APPGM-SDG
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SOCIETY FOR PROMOTION OF SUSTAINABLE DEVELOPMENT GOALS
PPM-023-14-07012020

FACES OF RESILIENCE:
DIVERSE VOICES AND STORIES THROUGH FOOD SECURITY INITIATIVES

Faces of Resilience: Diverse Voices and Stories through Food Security Initiatives

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APPGM-SDG

(All-Party Parliamentary Group Malaysia on Sustainable Development Goals)

Published by:

Persatuan Promosi Matlamat Pembangunan Lestari
(Society for the Promotion of Sustainable Development Goals)
A-1-10, Blok A, 8 Avenue, Jalan Sungai Jernih 8/1, Seksyen 8,
46050 Petaling Jaya, Selangor.

Cover Photo by: Arif Azhad Abdul Ghaffar
Photo taken during the Food Security Conference on 9 – 10 November 2024, organized by the Food Security Unit and the MySDG Centre for Social Inclusion

Cataloguing-in-Publication Data
Perpustakaan Negara Malaysia
A catalogue record for this book is available from the National Library of Malaysia

ISBN 978-629-7752-24-2

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Contributors

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Dr. Siti Suliza Salamat is a Senior Lecturer at Universiti Malaysia Sabah (UMS), specializing in oil palm plantation management, biofertilizers, and waste management. She holds dual PhDs in Biotechnology & Molecular Science from Universiti Putra Malaysia (UPM) and in Engineering from Kyushu Institute of Technology, Japan. She is currently running the project on knowledge transfer on vegetable production and marketing for the community at Parliament Libaran, Sandakan Sabah.

Elias Alexander @ Richard is an experienced Program Management professional with a strong background in education leadership, sustainability, and community empowerment. In addition to serving as Program Management Director with a leading multinational corporation in Penang, he is deeply committed to advancing the standards of Tamil schools and promoting transformative educational initiatives. As the Chairman of the School Board and former PIBG Chairman of SJK(T) Sungai Ara, Elias Alexander has been instrumental in pioneering innovative projects, including the Agro School Project, the Science Lab Transformation, and the AI Explorers Program. These initiatives are designed to align grassroots educational practices with national aspirations and the United Nations Sustainable Development Goals (SDGs). Driven by a vision to redefine how Tamil schools operate, his long-term goal is to position SJK(T) Sungai Ara as a benchmark of excellence and the leading Tamil school in Malaysia, integrating sustainability, technology, and holistic education into its core identity.

Siti Baizura Mohd Rafi is the Co-Founder and Chief Executive Officer of TT Organics, a social enterprise dedicated to advancing sustainable agriculture and strengthening local food security. Her work has been particularly focused on empowering smallholder farmers through the development of innovative contract farming models and the facilitation of knowledge transfer to rural communities. She has also been actively engaged in initiatives under the APPGM-SDG framework, contributing to national efforts towards sustainable development, with a particular emphasis on food security. The journal is co-authored by Eleena Norsin, Co-Founder of TT Organics, and Dr. Alia Azmi, Senior Lecturer at the Faculty of Health Sciences, Universiti Teknologi MARA (UiTM) Selangor, whose areas of expertise include environmental health and public health.

Assoc. Prof. Dr. Rosazlin Abdullah is a lecturer at the Institute of Biological Sciences (ISB), Universiti Malaya. She has over 18 years of experience in various national and international agricultural-environmental based projects and has demonstrated outstanding research achievement in the field of sustainable soil management, one of the national challenges. She currently serves as the President of the Malaysian Soil Science Society, National Focal Point for the Global Soil Partnership, Technical Soil Quality Department of Standard Malaysia and Technical Committee Members, Center of Excellence for Soil Research in Asia (CESRA). According to the Web of science (WOS), her h-index is 18 with over 1800 citations in recognition of her innovative contributions, she was awarded the Best Women Inventor Award at ITEX 2024. She actively contributes to the development of national guidelines and frameworks aimed at advancing sustainable agriculture in Malaysia. Her multifaceted contributions underscore her role as a distinguished figure in academia, research, and community engagement.

Zuredisham Hashim is the chairman of the community garden located in Mutiara Magna, Kepong. He is also a committee member of the LA21 DBKL Neighborhood Garden. Despite his main duty as an auxiliary police officer, Mr. Zurediham has been committed to strengthening and developing community garden activities. He is very active and consistently supports greening initiatives for the well-being of the community. His involvement in the APPGM project, together with solution partners from the University of Malaya, has provided his garden with opportunities to better manage garden waste, increase crop yields, and generate income.

Mohd Khairul Ridhwan Adhha Akhiar is Currently as Deputy Chief of ABIM Terengganu, Vice President of Pertubuhan Alam Sekitar Sejahtera Malaysia (GRASS Malaysia), co-founder of Sekolah Alam Malaysia (SALAM), work as a content developer and freelance trainer on environmental education, leadership, teamwork. Permaculture designer, editor and writer for Laskar Alam Module, mentor for Akademi Bakat Naturepreneur School.

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Dr. Julius Kulip is an expert in botany and ethnobotany from Tambunan, Sabah, has over 30 years of experience, including roles at Sabah Forestry Department and UMS. He has published 70+ research papers, developed 10 herbal prototypes, holds 3 patents, and earned national and international awards. Currently, he directs Botanicals Sabah Sdn. Bhd.

Nathaniel Maikol is a sustainable agriculture expert with over 8 years of experience in soil conservation and organic waste management. He holds a Master's in Soil Science from Universiti Putra Malaysia and is currently pursuing a PhD in Environmental Science at Universiti Malaysia Sabah, focusing on nutrient efficiency and soil health in rice cultivation. As a consultant and advisor, he collaborates with rural communities in Sabah, empowering farmers with eco-friendly practices that improve both livelihoods and the environment.

Mohd Shukri Mustaffa is the chairman for Persatuan Penduduk Bayu Damansara. A businessman for F&B industry and community leader of mosque & school PIBG in Kota Damansara, Petaling Jaya, Selangor.

Abang Ismail Abang Kerny holds a degree in Business and Management from UITM and is the owner of Syarikat Masyhur Jati, specializing in fertilizer and nutrient supply since 2019. He has been collaborating with APPGM on Phase 1 projects since 2024

Kon Onn Sein is the Managing Director of Foundation for Community Development and Studies, champions poverty eradication and community empowerment. He is a pioneer of natural farming with Orang Asli. And through a shared prosperity green economy, he advocates for SDGs integration in policy and business. He serves on various national and regional networks including ASEC, APPGM SDG, and the CSO-SDG Alliance.

Nur Liyani Abdul Latiff is a passionate nature enthusiast and emerging practitioner in sustainable agriculture. As one of the "Seeders" of Seeds Malaysia, she has been actively involved with the organization for two years. She currently manages an APPGM-SDG project in Kampung Orang Asli Jong, Pekan, Pahang, focusing on empowering local communities through sustainable farming practices.

Siti Subailah is the founder of Borneo Fertilyst, a social enterprise committed to advancing sustainable agriculture in the rural areas of Sabah, Malaysia. In partnership with APPGM SDG, she collaborates closely with indigenous communities to promote eco-friendly farming practices that harness local resources. Through her work, Siti enhances community resilience and environmental stewardship, paving the way for a sustainable agricultural future within her communities.

Khairul Rizal Kheli Kuzzaman is an accomplished professional with over 15 years of experience in rural and indigenous community development across Malaysia's East Coast Peninsula. He holds a bachelor's degree in civil engineering and an MBA, which have supported his career progression from civil engineer to social engineer at ECERDC. At ECERDC, Rizal contributed to transformative projects like Agropolitan Pekan and Akuapolitan Kuala Nerus, focused on sustainable community growth. Later, he managed the Smallholder team at Earthworm Foundation, promoting sustainable practices and responsible sourcing. Rizal has also contributed to the RSPO's P&C and Independent Smallholder standards, championing sustainability in palm oil production. Now with Aspirasi Lestari, Rizal aligns his work with the UN's SDGs, focusing on education, sustainability, and economic empowerment. His dedication is especially evident in his advocacy for indigenous groups like the Jakun tribe, promoting educational and welfare improvements.

Simon Anak Joseph is an experienced Health, Safety, and Environment (HSE) professional with over two decades of expertise in offshore and onshore safety management. He has served with major international clients including TOTAL, Chevron, and PETRONAS, holding key roles such as HSE Manager and Officer across various offshore projects in Nigeria, the UAE, Indonesia, and Malaysia. A certified NIOSH practitioner, Simon has extensive experience in safety training, risk assessment, and compliance monitoring. He holds a Diploma in Public Administration and multiple safety certifications and is known for his strong leadership in promoting workplace safety and operational excellence.

Hamdan Sulaiaman was a lecturer in the Faculty of Plantation and Agrotechnology at Universiti Teknologi MARA, Kampus Jasin, Melaka. He has over five years of experience in hydroponics and holds a master's degree in mechanical engineering from Universiti Teknikal Malaysia Melaka (UTeM). Currently pursuing his PhD, Mr. Hamdan's research focuses on an advanced hydroponic dosing system. His expertise combines engineering principles with agricultural technology, contributing to advancements in sustainable farming practices.

Kogilavani Supermaniam is passionate about sustainable development and innovative agriculture. She has been a driving force behind a successful community aquaponics project in urban housing areas, which promotes food security and environmental protection through water-efficient and chemical-free farming practices. By reducing water usage by up to 90%, the project demonstrates practical solutions for sustainable living. She has led community training and awareness sessions, including with schoolchildren, to build knowledge and collective problem-solving around aquaponics systems. Her work directly advances the Sustainable Development Goals, particularly SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), and SDG 12 (Responsible Consumption and Production).

Hamnah Jusri is the headmistress of SRI Al-Amin Paya Besar, Kuantan. She holds a Bachelor of Environmental Health with Honours from Universiti Kebangsaan Malaysia.

Gary Law is the Founder and CEO of Victory Farm at Rooftop (VF@RM), established in 2016. A pioneer in urban agriculture and vertical farming in Malaysia, he introduced the first Residential Model VGROW Systems, rooftop farming initiatives, and HABOponics cultivation techniques. His work focuses on innovative, localized solutions that help businesses and communities meet sustainability goals, strengthen ESG impact, and achieve profitability. Recognized by government agencies including FAMA and the Department of Agriculture, Gary has also shared his expertise internationally as a speaker in Japan, India, Malaysia, and Singapore.

Foreword

Dr. Lin Mui Kiang

Deputy Chairperson,
Society for Promotion of Sustainable Development Goals

Food security has become an increasingly urgent concern in Malaysia as food imports continue to grow year after year. Malaysia's food import bill was approximately RM78.80 billion in 2023, nearly doubling from RM42.64 billion in 2014. This figure has been increasing due to domestic demand outpacing local production, exacerbated by factors like global supply disruptions, currency fluctuations, and rising international prices. The largest import categories in 2023 were grains and grain products, followed by animal feed and meat and meat products. A lack of food security is particularly damaging for poorer communities that may lack access to and the money to afford food when it becomes scarce.

One of the factors that affected the agriculture industry in Malaysia is the underinvestment in research and development (R&D) in the agriculture sector and inadequate extension services. Spending on agricultural R&D as a share of agricultural GDP declined from its peak of 1.88 percent in 2002 to 0.85 percent in 2016 and has remained stagnant. Farming is still fairly labor-intensive and exactly how much of farm work in Malaysia has been mechanized is not known. There is a lack of a favorable ecosystem to productively produce basic food items. In order to ensure the supply of quality and safe food at affordable prices, investment in food production should not only be evaluated in terms of private benefits but also social returns and the country’s security. This requires an ecosystem and a mix between food policy, smart technology and entrepreneurship, and security of land tenure.

Food security is also more than just ensuring access to sustenance; it is about empowering communities, preserving traditions, and fostering resilience in the face of challenges. The stories and initiatives presented in this book, Faces of Resilience: Diverse Voices and Stories Through Food Security Initiatives, reflect the collective efforts of individuals, communities, and organizations working tirelessly to build sustainable and inclusive food systems across Malaysia. This compilation of twenty-one papers and reflective essays, drawn from the Food Security Conference 2024 and the APPGM-SDG initiatives, showcases the innovative approaches and transformative impacts of community-driven projects. From backyard egg production in Perak to vertical farming in urban spaces, and from women-led agricultural initiatives to Indigenous knowledge preservation, these stories highlight the diverse ways Malaysians are addressing food security challenges. It explores income generation strategies, sustainable farming practices, women-led initiatives, agribusiness innovations, Indigenous contributions, technological advancements, and community mobilization. Together, these narratives provide a comprehensive view of the evolving food ecosystem in Malaysia and the creative solutions being implemented to ensure a sustainable future.

As we face global challenges such as climate change, resource scarcity, and growing populations, the importance of sustainable food systems cannot be overstated. This book serves as a testament to the resilience, creativity, and solidarity of Malaysian communities in their pursuit of food security. It is a call to action for policymakers, practitioners, and citizens to collaborate and innovate for a future where food security is not just a goal but a reality for all.

I invite you to delve into these inspiring stories and reflections, and to join us in building a food system that nourishes not only individuals but entire communities, empowering lives and cultivating a sustainable future.

Introduction

Dana Claudia Undan Dumpangol
Former Assistant Director of Food Security Unit,
Project Management Department,
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Food is more than sustenance, it is community, identity, resilience, and the promise of a better future. Behind every harvest lies the dedication of farmers, innovators, communities, policymakers, and countless others who shape how food is grown, shared, and valued.

This book brings together the diverse voices and stories that emerged from our collective journey. It is the result of many hands and minds coming together, each offering insights grounded in lived experience. From regenerative farming practices and women-led initiatives to innovations in agribusiness and Indigenous knowledge, these writings reveal not only the challenges we face but also the creativity, determination, and hope that guide our path forward.

Rooted in the APPGM-SDG Food Security Initiative, which began in 2023, this compilation reflects the impact of more than 300 community-based projects implemented across Malaysia. From community farms to beekeeping, aquaculture, and agroecological ventures, these initiatives demonstrate how local communities guided by solution providers and supported by parliamentarians and government agencies are shaping practical pathways toward resilience and sustainability.

The Food Security Conference, held from 9th to 10th November 2024, built upon this strong foundation by providing a vibrant and inclusive platform for solution providers, practitioners, academicians, and government agencies to share experiences, exchange ideas, and reflect on lessons learned in the pursuit of sustainable food systems. This book carries forward that spirit, ensuring that the knowledge generated does not remain confined within the walls of the conference hall but continues to inform, inspire, and connect. A total of 22 papers were shortlisted for presentation, reflecting diverse innovations, research insights, and community-driven efforts that collectively advance Malaysia's journey toward sustainable and resilient food systems.

Within these pages are not abstract theories, but lessons from the ground narratives of hope, practices that inspire, and ideas that can be scaled and sustained. They reflect the richness of Malaysia's communities and their invaluable contribution to building food systems that are just, inclusive, and sustainable. As readers explore these stories and reflections, may they see the many faces of resilience and be reminded that food security is not merely about feeding people, but about nourishing communities, empowering lives, and cultivating futures together.

The Food Security Conference has established itself as an essential platform for fostering collaboration among solution providers, academicians, practitioners, government agencies, and community leaders in advancing Malaysia's sustainable food agenda. Moving forward, it is recommended that the conference continues to evolve as a national hub for knowledge sharing and policy dialogue, promoting stronger multi-stakeholder partnerships that translate research and innovation into tangible outcomes. Strengthening collaboration between academia, government, NGOs, and communities will help scale successful initiatives such as community farming, composting, and agroecological training under the APPGM-SDG framework, thereby enhancing food self-sufficiency and resilience. Emphasis should also be placed on integrating technology, including digital agriculture and smart monitoring systems, to improve productivity and climate adaptability. Inclusive participation of youth, women, and persons with disabilities must remain central to future initiatives, ensuring equitable access and leadership opportunities. To sustain momentum and track progress, it is further recommended that the Food Security Conference be institutionalized as an annual event aligned with the Sustainable Development Goals (SDG 2, SDG 12, and SDG 13), continuing to inspire innovation, empowerment, and collective action toward a more resilient and food-secure Malaysia.

In closing, I wish to express my heartfelt appreciation to Mrs. Nur Farah Ezzaty for her exceptional leadership and guidance in steering the Food Security Team toward the success of this conference. My sincere gratitude also goes to the dedicated team members Ms. Nur Shaidatul Sahira Adnan, Mrs. Nur Fatehah Abd Kadir, Ms. Darshini Rawichandran, Ms. Rose Helen Ambrose, Ms. Corrin Alicia Nero, and Ms. Mc Jeanet Lempisik @ Marx for their unwavering commitment and teamwork. I would also like to extend my deepest thanks to the APPGM-SDG Secretariat Team for their steadfast support and visionary leadership under Prof. Datuk Dr. Denison Jayasooria, Ms. Rahmah Othman, and Mr. James Ryan Raj. Together, we continue to cultivate empowerment and sustainability, ensuring that every seed planted contributes to a stronger and more resilient Malaysia.

Part I:
Income Generation Strategies

Chapter 1

Income Generation through Community-Based Backyard Egg Production: A Case Study from Kampung Perlok Lama, Sungkai, Perak

Abdullah Abd Rahim

ABSTRACT

This paper presents a community-based backyard egg production project implemented in Kampung Perlok Lama, Sungkai, Perak, by Tiong Trove Family Farm. Designed to enhance food security and generate household income, the initiative equipped 10 villagers with layer chickens and training in the deep litter method, a sustainable system that reduces labor, minimizes odor, and produces organic compost as a by-product. Within five months, participants achieved consistent egg production, enabling both household consumption and sales through diverse channels such as weekend markets, food businesses, farmstays, and online platforms. The project demonstrated multiple pathways for income generation while fostering environmental sustainability and social cohesion among participants. Challenges remain, particularly the rising cost of feed and the need to scale up production to meet growing demand. Nevertheless, this initiative highlights the potential of small-scale, eco-friendly poultry farming as a model for rural development, combining entrepreneurship, food security, and community resilience.

INTRODUCTION

In many rural communities, self-sufficiency and income generation are essential for sustainable development. Tiong Trove Family Farm, based in Sungkai, Perak, embarked on a community-based project aimed at empowering villagers in Kampung Perlok Lama by helping them produce eggs in their own backyards. This initiative not only improved food security for the participants but also provided them with a source of income. Through this project, 10 villagers were equipped with the knowledge and resources needed to raise layer chickens using sustainable and cost-effective methods, primarily the deep litter method. Over the course of several months, the project became a model for income generation, environmental sustainability, and rural community development.

BACKGROUND OF THE PROJECT

The community-based project was designed to address several key challenges facing rural households: limited access to fresh produce, fluctuating income levels, and the need for sustainable waste management practices. Tiong Trove Family Farm identified egg production as an ideal solution for these challenges. Not only are eggs a nutritious source of protein, but the waste produced by chickens could also be composted to enhance crop production. The project focused on enabling villagers to raise layer chickens with minimal investment and maximum returns.

Participants were provided with layer chickens and taught to manage their coops using the deep litter method. This method, which involves the periodic addition of bedding material such as dry grass cuttings to chicken coops, was chosen for its effectiveness in controlling odor, flies, and waste. As the chickens produce waste, the bedding naturally composts over time, eliminating the need for frequent cleaning and turning the waste into valuable organic fertilizer.

METHODOLOGY: THE DEEP LITTER SYSTEM

The deep litter method was central to the success of the project. Participants were encouraged to add fresh bedding material every 2-3 weeks, ensuring that the coop remained clean and odor-free. Over time, the combination of chicken manure and bedding decomposes, creating rich compost that can be used to fertilize gardens and crops.

This system was particularly well-suited for backyard farmers, as it significantly reduces labor and maintenance. Moreover, it allowed participants to avoid the negative impacts of traditional high-density chicken farming, such as strong odours and pest infestations, which often become barriers to small-scale farmers.

In addition to its environmental benefits, the deep litter method generated a secondary income stream for participants: compost production. The compost, which is nutrient-rich, can be sold or used to improve crop yields, further enhancing the project’s sustainability.

RESULTS: EGG PRODUCTION AND INCOME GENERATION

After five months of raising the chickens, all 10 participants reported success in egg production. The chickens matured and began laying eggs consistently, allowing participants to collect enough eggs for their families and for sale. Most households were able to produce more eggs than they could consume, leading to surplus production that could be monetized.

Income generation strategies varied among our participants. A few of the most effective strategies are described below:

Pooling Eggs for Weekend Markets and Festive Events

Several participants pooled their eggs and sold them together at local weekend markets. This collective approach allowed them to reach more customers and offer a steady supply of eggs. Special events and festive occasions, where demand for local produce is often higher, provided additional sales opportunities. Pooling resources also created a stronger sense of community among participants, as they collaborated to maximize their sales potential.

Incorporating Eggs into Breakfast Menus

One enterprising villager integrated egg sale into his existing small business by using them in breakfast meals. He sold dishes like fried eggs, omelettes, and egg sandwiches, which were popular with his morning customers. This added value to the eggs while also promoting fresh, farm-to-table meals. The additional income from both egg sales and meal preparation helped diversify his revenue stream.

Selling Eggs to Farmstay Visitors

Another participant ran a small farmstay business, where campers and tourists often visited. She began offering fresh eggs to her guests, many of whom appreciated the novelty of consuming locally produced eggs. The eggs became part of the farmstay experience, enhancing the guest offering while generating additional income. This approach highlighted the potential of niche markets and tourism-based businesses to promote local agricultural products.

Promoting Eggs via Online Platforms

A particularly entrepreneurial villager took to social media to promote her eggs. Using platforms like Facebook and WhatsApp, she marketed her eggs to local buyers. In addition to selling eggs, she also offered other farm produce such as fruits and vegetables. This online strategy allowed her to reach a broader customer base and increase her sales volume. The success of this approach demonstrated the growing importance of digital tools in rural enterprise development.

POTENTIAL ADDITIONAL STRATEGIES FOR INCOME GENERATION

While the above strategies have proven effective, there is room for further innovation. Several additional income generation strategies could be explored to enhance the project's sustainability:

Value-Added Egg Products

Participants could develop value-added products like salted eggs and egg-based snacks. These products have longer shelf lives and can be sold at higher prices, offering a way to maximize the value of surplus eggs. Salted eggs are popular in Malaysian cuisine and could be a lucrative addition to the participants' product offerings

Establishing an Egg Cooperative

Forming a cooperative would allow participants to pool their resources more effectively, streamline distribution, and negotiate better prices with larger buyers such as restaurants or grocery stores. A cooperative model could also provide access to training and shared equipment, further increasing the project's efficiency and profitability.

Collaborations with Local Businesses

Partnerships with local cafes, bakeries, and restaurants could create regular demand for the participants' eggs. Such collaborations would offer stable, long-term sales contracts and reduce the uncertainty associated with selling eggs individually at markets.

Establishing a Strong Brand

There is already a good demand for eggs produced by our participants. That the eggs are sold fresh and more nutritious than commercially produced eggs are well established and accepted by consumers. A strong brand and market presence, highlighting our unique eco-friendly approach, would create loyal and long-term customers

IMPACT ON THE COMMUNITY

The project has had a significant impact on the villagers of Kampung Perlok Lama. By participating in the project, villagers not only improved their household food security but also developed new streams of income. The process of raising chickens, managing coops, and selling eggs instilled a sense of ownership and entrepreneurship among the participants.

Moreover, the environmental sustainability of the deep litter method encouraged participants to embrace eco-friendly farming practices.

The production of organic compost helped improve soil quality and crop yields, contributing to the overall health of the local ecosystem. The social impact of the project was equally significant. The participants developed strong bonds as they worked together to solve challenges, pool resources, and share knowledge. The sense of community fostered by this collaboration will likely have long-term benefits for Kampung Perlok Lama as the villagers continue to support each other in their agricultural endeavours.

CHALLENGES

The project has its share of challenges, particularly with regards to:

Increasing cost of formulated layer feed

The price of formulated layer chicken feed has stayed relatively stable in the last 12 months. However, a few participants occasionally mix their formulated layer chicken feed with other less nutritious ingredients such as expired bread to reduce cost. This practice has affected daily egg production to a certain extent. A course on poultry nutrition and feed formulation using locally available feed sources, is being planned to address this issue.

Scaling-up to increase egg production

There is a growing interest among the villagers in purchasing fresh and better tasting eggs from our deep litter coops. Demand has risen more than supply. Some participants are already planning to build additional coops with their own funds or funds from the government, through agencies such as RISDA and SeJati MADANI programs.

CONCLUSION

The success of the backyard egg production project in Kampung Perlok Lama demonstrates the potential for small-scale, community-based agricultural initiatives to generate income, improve food security, and promote environmental sustainability. Using the deep litter method and creative marketing strategies, participants were able to generate multiple streams of income from their egg production. Moving forward, the project serves as a model for other rural communities seeking to build self-sufficiency and economic resilience through sustainable agriculture. By encouraging innovation and entrepreneurship, this project has not only improved the livelihoods of its participants but also laid the foundation for future growth and collaboration.

Chapter 2

Knowledge Transfer on Vegetable Production and Marketing for the Community at Parliament Libaran (P.184) Sandakan, Sabah

Siti Suliza Salamat, Mohd Rakib Mohd Rashid, Mohd Ilmas Abdurofi, Hendry Idol, Sholehuddin Fatih Mardin, Munah Nasri, Anika@Flora Bulangou, & Fatimah Jindang

ABSTRACT

The proposed project is another knowledge transfer program by the Faculty of Sustainable Agriculture, Universiti Malaysia Sabah to the community, related to vegetable production and marketing, that will benefit the communities of Parliament Libaran (P.184). Food safety is one of the main issues today where the demand exceeds the supply of vegetables in the local market. Short-term measures need to be worked on by establishing vegetable planting areas for each specific place. Cooperation between government bodies including universities that have expertise in the field of agriculture need to work with the community to produce vegetable stock in the area. The primary goal would be to address the needs of attracting interest in local farmers, entrepreneurs, and students in Parliament Libaran (N.184), Sandakan Sabah, to support the community in improving their vegetable production and marketing practices. Community engagement experience enables solution providers with relevant competence and extensive engagement to work directly with the local community in Parliament Libaran. They have engaged with students, farmers, small-scale agricultural enterprises, and other stakeholders to understand their challenges, requirements, and aspirations related to vegetable production and marketing. The solution provider has a team of researchers and supporting staff from a local university in agricultural

expertise with extensive knowledge and experience in various aspects of vegetable production. They are well-versed in modern and sustainable agricultural practices, crop management, pest control, irrigation techniques, and soil health improvement. This project provider's training and capacity-building experience will involve conducting training programs and capacity-building workshops for the local community in Sungai Manila. These sessions will cover a wide range of topics, including crop selection, planting methods, cultivation best practices, and post-harvest handling to ensure quality produce. The solution provider has experience in conducting market research to understand the demand for various vegetables in the local and regional markets. They are skilled in developing effective marketing strategies to help farmers promote and sell their produce successfully. The success of the project relies on strong community engagement. The solution provider will collaborate closely with the farmers and stakeholders. Finding from grant APPGM-SDG our community at Sungai Manila (Parliament Libaran) had increase production of vegetable including salad, mushroom, mustard and water spinach. Tamu as Pasar agreement with Faulty of Sustainable Agriculture, KESUMBA with Fama provider solution for selling product. One of our participants get grant from University Muhammadiyah Makassar RM8,000 for increasing facility of hydroponic and one of Sekolah Menengah Kebangsaan Libaran get grant from Universiti Malaysia Sabah RM10,000 for increasing production of mushroom.

INTRODUCTION

The Knowledge Transfer Universiti Malaysia Sabah (UMS) to Community is on Vegetable Production until Marketing and Selling at Parlimen Libaran (P.184). Four villages with two participants will be a pilot project at Kampung Peringkat 1, Kampung Peringkat 2, Kampung Peringkat 5, and Kampung Tanjung Pisang with a land area of 0.25ac for each participant. Two candidates from secondary schools with an agricultural science subject. One participant from Sekolah Menengah Kebangsaan Libaran and one participant from Sekolah Menengah Gum-Gum. Food safety is one of the main issues today where the demand exceeds the supply of vegetables in the local market. Short-term measures need to be worked on by establishing vegetable planting areas for each specific place. Cooperation between government bodies including universities that have expertise in the field of agriculture need to work with the community for the production of vegetable stock in the area. The primary goal would be to address the needs of attracting interest in local farmers, entrepreneurs, a student in Parliament Libaran (N.184), Sandakan Sabah, to support the community in improving their vegetable production, marketing, and selling practices. Community engagement experience enables solution providers with relevant competence and extensive engagement to work directly with the local community in Parliament Libaran. They have engaged with students, farmers, small-scale agricultural enterprises, and other stakeholders to understand their challenges, requirements, and aspirations related to vegetable production and marketing.

For awards received as a community-focused organization, the solution provider may have been recognized for its contributions and achievements. Awards and accolades received could be related to their positive impact on the livelihoods of local farmers, their efforts in promoting sustainable agriculture, and their successful initiatives in improving marketing and selling practices within the community.

The solution provider includes a team of researchers and support persons from a local university in agricultural expertise with extensive knowledge and experience in various aspects of vegetable production. They are well-versed in modern and sustainable agricultural practices, crop management, pest control, irrigation techniques, and soil health improvement. This project provider's training and capacity-building experience will involve conducting training programs and capacity-building workshops for the local community in Sungai Manila. These sessions will cover a wide range of topics, including crop selection, planting methods, cultivation best practices, and post-harvest handling to ensure quality produce. The solution provider has experience in conducting market research to understand the demand for various vegetables in the local and regional markets. They are skilled in developing effective marketing strategies to help farmers promote and sell their produce successfully. The success of the project relies on strong community engagement. The solution provider will collaborate closely with the farmers and stakeholders. Two-way communication listening to their needs, understanding their challenges, and involving them in decision-making processes to create a sense of ownership and empowerment. Sustainability and Environmental Considerations: As an experienced solution provider, priority will be given to sustainable agricultural practices, aiming to minimize environmental impact and promote biodiversity conservation. We would also encourage the use of eco-friendly methods and technologies. Monitoring and Evaluation: To ensure the effectiveness of the project, the solution provider would employ robust monitoring and evaluation mechanisms. This would help assess the progress, identify areas for improvement, and make necessary adjustments to achieve project goals. Networking and partnerships experience might include government agencies, NGOs, and other relevant stakeholders. Collaborative efforts could enhance the project's impact and reach, leading to more comprehensive support for the local community.

METHOD

The partner of the collaborative community services between Faculty Sustainable of Agriculture, Universiti Malaysia Sabah, Unit Kepimpinan

Pembangunan Masyarakat Kawasan Dun N51 Sungai Manila Sandakan, Sandakan District Education Offfice, Kelab Suri Rumah dan Staf Wanita (Kesumba) and Lembaga Pemasaran Pertanian Persekutuan (FAMA) with dan fund given by APPGM SDG with RM40,000. The 10 participants of the activity planting water spinach, green mustard using hydroponic system, mushroom production, organic fertilizer, marketing strategy and Tamu at Faculty Sustainable of Agriculture UMS for direct selling are around the partner's location. This community service activity will be carried out from September 2023 until March 2024 including socialization activities and implementation of the planting as well as assistance in recording the business. The socialization activity was carried out on September 1, 2024. The socialization was divided into 3 phases, namely: 1) three months for active phase; 2) three months for monitoring; 3) three months for strengthening.

The implementing team for this collaboration community service activity consists of lecturers and students from two universities, namely the Faculty of Sustainable Agriculture, Universiti Malaysia Sabah, is Majlis Perbandaran Sandakan (MPS), Pejabat Pendidikan Daerah Sandakan (PPDS), Chairman Tamu Kesumba FPL, and Chairman of the Manila River Community Leadership Unit N. 51, FAMA Sandakan.

The economic feasibility study was conducted by analysing the cost structure and revenue potential of the community-based project. The assessment began with the identification of fixed costs, variable costs, and the calculation of total cost, which represents the overall financial requirement needed to operate the activity. Fixed costs include expenses that remain constant regardless of production levels, such as equipment, tools, and basic infrastructure. Variable costs, on the other hand, consist of expenditures that change according to production volume, including raw materials, labour inputs, and operational supplies. These two components were combined to determine the total cost (TC) for the project.

