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“Ecosystem Services for Sustainability”



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Chief Editor: Sharon Yong Yee, Ong

Editor: Zahora Ismail

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Publisher: Institute of Ecosystem Science Borneo (IEB), Universiti Putra Malaysia
Sarawak P.O. Box 396, Nyabau Road, 97008 Bintulu, Sarawak, Malaysia

Tel: +6086-855204 E-mail: dir_ibs.btu@upm.edu.my

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About the Bulletin

The IEB Bulletin highlights recent research, community engagement, and environmental initiatives led by the Institute of Ecosystem Science Borneo.

Focusing on the theme Ecosystem Services for Climate Change and Sustainability, this issue brings together diverse voices and findings that showcase Borneo's ecological richness and the importance of preserving it.

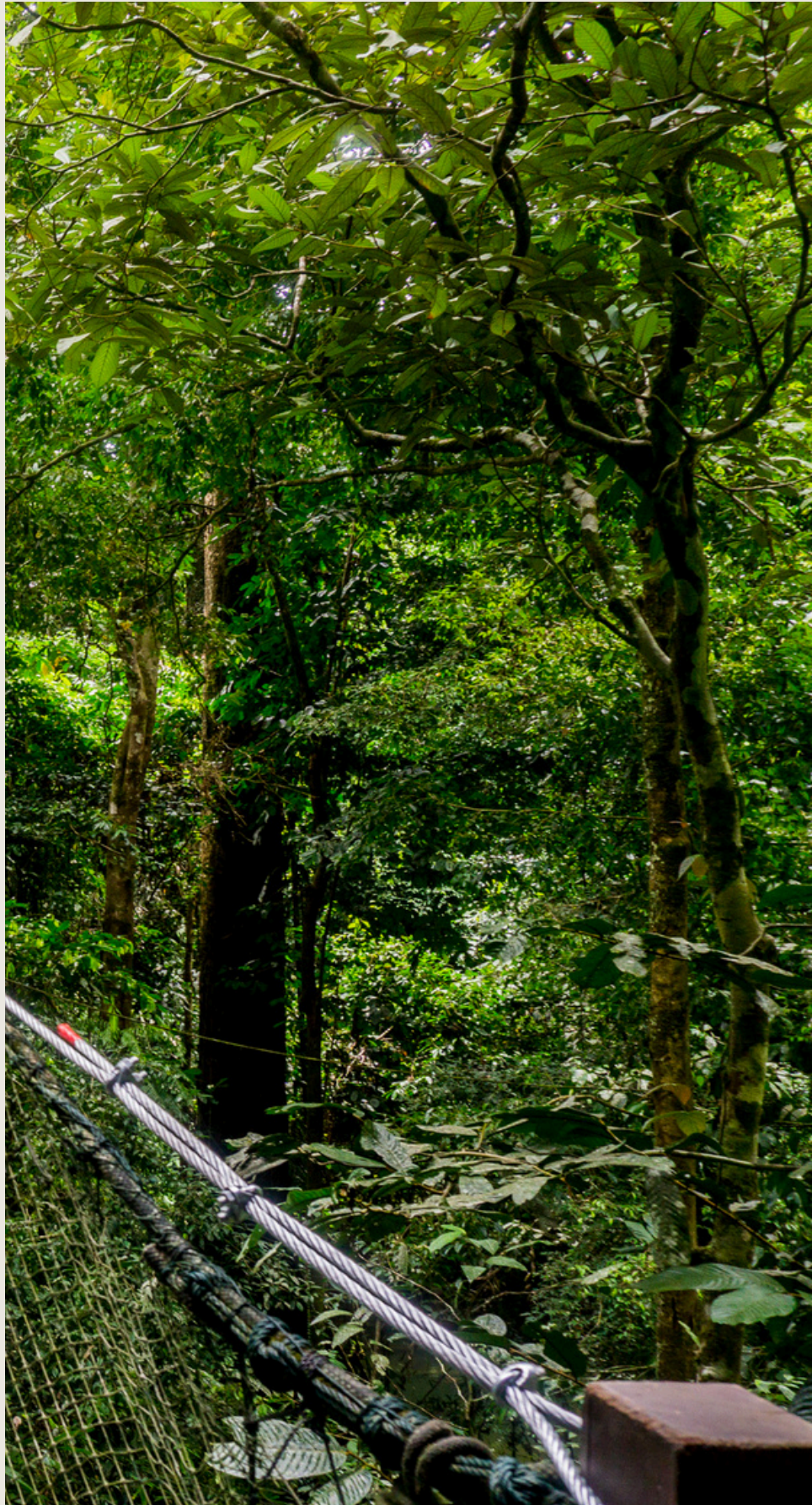


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FOREWORD BY DIRECTOR

**DR. SYEED SAIFUL AZRY
OSMAN AL-EDRUS**
DIRECTOR
INSTITUTE OF ECOSYSTEM SCIENCE
BORNEO (IEB)

Welcome to the latest edition of the IEB Bulletin. This platform is dedicated to advancing knowledge, sharing insights, and inspiring action on ecosystem services, climate change, and sustainability in Borneo.

At a time when we are confronted by pressing environmental challenges from climate change to biodiversity loss. The role of science, community collaboration, and evidence-based policy has never been more important. Guided by the University Driven Research Program (URDP) and its focus on climate change and sustainability, this bulletin highlights IEB's commitment to safeguarding the ecosystems that support both our environment and our communities.

Within these pages, you will find research, project, and achievements that reflect our mission: to translate knowledge into meaningful impact. I warmly invite you to explore these contributions and to stand with us in championing resilient ecosystems and sustainable futures for generations to come.



FOREWORD BY THE CHIEF EDITOR

DR. SHARON YONG YEE ONG
CHIEF EDITOR, IEB BULLETIN
INSTITUTE OF ECOSYSTEM SCIENCE
BORNEO (IEB)

This bulletin is more than a collection of research; it is a platform where science meets community voices, and where knowledge is translated into thoughtful action. Each contribution has been carefully selected to highlight not only the challenges we face, but also the innovative and collaborative efforts that are shaping the future of our ecosystems.

As an editorial team, we believe that sharing ideas with clarity and purpose is essential to raising awareness and sparking meaningful dialogue. Through this bulletin, we aim to provide insights that inspire reflection and encourage collective action towards climate resilience and sustainability.

I extend my sincere gratitude to all contributors, partners, and colleagues who have brought this issue to life. I invite you to explore the pages ahead with curiosity and to draw inspiration from the diverse work dedicated to protecting Borneo's rich and vital ecosystems.



EDITORIAL NOTE

**MADAM ZAHORA ISMAIL
EDITOR, IEB BULLETIN
INSTITUTE OF ECOSYSTEM SCIENCE
BORNEO (IEB)**

As part of the editorial team, it has been a privilege to coordinate the compilation of the publications, events, and awards featured in this edition of the IEB Bulletin. These sections showcase the depth of work and engagement taking place within the Institute and among our collaborators.

In this issue, we are pleased to feature 14 articles from various areas focusing on ecosystem services, reflecting the diversity of research, perspectives, and applications that contribute to this important field. These contributions highlight not only the scientific value of ecosystem services but also their relevance to communities, policy, and sustainable development.

Our goal has been to ensure that the Bulletin not only highlights current research but also reflects the broader impact of IEB's activities, from scholarly contributions to community initiatives and recognitions.

I would like to thank all contributors who provided articles, updates, and materials for this edition. It is my hope that readers will find both inspiration and insight in the accomplishments and milestones documented in these pages.

ABOUT IEB

The Institute of Ecosystem Science Borneo (IEB) is dedicated to advancing research, innovation, and community engagement in the fields of ecosystem science, climate change, and sustainability. IEB serves as a multidisciplinary platform that brings together experts, stakeholders, and local communities to explore the complex relationships between nature and human activity in Borneo. Currently, IEB comprises two key research laboratories:

- Ecosystem Science and Management (ESMa) Laboratory
- Ecotechnology and Climate Technology (ECTec) Laboratory



IEB contributes to global sustainability efforts, particularly Sustainable Development Goal 13: Climate Action.

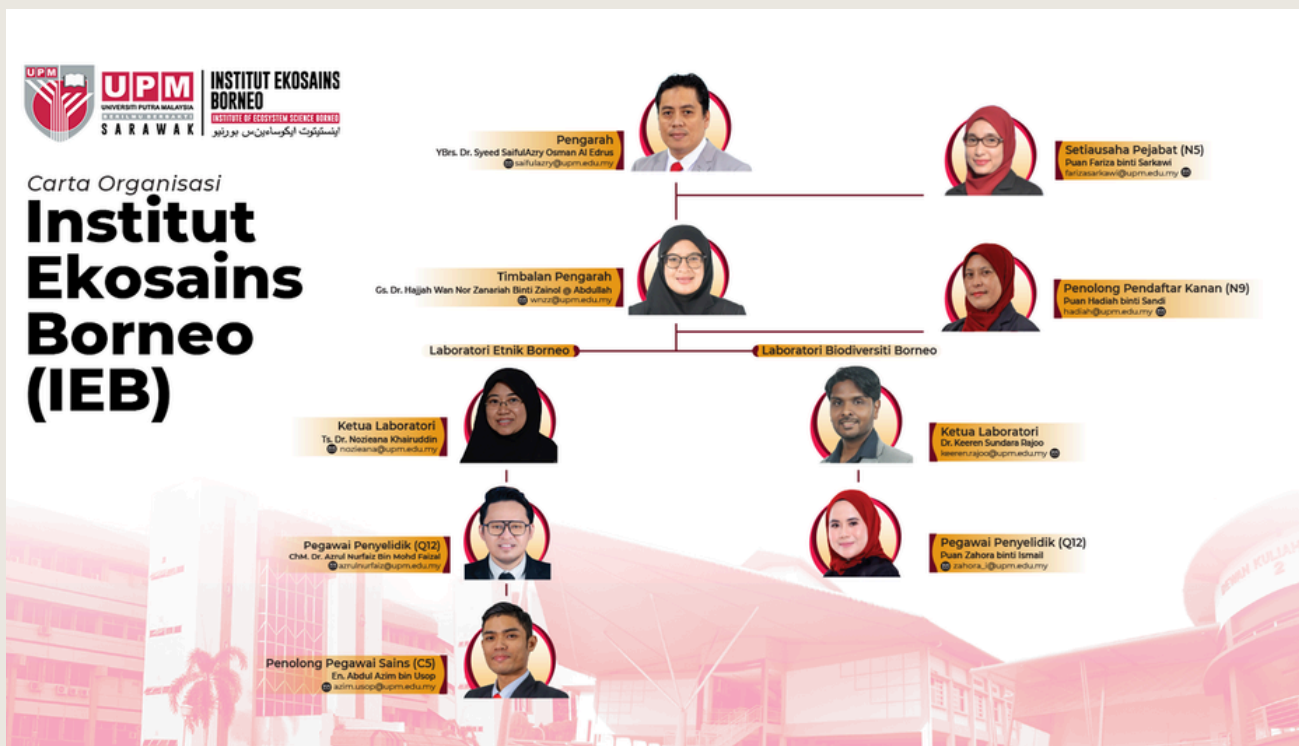
Ecosystem Science and Management (ESMa) Laboratory focuses on understanding biodiversity, ecosystem services, and the effects of land-use and climate change. Its research supports conservation efforts and sustainable development in Borneo's unique ecological landscapes.

Ecotechnology and Climate Technology (ECTec) Laboratory develops innovative technologies in areas such as renewable energy, waste management, and climate adaptation. The goal is to provide practical solutions that reduce environmental impacts and enhance resilience.

By combining ecological research with technological innovation, IEB is committed to supporting a more sustainable and climate-resilient future for Borneo and beyond.

ORGANIZATIONAL STRUCTURE OF IEB

The Institute of Ecosystem Science Borneo (IEB) operates under a structured framework that supports interdisciplinary research, innovation, and collaboration particularly for Sustainable Development Goal 13: Climate Action.



Forest Therapy as a Nature-Based Approach to Enhancing Ecosystem Services for Human Wellbeing

Keeren Sundara Rajoo
Universiti Putra Malaysia Sarawak, Malaysia
keeren.rajoo@upm.edu.my

Yasuhiro Kotera
University of Nottingham, United Kingdom
Center for Infectious Disease Education and Research, The University of Osaka,
Suita, Japan.
Department of Social Sciences, Azerbaijan University, Baku, Azerbaijan
yasuhiro.kotera@nottingham.ac.uk

Introduction

Forests provide a wide range of ecosystem services, from carbon sequestration to biodiversity preservation. Among these, cultural ecosystem services, those that support human wellbeing through recreation, spiritual connection, and psychological restoration, are often overlooked in conservation and development planning. Forest therapy is an emerging nature-based intervention that leverages these services to address modern mental health challenges.

Forest Therapy and Mental Health

Forest therapy, also known as shinrin-yoku or “forest bathing,” is a structured immersion in forest environments that promotes mindfulness, emotional regulation, and stress reduction. It is grounded in the growing body of research linking nature exposure with improved psychological wellbeing. Forests offer not just passive beauty, but active healing, through sounds, scents, textures, and sights that stimulate the parasympathetic nervous system.



Figure 1. Keeren Sundara Rajoo taking part in a forest therapy program at Harcourt Arboretum, University of Oxford.

Tropical Adaptation and Local Relevance

Our ongoing Malaysia–Japan–UK research collaboration plans to explore the application of forest therapy within the tropical rainforest context. Pilot studies in Malaysia suggest that structured immersion in tropical forest environments can significantly enhance physiological and psychological wellbeing. Unlike temperate forests, tropical forests offer denser biodiversity, warmer climates, and more complex sensory engagement. These elements may further deepen therapeutic effects when adapted appropriately but could also be a hindrance. Thus, studies need to consider these different aspects.

Forest Therapy as a form of Ecosystem Service

Positioning forest therapy within the ecosystem services framework allows us to make a stronger case for forest conservation. Beyond provisioning or regulating functions, forests contribute meaningfully to human mental health; An outcome increasingly recognized as essential for resilient societies. By embedding forest therapy into urban green space planning, public health policies, or protected area management, we simultaneously promote ecosystem integrity and social wellbeing.

Conclusion

Forest therapy is not merely a wellness trend; it is a viable and evidence-based strategy that connects mental health with environmental sustainability. As we continue refining its practice for tropical settings and diverse cultural groups, we reaffirm the idea that safeguarding nature is inseparable from safeguarding ourselves.

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Reducing Food Waste to Restore Ecosystem Balance: A Malaysia–Japan Collaborative Perspective

Mami Irie

Tokyo University of Agriculture, Japan

mami-o@nodai.ac.jp

Beatrice Lyeja Kayok

Universiti Putra Malaysia Sarawak, Malaysia

gs71307@student.upm.edu.my

Keeren Sundara Rajoo

Universiti Putra Malaysia Sarawak, Malaysia

keeren.rajoo@upm.edu.my

Introduction

Food waste is one of the most pervasive but overlooked environmental issues worldwide. Malaysia generates a staggering 260 kg of food waste per person per year, while Japan produces only around 38 kg per person per year. Food waste contributes to greenhouse gas emissions, depletes freshwater resources, and puts strain on land use systems. These impacts undermine vital ecosystem services, particularly regulating and provisioning functions such as climate regulation, soil fertility, and food security.

Food Waste and Ecosystem Services

When food is wasted, the embedded resources namely water, nutrients, energy, and labor, are also lost. This erodes the ecosystem's capacity to provide essential services. Moreover, improperly managed food waste generates methane, a potent greenhouse gas that contributes to climate change. Conversely, valorizing food waste through composting or other circular solutions can regenerate degraded soils, reduce landfill dependency, and close the nutrient loop, thereby restoring ecosystem balance.

Malaysia-Japan Collaboration: From Research to Action

Our Malaysia–Japan collaboration, currently centered in Bintulu, Sarawak, explores localized strategies for food waste reduction and valorization. Funded by and implemented in partnership with the Bintulu Development Authority (BDA), we engage stakeholders across schools, businesses, and food producers through townhalls, surveys, and community trials. The project, called Towards Zero Food Waste in Bintulu, takes a dual approach: (1) reducing edible food waste through education, and (2) using inedible waste for compost production to support soil rehabilitation and small-scale agriculture.

Japanese best practices, such as the enforcement of food loss reduction targets and efficient separation systems, serve as useful models to localize in Malaysian contexts. Simultaneously, the Malaysian side provides a real-world testing ground for innovations that must adapt to tropical conditions, community practices, and infrastructure constraints. The exchange of technical knowledge and field experience has allowed for practical, scalable insights.



Figure 1: As part of the Towards Zero Food Waste in Bintulu initiative, almost 500 kg of food waste was diverted from landfill during Bintulu's Bazaar Ramadhan.

Moving Forward: Zero Waste as a Shared Goal

Aligning with SDG 12 on Responsible Consumption and Production, food waste interventions contribute directly to ecosystem service restoration. Scaling these efforts requires not just infrastructure, but also behavioral change, policy alignment, and sustained cross-country collaboration. As food systems are deeply connected to ecosystems, small actions at the community level can collectively drive transformative impact.

Conclusion

Reducing and repurposing food waste is not just about waste management, it is about restoring the natural balance and ensuring the long-term health of our ecosystems. By building upon complementary strengths between Japan and Malaysia, this collaboration contributes to a more sustainable and regenerative food system.

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Harnessing Malaysia's Tropical Fruit Diversity for Ecosystem Services: A Path Forward

Adam Harris Gerten Ritay Abdullah
Malaysian Agricultural Research and Development Institute (MARDI)
Agrobiodiversity and Environment Research Centre
MARDI Bintulu, Sarawak, Malaysia.
gerten@mardi.gov.my

Zahora binti Ismail
Institute of Ecosystem Science Borneo (IEB)
Universiti Putra Malaysia Sarawak, Malaysia
zahora_i@upm.edu.my

Introduction

Malaysia, a megadiverse country, boasts an incredible array of tropical fruit diversity, both cultivated and wild. This rich genetic resource is not only vital for food security and rural livelihoods but also plays a crucial role in providing essential ecosystem services. The UNEP-GEF project titled "Conservation & Sustainable Use of Cultivated & Wild Tropical Fruit Diversity: Promoting Sustainable Livelihoods, Food Security & Ecosystem Services" has been instrumental in highlighting and addressing these interconnected values, with the Malaysian Agricultural Research and Development Institute (MARDI) as a key national partner.

