance, consumer perception, regulations, technological advancements, and resource availability. Notably, the Asia-Pacific economies experience substantial growth due to increased restrictions on conventional plastics and environmental concerns. Successful strategies, as seen in the United Kingdom and Korea, involve fees and bans on single-use plastic items. Chinese Taipei stands out with a comprehensive plan, including bans on straws and a goal to eliminate all single-use items by 2030. These initiatives signify a global shift towards reducing the environmental impact of plastic use through regulatory measures and innovative policies.

During the workshop presentation featuring representatives from different economies, it became evident that each economy possesses a unique domestic plan to reduce conventional plastic use and promote environmentally friendly materials. For instance, Thailand's comprehensive action plan on Plastic Waste Management aims to reduce plastic waste by 50% with potential leakage into the sea by 2027, utilizing the Bio-Circular-Green Economy Model. Similarly, Indonesia's government targets a 70% reduction in plastic waste by 2025 through regulations on waste management, marine-plastic waste monitoring, and the promotion of bioplastic materials. Representatives from the private sector, including Erthos, Greenhope, and PT. Intera Lestari Polimer, shared their insights, detailing products, industry overviews, technologies, and solutions to increase the usage of bioplastic materials.

VI. Pre-Test and Post-Test Evaluation

The participants were suggested by the committee to take the pre-test before the event began and to take another post-test upon the completion of the event. Pre- and post-tests, consisting of 10 matched true/false and multiple-choice questions, were designed to test similar areas of knowledge with each question set. Tests were used as comparative data to measure the level of knowledge of the participants before and after the workshop. The number of participants that managed to fulfill both the pre-test and post-test was commendable: 74 or 90.2% of the total participants. On average, the level of participants' understanding after attending the workshop is 90.4%. The knowledge level of all participants increased by 33%. The test results confirmed that all participants who fulfilled the post-test acquired a higher score compared to their score in the pre-test. The table below shows the

percentage of participants with correct answers on the pre-test and post-test.

Result of Pre and Post-Test

Question	Pre-Test	Post-Test
	% Correct	% Correct
Q1	62,2	81,1
Q2	59,5	90,5
Q3	64,9	86,5
Q4	54,1	87,8
Q5	47,3	94,6
Q6	64,9	95,9
Q7	51,4	93,2
Q8	60,8	89,2
Q9	56,8	93,2
Q10	52,7	91,9
Average	57,4	90,4

VII. Recommendation

To foster a sustainable and effective approach to plastic waste management, it is imperative to implement a multifaceted strategy that encompasses various aspects of promotion, regulation, innovation, awareness, and collaboration. The following comprehensive recommendations are designed to address the challenges associated with plastic waste and expedite the adoption of bioplastics in a circular economy framework:

- Promotion of Circular Economy:
 - Encourage a holistic Circular Economy approach, emphasizing reduction, reuse, and recycling.
 - Implement policies supporting Circular Economy principles.

- Promote the development of bioplastic materials aligning with circular economy principles.
- Bioplastic Adoption and Regulation:
 - Advocate for the adoption of bioplastics, dispelling misconceptions and emphasizing benefits.
 - Work towards comprehensive regulations differentiating between plastics and promoting eco-friendly materials.
 - Encourage the development and enforcement of regulations promoting the use of single-use bioplastics.
- Technological Innovation:
 - Support research and development for innovative plastic production and management technologies.
 - Emphasize the importance of technological advancements for monitoring plastic litter in oceans.
 - Invest in research and development to improve the competitiveness of bioplastics.
 - Promote the development of technologies allowing for the production of affordable bioplastics.
- Public Awareness and Communication:
 - Promote transparent communication strategies to increase public awareness of plastic's environmental impact and bioplastics' benefits.
- Waste Management Infrastructure:
 - Invest in waste management infrastructure, particularly in regions with limited incinerators.
 - Support effective plastic waste treatment, recycling, and the adoption of biodegradable plastics.
- Collaboration and Networking:
 - Encourage collaboration between researchers, academia, businesses, and government entities.
 - Build a network focused on circular economy solutions and sustainable practices.

- Financial Incentives:
 - Consider providing subsidies and tax incentives to the bioplastics industry to address cost challenges.
 - Allocate resources for investment and research initiatives to find durable and affordable bioplastic materials
 - Facilitate public-private partnerships to jointly address challenges associated with plastic waste.
- Research and Development Support:
 - Support ongoing research and development efforts in the bioplastics field.
 - Explore alternative feedstocks and efficient production methods.
- Education and Training:
 - Implement educational programs to increase awareness about bioplastics.
 - Utilize social media platforms to raise awareness about bioplastics.
 - Implement campaigns educating consumers about the environmental impact of plastic waste and the benefits of bioplastics.
- Monitoring and Evaluation:
 - Establish mechanisms to monitor and evaluate the effectiveness of policies and initiatives, making adjustments as needed.
- Industry Collaboration:
 - Encourage collaboration within the bioplastics industry to create a diverse range of green products.
 - Encourage collaboration between economies and stakeholders to share knowledge and best practices.
 - Support local companies to collaborate in the development of bioplastic products.