To evaluate the income-generating potential of the activity, a revenue analysis was carried out. This analysis measured the projected gross income based on the selling price of the product and the quantity produced. Total revenue was calculated using the standard equation:

Revenue analysis to see the amount of gross income business uses the following equation:

$$TR = PQ$$

Where:

TR = Total Revenue (RM)

P = Sales price (RM/kg)

Q = amount of production (kg)

By comparing the estimated total revenue with the total cost, the study determines whether the project is financially viable, profitable, or requires further intervention to improve its sustainability. This method provides a systematic approach to understanding the economic potential of the community activity and forms the basis for subsequent analysis, discussion, and decision-making.

Figure 2.1. Participant Knowledge Transfer on Vegetable Production and Marketing for the Community at Parliament Libaran (P.184) Sandakan, Sabah.

Figure 2.2. Production of water spinach using bedding system

Figure 2.3. Production of green mustard using hydroponic system

Figure 2.4. Mushroom Cultivation at Mushroom Research Facility at Faculty Sustainable of Agriculture, Universiti Malaysia Sabah


Figure 2.5. Production of organic fertilizer at community and Compost Research and Commercialization Facility at Faculty Sustainable of Agriculture, Universiti Malaysia Sabah

Figure 2.6. Marketing Strategy through online marketing and Tamu Kesumba/ Tamu Uptown @MyRakyat every month at Faculty Sustainable of Agriculture at Universiti Malaysia Sabah

RESULTS DAN DISCUSSION

Community service activities begin with an opening that explains the aims and objectives of community service activities to target partners from September 2023 until March 2024. This activity aims to share experiences between the implementing team and partners in water spinach cultivation, mustard cultivation, mushroom cultivation, and organic fertilizer production.

Table 2.1. Types of Vegetables Produced for Each Candidate

Candidate	Vegetable	Jan-24	Feb-24	Mar-24	Apr-24	Total	Price	Income	Total
SMK Gum-Gum	Water Spanich	-	1.0 kg	2.00 kg	2.00 kg	5.00 kg	RM5.00	RM25.00	
	Green Mustard	-	2kg	2kg	2kg	6.00 kg	RM10.00	RM60.00	RM100.00
	Mushroom	-	0.5 kg	0.5 kg	0.5kg	1.5 kg	RM10.00	RM150.00	
SMK Libaran	Water Spanich	3.2kg	3.6kg			6.8kg	RM2.50	RM23.00	
	Green Mustard	1.2 kg	1.8 kg	12.1		15.1kg	RM6.00	RM68.30	RM436.50
	Mushroom	2.9	3.1	7		15kg	RM15.00	RM156.20	
	Chilli Seedling				189	189 pokok	RM1.00	RM189.00	
En Rosli Yusof	Salad	-	40kg	40kg	40kg	120kg	RM15.00	RM1,800	RM2,700.00
	Green Mustard	-	30kg	30kg	30kg	90kg	RM10.00	RM900	
Puan Siti Syahidah Ulas	Water Spanich	10kg	20kg	7kg	5KG	42kg	RM5.00	RM210.00	
	Green Mustard	3kg	5kg	1kg	-	9kg	RM5.00	RM45.00	RM370.00
	Mushroom	-	5kg	2kg	500 kg	7.5kg	RM10.00	RM75.00	
	Chilli Seedling	-	-	3kg	1kg	4kg	RM10.00	RM40.00	
En Jailie Baharlin	Salad	30kg	30kg	30kg	30kg	120kg	RM15.00	RM1,800.00	
	Green Mustard	40kg	40kg	40kg	40kg	160kg	RM10.00	RM1,600.00	RM5,160.00
	Water Spanich	10kg	10kg	10kg	10kg	40kg	RM5.00	RM200.00	
	Pak Choy	30kg	30kg	30kg	30kg	120kg	RM10.00	RM1,200.00	
	Patshai	15kg	15kg	15kg	-	45kg	RM8.00	RM360	
Puan Masitah	Water Spanich	10kg	10kg	10kg	9kg	39kg	RM6.00	RM234.00	
Binti Zainal Abidin	Green Mustard	5kg	5kg	5kg	5kg	20kg	RM8.00	RM160.00	RM614.00
	Cendawan	4.5kg	2.0kg	2.0kg	2.5kg	11kg	RM20.00	RM220.00	
En Rosle Lado	Water Spanich	-	60kg	70kg	80kg	210kg	RM15.00	RM3,150.00	
	Green Mustard	-	70kg	85kg	110kg	265kg	RM10.00	RM2,650	RM5,809.93
	Mushroom	0.213g	-	0.180g	-	0.393g	RM10.00	RM3.93	
	Water Spanich	5kg	5kg	5kg	5kg	25kg	RM6.00	RM150.00	
En Zainal Abidin	Green Mustard	-	-	5kg	5kg	10kg	RM6.00	RM60.00	RM1,117.00
En Harun	Mushroom	0.5kg	1.0kg	1.0kg	0.7kg	3.2kg	RM10.00	RM32.00	
	Seedling	-	-	20 pokok	155 pokok	175 pokok	RM5.00	RM875.00	
Total									**RM16,307.43**

WATER SPINACH CULTIVATION

Although this practice is common around the world, it remains unpopular in Malaysia due to a lack of community awareness and engagement. Through this project, the first activity to produce water spinach using bedding system to community by figure 2. This activity for improving the well-being of both the community and the natural environment. Participances can cultivate several basic culinary vegetables that are simple to plant and care for, such as water spinach (kangkong). In general, farms can range from tiny individual setups in the rear of a house to cooperatives administered by community groups or citizens, as well as interior vertical farms (Nurafifah, 2020). Table 2.1 shown results candidate can produce water spinach consistently every month. Event production at candidate from Sekolah Menengah Kebangsaan Gum-Gum and Sekolah Menengah Kebangsaan Libaran until 11.8 kg and other candidate total production of water spinach 365 kg. This plant may be planted in a planter box to provide daily meals and decrease daily expenses. Sow the seeds in a seed tray or immediately into a medium-sized pot. Make careful to leave at least 3 inches between each seed (Kean, 2023). They germinate quickly, usually within a few days. In a few more days, move the seedlings to a sunny location outside (Anim, 2020). Water spinach can be grown using cuttings. When shopping at the market, choose a healthy bundle of water spinach leaves. Use the leaves for cooking but keep the top 6-inch section up to the fourth leaf node. Soak the lower end of the cuttings in water for a week, changing the water every few days. As soon as the roots emerge, transplant the cuttings to the ground or into a container filled with thick loamy soil. Water spinach can be grown in a container, which is the easiest method. When planting in a container, use a rich loamy soil amended with compost. Select a container with at least 12 inches of depth and diameter. The plant can thrive in either partial or full sun, however at least 4 hours of sunlight is recommended for it to produce additional leaves. Water the soil regularly to keep it moist. Water deeply to ensure that the roots reach their deepest point. During the hot and dry summer months, it is necessary to water every day (Anim, 2020). On the other hand, frequently takes place on vacant property, whether private or public, or in spaces like squares, parks, and schools. The underlying premise here is that many people each devote a short amount of time to working on their plots and reap the benefits of their efforts (Nurafifah, 2020).

MUSTARD CULTIVATION

Mustard plant (*Brassica spp Linn*.) is one of Malaysia's most popular leafy vegetables, alongside kailan, kangkong, spinach, and a few others (Pertubuhan Berita Nasional Malaysia, 2021). The requirement for mustard cultivation is a common concern faced by communities, particularly schools, as well as communities living in urban areas such as apartments and terraces. For school activities or communities living in building areas such as apartments and terraces, used bottles such as oil bottles, mineral bottles, gallons, and others can be planted. Bottles that are no longer in use should not be discarded; they can be recycled and reused for a variety of reasons (Pertubuhan Berita Nasional Malaysia, 2021). Table 2.1 shown production of green mustard at Sekolah Menengah Gum-Gum and Sekolah Menengah Libaran using bedding system 21 kg. Using hydroponic system for planting mustard green production given 573 kg from January 2024 until April 2024 573 kg. Hydroponics is a technology for cultivating plants without soil to produce high-quality, healthy, fresh and residue-free vegetables (Khan, Purohit, and Vadsaria 2020). Hydroponics is a farming technique without using soil by flowing nutrients to plant roots to support plant growth nutrients (Folorunso et al. 2023). And mustard greens can be harvested at 36-40 days old (Anim, 2020). Federal Territory of Kuala Lumpur (Jabatan Pertanian, 2016) looking Malaysia's activity project execution is now increasingly concentrated in high-density settlement regions with no space for farming. As a result, there are various varieties of vegetable crops that are easy to cultivate in using hydroponic system, including mustard plants.

MUSHROOM CULTIVATION

The organization of basic mushroom cultivation courses among communities, especially in rural areas, can help improve the opinion and economy of the local community. Sabah Rural Development Minister Datuk Jahid Jahim said this was because the participants were able to add new knowledge, especially in the manufacture of related food products. The Minister asserts that the participants can utilize the acquired knowledge to generate income and enhance the local economy (Sabah Media, 2023). Indeed, it is not wrong to choose a mushroom cultivation course by using blocks; in fact, this is a golden opportunity to gain as much knowledge as possible. Table 2.1 shown total production of mushroom for all candidate 31.09 kg. This implemented program will benefit and help the community develop themselves and their families through the expertise of modern farmers Figure 2.4. If the growing of this mushroom is done carefully, it will undoubtedly benefit entrepreneurs. Mushroom farming is distinctive and straightforward, making it easy to mimic. When combined with entrepreneurs ready to learn expertise from established mushroom growers, this will undoubtedly result in the formation of new mushroom producers. Making mushroom blocks and a mushroom house is a simple process, allowing people from all walks of life to cultivate mushrooms. Over time, the dumping of fresh mushrooms in one location has resulted in severe competition for the selling of both mushrooms and raw materials (Zalina *et al.,* 2021).

ORGANIC FERTILIZER PRODUCTION

On this project production of organic fertilizer from chicken manure and application on water spinach and green mustard. Figure 2.5 shown production organic fertilizer at community and production at Compost Research and Commercialization Facility at Faculty Sustainable of Agriculture, Universiti Malaysia Sabah. Organic fertilizers are materials with a specific chemical composition and high nutritional value that can offer sufficient nutrients for plant growth (Moller and Schultheiss, 2015; Rajan and Anandhan, 2015). Organic fertilizers were mostly created by composting animal dung, human excrement, or plant materials (such as straw and garden waste) with microbes that fermented at high temperatures (Chew *et al.,* 2019). Organic fertilizers improve soil structure, supply a variety of plant nutrients, and introduce helpful microbes into the soil. Organic fertilizers are commonly utilized in agriculture due to their benefits for soil structure and crop output (Brar *et al.,* 2015; Maltas *et al*., 2018). Furthermore, organic fertilizer can be generated from animal waste, such as goat dung, chicken excrement, cow manure, and so on. The Sustainable Development Goals (SDGs) are being implemented to ensure that natural resource production and usage are done sustainably in order to increase efficiency, construct sustainable infrastructure, and improve people's quality of life. Furthermore, it can assist achieve comprehensive development objectives while lowering long-term environmental, economic, and social costs, so conserving resources for future generations to exploit. Domestic solid waste in Malaysia is made up of around 40% to 60% food waste and organic matter (Harist *et al*., 2023). It is extremely important to reduce this amount and convert it into useable material so that the expense of eliminating waste can be reduced, preventing it from being delivered to landfills frequently. Composting is a natural method for recycling organic materials. It is the process by which microbes degrade organic molecules in the presence of oxygen (Chew *et al.,* 2019). As a result, this composting process will aid the environment by providing natural fertilizer for plantations and agriculture. This training session allows the community to gain knowledge and expertise in compost fertilizer preparation, which they can then use to their daily life.

MARKETING

The majority of our farmers sell their produce to intermediaries or at fresh outlets like Tamu at Sabah as farmers' markets. One strategy for marketing fresh vegetable by direct from farm to consumer with collaboration with Kelab Suri Rumah dan Staf Wanita (KESUMBE) under Faculty Sustainable of Agriculture, UMS and Federal Agricultural Marketing Authority's (FAMA) create Tamu Kesumba and Tamu Uptown @Myrakyat one a month to help our candidate sell their product Figure 5. Class marketing strategy online given by Madam Dina Melisa from E-Usahawan Coach MDEC. Farmers must pick other marketing methods, such as web marketing, to ensure that their products can be marketed while their income remains unaffected. In terms of availability, there are currently 28.7 million Internet users in Malaysia (Nolila, 2020). This enables farmers to market their products more effectively through internet sales. Farmers should take advantage of this chance to ensure that their sales are unaffected and that it becomes a best practice in the future. Farmers and other food supply chain partners must use the Federal Agricultural Marketing Authority's (FAMA) Agrobazaar Online program (FAMA, 2024). The Agrobazaar Online platform provides a new and sustainable market for agricultural products by creating an online business community to improve the community's quality of life. This virtual marketing platform for agricultural and agro-food products successfully finds producers, manufacturers, suppliers and consumers simultaneously (FAMA, 2024). The Malaysian Internet Entrepreneurs Association is also said to have established a new business model for selling raw commodities in bulk, such as vegetables purchased from farmers or suppliers. They then market the goods online, with a firm within the organization functioning as the logistical provider. This is one of the measures underway to ensure that customers continue to have access to, use, and stability in their food supply. Agricultural entrepreneurs must also do value-added activities on their produce, such as grading to assure uniform quality and packaging to entice consumers to purchase (Nolila, 2020). Such activities can assist agricultural entrepreneurs in maintaining control and increasing the selling price of their products. Agricultural entrepreneurs can conduct online buying and selling activities using social media. Online marketing via social media facilities does not require large expenses or operational skills, allowing agribusiness owners to contact and conduct sales transactions with their clients more conveniently, swiftly, and efficiently. The country's current condition of using advanced technologies and food supply chain travel for fresh produce necessitates that farmers and marketers take proper precautions to ensure that the harvest can be sold (Azni *et al.,* 2014). They cannot rely just on the marketing channel that is most convenient or appealing to them at the time; instead, there should be a variety of optional channels, such as web marketing, that can be used.

CONCLUSION

In conclusion, the knowledge transfer initiative on vegetable production, particularly focusing on water spinach, green mustard, mushrooms, and organic fertilizers, has shown significant potential in enhancing both agricultural productivity and marketing opportunities for the community at Parliament Libaran (P.184) in Sandakan, Sabah. By equipping local farmers with modern, sustainable farming practices, this program has empowered them to improve the quality and yield of their crops, thereby increasing their income-generating capacity. Moreover, the focus on organic fertilizer use not only promotes environmentally friendly farming practices but also positions the local produce as a healthier and more marketable alternative to conventional crops. This could lead to stronger market positioning both locally and potentially in wider markets, enhancing the community's economic stability. Additionally, through knowledge transfer in marketing strategies, community members are now better equipped to engage with consumers, understand market demand, and improve their selling techniques. The overall impact of this program extends beyond agricultural production, fostering self-sufficiency, improving food security, and boosting the socio-economic development of the community. Continuous support and monitoring, alongside further education on market trends and crop management, will ensure that the community can sustain and expand their agricultural activities in the long run.

ACKNOWLEDGEMENT

Thank you to the All-Party parliament Group Malaysia (APPGM-SDG) given RM40,00 under No.Vot: Y23-KK064. Faculty of Sustainable Agriculture, Universiti Malaysia Sabah for their willingness to collaborate with Sandakan Municipal Council, Unit Kepimpinan Pembangunan Masyarakat, Kawasan Dun N51 Sungai Manila, Sandakan District Education Office, Wisma Persekutuan, Kelab Suri Rumah dan Staf Wanita (KESUMBA) and Federal Agricultural Marketing Authority's (FAMA), Sabah. Special thanks for Muhd Azizan Omar, Nurain Nabilah L U Jamil and Ummul Khairah Kamal as Facilitator during this project.

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Part II:
Best Practices in Sustainable and Regenerative Farming

Chapter 3

SJK(T) Sungai Ara Agro School Project: Sustainable Transformation

Elias Alexander @ Richard

ABSTRACT

The SJK(T) Sungai Ara Agro School Project is a pioneering community-based initiative that integrates sustainable agriculture into primary education. Established in collaboration with the All-Party Parliamentary Group Malaysia–Sustainable Development Goals (APPGM-SDG), the project transformed a neglected and hazardous school plot into a thriving Agro Park. Since its inception, the initiative has empowered students through hands-on agricultural learning, cultivated biodiversity, and aligned with key Sustainable Development Goals (SDGs), including climate action, sustainable communities, and life on land. The project has generated both educational and economic benefits, producing over 3,300 kg of vegetables and nearly RM10,000 in revenue within its first year. Beyond its measurable outputs, it has strengthened community engagement, fostered cultural preservation, and elevated the school's profile through national recognition and awards. By combining resilience, innovation, and collaboration, the Agro School Project demonstrates how grassroots educational initiatives can drive sustainability, enhance learning, and inspire broader social transformation.

THE BEGINNING: A VISION AMIDST ADVERSITY

The Agro School Project under Y23-KK 186 under the P052 Parliamentary constituency led by YB Sim Tze Tzin, MP for Bayan Baru, Penang, was born out of necessity. Behind our school lay a neglected plot of land, transformed over time into an unmanaged dumping ground, a chaotic mini jungle littered with construction debris, discarded items, and waste. This neglected space posed significant risks to the school community. Snakes frequently entered classrooms, storerooms, and open spaces, endangering students and teachers. Fire department interventions became a regular necessity. Faced with these challenges, our Headmaster, my wife, and PIBG Chairman proposed an inspiring yet ambitious idea: transform the mini jungle into an “Agro Farm” that would serve as both an educational resource and a revenue-generating project. While the concept ignited excitement, the challenge of securing funding loomed large.

THE SPARK OF HOPE: SUPPORT FROM APPGM-SDG

Despite our enthusiasm, initial attempts to secure funding were unsuccessful. It was then that the All-Party Parliamentary Group Malaysia-Sustainable Development Goals (APPGM-SDG) extended a lifeline with a grant of RM40,000. This generous contribution was the spark we needed to turn our vision into a structured project.

However, the journey to approval was far from easy. Our initial proposal, submitted in July 2023, faced rejection four times, requiring five resubmissions over five months. It was only in November 2023 that we finally received official approval. With this support, we formalized our commitment through a Memorandum of Understanding (MOU) with APPGM-SDG, setting the stage for transformative change.

THE GRAND INAUGURATION

On 23rd June 2024, the Agro Park at SJK(T) Sungai Ara was officially inaugurated by YB Dato Seri S. Sundarajoo, Exco for Housing and Environment in Penang, and Dato' Ir. Rajendran P. Anthony, Mayor of Penang Island City Council. The event celebrated the school’s transformation and symbolized the potential of grassroots sustainability efforts. Guests were deeply impressed by the project’s impact, which had become a beacon of community spirit and innovation.

EMPOWERING STUDENTS: HANDS-ON LEARNING AND RESPONSIBILITY

Central to the Agro School Project is hands-on learning. Students participate in every stage of the agricultural process, from planting seeds to harvesting crops. They gain valuable skills in teamwork, patience, and problem-solving. The harvested produce is sold to parents, and some parents have even volunteered to sell crops at local markets.

The farm grows a diverse array of crops, including okra, red spinach, small eggplants, sweet potatoes, and kangkung. This variety not only educates students about agriculture but also highlights the importance of biodiversity. Through active involvement, students develop a deep sense of ownership and pride in their contributions.

ALIGNING WITH SUSTAINABLE DEVELOPMENT GOALS (SDGS)

The Agro School Project aligns with several SDGs, demonstrating its broader relevance:

1. SDG 11 - Sustainable Cities and Communities: The project exemplifies community-driven initiatives aimed at creating inclusive, safe learning environments.
2. SDG 13 - Climate Action: By practicing sustainable farming, the project raises awareness about climate action among students.
3. SDG 15 - Life on Land: Organic farming techniques help preserve soil quality and promote biodiversity.
4. SDG 17 - Partnerships for the Goals: Collaboration with APPGM-SDG and local stakeholders underscores the power of partnerships in achieving shared objectives.

KEY HIGHLIGHTS AND COMMUNITY IMPACT

The Agro School Project is not only unique but also serves as a model of innovation in education:

1. Pioneering Effort: We are proud to be the first Tamil school in Malaysia to undertake an Agro School Project. This milestone highlights our commitment to bringing agricultural education into a traditional schooling environment.
2. Educational Impact: The project goes beyond academics by teaching students' practical skills in agriculture and sustainability, preparing them for the future.
3. Community and Stakeholder Engagement: Our collaboration with APPGM-SDG is a vital part of the project's success, bringing in expertise, resources, and networking opportunities.
4. Cultural and Social Impact: By integrating agriculture into our curriculum, we preserve our cultural heritage while promoting modern skills and ADAPTABILITY.

CHALLENGES AND SOLUTIONS

The journey was not without its hurdles:

- Extreme Heat and Drought: Penang's climate, with temperatures soaring to 38 - 40°C, made planting challenging. Installing a pump system to draw freshwater from a nearby river resolved this issue, ensuring reliable irrigation and improved crop yields.
- Land Department Regulations: Questions about land use were addressed through collaboration with the Land Officer, emphasizing the project's benefits for the school and community.
- Parent Participation: Initial resistance to weekend market involvement was overcome through rotational schedules, fostering stronger engagement.
- Vendor Collaboration: Building trust with local vendors is ongoing, with efforts focused on improving partnerships.
- Organic Farming: Avoiding pesticides presented challenges, but the adoption of organic fertilizers and sustainable methods ensured the crops were safe and environmentally friendly.

ACHIEVEMENTS AND RECOGNITION

Since April 2024, the Agro School Project has:

- Generated nearly RM10,000 in revenue.
- Produced over 3,334 kg of vegetables.

We were thrilled to receive recognition from notable officials, including Ybhg Dato' Haji Abdul Said bin Hussain, the Director of the Penang State Education Department, who visited the school with other PPD & JPN Officers, praised the school's progress in education and sustainable agriculture.

In July 2024, the project gained national recognition through a feature in *The Star* newspaper.
https://www.thestar.com.my/metro/metro-news/2024/07/30/farming-to-keep-out-pests

Notable achievements include:

- 4th Place in AGRO STEM Sekolah Rendah: Recognized for our innovative aquaponics prototype
- Anugerah Harapan Institusi Pendidikan Madani: Awarded as the sole Tamil school in Malaysia to receive this prestigious accolade
- Top 5 Primary Schools in Penang
- 2 prestigious Awards from The Penang Green Council for Our Commitment to Sustainability and Environmental Education

FUTURE ENDEAVOURS: EXPANDING OUR VISION

Building on our success, we look to the future with ambitious plans:

- On-going Collaboration with the Department of Agriculture on a hydroponics project in 2025
- Partnering with Petronas and the Penang State Government for a used oil recycling campaign, earning commendation from Petronas' Head of Sustainability

CONCLUSION AND OUR HUMBLE GRATITUDE TO APPGM-SDG TEAM

Our gratitude extends to the APPGM-SDG team, particularly Mr. James Rayan Raj, Puan Rose Helen Ambrose, Puan Dharshini Rawichandran, Puan Dana, and Puan Nur Farah Ezzaty, whose guidance has been invaluable. Together, we have embedded sustainable development into the heart of SJK(T) Sungai Ara. The Agro School Project at SJK(T) Sungai Ara stands as a testament to the power of resilience, community, and innovative education. What began as a dream to clear an overgrown patch of land has blossomed into a thriving agricultural initiative, fostering skills, generating income, and serving as an inspiration for sustainable practices within the school and the community. Our journey does not end here. We have completed our Science Lab Transformation to Enhance Learning and Promote Sustainable Development (SDG) in collaboration with APPGM-SDG and the ongoing AI Explorers – Future Innovators Program, taking yet another step toward a holistic, inclusive educational environment and Technology. This project has shown us that through determination, collaboration, and a vision for a better future, we can create lasting, meaningful changes in our school communities.

Chapter 4

The Empowerment and Transformation of Beneficiaries via Community Farming: What We Have Learnt So Far

Siti Baizura Mohd. Rafi, Eleena Norsin, & Alia Azmi

ABSTRACT

Community farming or gardening has long been acknowledged as one of the sustainable solutions to the increasingly urbanized global ecosystem. In fact, gardening, either as a solitary endeavour or as a social activity, has been linked to better physical and mental health output, stronger community resilience and cohesion, as well as improved food security. However, most scientific literature on community farming focuses on the impact of well-established projects, with measured outputs and long-term impact assessment. For those of us keen to start a community gardening, much is needed to be made available. How do we start? What do we need? To answer these questions, this article presents an initial report of the development of a community farming project located in Olak Lempit, Banting. Starting from the initial creation of a community space as well as growth and skills enhancement; the community farm has grown to include both vegetable farming as well as poultry. Although benefitted from grants and skilled educators, the farm is also challenged by the allocation of suitable space, motivation as well as equipment and manpower, among others. However, initial response from participants have been positive, and an emphasis on sustainable and regenerative farming is expected in the future.

INTRODUCTION

A community farm is an age-old practice that brings a community of people together to produce food. Benefiting from a diverse range of members' background, community farms have the means to provide social, physical and cultural benefits, as well as economic benefits to its members, creating a mutually beneficial relationship. Unfortunately, most community farming initiatives often face resource shortages, prompting members to contribute whatever they can to ensure that the goals are achieved. Contributions can include financial support, labour, innovative ideas, practical execution, knowledge, and farming expertise. Community farming initiatives that lack resources can lead to a decline in motivation, ultimately hindering their progress toward becoming a sustainable community farm.

In Malaysia, despite her history of agricultural production, community farming has yet to be entrenched as part of the culture. However, in recent decades, more and more effort has been made by both government institutions and private to encouraged community to be a part of community farms. One such effort is via the funding of grants by organizations such as APPGM-SDG who established a grant scheme with the aim of empowering beneficiaries to become local SDG heroes, developing grassroot beneficiaries to succeed in both farming and food security. This grant provided the funds to create the "Kebun Komuniti (Kebuniti) Bukit Changgang", located in Bukit Changgang, Banting, and is wholly managed by beneficiaries from the surrounding community, with TT Organics as a solutions provider.

At the start of the program, approximately 15 beneficiaries (participants) were selected and participated in the community farming program, all of whom had diverse occupational backgrounds, age groups (see Figure 4.1), an almost equal split between male and female, and are within the B40 income range (see Figure

4.2). Focusing on sustainable and regenerative agricultural practices, the community farm initially started on an 0.1 acre land (approximately 4,500 sqft) donated by a landowner in Bukit Changgang. The selection process involved interviews to those within the vicinity of Sepang / Kuala Langat who are interested in venturing in the community farming initiative.

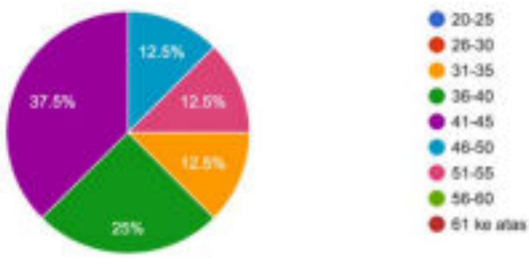

Figure 4.1. Participants with different age groups. Most age group recorded is between 41-45 years old

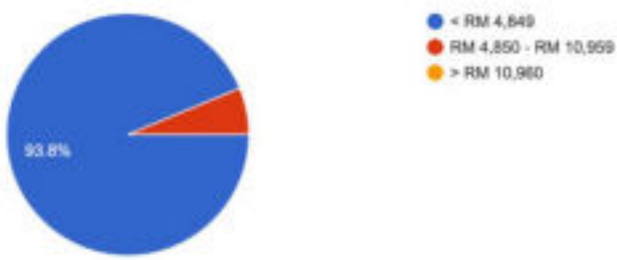

Figure 4.2. Over 90% of participants responded are within B40 group of income

Initial implementation of the program proved to be successful, however, within 6 months of activity, the community farm was relocated to another area within 5 km radius of Bukit Changgang, due to frequent flash floods occurring during the monsoon season affecting the crops. This marks the first initial problem faced by the community farm, in which a suitable location needed to be identified as well as analysed, prior to the establishment of the farm. After initial searching for a new location, a landowner who wishes to participate in community farming has generously offered a small portion of his land for the development of the community farm. This then allowed the community to establish a new farm in Kampung Olak Lempit, located in the district of Kuala Langat. Named after the nearby river (Sungai Lempit), this area is home to a population of 5,637 residents, the majority of whom are of Javanese descent. As reported by the Kuala Langat District and Land Office (2024), Olak Lempit is a vibrant, industry focused area that hosts over 50 industries, primarily centred around wood, steel, electronics, rubber, and palm oil. Based on the assessment of 2,289.84 acres of land in Olak Lempit (see Figure 4.3), at least 50% of the area is allocated for agricultural purposes, including estates and small farms. The remaining land comprises of residential areas, community development centres (such as schools, community centres and mosques), as well as commercial zones.

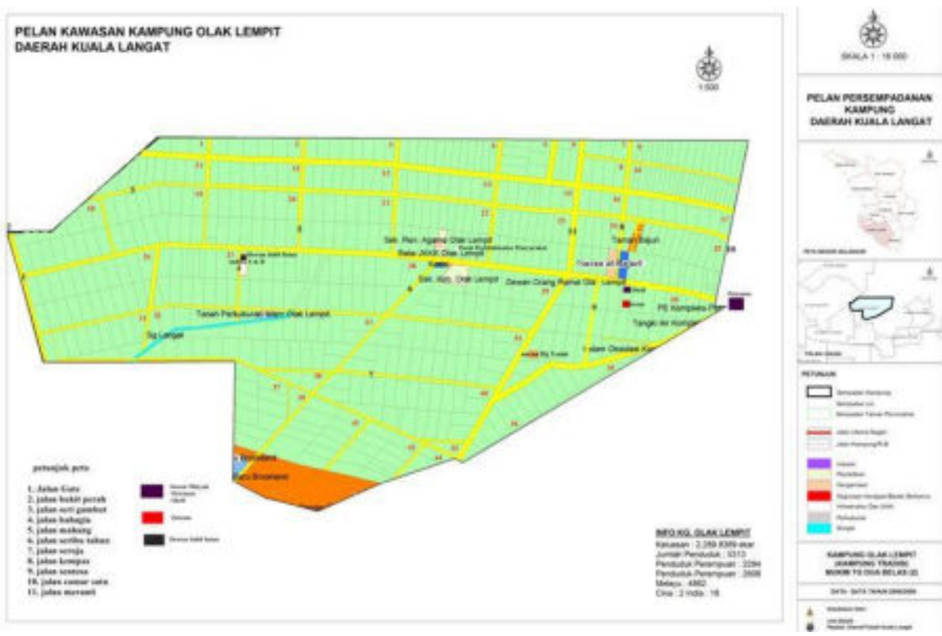

Figure 4.3. Kampung Olak Lempit

Farming has a long-standing presence in the Kuala Langat area, with over 100 small farmers residing in Olak Lempit alone. Additionally, numerous agro-preneurs are actively involved in government initiatives aimed at establishing a plantation hub, such as the Permanent Garden Food Collection Hub, known as *TKPM* (*Taman Kekal Pengumpulan Makanan*) program, which is overseen by the Ministry of Agriculture and Food Security (*Kementerian Pertanian dan Keterjaminan Makanan)*, including departments like Department of Agriculture (*Jabatan Pertanian*) and Department of Veterinary Service (*Jabatan Perkhidmatan Veterinar).*

INITIAL DEVELOPMENT OF COMMUNITY FARMING PROJECT

Sustainable and regenerative agricultural practices are the core ideas that drove the development of this community farm. Commonly understood as farming that also protects the environment, that aid and expand natural resources, sustainable agriculture primarily targets environmental conservation and social equity. Conversely, it emphasizes the importance of moderate use of non-renewable resources, considering both nature and future generations. This approach encourages a transition to renewable energy sources, responsible land use, and the eradication of pollution in natural environments (FAO, 2018). In contrary, regenerative agriculture focuses on revitalizing degraded soils through diverse methods, including adaptive grazing, no-till planting, and the minimal or complete absence of pesticides and synthetic fertilizers (Giller et al., 2021).