Tropical Fruits: Beyond the Plate, Towards Ecosystem Resilience

Tropical fruit trees, often found within diverse agroforestry systems and natural forests, offer a multitude of ecosystem services crucial for environmental health and human well-being. These services extend far beyond the provisioning of food and include:

- **Biodiversity Conservation:** Tropical fruit diversity contributes significantly to overall biodiversity, providing habitat and food sources for various fauna, including pollinators and seed dispersers, which are vital for maintaining healthy ecosystems.
- **Soil Health and Erosion Control:** Extensive root systems of fruit trees help bind soil, preventing erosion, especially in hilly and vulnerable areas. This is critical for maintaining soil fertility and water quality.
- **Water Regulation:** Forested areas rich in fruit trees contribute to watershed protection, regulating water flow, reducing flood risks and recharging groundwater.

- **Carbon Sequestration:** Like all trees, tropical fruit trees absorb carbon dioxide from the atmosphere, acting as carbon sinks and mitigating climate change impacts.
- **Cultural and Recreational Value:** Indigenous and traditional fruit varieties often hold significant cultural importance for local communities, contributing to their heritage and traditional practices. These diverse landscapes also offer recreational opportunities.

However, rapid deforestation, agricultural intensification and land-use change pose significant threats to this invaluable diversity and the ecosystem services they provide.

MARDI's Pivotal Role

MARDI, as Malaysia's primary custodian of crop genetic resources, has been a critical partner in the UNEP-GEF project. Their efforts in both ex-situ (field genebanks) and in-situ (on-farm) conservation of tropical fruit genetic resources are commendable. MARDI's involvement has focused on enhancing germplasm conservation through the participation of local communities and other stakeholders, recognizing the importance of traditional knowledge and practices in maintaining diversity. This includes establishing diversity blocks, heritage blocks and common blocks at various sites across the country to safeguard valuable fruit species like *Mangifera*, *Garcinia* and *Nephelium*.

Way Forward: Strengthening Collaboration with Universities

To further bolster these conservation efforts and maximize the benefits from tropical fruit diversity, stronger collaboration with academic institutions like Universiti Putra Malaysia (UPM) is crucial, as it has long-standing tradition in tropical agriculture research and a strong focus on sustainability and food security. Universities can play a pivotal role in several areas:

- **Applied Research and Innovation:** to conduct advanced research on the ecological functions and economic valuation of ecosystem services provided by tropical fruit diversity. This includes assessing the impact of different cultivation practices on ecosystem health and identifying climate-resilient fruit varieties.
- **Capacity Building and Knowledge Transfer:** integrate aspects of tropical fruit diversity conservation and ecosystem services into its curriculum and outreach programs, training a new generation of agricultural scientists, extension agents and community leaders. This includes developing practical guides and workshops for farmers on sustainable management practices.
- **Community Engagement and Policy Advocacy:** Leveraging its extensive network and community engagement programs, universities can facilitate greater local community involvement in on-farm conservation initiatives. Furthermore, research findings from universities can provide evidence-based recommendations for policy development, advocating for incentives that promote eco-friendly agricultural practices and the conservation of fruit diversity.

- **Interdisciplinary Collaboration:** MARDI and universities can foster interdisciplinary research by bringing together experts from various fields, including agronomy, ecology, economics and social sciences, to develop holistic solutions for sustainable fruit production and biodiversity conservation.

By fostering synergy between MARDI's research and practical conservation efforts and the university's research and educational capabilities, Malaysia can further unlock the potential of its tropical fruit diversity, ensuring food security, sustainable livelihoods and the long-term resilience of its vital ecosystems.



Figure 1: Kampung Kakeng, Serian, showcased diverse fruit species from its mixed orchard as part of the project's selected communities.

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Reviving Traditional Knowledge of Medicinal Plants: Safeguarding Ecosystem Services and Community Well-being

Zahora binti Ismail

Universiti Putra Malaysia Sarawak, Malaysia

zahora_i@upm.edu.my

Adam Harris Gerten Ritay Abdullah

Malaysian Agricultural Research and Development Institute (MARDI)

Agrobiodiversity and Environment Research Centre

MARDI Bintulu, Sarawak, Malaysia.

gerten@mardi.gov.my

Introduction

Ecosystem services are the benefits that humans receive from nature. These include provisioning services such as food and medicinal resources, regulating services like climate and flood control, cultural services that shape identity and traditions, and supporting services that underpin all ecological functions (Millennium Ecosystem Assessment, 2005). Traditional knowledge of medicinal plants is an important cultural and provisioning ecosystem service, particularly for rural and Indigenous communities that rely on natural remedies for health and well-being.

Project Highlights and Case Evidence

In many communities across Malaysia and Borneo, medicinal plants play a vital role in household healthcare. Elders, especially women, often possess deep knowledge of local flora used for healing purposes. This knowledge is passed down through generations via oral traditions, practices, and rituals. However, this biocultural heritage is under threat due to deforestation, habitat loss, and modernization.

The declining use of traditional remedies among younger generations has further endangered this knowledge. Additionally, overharvesting without sustainable practices puts both the plants and the associated knowledge at risk.

In a coastal village in Sabah, local women are revitalizing the use of traditional medicinal plants through community herbal gardens. These gardens not only conserve plant species but also serve as educational sites for children and tourists. For example, Kacip Fatimah (*Labisia pumila*) is used to support women’s reproductive health, while Tongkat Ali (*Eurycoma longifolia*) is traditionally used to boost energy and treat fevers.



Figure 1. A community herbal garden promotes traditional plant use and conservation.

Local Name	Scientific Name	Traditional Use	Habitat
Kacip Fatimah	<i>Labisia pumila</i>	Women’s reproductive health	Forest understory
Tongkat Ali	<i>Eurycoma longifolia</i>	Energy, fever relief	Lowland forest
Misai Kucing	<i>Orthosiphon stamineus</i>	Kidney and urinary health	Garden/Edge areas

Table 1. Common Medicinal Plants and Their Traditional Uses

Implications / Recommendations

Reviving traditional knowledge on medicinal plants offers multiple benefits. Communities can enhance self-reliance in health care, strengthen cultural identity, and contribute to conservation of biodiversity. It is recommended to document and preserve this knowledge ethically, promote sustainable harvesting practices, and develop partnerships between communities, researchers, and policymakers. Educational programs that integrate this knowledge into local schools or community workshops can further strengthen transmission to future generations.

Conclusion

Traditional medicinal knowledge represents a vital link between culture and nature. By recognizing and revitalizing this knowledge, communities can enhance both ecological and human well-being. This approach also supports key Sustainable Development Goals such as SDG 3 (Good Health and Well-being), SDG 13 (Climate Action), and SDG 15 (Life on Land).

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From Food Waste to Sustainability through Service Learning and Vermicomposting in Action

Sharon Ong Yong Yee*

Department of Social Science and Management,
Faculty of Humanities, Management and Science,
Universiti Putra Malaysia Sarawak

Institut Ekosains Borneo
Universiti Putra Malaysia Sarawak

*Correspondence: sharon.ong@upm.edu.my

Chan Siaw Leng

Department of Social Science and Management,
Faculty of Humanities, Management and Science,
Universiti Putra Malaysia Sarawak

Tan Toh Hii

Department of Animal Science and Fishery,
Faculty of Agriculture and Forestry Sciences,
Universiti Putra Malaysia Sarawak

Introduction

Today, food production and consumption present various social, environmental, and economic challenges. Campaigns to reduce food waste are widespread, but their impact is often limited (FAO, 2013). The Theory of Planned Behaviour (TPB) proposes that values and habits are most effectively developed during early childhood (Ajzen, 1991). Recent research indicates that social expectations and individuals' confidence in their ability to adopt sustainable practices, such as waste separation and composting, influence these behaviours (Zero-Waste Household Study, 2025). Therefore, learning activities that integrate entrepreneurship with practical experience are crucial for sustainable change. This article highlights a Service-Learning Malaysia – University for Society (SULAM) project from the SAB2407 Agro-Entrepreneurship course in Semester 1, 2023/2024 at Universiti Putra Malaysia Sarawak (UPMS). The project essentially united university students, young children, and the local community to participate in vermicomposting, reduce food waste, and explore small-scale agro-business opportunities. It also aligns with Sustainable Development Goal 12: Responsible Consumption and Production, highlighting the importance of waste reduction and sustainable practices.

Project Highlights and Case Evidence

The project started in September 2023, with students from the SAB2407 Agro-Entrepreneurship course, guided by lecturers and industry advisors, setting up a worm house at a local preschool in Bintulu.



Figure 1. Setting up the Worm house.

In October, a follow-up visit included training and materials, after which the preschool assumed responsibility for daily maintenance. Students subsequently provided monthly monitoring and advice.



Figure 2. Training and materials for pre-schoolers.

Between October 2023 and April 2024, kitchen waste was collected, introduced into the worm house, and regularly checked for moisture, aeration, and temperature. The system produced two batches of compost that were applied to the preschool's vegetable beds. This compost enhanced the soil quality and supported the growth of crops such as tomatoes and leafy greens.



Figure 3. Vermicompost from the worm house and a self-initiated vegetable garden after implementing the vermicomposting program.

In June 2024, the pre-schoolers independently organised a harvesting day, proudly bringing vegetables home to share with their families. This simple cycle of food waste turning into compost and then transforming back into food offers young learners and their families concrete, visual proof of sustainability in action.

Implications and Recommendations

The project also highlighted some challenges. Termite infestations complicated pest control efforts, and food waste often required flipping or partial composting before feeding to worms to speed up the process. Direct feeding was feasible, but it delayed the vermicomposting process. After the students finished their participation, the preschool found it challenging to maintain the worm house, leading to its eventual inactivity. Despite these issues, the project received widespread recognition. Three students received partial scholarships to attend the International Vermicomposting Symposium. Industry partners suggested that worms could be sold for as much as RM500 per kilogram, highlighting their commercial potential. The project poster, 'From Food Waste to Agribusiness Opportunity: Nurturing Future Agro-Entrepreneurs through Service Learning (SULAM),' also received the Silver Medal at the Putra InnoCreative Poster Competition (I-PICTL 2023), confirming its innovative approach to teaching and learning.

Conclusion

The SULAM vermicomposting project demonstrated how kitchen waste can be converted into compost, offering educational, environmental, and community benefits. Though the worm house is no longer operational, the project succeeded in raising awareness and delivering valuable learning experiences. With improved follow-up and support, vermicomposting can continue to be an effective means of reducing food waste and promoting sustainability in schools and communities.

Acknowledgement

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Inspiring Youth for Climate Action and Marine Conservation through *Laut Needs You* Project in Bintulu

Karmilah Abdullah*

Department of Social Science and Management,
Faculty of Humanities, Management and Science,
Universiti Putra Malaysia Sarawak

*Correspondence: karmilah.abdullah@upm.edu.my

Sharon Yong Yee, Ong

Department of Social Science and Management,
Faculty of Humanities, Management and Science,
Universiti Putra Malaysia Sarawak

Institut Ekosains Borneo

Universiti Putra Malaysia Sarawak.

Chua Tau Er

Sarawak Eco Warrior

Muhammad Abdul Rahim Bin Habib

Student Management Offices

Universiti Putra Malaysia Sarawak

Introduction

The “Laut Needs You” project was a one-day environmental program held on 22 June 2025 at Pantai Tanjung Batu, Bintulu. The main goal was to raise awareness about marine pollution and encourage Universiti Putra Malaysia Kampus Bintulu (UPMKB) students to take real steps in caring for the environment, especially the ocean. Research has shown that direct participation in conservation activities increases environmental awareness and pro-environmental behaviour among youth (Chawla & Cushing, 2007; Monroe et al., 2019). The program combined beach cleaning, rescue games, and environmental quizzes, reflecting the principle that interactive, experiential learning deepens student engagement with sustainability issues (Kolb, 1984; Sterling, 2010). By engaging in hands-on activities, students not only gained knowledge but also developed leadership and teamwork skills, which are crucial for advancing sustainability competencies in higher education (Lozano et al., 2017). Throughout this project, students learned the importance of protecting marine ecosystems by being directly involved in experiential activities.

Project Execution

The project was organized by the Majlis Perwakilan Pelajar (MPP) Sesi 2024/2025 in collaboration with Sarawak Eco Warriors. It aimed to raise awareness about environmental issues, particularly marine pollution, and to promote sustainable practices among students. The project successfully met its target of 30 students from Universiti Putra Malaysia Sarawak, representing diverse academic backgrounds and age groups. This diversity enriched group dynamics, making discussions and teamwork more engaging throughout the program.



Figure 1. Beach Cleaning in Tanjung Batu Beach, Bintulu



Figure 2. Wildlife Rescue Game in Tanjung Batu Beach, Bintulu

Implications

One of the most notable achievements was the collection of 373 kilograms of trash, which significantly improved the cleanliness of Tanjung Batu Beach while also serving as a powerful reminder of the scale of waste accumulation in coastal areas. The localized clean-up initiatives can contribute significantly to marine conservation efforts (Ocean Conservancy, 2022). The Laut Needs You project also highlights the importance of student-centered experiential learning in building sustainability awareness. By directly engaging in beach cleanups, games, and quizzes, students moved through Kolb's (1984) learning cycle, they gained concrete experience, engaged in reflection, developed conceptual understanding through environmental quizzes, and applied active experimentation in teamwork and leadership. This structure not only enhanced environmental knowledge but also cultivated soft skills such as communication, collaboration, and problem-solving—skills that are critical for addressing complex sustainability challenges (Lozano et al., 2017). Furthermore, the program's outcomes resonate strongly with the Sustainable Development Goals (SDGs), especially SDG 13 (Climate Action) and SDG 14 (Life Below Water), by showing that local, student-led actions can contribute meaningfully to global sustainability agendas (United Nations, 2015). Scaling up similar initiatives could extend impact by involving local communities, schools, and NGOs, thereby transforming higher education into a catalyst for climate action and marine conservation.

Conclusion

This project demonstrated how youth-led, experiential initiatives can move beyond awareness to generate meaningful impact on both the environment and student development. The collection of 373 kilograms of waste was more than just a cleanup but, it symbolized the power of collective responsibility and the ability of small-scale actions to contribute to broader sustainability goals. Equally important, the program cultivated critical competencies such as leadership, communication, and collaboration, showing that environmental engagement can strengthen both ecological outcomes and graduate attributes. By embedding environmental protection in interactive and reflective activities, the initiative turned sustainability into lived practice rather than abstract knowledge. Looking ahead, the program highlights the value of empowering students as active agents of change. When higher education integrates experiential learning with climate action, it not only nurtures environmentally responsible graduates but also contributes directly to achieving the Sustainable Development Goals (SDGs), particularly those on climate action and life below water.

Acknowledgement

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Utilization of Animal Waste (Eggshells, Bones) in Biodiesel Catalysis: A Pathway to Sustainable Ecosystem Use

Nur Afiqah Ali

Department of Science and Technology

Faculty of Humanities, Management and Science

Universiti Putra Malaysia Sarawak, 97008 Bintulu, Sarawak, Malaysia

nurafiqahali97@gmail.com

Nozieana Khairuddin

Institut Ekosains Borneo

Universiti Putra Malaysia Sarawak, 97008 Bintulu, Sarawak, Malaysia

Department of Science and Technology

Faculty of Humanities, Management and Science

Universiti Putra Malaysia Sarawak, 97008 Bintulu, Sarawak, Malaysia

nozieana@upm.edu.my

Introduction

Turning Animal Waste into Valuable Catalysts

As the world shifts toward more sustainable energy sources, biodiesel has emerged as a promising alternative to fossil fuels. It is renewable, biodegradable, and offers a significant reduction in greenhouse gas emissions (GHG) compared to petroleum diesel. A crucial component in biodiesel production is the catalyst used during transesterification – the process that converts oils or fats into fatty acid methyl esters (FAME), the chemical name for biodiesel. Traditionally, homogeneous catalysts like sodium hydroxide or potassium hydroxide are used, but these substances are corrosive, produce large volumes of wastewater, and are not reusable (Anil et al., 2024).

Heterogeneous catalysts have become a viable alternative due to their reusability and minimal post-treatment requirements. One of the most sustainable sources of such catalysts is animal waste, particularly eggshells and bones, which are rich in calcium carbonate (CaCO_3). These materials can be converted into calcium oxide (CaO) via calcination at high temperatures (800–900°C), producing a solid base catalyst suitable for transesterification (Hussain et al., 2021). The process involves washing, drying, grinding, and calcining the waste to produce high-purity CaO . This not only ensures catalyst efficiency but also diverts organic waste from landfills.

Recent innovations have further improved this approach. For example, the impregnation of transition metals like zinc or magnesium onto CaO surfaces enhances the catalyst's surface area, stability, and basic strength, resulting in improved biodiesel yields (Ali et al., 2023). These modifications also help overcome common issues such as catalyst leaching or deactivation after multiple uses.

Ecosystem and Environmental Benefits of Waste-Derived Catalysts

Using animal waste-derived catalysts provides multiple ecosystem benefits. Firstly, it addresses the critical issue of waste management. Eggshells and bones are often discarded as food or slaughterhouse waste, contributing to landfill volume and environmental pollution. Their valorization into catalysts supports circular economy principles by transforming waste into a valuable input for renewable energy production (Judijanto, 2025).

Secondly, biodiesel itself contributes to climate change mitigation — a major regulating ecosystem service. Biodiesel emits significantly less carbon dioxide compared to conventional diesel. Furthermore, producing CaO from waste materials instead of mining limestone or synthesizing chemicals reduces industrial emissions and energy consumption. This holistic approach not only reduces the carbon footprint of the fuel but also the environmental impact of catalyst production.

Moreover, when waste cooking oil (WCO) is used as the feedstock, the environmental benefit is multiplied. It prevents improper oil disposal — which can clog waterways and damage aquatic ecosystems — while simultaneously reducing reliance on edible oils for fuel, avoiding competition with food production. When paired with eggshell or bone-derived CaO catalysts, WCO-based biodiesel production becomes a model for integrated resource recovery (Ali et al., 2023)



Figure 1: From used cooking oil to biodiesel (top right), and from organic waste like eggshells, bones, and wood through pyrolysis into activated biochar (bottom right), innovative green technologies are paving the way for renewable energy and waste valorization (left: refined oil for biodiesel production). This circular approach not only reduces environmental impact but also promotes sustainable resource use.

Challenges, Opportunities, and Future Directions

Despite its advantages, this method presents several challenges. The calcination process consumes a substantial amount of energy. If powered by fossil fuel, this may reduce the overall sustainability of the approach.