As such, with the support from APPGM-SDG, the community farm in Olak Lempit focused on establishing a community farm that utilizes a regenerative agriculture approach, which minimizes – if not eliminate – the use of conventional fertilizers and pesticides. This initiative offered beneficiaries the chance to engage in community farming, fostering connections with various stakeholders such as local government, agencies, academia, industry players, and like-minded individuals.

Additionally, in setting up this community farm, we also believe that the personal motivation of participants in discovering ways to grow and preserve their own food should not be underestimated. In this community farming project, most of the beneficiaries have experience with backyard gardening (see Figure 4.4), but limited space has hindered their ability to fully harness their gardening potential. This further driven their personal motivation in the establishment of this community farm.

Figure 4.4. Over half of the participants produce less food than they consume.

This project also aligns with Sustainable Development Goals (SDGs) 1, 2, 3, 4, 5, 11, 12, 13, and 15 in response to their indicators. Table 4.1 provides an explanation of each SDG indicator relevant to this community farming initiative.

Table 4.1. SDG indicators

SDG GOAL	TARGET	INDICATOR	APPLICATION
SDG 1: No Poverty – End poverty in all its forms everywhere.	1.1 By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day.	1.1.1 Proportion of population below the international poverty line, by sex, age, employment status, and geographical location (urban/rural).	To provide knowledge of farm and business management to at least 10 women and 10 youths by the end of 2025 and ensure that at least 3 women and 5 youths can manage their own edible organic gardens by the end of this project.
SDG 2: Zero Hunger – End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.	2.1 By 2030, end hunger and ensure access by all people, in particular the poor and vulnerable, including infants, to safe, nutritious, and sufficient food all year round.	2.1.1 Prevalence of undernourishment.	To establish a regenerative agriculture system that provides a consistent supply of fresh produce, ensuring access to nutritious and flavorful food throughout the year.

SDG GOAL	TARGET	INDICATOR	APPLICATION
SDG 3: Good Health and Well-being – Ensure healthy lives and promote well-being for all at all ages.	3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination.	3.9.1 Mortality rate attributed to household and ambient air pollution.	To encourage awareness among the community about the impact of hazardous chemicals surrounding them and promote ways to prevent exposure and health risks.
SDG 4: Quality Education – Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.	4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs, and entrepreneurship.	4.4.1 Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill.	To provide knowledge sharing on regenerative agriculture techniques and skills for community empowerment, contributing to the local economy.
SDG 5: Gender Equality – Achieve gender equality and	5.1 End all forms of discrimination against all	5.1.1 Whether or not legal frameworks are in place to promote, enforce, and	To ensure that at least half of the farming community

SDG GOAL	TARGET	INDICATOR	APPLICATION
empower all women and girls.	women and girls everywhere.	monitor equality and non-discrimination on the basis of sex.	participants are women or girls.
SDG 11: Sustainable Cities and Communities – Make cities and human settlements inclusive, safe, resilient, and sustainable.	11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by focusing on air quality and municipal and other waste management.	11.6.1 Proportion of urban solid waste regularly collected and adequately discharged out of total urban solid waste generated, by cities.	To collaborate with local government and municipal authorities to encourage sustainable farming models within urban communities by the end of 2025.
SDG 12: Responsible Consumption and Production – Ensure sustainable consumption and production patterns.	12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling, and reuse.	12.5.1 National recycling rate, tons of material recycled.	To educate community members on waste management and promote the use of recyclable materials in community farming activities.

SDG GOAL	TARGET	INDICATOR	APPLICATION
SDG 13: Climate Action – Take urgent action to combat climate change and its impacts.	13.3 Improve education, awareness-raising, and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning.	13.3.2 Number of countries that have communicated the strengthening of institutional, systemic, and individual capacity-building for adaptation, mitigation, and technology transfer.	Regenerative agriculture techniques used in the project minimize greenhouse gas emissions from traditional farming. Food waste is reused as compost, and smart irrigation systems optimize water use, contributing to climate change mitigation.
SDG 15: Life on Land – Protect, restore, and promote sustainable use of terrestrial ecosystems.	15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by drought and floods, and strive to achieve a land-degradation-neutral world.	15.3.1 Proportion of land that is degraded over total land area.	Regenerative agriculture helps restore soil microbiota, reduce tillage, and minimize pressure on terrestrial ecosystems, supporting sustainable land use and preserving natural habitats.

IMPLEMENTATION OF COMMUNITY FARMING PROJECT

Following consultation with the beneficiaries (see Figure 4.5), a series of 12 modules were developed involving speakers and educators from agencies, universities and the industry, among others. The aim of these modules varies, but all had the overarching aim of developing a vibrant and sustainable community farm.

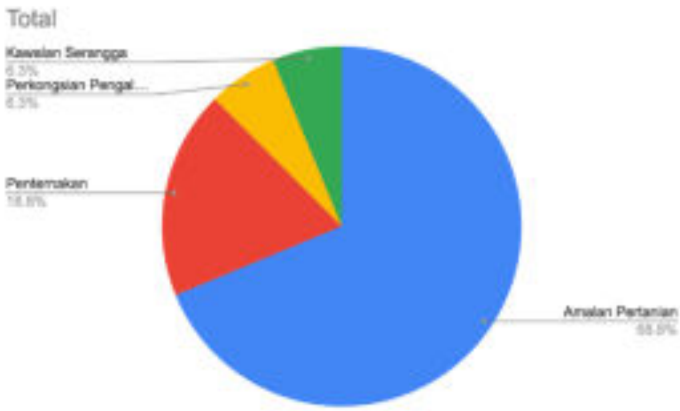

Figure 4.5. Modules selected are based on respondents' needs and objectives of the project. It comprises of Good Agricultural Practice, Integrated Pest Management, Mixed Farming Activities as well as Knowledge and Technology Transfer from Various Stakeholders (including universities, agencies, industry players and like-minded individuals)

The modules are inclusive of training on good agricultural practices, health and safety in agriculture as well as farm management. Further details on each of the modules are presented in Table 4.2.

Table 4.2. List and description of modules conducted

MODULE	IMPLEMENTATION SPEAKER	ORGANIZATION	CONTENT	SDG
Good agricultural practices	Completed	Selamat bin Sawoji, Jabatan *Pertanian Daerah Sepang*	Produce nutrient fertilizer from fruits and vegetable wastes, organic repellent from foods	SDG 1, 2, 3, 4, 11, 12, 13 and 15
Sustainable agriculture Completed	Completed	Ahmad Sufi Badrul Amini and Mohd. Azim Mohd. Razully, Permaculture School of Australia and Three Farm Janda Baik	Kickstart a permaculture, understanding themes in permaculture, garden design	SDG 1, 2, 3, 4, 11, 12, 13 and 15
Agricultural marketing Completed	Completed	Faizal Hafiz Aziz, Telaga Emas Agronomi Sdn. Bhd.	Market and demands in agriculture	SDG 4

MODULE	IMPLEMENTATION SPEAKER	ORGANIZATION	CONTENT	SDG
Business Accounting	Planned	Nur Izmalyana Mohd. Amir, ZEA MSCO Sdn. Bhd.	Basic in accounting for agriculture	SDG 4
Introduction to Entrepreneurship	Completed	Mohamad Taqdir Sajin, Taqdir Enterprise (Sabak Salai)	Business plan proposals for grants and loans	SDG 4
Basic in Marketing	Completed	Jamalee Bashah, Patriots Holding Sdn. Bhd. (Kebun Kita)	Understanding demands and priorities in marketing	SDG 4
Introduction to health and safety	Completed	Dr. Alia Azmi, Centre of Environmental Health and Safety, Faculty of Health Sciences, UiTM	Dos and Don'ts in farming activities	SDG 3 and 4
Introduction to basic physical movements	Completed	Dr. Azliyana Mohd. Azizan,	Basic ergonomic skills related to	SDG 3 and 4

MODULE	IMPLEMENTATION SPEAKER	ORGANIZATION	CONTENT	SDG
		Centre of Physiotherapy, Faculty of Health Sciences, UiTM	farming, understanding motor movements and applications in farming activities	

Additionally, the beneficiaries were encouraged to create their own organizational structure, as a means of creating responsibilities and order the management of the community farm. This structure (see Figure 4.6), designed by the beneficiaries includes a leader, an assistant leader, a treasurer, and various bureaus: infrastructure, food and beverages, nursery, marketing, and downstream products.

Figure 4.6. Figure shows over half of the participants are women

SOCIOECONOMIC, ENVIRONMENTAL AND EDUCATIONAL IMPACT

With the establishment of the community farm, all participants can now grow and harvest their own fresh produce, gaining access to nutritious food cultivated directly from the farm. Consequently, many of them have significantly decreased their purchases of vegetables from the market. One of the upcoming modules will focus on creating nutritious meals using ingredients sourced from their own harvest. Given that this project is still in its early stages, the economic impact is yet to be significant. However, beneficiaries are still able to earn some income by selling seedlings from the nursery, producing downstream products from harvested crops, and continually adapting their offerings to meet market demands.

In the realm of community empowerment, the project offers significant insights into social cohesion, allowing beneficiaries to develop their social networks through various programs. Additionally, it fosters greater collaboration with stakeholders. In fact, the collaboration extends outside of the community farming beneficiaries, where friends and families were motivated to join in the activities despite not being officially part of the project. Not only that this increase the number of participants during each module, but this also helps them to share what they have learnt throughout experience and modules that have been shared by the speakers. The community grows well with new network and acquaintances during the programs conducted.

The community farming initiative also operates without heavy machinery, primarily relying on traditional methods to minimize soil damage. Participants have been educated on key aspects of environmental conservation by utilizing natural resources. This includes managing kitchen waste through the Bokashi method to create fertilizers, establishing raised beds with soil mixtures that incorporate spent mushroom substrate sourced from local mushroom growers, and producing organic pesticides from plants cultivated on the farm, such as lemongrass.

CHALLENGES AND LESSON LEARNED

In every project, there are inherent risks and challenges that the involved community must confront. In this case, the community is dealing with a difficult climate factor, as their cultivated crops are inundated with floodwaters following heavy monsoon rains. Although the area has previously been developed with improved infrastructure, such as drainage systems and ponds, the predominant soil types—primarily peat and marsh— retain water for extended periods. This results in flooding, which occurred despite raised beds designed to be one foot above the ground. To address this challenge, the project site needs to be relocated. Fortunately, one of the participants generously offered their land for community use. Before finalizing the agreement, the participants and the solution provider engaged in thorough discussions and careful planning to begin afresh. This scenario allows both the solution provider and the beneficiaries to participate in decision-making and develop strategic plans together.

Another challenge faced in this community farming is sharing common responsibilities. Although each beneficiary was allotted their own space or garden beds, the communal areas and responsibilities such as watering plants, organizing equipment and raw materials like potting mix bags and layering pellets as well as maintenance of garden are shared. However, in the initial stages of this farm we find it difficult to monitor and encourage the beneficiaries to equally participate in shared responsibilities. This matter was improved by the creation of a formal organization structure, but as of now, periodical monitoring is still required. Therefore, in the future, detailed task responsibility shall be given to avoid clashing responsibilities among the participants.

Additionally, this community farm also faced issues such as lack of proper equipment and systems that can help automate some of the processes in the farm. This means that a number of activities such as watering, feeding hens and ploughing were done manually, making it physically demanding and time-consuming. One effort to overcome this is by the application of external grant from Selangor State Government. This grant, worth of RM4,000.00, allowed the community farm and the beneficiaries to design and set-up a rainwater harvesting system. The rainwater will be collected from the gutter installed in the farm into the downspouts and into tanks which will then supply the water throughout the garden by using water pump and sprinklers. Not only that, but the farm is also able to gain the support from a local university (Univeristi Teknologi MARA) via their University Social Responsibility and SULAM (Service-Learning Malaysia-University for Society) program. This meant assistance from students and staff in some of the more demanding tasks.

CONCLUSION

The journey of the community farm has been a testament to resilience and collective strength, illustrating the profound lessons learned through adversity. Relocating due to flooding initially posed a significant challenge, yet it became an opportunity to rethink the farm's layout and operations, fostering innovation and adaptability among members. This experience underscored the importance of preparedness and flexibility in the face of environmental uncertainties. Sharing responsibilities also emerged as a pivotal lesson, where we learned that via collaborative efforts and formal organizational structure, members are able to cultivate a sense of ownership and accountability.

Apart from that, securing external grants played a crucial role in alleviating financial pressures of the farm. This experience highlighted the importance of seeking diverse funding sources and the need for proactive outreach to sustain community initiatives. Meanwhile, engaging students in hands-on tasks not only provided much-needed labour but also enriched the learning experiences of young volunteers, creating a bridge between generations and fostering a sense of stewardship for the land. Ultimately, the community farm's journey illustrates that through collaboration, resourcefulness, and a shared vision, it is possible to transform challenges into stepping stones for growth. The lessons learned here extend beyond agriculture, offering valuable insights into resilience, community engagement, and the power of collective action in the face of adversity.

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Chapter 5

Strategi Menjamin Pencapaian Sekuriti Makanan Melalui Transformasi Sisa Kebun Kepada Biochar-Kompos (Kombi) Untuk Meningkatkan Produktiviti Tanaman

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ABSTRAK

Projek ini bertujuan melibatkan komuniti dalam usaha menjamin sekuriti makanan melalui transformasi sisa kebun kepada biochar-kompos, selaras dengan Matlamat Pembangunan Lestari SDG1, SDG2, SDG12, SDG13 dan SDG15. Dalam menghadapi cabaran global seperti perubahan iklim dan degradasi tanah, penyelesaian mampan diperlukan untuk memastikan bekalan makanan yang mencukupi. Melalui projek ini, komuniti telah dilatih untuk menghasilkan bahan organik melalui mengitar semula sisa kebun seperti daun, ranting, sisa tanaman kepada biochar-kompos (KOMBI) untuk memperbaiki kualiti tanah dan meningkatkan produktiviti tanaman. Kajian telah dijalankan untuk meneroka keberkesanan biochar dalam meningkatkan proses pengkomposan bahan organik daripada sisa kebun. Selepas 56 hari , hasil menunjukkan gabungan biochar semasa proses pengkomposan sisa-sisa kebun dapat meningkatkan kualiti kompos secara signifikan. Secara fizikalnya, ia dapat meningkatkan pengudaraan, aktiviti mikrob, kompos yang stabil serta tidak berbau dengan tekstur yang sesuai untuk kegunaan pertanian berbanding perkomposan tanpa menggunakan biochar. Dari segi sifat kimia, gabungan biochar semasa proses pengkomposan dapat menstabilkan pH dan

meningkatkan ketersediaan nutrien, Selain itu, ia mempercepatkan proses penghumusan, menghasilkan kandungan bahan humik tinggi dan kandungan kation daripada asid fulvik yang penting untuk kesuburan tanah. Penemuan ini menekankan keberkesanan biochar dalam menghasilkan kompos berkualiti tinggi amat sesuai untuk pertanian lestari.

PENGENALAN

Penggunaan bahan kimia sebagai sumber nutrien untuk pertumbuhan pokok boleh menyebabkan kemerosotan tanah, penurunan hasil tanaman, dan peningkatan pelepasan gas rumah hijau. Oleh itu, penyelesaian lestari adalah diperlukan (Beus et al., 1990). Teknologi kompos dan biochar telah menjadi penyelesaian yang efisien untuk mengurangkan pelupusan sisa pertanian (Tran et al., 2018). Teknologi ini bukan sahaja bagus dalam meningkatkan kualiti tanah tetapi juga sangat berkesan dalam mengatasi pencemaran. Kompos adalah produk organik yang kaya dengan bahan organik, dapat meningkatkan kesuburan tanah, pengekalan air, dan pengudaraan, serta meningkatkan aktiviti mikroorganisma tanah, mempromosikan kelonggaran dan pengudaraan tanah. Manakala Biochar dicirikan oleh struktur fizikalnya yang berliang, mempunyai kandungan karbon yang tinggi dan keupayaannya untuk meningkatkan pengekalan nutrien (Steiner et al., 2010).

Amalan pengkomposan yang tidak terurus atau fermentasi yang tidak lengkap boleh menyebabkan kompos tidak matang dan tidak berkualiti. Sifat biochar yang mempunyai liang dapat mempercepatkan proses pengkomposan. Kombinasi biochar semasa proses pengkomposan dapat mengurangkan beberapa kelemahan berbanding kaedah pengkomposan tradisional. Ia juga dapat mengurangkan kehilangan nutrien semasa proses pengkomposan kerana keupayaan biochar mengekalkan dan menyimpan nutrien.

Penggunaan kompos dan biochar berpotensi meningkatkan kesuburan tanah, meningkatkan hasil tanaman, mengurangkan kebergantungan terhadap baja sintetik yang membawa kepada pengurangan penggunaan input kimia dan meminimumkan potensi kerosakan alam sekitar (Pimentel et al., 2005).

Penggunaan biochar sebagai sumber bahan organik memberi peningkatan kepada kesuburan tanah dan tanaman. Walaubagaimanapun, disebabkan oleh kos yang tinggi menyebabkan penggunaan biochar di kalangan pekebun adalah sangat rendah. Inovasi gabungan penggunaan biochar semasa proses pengkomposan dapat memberi tambah nilai kepada produk kompos yang berkualiti tinggi, Oleh itu, kajian ini dijalankan untuk membuktikan keberkesanan kombinasi biochar semasa proses pengkomposan menggunakan sisa-sisa kebun.

OBJEKTIF

1. Menentukan kesan kombinasi biochar semasa proses pengkomposan menggunakan sisa kebun terhadap sifat fizikal kompos
2. Menilai kesan kombinasi biochar semasa proses pengkomposan menggunakan sisa kebun terhadap sifat kimia kompos
3. Menilai kesan kombinasi biochar semasa proses pengkomposan menggunakan sisa kebun terhadap proses humifikasi

METODOLOGI

Kajian dijalankan di Kebun Institut Sains Biologi, Fakulti Sains, Universiti Malaya. Sisa-sisa kebun diperolehi daripada aktiviti berkebun oleh peserta projek seperti daun kering dan sisa substrat cendawan. Pengkomposan dijalankan dalam tong pengkomposan dawai dengan dimensi panjang 92 cm dan diameter 34 cm. Kaedah rawatan proses pengkomposan ialah tanpa kombinasi biochar (T1) dan dengan kombinasi biochar semasa proses pengkomposan (T2). Pengkomposan dijalankan selama 56 hari.

Analisis Fizikal

Suhu direkodkan setiap hari menggunakan termometer digital. Suhu kompos dipantau dengan teliti sehingga ia menyamai suhu persekitaran, yang menandakan berakhirnya penguraian aktif. Pengalihan dilakukan setiap 7 hari untuk memastikan pengudaraan yang mencukupi.

Semasa proses pengkomposan, warna kompos di ambil menggunakan Carta Warna Munsell sebagai penunjuk kematangan, kualiti kompos dan aktiviti mikroorganisma yang sedang berlaku.

Penilaian bau kompos dilakukan dengan inkubasi sampel pada suhu bilik (20-25°C) selama 48 jam untuk mendapatkan perkembangan bau kompos. Selepas tempoh inkubasi, balang dibuka di kawasan yang berventilasi baik untuk mengurangkan kesan bau yang kuat. Bau dinilai serta-merta oleh penilai tidak terlatih bagi tujuan mensimulasikan keadaan dunia sebenar di mana bau kompos sering dinilai oleh bukan pakar. Selain itu, penilai yang tidak terlatih digunakan untuk mengenalpasti persepsi masyarakat terhadap bau kompos dengan memberikan gambaran mengenai potensi penerimaan atau penolakan kompos berdasarkan baunya.

Tekstur kompos di analisis menggunakan saiz mesh yang berbeza iaitu 2000 μm, 425 μm, dan 250 μm. Sampel kompos dikumpulkan daripada pelbagai bahagian timbunan untuk memastikan keseragaman dan pengukuran yang tepat.

Analisis Kimia

pH kompos ditentukan menggunakan meter pH. 10 gram sampel ditimbang dengan teliti ke dalam vial plastik, dan 25 mL air suling ditambahkan. Campuran tanah-air dikacau dengan teliti dan dibiarkan tanpa gangguan selama 24 jam. Kaedah ini adalah penting untuk menilai keasidan atau kealkalian kompos yang secara langsung memberi kesan kepada ketersediaan nutrien dan aktiviti mikroorganisma.

Kekonduksian Elektrik (EC) kompos diukur menggunakan meter EC dalam nisbah kompos-air 1:5 yang biasanya digunakan untuk menilai tahap kemasinan dalam kompos. Kandungan bahan organik (OM) dalam kompos ditentukan menggunakan kaedah kehilangan semasa pembakaran (LOI). Kaedah ini diterima secara meluas untuk analisis kandungan organik. Kira-kira 10 gram setiap sampel kering dibakar pada suhu 550°C selama 4 jam. Selepas penyejukan dalam desikator untuk mengelakkan penyerapan kelembapan, sampel kompos ditimbang. Kandungan bahan organik dikira menggunakan formula: Bahan Organik (%)= (Berat Sampel Kering-Berat Abu)/Berat Sampel Kering ×100, Pengukuran yang tepat bagi kandungan bahan organik (OM) adalah penting untuk menilai kualiti dan kematangan kompos. Secara amnya, kandungan OM yang lebih tinggi menunjukkan pengkomposan yang lebih berkesan dan nilai nutrien yang lebih tinggi. Dengan membandingkan nilai OM daripada pelbagai peringkat proses pengkomposan, dapat menentukan keberkesanan pengkomposan dan tahap penguraian yang berlaku. Oleh itu, kandungan OM adalah metrik utama untuk menilai kualiti dan kematangan kompos, dan mengesan perubahan sepanjang proses pengkomposan.

Bagi menentukan kandungan Karbon Organik (TOC), Nitrogen (N), Fosforus (P), dan Kalium (K) dalam kompos, sampel perlu dikeringkan dan dikisar halus. Kandungan Organik Karbon dan Nitrogen diukur menggunakan kaedah *combustion*. Kandungan Kalium ditentukan menggunakan ICP-OES. Fosforus dianalisis menggunakan kaedah pengukuran kolorimetrik.

Analisis Asid Humik

Pengasingan asid humik (HA) dijalankan menggunakan versi yang diubah suai daripada kaedah yang dinyatakan oleh Ahmed et al. (2005). Kaedah ini berpotensi untuk mendapatkan asid humik berkualiti tinggi daripada kompos. Asid humik yang diekstrak daripada kompos untuk proses pencirian terperinci bagi memahami sifat kimia dan kumpulan fungsinya. Nisbah E4/E6 adalah penunjuk penting bagi saiz molekul dan tahap humifikasi yang ditentukan menggunakan kaedah Campitelli dan Ceppi (2008) dan dianalisis dengan spektrofotometer UV-Vis (PerkinElmer Lambda 25). Nisbah ini membantu dalam menilai kematangan dan kualiti asid humik. Selain itu, kandungan abu dan karbon organik total HA ditentukan menggunakan kaedah kehilangan semasa pembakaran seperti yang dinyatakan oleh Chefetz et al. (1996). Kaedah ini melibatkan pemanasan HA ke suhu tinggi untuk mengoksidakan bahan organik, meninggalkan sisa tak organik, yang kemudiannya ditimbang untuk mengira kandungan abu. Manakala, pencirian kumpulan fungsi asid humik dijalankan menggunakan kaedah titrasi (Inbar et al., 1990).

Manakala, asid fulvik mentah (FA) yang diekstrak daripada kompos ditapis dengan berhati-hati menggunakan kertas turas Whatman nombor 2 untuk menghilangkan sebarang bahan partikel. pH FA mentah kemudian diukur menggunakan elektrod kaca, mengikuti kaedah yang diterangkan oleh Peech (1965), dan menggunakan meter pH S20-K SevenEasy™ (Mettler-Toledo GmbH). Pengukuran pH yang tepat adalah penting kerana ia mempengaruhi sifat kimia dan kereaktifan asid fulvik. Selepas pengukuran pH, jumlah kation yang hadir dalam FA dianalisis menggunakan Spektrometer Serapan Atom (PerkinElmer AAnalyst 800). Langkah-langkah analitik ini menyediakan pemahaman yang komprehensif mengenai sifat kimia asid fulvik mentah.

Pertumbuhan Pokok

Pemantauan secara visual telah dijalankan terhadap tanaman kangkong dan terung yang telah ditanam oleh komuniti menggunakan dua rawatan tersebut iaitu T1 rawatan tanpa kombinasi biochar semasa proses pengkomposan dan T2 rawatan dengan kombinasi biochar semasa proses pengkomposan.

Analisis Statistik

Analisis statistik data dijalankan menggunakan Analisis Varians (ANOVA) untuk mengesan sebarang perbezaan ketara antara rawatan eksperimen. Seterusnya, ujian T-test dijalankan mengenalpasti perbezaan antara purata rawatan tertentu. Pakej perisian statistik yang digunakan untuk analisis ini ialah versi R 4.4.1.

KEPUTUSAN DAN PERBINCANGAN

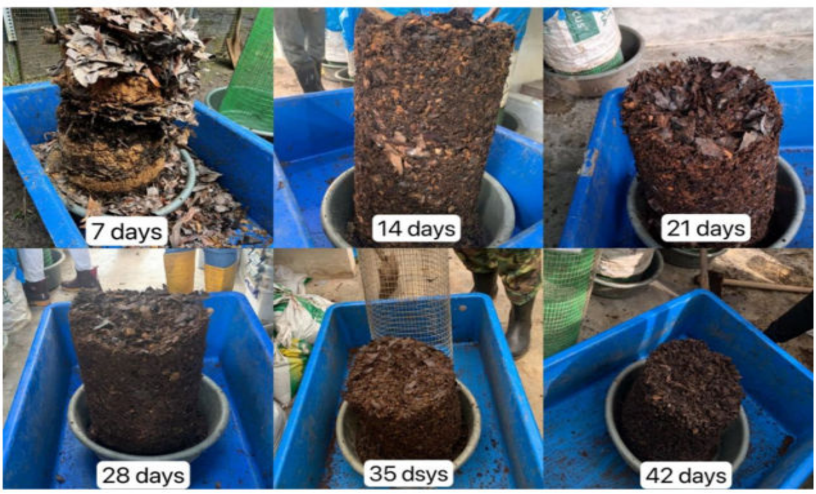
Sifat Fizikal

Pemerhatian secara visual selepas 56 hari proses pengkomposan didapati bahawa rawatan tanpa kombinasi biochar masih belum terurai sepenuhnya dan bahan kompos juga masih bersaiz besar (Gambar Rajah 5.1). Ia jauh berbeza dengan rawatan kompos dengan kombinasi biochar di mana warnanya yang gelap dan saiz yang lebih halus. Ini menunjukkan bahawa biochar dapat membantu mempercepatkan proses pengkomposan dan menghasilkan kompos lebih berkualiti berbanding kompos tanpa kombinasi biochar. Ini adalah kerana Biochar secara signifikan meningkatkan fasa termofilik, menghasilkan suhu puncak yang lebih tinggi dan aktiviti mikrob yang berterusan menyebabkan kompos rawatan T2 adalah lebih cepat matang seperti di Rajah 5.2.

T1- Pengkomposan tanpa kombinasi biochar

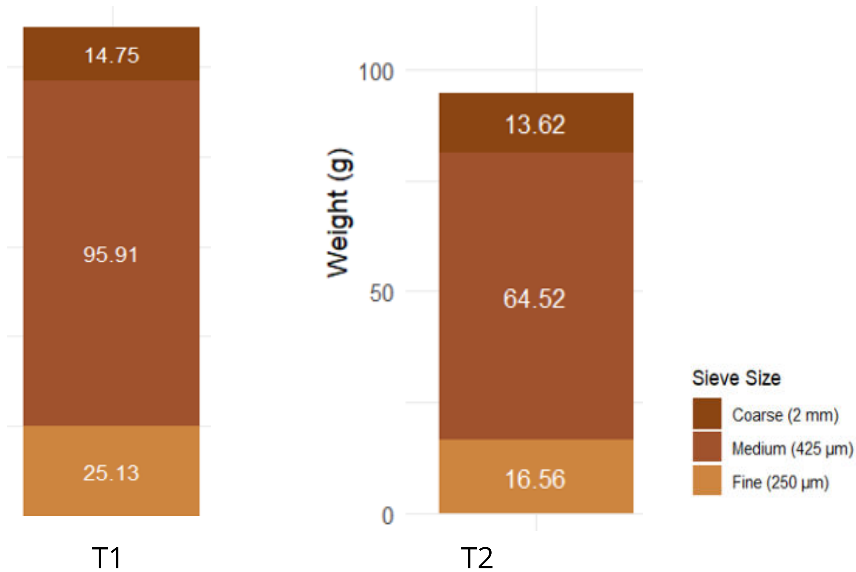
T2- Pengkomposan dengan kombinasi biochar

Rajah 5.1. Visual pemerhatian terhadap kualiti kompos selepas 56 hari perkomposan



Rajah 5.2. Visual pemerhatian terhadap perkomposan melalui kombinasi biochar

Tesktur kompos menunjukkan kompos dengan kombinasi biochar memberi kesan yang ketara ke atas pengagihan saiz zarah kompos berbanding kompos tanpa kombinasi biochar semasa proses pengkomposan di jalankan (Rajah 5.3). Peningkatan struktur ini penting untuk kestabilan jangka panjang kompos dan keberkesanannya sebagai penambahbaikan tanah.



Rajah 5.3: Tekstur kompos selepas 56 hari perkomposan

Nota:

T1- Pengkomposan tanpa kombinasi biochar

T2- Pengkomposan dengan kombinasi biochar

Penilaian bau kompos berdasarkan penilaian intensiti bau untuk setiap rawatan pengkomposan yang diukur pada skala dari 1 hingga 4, di mana 4 mewakili tahap bau tertinggi. Didapati pada akhir pengkomposan, skala T1-pengkomposan tanpa kombinasi biochar adalah pada skala 3 dan manakala pengkomposan dengan kombinasi biochar adalah pada skala 2. Struktur berliang biochar mungkin memainkan peranan penting dalam menyerap bahan penyebab bau dan meningkatkan pengudaraan dalam timbunan kompos, yang membantu mengurangkan penghasilan bau yang tidak menyenangkan. Hasil ini disokong oleh penyelidikan daripada Lee et al. (2022) dan Ji et al. (2023), yang menekankan keupayaan biochar untuk meningkatkan kualiti kompos dengan memperbaiki struktur fizikalnya dan mengurangkan keadaan anaerobik yang menyumbang kepada bau yang kuat.

Perubahan warna semasa proses pengkomposan dianalisis dengan membandingkan carta warna Munsell pada awal dan akhir proses pengkomposan (Jadual 5.1). Perubahan warna mencerminkan tahap penguraian bahan organik dan pembentukan humus, tetapi juga berfungsi sebagai penunjuk penting kematangan kompos. Rawatan kompos dengan kombinasi biochar menghasilkan kompos berwarna hitam yang menunjukkan penunjuk bahawa kompos tersebut sudah mencapai tahap kematangan berbanding kompos tanpa kombinasi biochar.

Jadual 5.1. Warna kompos selepas 56 hari perkomposan

RAWATAN	**HARI PERTAMA PENGKOMPOSAN (HARI PERTAMA)**	**HARI TERAKHIR PENGKOMPOSAN (HARI KE-56)**
T1 Pengkomposan tanpa kombinasi biochar	5YR 4/3 *Moderately dark reddish-brown*	10 YR 3/3 Coklat gelap
T2 Pengkomposan dengan kombinasi biochar	5YR 4/3 *Moderately dark reddish-brown*	10YR 2/1 Hitam

Sifat Kimia

Melalui data sifat kimia tanah yang komprehensif tentang kesan rawatan pengkomposan yang berbeza mempengaruhi kualiti akhir produk kompos (Jadual 5.2). Parameter sifat kimia kompos membolehkan mengenal pasti pendekatan pengkomposan yang optimum yang menghasilkan produk kompos yang berkualiti tinggi dan stabil. Penambahan biochar menyumbang kepada peningkatan pH, walaupun tidak sebanyak yang dijangkakan, penemuan ini adalah konsisten dengan Lehmann dan Joseph (2015), yang melaporkan bahawa biochar terkenal dengan sifat alkali, yang dapat membantu menaikkan pH tanah dan kompos dengan meneutralkan komponen asid.

Jadual 5.2. Sifat kimia kompos selepas 56 hari perkomposan

PARAMETER	**T1 PENGKOMPOSAN TANPA KOMBINASI BIOCHAR**	**T2 PENGKOMPOSAN DENGAN KOMBINASI BIOCHAR**
pH_{water}	7.1 b	7.49 a
EC	7.89 a	4.85 b
Ash (%)	25.13 b	32.65 a
Organic matter (%)	75.94 a	67.35 a
Total Organik Karbon (%)	1.61 b	9.30 a
Nitrogen (%)	1.47 a	1.43 a
Phosphorus (%)	0.21 a	0.20 a
K (mg kg^{1})	3294 b	4379 a
C/N ratio	1.09 b	6.52 a
C/P ratio	7.33 b	45.67 a

Huruf yang berbeza dalam satu baris menunjukkan perbezaan yang ketara antara purata menggunakan ujian T-test pada P=0.05.

Rawatan kombinasi biochar semasa pengkomposan menunjukkan penurunan paling ketara dalam EC. Penambahan biochar memainkan peranan penting dalam pengurangan ini kerana biochar dikenali dengan kapasiti penyerapan ion yang tinggi dan keupayaannya untuk meningkatkan kapasiti pertukaran kation (CEC) kompos (Lehmann & Joseph, 2015). Pengurangan EC yang ketara diperhatikan dalam rawatan ini mencadangkan bahawa biochar dengan berkesan mengurangkan kekuatan ion kompos, menjadikannya kurang masin dan berpotensi lebih sesuai untuk tanaman sensitif. Pengurangan EC ini juga mungkin menunjukkan bahawa biochar membantu menstabilkan kompos dengan mengikat ion berlebihan, yang mungkin sebaliknya menyumbang kepada nilai EC yang lebih tinggi.
Secara keseluruhannya, rawatan kombinasi biochar semasa proses pengkomposan menunjukkan peningkatan karbon dan nutrien selepas 56 hari pengkomposan. Biochar menyediakan sumber karbon yang stabil yang boleh berinteraksi dengan nitrogen semasa proses pengkomposan, membantu menstabilkan nisbah C/N. Lehmann dan Joseph (2015) menekankan peranan biochar dalam mempengaruhi dinamik nutrien di dalam kompos, di mana struktur liangnya boleh meningkatkan habitat mikrob.

Asid Humik

Asid humik memainkan peranan penting dalam kesuburan tanah dengan meningkatkan kapasiti pertukaran kation dan menstabilkan bahan organik dalam tanah dengan memperbaiki struktur tanah, pengekalan air, dan ketersediaan nutrien. Nisbah E4/E6 tertinggi dalam rawatan ini menunjukkan peningkatan ketara dalam kandungan asid humik, yang disebabkan oleh penambahan biochar semasa pengkomposan. Lehmann & Joseph (2015) mendapati bahawa sifat biochar yang mengandungi karbon dan mineral secara signifikan meningkatkan tahap asid humik. Nisbah E4/E6 yang tinggi ini menekankan keberkesanan biochar dalam meningkatkan kualiti organik kompos, menjadikannya penambahan berharga untuk amalan pertanian yang mampan. Manakala menurut Bünemann et al. (2018) mendapati bahawa biochar mempengaruhi tahap asid fenolik dan aktiviti mikrob dengan menyumbang kepada kestabilan dan keberkesanan kompos secara keseluruhan.

Jadual 5.3. Asid Humik kompos selepas 56 hari perkomposan

PARAMETER	T1 PENGKOMPOSAN TANPA KOMBINASI BIOCHAR	T2 PENGKOMPOSAN DENGAN KOMBINASI BIOCHAR
E_4/E_6	2.532 b	3.573 a
Carbon (%)	66.56 a	65.48 a
Phenolic (cmol kg^{-1})	1.02 a	0.97 a
Carboxylic (cmol kg^{-1})	0.77 b	0.81 a
Total Acidity (cmol kg^{-1})	2.00 b	2.52 a

Huruf yang berbeza dalam satu baris menunjukkan perbezaan yang ketara antara purata menggunakan ujian T-test pada P=0.05.

Asid karboksilik dapat membantu meningkatkan kapasiti pertukaran kation (CEC) kompos dengan memperbaiki keupayaannya untuk mengekalkan nutrien penting dan menjadikannya lebih tersedia untuk tumbuhan. Zhang et al. (2021) menekankan bahawa biochar memperbaiki keasidan kompos, dan menyokong ketersediaan nutrien yang lebih baik serta menyumbang kepada pertumbuhan tanaman yang lebih sihat. Peningkatan asid karboksilik ini menekankan peranan biochar dalam meningkatkan sifat asid kompos, menjadikannya lebih berkesan dalam mempromosikan kesihatan tanah. Seterusnya, rawatan ini amat berkesan dalam menghasilkan produk kompos yang kaya dengan nutrien dan bermanfaat untuk pengurusan tanah jangka panjang.

Asid Fulvik

Secara keseluruhan, rawatan T2 iaitu kombinasi biochar semasa proses pengkomposan memberi peningkatan kepada kandungan kation asid fulvik yang dapat membantu pertumbuhan pokok dan kesuburan tanah (Jadual 5.4).

Jadual 5.4. Kandungan kation asid fulvik kompos selepas 56 hari perkomposan

PARAMETER	T1 PENGKOMPOSAN TANPA KOMBINASI BIOCHAR	T2 PENGKOMPOSAN DENGAN KOMBINASI BIOCHAR
Total K (%)	0.47 a	0.47 a
Total Ca (%)	0.012 b	0.016 a
Total Mg (ppb)	106 b	235 a
Total Na (ppb)	2375 b	4786 a

Huruf yang berbeza dalam satu baris menunjukkan perbezaan yang ketara antara purata menggunakan ujian T-test pada P=0.05.

Pertumbuhan Pokok

Pemantauan secara visual telah dilakukan untuk membandingkan kesan aplikasi antara dua rawatan. Didapati pokok sayur dan terung yang diletakkan kompos (kombinasi biochar semasa proses pengkomposan) menghasilkan tanaman yang lebih tinggi dan besar berbanding kompos tanpa kombinasi biochar semasa perkomposan.

Rujuk Rajah 5.4 untuk pokok terung dan Rajah 5.5 untuk pokok kangkung.

Rajah 5.4. Pokok Terung

Rajah 5.5 Pokok Kangkung

KESIMPULAN

Hasil kajian menunjukkan bahawa penambahan biochar semasa proses pengkomposan meningkatkan kualiti kompos, seperti yang dibuktikan oleh tekstur yang lebih baik, pengurangan bau, dan perubahan warna berbanding kawalan dan juga peningkatan kandungan nutrien, asid humuk dan kation asid fulvik. Ini juga membuktikan bahawa kombinasi biochar semasa proses pengkomposan menggunakan sisa daripada kebun memberi hasil yang lebih baik dari segi penguraian dan kematangan kompos yang lebih cepat berbanding tanpa kombinasi biochar. Dengan penghasilan bahan organik yang berkualti seperti Biochar-kompos (KOMBI) dapat membantu meningkatkan hasil produktiviti tanaman dan seterusnya menjadi salah satu strategi bagi mencapai pencapaian sekuriti makanan.

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Part III:
The Role and Achievements of Women-Led Initiatives In Agriculture

Chapter 6

Wanita Bertani, Sejahtera Hayat

Mohd Khairul Ridhwan Adhha Bin Akhiar

ABSTRAK

Bidang pertanian telah sekian lama menyaksikan peranan wanita dalam keberhasilannya. Dalam tradisi pelbagai bangsa seluruh dunia, wanita menjadi sebahagian daripada pemain utama kelangsungan hidup manusia seluruh dunia. Namun, pelbagai kekangan dan cabaran yang wujud di era moden ini semakin memudarkan peranan dan kepimpinan wanita dalam dunia pertanian dan kelestarian. Ini menyebabkan banyak perkara merangkumi amalan dan budaya turut larut antaranya semangat muhibbah, kemandirian dan daya tahan diri, kesihatan, maruah dan kemuliaan diri serta ilmu-ilmu tradisi. Justeru itu, inisiatif dan usaha pemerkasaan wanita dalam bidang pertanian yang dijalankan di Setiu dan Kuala Nerus mendatangkan impak positif kepada mereka yang terlibat. Kebersamaan dan kesalingan, kemampuan berinisiatif, mandiri ekonomi, peningkatan kadar keterjaminan makanan dan sistem sokongan sosial adalah antara hasil memberangsangkan dari projek. Antara cabaran yang besar yang dihadapi oleh para peserta ialah kekurangan ilmu dan kemahiran, keterhadan ruang masa, keupayaan ekonomi, sistem sokongan yang lemah dan tenaga kerja. Dasar penting yang menjadi kunci kejayaan projek ialah pada matlamat pembangunan mampan ke-17, Kerjasama Demi Matlamat yang menyatukan pihak-pihak yang bersedia menyumbang pelbagai sumber masing-masing. Di bawah SDG tersebut, beberapa SDG lain yang berkaitan projek dapat dilaksanakan sesuai dengan fungsi masing-masing. Begitu juga dengan usaha-usaha pelbagai pihak lain yang menguatkan kefahaman terhadap kepentingan dan hubungkait diantara

kelestarian alam, keselamatan, keterjaminan dan kedaulatan makanan serta kelangsungan hidup. Hal ini berjaya membangkitkan nyala rasa di kalangan para wanita untuk memastikan kesejahteraan diri dan generasi akan datang. Selain itu, usaha mengatasi segala cabaran yang dihadapi dibuat melalui siri-siri bengkel yang meningkatkan kefahaman, ilmu dan kemahiran. Selain itu, kewujudan sistem sokongan di antara sesama peserta, pakar dan badan bukan kerajaan membolehkan kesejahteraan hayat peserta bertambah baik.

WANITA DAN TRADISI BERTANI

Suatu ketika, sewaktu mengendalikan sesi pertanian bandar kepada komuniti di sebuah flat di Kuala Lumpur, ada beberapa penduduk wanita mengeluh bahawa mereka tidak lagi dapat hidup seperti dulu, iaitu bercucuk tanam dan menuai hasil sendiri. Semuanya perlu dibeli. Antara faktor penyebab keadaan itu ialah ketiadaan ruang untuk bercucuk tanam dan tiada kebenaran dari pihak berkuasa.

Ini membuatkan penulis seringkali mengimbau kenangan dan kehidupan, dari kecil hingga ke saat ini, yang dikelilingi dengan ramai para wanita yang terlibat aktif dengan pertanian dan usaha-usaha berkait langsung dan tidak langsung dengan pertanian. Pelbagai persoalan muncul di dalam fikiran, antaranya apakah yang menyebabkan para wanita semakin terputus dari dunia pertanian? Apa pula usaha yang boleh dilakukan bagi mengembalikan atau menghidupkan kembali hubungan istimewa wanita dan pertanian serta alam sekitar?

Mengapa disebut sebagai hubungan istimewa? Skop bidang pertanian yang melibatkan para wanita bukan hanya bercucuk tanam dan penghasilan makanan atau menuai hasil sahaja. Ianya tidak hanya berlegar sekitar hal ekonomi, keterjaminan makanan dan pekerjaan, malah lebih dari itu. Ini antaranya merangkumi menu tradisi, amalan pemakanan dan petua-petua serta produk kesihatan seperti bedak sejuk, pencuci muka dan pelebat rambut. Tidak sedikit juga dari rutin harian dihubungkan dengan amalan pertanian, seperti menggunakan air beras sebagai baja. Bercucuk tanam dan hal yang berkaitan dengannya menjadi satu elemen penting penghidupan para wanita. Pelbagai ilmu dan hikmah dari para wanita semakin pudar ditelan zaman dan teknologi.

Pertanian adalah satu perkara asasi dalam kemanusiaan. Dan ianya adalah bidang yang tidak asing dalam kehidupan para wanita. Setidak-tidaknya, laman dapur atau pasu-pasu bunga menjadi ruangan kecil untuk para wanita memetik hasil bagi menyediakan makanan mengisi perut ahli keluarga, melepaskan lelah dan '*healing*'. Meskipun dalam dunia moden, banyak hambatan yang membuatkan wanita semakin jauh dari dunia pertanian dan bidang berkaitan, namun kita tidak boleh membiarkan hubungan wanita dan pertanian hilang ditelan zaman. Oleh kerana itu, pelbagai usaha perlu diteroka bagi membolehkan para wanita dapat mencapai kesejahteraan kehidupan.

KISAH WANITA BERTANI

Penulis sentiasa merasa penting untuk mengangkat peranan wanita dalam perjuangan pertanian, kesihatan dan kekeluargaan. Barangkali kerana penulis sendiri telah menyaksikan sejak kecil para wanita di sekeliling yang banyak menjalani kehidupan masing-masing dengan memanfaatkan tanah dan tanaman untuk diri, keluarga dan masyarakat setempat.

Antaranya sosok wanita bertani yang menjadi ingatan kuat ialah nyai Musaropah Binti Saleh. Beliau ialah nenek sebelah bapa penulis yang gemar menanam pelbagai jenis tanaman sayuran dan herba di mana-

mana sahaja dia berada. Kaya dengan petua kesihatan dan mahir membuat jamu. Antara rutin hariannya ialah meminum air daun cerita (Hempedu Bumi) yang amat pahit, pagi dan malam. Meskipun berada di usia tua, beliau tidak boleh duduk diam. Pagi-pagi akan keluar ke kebun sebelum kemudiannya menyelesaikan urusan lain. Penulis masih ingat beliau tekun membuat bedak sejuk dari beras untuk dipakai sendiri, selain membuat inai dari pokok keembung.

Saat mula aktif dalam pertubuhan alam sekitar, lebih banyak nama tokoh wanita di seluruh dunia menjadi perhatian. Antaranya ialah mendiang Prof. Wangari Mathai yang namanya yang tidak asing di seluruh dunia. Penerima anugerah nobel dan pengasas kepada *Green Belt Movement* dan juga aktivis wanita. Terinspirasi dari kisah dan semangatnya, penulis masukkan beliau sebagai salah seorang wira alam dalam buku modul Laskar Alam yang diterbitkan pada tahun 2019.

Dalam pada itu, penulis turut terinspirasi dengan seorang wanita yang telah lama dikenali dalam ABIM. Pn. Junaidah Binti Sairan. Beliau dan suaminya telah banyak memperkenalkan pelbagai jenis ulam kepada penulis, bermula dengan ulam Sambung Nyawa. Kini, beliau telah berjaya memiliki nurseri, di rumahnya sendiri melalui suntikan dana pemula. Tumpuannya banyak kepada tanaman ulaman untuk menerapkan kepentingan dan tabiat pemakanan ulaman kepada generasi muda selain bertekad memastikan tradisi pemakanan ulam tidak putus. Kunjungan terakhir ke rumahnya pada Jun 2024, penulis dihadiahi dengan pelbagai jenis anak pokok ulam untuk ditanam.

Pada tahun 2017, perpindahan ke Terengganu membuka lembaran baru kehidupan penulis dengan agenda alam sekitar dan pertanian. Penulis bersama isteri membuka sekolah alam, mengasaskan jaringan Sekolah Alam Malaysia (SALAM) bersama beberapa rakan lain dan meneroka ruang-ruang pertanian alami yang boleh dijalankan di Terengganu. Hijrah Terengganu sebenarnya bertitik tolak dari perbincangan awal bersama Dr. Maimunah Ropar untuk membuka sekolah model baru yang mendidik pelajar untuk bercucuk tanam dan berinteraksi dengan alam.

Beliau seringkali mengajak penulis untuk berbincang agenda pembangunan wanita. Suatu ketika, beliau menyatakan hasrat untuk membantu para wanita melalui usaha pertanian Moringa. Ketika itu, beliau telah memulakan syarikat perniagaan produk berasaskan Moringa. Disebabkan rumah-rumah masyarakat di Terengganu memiliki kawasan laman yang agak luas atau sekurang-kurangnya terdapat sedikit ruang untuk bercucuk tanam, maka kami berbincang dan bersetuju untuk menjalankan projek menanam Moringa di kawasan rumah bagi membantu golongan wanita kategori B40, ibu tunggal dan surirumah. Bertujuan mengatasi kitaran kemiskinan, meningkatkan kesihatan, menyediakan ruang pendidikan kepada ilmu yang bersesuaian dan membantu meningkatkan taraf ekonomi selari dengan SDG 1 – Sifar Kemiskinan, 3 – Kesihatan yang Baik dan Sejahtera, 4 – Pendidikan Berkualiti dan 8 – Pekerjaan yang Baik dan Pertumbuhan Ekonomi.

Idea menghidupkan semula pertanian, kelestarian dan kesihatan di kalangan wanita sentiasa bermain di fikiran kami. Apabila mendapat maklumat berkenaan Geran Kebun Komuniti APPGM, ianya seperti pucuk dicita, ulam mendatang. Hasrat yang telah dicitakan akhirnya dapat direalisasikan melalui dua projek iaitu di Tepoh dan Sg. Tong.

PROJEK, CABARAN DAN HIKMAH

Dalam laporan Sinar Harian pada Julai 2022, Dr. Anizan Ishak, Naib Presiden Persatuan Kesaksamaan Wanita (WEA) Kuala Lumpur dan Selangor yang juga merangkap bendahari Persatuan Agroekologi

Malaysia (SRI-Mas) ketika itu, menegaskan kepentingan untuk melibatkan wanita secara aktif dalam pertanian. Ramai yang berminat namun beberapa kekangan termasuk tuntutan kerja dan keluarga menjadi penghalang. Namun pendekatan yang lebih bersifat setempat iaitu dengan membawa pertanian ke kawasan mereka ternyata mendapat sambutan.

Pada pandangan penulis, ruang bersesuaian dan peluang yang tepat perlu disediakan kepada para wanita bagi membolehkan mereka aktif berpartisipasi dalam pertanian. Ruang yang dimaksudkan ialah kawasan berdekatan yang berada dalam capaian dan bersesuaian serta metod pertanian yang mampu diuruskan oleh mereka, selain ruang masa bagi mereka menjalankan aktiviti bertani. Manakala peluang pula antaranya merangkumi pemindahan ilmu, suntikan dana, peralatan, dan sistem sokongan.

Projek di Sg. Tong, Setiu dan Tepoh, Kuala Nerus melibatkan kelompok wanita B40, surirumah dan ibu tunggal. Kelebihan situasi di Terengganu ialah kebanyakan rumah-rumah memiliki kawasan sekeliling yang agak luas untuk bercucuk tanam. Oleh itu, kedua-dua projek dijalankan di kawasan rumah para peserta bagi membolehkan capaian dan pengurusan yang lebih mudah. Projek di Sg. Tong menggunakan sistem fertigasi dan digabungkan dengan konsep polikultur, iaitu kepelbagaian tanaman di satu kawasan atau satu polibeg. Manakala di Tepoh pula menggunakan konsep perkebunan hutan.

Secara asasnya, kedua-duanya menggunakan beberapa prinsip yang sama iaitu kepelbagaian tanaman dan penanaman regu (*companion planting*), selain memanfaatkan pendekatan pertanian alami seperti baja organik, penghalau serangga dan kompos. Konsep ini bertepatan dengan SDG 2 – Kebuluran sifar dan 15 – Kehidupan Darat. Ilmu-ilmu berkaitan kelestarian serta pembangunan diri seperti pengukuhan diri, penghasilan produk, menjalankan perniagaan turut diberikan kepada peserta projek di Tepoh. Manakala projek di Sg. Tong pula menumpukan kepada pelbagai kemahiran pengurusan dan penyelenggaraan sistem fertigasi. Latihan kemahiran dan sesi pemindahan ilmu turut melibatkan wakil dari Jabatan Pertanian dan Persatuan Pedagang dan Pengusaha Melayu Malaysia (PERDASAMA) Terengganu. Begitulah perancangan awal untuk kedua-dua projek.

Cabaran bermula apabila musim hujan yang melanda Terengganu pada bulan November hingga Januari menyebabkan kami agak resah kerana menyangkakan bahawa projek tidak akan berjaya mencapai objektif. Banyak perancangan yang telah dibuat terencat. Anak pokok Moringa yang sepatutnya diserahkan kepada peserta, 80 peratus daripadanya mati, beberapa tapak peserta di Tepoh ditenggelami air, 1 projek hanyut dan sekitar 70 peratus pokok cili di Sungai Tong dijangkiti penyakit. Penanaman Moringa tidak dapat dimulakan seperti jadual, manakala hasil cili tidak dapat dipasarkan kerana cacat.

Di Tepoh, penanaman dan pemindahan anak pokok ditangguhkan. Aktiviti ditumpukan kepada menyelesaikan pemindahan ilmu, penyerahan peralatan berbaki dari senarai kit peserta dan penanaman semula anak pokok Moringa. Aktiviti di Sg. Tong pula memfokuskan kepada penyelenggaraan tanaman, pembajaan dan semburan kawalan serangga. Sepanjang proses tersebut, beberapa kali aturan semula terpaksa dibuat memandangkan hasil yang diharapkan tidak berlaku.

Meskipun dalam fikiran tidak meletakkan harapan yang tinggi kerana cabaran yang dihadapi, namun sebaliknya berlaku. Apabila musim panas mula tiba, hikmah muncul disebalik takdir Tuhan. Para wanita ini, bijak berinisiatif sendiri dalam memanfaatkan hasilan yang ada. Di

Sg. Tong, selain berkongsi atau dijual kepada saudara mara dan rakan sekampung, para peserta membuat lada jeruk, cili kering dan solok lada. Malah, tuaian cili sesama peserta dijadikan solok lada untuk kenduri di surau kampung. Para peserta projek di Tepoh juga memanfaatkan kemahiran dan pekerjaan masing-masing untuk menghasilkan produk moringa untuk dijual. Antaranya ialah roti canai moringa, jemput-jemput Moringa dan lompat tikam Moringa.

Sepanjang tempoh pemantauan, selain pemantauan berkala dan khidmat nasihat, peserta dibekalkan dengan kit semaian dan pelbagai benih agar mereka boleh terus bercucuk tanam. Sistem sokongan juga diwujudkan seperti pertemuan keilmuan dan ziarah kebajikan. Para peserta juga saling membuat pertemuan dan bekerjasama sesama sendiri. Gerakan seterusnya yang dihasratkan ialah untuk mengupayakan para peserta sebagai model dan tenaga pengajar kepada orang lain yang mungkin menjadi peserta di bawah geran atau projek baru.

Pelbagai impak positif dikongsikan dengan para peserta disebalik tanaman dan tuaian. Kebanyakannya merasa seronok kerana dapat menuai hasil untuk makan dan perubahan rutin yang banyak menumpukan kepada penjagaan tanaman. Tanaman jadi seperti anak. Perkongsian dari salah seorang peserta dari projek di Tepoh, Puan Rozita, amat memberi kesan mendalam kepada penulis. Beliau menyatakan bahawa suaminya gembira dan rasa senang melihat kebun tanaman yang diusahakannya di sekitar rumah. Suami beliau sehingga kini berkerusi roda kerana sakit dan dijaga oleh puan Rozita di rumah. Kebun sekeliling rumah itu menjadi terapi jiwa kepada mereka berdua. Menjadi suatu kebahagiaan. Hal ini juga dialami oleh Puan Masjieda yang bekerja di siang hari dan membuat sendiri serta berniaga roti canai di malam hari. Ibunya yang juga kurang sihat menjadikan aktiviti berkebun dari projek sebagai terapi.

KEBERLANGSUNGAN WANITA BERTANI DAN KESEJAHTERAAN HAYAT

Di skala yang besar, bidang pertanian banyak dimonopoli oleh lelaki. Meskipun begitu, ianya bukan ketetapan kehidupan serta tidak menjadi penghalang untuk para wanita mencapai satu tahap yang tinggi dalam bidang pertanian. Kini, semakin ramai aktivis yang berusaha mengangkat para wanita dalam dunia agro. Penglibatan penulis dalam kumpulan Inisiatif Rizab Benih Komuniti (IRBK), menyaksikan penyertaan ramai wanita sebagai ahli jawatankuasanya. Dengan pengalaman yang luas dan keupayaan yang hebat, mereka tekun dan bersungguh-sungguh dalam mengangkat hak-hak petani, kedaulatan makanan, kebebasan pemilikan benih dan memartabatkan agroekologi. Wanita-wanita yang aktif ini, mereka juga adalah penggerak kepada pemerkasaan wanita. Semuanya demi mencapai kelestarian dan kesejahteraan kehidupan umat manusia.

Secara lumrahnya, manusia akan ada masa melalui saat-saat getir dalam hidup yang mengoyah jiwa dan akal. Kisah Pn. Kamariah Md Yatim, petani pandan, yang suatu ketika tular di media sosial, menunjukkan bahawa peri penting gerakan mengupayakan wanita dalam pertanian sebagai salah satu jalan mencapai kesejahteraan hayat. Gerakan yang mesti diusahakan secara bersama oleh pelbagai pihak dengan model yang praktikal serta terbukti boleh berjaya. Kesepaduan diantara perkongsian ilmu dan latihan kemahiran, suntikan dana dan peralatan serta sistem sokongan sosial.

Dasar penting yang menjadi kunci keberhasilan projek seperti yang dinyatakan ialah pada matlamat pembangunan mampan ke-17, Kerjasama Demi Matlamat yang menyatukan pihak-pihak yang bersedia menyumbang pelbagai sumber masing-masing. Di bawah SDG tersebut, beberapa SDG lain yang berkaitan projek dapat dilaksanakan sesuai dengan fungsi masing-masing.

BEBERAPA KEPERLUAN DAN PIHAK YANG BERPOTENSI MENYOKONG GERAKAN WANITA BERTANI MENGEMBALIKAN PENGHIDUPAN PARA WANITA

Pertanian bermakna manusia akan berinteraksi dengan alam ciptaan Tuhan – tanah, tumbuhan, haiwan, air, udara, serta kitaran-kitarannya. Fitrahnya, interaksi dan hubungan baik dengan alam akan mewujudkan suasana harmoni dan ketenangan dalam jiwa manusia. Usaha memperkasa wanita dalam pertanian merupakan gagasan asli dalam mengangkat martabat wanita sesuai dengan tempatnya secara adil. Mengembalikan pelbagai hikmah, ilmu dan tradisi pertanian yang sekian lama berhubungan rapat dengan para wanita. Ianya perlu disesuaikan dan digandingkan dengan peranan lelaki.

Seruan kepada gerakan wanita bertani adalah sebagai salah satu usaha untuk mengembalikan hubungan istimewa wanita dan alam. Membolehkan wanita merasa hidup (*feel alive*), memilki jiwa yang lebih bahagia juga fikiran yang lebih tenang. Membugarkan dan mewariskan pelbagai amalan, pesan dan petua kelestarian kepada generasi akan datang. Kata Lailah Gifty Akita, seorang penulis dari Ghana, "Keajaiban kehidupan bermula dalam rahim seorang wanita". Mari sama-sama kita memulakan keajaiban kehidupan manusia melalui tangan-tangan wanita yang bertani!

Chapter 7

Wanita dan Transformasi Komuniti melalui Pertanian: Kisah Inspirasi Cikgu *Norlia*

Ts. Wan Amishah Wan Mahmud

ABSTRAK

Bagaimana seorang wanita boleh mengubah sebuah komuniti? Kisah Cikgu Norlia memberikan jawapan yang inspiratif. Sebagai seorang bekas guru berusia 64 tahun, beliau memimpin sebuah projek pertanian komuniti yang berjaya mengumpulkan hasil bernilai RM50,000 dalam tempoh hanya 10 bulan. Namun, ini bukan hanya tentang angka, ia adalah cerita tentang kepimpinan melalui teladan, mengatasi cabaran cuaca yang tidak menentu, serangga perosak, dan kekurangan pendidikan teknikal. Dengan sokongan daripada kerajaan, rakan strategik, dan komuniti, projek ini telah menjadi model keberhasilan yang mencetuskan semangat generasi muda. Kisah ini bukan sekadar tentang pertanian; ia adalah tentang bagaimana seorang wanita dapat memimpin perubahan sosial yang berdaya tahan. Artikel ini menyeru kepada semua pihak untuk mengiktiraf dan memperkasakan wanita sebagai agen transformasi dalam pelbagai bidang, terutama dalam sektor pertanian.

PENDAHULUAN

Wanita memainkan peranan penting dalam sektor pertanian di seluruh dunia. Mereka adalah tulang belakang banyak komuniti luar bandar, bertanggungjawab bukan sahaja untuk pengeluaran makanan tetapi juga untuk kesejahteraan keluarga dan masyarakat. Namun, mereka sering menghadapi pelbagai cabaran seperti kekurangan akses kepada sumber, teknologi, dan pengiktirafan. Dalam konteks Malaysia, wanita seperti Cikgu Norlia menunjukkan bahawa mereka bukan sahaja mampu mengatasi cabaran ini tetapi juga menjadi agen perubahan yang memacu pembangunan komuniti. Selepas bersara sebagai seorang guru, Cikgu Norlia memilih untuk menggunakan pertanian sebagai platform untuk memperkasakan komuniti. Kisah beliau adalah contoh bagaimana dedikasi dan sokongan yang betul dapat mencetuskan perubahan besar.

INSPIRASI CIKGU NORLIA

Cikgu Norlia memulakan projek kebun komuniti dengan visi untuk membantu masyarakat setempat. Melalui inisiatif ini, beliau bekerja bersama-sama komuniti, menunjukkan kepimpinan melalui teladan. Empat hari seminggu, beliau turun ke lapangan untuk bersama-sama peserta lain, memupuk semangat kerjasama dan kepercayaan.

Dalam masa hanya 10 bulan, projek ini berjaya menghasilkan sayur-sayuran bernilai RM50,000. Kejayaan ini bukan sahaja memberi manfaat dari segi kewangan tetapi juga meningkatkan keyakinan komuniti terhadap potensi pertanian sebagai sumber pendapatan dan pembangunan. Kejayaan ini juga menjadi inspirasi kepada generasi muda, terutama ahli Misi Amal, yang melihat pertanian bukan sekadar pekerjaan tetapi juga sebagai platform untuk membawa perubahan sosial.

CABARAN DALAM PROJEK PERTANIAN KOMUNITI

Projek yang dipimpin oleh Cikgu Norlia tidak terlepas daripada cabaran yang menguji ketabahan dan kreativiti pasukan.

Cabaran Cuaca

Keadaan cuaca yang tidak menentu seperti hujan lebat atau kemarau panjang memberi kesan kepada hasil tanaman. Tanaman sering kali terdedah kepada risiko banjir yang merosakkan atau kekurangan air yang menghalang pertumbuhan.

Gangguan Serangga dan Penyakit

Serangan serangga perosak dan penyakit adalah satu lagi cabaran utama. Tanpa pengetahuan teknikal yang mendalam, peserta sukar menangani masalah ini dengan berkesan, menyebabkan kerugian yang ketara.

Pendidikan dan Pengetahuan Teknikal

Ramai peserta adalah pendatang baru dalam bidang pertanian. Kekurangan pendidikan dan kemahiran teknikal menjadi cabaran besar dalam memastikan kelangsungan dan keberkesanan projek ini.

Kekangan Sumber

Dana yang terhad memaksa pasukan menggunakan kaedah tradisional yang kurang efisien. Alat moden dan teknologi sering kali di luar kemampuan kewangan mereka, memperlahankan perkembangan projek.

Persepsi Awal Komuniti

Pada peringkat awal, ramai dalam komuniti ragu-ragu terhadap potensi projek ini. Cikgu Norlia perlu bekerja keras untuk membina kepercayaan mereka terhadap pertanian sebagai alat perubahan yang berkesan.

Sokongan yang Memacu Kejayaan

Keberhasilan projek ini banyak bergantung kepada sokongan pelbagai pihak yang membantu mengatasi cabaran.