Transitioning to renewable-powered kilns or using lower-temperature synthesis methods could improve environmental performance. Additionally, collecting and processing large volumes of animal waste at scale requires efficient logistics. Hygiene concerns, especially for bones from slaughterhouses, must be managed with proper sanitization steps. Further, impurities like phosphorus in bones or residual organics in eggshells can affect catalyst activity if not properly removed.

Nonetheless, with the right support, this approach offers great promise. Governments and industries can establish local collection centers for eggshells and bones and integrate them into biodiesel production units, particularly in rural or agricultural communities. Public awareness campaigns can also encourage households and businesses to separate their organic waste for reuse.

In conclusion, the utilization of animal waste such as eggshells and bones as heterogeneous catalysts for biodiesel production offers a sustainable, low-cost, and eco-friendly alternative to synthetic or mineral-based catalysts. This method contributes to multiple ecosystem services, including waste reduction, climate regulation, water quality improvement, and energy provisioning. As research and innovation continue to refine this technology, animal-waste-derived catalysts could become a mainstream solution in the journey toward renewable energy and ecological sustainability.

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Flexible Volume Prediction Model with Carbon Sequestration Expansion: Insights from Sabal Forest Plots

Wan Nor Zanariah Zainol @ Abdullah^{1,2*}

Corresponding author email: wnzz@upm.edu.my

^{1*}Institute of Ecosystem Science Borneo (IEB), Universiti Putra Malaysia Bintulu Sarawak Campus, P.O Box 396, Nyabau Road, 97008 Bintulu, Sarawak, Malaysia

^{2*}Department of Science and Technology, Faculty of Humanities, Management and Science, Universiti Putra Malaysia Bintulu Sarawak Campus, P.O Box 396, Nyabau Road, 97008 Bintulu, Sarawak, Malaysia

Omar Faruqi Marzuki

Department of Science and Technology, Faculty of Humanities, Management and Science, Universiti Putra Malaysia Bintulu Sarawak Campus, P.O Box 396, Nyabau Road, 97008 Bintulu, Sarawak, Malaysia

Mohammad Firdaus Bohari

Forest Department Sarawak Headquarters, Level 15, East Wing Bangunan Baitul Makmur II, Medan Raya, Petra Jaya, 93050 Kuching, Sarawak, Malaysia

Hamdan Omar

Forest Research Institute Malaysia (FRIM), 68100 Kuala Lumpur, Federal Territory of Kuala Lumpur, Malaysia

Mira Debra Ranti Tiong Anak Anjie

Universiti Teknologi Malaysia (UTM), Jalan Iman, 81310 Skudai, Johor Darul Ta'zim, Malaysia

INTRODUCTION

Forests play a crucial role in the global carbon cycle by acting as natural carbon sinks, sequestering CO₂ from the atmosphere. They are essential for climate change mitigation, biodiversity conservation, and sustaining ecosystem services. With rising concerns over global warming and increasing carbon emissions, there is growing interest in accurately estimating the carbon sink capacity of forests to inform management strategies aimed at enhancing carbon sequestration. However, estimating carbon sink capacity is fraught with challenges, including the complexities of forest dynamics, land quality, and species composition (Dong et al., 2024; Manso et al., 2022).

To address these challenges, recent advances have focused on refining models that predict tree growth, biomass, and carbon storage. These models incorporate factors such as tree height, diameter at breast height (DBH), and stand density, which are crucial for estimating forest volume and carbon sink potential. The development of such models is increasingly supported by advanced technologies like Light Detection and Ranging (LiDAR) and remote sensing, enabling the collection of detailed forest inventory data over large spatial scales (Umemi & Inoue, 2024; Zhao et al., 2023).

METHODOLOGY

The data for this study were obtained from five forest plots at Sabal, Sarawak, Malaysia, each measuring 20 m x 20 m (Figure 1). These plots provide critical field measurements, including information on tree species, DBH, total tree height, and crown diameter—parameters that are essential for accurate tree volume and biomass estimation. The dominant species across these plots is *Rubroshorea leprosula*, alongside a mix of other species. Such detailed inventory data have been shown to improve the robustness of volume projections and carbon stock assessments (Sharma, 2020; Huang et al., 2024).



Figure 1 : Five forest plots at Sabal Forest, Sarawak.

Tree volume calculation is a critical step in estimating biomass and carbon sequestration potential. For this study, a standard tree volume calculation formula was employed:

$$V = \frac{\pi}{4} \times (DBH)^2 \times H$$

Where V is the tree volume in cubic meters, DBH is the diameter at breast height in meters, and H is the total height of the tree in meters. This formula assumes a cylindrical shape for the tree, providing a reasonable approximation of tree volume (Manso et al., 2022).

Once tree volumes were calculated, biomass was estimated as approximately 50% of the tree volume, following established forestry practices. The carbon content of the biomass was then estimated as 50%, and carbon sequestration capacity was calculated by multiplying the carbon content by 3.67, representing the molecular weight ratio of CO_2 to carbon.

RESULT AND DISCUSSION

The results from the five forest plots show significant variation in CO_2 sequestration capacities, primarily driven by differences in tree volume and species composition. Plot 1 demonstrated the highest potential with a sequestration capacity of 0.034 tons of CO_2 , whereas Plot 5 exhibited the lowest with only 0.001 tons. This variation underscores the crucial role of site-specific factors such as tree density, species type, and age in determining the carbon sequestration capacity of a forested area (Huang et al., 2024; Yu et al., 2024).

Biomass estimates across the five plots ranged from 0.0005 m^3 in Plot 5 to 0.0185 m^3 in Plot 1, reinforcing the link between tree volume and carbon storage potential. The findings emphasize the need for careful management to maximize biomass accumulation. Optimizing forest management practices, including selective tree harvesting and afforestation with high carbon-sequestering species, can further enhance the carbon sink potential of forests (Qin et al., 2024; Zhao et al., 2023).

Table 1. Volume and Carbon Sequestration Estimates for Sabal Plots

Plot	Total Volume (m³)	Biomass (m³)	Carbon Content (m³)	CO Sequestration (tons)
Plot 1	0.037	0.0185	0.00924	0.3034
Plot 2	0.011	0.005	0.0027	0.01
Plot 3	0.022	0.011	0.005	0.02
Plot 4	0.002	0.001	0.0006	0.002
Plot 5	0.001	0.0003	0.00015	0.001

Conclusion

The volume projection model developed in this study offers a practical and scalable approach for estimating carbon sink capacity using standard forestry measurements such as tree height and diameter at breast height (DBH).

By applying the model to five forest plots, its effectiveness in estimating tree volume, biomass, and CO₂ sequestration was demonstrated. The variability in carbon sequestration across the plots emphasizes the importance of site-specific factors like species composition, tree density, and environmental conditions, highlighting the need for tailored forest management practices.

This model's scalability makes it suitable for broader applications in forestry management, afforestation programs, and climate change mitigation efforts. Its ability to provide reliable estimates of forest carbon storage, even in small plots, aligns with the increasing focus on optimizing forest resources as a key strategy to meet global carbon neutrality goals. Future refinements to the model, including the incorporation of dynamic environmental factors and species-specific data, will further improve its utility in developing sustainable forest management strategies that contribute to global climate goals.

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Green-Synthesized Nanoparticles for Ecosystem Restoration: Material Chemistry Perspectives on Pollution Mitigation

Alvin Lim Teik Zheng

Institute of Ecosystem Science Borneo,
Universiti Putra Malaysia Sarawak (UPMS)

alvinltz@upm.edu.my

Ecosystems face growing pressures from industrialization, urban expansion, and intensive agriculture, all of which contribute to soil degradation, water contamination, and declining air quality. Conventional remediation strategies, while sometimes effective, often involve chemical-intensive methods that generate secondary waste, demand high energy inputs, or disrupt long-term ecological balance. Against this backdrop, material chemistry offers innovative pathways for environmental restoration. Among its most promising developments is the creation of green-synthesized nanoparticles, designed at the nanoscale to interact with contaminants while being produced under environmentally friendly conditions. These materials not only restore essential ecosystem services but also align with sustainability goals, making them an important approach to pollution mitigation.

The Promise of Green Nanotechnology

Green nanotechnology integrates precise material engineering with biologically inspired synthesis. This combination enables the production of nanoparticles with high reactivity, stability, and selectivity while avoiding the environmental costs typical of conventional fabrication. Traditional synthesis methods rely on harsh chemicals, extreme temperatures, and toxic solvents, whereas green synthesis employs natural reducing and stabilizing agents, including plant-derived phytochemicals, microbial metabolites, and biopolymers, under ambient or mild conditions (Eddy et al., 2024). These adjustments lower the toxicity of the process and enhance the biocompatibility and functionality of the resulting nanoparticles.

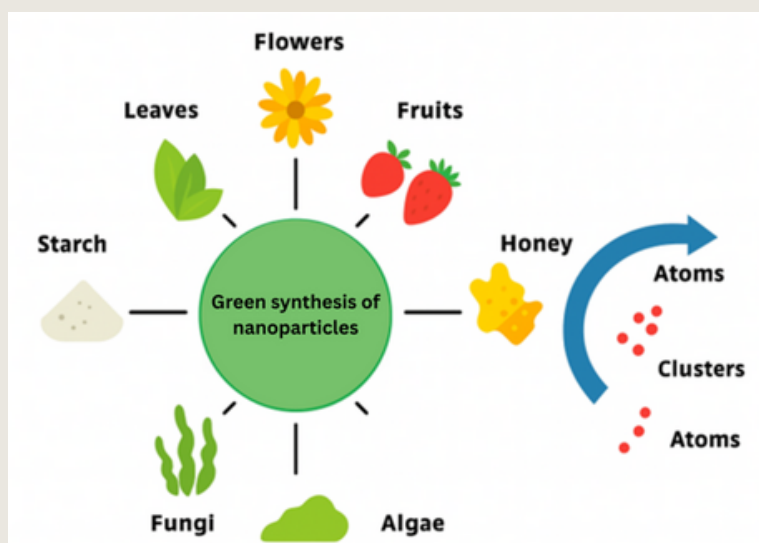


Figure 1. Different type of green synthesis for the preparation of metal/metal oxides.

For instance, bioactive phytochemicals such as phenolics, flavonoids, and terpenoids found in plant extracts can reduce metal ions into stable nanoparticles while capping them to prevent aggregation. Microorganisms, including bacteria and fungi, also facilitate nanoparticle formation through metabolic pathways, providing scalable and reproducible biosynthetic platforms (Deka et al., 2025). Figure 1 briefly collates the different type of green synthesis for the preparation of metal/metal oxide nanoparticles. This approach effectively blends nature and nanotechnology, producing materials that are functional, safer, and more sustainable.

Expanding Applications Across Environmental Media

Green-synthesized nanoparticles demonstrate versatility across multiple environmental compartments, particularly in water, soil, and air, where they address different types of pollutants through tailored properties.

Water Purification

Polluted water bodies often contain complex mixtures of dyes, heavy metals, and microbial contaminants, posing significant health and ecological risks. Green-synthesized nanoparticles provide a multifaceted solution through adsorptive, catalytic, and antimicrobial activities. For example, silver nanoparticles synthesized using *Peltophorum pterocarpum* flower extract achieved rapid degradation of Acid Blue 113 dye in the presence of NaBH_4 , with a rate constant of 0.247 min^{-1} at 30 mg/L (Vinayagam et al., 2025). This illustrates their effectiveness in breaking down complex organic pollutants. Likewise, iron oxide and titanium dioxide nanoparticles, fabricated via green methods, have shown strong potential for adsorbing heavy metals, degrading organic contaminants, and deactivating waterborne pathogens.

Soil Remediation

Green-synthesized nanoparticles also play an important role in revitalizing degraded soils. Zero-valent iron nanoparticles are particularly effective in immobilizing toxic metals and breaking down petroleum hydrocarbons, reducing pollutant bioavailability and supporting nutrient cycling (Galdames et al., 2020). A recent study on zinc oxide nanoparticles (ZnONPs) applied to cucumber plants infected with *Fusarium oxysporum* found that they could suppress disease progression, enhance root physiology, and promote plant growth without phytotoxic effects when used at appropriate concentrations (Li & Liu, 2024). These results suggest that nanoparticles can simultaneously manage pollutants and support plant health, offering a sustainable solution for agriculture.

Air Purification

Air pollution control has also benefited from green nanotechnology. Titanium dioxide nanoparticles produced through eco-friendly methods exhibit strong photocatalytic oxidation properties, enabling them to generate reactive oxygen species that degrade volatile organic compounds and neutralize airborne microbes (Salama & Zafar, 2022). When incorporated into air filters and surface coatings, these nanoparticles have improved both indoor and outdoor air quality, extending the impact of green nanomaterials beyond soil and water systems.

Pest Management

Green-synthesized nanoparticles are also being explored as safer alternatives to chemical pesticides. For instance, titanium dioxide nanoparticles synthesized using latex from *Calotropis procera* displayed up to 95% insecticidal activity against dusky cotton bugs (*Oxycarenus laetus*), with the highest effectiveness observed in 2nd instar nymphs (Fatima et al., 2025). Such results open new opportunities for environmentally friendly pest management that maintains crop productivity without relying on harmful agrochemicals.

Advantages and Contributions to the Circular Economy

The advantages of green-synthesized nanoparticles extend beyond their remediation performance. By avoiding hazardous chemicals during production, these nanoparticles display reduced toxicity, making them safer for ecosystems and human use. They are also cost-effective since low-cost precursors such as agricultural residues or microbial cultures can serve as starting materials, ensuring accessibility in resource-limited contexts.

Biologically derived capping agents enhance nanoparticle stability and dispersibility in complex environmental systems, improving performance in real-world applications.

Importantly, incorporating green nanotechnology into circular economy models creates additional value. Agricultural and food waste, often a disposal burden, can be repurposed as precursors for nanoparticle synthesis, effectively transforming waste into useful remediation resources (Madhavan et al., 2024). This not only reduces environmental impact but also promotes economic sustainability.

Challenges to Implementation

Despite their promise, scaling up green-synthesized nanoparticles presents several challenges. Laboratory-scale methods often lose efficiency and reproducibility when adapted for industrial production. Furthermore, the environmental fate, transport, and long-term ecotoxicological effects of these nanoparticles remain poorly understood. In-depth studies on their persistence, accumulation, and interactions within ecosystems are critical to prevent unintended consequences (Alhassan et al., 2024).

Another obstacle is the lack of well-defined regulatory frameworks for their safe application. Without clear guidelines, broader adoption is limited, and public trust remains low. Establishing standardized performance criteria, safety assessments, and regulatory protocols is essential for responsible deployment.

Future Research Directions

To address these barriers, researchers are developing hybrid materials that combine nanoparticles with biochar, biopolymers, and other sustainable carriers. For example, biochar-TiO₂ composites integrate adsorption and photocatalysis, achieving superior pollutant removal efficiency in wastewater compared to single-component systems (Zoroufchi Benis et al., 2023).

Additionally, machine learning and computational modeling are emerging as tools for optimizing synthesis parameters, predicting material interactions with contaminants, and accelerating the design of purpose-built nanoparticles for specific environmental applications.

Field-based trials, particularly in tropical ecosystems such as Malaysia, are also needed. These trials can validate laboratory findings, refine application protocols, and support the development of context-specific guidelines. Collaborative efforts between scientists, policymakers, and local communities will be vital for translating laboratory innovations into practical environmental solutions.

Conclusion

Green-synthesized nanoparticles represent a rapidly advancing area of sustainable material chemistry, offering effective tools for pollution mitigation and ecosystem restoration. Case studies, such as *Etlingera elatior*-mediated titanium dioxide nanoparticles for water purification, agro-waste-derived silver nanoparticles for dye degradation, and zinc oxide nanoparticles for managing soil pathogens, demonstrate their tangible benefits.

For these technologies to reach their full potential, efforts must focus on scalable synthesis, thorough environmental risk assessment, clear regulatory development, and interdisciplinary collaboration. By connecting laboratory innovation with field applications and embedding these approaches within circular economy models, green nanotechnology can make a meaningful contribution to ecosystem resilience, environmental protection, and sustainable development.

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Assessment of Skid Trails Effects on the Regeneration of Commercial Trees Species at Similajau Forest Reserve, Bintulu Sarawak

Lepun, P.^{1,2*}

¹Faculty of Agriculture and Forestry Science, UPM Bintulu Sarawak Campus, 97008 Bintulu, Sarawak, Malaysia

²Institut Ekosains Borneo, UPM Bintulu Sarawak Campus, 97008 Bintulu, Sarawak, Malaysia
philip@upm.edu.my

Keeren Sundara Rajoo^{1,2}

¹Faculty of Agriculture and Forestry Science, UPM Bintulu Sarawak Campus, 97008 Bintulu, Sarawak, Malaysia

²Institut Ekosains Borneo, UPM Bintulu Sarawak Campus, 97008 Bintulu, Sarawak, Malaysia
keeren.rajoo@upm.edu.my

INTRODUCTION

Most of the trees that dominated the main canopy of forest areas in the tropical rainforest are high-quality tree types that contribute to the logging industry. The contribution of the forest which is very rich in plant diversity in the tropical rainforest area refers more to the Dipterocarpaceae family which has high quality wood. The preservation and conservation of forests is an important agenda in ensuring sustainable development in the country because its importance is very significant to the life around it. The effects of changes to forest types in tropical countries are still under control because the richness of plant species can be restored so quickly. The plant diversity of the tropics is studied to serve in many functions not only limited to determining the diversity of the forest itself (Draper et al., 2020).

Disturbance to the physical nature of the forest has affected the process of natural forest recovery because extreme weather changes often occur. The frequency of soil erosion and extreme heat conditions have changed the microclimate conditions and caused displacement processes to change frequently, especially in newly opened areas. Forest exploration that often happens as happened to Similajau Forest Reserve, Bintulu, Sarawak has affected the process of forest restoration and the reduction of commercial tree species in this forest. Logging activities have changed the profile and structure of tropical rainforests that are rich in various plant species.