Sokongan Kerajaan dan APPGM

Program seperti APPGM menyediakan sokongan kewangan dan bimbingan strategik. Bantuan ini merangkumi peralatan pertanian, latihan teknikal, dan logistik yang sangat diperlukan untuk memastikan kejayaan projek.

Rakan Strategik

Kerjasama dengan syarikat swasta dan NGO membolehkan projek ini mendapat sumber tambahan seperti benih berkualiti, teknologi moden, dan akses kepada pasaran. Sokongan ini mempercepatkan pencapaian hasil yang memberangsangkan.

Penglibatan Komuniti

Ahli komuniti memberikan sokongan moral dan tenaga kerja. Kepercayaan mereka kepada projek ini semakin kukuh selepas melihat kejayaan awal, menjadikan mereka lebih komited terhadap usaha ini.

Latihan dan Pendidikan

Beberapa institusi menyediakan kursus pendek dan bengkel praktikal untuk peserta. Latihan ini memberi mereka pengetahuan tentang teknik pertanian moden, pengurusan perosak, dan pemasaran hasil pertanian.

PERBINCANGAN

Kisah Cikgu Norlia menunjukkan bahawa wanita boleh menjadi pemimpin perubahan dalam sektor pertanian. Kepimpinan melalui teladan, disokong oleh kerjasama dan sumber yang mencukupi, mampu mengatasi cabaran besar. Walaupun berdepan dengan kekangan cuaca, perosak, dan dana, ketabahan beliau membuktikan bahawa usaha kolektif mampu menghasilkan kejayaan yang luar biasa. Selain itu, sokongan daripada pelbagai pihak memainkan peranan penting. Kombinasi usaha kerajaan, rakan strategik, dan komuniti setempat mencipta sinergi yang mempercepatkan pembangunan projek ini. Ini adalah model yang boleh ditiru oleh komuniti lain yang ingin memulakan inisiatif serupa.

PENUTUP

Kisah Cikgu Norlia adalah bukti bahawa wanita mampu membawa perubahan besar dalam masyarakat. Dengan kepimpinan, dedikasi, dan sokongan yang betul, mereka boleh mengatasi pelbagai cabaran dan mencipta impak yang berkekalan. Dalam konteks pertanian, wanita bukan sahaja sebagai pekerja tetapi juga sebagai agen perubahan yang mencipta peluang dan harapan untuk masa depan. Artikel ini adalah seruan untuk memperkasakan wanita dalam semua aspek kehidupan, terutama dalam bidang pertanian. Dengan memberikan mereka akses kepada pendidikan, teknologi, dan sumber yang mencukupi, kita bukan sahaja membantu mereka tetapi juga memajukan komuniti dan negara. Kisah ini adalah inspirasi untuk kita semua untuk bertindak dan menyokong usaha yang membawa perubahan positif.

Part IV:
Agribusiness and
Product Down-streaming

Chapter 8

Agribusiness And Product Down Streamingofherbspegaga Sabah & Tuhau Sabah: A Case Studyinpenampang, Sabah, Malaysia

Julius Kulip and Nor Hayati Pindia

ABSTRACT

A case study on the agribusiness and product down-streaming of local herbs of Sabah namely Pegaga Sabah (Centella asiatica var. Sabah) and Tuhau (Etlingera coccinea var. Red Culm) was conducted in Penampang district, Sabah, Malaysia, under the APPGM-SDG Community Farming Project code Y23-KK077 from 28th August 2023 to 22nd March 2024. A total of 8 villages involved with 10 local participants of Kadazan-Dusun ethnic included 3 men and 7 women. Most of them are in the B40 category where farming is their main source of income. The purpose of this study is to know if local herbs of Sabah can be cultivated and sold to consumers. The goal was to achieve harvestable fresh herbs from the participants, make products and sell them to the markets. The project was started by delivering 7 series of courses to the participants. A total of 11 field visits were conducted to monitor the progress of each participant. Planting of Pegaga and Tuhau Sabah were started from seedlings at the nursery. The total number of Pegaga Sabah seedlings planted was 2,354 in 1.7 acres and Tuhau was 468 in 2.35 acres. The results showed that the total fresh weight of Pegaga Sabah harvested was 38,335 grams, while Tuhau was 4,500 grams. These fresh herbs were bought by Botanicals Sabah Sdn. Bhd. company and the participants received a total of RM 598.97. Processing of Pegaga herbs was done at the factory while Tuhau was processed at home-based business. Products were distributed in Penampang, Papar and Kota Kinabalu districts. Some of

them were sold at weekly Tamu and during festivals. Challenges encountered in this process were soil, source of water, climate, geography, attacks by pests and processing cost. The problem of pests was solved by biological control and using organic pesticides. Processing costs need to be reduced so that the price of end products would be cheaper.

INTRODUCTION

Sabah is rich in plants diversity that contains medicinal properties that beneficial to human and animal health. Indigenous people in Sabah have been using these plants as herbal medicine to cure their diseases, maintenance their body's health since time immemorial. Research on medicinal herbs in Sabah started in 1980 especially on documentations of traditional knowledge. According to Kulip (2004), there were 1,300 species of traditional medicinal herbs that commonly being used by the indigenous people in Sabah which 80% of them are natives to Sabah. However, the herbal industry in Sabah just started in 2010 but in a small scale whereby local indigenous people were seen selling their fresh and dried herbs at weekly Tamu market.

Herbs have been identified as a new source of income for people in Malaysia. However, the herbal industry is small and fragmented. There were no general comprehensive programs and initiatives for this industry until 2011 when the Ministry of Agriculture and Agrobased Industry started to recognise the importance of these commodities.

Agrobusiness is defined as the various businesses collectively that process, distribute, and support farm products. The purpose of agribusiness is to create and supply agricultural products for end-consumption. Agricultural products are naturally produced resources for human consumption or other uses. The products require a variety of sectors and industries to support the producers, which are central in this value chain. The four basic functions of agribusiness management are marketing and sales, production and operations, financial management and planning, and human resources management.

Malaysia's agricultural sector is separated into two sectors: industrial crops and agro-food crops. Palm oil, rubber, and cocoa account for 86% of Malaysian agricultural land. At the same time, fruits and vegetables comprise the remaining 14% of agro-food commodities production (Shahiida, 2022).

The domestication of wild herbs has increased the production of herbal products in Malaysia. As a result, the market value of the herbal industry reached RM10 billion (US$2.44 billion) in 2008 (NAP, 2011) and this figure is expected to increase further to RM32 billion (US$7.8 billion) by 2020.

Penampang is the capital of the Penampang District in the West Coast Division of Sabah, Malaysia. It is about 178.948 square miles. Its population was estimated to be around 93,616 in 2010, with ethnic Kadazan/Dusun as the majority. The name Penampang came from an old village within the district. The village’s name in turn originates from a Kadazan/Dusun word pampang meaning a big rock. This is because huge rocks were easily found within the vicinity of the village a long time ago. The first township in Penampang district was built in Kasigui area in the 1960s. There were two rows of wooden shophouses. Many travellers who went to Tambunan and Keningau from all over the west coast of Sabah will stop at Kasigui shops to eat and buy something. Nowadays, many retail stores are found scattered in the district primarily in the Donggongon area. It also features a popular weekly tamu (market) in the town every Thursday and Friday where the market sells a variety of household products, foods, and traditional handicrafts such as bangles, headbands or gong. A new popular wayside market is found in Babagon about 15 KM form Donggongon township towards Tambunan district

LOCALITY OF THE STUDY

This study was conducted in 8 villages in Penampang District with a total of 10 local Kadazan-Dusun participants (Figure 8.1) and (Figure 8.3 – 8.13).

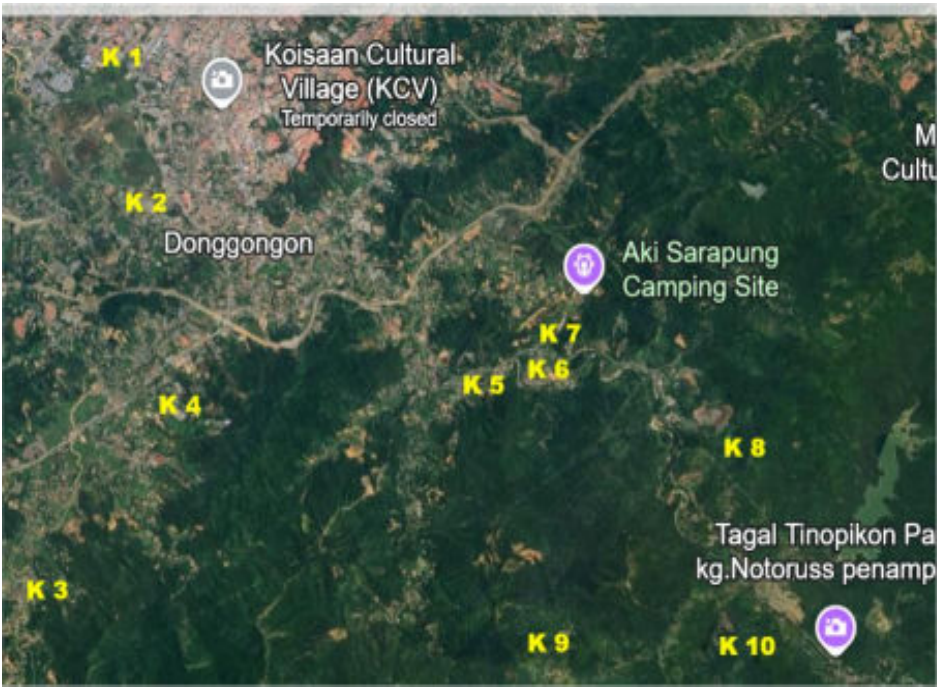


Figure 8.1. Showing the locations of each garden in Penampang District, Sabah. K1 Kg. Kobusak, K2 Kg. Mahandoi, K3 Kg. Kituau, Limbanak, K4 Kg. Limbanak, K5 Kg. Nampasan, K6&K7 Kg. Tomposik, Inobong, K8 Kg. Tompoluon, K9 Kg. Babagon dan K10 Kg. Notoruss.

Figure 8.2. Map of sabah showing Parliament of Penampang P.174

THE PROJECT: APPGM-SDG "PROJEK KEBUN KOMUNITI HERBA TEMPATAN SABAH" (Y23-KK077) AND "PENANAMAN HERBA TEMPATAN SABAH SECARA ORGANIK" (Y24-KK002)

About our project

Our 1st project (Phase 1) entitle with APPGM-SDG is "Projek Kebun Komuniti Herba Tempatan Sabah" (Local Herbs Community Sabah Garden) Code Y23-KK077 was started in end of August 2023, based in Penampang District under the P.174 Parliamentary of Penampang and ended on June 2024. Now we are continuing this project in Phase 2 (Y24- KK002) entitled "Penanaman Herba Tempatan Sabah secara Organik" (Organic Planting of Local Herbs Sabah) which was started in May 2024.

Project descriptions

The herbal industry in Malaysia is increasing annually but most of the plantations and industries are in Peninsular Malaysia. For many years, people in Sabah had been harvesting local herbs from the wild and no proper gardens or plantations, so this project will make Sabah one of the producers of herbs raw materials and products. We need to help local Sabahans to become seriously involved in this good income industry. With this project the people (especially the rural people) living within the parliament will be able to get the knowhow on how to choose good quality of herbs materials, propagate them in large scale and sell them to improve their income. They will also be taught on how to identify and propagate herbs in scientific methods and to take care of their plantation. They will produce quality herbs and raw materials from their garden in a sustainable manner and produce their own products to be sold locally and internationally. There are 4 Sustainable Development Goals to be achieved in this project in order to reach 10 farmers in Sabah (Penampang Parliament) by end of December 2023:

1. Goal 1 No Poverty: Empowering local people by providing them the skill to market their products locally and internationally.
2. Goal 3 Good Health and Well Being: Empowering local farmers by providing them knowledge and skill to grow local herbs.
3. Goal 5 Gender Equality: Making sure at least 5 persons will have their own herbs garden.
4. Goal 8 Decent work and Economic Growth. Provide entrepreneurship education to 10 participants from the localities and give information to them about government funds. Also provide workshops on how to open and register a business.

The objectives are:

1. The main objective of this programme is to produce many knowledgeable and successful participants that could plant large scale herb raw materials for the herbal industry in Sabah and Malaysia generally. This will lift up their income and lessen the dependence of importing raw materials from other countries (Phase 1)

2. To plant, produce and sell Pegaga (Centela asiatica var. Sabah) Apiaceae and Tuhau (Etlingera coccinea var Red Culm) Zingiberaceae (Phase 2)
3. To make products from Pegaga dan Tuhau (Company and community) and sell for income (Phase 2)

Project activities involved:

1. Design planning to identify sectors to be focused and training modules to be executed: 6 training modules to be carried out throughout the project namely:
    a) Module 1: Basic scientific knowledge on plants (Botany). There will be 3 Chapters: Introduction to plants Kingdom; Diversity of plants; and Basic Plant physiology
    b) Module 2: Basic of plant breeding and propagation
    c) Module 3: Plants Nursery establishment and maintenance
    d) Module 4: Implementation of seedling raising and nurturing
    e) Module 5: Workshop on Fundamentals of Herbs Garden development and business
    f) Module 6: Workshop on taking care of herbs in the field. Learn how to manage insects, diseases etc.

2. Mentoring and Coaching Session
   Visits to participants' gardens were conducted 11 times from month of September 2023 to January 2024. During these times, gardens were inspected carefully to see if any problems arose such as herbs not growing well, attacked by insect pests, diseases and to make sure the basic necessary basic needs such as water tanks supplied for clean water etc ... were used.

3. Harvesting of Pegaga and Tuhau herbs
   The 1st harvesting of Pegaga was conducted on the 28th of Dec 2024 after 3 months planted. Followed by the 2nd harvest on the 2nd of Mac 2025 and the 3rd harvest was on 16th of May 2025. The 1st harvest of Tuhau was conducted on the 29th of August. Tuhau herbs took about 8-9 months.

METHODOLOGY

Two herbs were used during this study namely Pegaga Sabah (Centella asiatica var. Sabah) and Tuhau (Etlingera coccinea var. Sabah). Both materials were identified by the first author (Botanist). There were ten people involved in this project, all of them from the Kadazan-Dusun indigenous ethnic group in Sabah (Table 8.1).

Table 8.1. Participants of the project

NO.	NAME	GENDER	AGE	VILLAGE	OCCUPATION
1	F. L Graasia Nelly	Female	43	Tomposik, Inobong	Entrepreneur
2	Linda Grace Legum	Female	46	Tomposik, Inobong	Entrepreneur
3.	Shirley Daitan	Female	59	Tompoluon, Babagon	Farmer
4.	Juliana Dumpil	Female	53	Babagon	Farmer
5.	Maria Benedict Lasimbang	Female	60	Nampasan	Farmer & Entrepreneur
6.	Caroline Mokunjil	Female	56	Mahandoi	Farmer
7.	Patricia Vincent Mobilik	Female	62	Kobusak	Retired & Farmer

NO.	NAME	GENDER	AGE	VILLAGE	OCCUPATION
8.	Robin Frederick Lojiwin	Male	63	Kituau, Limbanak	Retired & Farmer
9.	James Molijoh	Male	60	Limbanak	Retired & Farmer
10.	Gidius Gonsuin	Male	64	Notoruss, Babagon	Retired & Farmer

The project was started on 25th August 2023 by gathering all the participants and briefing about the project. On 31st August 2023, visits to all participants' gardens were conducted to see the suitability of their lands and for the confirmation of the participation. Activities conducted for the participants during the project were:

1. Construction of seedlings nursery
2. Delivering herbs seedlings
3. Preparation of land
4. Delivering of courses
5. Planting of herbs on garden
6. Monitoring of gardens
7. Visiting other related institutions
8. Harvesting
9. Developing of products
10. Selling of products

The first activity conducted for the participants was construction of a nursery for the new seedlings from 4th - 14th of September (Figure 8.3). Nursery is a very important place for raising seedlings (Figure 8.4) before transplanting into an open garden. Here the seedlings were placed inside the nursery for a period of between two to three weeks. This is to ensure that the seedlings developed healthy and strong roots systems hence will supply water and nutrition to the seedlings for developing of new leaves. The roof of the nursery was developed by putting up a 70% sun block penetration black net. Extreme direct and hot sunlight is avoided because it will kill the seedlings. When the nursery is completed, seedlings were given to all participants.

Figure 8.3. Nursery constructed by participant Mr. Gidius Gonsuin at Kg. Notoruss, Babagon

Figure 8.4. Seedling of Pegaga inside Nursery

Figure 8.5. Participants planting seedlings

Preparation of land for planting herbs from Nursery was conducted while waiting for the new herbs' seedling growing inside the nursery. Participants were invited to join courses related to planting and herbs to increase their knowledge (Figure 8.6 – 8.14). There were 7 courses / workshops conducted, namely:

a) Module 1: Basic Botany
b) Module 2: Propagation
c) Module 3: Nursery development and management
d) Module 4: Preparation of land for planting
e) Module 5: Assistances for governments
f) Module 6: Insects & Pests Management Workshop 1: Making of Compost
g) Module 7: Harvesting

Figure 8.6. Participants

Figure 8.7. Participants attending courses

Figure 8.8. Demonstration to participants

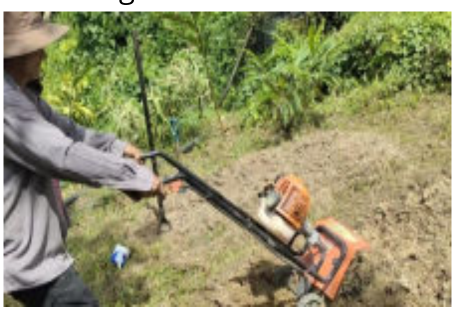


Figure 8.9. Preparation of land.

Figure 8.10. Planting seedlings on beds

Figure 8.11. Taking care herbs growing

Figure 8.12. Insects & Pest management

Figure 8.13. Making Compost

Figure 8.14. Harvesting

Figure 8.15. Monitoring visits by Solution Provider

Tuhau garden

Figure 8.16. Harvesting Tuhau

Figure 8.17. Tuhau herbs garden at Kg. Kituau, Limbanak.

Monitoring of gardens were conducted 14 times in 4 active months (Figure 8.15). During monitoring, we gathered information such as problems encountered by the participants, our solutions to their problems and our advice and instructions for them to improve their gardens' productivity. Data on the growth performances were also recorded.

Participants were brought to visits to other agriculture related institutions to increase their knowledge and make contacts to the institutions involved (Figure 8.16 – 8.17).

Figure 8.18. Integrated Agriculture Center, Putatan

Figure 8.19. Breeding Center for Fresh water fish Sabah, Kota Marudu.

Harvesting of Pegaga was conducted every 3 months after planting. The first harvesting of Pegaga was started after 3 months of planting (28.10.2023) followed by the second harvest on 12.03.2024 and the third one on 29.7.2024.

RESULT

Pegaga

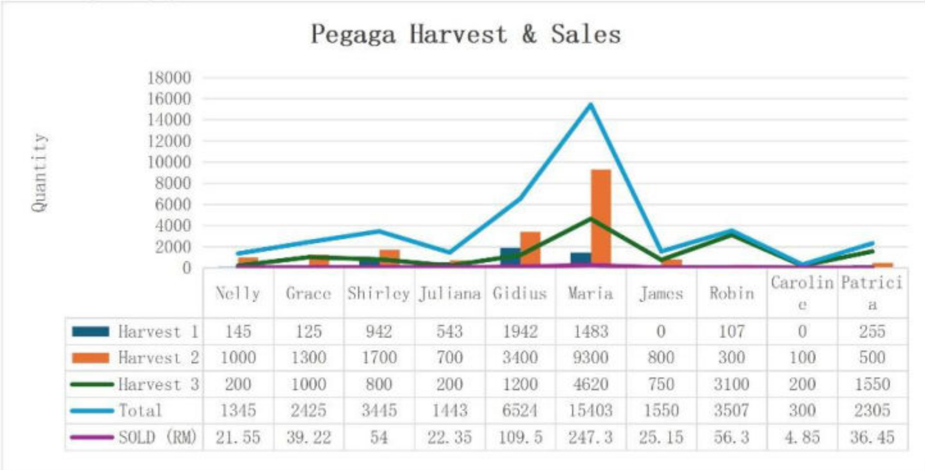
Table 8.2 shows the latest (as at 22.10.2024) data on Pegaga status on each garden. The first harvest was on 28.12.2023, second harvest was 12.3.2024 and the third was 29.7.2024.

Table 8.2. Pegaga Harvests & income

NO.	NAME	VILLAGE	AREA (M2)	1st. HARVEST (Gram) / SOLD (RM)	2nd. HARVEST (Gram) / SOLD (RM)	3rd. HARVEST (Gram) / SOLD (RM)	TOTAL HARVEST (Gram)	TOTAL SOLD (RM)
1	F.L Graasia Nelly	Tomposik, Inobong	2	145 / 2.1	1,000 / 16.2	200 / 3.25	1,345	21.55
2	Linda Grace Legum	Tomposik, Inobong.	2	125 / 1.8	1,300 /21.1	1,000 / 16.22	2,425	39.22
3	Shirley Daitan	Tompoluon, Babagon.	7.1	942 / 13.5	1,700 / 27.5	800 / 13	3,445	54
4	Juliana Dumpil	Babagon	3.6	543 /7.8	700 /11.30	200 / 3.25	1,443	22.35
5	Gidius Gonsuin	Notoruss, Babagon	46.6	1,942 / 28.2	3,400 / 55.1	1,200 /19.5	6,542	109.5

NO.	NAME	VILLAGE	AREA (M2)	1st. HARVEST (Gram) / SOLD (RM)	2nd. HARVEST (Gram) / SOLD (RM)	3rd. HARVEST (Gram) / SOLD (RM)	TOTAL HARVEST (Gram)	TOTAL SOLD (RM)
6	Maria Benedict Lasimbang	Nampasan Kivatu	38.4	1,483 /21.3	9,300 / 151	4,620 / 75	15,403	247.3
7	James Geodfrey Molijoh	Limbanak	2	0 /0	800 / 13	750 / 12.15	1,550	25.15
8	Robin Frederick Lojiwin	Kituau, Limbanak	12	107 / 1.5	300 / 4.9	3,100 / 50.3	3,507	56.3
9	Caroline Marcus Mokujil	Mahandoi	1.5	0 /0	100 / 1.6	200 / 3.25	300	4.85
10	Patricia Vincent Mobilik	Kobusak	6	255 / 3.2	500 / 8.1	1,550 / 25.15	2,305	36.45

Figure 8.20. Pegaga Harvest & Sales



	Nelly	Grace	Shirley	Juliana	Gidius	Maria	James	Robin	Caroline	Patricia
Harvest 1	145	125	942	543	1942	1483	0	107	0	255
Harvest 2	1000	1300	1700	700	3400	9300	800	300	100	500
Harvest 3	200	1000	800	200	1200	4620	750	3100	200	1550
Total	1345	2425	3445	1443	6524	15403	1550	3507	300	2305
SOLD (RM)	21.55	39.22	54	22.35	109.5	247.3	25.15	56.3	4.85	36.45

Participants harvested and sold to buyer Botanicals Sabah Sdn. Bhd.

Figure 8.21. Harvesting Pegaga

Tuhau

Table 3 shows the latest (as at 22.10.2024) data on Tuhau status each garden:-

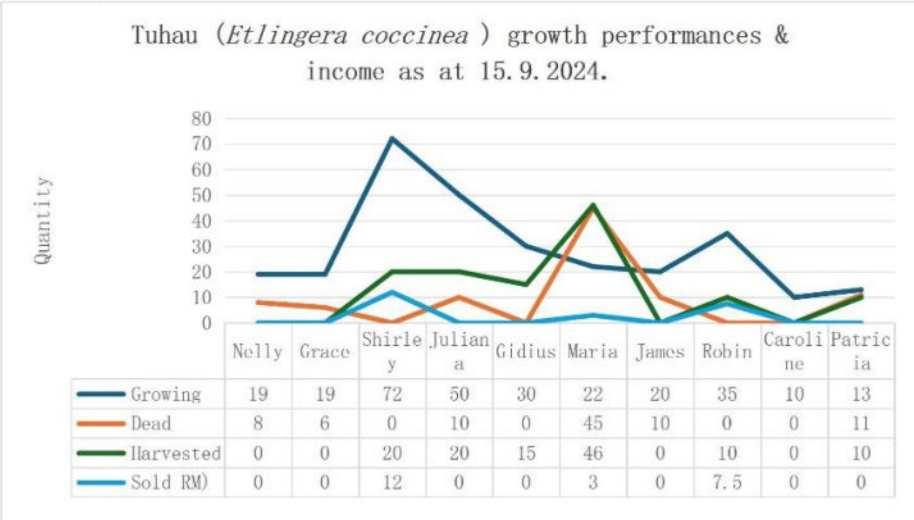
Table 8.3. Data on Tuhau Status in Each Garden

NO.	NAME	VILLAGE	NO. OF CLUMP STILL GROWING	NO. OF DEAD CLUMP	NO. OF NEW CULM	HARVESTED RAW WEIGHT (Gram)	SOLD (RM) 1st Harvest	OTHER NOTES
1	F.L Graasia Nelly	Tomposik, Inobong	27	8	0	NA		
2	Linda Grace Legum	Tomposik, Inobong.	25	8	0	NA		
3	Shirley Daitan	Tompoluon, Babagon.	72	0	70	Raw= 24 culms (2,700g). (15.9.2024)	12 (Pith= 768 gram)	30 new culm harvested for own use (9.10.2024)
4	Juliana Dumpil	Babagon	50	10	20	NA		
5	Gidius Gonsuin	Notoruss, Babagon	30	0	0	NA		

NO.	NAME	VILLAGE	NO. OF CLUMP STILL GROWING	NO. OF DEAD CLUMP	NO. OF NEW CULM	HARVESTED RAW WEIGHT (Gram)	SOLD (RM) 1st Harvest	OTHER NOTES
6	Maria Benedict Lasimbang	Nampasan Kivatu	16 6	6 39	13 33	3 (200 g) (15.9.2024)	3	
7	James Geodfrey Molijoh	Limbanak	20	10	0	NA		
8	Robin Frederick Lojiwin	Kituau, Limbanak	35	0		15 (1,700 g) (15.9.2024)	7.50	
9	Caroline	Mahandoi	10	0	0	NA		
10	Patricia Vincent Mobilik	Kobusak	13	11	0	NA		

Note:
Weight of one raw new stem (Unopen sheaths)= 110g
Weight of one new fresh pith = 32g.
Current retail market price = RM1 per stem or per 32 gram new fresh pith. Current wholesale price = RM0.50 per 32 gram
NA= No data.

Figure 8.22. Tuhau's Growth Performance & Income



	Nelly	Grace	Shirley	Juliana	Gidius	Maria	James	Robin	Caroline	Patricia
Growing	19	19	72	50	30	22	20	35	10	13
Dead	8	6	0	10	0	45	10	0	0	11
Ilarvested	0	0	20	20	15	46	0	10	0	10
Sold RM)	0	0	12	0	0	3	0	7.5	0	0

Products Development

At the moment there are three products made namely Pegaga Herbal tea, Tuhau pickles and Pegaga plus pellets for freshwater fish.

Figure 8.23. Herbal Pegaga tea herbal

Figure 8.24. Pegaga herbs based pellets

Figure 8.25. Tuhau pickles

Figure 8.26. The official opening of Pegaga tea products

Marketing

Both products are now available at Papar district, Penampang district and Kota Kinabalu district (UMS main campus).

Figure 8.27. Outlet at Papar shop

Figure 8.28. Outlet at UMS main campus KK

Figure 8.29. Outlet at Babagon, Penampang shop

Figure 8.30. Outlet at Inobong Penampang

Apart from selling at outlets, selling directly to individuals is also being done. We also sell during festivals around Kota Kinabalu.

Figure 8.31. Tadau Kaamatan festival

Figure 8.32. Festival Kota Kinabalu

DISCUSSION

Agribusiness and product down streaming of local herbs Pegaga Sabah dan Tuhan Sabah which was conducted in Penampang district under the APPGM-SDG program (Project code Y23-KK077) from 1st of Sept. 2023 was the first case in Sabah which was conducted by Botanicals Sabah Sdn. Bhd. Company. Ten participants from the Penampang district community were selected to join this project. Before signing the agreement by the participants, a briefing was held on 28th August 2023 by the company to all participants. Participants asked questions especially on how this project can be sustained. After four months of operation, participants successfully produced their first fresh leaves of Pegaga herbs about 5,542 grams and they received RM79.40. The second harvest was on the 12th March 2024 whereby they produced 19,100g and they gained RM309.8. The third harvest was on the 29th July 2024 where they produced 13,620 grams and they received RM221.07. Total Weight for three harvests was 38,262 grams and total income was RM616.67. The first harvest of Tuhau was on 15th Sept 2024. It took a year to produce Tuhau herbs. Total harvest was 4,400 grams and only two gardens successfully produced. Total income was RM22.5.

There were three products produced from this project, namely Pegaga herbal tea, Pegaga based fish pellets and Tuhau pickles. Pegaga herbal tea was made by an OEM factory, fish pellets were made by the participant himself in Babagon and Tuhau pickles were made by the cooperation of the company and participants.

Marketing of products was conducted by the company. At present there were four outlets namely two in Penampang district, one in Papar district and one inside UMS main campus. Our company is planning to increase the outlets throughout Sabah next month. We are also planning to sell online.

CONCLUSIONS

Agribusiness and product down-streaming of local herbs Pegaga Sabah dan Tuhan Sabah which was conducted in Penampang district under the APPGM-SDG program from 1st of Sept 2023 was the first case in Sabah. Participants were taught to select suitable and marketable local Sabah herbs, raising at nursery, preparations of soil, raising on beds, management of insects and pests and harvesting. A total of 4,400 g of Tuhau and 38,262 g of Pegaga were harvested until 15.9.2024. Total income received by the participants were RM 616.67

from Pegaga and RM22.5 from Tuhau. There were three products produced in this project namely Pegaga herbal tea, Tuhau pickles herbs and Pegaga herbs-based Pellets for freshwater fish.

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Chapter 9

Proposed Agribusiness Framework for Agricultural Development in Kampung Kuyungon, Tambunan, Sabah

Nathaniel Maikol, Justin Sentian, Hanisah Kamilah Abd Razak, Shafinah Kamarudin, Mohamad Zaki Mohamad Saad

ABSTRACT

The Sustainable Development Goals (SDG) 2030, specifically SDG 1, seek to eliminate poverty and rectify deficiencies in multiple dimensions. Nonetheless, Sabah's extreme poverty rate is sixfold greater than the national average. This problem arises from disparities and uneven progress in areas such as income, education, and infrastructure. The Community Farm-Social Lab Project, launched in 2023 at Kampung Kuyungon, Tambunan, Sabah, has effectively developed ten greenhouses in collaboration with local farmers and strategic partners. The project's current vegetable harvests comprise cherry tomatoes, cabbage, mustard greens, Japanese cucumbers, kale, okra, Taiwan pak choy, long beans, French beans, and lettuce. The solutions partner, the All-Party Parliamentary Group Malaysia - Sustainable Development Goals (APPGM-SDG), Tumparak Sdn. Bhd., and public institutions, including Universiti Malaysia Sabah, Universiti Putra Malaysia, and the Tambunan Agriculture Department, seek to advance the rural agricultural sector. This paper presented a framework highlighting agribusiness as a strategy for agricultural development in Kampung Kuyungon, Sabah. This framework encompasses local community needs assessments, human capital development, financial resources, innovation and technology, product marketing, value chain development, government policy, sustainability, agribusiness monitoring, and social inclusion. The

resultant framework is anticipated to function as a comprehensive reference for more successfully attaining SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 10 (Reduced Inequalities).

INTRODUCTION

Sabah is an area abundant in natural resources, including oil, gas, timber, and arable ground for agriculture. Nonetheless, development in Sabah continues to be a significant subject of discourse among economists, policymakers, and the general populace (Ng *et al*., 2022). Despite Sabah's considerable potential, the region encounters numerous important issues that necessitate prompt action to guarantee sustainable and holistic advancement. Key difficulties include inadequate food self-sufficiency, an adverse food trade balance, regulatory challenges, and institutional deficiencies that impede workforce development and company licensing (Zhilu & Defeng, 2021).