Physical changes in the forest contribute to long-term effects in the structure of the forest as a result of disturbance to the stand and the alteration of the soil layer that occurs in the forest which ultimately results in the dominance of quality trees that usually exist in the forest at the climax stage such as the Dipterocarpaceae family which are difficult to survive due to the loss of nutrients and clearing forest canopy. Most of the parent trees in the forest area, especially around the developed log road, have been completely cut down. Disruption due to logging without perfect planning has caused the forest environment and the environment has changed in terms of plant species that originally flourished in their original areas in the forest. The level of disturbance from logging also affects the dominance of certain plants according to their suitability for forest restoration purposes. Therefore, to assess the impact of the construction of the log road used to transport the logs to the collection area, a study was conducted to identify the composition of tree species that will grow in the area of this skid trail and evaluate the tree stand.

METHODOLOGY

Study Site

This research area is in the 804 ha Similajau Forest Reserve that has been illegally encroached for log production activities with a distance of five kilometers from the Universiti Putra Malaysia Sarawak Campus (UPMS). The study site is situated in Similajau Forest Reserve, Bintulu, Sarawak where the entrance to the study site located in front of the Bintulu Hospital, Bintulu Sarawak (Figure 1).



Figure 1. Map of Similajau Forest Reserve, Bintulu, Sarawak.

A total of three study plots has been developed for the needs of this study to ensure that the objectives are achieved. The coordinate of the plot namely as Plot A, B and C. The selection of determining the plot area is also based on the height above sea level where the ridge plot (Plot C) is located on the altitude of 86.816 m, slope plot (Plot B) altitude is 61.187 m and the riverine plot (Plot A) altitude is located 40.520 m from the sea level. The trees that were accounted in the plot are with DBH ≥ 5 cm and the tree seedlings were less than 5cm. All plants found in subplot were recorded in the inventory data recording is recorded in a data inventory form. Based on the form, every plot that have been divided in accordance with the subplot, the plants distribution has also been recorded.

Data analysis

All of the plants and trees observed in the plots have gone through the process of identification in order to identify to where the plant's family, genus and species. The stand data were analysed for species composition, calculated based on the percentage of the individual species over the total species recorded. The basal area (BA) of trees was calculated for each diameter using the formula below (Hush et al., 2002):

$$\begin{aligned} \text{BA} &= \frac{p \text{ dbh}^2}{4 (10,000)} \\ &= 0.00007854 (\text{dbh}^2 \text{ in a Ha}) \end{aligned}$$

Results and Discussion

The result of the plot study, a total of 398 individual plants were identified, and they belonged to 48 families, 98 genera and 159 species (Table 1) When compared the plots in this study, the high in term of plants species was Plot B with 82 species, 56 genera and 35 families. The second highest was Plot C with 76 species, 51 genera and 33 families and the lowest was Plot A which is in the riverine recorded of 32 families, 47 genera and 59 species with total plant individual observed which included trees, shrub, seedling, climber and herbs are 100.

Table 1: The total of plants (tree, seedling, shrub, herb and climber) recorded in the plot study areas.

Plot	Family	Genus	Species	Total
Plot A (Riverine)	32	47	59	100
Plot B (Slope)	35	56	82	145
Plot C (Ridge)	33	51	76	153
Total area (0.3 ha)	48	98	159	398

However, for the trees inventory result of area of Plot A, B and C with the sizes of 0.3 hectare recorded about 39 families, 81 genera and 138 species with the total of recorded trees individual were 304 trees (Table 2). While for trees with ≥ 5 cm in Plot A or the riverine area has recorded a total of 22 families, 31 genera and 44 species with the total trees recorded were only 65 trees. Secondly, Plot B or the slope area has 27 families, 49 genera and 70 species together with the recorded trees individuals were 114 trees. Plot B has the highest number of recorded genera and species which were 49 genera and 70 species. However, Plot C has the recorded highest of family with 29 families, which contributed by 44 genera and 67 species of trees. This plot also recorded greatest number of individual trees with the total of 125 trees.

Table 2: Number of trees taxon identified based on the plot study areas.

Plot	Family	Genus	Species	Total tree stands
Plot A	22	31	44	65
Plot B	27	49	70	114
Plot C	29	44	67	125
Total area	39	81	138	304

The DBH distribution of all the observed trees with ≥ 5 cm DBH was presented in Figure 2 below. The result shows about 63.82% of the trees in the plot study are trees with the sizes between 5.0 cm to 10.0 cm DBH (Table 3). From the data also showed that there was no of tree with the diameter greater 60.0 cm DBH. The size class distribution can be used to describe the feature of the forest structure (Kacholi, 2014) which was indicated that the forest areas have a great impact of the logging activities in the previous years.

Figure 2: Distribution Tree Sizes in the Plot.

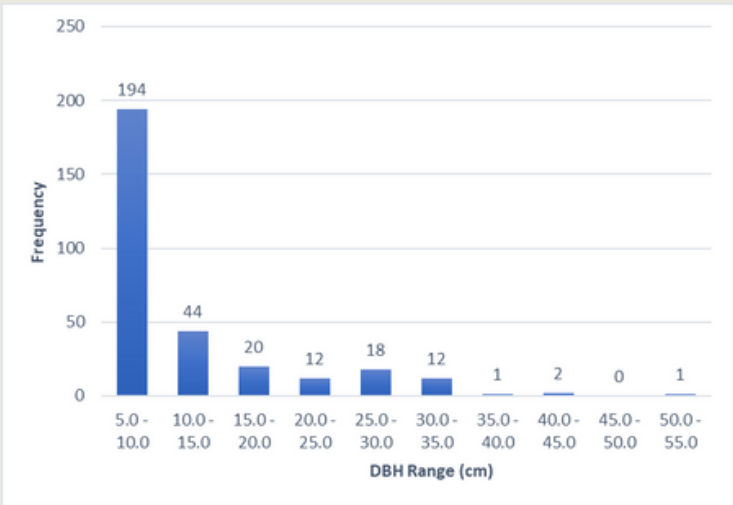


Table 3: Tree DBH classes in the plot study.

Range (cm)	Frequency	Mean (cm)	Tree Percentage (%)
5.0 - 10.0	194	7	63.82
10.0 - 15.0	44	12	14.47
15.0 - 20.0	20	17.9	6.58
20.0 - 25.0	12	22.3	3.94
25.0 - 30.0	18	27.6	5.92
30.0 - 35.0	12	32.8	3.94
35.0 - 40.0	1	36.5	0.32
40.0 - 45.0	2	42.7	0.66
45.0 - 50.0	0	0	0
50.0 - 55.0	1	50.1	0.32
Total	304	11.7	100

The total of trees recorded in Plot A were 65 trees. From those trees, the largest tree measured only with the size of 50.1 cm DBH occurred in Plot A (Riverine) which belonged to *Whiteodendron moultonianum* (Myrtaceae) and followed by *Rubroshorea leprosula* (Dipterocarpaceae) with 36.5 cm DBH. The small stream might had impacted the tree DBH distribution on the site. The presence of river or stream might lower the number of plants and trees growing on the site due to the presence of excessive water that can damage, but the trees that had tolerated to the river or stream flooding would take a lot of benefits from great resources provided by the stream such as more nutrient availability from river soil deposit and there would be lesser individuals competition from the site. The basal area calculated in the study was an important information to know the density of plant especially trees in the plot area. Basal area can be used to describe the forest structure (Ganivet et al., 2020; Kacholi, 2014). Therefore, the larger the basal area reading obtained from the tree diameter reading will indicate the higher the tree density or the number of large trees. The formula to calculate the basal area used here was based on (Kacholi, 2014). Based on the results of this study, the total BA for this study plot with an area of 0.3 hectares is 4.1903 m² (Table 4).

Table 4: Summary of BA in the Plot Study.

Plots	Basal Area (m2)
Plot A (Riverine)	1.4072
Plot B (Slope)	1.8005
Plot C (Ridge)	1.7026
All Plots (0.3 ha)	4.1903

As DBH in Plot A was the least compared to Plot B and Plot C. Low basal area can be a sign that the area had many small size DBH trees that were still young while the larger DBH trees were lacking in the area (Kacholi, 2014). The highest BA was on Plot B (Slope) while the lowest BA was on Plot A (Riverine). The growth of stand can be influenced by the feature and characteristics such as elevation, aspect and slope since the three features would temperature of the site and sunlight radiation.

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Sago Palm Tree

Ann Anthony
Department of Crop Science
Faculty of Agriculture and Forestry
Universiti Putra Malaysia Sarawak
gs69858@student.upm.edu.my

Muhammad Huzaifah bin Mohd Roslim
Department of Crop Science
Faculty of Agriculture and Forestry
Universiti Putra Malaysia Sarawak
muhammadhuzaifah@upm.edu.my

INTRODUCTION

The Metroxylon sago, commonly known as the Sago Palm tree, is a vital tropical plant native to Southeast Asia. Sago palm belongs to the family Palmae (Arecaeae) which is widely found in Indonesia, Papua New Guinea and Malaysia (Yacob et al., 2023). The sago tree is an underutilized plant that serves communities as a source of food, building materials and income. According to Talib et al. (2023), the largest sago palm plantation is located in the Mukah district of Sarawak.

The word “sago” is originally Javanese, which means starch containing palm pith. This tree is known by different names depending on the country, such as rumbia in Indonesia and Malaysia, saksak in Papua New Guinea and sa khu in Thailand (Flach, 1997). In Sarawak, the Melanau ethnic group in Mukah commonly refers to the sago palm as balaw (Shin and Collins, 2015). Moreover, the sago palm is capable of flourishing in different environments such as marshy peat soils, acidic soils and moist environment (Yacob et al., 2023). This tree was unique and valuable for its ability to produce an exceptionally high yield of starch. A single palm produces up to 300 kg of starch (Ehara et al. 2018).

Sago Tree Growth

Extensive research has been carried out to understand the different growth stages of the sago palm. The development of the sago palm begins with the rosette stage, where the trunk has not yet developed (Figure 1). In Sarawak, local farmers characterized sago palm growth into five major stages using the local language, which are Plawei (palms at maximum vegetative growth), Plawei Manit (inflorescence emerging), Bubul (inflorescence developing), Angau Muda (Flowering), Angau Tua (Fruit ripening). The commercial maturity for sago palm is reached in 9-12 years with a height around 7m to 14m, which is suitable for starch harvesting (Chua et al., 2021, Lim et al., 2019). Moreover, Singhal (2008) described that sago tree can grow up until 25m with a diameter of 40cm and will start to wither after flowering. According to Chua et al. (2022) the maximum starch accumulation in the sago trunk is at the flowering stage or before fruit formation. Other than that, Uthumporn et al. (2014) expressed that Plawei and Angau muda growth stages shows the highest starch content, with more than 90% value.

Sago Industry

In Malaysia, the development of sago plantations has been actively supported by various agencies, such as the Sarawak Department of Agriculture, CRAUN research and also the Sago and Nipah Development Board (SNDB). According to the Department of Agriculture (DOA), the planted area and production of sago palm have shown a declining trend over the eight-year period from 2016 to 2023 (Figure 2). The sago production was at its peak in 2019 (199 370.9 tonnes) and declined from 2020 to 2023. Furthermore, Figure 3 depicts that the largest sago plantations in Malaysia are located in Sarawak, which cover 98% of the total planted area, followed by Sabah with just two percent. This plantation, predominantly managed by smallholders, covered about 28,693.20 hectares, with the majority located in the Mukah (23,620.60ha) and Betong (2,340.60ha) divisions (Table 1). There are no current records of sago plantations in Peninsular Malaysia; however, in 2018, Kelantan (Tumpat) was documented to have 1.2 hectares of planted area that produced 8.1 tonnes of sago.

The sago starch was one of the main products from the sago palm tree. This starch was extracted from the sago pith, which refers to the inner portion of the trunk after the outer layer has been removed (Figure 4). The Minister of Food Industry, Commodities and Regional Development says that Sarawak was the sole state that exported sago starch. According to Department of Statistics Malaysia, Sarawak has exported 35,000 metric tons of sago starch in 2023, primarily to Peninsular Malaysia and Japan, for a total value of RM113 million.

Moreover, some of the sago starch was use in various traditional food industries such as noodles, biscuits and cakes. It has also been used for food stability or thickening and also in textile, paper and pharmaceutical industries (Du et al., 2020). Figure 5(a) to 5(c) shows some of the goods that come from the sago palm, particularly in Sarawak.



Figure 1 Malaysia sago performance (2016-2023). Source: DOA



Figure 2 Sago palm planted area in 2023. Sources: DOA

Table 1 Sago performance by division. Source: DOA

Year		2022		2023	
Division	District	Planted Area (ha)	Production (Tonnes)	Planted Area (ha)	Production (Tonnes)
Sabah					
West coast	Papar	35	-	35	-
Interior	Beaufort	252	1024	252	975
	Kuala Penyu	285	1177	285	1125
Total		572	2201	572	2100
Sarawak					
Sibu	Sibu	402	295	402	295
	Kanowit	10	-	10	-
	Selangau	740	574.1	740	574.1
Sarikei	Sarikei	50	-	50	-
	Meradong	1694.2	1911.6	1530	682.8
Mukah	Mukah	8148.6	7121.5	5014.6	5903.5
	Dalat	14611	81990.6	14066.5	83078
	Daro	364.5	207.2	349.5	207.2
	Matu	4425	6699.5	4190	6372
Betong	Betong/Saribas	1286.5	1687.3	1286.5	478.6
	Pusa	608.8	2849.6	608	2847.3
	Kabong	402.5	21	446.1	14.2
Total		32743.1	103357.4	28693.2	100452.7



Figure 3 A sago palm tree growth stages

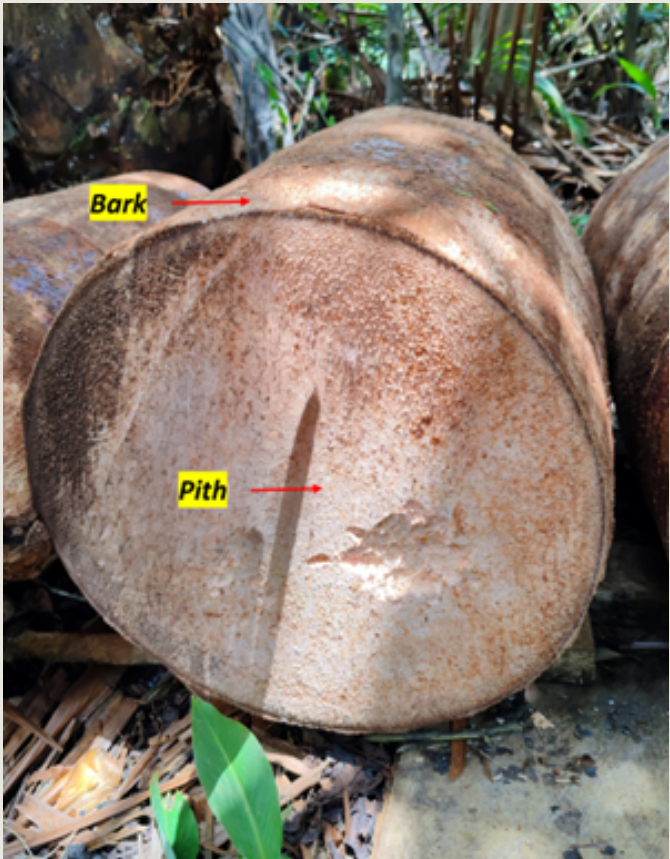


Figure 4 Sago log



Figure 5(a) Sago starch, Figure 5(b) Sago Snack, Figure 5(c) Linut/Ambuyat.

Conclusion

Sago is one of the major agricultural crops that contribute to Sarawak revenue. As a result, the Sarawak government has supported extensive research on the sago palm tree. The research not only focused on upstream activities but also on downstream activities that can enhance various aspects of food security, sustainability and industrial applications.

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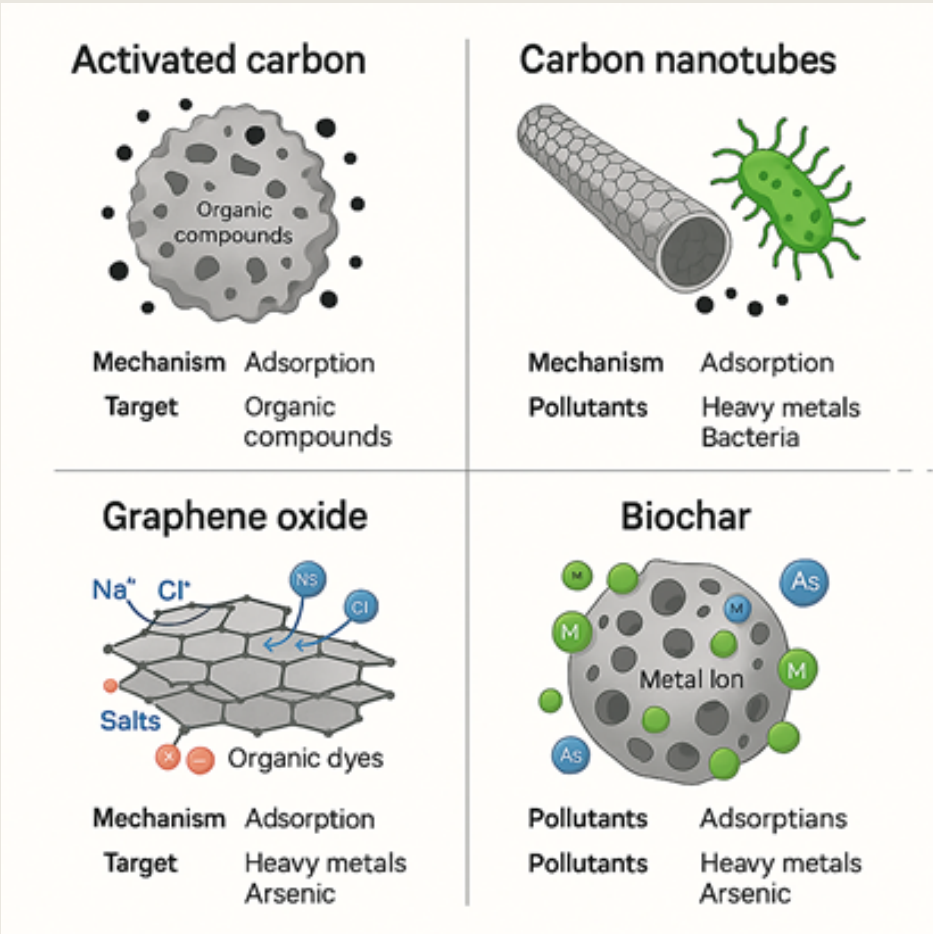
Innovative Carbon-Based Materials for Sustainable Drinking Water Treatment

Azrul Nurfaiz Mohd Faizal
Institute of Ecosystem Science Borneo (IEB), Universiti Putra Malaysia Sarawak.
97008 Bintulu, Sarawak, Malaysia.

azrulnurfaiz@upm.edu.my

Introduction

Access to clean drinking water is a fundamental human right, yet global challenges such as industrial pollution, population growth, and emerging contaminants continue to threaten water quality. In recent years, carbon-based materials and composites have emerged as promising candidates in drinking water treatment technologies. Their high surface area, porosity, and customizable surface chemistry enable the removal of a wide spectrum of pollutants, from heavy metals to organic compounds and pathogens. This article explores various types of carbon-based materials including activated carbon, carbon nanotubes, graphene oxides, biochar, and advanced composites for their roles in purifying drinking water.



Key Discussions

Activated Carbon

Activated carbon (AC) is a widely used material due to its high surface area and porosity, enabling effective adsorption of pesticides, pharmaceuticals, natural organic matter, and volatile organic compounds (VOCs). Its applications extend from household filters to large-scale municipal systems, with the added advantage of regeneration and reuse.

Table 1. The use of activated carbon for drinking water treatment

Precursor	Activator	Pollutant	Maximum adsorption	Reference
Sugarcane bagasse	ZnCl ₂	Sodium diclofenac	315	Abo El Naga et al., 2019
Rice husk	NH ₄ Br	Hg	769	Zeng et al., 2023
Pistachio wood	NH ₄ NO ₃ and NaOH	Pb ²⁺	190	Sajjadi et al., 2019

Carbon Nanotubes (CNTs)

CNTs possess nanostructured tubes with high chemical stability and adsorption potential for heavy metals, hydrophobic compounds, and persistent organic pollutants. They also serve as nano catalysts and antimicrobial agents, with increasing application in filtration membranes.

Table 2. The use of carbon nanotubes for the disinfection of water

Type	Microorganism	Parameters	Outcomes	Reference
SWCNTs-OH; SWCNTs-COOH	<i>P. denitrificans</i>	50 mg/L	Disruption of genes involved in membrane and metabolism	Zheng et al., 2018
ZnO + MWCNT	<i>E. coli</i>	0.5 mg/mL	Complete bacterial elimination	Haider et al., 2018
MCNTs/RP/CN composite	<i>S. aureus</i>	CN/RP:MCNT = 4:1, ~10 ⁷ CFU/mL	13.9x higher disinfection than commercial TiO ₂ catalyst	Yang et al., 2023

Graphene Oxides (GOs)

GOs exhibit strong binding capabilities for heavy metals and pharmaceuticals. Functionalization increases their affinity for specific contaminants, while integration into membranes improves salt rejection and permeability.

Table 3. GO-based membrane performance in water purification

Membrane	Permeance (L m ⁻² h ⁻¹ bar ⁻¹)	Pollutants	Rejection (%)	Reference
GO/Gr	12.8 ~ 20	Na ₂ SO ₄	78.3	Zhang et al., 2022
ZIF-67/cGO-HFMs	346.4 ± 11.2	Cu ²⁺ , Pb ²⁺	94.5, 97.8	Modi & Bellare, 2020
SGO@UiO-66TFN	14	Cu ²⁺ , Pb ²⁺	99.4, 99.4	He et al., 2020

Biochar

Derived from biomass pyrolysis, biochar serves as a sustainable alternative for removing heavy metals, antibiotics, and microplastics. Its tunable surface chemistry can be enhanced through doping or functionalization.

Table 4. Use of biochar in drinking water treatment

Precursor	Temp (°C)	Pollutant	Max Adsorption (mg/g)	Reference
Prosopis juliflora	550–850	Microplastics	>200	Wang et al., 2021
Spent mushroom	200–600	Progesterone	80%	Vieira et al., 2022
Wheat straw	700	Tetracycline	268.3	Li et al., 2020

Metal-Oxide Biochar

By incorporating metal oxides such as Fe, Mn, Ti, and Ce, biochar gains catalytic and antibacterial capabilities. It becomes suitable for both adsorption and advanced oxidation processes.

Table 5. Adsorption performance of biochar-metal composites

Biomass	Modifier	Adsorbate	Capacity (mg/g)	Removal (%)	Reference
Peanut hull	Zero valent iron	Cr (VI)	223	100	Liu et al., 2019
Rice husk	Hydroxyapatite	Pb ²⁺	110	99.5	Wu et al., 2022
Lufa fiber	MnO ₂	U (VI)	904	100	Ioannou et al., 2019

MXene-Polymer Composites

MXenes, with unique conductivity and reactivity, offer outstanding removal of metals and pathogens. Their polymer composites show promise in nanofiltration, catalysis, and sensor applications.

Table 6. MXene-polymer composites for heavy metal removal

Composite	Pollutant	Mechanism	Capacity (mg/g)	Reference
Polyethyleneimine@MXene	Cr ⁶⁺	H-bonding, reduction	1240	Li et al., 2023
Chitin/MXene/poly(L-arginine)	Bilirubin	Chemisorption, multilayer adsorption	596	Yao et al., 2023
Polydopamine/MXene	Cr ⁶⁺	Electrostatic, reduction	862	Qing et al., 2023

Carbon Dots (CDs)

CDs are emerging materials that degrade organic pollutants under visible light and exhibit antimicrobial and sensing properties. Their eco-friendly synthesis and multifunctionality make them ideal for future water purification systems.

Table 7. Carbon dot composites for metal adsorption

Adsorbent Type	Precursor	Pollutant	Max Adsorption (mg/g)	Reference
Magnetic k-carrageenan-N-	<i>A. gossypinus</i> , EDA	Cu ²⁺ , Cd ²⁺ , Pb ²⁺ , Hg ²⁺	115–120	Rahmani et al., 2022
MOF/CD	CMC	U ⁶⁺	606	Guo et al., 2019
MnFe ₂ O ₄ /CD nanocomposite	Citric acid, PEI	U ⁶⁺	194	Huang et al., 2019

Conclusion

Carbon-based materials and composites offer transformative solutions for drinking water treatment, addressing a wide range of contaminants through adsorption, catalysis, and disinfection. As research advances, hybrid materials and functionalized composites will continue to enhance performance and sustainability. The integration of these materials into scalable systems particularly in low-resource or rural settings will be crucial in achieving global water security goals.

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From Waste to Resource: The Role of *Nypa fruticans* Fibre in Advancing Composite Industry

Raymond Lubun Tinsang¹

Nor Hanifawati bt Inai^{1,2*}

¹Department of Science and Technology, Faculty of Humanities, Management and Sciences, Universiti Putra Malaysia Sarawak, Nyabau Road, 97008 Bintulu, Sarawak, Malaysia

²Institute of Ecosystem Science Borneo, Universiti Putra Malaysia Sarawak, Nyabau Road, 97008 Bintulu, Sarawak, Malaysia

hanifawati@upm.edu.my

Introduction

In recent years, the demand for sustainable materials has increased globally as industries and educational institutions seek innovative alternatives to conventional resources. In Malaysia, particularly in Sarawak, the abundance of natural resources has created opportunities to explore eco-friendly solutions that align with both environmental conservation and industrial advancement. One such potential lies in the utilization of *Nypa fruticans* a mangrove palm species widely found along Sarawak coastal and riverine areas.

Traditionally regarded as a source of food, handicrafts, and fuel, the fibrous waste of *Nypa fruticans* has often been overlooked, leading to underutilization of this valuable biomass. (a) demonstrates *Nypa* fibres that have been reduced in size according to the suitability of the experiment, while (b) and (c) show the fibres in their original thread-like form within the fruit.

As shown in Figure 1, *Nypa fruticans* wurmb.



FIGURE 1: NYPA FRUTICANS WURMB (FIBRE AND PARTICLE)

Nypa fruticans fibre can be processed and applied as a composite material. It can break down into fibre extraction and preparation, composite manufacturing processes and industrial applications. Figure 2 shows the flow chart of Nypa fruticans in process into composite and its application in industry.

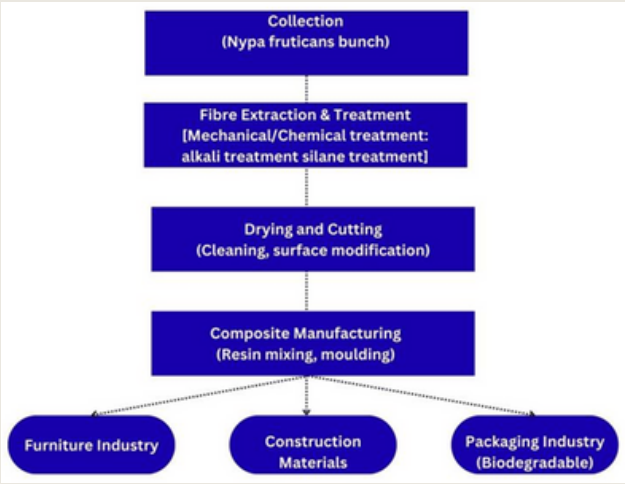


FIGURE 2: NYPA FRUTICANS FIBRE IS PROCESSED INTO COMPOSITES AND ITS APPLICATIONS IN INDUSTRY

Unlike petroleum-based synthetic fibres examples glass fibre, carbon fibre, Nypa fruticans fibre is renewable, biodegradable and eco-friendly. Its natural lignocellulosic composition (cellulose, hemicellulose, lignin) allows it to decompose safely at the end of its life cycle. This aligns with circular economy practices in Malaysia agricultural sector (Khor. et. al. 2021). Fibre extraction and processing are relatively low-energy compared to producing synthetic fibres. Using local Nypa waste reduces the need for importing raw materials, lowering transportation-related carbon emissions.

This supports Malaysia's commitment to carbon reduction and green economy initiatives. Provides income opportunities for rural communities by turning unused agricultural residues into marketable products. Integrates into educational programs, training students in green materials science and sustainable entrepreneurship. This promotes local empowerment while supporting industrial development. When reinforced into composites, *Nypa fruticans* fibre can replace timber and plastics in furniture, construction, and packaging. Reduces reliance on non-renewable materials like hardwood or petroleum plastics.

In composite manufacturing, *Nypa fruticans* fibres can be processed, treated, and combined with polymer matrices such as polypropylene, polyethylene, pvc or biodegradable polymers like polylactic acid (PLA) and thermoplastic starch (TPS), which offer sustainable alternatives for bio-composite production (Rasidi et. al 2015). This integration improves mechanical properties such as tensile strength, stiffness, and impact resistance while enhancing biodegradability compared to conventional synthetic composites (Mishra et. al. 2023). Potential applications include furniture production, packaging materials, automotive components, and building panels, aligning with Sarawak's aspiration to promote green industries and sustainable economic growth.

By converting agricultural waste into industrial raw material, *Nypa fruticans* fibre utilization not only minimizes environmental impact but also supports Malaysia's circular economy and carbon reduction goals. The development of nypa based composites can strengthen Sarawak's position as a hub for sustainable material innovation, benefiting both industry and local communities.

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In 2025, the Institute of Ecosystem Science Borneo (IEB) successfully organised a series of 10 webinars as part of its strategic commitment to advancing research excellence and strengthening stakeholder engagement. Each session was carefully curated in alignment with IEB's mission to promote evidence-based insights, support informed decision-making, and enhance community well-being. Featuring distinguished experts from diverse fields, the webinars provided valuable perspectives on emerging environmental and societal issues while fostering cross-sector collaboration. These initiatives reflect IEB's ongoing dedication to delivering impactful research and contributing to sustainable development at national, regional, and international levels.

SPEAKER 1
TS. DR. AHMAD HAZIM ABDUL AZIZ
UNIVERSITI MALAYSIA SABAH (UMS)

SPEAKER 2
IR. DR. NICKY RAHMANA PUTRA
NATIONAL RESEARCH AND INNOVATION AGENCY INDONESIA (BRIN)

MODERATOR
TS. CHM. DR. AZRUL NURFAIZ MOHD FAIZAL
UNIVERSITI PUTRA MALAYSIA KAMPUS BINTULU (UPMKB)

UPM PUTRA
PERTANIAN UNTUK RAKYAT

INSTITUT EKOSAINS BORNEO, UPMKB
INSTITUTE OF ECOSYSTEM SCIENCE BORNEO

GREEN EXTRACTION: TOWARDS ZERO-WASTE AND SUSTAINABLE SOLUTIONS

29 April 2025 (Tuesday)
10.00 am - 12.00 pm

ZOOM Meeting
Meeting ID: 973 4680 2166
Passcode: upmkb2025

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CLIMATE CHANGE AND FOREST CARBON INITIATIVES IN SARAWAK

21 MAY 2025, WEDNESDAY
9:00AM

OFFLINE LOCATION
Smart Classroom, Level 2, INFOCOMM Development Centre Building UPMKB

ONLINE VIA ZOOM
(Link will be provided upon registration)

REGISTER NOW

SCAN ME

SPEAKER
DR. MALCOM DEMIES
Research Officer
Carbon Unit
Planning and Management Division
Forest Department Sarawak

MODERATOR
ZAHORA ISMAIL
Research Officer
Biodiversity Borneo Laboratory
Institute of Ecosystem Science Borneo
UPM Bintulu Campus

Upon successful participation, you will receive:

- E-certificate
- CPD Points (UPM Staff)

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GENEBANKS AND AGROBIODIVERSITY: FOUNDATIONS FOR SUSTAINABLE AGRICULTURE AND CLIMATE CHANGE ADAPTATION

17 June, 2025 [Tuesday]
9:00AM

The link will be provided upon registration!

REGISTER NOW!

SCAN ME

SPEAKER
DR. MOHD NORFAIZAL GHAZALLI
Deputy Director
Agrobiodiversity and Environment Research Centre
Malaysian Agricultural Research and Development Institute (MARDI)

MODERATOR
ZAHORA BINTI ISMAIL
Research officer
Biodiversity Borneo Laboratory
Institute of Ecosystem Science Borneo UPMKB

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From Ecosystems to Communities: Building Climate Resilience for a Sustainable Future

WHAT YOU WILL LEARN:

- ✓ PROVEN WAYS COMMUNITIES CAN BUILD CLIMATE RESILIENCE
- ✓ HOW WOMEN AND YOUTH CAN DRIVE AGRICULTURAL INNOVATION
- ✓ STRATEGIES FOR FOOD SYSTEMS AND CLIMATE-SMART AGRICULTURE
- ✓ LIVE Q&A WITH CHRISTINE — ASK YOUR QUESTIONS!

**TUESDAY
13 MAY, 2025**

**TIME
10:00AM**

CHRISTINE JODLOMAN
Director of Community Development and Programs, AGREA Foundation
Global Ambassador, NextGen Agriculture Impact Network

SHARON ONG YONG YEE (DR.)
Moderator
University Putra Malaysia
Bintulu Sarawak Campus

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IEB Talk Session 5

Title: CO₂ Capture, Utilisation and Storage (CCUS) Technology in Construction Materials

Detail Information:

- 18 JULY 2025**
- 2:30PM - 4.00PM**
- ZOOM ONLINE**

REGISTER NOW!

Invited Speaker
DR. NUR HAFIZAH ABD KHALID
UNIVERSITI TEKNOLOGI MALAYSIA

Moderator
TS. DR. MUHAMMAD HUZAFHA MOHD ROSLIM
INSTITUTE OF ECOSYSTEM SCIENCE BORNEO
UNIVERSITI PUTRA MALAYSIA SARAWAK

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IEB TALK SESSION 6: CARBON MAPPING AND MONITORING: GEOSPATIAL TOOLS FOR FOREST-BASED CLIMATE MITIGATION

This topic will cover the application of LiDAR, satellite data, and GIS in estimating forest carbon stocks and monitoring changes for REDD+ initiatives and carbon credit schemes.

29 July, 2025
9:00 am - 10:30 am

Online

Gs. Dr. Hamdan Omar
Senior Research Officer, FRIM

MODERATOR
Ts. Gs. Dr. Wan Nor Zanariah Zainol @ Abdullah

Scan here for zoom link

ZOOM LINK

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IEB TALK SESSION 7 AGRICULTURAL MECHANIZATION AND AUTOMATION IN MALAYSIA (CURRENT STAGE AND WAY FORWARD)

To discover how modern technology is transforming Malaysia's agriculture landscape. Gain insights on national and Sarawak state policies, innovations, and the path towards sustainable and smart farming

11 August 2025
9:00am - 10:30am

ZOOM online meeting
Meeting ID: 910 5296 0617
Passcode: upms2025

Mr. Chong Seng Kiet
Senior Principal Assistant Director
Agricultural Engineering Division
Department of Agriculture
Ministry of Agriculture and Food Security Malaysia

Dr. Nor Hanifawati Inai
Moderator
Institute of Ecosystem Science Borneo
UPM Sarawak

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BLUE TO GREEN SOLUTIONS: MICROPLASTICS, BIOFILMS & FOOD SYSTEM SUSTAINABILITY

IEB TALK SESSION 8



Dr. Natália Čeryová
Assistant Professor
Slovak University of Agriculture, Nitra



Dr. Florence Jong Mui Choo
Assistant Professor
Tsinghua Shenzhen International Graduate School, China



MODERATOR
ChM. Dr. Alvin Lim Teik Zheng
Institute of Ecosystem Science Borneo (IEB)
Universiti Putra Malaysia Sarawak



Register Here

Date
18 September 2025

Time
2:30pm - 4:30pm

Zoom Online Meeting



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Laboratory Safety and Risk Assessment – Building a Safe Work Environment

Knowledge Sharing Programme

IEB TALK SESSION 9



Guest Speaker
Ts. ChM. Fera Shima
Managing Director
Quinz Industrial Hygiene Consultancy & Services

14th October 2025 (Tuesday)

9:30 AM - 12:30 PM

Putra Smart Classroom
(Hybrid: Physical & Online Modes)

Register Here



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EMERGING BIOMASS-DERIVED ADVANCED MATERIALS FROM ENGINEERED PARTICLEBOARD OPTIMIZATION TO MILITARY-GRADE NANOCELLULOSE STRUCTURES

IEB TALK Session 10



DR. MOHD NOR FAIZ NORRAHMAN
Research Officer,
Research specialisation:
Nanotechnology, composites, and polymers
National Defence University of Malaysia



PROF. DR ROMAN REH
Professor,
Research specialisation:
Wood composites
Technical University in Zvolen, Slovakia



MODERATOR
Dr. Syed Saifulakary Osman Al-Kadus
Institute of Ecosystem Science Borneo (IEB)
Universiti Putra Malaysia Sarawak

DATE: 14 NOVEMBER 2025
TIME: 2.30PM-4.30PM
MODE: ZOOM ONLINE MEETING

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Mainly organized by:

UPM PUTRA INSTITUTE KEDAHANG

In collaboration with:

Faculty of Agricultural and Forestry Sciences UPMs
Student Management Office UPMs
INFOCOMM Development Centre UPMs

LiDAR TECHNOLOGY WORKSHOP

11-15 August 2025
PUTRA Smart Classroom, Level 2, INFOCOMM Development Centre Building UPM Sarawak

WORKSHOP HIGHLIGHTS:

- **Objective:** To develop a standardized field protocol for forest carbon stock assessment utilizing UAV-based LiDAR system and mobile SLAM technology in alignment with established geospatial data standards.
- **Expected output:** A draft guideline will be produced.
- **Expected outcome:** To enhance the technical capacity among personnel in the operating and applying LiDAR equipment.