Sabah's food self-sufficiency levels are inferior to other Malaysian states (Ationg et al., 2020). Reliance on external food sources results in elevated living expenses (Suffian et al., 2022) and heightens the likelihood of supply shortages during interruptions. The food trade balance deficit indicates that Sabah imports exceed its exports (Suffian, 2024; Idris & Mansur, 2020). Consequently, a robust agricultural sector is essential, encompassing investments in advanced technologies and high-value products that satisfy domestic and international demand. Moreover, legislative obstacles and institutional deficiencies encumber developmental initiatives in Sabah. Stringent laws and intricate company license bureaucracy hinder entrepreneurs from initiating or expanding enterprises (Yaacob, 2018; Man *et al*., 2021). Transforming institutions to streamline the licensing process is crucial for making Sabah more business-friendly, attracting domestic and foreign investment, enhancing job possibilities and lowering unemployment rates (Othman, 2021).

Further, Sabah encounters inconsistent water supply challenges in certain regions, impacting health, agriculture, and industry. The absence of access to a clean water supply hinders investment attraction in water-dependent industries. Enduring solutions are essential to guarantee a reliable water supply via enhanced infrastructure and effective water management technology. Furthermore, Sabah’s economy, which is dependent on commodity sectors such as agriculture, mining, oil, gas, and tourism, is susceptible to global price volatility (Patrick & Imang, 2016). The COVID-19 pandemic crisis underscored Sabah’s economic fragility, characterised by rising unemployment, escalating poverty, and an economic decline of 9.5%, far surpassing the national average (Wangkiat, 2022). This tragedy underscores the necessity for the diversification of Sabah’s economic sector to mitigate susceptibility to fluctuations in the global market.

Initiatives to augment revenue to enhance the socio-economic conditions of the community are a primary emphasis for the residents of Kampung Kuyungon, Tambunan, Sabah. In 2023, the proprietor of the Tumparak Sdn. Bhd., with financial backing from the All-Party Parliamentary Group Malaysia - Sustainable Development Goals (APPGM-SDG) and collaboration with entities such as Universiti Putra Malaysia and the Department of Agriculture Tambunan, Sabah, has launched the Social Lab concept as a conduit linking farmers to cutting-edge technology, directing them towards sustainable agriculture, and executing sustainable farming methodologies. Table 1 presents the Kampung Kuyungon community’s average income and the supplementary revenue generated per Social Lab cycle. The Social Lab initiative emphasises the growth of organic vegetables. The Social

Lab initiative has effectively produced gross profits ranging from RM1200 to RM2000 for a single Social Lab cycle. While this Social Lab experiment has effectively augmented the members' income, enhancements are necessary for optimal returns.

Table 9.1: Average income of the Kampung Kuyungon community and additional income for Social Lab per cycle

Average Monthly Income (RM)		**Additional Income (RM) per cycle**
< RM 250	17.2%	RM1200 - RM 2000
< RM 500	3.5%	
> RM 500	51.7%	
> RM 1000	13.8%	
< RM 1000	13.8%	

Source: Sepilok Buletin. (2023). Volume 32, Special Edition. ISSN 1823-0067, e-ISSN 2821-2327.

The predominant segment of the Kampung Kuyongon community is actively engaged in hill paddy agriculture and continues to employ traditional farming techniques, utilising the available agricultural area. This strategy seeks to guarantee that agricultural practices do not compromise the quality of river water, the primary water source for the village inhabitants. The agricultural endeavours undertaken by the local population are solely for self-sufficiency, aimed exclusively at fulfilling their daily requirements without producing further money.

Consequently, the notion of agribusiness must be presented to the Kampung Kuyongon community to motivate them to pursue expanded prospects within the agricultural sector. Implementing agribusiness is expected to diversify agricultural products and enhance marketing efficacy, consequently assisting the community in augmenting their revenue sources. These initiatives enable participants to produce more steady income, enhance the village economy, alleviate poverty, and empower residents in commercial agriculture. Agribusiness can contribute to attaining SDG 1; no poverty; SDG 2; zero hunger, and SDG 10; reduced inequalities. This study aims to propose an agribusiness framework for agricultural growth in Kampung Kuyongon, Sabah.

LITERATURE REVIEW

The term "agribusiness" originated in the 1950s, subsequent to advancements in the agricultural sector associated with the production of agricultural goods and capitalist progress (Ioris, 2018). Agribusiness is regarded as a vast and intricate sector as it includes all entities engaged in delivering food to consumers. Agribusiness encompasses the complete value chain, comprising land cultivators, input suppliers, output processors, food product manufacturers, distributors, and retailers (FAO, 2017; Sulthana and Anthony, 2024). Agribusiness encompasses a range of economic operations related to the production, processing, and marketing of agricultural and forestry goods, catering to food and non-food requirements (Walter *et al*., 2021).

The FAO (2017) enumerates the significance of agribusiness as follows:

1. Expanding comprehensive employment opportunities, including non-agricultural positions, particularly in rural regions;
2. Effectively contributing to poverty alleviation and the empowerment of women in nations with lucrative agricultural exports;
3. Augmenting rural household incomes through wage employment and ancillary effects that enhance agricultural productivity by improving access to inputs and increasing technological capacity; and

4. Facilitating the essential linkages between the agricultural and manufacturing sectors, which can catalyse broader industrial advancement by supplying raw materials for food processing, textiles, and biofuels.

Nonetheless, numerous significant challenges impede the sustainability of agribusiness, including inadequate climate change policies, insufficient financial assistance, substantial post-harvest losses, gender inequality or social inclusion issues, and feeble institutional oversight (Silvestri et al., 2024). The agro-industry significantly contributes to food and animal feed production and processing, in addition to supplying raw materials for other industrial sectors. In 2022, the agricultural sector provided 4.27 percent, the industrial sector contributed around 27.22 percent, and the service sector contributed around 63.97 percent to the world's Gross Domestic Product (GDP) (Aaron, 2024).

PROPOSED AGRIBUSINESS FRAMEWORK FOR AGRICULTURAL DEVELOPMENT IN KAMPUNG KUYUNGON, SABAH

Figure 9.1 illustrates the proposed agribusiness framework designed to facilitate the advancement of the agriculture sector in Kampung Kuyungon, Tambunan, Sabah. This framework highlights essential elements anticipated to influence agribusiness advancement in Kampung Kuyungon, encompassing needs assessment (current technology, environmental considerations, agricultural inputs, and social inclusion) and aspects pertaining to governmental policies, such as financial resources, innovation and technology, human capital development, sustainability, product marketing, agribusiness monitoring, and value chain development.

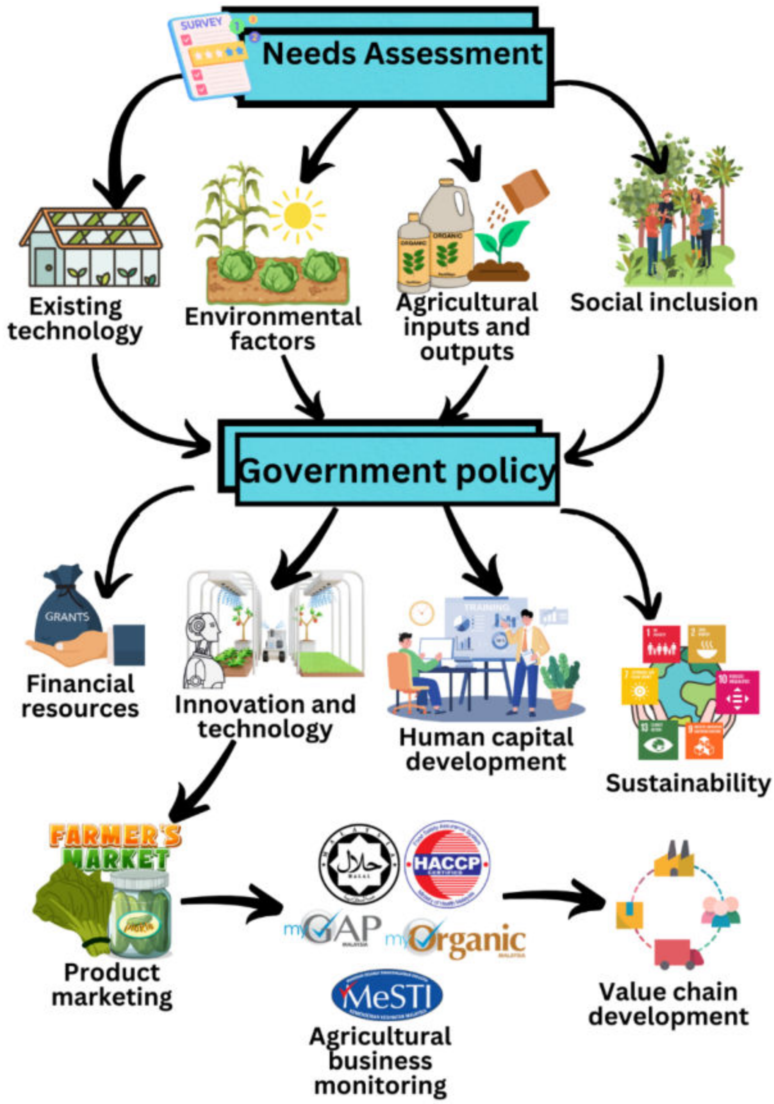

Figure 9.1. Proposed Agribusiness Framework for Agricultural Development in Kampung Kuyungon, Sabah

The following is an explanation of each phase included in this proposed framework.

1) Needs Assessment
   The first highlighted factor relates to the needs assessment. The need assessment must be carried out to understand the needs, existing resources, and constraints faced by the agropreneurs of Kampung Kuyungon. This assessment can be conducted through surveys, interviews with agropreneurs, and observations in the field. The needs assessment encompasses four main factors: environmental factors, existing technology, agricultural inputs and outputs, and social inclusion. Currently, the existing technology in Kampung Kuyungon includes paddy machines, the use of greenhouses, and semi-automated irrigation systems.

2) Environmental Factors
   The main factor to be considered is related to the environmental information of Kampung Kuyungon. Kampung Kuyungon is a village located in a rural area of Sabah, Malaysia. Located in the Papar district, this village is a small community that still retains the traditional characteristics of the Kadazan-Dusun people, one of the main ethnic groups in Sabah. Kampung Kuyungon is surrounded by forested areas and agricultural land, making it suitable for farming and livestock activities, which are its residents' main income sources.

   This village also often benefits from rural development programs carried out by the government and non-governmental organisations (NGOs) to improve infrastructure and the well-being of its residents. Traditional activities such as paddy planting, oil palm cultivation, and other vegetable crops are the main sources of income besides employment in the public and private sectors in nearby areas.

In terms of basic facilities, Kampung Kuyungon has amenities such as a primary school, a multipurpose hall, and water and electricity supplies. However, some areas may face challenges such as limited road access and a lack of clean water supply during the dry season. The residents of this village also participate in religious and cultural activities, with a church and traditional celebrations like the Kaamatan Festival, which celebrates the local community's culture and heritage.

Furthermore, information related to an area's weather and rainfall distribution is important in determining the types of crops suitable for cultivation. Generally, Kampung Kuyungon has a tropical rainforest climate with consistent rainfall throughout the year. The highest rainfall is from October to December, with an average amount of around 357 to 373 mm. Meanwhile, the lowest rainfall occurs in July, with an average of around 255 mm. The temperature in Kampung Kuyungon throughout the year ranges from 21°C to 22°C. The humidity in this area is also high, with a maximum level of around 90% in November and December. This consistent rainfall pattern and stable temperature make Tambunan a fertile and suitable area for agricultural activities, but it is also prone to seasonal heavy rains that can affect local conditions (Climate Data, 2024).

3) Existing Technology

Currently, 10 greenhouses have been developed as a result of the Social Lab project. Figures 9.2 and 9.3 show the Social Lab project equipped with a semi-automated irrigation system.

Figure 9. 2. Social Lab Project in Kampung Kuyungon, Tambunan, Sabah

Figure 9.3. Semi-Automated Irrigation System, Social Lab Project

The community of Kampung Kuyungon has two units of rice hullers (rice huller or rice dehusker). Figure 9.4 shows the rice huller, a tool used to remove the outer layer or husk from paddy grains to produce white rice or broken rice. This machine is important in the rice milling process as it speeds up and simplifies the work that was previously done manually. This machine is important to accelerate the rice production process and helps reduce the loss that occurs during the manual hulling process.

Figure 9.4. Rice Huller

4) Agricultural Inputs and Outputs

The agricultural inputs and outputs currently managed in Kampung Kuyungon include main crops such as paddy and various types of green vegetables like cucumbers, mustard greens, and bitter gourd. Prioritising these crops aligns with the community's goals to utilise natural resources without compromising environmental quality. However, livestock activities are not permitted in this area to ensure that the rivers, which are the primary water sources for Kampung Kuyungon and surrounding areas, remain clean, unpolluted, and safe to use as drinking water sources, especially for the community in the Tambunan district. This prohibition is consistent with the community's efforts to maintain the well-being and sustainability of water resources, which are very important to the residents. Therefore, an emphasis on agriculture based on organic concepts is paramount, aiming to reduce the risk of soil and water pollution and preserve the ecosystem's health in Kampung Kuyungon. This concept is expected to guide the local community in achieving sustainable and safe agriculture in the long term.

5) Social Inclusion

Social inclusion focuses on individual well-being, which is determined by a community's living conditions and access to material resources (such as natural and financial resources) and by their personal well-being compared to others (McGregor, 2017; Hickey et al., 2014; Gupta & Vegelin, 2016). Furthermore, assessing social inclusion is crucial to ensure that the entire community in Kampung Kuyungon benefits from implementing this framework. In the context of Kampung Kuyungon, social inclusion encompasses categories like youth, women, and the indigenous community of Sabah, which are the backbone of social and economic life in this area. With a holistic approach, programs that can be planned include providing skills training and knowledge transfer in agriculture, business, and marketing, both physically and online. These programs can help enhance the community's skills and knowledge in relevant fields, thereby strengthening their economic capacity.

Additionally, efforts to empower existing cooperatives or associations in Kampung Kuyungon can also be undertaken to make them more effective platforms for encouraging economic participation and facilitating access to necessary resources. Through this comprehensive approach, it is hoped that social inclusion can be better achieved, leading to an overall improvement in the well-being of the Kampung Kuyungon community. These overall needs must be aligned with existing government policies or regulations based on the assessments conducted.

6) Government Policy
   Government policy plays a crucial role in regulating and ensuring that the development of the agricultural sector achieves its objectives through the provision of financial resources, innovation, technology, human capital development, and sustainability. An example of Malaysian government policy related to agribusiness is Agromadani. Agromadani is a rebranding of the Direct Sales From Farm (JTDL) Program implemented by the Ministry of Agriculture and Food Security (KPKM) through the Federal Agricultural Marketing Authority (FAMA), the Farmers' Organization Authority (LPP), and the Fisheries Development Authority of Malaysia (LKIM) nationwide to help the public easily obtain fresh products at affordable prices by reducing market intermediaries with savings of 10%-30%.

7) Financial Resources
   Financial resources are fundamental to ensuring that every aspect of agribusiness can be carried out efficiently. Grants and financial incentives from the government or private agencies can assist in various aspects:

   - Purchase of Inputs and Infrastructure: Agropreneurs can use these financial resources to buy inputs such as seeds, fertilisers, and other necessary equipment for agriculture. Additionally, it can be used to build or upgrade infrastructure like greenhouses and irrigation systems.
   - Research and Development (R&D): These financial resources can also be used for R&D to develop new technologies and methods that can increase crop yields and reduce costs. This includes research on more disease-resistant crops and better soil management techniques.

- Innovation and Technology: Agricultural technology investments, such as automation, smart sensors, and data analytics applications, can increase productivity. This technology also reduces reliance on physical labour and enhances precision in crop management.

Financial resources are one of the main factors playing a crucial role in efforts to develop the agricultural sector in rural areas, particularly in ensuring the implementation of modern agriculture in Kampung Kuyungon can be realised. Access to financial resources helps purchase agricultural inputs like seeds, fertilisers, and modern equipment, but it is also essential for enabling the community to access the latest technology that can improve agricultural productivity and quality. Therefore, this framework is created to ensure that the Kampung Kuyungon community has sufficient access to various financial resources, including microloans, development grants, or financing from relevant financial institutions. Table 9.2 shows some of the financial facilities available in Malaysia for the agricultural sector:

Table 9.2. Examples of Financial Resources for Agriculture

TYPE OF FINANCIAL RESOURCE	NAME OF LOAN/GRANT/AGENCY	DESCRIPTION	REFERENCE
Agricultural Loan	AgroCash-i Product, Agrobank	Offers various agricultural financing schemes, including loans for working capital, equipment purchase, and agricultural project development. Agrobank provides loan facilities amounting to 200 million ringgit to agri-food entrepreneurs who support food security efforts and sustainable agricultural practices, in addition to providing incentives amounting to 27 million ringgit to farmers and breeders to increase the production of beef cattle, small ruminants such as meat goats, dairy goats, sheep, and local onion production.	Agrobank (2024)
Agricultural Loan	TEKUN Niaga Financing Scheme, Tekun Nasional	Provides microloans to small entrepreneurs, including those in the agricultural sector.	Tekun Nasional (2024)
Agricultural Loan	Agrofood Security Product, National Savings Bank (BSN)	Offers microloans for agropreneurs who need small capital.	BSN (2024)

TYPE OF FINANCIAL RESOURCE	NAME OF LOAN/GRANT/AGENCY	DESCRIPTION	REFERENCE
Agricultural Loan	Agribusiness Microcredit Scheme, Sabah Credit Corporation	Provides special loans for the agribusiness sector in Sabah, including farmers, livestock breeders, and fisheries operators, to develop their activities towards more commercial endeavours.	Sabah Credit Corporation (2024)
Government Grants and Assistance Programs	Geran Agropreneur Muda (Ministry of Agriculture and Food Security)	This grant is provided to youth involved in agriculture as start-up capital and to help them purchase equipment.	Ministry of Agriculture and Food Security
Government Grants and Assistance Programs	Community Agricultural Development Program	Grants are provided to community groups or cooperatives for community-based agricultural projects.	Department of Agriculture
Government Grants and Assistance Programs	Program Pembangunan Usahawan Tani (Ministry of Agriculture and Food Security)	Provides financial assistance and training to agropreneurs.	Ministry of Agriculture and Food Security
Special Financing Scheme for	Dana Program Pembiayaan Agroteknologi MADANI	Financial assistance provides funding to enhance competitiveness in the agricultural sector through technological innovation.	Ministry of Agriculture and Food Security

TYPE OF FINANCIAL RESOURCE	NAME OF LOAN/GRANT/AGENCY	DESCRIPTION	REFERENCE
the Agricultural Sector	(DPPAM) (Ministry of Agriculture and Food Security)		
Rural Development Initiatives	Lembaga Pertubuhan Peladang (LPP)	Provides loans and financial assistance to farmers to start or expand existing projects.	Official Portal of the Farmers' Organization Authority (2024)
Financial Support from Development Institutions	Micro Business Financing, SME Corp	Provides financial assistance to empower micro enterprises in Malaysia while catalysing their growth. Supports capacity building and market expansion for micro-enterprises.	SME Corp Malaysia (2024)
Financial Support from Development Institutions	Malaysian Industrial Development Finance Berhad (MIDF)	Provides loans for the development of commercial agricultural projects.	MIDF
Financial Support from Development Institutions	Technology Investment, Malaysian Technology Development Corporation (MTDC)	Provides financing for agropreneurs who want to use modern technology in agriculture.	MTDC (2024)

TYPE OF FINANCIAL RESOURCE	NAME OF LOAN/GRANT/AGENCY	DESCRIPTION	REFERENCE
Subsidy and Incentive Schemes	Subsidy for Fertilisers and Pesticides for Hill Paddy	Government subsidies are provided for farmers to purchase essential agricultural inputs, specifically for hill paddy in Sabah and Sarawak.	RTM News (2024)
Subsidy and Incentive Schemes	Program Rezeki Tani	Subsidy to help small-scale farmers increase their productivity in staple food crops.	Ministry of Agriculture and Food Security (2024)

However, each financial source has specific eligibility requirements and application procedures and depending on the type of agricultural project to be undertaken, agropreneurs need to identify and choose the most suitable source to help start or expand their projects. Additionally, physical facilities such as good roads, access to clean water, and efficient irrigation systems are important factors supporting the success of modern agricultural development in this area. With a holistic and inclusive framework in place, it is hoped that the community of Kampung Kuyungon can enjoy the benefits of this agricultural development, thereby contributing to their increased income and standard of living in the long term.

Technology and Innovation

Innovation and technology play a crucial role in advancing the agribusiness sector. Indirectly, the use of modern technology helps to increase crop yields and reduce operating costs. This will aid in the development of agribusiness in Kampung Kuyungon. Some recommendations that can be considered are as follows.

1) **Automation and Machinery:** This technology aids in the harvesting, planting, and monitoring processes of hill paddy and vegetables. This will help the community perform routine tasks with minimal supervision.
2) **Use of Smart Sensors:** Sensors help monitor soil and crop conditions. The data collected can be used to determine the amount of water or fertiliser needed, thus optimising resource usage and reducing wastage.
3) **Use of AI and IoT:** Artificial Intelligence (AI) and the Internet of Things (IoT) allow farmers to analyse data and make decisions based on more accurate predictions. For example, AI can predict weather and inform farmers about the best times to plant or harvest.

4) **Innovation in Downstream Products:** Vegetables like cucumbers and mustard greens have a high potential to be processed into pickles, which can be enjoyed as side dishes or appetisers. The pickling process preserves these vegetables for longer periods and adds variety to daily meals. Pickled cucumbers and mustard greens can also be marketed as local food products, opening economic value opportunities to the local community.

Human Capital Development

This framework also emphasises human capital development as a main foundation for ensuring that agropreneurs in Kampung Kuyungon have the knowledge and skills needed to develop the agricultural sector in rural areas more effectively. The focus on human capital development is not only limited to increasing knowledge and skills in agriculture but also involves efforts to commercialise agricultural products from Kampung Kuyungon to enhance economic value and generate income for the local community. In this context, various training and human capital development programs need to be introduced to ensure that farmers in Kampung Kuyungon are prepared to face challenges in the modern agricultural industry. Some types of training or workshops that can be planned are as follows:

1) Technical Training Based on Modern Agriculture: Training focused on modern agricultural techniques, such as sustainable agriculture and organic farming, is important to enhance effectiveness and productivity. Through this training, participants can learn sustainable planting techniques, environmentally friendly soil management, and the use of organic fertilisers and pesticides that are safe for the environment.

2) Agribusiness Management Training: Training related to agribusiness management will cover aspects of financial literacy, business plan preparation, logistics, and cost and resource management strategies. Skills in managing agricultural businesses are essential to ensure that agropreneurs can operate more competitively and generate consistent profits. This knowledge can help the Kampung Kuyungon community manage their agricultural produce more effectively and in a more organised way.
3) Agricultural Technology Usage Workshops: Introduction to the latest agricultural technology, such as efficient irrigation systems, automatic watering tools, and downstream processing technology for local products, is a critical aspect of increasing productivity. Through these workshops, participants can understand how to use modern technological equipment in managing their crops and agricultural produce, thereby improving the quality and market value of the products.
4) Marketing and Digital Skills Workshops: Online product marketing is important for expanding market reach in this digital era. This workshop will emphasise mastering digital marketing skills, including using social media, e-commerce platforms, and digital marketing strategies to introduce products to a broader market. These skills enable agropreneurs in Kampung Kuyungon to promote their products locally, nationally, and internationally.

Overall, these training and workshops aim to empower the Kampung Kuyungon community with relevant knowledge and skills to compete in the modern agricultural industry, thus ensuring they can improve their standard of living and take advantage of economic opportunities in this sector.

Agribusiness Sustainability

Sustainability is defined as continuous development and resource use without compromising future generations' ability to meet their needs. In the context of ecology and development, sustainability emphasises the balance between economic growth, environmental sustainability, and social well-being. This includes avoiding the destruction of natural resources, protecting biodiversity, and ensuring social equity in access to resources (Sachs, 2015, United Nations, 2015). Sustainability is often associated with the concept of "sustainable development," these sources provide theoretical and practical foundations for sustainability in various sectors. Therefore, the United Nations (UN) outlined 17 Sustainable Development Goals, the 2030 Sustainable Development Agenda in 2015 (Figure 9.5).

Figure 9.5. 17 Sustainable Development Goals, 2030 Sustainable Development Agenda

The advancement of agribusiness in Kampung Kuyungon is anticipated to contribute to sustainable development objectives, particularly SDG1: No Poverty. SDG 2: Eradication of Hunger; SDG 4: Quality Education; SDG 5: Gender Equality; SDG 8: Decent Work and Economic Growth; SDG 9: Innovation, Industry, and Infrastructure; SDG 10: Reduced Inequality; SDG 12: Responsible Consumption and Production, and SDG 17: Partnerships for the Goals. Agribusiness sustainability encompasses strategies that fulfil present food and resource requirements while safeguarding the capacity of future generations to satisfy their own needs. Sustainability in agribusiness entails a balance among environmental stewardship, social accountability, and economic feasibility.

Economic viability refers to a business or project's capacity to provide profit and sustain competitiveness over an extended period. To guarantee the sustainability of agriculture in Kampung Kuyungon, it is essential to prioritise operating expenses, including raw materials, labour, maintenance, and management. This is to guarantee the business's resilience against market fluctuations, economic adversities, or unforeseen weather conditions. Agribusiness can expand independently of external support while delivering adequate profits to its proprietors or investors. This facet of economic viability entails meticulous risk management and financial planning. Agribusiness may achieve long-term sustainability through meticulous planning, consistently deliver customer value, and enhance the local economy. By incorporating sustainability along the entire value chain, agribusiness can enhance food security, safeguard the environment, and bolster communities while maintaining profitability. This strategy cultivates a robust agro sector equipped to confront future problems.

Product Marketing

Product marketing is an important step to ensure that agricultural produce reaches consumers. Effective marketing strategies include:

1) **Agricultural product markets:** Encourage the use of local markets to help farmers sell their products directly to consumers, thereby increasing profits and reducing transportation costs.
2) **Certification and recognition:** Certifications like myGAP, myOrganic, and HACCP help increase consumer trust in the quality of local agricultural products (Table 9.4).
3) **Use of digital platforms**: Encourage agropreneurs to market their products online using social media applications like Facebook, TikTok, Shopee, Lazada, and other platforms.
4) **Involvement of government agencies:** Through the Federal Agricultural Marketing Authority (FAMA), the government can help farmers, especially in rural areas, to market their products. FAMA is responsible for marketing agro-food products such as vegetables, fruits, flowers, and agro-based industrial products. Additionally, the Sabah Department of Industrial Development and Research (DIDR) plays an important role in supporting the SME industry in Sabah, including (i) drafting and implementing policies related to industry in Sabah, (ii) providing training and advisory services for local agropreneurs, (iii) attracting investments from inside and outside the country through various promotional programs and incentives to attract foreign investors and encourage them to invest, (iv) conducting research and development to identify new technologies, industry opportunities, and innovations that can be applied in the local industry, (v) providing technical support and training, and (vi) helping the local community by providing opportunities to

develop businesses based on natural resources, such as handicrafts and traditional food products, to provide economic benefits to the local population.

Agribusiness product marketing plays a crucial role in raising awareness and demand for products, maximising profits, the ability to compete in the market, opening new markets, building long-term relationships with customers, and advancing product innovation. Overall, agribusiness product marketing is key to connecting products with consumers, increasing economic value, and ensuring agribusiness products compete well in the market. With planned marketing, agribusiness can increase competitiveness, maintain sustainability, and ensure positive development in the long term.

Figure 9.6. Participation at the Sustainable Development Goals (SDG) Summit Malaysia, Sabah Region 2024

Figure 9.7. Award certificate presented by the Honorable Datuk Seri Panglima Dr. Jeffrey G. Kitingan, JB Deputy Chief Minister and Minister of Agriculture, Fisheries, and Food Industry (MAFFI) Sabah State, ADUN N.39 Tambunan. Member of Parliament P.180 Keningau and Chairman of the Organizing Committee of the Kaamatan Festival State Level Sabah 2024. Representatives from APPGM-SDG were also attended to witness the presentation.

Figure 9.8. Participation at the Innovation Exhibition/ PBL/ Best Practices/PIBG in conjunction with the 5-in-1 Ceremony - School Management Excellence Ceremony, Academic Excellence Recognition Ceremony, Excellent Service Award Ceremony, Retirement Appreciation Ceremony, and Open Day at the PPD Tambunan District Level 2024.

Figure 9.9. Pasar Tamu in Kampung Kuyungon is held every Tuesday

Agribusiness Monitoring

Agribusiness monitoring is crucial to ensure operational efficiency, competitiveness, and business sustainability and maintain product quality and safety. Business-oriented agribusiness monitoring aims to optimise profits, meet market demands, and maintain brand quality and reputation. This includes compliance with safety standards such as MeSTI, myGAP, and HACCP, which provide quality assurance to consumers. There are several key aspects to emphasise in agribusiness monitoring:

1) Ensure the quality of products, whether vegetables, paddy, or downstream products, is consistent.
2) Strive to comply with food safety standards, hygiene, and certifications such as Good Agricultural Practices (GAP) and Hazard Analysis and Critical Control Points (HACCP). Table 9.4 shows the certificates related to agribusiness monitoring.
3) Monitor the use of energy, raw materials, and labour resources, allowing agribusinesses to manage costs more efficiently.
4) Monitor productivity, market performance, and customer feedback.
5) Monitor changes in prices, product quality, or market demand.

6) Monitor the readiness of agropreneurs to adopt new technology and preservation methods or innovate additional products that can attract customer interest and add value to the original product.
7) Monitor marketing and sales aspects
8) Monitor the supply chain and distribution to ensure products reach the market or customers quickly and in the best condition, including logistics management monitoring.

The agencies involved are the Ministry of Agriculture and Food Security (KPKM), Sabah Department of Agriculture, Farmers' Organization Authority (LPP), Malaysian Agricultural Research and Development Institute (MARDI), FAMA, Sabah Industrial Development and Research Department (DiDR), SIRIM, Sabah Land Development Board (SLDB), University of Malaysia Sabah (UMS), and Sabah Economic Development Corporation (SEDCO). Each agency supports and monitors agribusiness through various programs and initiatives tailored to increase productivity, reduce risks, and ensure sustainable and profitable practices for all agropreneurs. Overall, agribusiness monitoring is critical to ensure operational efficiency, product quality, the ability to meet market demands, and adaptability to changes. This monitoring helps agribusinesses remain competitive and sustainable in the long term.

Figure 9.10. A visit by the Tambunan Department of Agriculture was conducted for the purpose of taking plant samples and submitting documents for myOrganic/myGAP certification application.

Table 9.4. Certificates of Recognition and Descriptions Related to Agribusiness Products

CERTIFICATE OF RECOGNITION	DESCRIPTION
MeSTI (Food Safety is the Responsibility of the Industry)	
• Issued by the Ministry of Health Malaysia (KKM). • Aims to ensure that food premises and production comply with basic food safety requirements. • Focuses on the cleanliness of premises, production processes, and storage that comply with standards to ensure food safety for consumers. • Serves as a basic requirement for food companies that want to move to higher certifications such as HACCP.	• Although MeSTI focuses more on food safety, it plays a role in sustainable agriculture by ensuring that agricultural products produced are safe and free from contamination. • It encourages agricultural producers to practice cleanliness in the handling process of agricultural produce, including storage and transportation. • Ensures food safety aspects are maintained from the farm level, which is relevant for organic and sustainable products to be free from harmful contaminants.
Halal Certificate	
• Issued by the Department of Islamic Development Malaysia (JAKIM) or the State Islamic Religious Department.	• Halal Certification ensures that agricultural products, including organic products, are processed according to Islamic law principles.