For inquiries, contact:
zahora_l@upm.edu.my (IEB, UPMs)
malcoma@sarawak.gov.my (FDS)

4 years 13 years 16 years

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Towards Zero Food Waste in Bintulu Collaborating with stakeholders for solution 18-19 Februari 2025

xxx



IEB menganjurkan Program Towards Zero Food Waste in Bintulu bermatlamat meningkatkan kesedaran dalam kalangan pengusaha makanan mengenai pengurusan sisa makanan secara mampan

Lembaga kenaf dan Tembakau Negara: Pejabat wilayah dan Pusat R&D LKTN Kenaf Rantau Borneo

xxx



Nilai faedah kepada UPM di
anggarkan sekitar > RM 1.5 juta
(termasuk sewaan dan kemudahan pembangunan
fasiliti, plot tanaman, R&D, jentera dan peralatan
makmal)



Kunjungan Hormat
Delegasi LKTN

Tokyo NODAI-UPMKB "Borneo Mangrove Exploration Student Inbound Program 2025"



IEB dengan kerjasama Universiti Pertanian Tokyo (Tokyo-NODAI) menganjurkan Tokyo NODAI-UPMKB "Borneo Mangrove Exploration Student Inbound Program 2025"

UPMKB-Tokyo NODAI sepakat pulihara ekosistem unik bakau

Kerjasama pertahan khazanah alam di Sarawak, selain perkukuh hubungan akademik

Oleh Noor Eszreen Juferi
bipexidikan@ibb.com.my

Bintulu: Institut Ekosains Borneo (IEB), Universiti Putra Malaysia Kampus Bintulu Sarawak (UPMKB) dengan kerjasama Universiti Pertanian Tokyo (Tokyo NODAI) menganjurkan Tokyo NODAI-UPMKB "Borneo Mangrove Exploration Student Inbound Program 2025" bagi memperkukuhkan kerjasama pemuliharaan bakau di Sarawak.

Program yang berlangsung di

Kuala Sibuti, Sarawak, menghimpunkan 10 ahli dari Kelab Penyelidikan Bakau Tokyo NODAI untuk mengkaji dan mengalami sendiri ekosistem bakau di Borneo.

Pengarah Program, Dr. Keeren Sundara Rajoo, berkata kerjasama antarabangsa seperti ini penting dalam memelihara ekosistem unik Borneo, selain memperkukuh hubungan akademik antara UPMKB dan Tokyo NODAI.

"Inisiatif seperti ini bukan sahaja memberi manfaat kepada pelajar tetapi juga menyumbang kepada usaha pemuliharaan ekosistem bakau yang kritikal bagi kesejahteraan alam sekitar dan kelestarian biodiversiti," katanya.

Beri pendedahan
Sementara itu, Pengarah IEB, UPMKB, Dr. Syed Saifuzzar Osman Al-Edrus, berkata program ini bertujuan memberikan pendedahan kepada peserta mengenai kepentingan ekosistem bakau dan usaha pemuliharaannya.

"Melalui program ini peserta



Keeren Sundara (tiga dari kiri belakang) bersama peserta Tokyo NODAI-UPMKB Borneo Mangrove Exploration Student Inbound Program 2025.

dapat memahami secara langsung kepelbagaian biologi bakau di Sarawak serta cabaran pemuliharaanannya. Kajian lapangan ini juga membolehkan mereka memperoleh pengalaman praktikal dalam usaha konservasi.

"Kerjasama ini juga bukan saja memperkukuh pemahaman pela-

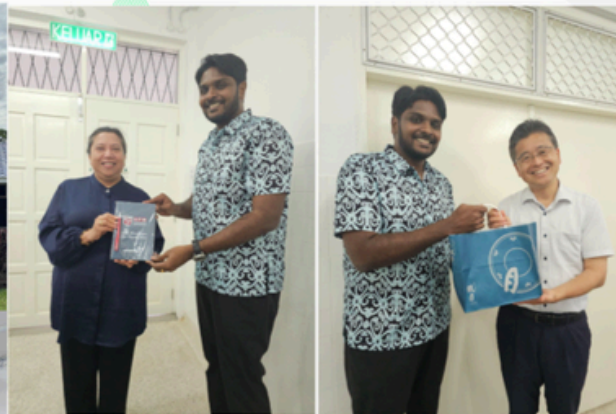
jar mengenai pemuliharaan bakau, malah kami dalam memupuk pertukaran akademik antarabangsa ke arah kelestarian alam sekitar," katanya.

Pelajar jurusan perhutanan dari Tokyo NODAI, Naoki Kato, berkata program ini memberinya pengalaman pertama meneroka

ekosistem bakau di Borneo dan memperkukuhkan pemahaman dalam bidang perhutanan.

"Saya berharap program ini dapat dijadikan sebagai inisiatif tahunan untuk kelas kami dalam memberi lebih banyak peluang kepada pelajar untuk menjalankan penyelidikan," katanya.

Lawatan Rombongan KEAA, IRDA dan MBBJ KE IEB UPMS



Lawatan rombongan KEAA, Iskandar Regional Development Authority (IRDA), dan Majlis Bandaraya Johor Bahru (MBJB) pada 17 Jun 2025. Lawatan ini bertujuan untuk melihat status projek kolaborasi bersama BDA serta lain-lain usaha kelestarian yang turut dijalankan disamping bertukar pendapat dalam memahami isu berkaitan alam sekitar di Bintulu.

KUNJUNGAN HORMAT KE AGENSI ANGKASA MALAYSIA (MYSA)



Kunjungan hormat ke Agensi Angkasa Malaysia (MYSA) pada 8 Julai 2025 di Ibu Pejabat MYSA, Kuala Lumpur. Fokus perbincangan tertumpu kepada potensi kerjasama dalam bidang penyelidikan, pembangunan aplikasi dan pemantauan sumber asli menerusi penggunaan teknologi angkasa.



Projek Pendayaan Komuniti Universiti Awam (Komuniti@UniMADANI)



xxx

Geran Komuniti@UniMadani yang terdiri daripada rakan kerjasama strategik dari Fakulti Sains Pertanian dan Perhutanan UPM Sarawak, Institut EkoSains Borneo UPM Sarawak, Fakulti Kejuruteraan UPM Serdang dan National Institutes of Biotechnology Malaysia (NIBM), Serdang



xxxx

Jom Masuk U (JMU 2025)



Jom Masuk U 2025 Zon Sarawak 1 telah berlangsung pada 26-27 April 2025 di Boulevard Shopping Mall Bintulu Sarawak.



Program ECF2025: RHISS @ IEB-UPMS – Exploring Climate Futures: A Journey into Environmental Innovation.



The Borneo Ecoscience Institute (IEB), Universiti Putra Malaysia Sarawak (UPMS), recently hosted ECF2025: RHISS @ IEB-UPMS – Exploring Climate Futures: A Journey into Environmental Innovation, which welcomed 54 students and six teachers from Riam Hill International Secondary School (RHISS), Miri.

Led by Ts. ChM. Dr. Azrul Nurfaiz Mohd Faizal, the programme introduced students to the role of science, technology, and innovation in addressing climate change and sustainable development. The opening ceremony, officiated by IEB Director YBrs. Dr. Syeed Saifulazry Al-Edrus, highlighted the importance of climate education and green technology in nurturing environmentally aware future leaders.

Across three campus venues, students took part in hands-on workshops ranging from GPS mapping and climate-conscious fashion, to making soap from waste oil, starch-based polymers, and synthetic nylon. The sessions were facilitated by UPMS lecturers and further supported by a dedicated team of postgraduate and undergraduate student facilitators from UPMS, who shared their knowledge and experiences with the visiting RHISS students.

A variety of interactive and hands-on activities were conducted across three locations within the campus, providing students with a holistic learning experience:

Lecture Hall Centre 2B

GPS Data Collection – “Mark & Find Location” using handheld GPS, conducted by Ts. Gs. Dr. Wan Nor Zanariah Zainol @ Abdullah

From Closet to Climate: The Hidden Impact of What We Wear by Dr. Sharon Ong Yong Yee



Soil Mechanics Laboratory

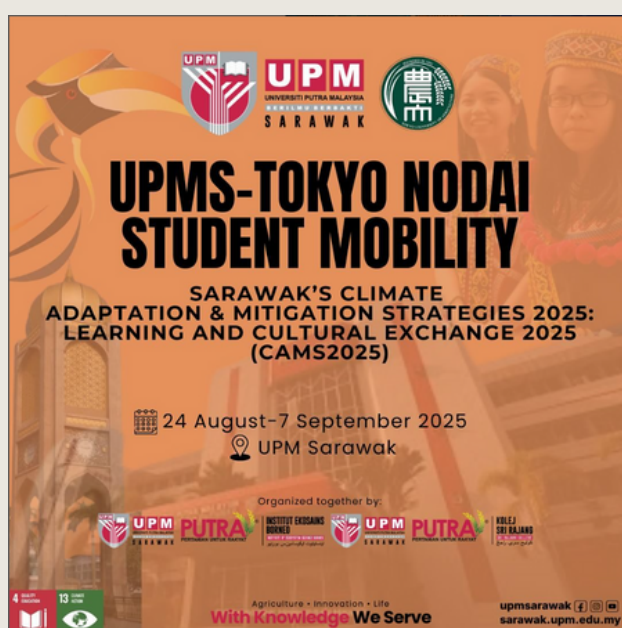
Making Soap from Waste Cooking Oil by Ts. ChM. Dr. Azrul Nurfaiz Mohd Faizal
Polymer from Starch by Dr. Hanifawati Inai



Physical Chemistry Laboratory

Determination of Functional Groups by ChM. Dr. Alvin Lim Teik Zheng
Nylon Synthesis – Making Synthetic Polymers by ChM. Dr. Sivasangar Seenivasagam





CAMS2025: Strengthening International Collaboration with Tokyo NODAI

IEB aims to strengthen international academic collaboration by engaging 18 students and 2 staff members from Tokyo NODAI in an intensive two-week programme from 24 August to 7 September 2025. CAMS2025 will combine academic sessions, research discussions, and hands-on community engagement to deepen understanding of climate change adaptation and mitigation in Sarawak's local context.

At the same time, IEB will use this platform to showcase Sarawak's cultural richness, offering participants immersive experiences that connect environmental knowledge with heritage and tradition. By positioning climate science within a cultural and community framework, IEB seeks to inspire future leaders who are both globally connected and locally grounded. CAMS2025 reinforces IEB's commitment to advancing impactful research, fostering global partnerships, and shaping resilient strategies for a sustainable future.





The Economics of Climate Change by Dr. Adrian Daud



Biochar for Dye Removal in Water by Ts. ChM. Dr. Azrul Nurfaiz Mohd Faizal



Educational Visit to Local Market



Educational Visit to Local Market



Educational Visit to Local Market



Educational Visit to Sarawak Agrofest 2025



Photodegradation of Antibiotic Pollutants by Dr. Alvin Lim Teik Zheng



Sarawak's Climate Strategies & Role of IEB, UPM, and Tokyo NODAI by Director of IEB, Dr. Syeed Saiful Azry Osman Al-edrus



Climate Entrepreneurship from Lab to Community by Dr. Sharon Yong Yee, Ong



Plant Usages in Sarawakian Communities by Mr. Philip Lepun



Biochar in Biogas and Biodiesel Production by Ts. Dr. Nozieana Binti Khairuddin



Carbon Stock in Forest Tree Seedlings & Climate Mitigation by Ts. Gs. Dr. Wan Nor Zanariah Zainol @ Abdullah



Educational Visit Taman Tumbina



MOF Catalysts in Biomass Conversion by ChM. Dr. Sivasangar Seenivasagam



Carbon Stock in Forest Tree Seedlings & Climate Mitigation by Ts. Gs. Dr. Wan Nor Zanariah Zainol @ Abdullah



Presentation by a Tokyo NODAI student during CAMS2025 at UPM Sarawak.



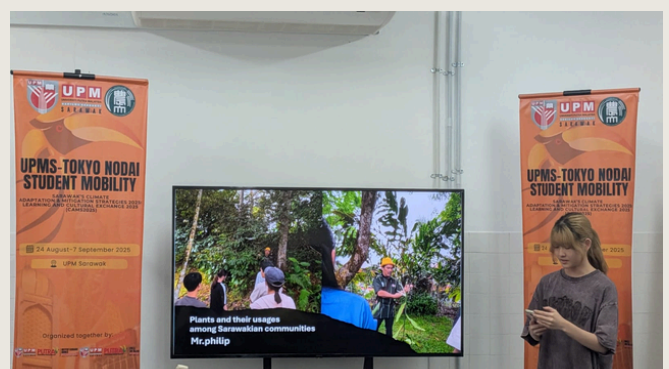
Reading Climate Change Through Plant Pathogens by Dr. Anysia Hedy



Presentation by a Tokyo NODAI student during CAMS2025 at UPM Sarawak.



A warm send-off from Dr. Kereen to Tokyo NODAI team



Presentation by a Tokyo NODAI student during CAMS2025 at UPM Sarawak.

Usaha kerajaan teroka potensi karbon hutan mampu tangani perubahan iklim

BINTULU: Pemeliharaan hutan merupakan penyumbang kepada kelestarian iklim global sekali gus usaha Kerajaan Sarawak meneroka potensi karbon hutan sebagai sumber ekonomi dan pemuliharaan alam semula jadinya mampu menangani cabaran perubahan iklim.

Pengarah Institut Ekosains Borneo (IEB) Universiti Putra Malaysia (UPM) Kampus Bintulu Dr Syeed Saifulazry Osman Al Edrus berkata, adalah penting program-program yang dapat membina jaringan profesional diadakan, sekaligus meningkatkan kesedaran berkaitan pemeliharaan hutan sebagai penyumbang kepada kelestarian iklim global.

Katanya, program 'Inisiatif Perubahan Iklim dan Karbon Hutan di Sarawak' bukan sahaja bertujuan untuk menyampaikan maklumat ilmiah, tetapi juga membawa harapan besar ke arah masa depan yang lebih lestari.

"Ia memberi pendedahan kepada peserta tentang usaha Kerajaan Sarawak dalam meneroka potensi karbon hutan sebagai sumber ekonomi dan pemuliharaan alam semula jadi, sekali gus merintis kerjasama strategik merentas agensi dan sektor bagi menangani cabaran perubahan iklim," ujarnya.

Beliau berkata demikian pada perasmian program 'Inisiatif Perubahan Iklim dan Karbon Hutan di Sarawak' secara hibrid dalam talian dan bersemuka di UPMKB



BINCANG: Dr Malcom (kiri) Dr Syeed Saifulazry (dua kanan), Dr Keeren (kanan) dan Zahora (dua kiri) semasa mengadakan perbincangan bersama program diadakan.

di sini, baru-baru ini.

Program tersebut disertai 95 peserta dari pelbagai agensi, syarikat dan institusi pendidikan dalam dan luar Sarawak, terdiri daripada Jabatan Perhutanan Sabah, Jabatan Hutan Sarawak, UPM, Universiti Malaysia Sabah (UMS), Universiti Malaysia Sarawak (UNIMAS), Universiti Teknologi MARA (UiTM), Tunku Abdul Rahman University of Management and Technology (TAR UMT), Lembaga Sumber Asli dan Alam Sekitar (NREB) Sarawak.

Seterusnya Syarikat Samling, Sarawak Forestry Corporation (SFC), Perbadanan Kemajuan Perusahaan Kayu Sarawak (PUSAKA), Lembaga Minyak Sawit Malaysia (MPOB), Envisar Sdn Bhd, SaraCarbon, South East Carbon, Worldview Climate Solutions (Sarawak), GE-

Sinohydro Consortium dan lain-lain.

Ceramah berkaitan disampaikan oleh Pegawai Penyelidik Jabatan Hutan Sarawak Dr Malcom Demies serta turut dihadiri Ketua Laboratori Biodiversiti Borneo IEB Dr Keeren Sundara Rajoo dan moderatornya Pegawai Penyelidik Laboratori Biodiversiti Borneo IEB Zahora Ismail.

Dr Syeed Saifulazry berkata, kehadiran peserta dari pelbagai latar belakang dan agensi membuktikan isu perubahan iklim dan pemeliharaan hutan kini menjadi tanggungjawab bersama yang memerlukan tindakan kolektif dan kerjasama rentas sektor.

Justeru katanya, pihak penganjur berharap program itu dapat menjadi pemangkin kepada kerjasama strategik antara agensi kerajaan, insti-

tusi akademik, industri dan organisasi bukan kerajaan.

Ujarnya, melalui perkongsian ilmu dan pengalaman diharap lebih banyak kerjasama terjalin dalam merangka dan melaksanakan inisiatif berimpak tinggi yang menyokong agenda pembangunan lestari khususnya dalam bidang karbon hutan dan pemuliharaan biodiversiti.

Beliau berharap agar program itu dapat merangsang lebih banyak penyelidikan dan inovasi dalam bidang sains alam sekitar serta memperkukuh jaringan profesional dalam kalangan pengamal, penyelidik dan pembuat dasar.

Menurutnya, sinergi ini juga akan membentuk asas kukuh untuk menangani bersama cabaran perubahan iklim yang semakin mende-

UPMKB-Tokyo NODAI sepakat pulihara ekosistem unik bakau

Kerjasama pertahan khazanah alam di Sarawak, selain perkukuh hubungan akademik

Oleh Noor Eszreen Jufri
bipenditikan@fb.com.my

Bintulu: Institut Ekosains Borneo (IEB) Universiti Putra Malaysia Kampus Bintulu Sarawak (UPMKB) dengan kerjasama Universiti Pertanian Tokyo (Tokyo NODAI) mengajarkan Tokyo NODAI-UPMKB 'Borneo Mangrove Exploration Student Inbound Program 2025' bagi memperkukuh kerjasama pemuliharaan bakau di Sarawak.