CERTIFICATE OF RECOGNITION	DESCRIPTION
• Ensures that products and production processes comply with Islamic law regarding the materials used, production processes, storage, and handling. • Increases Muslim consumer confidence in the halal status of products, and is also important for companies seeking access to local and international markets that require halal status.	• In the context of sustainable agriculture, it helps ensure that production and handling methods are clean, free from chemicals or prohibited substances. • The halal certificate also emphasises animal welfare in livestock farming (if involved), which aligns with the principles of sustainable agriculture that emphasise ecosystem well-being.
HACCP (Hazard Analysis and Critical Control Points)	
• A management system aimed at identifying, evaluating, and controlling food safety risks in production. • Recognised internationally and important for companies looking to export their products. • Helps ensure food products are safe for consumption by identifying critical control points requiring strict production monitoring.	• HACCP plays a role in sustainable and organic agriculture by ensuring product safety through control at every stage of production and processing. • In organic farming practices, HACCP can be used to ensure that crops are not exposed to chemicals or contamination that could affect the organic status of the products.

CERTIFICATE OF RECOGNITION	DESCRIPTION
	• Helps organic farms achieve high standards in terms of food safety, which can increase consumer confidence and access to broader markets.
myGAP (Malaysian Good Agricultural Practices)	
• Issued by the Department of Agriculture Malaysia. • Emphasises good agricultural practices in terms of soil care, use of inputs such as fertilisers and pesticides, and overall farm management. • Helps produce high-quality agricultural products that are safe for consumers and environmentally friendly. • This certification can also enhance the competitiveness of products in the market as it demonstrates a commitment to responsible agricultural practices.	• myGAP is directly related to sustainable agricultural practices as it sets guidelines on the use of environmentally friendly inputs such as fertilisers and pesticides. • Ensures that farm management is well-executed, including soil and water conservation aspects, and responsible waste management. • Supports the maintenance of biodiversity and environmental preservation through practices that minimise negative impacts on ecosystems. • These practices align with the principles of organic farming and help operators transition to higher standards such as myOrganic. •

CERTIFICATE OF RECOGNITION	DESCRIPTION
myOrganic	
• Issued by the Department of Agriculture Malaysia to ensure agricultural products meet established organic standards. • Provides assurance that crops are produced without the use of synthetic chemicals such as chemical fertilisers and pesticides. • Focuses on environmentally friendly agricultural principles, long-term soil fertility, and ecosystem well-being. • Increases consumer confidence in the organic status of products, which is important for a market increasingly sensitive to health and environmental issues.	• myOrganic is a certification designed to ensure agricultural products are produced without the use of synthetic chemicals, chemical fertilisers, and pesticides. • Encourages agricultural practices that prioritise natural soil fertility, such as the use of compost and organic fertilisers, as well as biological pest control techniques. • Promotes sustainability in agriculture through environmentally friendly approaches, maintaining ecosystem balance, and long-term soil health. • This certification provides assurance to consumers about the organic status of products and helps increase demand for products produced in an environmentally responsible manner.

Value Chain Development

The National Agro-Food Policy (DAN) 2011-2020 and its continuation, the National Agro-Food Policy 2021-2030 (DAN 2.0), focus on the modernisation and competitiveness enhancement of the agro-food sector to ensure national food security. This policy is based on five main pillars: agricultural modernisation, market access strengthening, human capital development, food system sustainability, and the creation of a conducive business ecosystem. New approaches with eight main ideas are also applied, including food supply assurance, sustainable agricultural development, dynamic agricultural clusters, and private investment as a driver for modern agriculture.

FAMA plays an important role in expanding the market for agro-food products and increasing producer incomes by focusing on marketing chain efficiency and infrastructure. FAMA is also responsible for ensuring that agricultural products and the food industry are available at affordable prices. To execute this role, FAMA actively increases efficiency throughout the marketing chain through strategies that include market space development, marketing infrastructure development, entrepreneurship development, product marketing development, and marketing regulation development.

Value chain development is a comprehensive process from production to marketing. With an efficient network, every element in the production process can function better, adding value to the products. Value chain development enables every party in the agricultural industry to earn a fair profit. Based on this agribusiness framework, effective value chain development can be achieved through several key steps that are supportive and continuous. Each component in this framework strengthens the position of farmers and increases the value of agricultural products from the initial production stage to the final market. Here are detailed steps in value chain development through this agribusiness approach:

1) **Needs Assessment:** The initial step in value chain development is to conduct a comprehensive needs assessment at the farming community level. This includes studying the existing technology used by farmers, environmental factors affecting production (such as climate and soil type), agricultural inputs and outputs produced, and social inclusivity aspects involving the local community's involvement in the industry. By understanding the actual needs and challenges, relevant parties can identify new technologies required, support farmers with better inputs, and ensure that all segments of the community benefit from this agricultural development.
2) **Government Policies that Support:** Next, to ensure sustainable and comprehensive development, government policies play a crucial role as the main pillar in supporting this value chain. Financial resources in the form of grants and incentives help farmers obtain the necessary capital to increase their production. Modern innovation and technology enable farmers to utilise the latest agricultural techniques, such as automation or smart systems in irrigation and crop monitoring, which can enhance productivity and product quality. Additionally, human capital development through training programs and courses helps farmers improve their management skills and agricultural techniques. Sustainability is also given attention through policies ensuring that agricultural practices do not harm the environment, which aligns with sustainable agriculture principles for a greener and safer future.

3) **Product Marketing:** After agricultural products are well produced, the next step is to market these products strategically through various channels. Marketing can be done through farmers' markets for local buyers, supermarkets for larger-scale marketing, and digital platforms for broader access to distant consumers. With effective marketing strategies, farmers can sell their products directly to end-users, increasing demand and product value. Additionally, this broader marketing approach helps increase the recognition of local brands and enhances product competitiveness in the market.
4) **Standards-Based Agribusiness Monitoring:** To ensure that the products produced meet high standards, strict monitoring must be conducted. Compliance with standards such as HALAL certification, HACCP, myGAP, myOrganic, and MeSTI ensures that agricultural products meet recognised quality and safety standards, thereby increasing consumer confidence in the products. This certification also expands access to international markets that increasingly demand products complying with specific safety and quality standards. With these certifications, products from Kampung Kuyungon can compete globally, thereby increasing the value added to products in the value chain.
5) **Value Chain Development:** Finally, with the integration of all these steps, a robust and comprehensive value chain can be formed. Each stage in this chain, from needs assessment, policy support, sustainable production, and strategic marketing to standards compliance, works synergistically to connect production with end-users. The agricultural products produced not only achieve high quality but also can meet broader market needs, making these products more valuable and able to be sold at more competitive prices. This provides

opportunities for farmers to enjoy higher incomes, improve their living standards, and contribute to a more stable local economy.

By using this agribusiness framework, Kampung Kuyungon has the potential to become a model of sustainable and productive agriculture. This comprehensive approach not only boosts the economic output of the village but also empowers farmers with relevant knowledge and skills. These value chain development efforts can transform the local community into competitive, sustainable, and self-reliant producers. Furthermore, this initiative supports Sustainable Development Goals (SDGs) such as “no poverty” and “zero hunger,” which are hoped to create a brighter, more prosperous, and inclusive future for all.

CONCLUSION

The proposed agribusiness framework for agricultural development in Kampung Kuyungon, Sabah, introduces a comprehensive approach that includes assessing existing technological needs, environmental factors, agricultural inputs, as well as social inclusivity aspects to ensure a more holistic and effective approach. With support from government policies, the focus is on providing financial resources such as grants, modern technological innovation, human capital development through farmer training, and environmental sustainability to ensure more sustainable agricultural development. This framework also focuses on marketing agricultural products through broader channels, such as farmers’ markets and digital platforms, and strict monitoring of agribusiness standards like HALAL, HACCP, and myOrganic to enhance the value and competitiveness of local agricultural produce. This framework aims to improve the village’s economic output and strengthen the agricultural value chain, enhancing Kampung Kuyungon’s competitiveness as a productive, sustainable, and progressive farming community. Through the integration of the Social Lab project and the proposed agribusiness framework, Kampung Kuyungon has the potential to become a sustainable agriculture model that can increase the income and living standards of the community, reduce poverty, and strengthen local economic stability. With ongoing improvements and the application of more strategic agribusiness concepts, agricultural produce in this village can be diversified, processed, and marketed more effectively. This framework is expected to contribute to improving the living standards of the local community, as well as empowering the community to be more competitive, resilient, and aligned with SDG goals such as “no poverty” and “zero hunger” to create a more prosperous and inclusive future for all.

ACKNOWLEDGMENT

Our deepest gratitude goes to the All-Party Parliamentary Group Malaysia - Sustainable Development Goals (APPGM-SDG) for the funding support provided to the Social Lab Project in Kampung Kuyungon, Tambunan, Sabah for the year 2023-2024. This support has been a key catalyst in strengthening our efforts to implement resilient community development and promote sustainable agricultural practices at the local level. This support encourages sustainability in resource management and empowers the community through ongoing and impactful development programs that align with the sustainable development goals we aim to achieve.

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Chapter 10

Madu Kelulut Sebagai Penjana Pendapatan Dan Produk Agribisnis: Strategi Dan Pelaksanaan

Mohd Shukri Mustafa

ABSTRAK

Madu kelulut, dihasilkan oleh lebah tanpa sengat, semakin diiktiraf sebagai sumber agribisnis berdaya saing dan berpotensi tinggi di Malaysia. Dengan kandungan nutrisi yang kaya serta manfaat kesihatan yang terbukti, madu kelulut bukan sekadar produk kesihatan tetapi juga mampu menjadi pemacu ekonomi hijau negara. Permintaan pasaran yang kian meningkat membuka peluang kepada petani, usahawan, dan komuniti untuk menjadikan penternakan kelulut sebagai sumber pendapatan mampan. Projek Penternakan Madu Kelulut Bayu SmartFarm menjadi contoh nyata bagaimana inovasi pertanian bandar boleh diterjemahkan secara praktikal. Beroperasi dalam persekitaran kebun bandar, projek ini menggabungkan teknologi moden, kelestarian ekologi, dan model pendidikan komuniti. Inisiatif ini bukan sahaja menghasilkan madu berkualiti, tetapi juga memberi nilai tambah melalui produk inovatif seperti minuman kesihatan, kosmetik, dan pembungkusan bulb squeeze pack. Strategi pemasaran digital serta kolaborasi dengan pelbagai pihak turut memperluas pasaran ke peringkat antarabangsa, termasuk penglibatan dalam Osaka Expo 2025. Kajian kes dari dalam dan luar negara membuktikan keberkesanan penternakan kelulut dalam meningkatkan taraf hidup masyarakat dengan kos penyelenggaraan rendah, impak positif terhadap biodiversiti, serta hasil ekonomi yang stabil. Projek ini turut menerima sokongan dana kerajaan melalui program ICU Sejati Madani, melibatkan latihan komuniti, penyediaan peralatan, dan pemantauan berterusan untuk

menjamin kualiti serta kesinambungan operasi. Secara keseluruhan, madu kelulut mempunyai potensi besar sebagai penjana ekonomi mampan. Bayu SmartFarm memperlihatkan bagaimana kolaborasi komuniti, inovasi, dan sokongan dasar mampu menjadikan madu kelulut sebagai model agribisnis lestari yang menghubungkan pembangunan ekonomi, pendidikan, dan kelestarian alam sekitar.

PENGENALAN

Madu kelulut, yang dihasilkan oleh lebah tanpa sengat, semakin mendapat perhatian di Malaysia dan di peringkat global. Dengan kandungan nutrisi yang tinggi serta manfaat kesihatan yang pelbagai, madu kelulut bukan sahaja diminati sebagai produk kesihatan malah berpotensi besar untuk dijadikan sumber ekonomi baharu. Permintaan yang meningkat memberi peluang kepada petani, pengusaha dan usahawan untuk menjadikan madu kelulut sebagai sumber pendapatan mampan. Justeru, satu strategi menyeluruh perlu dirangka bagi memastikan industri ini dapat berkembang dengan baik, sekali gus menempatkan madu kelulut sebagai produk agribisnis berdaya saing. Di peringkat tempatan, inisiatif Projek Penternakan Madu Kelulut di Kebun Bandar Bayu SmartFarm adalah contoh nyata bagaimana potensi ini boleh diterjemahkan secara praktikal dalam komuniti. Projek ini bukan sahaja memperkenalkan sumber ekonomi baharu kepada penduduk setempat, tetapi turut mendidik masyarakat tentang pentingnya agribisnis berasaskan kelestarian.

LATAR BELAKANG

Penternakan lebah kelulut sesuai dijalankan di Malaysia kerana iklim tropika yang kondusif serta ketahanan lebah ini terhadap penyakit. Selain kos pemeliharaan yang rendah, lebah kelulut turut memberi impak positif kepada alam sekitar kerana peranannya dalam pendebungaan semulajadi dan menyokong biodiversiti. Di Bayu SmartFarm, penternakan kelulut dijalankan dalam persekitaran kebun bandar yang menggabungkan elemen pertanian moden dengan kelestarian ekologi. Kehadiran madu kelulut di kebun bandar bukan sahaja meningkatkan nilai komersial kawasan tersebut, malah memperkaya biodiversiti melalui pendebungaan tanaman buah-buahan dan sayuran yang diusahakan komuniti.

KAJIAN KES DAN PENEMUAN PENYELIDIKAN

Beberapa kajian kes menunjukkan bahawa penternakan lebah kelulut mampu mengubah taraf hidup masyarakat luar bandar. Sebagai contoh, di Kedah, projek penternakan kelulut yang disokong agensi kerajaan berjaya meningkatkan pendapatan keluarga petani yang terlibat. Manakala di Indonesia, kerjasama antara petani dan institusi akademik dalam sistem penternakan bersepadu bukan sahaja meningkatkan hasil madu, tetapi juga memperbaiki kualitinya. Pengalaman ini sejajar dengan pencapaian di Bayu SmartFarm, di mana projek kelulut telah berjaya menghasilkan madu berkualiti yang dipasarkan kepada komuniti setempat. Selain menjana hasil ekonomi, projek ini juga dijadikan model rujukan bagi sekolah, pelajar universiti, serta pelawat antarabangsa yang berminat mendalami konsep agribisnis mampan.

STRATEGI DAN PENDEKATAN INOVATIF

Bagi memastikan industri madu kelulut terus berkembang, beberapa strategi inovatif boleh dilaksanakan. Pertama, pembangunan inovasi produk perlu diberi penekanan, contohnya menghasilkan variasi baharu seperti minuman kesihatan, kosmetik dan suplemen. Teknologi moden wajar digunakan untuk mengekalkan kualiti madu serta meningkatkan daya tahan produk di pasaran.

Di Bayu SmartFarm, strategi ini telah mula dipraktikkan dengan memperkenalkan madu kelulut dalam pelbagai bentuk pembungkusan – termasuk botol kaca, pek hadiah, dan inovasi terbaru iaitu bulb squeeze pack. Pendekatan ini membolehkan produk mudah dipasarkan dalam acara komuniti, majlis rasmi, dan juga pasaran digital.

Rajah 10.1. Inovasi Produk Kelulut – Dari sabun propolis organik hingga madu kelulut dalam bentuk bulb kecil serta hamper batik rekaan khas, setiap produk menggabungkan kesihatan, warisan dan kreativiti. Hasil ini mencerminkan kebaikan asli madu kelulut serta inovasi usahawan tempatan.

Selain itu, pemasaran digital dan kolaborasi dengan pelbagai pihak luar adalah teras strategi Bayu SmartFarm. Produk madu kelulut bukan sahaja dipasarkan kepada penduduk sekitar Kota Damansara, malah turut diketengahkan dalam program antarabangsa seperti Osaka Expo 2025.

Rajah 10.2. Lawatan pelajar-pelajar dari Hosei Universiti, Tokyo, Jepun ke Kebun Kelulut Bayu SmartFarm pada 8hb September 2025

RANCANGAN PELAKSANAAN

Pelaksanaan projek madu kelulut di Bayu SmartFarm melalui beberapa fasa penting. Pada peringkat awal, lokasi yang strategik dipilih di dalam kebun bandar yang kaya dengan flora untuk menyokong aktiviti pendebungaan. Petani komuniti dilatih dengan teknik asas penternakan kelulut melalui kursus dan bimbingan daripada pakar. Seterusnya, penternakan dijalankan dengan sokongan dana kerajaan di bawah program ICU Sejati Madani. Peralatan dan modal kerja disediakan bagi memastikan operasi lebih sistematik. Kini, projek Bayu SmartFarm berada di fasa pemantauan berterusan dengan menilai kualiti madu, memperbaiki teknik pemeliharaan, serta mengembangkan variasi produk untuk pasaran.

KESIMPULAN

Madu kelulut mempunyai potensi besar sebagai sumber pendapatan mampan dan produk agribisnis bernilai tinggi. Dengan pendekatan inovatif, strategi pemasaran berkesan, serta sokongan kerajaan yang padu, industri ini mampu berkembang pesat di Malaysia. Projek Penternakan Madu Kelulut Bayu SmartFarm membuktikan bahawa inisiatif komuniti boleh dijadikan model bagi agribisnis mampan. Ia bukan sahaja menjana ekonomi penduduk setempat, tetapi juga memperkukuh peranan komuniti sebagai penggerak inovasi hijau. Lebih penting lagi, projek ini menghubungkan masyarakat dengan visi pembangunan lestari, menjadikan madu kelulut sebagai pemacu ekonomi hijau negara dan inspirasi kepada komuniti lain.

Chapter 11

Penanaman Cili Secara Fertegasi Untuk Golongan Belia, Surirumah, Dan Mereka Berpendapatan Kurang Dari Rm1,500 Sebulan Di Petra Jaya

Abang Ismail Abang Kerny

PENGENALAN

Petra Jaya di Sarawak, dengan anggaran populasi seramai 150,000 orang, terdiri daripada pelbagai latar belakang ekonomi dan sosial. Sebahagian besar penduduknya berada dalam lingkungan berpendapatan rendah, yang merangkumi golongan belia, suri rumah, serta mereka yang berpendapatan kurang dari RM1,500 sebulan. Berdasarkan statistik, kira-kira anggaran 45% daripada penduduk ini adalah dari kategori berpendapatan rendah,miskin bandar dan menghadapi cabaran ekonomi yang signifikan.

Sebagai satu usaha untuk mengatasi masalah kemiskinan dan meningkatkan taraf hidup mereka, Masyhur Jati telah melaksanakan satu projek penanaman cili secara fertigasi di Petra Jaya dengan kerjasama pihak APPGM-SDG. Program ini bertujuan untuk menyediakan peluang ekonomi baharu kepada masyarakat tempatan dengan memberi mereka peluang dan pengetahuan dalam bidang pertanian moden. Selain itu, projek ini juga memfokuskan kepada pembangunan kemahiran, di mana peserta dari golongan sasaran diajar kaedah fertigasi yang efektif serta diberi bimbingan mengenai teknik pemasaran dan pengurusan hasil. Dengan pendekatan ini, kami berhasrat untuk memberi inspirasi kepada peserta untuk berdikari dan mengembangkan potensi diri mereka sebagai usahawan dalam sektor pertanian.

MISI DAN VISI PROJEK

Sebagai pengendali projek ini, Masyhur Jati bersama APPGM-SDG mempunyai misi untuk mengurangkan kadar kemiskinan dalam kalangan masyarakat berpendapatan rendah, meningkatkan taraf hidup melalui pertanian mampan, dan membina ketahanan ekonomi dalam kalangan golongan belia dan suri rumah di Petra Jaya. Kami berhasrat untuk menyediakan latihan dan sokongan teknikal bagi membolehkan peserta mengurus tanaman mereka dengan cekap, seterusnya mengurangkan kebergantungan mereka kepada bantuan kewangan dari pihak luar.

Visi jangka panjang kami adalah untuk menjadikan peserta projek ini sebagai usahawan tani yang berdikari dan berdaya saing, mampu menjana pendapatan sendiri serta menyumbang kepada pertumbuhan ekonomi Petra Jaya secara mampan. Kami ingin melihat para peserta menjadi role model kepada masyarakat sekeliling, sekaligus membantu menjadikan Petra Jaya sebagai satu komuniti pertanian yang progresif dan inovatif dalam mengamalkan teknologi fertigasi.

PERANCANGAN PROJEK

Projek ini dirancang dengan teliti melalui beberapa fasa, bermula dengan penilaian keperluan komuniti. Setelah mendapat gambaran jelas tentang keperluan dan kehendak masyarakat sasaran, kami memulakan langkah-langkah strategik dengan mengaturkan sumber-sumber yang diperlukan serta mengenalpasti rakan kerjasama yang berpotensi. Sebagai contoh, untuk mencapai matlamat projek, kami bekerjasama dengan pelbagai agensi seperti Jabatan Pertanian, NGO, dan badan-badan kerajaan tempatan yang menyediakan bantuan dalam bentuk dana, kemahiran, dan kepakaran teknikal.

Di samping itu, peserta dipilih berdasarkan kriteria tertentu yang bertujuan untuk memaksimumkan impak projek kepada komuniti setempat. Mereka yang menunjukkan minat tinggi dalam bidang pertanian diberi keutamaan, terutamanya golongan belia dan suri rumah. Ini kerana mereka adalah kumpulan yang berpotensi untuk terus membangun dan memperkembangkan projek ini dalam jangka panjang. Peserta turut diberi kursus asas dan latihan intensif dalam kaedah fertigasi, yang merangkumi penyelenggaraan sistem pengairan, pengurusan baja, serta kawalan perosak yang mesra alam.

Untuk membantu mereka memasarkan hasil tanaman, kami turut memberikan latihan dalam aspek pemasaran, pengurusan perniagaan, dan strategi penjenamaan. Aspek-aspek ini penting bagi memastikan mereka dapat bersaing di pasaran dan meningkatkan pendapatan hasil daripada projek penanaman cili ini. Kami juga memberi fokus kepada penjenamaan produk, di mana setiap peserta dididik tentang cara untuk membezakan hasil mereka dari yang lain melalui pembungkusan, penggunaan media sosial, dan platform e-dagang untuk memasarkan cili mereka ke pasaran yang lebih luas.

PELAKSANAAN DAN KEMAJUAN PROJEK

Fasa pelaksanaan dimulakan dengan pemasangan sistem fertigasi pada tanah yang dikenal pasti sebagai kawasan yang sesuai untuk penanaman cili. Sistem ini melibatkan penggunaan alat pengairan titis yang menyampaikan air dan nutrien terus ke akar tanaman. Kaedah ini menjimatkan air dan baja berbanding teknik pengairan konvensional. Pendekatan ini memastikan cili tumbuh dengan lebih sihat dan mengurangkan risiko serangan penyakit. Sistem fertigasi juga menjimatkan masa dan tenaga peserta, membolehkan mereka memberi tumpuan kepada aspek lain dalam pengurusan tanaman.

Sepanjang proses ini, peserta diberi bimbingan dalam penyelenggaraan sistem, yang merupakan elemen penting dalam memastikan ladang mereka berfungsi secara optimum. Latihan pengawalan perosak secara organik turut diberikan untuk memastikan cili yang dihasilkan berkualiti tinggi tanpa menggunakan racun serangga berbahaya. Teknik kawalan perosak secara semulajadi, seperti penggunaan tanaman penghalau perosak, juga diperkenalkan. Selain itu, peserta dilatih untuk melakukan pemeriksaan rutin terhadap tanaman mereka bagi mengenal pasti tanda-tanda awal serangan perosak.

Setelah cili matang dan sedia untuk dituai, peserta dibantu dalam proses pemasaran produk mereka. Kami bekerjasama dengan rangkaian pasar tani tempatan dan platform e-dagang untuk membolehkan peserta menjual cili mereka kepada pasaran yang lebih besar. Ini memberi peluang kepada peserta untuk memaksimumkan pendapatan mereka dengan memasarkan cili pada harga yang lebih kompetitif.

IMPAK SOSIAL DAN EKONOMI PROJEK

Projek fertigasi cili ini memberi impak yang besar kepada ekonomi dan sosial masyarakat Petra Jaya. Dari segi ekonomi, ia membuka peluang pekerjaan baru kepada golongan belia dan suri rumah, yang sebelum ini berdepan dengan masalah pengangguran atau kekurangan peluang pekerjaan. Dengan menyertai projek ini, mereka dapat memperoleh kemahiran baru dalam bidang pertanian moden dan mula meraih pendapatan yang lebih stabil. Selain itu, projek ini mengurangkan kadar kebergantungan komuniti ini terhadap bantuan kerajaan dan membolehkan mereka berusaha sendiri untuk meningkatkan taraf hidup.

Dari segi sosial, projek ini menggalakkan hubungan kerjasama antara peserta. Mereka saling berkongsi pengalaman dan membantu antara satu sama lain dalam mengatasi cabaran yang dihadapi. Projek ini juga memberi peluang kepada golongan suri rumah untuk menyumbang kepada ekonomi keluarga, meningkatkan keyakinan diri mereka, dan mengembangkan jaringan sosial. Dengan adanya projek seperti ini, masyarakat setempat lebih peka terhadap pertanian mampan dan kesedaran terhadap kepentingan memelihara alam sekitar turut meningkat.

Secara keseluruhannya, projek ini bukan sahaja mengubah kehidupan individu yang terlibat, tetapi turut memberi manfaat kepada masyarakat sekeliling. Penglibatan belia dalam projek ini juga mengurangkan kadar jenayah dan aktiviti negatif kerana mereka kini lebih fokus kepada usaha-usaha produktif. Projek ini berjaya mewujudkan masyarakat yang lebih berdaya tahan dari segi ekonomi, lebih inklusif, dan bersedia untuk menghadapi cabaran-cabaran yang mendatang.

CABARAN DAN PENYELESAIAN

Seperti projek lain, kami juga menghadapi beberapa cabaran sepanjang pelaksanaan projek fertigasi ini. Salah satu cabaran terbesar ialah kos permulaan yang tinggi untuk pemasangan sistem fertigasi. Untuk mengatasi masalah ini, bantuan kewangan disediakan oleh pihak APPGM-SDG. Ini membantu peserta menanggung kos permulaan projek tanpa perlu membayar jumlah yang besar secara sekaligus.

Cabaran lain adalah dari segi teknikal, di mana peserta perlu memahami penggunaan dan penyelenggaraan sistem fertigasi yang mungkin agak kompleks bagi mereka yang baru dalam bidang ini. Untuk mengatasinya, kami menyediakan latihan berterusan dan bimbingan daripada pakar dalam bidang pertanian untuk membantu peserta memahami dan mengatasi cabaran-cabaran teknikal yang dihadapi. Peserta juga dibekalkan dengan manual ringkas serta panduan langkah demi langkah dalam penggunaan dan penyelenggaraan sistem.

Di samping itu, harga cili yang tidak menentu turut menjadi satu cabaran. Untuk mengurangkan risiko ini, peserta diajar untuk menubuhkan jaringan pemasaran yang pelbagai, termasuk menjual secara terus kepada pengguna, bekerjasama dengan pemborong, dan memasarkan produk secara atas talian. Dengan cara ini, mereka tidak terlalu bergantung pada satu saluran pemasaran sahaja dan lebih fleksibel dalam menghadapi turun naik harga pasaran.

KESINAMBUNGAN DAN VISI MASA DEPAN

Projek fertigasi ini mempunyai potensi yang besar untuk berkembang dan memberi manfaat dalam jangka masa panjang. Dalam usaha untuk memastikan kesinambungan projek ini, kami telah merangka strategi untuk menyediakan latihan lanjutan dalam bidang pengeluaran nilai tambah. Sebagai contoh, peserta diperkenalkan dengan cara memproses cili menjadi produk-produk seperti sambal,cili kering, serbuk cili, dan sos cili. Ini bukan sahaja meningkatkan pendapatan peserta tetapi juga memberi mereka peluang untuk menjual produk mereka pada harga yang lebih tinggi di pasaran.

Kami juga merancang untuk memperkenalkan lebih banyak jenis tanaman yang boleh ditanam menggunakan sistem fertigasi. Dengan mempelbagaikan hasil tanaman, risiko kehilangan pendapatan akibat perubahan harga pasaran bagi satu produk sahaja dapat dikurangkan. Visi masa depan kami adalah untuk mewujudkan komuniti usahawan tani yang berdaya saing dan berdikari, yang mampu meningkatkan ekonomi Petra Jaya serta memperkasa masyarakat dari segi kewangan dan kemahiran.

Dalam jangka panjang, kami berharap projek ini boleh dijadikan model pertanian mampan untuk kawasan luar bandar yang lain. Dengan sokongan kerajaan, NGO, dan komuniti setempat, kami percaya projek ini akan dapat memberi manfaat yang berkekalan kepada generasi akan datang.

Part V:
The Involvement And Impact On Indigenous Communities

Chapter 12

Involvement and Impact of Orang Asli Communities in Agriculture: A Pathway Toward Food Production, Economic Sustainability and Environmental Preservation

Kon Onn Sein

ABSTRACT

This article explores the crucial role of the Orang Asli (OA) communities of Peninsular Malaysia in agriculture, environmental stewardship, and the development of a sustainable green economy. Traditionally, the OA have practiced agroforestry, shifting cultivation, and biodiversity conservation, maintaining a harmonious relationship with nature while safeguarding ecosystems. However, they face severe socio-economic marginalisation, including high poverty rates, limited educational opportunities, land insecurity, and inadequate infrastructure, all of which hinder their ability to contribute meaningfully to national development. The multidimensional nature of their poverty—encompassing cultural erosion, loss of autonomy, and environmental degradation—highlights the need for development models that align with their values and worldview. The OAorganik initiative demonstrates a promising pathway by integrating traditional practices with sustainable, market-oriented agriculture, fostering income generation, community cohesion, and leadership. Furthermore, recognising the OA's role as co-managers of forests could enhance biodiversity conservation, mitigate climate change, and support national economic growth. Policy interventions such as inclusive governance, infrastructure investment, diversified livelihoods, and respect for indigenous knowledge are essential for empowering these communities. Ultimately, the article argues that

sustainable development must be rooted in cultural respect, environmental stewardship, and shared governance. By leveraging the OA's ecological wisdom and promoting their participation in decision-making, Malaysia can create a model of inclusive, resilient, and sustainable growth that benefits both people and the planet.

INTRODUCTION

The Orang Asli (OA), the indigenous people of Peninsular Malaysia, represent a diverse group of communities that have lived harmoniously with the natural environment for centuries. These communities, including various ethnic groups such as the Semai, Temiar, Jakun, and others, have an intrinsic cultural and spiritual connection to the forests and lands they inhabit. For generations, they have been the stewards of Malaysia's rich biodiversity, managing the forest ecosystems in ways that promote sustainability and a safe planet. However, despite their deep knowledge of agroforestry and environmental sustainability, the Orang Asli communities are facing increasingly difficult challenges.

Today, they find themselves marginalised within the larger Malaysian economy. High poverty rates of 89%. Fragmented communities, lack of land security, and capital severely constrain their ability to harness their potential for economic growth. A strong push in mainstream education that somehow is not translating into expected decent work and livelihood opportunities. While the Orang Asli have the cultural values and traditional knowledge necessary to support sustainable agricultural practices, their challenges such as inadequate infrastructure, poor access to markets, and deforestation have placed them on the brink of further marginalisation. This article seeks to examine the involvement and impact of Orang Asli communities in agriculture, explore the problems they face, and present potential solutions that could empower them to become key players in

Malaysia's green economy. By leveraging their rich cultural heritage and knowledge of agroforestry, the Orang Asli have the potential to create a sustainable and prosperous future for themselves and the nation at large.[1]

THE ROLE OF ORANG ASLI IN AGRICULTURE AND ENVIRONMENTAL PROTECTION

For the Orang Asli, agriculture and environmental stewardship are not merely economic activities; they are part of a deep cultural connection with the land. Historically, the Orang Asli have practiced subsistence agriculture in a manner that promotes ecological balance. Shifting cultivation, multi-cropping, and agroforestry are central to their farming systems, all of which are rooted in a philosophy of sustainability and respect for nature. These practices are based on principles of minimising ecological impact, maintaining soil fertility, and ensuring that the forest's resources are used in harmony with its cycles. Contrary to popular belief that shifting agriculture is destructive to forest, the OA mimics how nature regenerates itself. And it is the small size in which cut and slash practices are done rather

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[1] Waldron's comprehensive study shows that the global economy is better off with more nature protected. Also, cost benefit analysis across multiple economic sectors in addition to nature conservation outweighs the cost to at least 5- to-1 than logging.