Program yang berlangsung di

Kuala Sibiti, Sarawak, menghimpunkan 10 ahli dari Kelab Penyelidikan Bakau Tokyo NODAI untuk mengkaji dan memahami sendiri ekosistem bakau di Borneo.

Pengarah Program, Dr Keeren Sundara Rajoo, berkata kerjasama antarabangsa seperti ini penting dalam memelihara ekosistem unik Borneo, selain memperkukuh hubungan akademik antara UPMKB dan Tokyo NODAI.

"Inisiatif seperti ini bukan sahaja memberi manfaat kepada pelajar tetapi juga menyumbang kepada usaha pemuliharaan ekosistem bakau yang kritikal bagi keseimbangan alam sekitar dan kelestarian biodiversiti," katanya.

Beri pendedahan
Sementara itu, Pengarah IEB, UPMKB, Dr Syeed Saifulazry Osman Al Edrus, berkata program ini bertujuan memberikan pendedahan kepada peserta mengenai kepentingan ekosistem bakau dan usaha pemuliharaan.

"Melalui program ini peserta



Keeren Sundara (tiga dari kiri belakang) bersama peserta 'Tokyo NODAI-UPMKB Borneo Mangrove Exploration Student Inbound Program 2025'.

dapat memahami secara langsung kepelbagaian biologi bakau di Sarawak serta cakaran pemuliharaan. Kajian lapangan ini juga membolehkan mereka memperoleh pengalaman praktikal dalam usaha konservasi.

"Kerjasama ini juga bukan saja memperkukuh pemahaman pelajar mengenai pemuliharaan bakau, malah kami dalam memupuk pertukaran akademik antarabangsa ke arah kelestarian alam sekitar," katanya.

Pelajar jurusan perhutanan dari Tokyo NODAI, Naoki Kato, berkata program ini memberinya pengalaman pertama meneroka ekosistem bakau di Borneo dan memperkukuh pemahaman dalam bidang perhutanan.

"Saya berharap program ini dapat dijadikan sebagai inisiatif tahunan untuk kami dalam memberi lebih banyak peluang kepada pelajar untuk menjalankan penyelidikan," katanya.

RTK, LiDAR taskforce deployed at UPMKB for post-flood mapping

BINTULU: The Public Works Department (JKR) has initiated a post-flood technical taskforce to conduct Real-Time Kinematic (RTK) and Light Detection and Ranging (LiDAR) mapping at Universiti Putra Malaysia Bintulu Campus (UPMKB).

This initiative follows recent floods that severely affected several regions across Sarawak, including critical educational and agricultural zones here.

The primary goal of the taskforce is to produce high-precision geospatial data to assess terrain changes, detect topographical shifts, and support long-term flood mitigation strategies.

A JKR spokesperson explained that by integrating RTK and LiDAR technologies, the team can generate accurate, real-time 3D maps of the affected areas.

"This is vital for assessing post-flood damage and for planning resilient infrastructure upgrades for the campus and nearby communities."

The spokesperson said the data gathered will aid not only in identifying immediate flood-affected zones, but also in guiding future land use planning, drainage improvements, and environmental monitoring efforts.

Seven students from the Bachelor of Science in Bioindustry programme, currently enrolled in the elective course CAT4100 (Precision Agriculture), took part in the post-flood surveying operations under the Institute of Ecosystem Science Borneo.

Dr Wan Nor Zanariah Zainol @ Abdullah, a geomatic engineering expert from UPMKB, also participated in the taskforce's fieldwork, offering academic insight and technical guidance throughout the operation.

The students engaged in hands-on learning through the monitoring and demonstration of advanced geospatial technologies such as the LiDAR and RTK systems, key tools for precise topographical mapping and disaster site analysis.

They also gained practical experience using industry-standard software for real-time data collection, mapping, visualisation, and analysis, including Global Mapper, DJI



Students try their hands at observing the RTK setup conducted on an established standard station.

Terra, and Agisoft.

Wan Nor Zanariah expressed pride in her students' involvement, noting their remarkable progress during the fieldwork.

"I am very proud of my students for embracing this real-world learning opportunity. Their enthusiasm and adaptability in applying geospatial and precision agriculture tools reflect a meaningful learning curve that connects classroom theory with impactful fieldwork," she said.

She added that this field experience provided valuable exposure to remote sensing and precision agriculture technologies, while emphasising the importance of interdisciplinary collaboration in addressing environmental issues.

"It served as a significant bridge between academic learning and real-world application."

She said this operation reflects a strong collaboration between federal and state agencies, academia, and local authorities, as well as showcases the Sarawak government's commitment to incorporating cutting edge technologies in disaster response and infrastructure planning.

UPM Kampus Bintulu, BDA jalin kerjasama urus sisa makanan

Program 'Towards Zero Food Waste' bantu pelbagai pihak

Oleh Noor Eszreen Jufri
blpendidikan@bh.com.my

Bintulu: Universiti Putra Malaysia Kampus Bintulu (UPMKB) dan Lembaga Kemajuan Bintulu (BDA) bekerjasama dalam pengurusan sisa makanan menerusi program 'Towards Zero Food Waste'.

Program yang diketuai Ketua Laboratori Biodiversiti Borneo, Institut Ekosains Borneo (IEB), UPMKB, Dr Keeren Sundara Rajoo, adalah inisiatif UPMKB dan BDA untuk membantu pelbagai pihak di Bintulu yang terbahit

dengan penyediaan makanan.

Pengarah UPMKB, Prof Dr Shahrul Razid Sarbini, berkata inisiatif ini antara langkah penting dalam mengurangkan pembaziran makanan, menangani isu kebuluran, serta menetapkan penanda aras pengurusan sisa makanan yang lebih mampan di Malaysia.

Katanya, kerjasama strategik dalam pengurusan sisa makanan mampu mencetuskan penyelesaian inovatif yang memberi manfaat kepada masyarakat dan alam sekitar.

Amalan lestari

"Usaha ini sejajar dengan Pelan Induk Sekuriti Makanan UPM yang menekankan amalan lestari, inovasi berasaskan penyelidikan serta pembabitn komuniti dalam

memastikan bekalan makanan yang stabil dan berdaya tahan," katanya.

Timbalan Pengerusi BDA, Datuk Haider Khan Asghar Khan, berkata kajian kebolehlaksanaan ini adalah fasa pertama dalam usaha mencari penyelesaian mampan pengurusan sisa makanan.

"Kita sedang merealisasikan idea dan strategi, jadi harapan saya projek ini berjaya direalisasikan serta diteruskan dalam jangka masa panjang sekali gus menjadi contoh terbaik."

Selain itu, projek ini diharap menjadi titik permulaan untuk berkongsi idea, menyokong satu sama lain, dan bekerjasama mencipta masa depan yang lebih baik demi kestabilan dan kesejahteraan alam sekitar," katanya.



Shahrul Razid Sarbini

Utusan Borneo Online
20 August at 15:49 ·

Usaha strategik untuk memperkukuh penyelidikan berkaitan pemantauan karbon hutan perlu dilakukan dengan memajukan kapasiti teknikal dalam kalangan penyelidik serta pengurus sumber hutan.

Laporan penuh: <https://www.utusanborneo.com.my/.../majukan-kapasiti...>



Utusan
Borneo
Online

RABU, 20 OGOS 2025

Majukan kapasiti teknikal penyelidik dan pengurus sumber hutan

Majukan kapasiti teknikal dalam kalangan penyelidik dan pengurus sumber hutan

BINTULU: Usaha strategik untuk memperkukuh penyelidikan berkaitan pemantauan karbon hutan perlu dilakukan dengan memajukan kapasiti teknikal dalam kalangan penyelidik serta pengurus sumber hutan.

Justeru, Bengkel Teknologi Light Detection and Ranging (LiDAR) telah diadakan selama lima hari bermula 11 hingga 15 Ogos lalu di Universiti Putra Malaysia Sarawak (UPMS).

Pengarah Institut Ekosains Borneo (IEB) UPMS Dr Syeed SaifulAzy Osman Al-Edrus berkata, LiDAR merupakan teknologi berimpak tinggi dalam penyelidikan karbon hutan yang menyokong usaha pengurusan hutan secara saintifik.

"Ia bahkan membuka ruang baharu kepada kerjasama penyelidikan antara universiti dan agensi kerajaan khususnya dalam konteks Sarawak yang kaya dengan ekosistem hutan hujan tropika," ujarnya.

Pegawai Penyelidik IEB UPMS Zahara Ismail berkata, bengkel itu tidak hanya memperkukuh kapasiti penyelidik dan pelajar dalam menguasai teknologi LiDAR, bahkan menjadi platform penting untuk membina jalinan kerjasama antara universiti dan agensi kerajaan.

Melalui bengkel tersebut katanya, peserta dapat memahami dengan lebih mendalam peranan teknologi penderian jauh dalam penilaian karbon hutan yang menyokong agenda kelestarian negara.

Katanya, objektif bengkel itu adalah untuk membangunkan protokol lapangan bagi penilaian stok karbon hutan menggunakan sistem LiDAR berasaskan pesawat tanpa pemandu (UAV) yang disokong pawaian data geospasial serta memperkasa kerjasama strategik antara institusi akademik dan agensi kerajaan dalam aspek pembangunan kapasiti teknikal dan penyelidikan.

"Satu rangka kerja saintifik yang standard untuk penilaian karbon hutan dijangka dapat dihasilkan sekali gus menyumbang kepada usaha



BENGKEL: Para peserta diberi penerangan tentang penggunaan UAV.

mitigasi perubahan iklim serta pemantauan komitmen negara terhadap agenda pembangunan mampan.

"Ia juga satu perkongsian ilmu, pemindahan teknologi serta pembangunan kepakaran tempatan dalam bidang pemantauan karbon hutan menggunakan teknologi penderian jauh terkini," jelasnya.

Katanya, hasil daripada bengkel ini diharap dapat dimanfaatkan dalam penyelidikan berterusan serta diaplikasikan secara praktikal dalam pengurusan hutan di Sarawak selari dengan aspirasi negeri dan negara dalam memperkukuh kelestarian ekosistem serta pengurusan sumber semula jadi.

Sementara itu, Pegawai Penyelidik Jabatan Hutan Sarawak (JHS) Dr Malcom Demies berkata, kerjasama dengan UPMS dalam pengantaraan bengkel itu amat bermakna kerana ia menyediakan peluang pembangunan kepakaran teknikal kepada pegawai JHS.

"Pengetahuan dan kemahiran yang diperolehi akan dapat diaplikasikan terus dalam pengurusan hutan, seterusnya memperkukuh usaha Sarawak dalam mitigasi perubahan iklim serta pemeliharaan ekosistem hutan tropika," ujarnya.

Bengkel anjuran IEB UPMS dengan kerjasama JHS dan disokong Fakulti Sains Pertanian dan Perhutanan (FSPH), Pejabat Pengurusan Pelajar serta Pusat Pembangunan Teknologi Maklumat

UPMS itu disertai 30 peserta JHS Wilayah Miri, Bintulu, Sibau dan Ibu Pejabat JHS.

Peserta dari UPMS pula terdiri daripada penyelidik, staf dan pelajar siswazah daripada IEB, Pusat Pembangunan Maklumat dan Komunikasi (IDEC) UPMS, FSPH serta Fakulti Kemasyarakatan, Pengurusan dan Sains (FKPS) UPMS akan memperkukuh kerjasama rentas disiplin dan institusi dalam bidang pengurusan melalui pemantauan sumber hutan secara lestari.

Bengkel itu dikendalikan konsultan jemputan Destisar Sdn Bhd dengan pengisian enam modul komprehensif yang memberi tumpuan pembangunan pengetahuan teori serta kemahiran praktikal iaitu penerokaan konsep karbon dan aplikasi Teknologi LiDAR dalam penilaian stok karbon hutan.

Seterusnya, kaedah reka bentuk plot dan pengumpulan data, latihan penggunaan peralatan canggih seperti DJI Matrice 300 RTK dan GeoSLAM ZEB Horizon, amali lapangan di hutan simpan UPMS serta pemprosesan data dan Pembangunan Prosedur Operasi Standard (SOP).

Pendekatan holistik ini menggabungkan teori, latihan teknikal dan aplikasi lapangan, sekali gus memberi peluang kepada peserta untuk menguasai alatan berteknologi tinggi dalam bidang penderian jauh serta meningkatkan kompetensi dalam pemprosesan data geospasial.

IRIS Carnival in Bintulu out to educate public on green innovation

BINTULU: The IRIS Carnival 2025, themed Green Innovation Generation for a Sustainable World, was recently held at the Dewan Sri Kenyalang of Universiti Putra Malaysia Bintulu Campus (UPMKB).

With the presence of 300 visitors, the carnival sought to raise awareness about climate change and the adoption of green technology in daily life. It was organised by UPMKB students through the Co-Curriculum and Student Management Centre, in collaboration with the Institute of Ecoscience Borneo (IEB).

Sarawak Natural Resources and Environment Board, and SMK Bintulu.

Several private companies also participated, including Zha Environmental Sdn Bhd, SAR-Alam Indah Sdn Bhd, and Trienekens (Sarawak) Sdn Bhd.

The collaboration with the Sarawak Natural Resources and Environment Board demonstrates the strong commitment and continuous efforts of the agencies and the university in fulfilling their responsibility to preserve the environment and nurture

Various exciting activities were featured, such as drone applications, Arduino, tree planting and compost fertiliser production at the Future Green Expo.

Programme spokesperson

a green generation among the community," said a spokesperson.

The opening ceremony was performed by UPMKB director Prof Dr Shahruil Razid Sarbini, who emphasised the importance of innovation in

addressing environmental challenges.

Also present were Co-Curriculum Centre special facilitator Fakhran Buang, and IEB director and programme advisor Dr Syeed SaifulAzy Osman Al-Edrus.

Various exciting activities were featured, such as drone applications, Arduino, tree planting, and compost fertiliser production at the Future Green Expo.

The Eco-Maze booth allowed participants to play while learning about green technology, while Adventure Cove offered interactive activities for children," added the spokesperson.

Additionally, the exhibition booths from co-organisers and private companies showcased innovations in sustainable waste management, virtual

reality in environmental education, and wastewater treatment technology.

Programme director Erickson Gravesent Muzidi, meanwhile, highlighted that the carnival provided students with the opportunity to showcase their creativity and leadership skills, while educating the public about green innovation.

"The IRIS Carnival 2025 has proven that such initiatives can foster an innovative and environmentally conscious society, paving the way for more similar programmes in the future."

Rentak Kampus
CHI SARAWAK, DZAHRI MUBIN

SERAMAI 18 pelajar Tokyo University of Agriculture (Tokyo NODAI) Terbilang 10 Malaysia yang menyertai Program Mobiliti Pelajar Sarawak (UPMS) di Sarawak. Program tersebut membolehkan pelajar sarawak untuk belajar di Sarawak dan Tokyo NODAI. Pelajar sarawak yang menyertai program ini akan belajar di Sarawak dan Tokyo NODAI. Pelajar sarawak yang menyertai program ini akan belajar di Sarawak dan Tokyo NODAI.

UPMS angkat budaya Sarawak ke pentas global

Pengalaman yang diperoleh daripada program ini bukan sekadar aktiviti sosial. Sebaliknya, mempromosikan keagamaan ilmu dan budaya sarawak kepada pentas global yang memperkukuh daya tahan komuniti.

menyertai program mobiliti pelajar sarawak (UPMS).
 "Saya sangat berpuas hati dengan pengalaman ini. Saya telah belajar banyak tentang budaya sarawak dan saya akan membawa pulang banyak kenangan yang berharga."
 Dalam pada itu, pelajar sarawak yang menyertai program ini akan belajar di Sarawak dan Tokyo NODAI.

Tokyo NODAI dan UPMS berkolaboratif dalam program mobiliti pelajar

BINTULU: Seramai 18 pelajar dan dua pengiring dari Universiti Pertanian Tokyo (Tokyo NODAI) Jepun serta warga akademik Universiti Putra Malaysia Sarawak (UPMS) menyertai Program Mobiliti Pelajar Sarawak (UPMS)-Tokyo NODAI 2025 di UPMS baru-baru ini.

Program selama dua minggu itu bertemakan 'Strategi Tebatan dan Penyesuaian Iklim Sarawak 2025: Pembelajaran dan Pertukaran Budaya (CAMS 2025)' memberi peluang kepada para pelajar untuk menimba pengalaman berharga dalam memahami isu perubahan iklim dan pertukaran budaya.

Pengarah programnya Dr Keeren Sundara Rajoo berkata, program ini lebih daripada sekadar mobiliti pelajar bahkan platform menyatukan ilmu, budaya dan pengalaman kehidupan sebenar dalam satu perjalanan akademik yang bermakna.

"Saya amat berbangga melihat para pelajar bukan sahaja memperoleh pengetahuan baharu melalui kuliah dan penyelidikan tetapi juga merasai sendiri kehidupan komuniti tempatan di Sarawak," ujarnya.

Katanya, para pelajar terbahit telah didedahkan kepada 10 siri kuliah berimpak tinggi yang menyentuh aspek sains, teknologi, ekonomi dan masyarakat.

Ujarnya, daripada kajian mengenai 'biochar' dalam rawatan air, ekonomi, perubahan iklim, keusahawanan berasaskan



TERUJA: Para pelajar Tokyo NODAI menimba ilmu berkaitan di UPMS.

kelestarian sehinggalah kepada penggunaan bahan biojisim untuk penghasilan tenaga hijau, setiap sesi membawa pelajar mendekati dunia penyelidikan yang realistik dan praktikal.

Menurutnya, CAMS 2025 juga bukan sekadar kuliah dalam bilik seminar memandang para pelajar terbahit turut merasai denyut nadi kehidupan masyarakat Sarawak melalui aktiviti di lapangan.

"Lawatan pendidikan ke Taman Tumbina (Tumbuhan dan Binatang) Bintulu memperlihatkan kekayaan biodiversiti negeri ini manakala penglibatan para pelajar dengan komuniti di rumah panjang membuka ruang interaksi yang lebih mendalam dengan masyarakat

tempatan," katanya.

Katanya, para pelajar universiti dari Jepun itu turut menyaksikan sendiri warisan budaya, adat resam serta amalan lestari yang diwarisi turun-temurun oleh komuniti peribumi di negeri ini.

Sementara itu, pelajar Tokyo NODAI Tomoka Kamata berkata, menyertai program tersebut merupakan pengalaman yang tidak ternilai baginya.

"Terima kasih atas kuliah yang menarik disampaikan, layanan mesra pelajar UPMS dan peluang untuk mempelajari budaya Malaysia khususnya mengenai kaum Iban," ujarnya.

Katanya, melalui program ini dia berpeluang mendapat kawan baik dalam dan luar negara serta amat menghargai

nilai pertukaran budaya dan kepentingan mengambil langkah baharu ke hadapan.

"Saya berharap melalui program ini akan dapat menerapkan aktiviti baharu untuk penyelidikan pada masa depan," katanya.

Terdahulu majlis penutupan program pada 4 September lepas meriah dengan membabitkan persembahan pelajar, jamuan makan malam dan ucapan penghargaan daripada kedua-dua pihak universiti terbahit.

Hadir sama Pengetua Kolej Sri Rajang Tengku Sharifah Marliza Tengku Azmi, Pengarah Institut Ekosains Borneo (IEB) UPMS Dr Syeed Saiful Azry Osman Al Edrus, Felo penasihat serta pegawai-pegawai IEB UPMS.

Hotel pioneers sustainable waste management, drives innovation in Bintulu

BINTULU: Fairfield by Marriott Bintulu Paragon has set a new milestone by becoming the first hotel here to implement the 'Towards Zero Food Waste' in Bintulu project, an environmental initiative jointly led by the Bintulu Development Authority (BDA) and Universiti Putra Malaysia Sarawak (UPMS).

The project, coordinated by Dr Keeren Sundara Rajoo from UPMS' Institute of Ecosystem Science Borneo and Lydia Soloma Jalong from BDA, marks a significant step forward in advancing sustainable waste management practices in the hospitality sector.

On July 31 this year, the hotel launched its pioneering food waste composting initiative, developed in collaboration with Naim, using a composting box filled with more than 400 kg of vegetable scraps and fruit peels collected from its kitchen.

The composting box system a joint research outcome between UPMS and Tokyo University of Agriculture offers a practical, low-cost, and eco-friendly solution for managing food waste in tropical climate, without requiring chemical additives or electricity.

In early October, Keeren and his team of students visited the site to observe the successful completion of the first composting cycle, which produced over 30kg of high-quality compost suitable for



Keeren (third right) inspects the composting box with the hotel staff. — Photo from Facebook/Universiti Putra Malaysia Sarawak

sustainable soil enrichment.

Encouraged by this success, the hotel has since expanded its composting efforts with additional batches underway, underscoring its long-term commitment to sustainability and circular waste management.

Looking ahead, Fairfield by Marriott Bintulu Paragon plans to establish a small farming area adjacent to the composting

site, where the nutrient-rich compost will be used to grow local plants.

"This initiative aims to create a closed-loop sustainability model that integrates waste reduction, soil recovery and green growth.

"I am confident that it will inspire more local businesses to adopt responsible food waste practices and help raise public awareness on environmental

stewardship," said hotel manager Lee Chin Yin.

The 'Towards Zero Food Waste' in Bintulu project is expected to grow through strategic collaborations with small and medium enterprises, civil society organisations, and schools across Bintulu, fostering inclusive, community-driven solutions for a cleaner and more sustainable town.

RESEARCH GRANTS 2025

IEB has secured six (8) new research grants in 2025, further reinforcing the institute's capacity to deliver high-impact and globally relevant research.

Tahniiah
atas penerimaan
Geran Swasta (CHEMSAIN)

Dr. Keeren Sundara Rajoo
Institut Ekosains Borneo
Universiti Putra Malaysia Kampus Bintulu Sarawak

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Evaluation of Offshore Food Waste Compost for Enhancing the Growth of Selected Sarawak Forest Tree Species and Vegetables

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Dr. Keeren Sundara Rajoo
Ketua Laboratori Biodiversiti Borneo
Institut Ekosains Borneo UPM

Tajuk :
Development of a Culturally Adaptive Forest Based Intervention Prototype Grounded in Nature Connectedness : A Comparative Study between Korea and Malaysia

Penaja :
Glocal University 30 Project, Chungbuk National University, Cheongju Korea

Tempoh :
1 Jun 2025 hingga 31 Januari 2026

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Ketua Projek
Institut Ekosains Borneo
Universiti Putra Malaysia Kampus Bintulu Sarawak

PROF. MADYA DR. GEOFFREY JAMES GERUSU
ANI Projek
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DR. DALJIT SINGH A/L KARAM SINGH
ANI Projek
Institut Ekosains Borneo
Universiti Putra Malaysia

Tajuk Projek Penyelidikan
Feasibility Study on Japanese Food Waste Management Strategies for Bintulu: Towards Zero Food Waste in Bintulu

Berjumlah
RM 200,000.00

Ikhtis dari pada
Pengarah dan Seluruh Warga UPMKB

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Berilmu Berbakti

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Tahniiah
atas penerimaan
Geran Antarabangsa Projek Penyelidikan Asia-Pacific Telecommunity Tahun 2024 : Extra Budgetary Contribution From Japan (EBC-J 2024)

Dr. Keeren Sundara Rajoo
Ketua Projek
Institut EkoSains Borneo

Tajuk projek geran
Digitizing Waste Management : An Inclusive Circular Economy Approach for Malaysia and Beyond

berjumlah
US\$ 40,538.40

Ikhtis dari pada
Pengarah dan Seluruh Warga UPMKB

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RESEARCH GRANTS 2025



Tahniah

atas penerimaan
Geran Putra - Inisiatif Putra Muda (GP-IPM)

Tajuk projek geran
Valorization of Crustacean Waste into Functional Carbon Materials for Advanced Water Purification

berjumlah
RM15,000.00

ikhlas daripada
Pengarah dan Seluruh Warga UPMS



Ketua Projek
Ts. ChM. Dr. Azrul Nurfaiz Bin Mohd Faizal
Institut EkoSains Borneo

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Tahniah

atas penerimaan
Geran Inisiatif Putra Siswazah (GP-IPS)

Tajuk projek geran
Smart Farming Innovation: Ai-Enhanced Seeding Mechanism For Hill Paddy Cultivation in Sarawak

berjumlah
RM20,000.00

ikhlas daripada
Pengarah dan Seluruh Warga UPMS



KETUA PROJEK
Ts. GS. DR. WAN NOR ZANARIAH BINTI ZAINOL @ ABDULLAH
Institut EkoSains Borneo

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Tahniah

atas penerimaan
Geran Putra Berimpak (GPB)

Tajuk projek geran
SUSTAINABLE VALORIZATION OF COCOA POD HUSKS INTO HIGH-EFFICIENCY BIOCHAR AND BIOFERTILIZER THROUGH SOLVOTHERMAL CARBONIZATION

berjumlah
RM100,000.00

ikhlas daripada
Pengarah dan Seluruh Warga UPMS



KETUA PROJEK
Ts. DR. NOZIEANA BINTI KHAIRUDDIN
Ketua Laboratori Etnik Borneo
Institut Ekosains Borneo, UPMS

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Tahniah

atas penerimaan
Geran Putra Berimpak (GPB)

Tajuk projek geran
ENGINEERING MULTIFUNCTIONAL BIVO. / BIOCHAR NANOCOMPOSITES FOR SIMULTANEOUS PHOTODEGRADATION AND ELECTROCHEMICAL SENSING OF 2,4-DICHLOROPHENOXYACETIC ACID

berjumlah
RM100,000.00

ikhlas daripada
Pengarah dan Seluruh Warga UPMS



KETUA PROJEK
ChM. DR. ALVIN LIM TEIK ZHENG
Ahli Institut
Institut Ekosains Borneo, UPMS

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AWARDS 2025



AWARDS 2025





ONGOING RESEARCH GRANTS 2025

STAFF NAME	RESEARCH TITLE	SPONSOR (MOHE/MOSTI ETC.)	END DATE (dd-mmm-yy)
King Jie Hung	Promote Oil Palm Yield for Estates on Peat by Improving Soil Ecosystem Functionally	Sarawak Oil Palm Berhad	2025
Noorasmah Saupi	Improvement of post-harvest handling of hill paddy and its effects on paddy quality.	TRGS	30/11/2025
Tunung Robin	Improvement of Sarawak hill paddy (<i>Kerawing variety</i>) yield at Sg. Asap, Belaga Sarawak	TRGS	30/11/2025
King Jie Hung	Sustainable pests' management for increasing yield and conserving Sarawak hill paddy ecosystem at Sg. Asap, Belaga Sarawak	TRGS	30/11/2025
Keeren a/l Sundara Rajoo	Development Of a Collaborative Ethnobotanical Handbook for Field Researchers in Asia: A Joint Effort Between Malaysia, Indonesia And India	Universiti Putra Malaysia	Nov 30, 2025
Dr. Wan Nor Zanariah bt Zainol @ Abdullah	Penyelidikan Hutan Sarawak (Fasa II) - Forest Landscape Restoration (FRL) Assessment Using Small Multicopter UAV at Sabal and Labang Forest Reserves	Jabatan Hutan Sarawak	5/6/2027
Keeren a/l Sundara Rajoo	Evaluation of Offshore Food Waste Compost for Enhancing the Growth of Selected Sarawak Forest Tree Species and Vegetables	Chemsains Konsultant Sdn Bhd	2025
Keeren a/l Sundara Rajoo	Feasibility Study on Japanese Food Waste Management Strategies for Bintulu : Towards Zero Food Waste in	Bintulu Development Authority	Nov 2026

STAFF NAME	RESEARCH TITLE	SPONSOR (MOHE/MOSTI ETC.)	END DATE (dd-mmm-yy)
Adrian Daud	Socioeconomic valuation of Sarawak hill paddy ecosystem at Sg. Asap, Belaga, Sarawak	TRGS	30/11/2025
Keeren a/l Sundara Rajoo	Digitizing Waste Management : An Inclusive Circular Economy Approach for Malaysia Beyond	Asia Pacific Telecommunity	Dec 2025
Keeren a/l Sundara Rajoo	Development Of A Collaborative Ethnobotanical Handbook For Field Researchers In Asia: A Joint Effort Between Malaysia, Indonesia And	Universiti Putra Malaysia	Nov 30, 2025
Dr. Wan Nor Zanariah bt Zainol @ Abdullah	Penyelidikan Hutan Sarawak (Fasa II) - Forest Landscape Restoration (FRL) Assessment Using Small Multicopter UAV at Sabal and Labang	Jabatan Hutan Sarawak	5/6/2027
Keeren a/l Sundara Rajoo	Evaluation of Offshore Food Waste Compost for Enhancing the Growth of Selected Sarawak Forest Tree Species and Vegetables	Chemsains Konsultant Sdn Bhd	2025
Keeren a/l Sundara Rajoo	Feasibility Study on Japanese Food Waste Management Strategies for Bintulu : Towards	Bintulu Development Authority	Nov 2026
Keeren a/l Sundara Rajoo	Digitizing Waste Management : An Inclusive Circular Economy Approach for	Asia Pacific Telecommunity	Dec 2025

PUBLICATIONS 2025

STAFF NAME	DOCUMENT TITLE	SOURCE TITLE
Keeren a/l Sundara Rajoo	Ethnomedicinal Survey of Antidiabetic Plants Used by Six Indigenous Communities in Sarawak, Borneo	Journal of Herbal Medicine
Keeren a/l Sundara Rajoo	Ethnobotanical Survey of Medicinal Plants Used by the Punan People of Sarawak, Borneo: A Conservation Perspective	Tropical Conservation Science
Keeren a/l Sundara Rajoo	Comparative Analysis of Soil Quality in Natural, Logged, and Plantation Forests in Kuala Kubu Bharu, Malaysia	Malaysian Journal of Soil Science
Keeren a/l Sundara Rajoo	Influence of Soil Fertility on Growth Performance and Optimal Harvesting Age of <i>Shorea angustifolia</i> in Logged Forests of Sarawa	Malaysian Journal of Soil Science
Dr. Wan Nor Zanariah bt Zainol @ Abdullah	Drone STEM Education : Revolutionizing Learning for the Future	International Journal of Academic Research in Progressive Education & Development
Nozieana Khairuddin	Post-harvest storage effects on enzymatic browning, physicochemical and phytochemical characteristics of <i>Artocarpus odoratissimus</i> flesh	Cogent Food & Agriculture
Nozieana Khairuddin	Brassica oleracea L. Anthocyanin-based films for intelligent packaging: A concise review	Journal of Food Measurement and Characterization

PUBLICATIONS 2025

STAFF NAME	DOCUMENT TITLE	SOURCE TITLE
Nozieana Khairuddin	Characterization and pH Response of Passiflora suberosa Extract as a Novel Biosensor Intended for Smart Food Packaging Film	Journal of Food Process Engineering
Alvin Lim Teik Zheng	Bismuth vanadate modified glassy carbon electrode for sensitive electrochemical antibiotic detection	Journal of Nanoparticle Research
Alvin Lim Teik Zheng	Biochar-based electrochemical sensors: a tailored approach to environmental monitoring	Analytical Sciences
Alvin Lim Teik Zheng	Recent review on porous adsorbents for water decontamination: strategies for enhanced removal of tetracycline	Journal of Porous Materials
Alvin Lim Teik Zheng	Assessing the Photocatalytic Performance of Hydrothermally Synthesized Fe-Doped BiVO ₄ Under Low-Intensity UV Irradiation	Arabian Journal for Science and Engineering
Alvin Lim Teik Zheng	Rare earth elements for enhancing photocatalysis in pollutant degradation and water treatment	International Journal of Environmental Science and Technology

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CR - 1

Application No: **LY2024W05248**

Applicant :

* Title of work (Original language) : **MODULE ON HYDROPONIC FARMING WITH EFFECTIVE MICROBES FOR DISABLED INDIVIDUAL TRAINER**

Translation (if the title of work is neither in Bahasa nor English) : _____

Transliteration (if the title of work is neither in Bahasa nor English) : _____

Name of the Language : **English**
(Language use in the work)

* Section A : Category of Works (Please tick ONE only)

☒ Literary ☐ Musical ☐ Artistic ☐ Film ☐ Sound Recording ☐ Broadcast (broadcasting service only) ☐ Derivative

Date of Creation / Fixation : **14** / **12** / **2023**

Section B : Publication

The Work is : ☒ Published ☐ Unpublished

If published : **14** / **12** / **2023** **Malaysia**
(Date of first publication) (Country)

* Section C : Author (To add additional Authors, please attach separate sheet)

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CR - 1

Application No: **FM2024W08570**

Applicant :

* Title of work (Original language) : **Harimau Malaya & Animal Conservation Animatic Storyboard**

Translation (if the title of work is neither in Bahasa nor English) : _____

Transliteration (if the title of work is neither in Bahasa nor English) : _____

Name of the Language : **English**
(Language use in the work)

* Section A : Category of Works (Please tick ONE only)

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Date of Creation / Fixation : **27** / **03** / **2024**

Section B : Publication

The Work is : ☒ Published ☐ Unpublished

If published : **27** / **03** / **2024** **Malaysia**
(Date of first publication) (Country)

* Section C : Author (To add additional Authors, please attach separate sheet)

Name (as per NRIC/Passport) : **as attachment**

NRIC / Passport No. : _____

Nationality : _____ **DD** / **MM** / **YYYY**
(Date of Death (if applicable))

* Section D : Owner (To add additional Owners, please attach separate sheet)

Name (as per NRIC/Passport) or Company Name : **Universiti Putra Malaysia**

NRIC / Passport / Company No. : _____

Nationality : _____

Address : **Putra Science Park**
Universiti Putra Malaysia
Postcode : 43400 **City : Serdang**
State : Selangor **Country : Malaysia**

Telephone No. : **03-97691636** E-mail: **bhi_psp@upm.edu.my**

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PAGE 1 OF 2

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CR - 1

Application No: **LY2025W02597**

Applicant :

* Title of work (Original language) : **INNOVATIVE ECOPEAT-GEL APPLICATIONS FOR SUSTAINABLE PLANTING PRACTICES**

Translation (if the title of work is neither in Bahasa nor English) : _____

Transliteration (if the title of work is neither in Bahasa nor English) : _____

Name of the Language : **English**
(Language use in the work)

* Section A : Category of Works (Please tick ONE only)

☒ Literary ☐ Musical ☐ Artistic ☐ Film ☐ Sound Recording ☐ Broadcast (broadcasting service only) ☐ Derivative

Date of Creation / Fixation : **31** / **09** / **2024**

Section B : Publication

The Work is : ☒ Published ☐ Unpublished

If published : **31** / **09** / **2024** **Malaysia**
(Date of first publication) (Country)

* Section C : Author (To add additional Authors, please attach separate sheet)

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CR - 1

No. Permohonan : **AR2025W02600**

Pemohon :

* Tajuk Karya (Bahasa asal) : **3 in 1 Moveable Seedponic Rack**

Terjemahan (jika tajuk karya bukan dalam Bahasa Melayu atau Inggeris) : _____

Transliterasi (jika tajuk karya bukan dalam Bahasa Melayu atau Inggeris) : _____

Jenis Bahasa : **English**
(Bahasa yang digunakan dalam karya)

* Seksyen A : Kategori Karya (Sila pilih SATU sahaja)

☐ Sastera ☐ Muzik ☒ Seni ☐ Filem ☐ Rakaman Bunyi ☐ Siaran (perkhidmatan penyiaran sahaja) ☐ Terbitan

Tarikh Ciptaan/Penetapan Karya : **30** / **09** / **2024**

Seksyen B : Penerbitan

Karya ini : ☒ Telah Diterbitkan ☐ Belum Diterbitkan

Jika telah diterbitkan : **30** / **09** / **2024** **Malaysia**
(Tarikh Kali Pertama Diterbitkan) (Negara)

* Seksyen C : Pencipta (Sila lampirkan helaian berasingan jika terdapat penambahan Pencipta)

Nama (seperti di KP/Passport) : **as attachment**

No. KP / Passport : _____

Kewarganegaraan : _____ **HH** / **BB** / **TTTT**
(Tarikh Kematian (jika berketat))

* Seksyen D : Pemunya (Sila lampirkan helaian berasingan jika terdapat penambahan Pemunya)



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Further Information



Institut Ekosains Borneo
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upmkb@upm.edu.my



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