> "*In the most comprehensive report to date on the economic implications of protecting nature, over 100 economists and scientists find that the global economy would benefit from the establishment of far more protected areas on land and at sea than exist today. The report considers various scenarios of protecting at least 30% of the world's land and ocean to find that the benefits outweigh the costs by a ratio of at least 5-to-1*."

Waldron's report has also offered new evidence that the nature conservation sector drives economic growth, delivers key non-monetary benefits and is a net contributor to a resilient global economy. The experts find that "the benefits are greater when more nature is protected as opposed to maintaining the status quo".
https://www.conservation.cam.ac.uk/news/protecting-30-planet-nature-costs-benefits-and-economic-implications

than cutting down hundreds of acres of forest or more that ensures both nature and people thrive in an equitable balance designed for sustainability.

The Orang Asli's role as guardians of the forest extends beyond agriculture. They have long been recognised as essential stewards of Malaysia's rich biodiversity. Their traditional knowledge of forest ecosystems, medicinal plants, and wildlife conservation practices has been integral in preserving the ecological balance of the forests. The Orang Asli understand that the forest provides more than just timber and land—it is a source of food, materials for rituals, medicine, and spiritual connection. This relationship with nature is also a cornerstone of their identity and survival. Without the forest, the OA lose their uniqueness as people of the forest. And in the loss of their forest, they will lose their place of rootedness, and they will be no different from any "kampung "people. Their destroyed forest home is no longer an anchor point for their community to come back to for remembering and sustaining their unique culture and identity. It is this intimate relationship of OA with nature that makes them the best partner to be guardians and stewards of the forest. [2]

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[2] In another recent study by Re Swiss Institute (2020), it is reported that nature conservation is intertwined with economic growth and that nature contributes as much as 55% towards global Gross Domestic Product. The huge direct link between economic growth and environment is inextricably interconnected; to sustain economic growth, it is imperative to protect our forest and environment.

> "*Countries across the world are reliant on a range of services that are based around their natural ecosystems. Biodiversity and Ecosystem Services (BES) include such necessities as food provision, water security and regulation of air quality that are vital to maintaining the health and stability of communities and economies.*
>
> *Over half (55%) of global GDP, equal to USD 41.7 trillion, is dependent on high-functioning biodiversity and ecosystem services. However, a staggering fifth of countries globally (20%) are at risk of their ecosystems collapsing due to a decline in biodiversity and related beneficial services, reveals a new study by Swiss Re Institute."*

This intimate worldview that the OA holds of nature makes it ideal to leverage on their strength and position them as the creation of a green economy through Agroforestry. The zoning of parts of the forest for integration of trees and crops in farming systems will help the OA adapt to the market economy, safeguards their livelihood and empower them to continue to protect the forest. Through agroforestry, they can create productive landscapes that not only meet their subsistence needs but also contribute to environmental conservation. Agroforestry models practiced by the OA communities can increase biodiversity, reduce soil erosion, enhance water retention, and sequester carbon. This aligns with global calls for sustainable farming systems that contribute to climate change mitigation and food security.

However, the rise of industrial agriculture, mining, and large-scale deforestation has placed these ecosystems under threat. As commercial agriculture expands into Orang Asli territories, it disrupts their ability to practice traditional farming methods and threatens the very ecosystem services they have long protected. The Orang Asli's role as environmental stewards is therefore crucial, not only for their own survival but for the broader health of the Malaysian environment and our shared planet.

THE STRUGGLES OF THE ORANG ASLI IN MODERN MALAYSIA

The Orang Asli faces a complex web of challenges in the modern world to realise their potential and shape a green economy, primarily stemming from their socio-economic marginalisation. Despite their deep knowledge of sustainable agriculture and the environment, their ability to capitalise on these strengths is hindered by multidimensional

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https://www.swissre.com/media/press-release/nr-20200923-biodiversity-and-ecosystems-services.html barriers in education, fragmentation, lack of infrastructure, and the erosion of their land rights and access to natural resources.

Challenges in Education

In November 2021, MoE was quoted as saying that 42.29 per cent of Orang Asli students did not complete schooling up to Form Five in 2021 compared to 58.62 per cent in 2020.

The dropout issue was also acknowledged in a report by the Institute for Democracy and Economic Affairs (IDEAS). The October 2020 report, titled 'Education Policies in Overcoming Barriers Faced by Orang Asli Children: Education for All', was prepared by researcher Wan Ya Shin.[3]

Over 40% of Orang Asli children do not complete SPM-level schooling, and this contributes to a lack of technical and business skills among the adult population. One of the primary obstacles faced by the Orang Asli is access to education. The distance between rural OA settlements and educational institutions, compounded by poor infrastructure, further limits their opportunities for education.

With few educated role models and parents who are not literate or have a low literacy level will have serious difficulty guiding the children and shaping homework discipline and a learning environment. In addition to poverty and poor infrastructure, the students are further disadvantaged by the curriculum used. Mainstream education systems have not been designed to accommodate the unique cultural and environmental context of the Orang Asli. The Orang Asli come from a long tradition of oral based learning and are disadvantaged

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[3]https://www.bernama.com/en/bfokus/news.php?id=2151344#:~:text=In%20November%202021%2C%20MoE%20was,and%20Economic%20Affairs%20(IDEAS).

with a mainstream pedagogy system that puts reading and writing as the primary base for learning to take place.

The education system, which largely ignores their traditional knowledge and way of life, also increases barriers for the Orang Asli to relate. There is also scepticism that the current mainstream education prepares them for decent work. Many who finish at SPM level are only able to secure low-income work as security, working in restaurants or workshops, cleaners and cashiers or salespersons. There is no career path. In these roles, they barely have any savings that they can bring back to their family and village.

Perhaps about 10% of the OA students who are more academically inclined get through to tertiary education. However, some feel they have lost alignment with their spiritual and OA worldview plus their connection to the forest. They feel lost and not quite able to adapt to the modern world dominated by an aggressive market economy and efficiency.

Another 30- 50% of OA students who have battled through to SPM levels are disenchanted with their work and find that the way of life in urban centres also do not resonate with their worldview as people of the forest. Many return to their village but are now disadvantaged with lost skills in forest living as they have spent 12 years of life in an education system that poorly prepares them for life in their forest-based communities.

The remaining 40% who dropped out at primary levels or who never went to school are in turn disenfranchised with development programmes that exploit their environments and diminish their natural resources.

Fragmentation and Isolated Small Groupings

The Orang Asli communities are often fragmented, both geographically and socially, which makes it difficult to organise themselves into cohesive economic units. Without the critical mass needed to achieve economies of scale, they struggle to access markets or attract investment. Their agricultural output is often small-scale and disconnected, meaning that they lack the bargaining power to negotiate fair prices or access larger, more profitable markets. Additionally, the high costs of transportation and logistics also make it difficult for Orang Asli farmers to compete with more commercially organised agricultural operations, such as plantations or corporate farms.

Deforestation and Environmental Degradation

Perhaps the most pressing issue for the Orang Asli is the loss of their ancestral lands due to deforestation and land encroachment. The rapid expansion of palm oil plantations, logging operations, and other industrial activities has reduced the size of forests that the Orang Asli rely on for sustenance and cultural practices. As they lose their natural resources, they are forced into wage labour on plantations or in urban areas, which often offer low-paying and unstable jobs. This loss of land, along with the degradation of ecosystems, exacerbates poverty and increases their shift and deeper integration into a cash economy, leaving them further behind.

The Concept of Poverty Among the Orang Asli

To truly understand the plight of the Orang Asli, it is essential to redefine the concept of poverty. While mainstream definitions of poverty often focus on income levels, the poverty experienced by the Orang Asli is more multi-dimensional, nuanced and involves a loss of self-determination, culture, security of tenure, access to natural resources, sense of belonging and respect.

Beyond Income

For many Orang Asli, poverty is not solely a financial issue but also a matter of cultural, spiritual and freedom deprivation. They do not measure their wealth primarily in the number of possessions they own or the income they earn; instead, their sense of well-being is tied to their ability to live according to their traditional way of life. The loss of access to their ancestral forests, the erosion of their cultural practices, and the loss of autonomy in decision-making are all seen as forms of poverty. They value access to clean water, forests, and the freedom to engage in cultural practices such as hunting, fishing, and gathering as central to their identity and well-being.

Cultural Autonomy and Freedom

The Orang Asli's deep connection to their land and traditions is integral to their sense of dignity and belonging. Poverty, for them, is as much the inability to exercise freedoms of self-determination and lead lives that respect their world views —to live in harmony with nature, to practice traditional rites and rituals, and to pass down ancestral knowledge to the next generation. This freedom of self-determination is just as significant, if not more so, than material poverty. The OA desire the freedom to make their own choices. To connect to their history, to be able to live in their beloved forests, to gather fruits, medicinal plants, hunt, fish, swim and go on their forest adventures, enjoy the cool and clean air, the pristine water and retain their intimate connections and reverence to their land and ancestors. And by failing to recognise or support their unique contributions to conserving the forest and biodiversity, it deprives them of the ability to enjoy such freedoms and contribute to society while retaining their identity and values.

So, how do we shape a development model that meets their basic needs, provide decent livelihoods that align with their values and can truly empower the OA to enjoy self-determination?

In broad terms, the development model should capitalise on their strengths as leaders in nature economics. Over and above meeting their basic needs of shelter, food, clothing and health, it should give them choices and preferences to education, decent livelihoods, culture and way of life. In enabling the OA to realise these freedoms and choices, the OA will feel and know they have a place in the Malaysian sun. A place where they belong and are respected.

THE OAORGANIK MODEL

The **OAorganik** initiative, which began in 2015, offers a promising model for empowering Orang Asli communities through agriculture while preserving their cultural heritage and promoting environmental sustainability. This model is based on natural farming principles and agroforestry practices, with the aim of creating an inclusive, sustainable, and economically viable agricultural system for the Orang Asli.

Economic and Social Impact

Since its inception, OAorganik has expanded to five villages, with 49 active farmers and 33 households participating. Over the course of eight years, these farmers have earned more than RM1 million, with some households experiencing a doubling of their income. For many, this has been a lifeline, helping them to adapt beyond subsistence farming into more market-oriented, sustainable livelihoods.

The surplus income of the farmers has also helped some to provide pocket money for the school going children. Some have used their surplus to buy washing machines. They no longer need to fear if they do not have enough to feed their children during the end of year monsoon period. Some have used their surplus to buy vehicles. Some are also able to expand their houses and farms. And some have started saving.

However, the model also faces challenges. While 20% of farmers have seen significant increases in income, the remaining 80% have been slower to see the same gains. Many farmers earn between RM300 and RM800 per month, which is not sufficient to be comfortable. The slow pace of income growth can be attributed, in part, to the "Santai" mindset—the relaxed, patient approach to life that is deeply ingrained in the Orang Asli's cultural values. Their priority is earning only enough to feed themselves. There is no need to think of savings or enjoy a more consumerist lifestyle. They are accepting of what they have. Their savings, housing materials and food needs are all in the forest for them to draw upon anytime they are needed. They have lived for generations with a mindset of abundance in that the forest has everything they need. Their worldview prohibits them from exploiting the forest for economic gains as the forest is needed to sustain life. This culture is expressed in their way of life and *santai* mindset. This is in turn entrenched into habits. So, despite the diminishing forest and the dwindling of natural resources, some of these OA have yet to adapt to this change. It's a situation of *cukup but kurang.* But as they have yet to feel the full impact and deprivation and are able to make sense of what is happening, they are living life as before and holding on to their worldview that they should not exploit the forest even though outsiders are doing so. They may be thinking things won't get any worse or they are not giving deeper thought to this possibility. This mindset, while valuable in many respects, can also slow down the pace of their adaptation to the modern world and ability to protect their environment and livelihoods.

Community Unity and Capacity Building

A key success of the OAorganik model is its focus on strengthening community cohesion and unity. By organizing farmers into groups and appointing champions to lead them, OAorganik has fostered a sense of collective responsibility and mutual support. This has helped create a stronger social fabric, enabling the community to engage in joint marketing, share resources, and build the collective capacity needed for long-term success and building of a meaningful and flourishing community.

One very significant indicator is that of community cohesion and resilience. In order to move beyond poverty alleviation to poverty eradication, a more holistic approach is needed and the whole community needs to be mobilised to address the bigger issues of development, unsuitable policy and systemic deprivation. And thereby removing the barriers of their social exclusion. A critical gap to mobilise the community is effective leadership. This is profoundly challenging as communities are divided and fragmented. Whilst there is harmony in the sense of absence of conflict, there is little cooperation and trust in moving forward collectively. There is a lack of a clear vision and direction which in turn is due to lack of information, knowledge and transparency. The leadership is further plagued with growing poverty and a community that is feeling helpless where hope is barely alive. Here, it is important to build an environment for effective leadership to rise. The project does more than improve income for the OA farmers, it also creates a platform for the farmers to share experiences and knowledge. It also creates spaces where they update each other on village activities and news. In short it creates spaces for the farmers to bond and build friendships. And in this growing environment of trust, they are able to share their concerns and challenges. In this process, they now don't feel all alone and that this problem is uniquely theirs alone. It is shared and that empowers them to realise that whilst they cannot solve this problem alone as individuals, they can do so together. By organising themselves together, they have the potential and possibility to overcome these challenges. The farm has enabled them to grow solidarity and grow hope to find a way forward. This in turn grows an environment for a core group and leaders to emerge that inject welcomed ideas, strength and support to existing village leaders. Through this project, the environment for growing effective leadership has been set up. Now it needs to be nurtured to mature into leadership of integrity that is visionary, empowering and community focused. Leadership that is ready to build towards a meaningful and flourishing community. A community that has a sense of belonging and respect.

A couple of stories below will illustrate the process of how the project is building an environment of effective leadership and community cohesion.

Stories of community conversations OA farmers congregate in their rest time in the farm, and this has resulted in inspiring conversations. In the past, the OA hardly met and knew very little of the details each was facing. They would work individually in their respective small rubber holdings and had no regular meet up with the wider OA community. Without regular meet ups and little bonding between the OA, and where the OA usually do not share much outside of their family or with their distant neighbours, the OA function with little engagement with each other. As such, the OA are not informed of the development and challenges facing the community. Also, the culture of living in harmony with one another is often expressed in terms of absence of conflict. And so the thinking is: it is best that I will not interfere with your individual affairs. I will mind my business, and you mind your business. "*Saya saya " and "kau kau*" type of thinking.

With working together on the collective farm, this has changed for the good. It has built trust and bonded the farmers together as friends. There are now solidarity and friendship. They can no longer take an isolationist view as what is harming one is now a shared pain of the friend, their fellow farmer.

They are exchanging stories and enquiring about the well-being of each other. In sharing about what happened to one of the OA whose land was stolen and burial sites desecrated, the farmers are able to share their views with each other and discover they have a common concern to find a solution to the increased encroachment of their OA land. In the past, they were not connected enough to make collective discussions and find ways to solve the problem. Each was alone and had to find their own solutions. The individual encroachment of OA land was not their problem, and they are not in a position to interfere. In the past, it was the problem of the other OA whose land was affected. It was not theirs and so they could turn a blind eye. Now, they are having common ground to share, discuss and realise they have shared concerns and collectively, they are realising there is power in community bonds and the need to unite and find answers. And with the discussion of this land encroachment of the individual, the group is now talking about it with each other and debating the different ways to find a collective response. Now, they know they are not alone in facing their problems. They are in it together. Now, they know they have shared challenges and together, they are stronger and can now envision the possibility they are able to mobilise the whole community to action and find answers. The platform created in the farm for sharing has sparked conversations and thinking and is shaping solidarity, hope and collective responses. There is hope that they can work through the democratic system of government to resolve their woes and find justice.

This has also encouraged the Batin. In the past, the Batin was not able to get the support of the young adults. Leadership lacked vision and clarity in the way ahead. There was no clear vision for the community and the young people had no direction. With this organised group of farmers, they are now able to see change and a way forward. They want progress for the community and in sharing the ideas of creating decent jobs through the farm, Batin is inspired to give his support and grow this farm to benefit more of the community.

The Batin in turn is supported by this group who is willing to work for progress. With this core team of 10 farming families, the Batin has options and ideas of how to support this group to improve the community. As a result, the group has together with other leaders begun to do community mapping in their pursuit to protect their land from encroachment and connect with the authorities and institutions of governance.

There is hope and a confidence they can build their rights to defend their land from encroachment. To enjoy their rights to their ancestral land. To have hope they can work towards solutions that will enable them to achieve decent livelihoods and a sense of belonging and respect. The farm has generated spaces for the OA to share with each other their fears and suffering. It has created a platform for them to build trust and friendship. And they are realising that they are not in this alone and that together, they are no longer helpless. There is strength in being together.

SOLUTIONS FOR GROWING THE GREEN ECONOMY AND EMPOWERING THE OA

The road to a sustainable green economy and sense of belonging for the Orang Asli is not without its challenges, but there are several ways in which these communities can be empowered to play a more active role in agriculture and environmental preservation.

Embracing the Santai Mindset

Rather than trying to “change” the Orang Asli’s slow, relaxed pace of life, development initiatives should seek to understand and work with this mindset. The “Santai” approach, when given time to adapt, can lead to long-term sustainability in both environmental practices and economic development. Patience is needed, and this requires long-term commitment and investment.

Diversified Livelihoods

To help reduce economic vulnerability, it is essential to provide the Orang Asli with multiple livelihood options. Agroforestry, natural farming, and eco-tourism could serve as complementary sources of income. By diversifying livelihoods, OA communities can reduce their dependency on any one sector and build a more resilient local economy.

Improved Access to Markets and Infrastructure

To truly capitalize on their agricultural potential, the Orang Asli need improved infrastructure, such as better roads, solar energy, and internet access. This will enable them to connect to larger markets, reduce transportation costs, and increase their bargaining power. Establishing cooperatives and local networks will also allow them to collectively negotiate better prices for their produce and access fairer markets.

Policy and Governance: Creating the Enabling Environment

For any initiative to succeed, there must be an enabling environment that supports it. This includes both governmental and corporate policies that respect and promote the rights of the Orang Asli, protection of their ancestral lands, and build such necessary infrastructure for economic development.

Inclusive Governance

Inclusive governance is crucial for ensuring that the Orang Asli have a voice in the decisions that affect their land, culture, and livelihoods. This means recognizing their rights to ancestral customary land, their role in environmental stewardship, and their right to develop their own economic models. The government should actively engage with the Orang Asli in the design and implementation of policies that impact them. A co-managed forest with the OA is a good way forward that will restore their sense of belonging and respect. By recognising the unique giftings of the OA as leaders in nature economics and their special relationship with the forest, it would do well to capitalise on their strength. [4] Rather than expanding more large-scale livelihood development strategies like TSK or RPS and monocrop schemes managed by others that are showing mixed results, it is more impactful and inclusive to let the OA co-manage the forest. Without allowing the OA co management, their greater measurement of

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[4] A strong body of growing international studies show the indigenous people are the best people to protect the forest more than any other group. In other words, the indigenous communities living and working within the forest are proving to be the best line of defence against deforestation.

> "*Deforestation has been found to be five times higher outside of indigenous territories and conservation units, according to a recent study by RAISG (The Amazon Network of Georeferenced Socioenvironmental Information)*"
> "*And no one stewards the land better: Research shows that Indigenous peoples achieve conservation results at least equal to those of government-run protected areas - with a fraction of the budget*."
> "*Another study shows that from 2000 to 2012, the annual deforestation rates inside tenured Indigenous forestlands across the Amazon were 2-3 times lower than outside of them.*"

The message is clear: the Indigenous peoples know best how to protect the forests.
https://www.wri.org/insights/5-maps-show-how-important-indigenous-peoples-and-local-communities-are-environment

poverty in self-determination is not met. They won't feel a sense of belonging nor their choices and dignity respected. A co-managed forest will give them a sense of belonging and respect. But also, it leverages on their strength to conserve the environment and build a green economy and agroforestry. The green economy will uplift poverty, create jobs and sustain economic growth. Additionally, it will contribute significantly to carbon gas emissions whereby the state can stand to be compensated through carbon credit payments or through EFT provided by the Ministry of Natural Resources and Environment Sustainability. In this way, everyone wins.

Long-term Investment in Infrastructure and Capital

Long-term investments in infrastructure—roads, electricity, internet, and transportation—are essential for linking OA communities to national and international markets. Patient capital, which recognizes the slow ROI of these initiatives, is necessary to sustain their growth and development. This will require both governmental support and partnerships with corporations and NGOs willing to invest in long-term solutions.

CONCLUSION

The Orang Asli communities possess a wealth of knowledge and skills that could play a central role in building Malaysia's green economy. By focusing on their strengths—agroforestry, environmental stewardship, and cultural heritage—we can create a co-managed forest with the OA in this development model that benefits not only the Orang Asli but also the broader environment and society. Through recognising their talents and letting the OA co-manage the forest, and with patient capital, long-term investment, and inclusive governance, we can help empower the Orang Asli to become leaders in sustainable agriculture and environmental preservation. The OA in turn also strengthened the governance on environmental and biodiversity policies. With the institutionalisation of their roles as co-managers of the forest, the nation is more inclusive and has more safeguards to ensure the environment and planet is kept safe for the good of all.

It is clear that economic development for the Orang Asli cannot be achieved without respecting their cultural values and their deep connection to the land. With the right structural support, the Orang Asli can thrive, contributing to the prosperity of Malaysia while preserving biodiversity and environment that benefit everyone. The future of the Orang Asli, and indeed of Malaysia, lies in creating an inclusive, sense of belonging and respect, sustainable model of development that honours both people and the planet.

Chapter 13

Food Forest: Adakah ia Pendekatan Pertanian Regenaratif Terbaik?

Nur Liyani Abdul Latiff

ABSTRAK

Di Kampung Orang Asli Jong, Pekan, Pahang, Kami sedang menjalankan projek di Kampung Orang Asli Jong, Pekan, Pahang, hasil dana yang diberikan oleh APPGM-SDG. Projek ini bertujuan untuk mencapai beberapa Matlamat Pembangunan Mampan (SDG) yang penting. Di kampung ini, penduduk seperti Pak Jabar dan Amai Busu telah lama bergantung pada tanah untuk sumber rezeki. Namun, kebergantungan ini kini terancam akibat cuaca yang tidak menentu, serangan perosak, dan penggunaan bahan kimia yang berlebihan. Keadaan ini bukan sahaja menjejaskan hasil tanaman mereka, tetapi juga menambah beban kewangan, menyukarkan mereka untuk mencapai Matlamat Pembangunan Mampan (SDG) yang penting, terutamanya SDG 1 (Tiada Kemiskinan) dan SDG 2 (Tiada Kelaparan). Hasil tanaman yang merosot membawa kepada kesukaran untuk mendapatkan makanan yang mencukupi dan berkualiti, meresahkan kesihatan dan kesejahteraan mereka (SDG 3). Namun, ada cahaya harapan yang datang daripada usaha NGO Global Peace Malaysia, yang membawa mereka untuk mengikuti kursus di Seeds Malaysia. Di sinilah mereka diperkenalkan kepada konsep *food forest* yang menarik dan berpotensi memulihkan tanah mereka.

KONSEP *FOOD FOREST*

Food forest adalah satu pendekatan pertanian yang meniru ekosistem semula jadi. Dalam sistem ini, pelbagai lapisan tumbuhan saling menyokong, membentuk satu ekosistem yang seimbang. Tumbuhan berakar dalam membantu mengikat tanah, mencegah hakisan, dan menyediakan nutrien semulajadi (SDG 15: Kehidupan di Darat). Konsep ini membangkitkan minat Pak Jabar dan Amai Busu kerana ia menjanjikan cara untuk memulihkan tanah yang rosak dan menghasilkan tanaman berkualiti tanpa perlu bergantung kepada baja kimia.

PERMULAAN PROJEK *FOOD FOREST*

Setelah mengikuti kursus, semangat untuk bertransformasi membara dalam hati Pak Jabar dan Amai Busu. Mereka memulakan projek *food forest* sintropik yang pertama di kampung mereka. Dengan bantuan Global Peace Malaysia dan En Imran dari A Little Wild, mereka menanam pokok buah-buahan sebagai lapisan kanopi, diikuti oleh pokok renek seperti pisang, serta sayuran seperti kacang panjang dan serai. Setiap tanaman dipilih dengan teliti untuk memulihkan kesihatan tanah secara semula jadi.

Melalui kaedah sintropik ini, setiap lapisan tumbuhan berfungsi dalam ekosistem, memperbaiki struktur tanah dan mengekalkan kelembapan. Hasilnya, tanah yang dulunya tandus kini subur, memberi peluang ekonomi yang lebih baik kepada keluarga mereka (SDG 8: Pekerjaan yang layak dan Pertumbuhan Ekonomi). Dalam tempoh yang singkat, mereka menyaksikan transformasi yang mengagumkan dalam produktiviti tanaman mereka.

KESAN EKONOMI KEPADA KOMUNITI

Kehidupan Pak Jabar kini jauh berbeza. Hasil tanaman yang lebih stabil mengurangkan risiko kegagalan tanaman dan memberikan pendapatan yang lebih terjamin (SDG 1 dan 2). Dengan produk organik yang bebas bahan kimia, beliau kini mampu menjual hasil tanaman dengan harga yang lebih berpatutan, memberi manfaat kepada ekonomi komuniti secara keseluruhan (SDG 8). Penduduk

Kampung Jong kini memiliki akses kepada makanan sihat dan segar, manakala generasi muda belajar tentang pertanian lestari melalui pengalaman langsung (SDG 4: Pendidikan Berkualiti).

KESATUAN KOMUNITI

Projek *food forest* ini bukan sahaja meningkatkan hasil pertanian, tetapi juga mengukuhkan hubungan sosial dalam komuniti. Dengan penduduk yang berkongsi hasil, pengetahuan, dan bekerja bersama, mereka membentuk kolaborasi yang lebih kuat. Peralihan dari persaingan ke kerjasama dalam pengeluaran yang berkualiti memberi impak positif kepada SDG 10 (Pengurangan Ketidaksamaan). Kini, semua penduduk, tanpa mengira latar belakang, dapat bersama-sama merasai faedah.

Kerjasama ini membawa kepada penyertaan yang lebih aktif dalam aktiviti komuniti, termasuk program pemuliharaan dan pendidikan. Setiap individu merasa lebih bertanggungjawab terhadap tanah dan sumber daya yang mereka miliki, meningkatkan kesedaran tentang kelestarian (SDG 11: Bandar dan Komuniti yang Lestari).

PERANAN WANITA DALAM KOMUNITI

Penglibatan wanita dalam pengurusan *food forest* adalah kritikal. Mereka tidak hanya terlibat dalam perancangan dan penuaian, tetapi juga dalam pemasaran produk. Dengan penglibatan ini, wanita di Kampung Jong dapat meningkatkan kemahiran dan pengetahuan mereka, menunjukkan bahawa pertanian bukan hanya tanggungjawab lelaki (SDG 5: Kesetaraan Jantina). Wanita dalam komuniti ini kini mengajar generasi muda tentang pertanian dan pemeliharaan alam, memastikan pengetahuan tradisional diteruskan.

Selain itu, mereka juga terlibat dalam pembuatan produk nilai tambah, seperti kerepek dan makanan organik. Aktiviti ini memberi mereka peluang ekonomi tambahan dan memperkuat kedudukan ekonomi wanita, membolehkan mereka berpartisipasi lebih aktif dalam keputusan keluarga dan komuniti (SDG 8).

DAYA TAHAN TERHADAP PERUBAHAN IKLIM

Food forest bukan sahaja meningkatkan hasil tanaman, tetapi juga memberikan ketahanan terhadap perubahan iklim (SDG 13: Tindakan Terhadap Perubahan Iklim). Sistem ini melindungi tanaman daripada cuaca ekstrem, membantu mengekalkan kelembapan tanah, dan mengurangkan hakisan. Ketahanan ini penting dalam menghadapi cabaran akibat perubahan cuaca, memastikan keselamatan makanan dan kesejahteraan penduduk.

Dalam menghadapi musim kemarau, tanaman dalam sistem *food forest* menunjukkan daya tahan yang lebih baik. Akar yang dalam dapat menarik air dari lapisan tanah yang lebih dalam, manakala ketika musim hujan, akar tumbuhan membantu mengikat tanah dan mengurangkan risiko hakisan. Ini menunjukkan bahawa sistem *food forest* berfungsi untuk menghasilkan makanan dan melindungi tanah daripada impak perubahan iklim.

MENJAMIN AKSES KEPADA AIR BERSIH

Sistem *food forest* juga menyokong SDG 6 (Air Bersih dan Sanitasi). Dengan memulihkan tanah dan meningkatkan strukturnya, sistem ini membantu mengekalkan kelembapan tanah, yang meningkatkan kualiti dan ketersediaan air di kawasan tersebut. Penduduk yang bergantung pada sumber air semulajadi kini dapat menikmati air yang lebih bersih dan mudah diakses.

1) Sumber Tenaga Bersih dan Aksesibiliti
   Projek ini juga berusaha untuk mempromosikan penggunaan sumber tenaga bersih (SDG 7). Melalui sistem penangkapan air hujan, penduduk tidak lagi bergantung sepenuhnya kepada sumber air bawah tanah. Ini menjadikan mereka lebih berdaya tahan dalam menghadapi kenaikan kos tenaga, serta membantu mereka untuk mengurus sumber daya dengan lebih baik.

2) Penggunaan dan Pengeluaran yang Bertanggungjawab
   Pendekatan *food forest* menyokong SDG 12 (Penggunaan dan Pengeluaran yang Bertanggungjawab) dengan menggalakkan amalan pertanian yang berkelanjutan dan pengurangan sisa. Dengan menghasilkan makanan secara organik dan mengurangkan penggunaan bahan kimia, penduduk memastikan bahawa sumber daya digunakan dengan cara yang lebih bertanggungjawab. Ini memberi impak positif kepada alam sekitar dan meningkatkan kesedaran tentang kepentingan pemuliharaan.

KEHIDUPAN BAWAH AIR

Walaupun tidak secara langsung berkaitan, terdapat juga hubungan antara *food forest* dan SDG 14 (Kehidupan Bawah Air). Dengan mengurangkan penggunaan bahan kimia dan racun perosak, kualiti air di sekitar kawasan pertanian dapat dipelihara. Ini penting untuk menjaga ekosistem akuatik di kawasan berdekatan, membantu memastikan keseimbangan biodiversiti.

PEMBANGUNAN DAN PERDAMAIAN

Projek ini bukan sahaja memberi kesan positif kepada ekonomi dan sosial penduduk, tetapi juga memperkukuh keamanan dan kestabilan dalam komuniti (SDG 16). Dengan mendorong kerjasama dan penglibatan masyarakat dalam aktiviti bersama, hubungan antara penduduk diperkukuh, mengurangkan ketegangan dan konflik yang mungkin timbul. Pembangunan kapasiti melalui pendidikan dan pemahaman tentang kelestarian juga menyokong prinsip prinsip keamanan yang berterusan.

MASA DEPAN YANG LEBIH CERAH

Kejayaan Pak Jabar dan Amai Busu kini menjadi inspirasi bagi penduduk lain. Mereka berperanan sebagai pendidik, berkongsi pengalaman dan pengetahuan mereka kepada kampung-kampung berdekatan. Dengan pendekatan yang sama, lebih banyak kampung berusaha untuk mengadopsi konsep *food forest*, yang membawa kepada peningkatan hasil pertanian di seluruh kawasan (SDG 17: Kerjasama untuk Mencapai Matlamat).

Projek Terkini di Kg OA Jong

Dalam usaha mencapai matlamat ini, projek yang dijalankan bersama APPGM-SDG di Kampung Orang Asli Jong meliputi pembinaan bangsal kerepek dan penanaman pokok pisang serta ubi kayu. Selain itu, penternakan ayam penelur dan lalat askar hitam (BSF) diperkenalkan sebagai sumber makanan alternatif untuk ternakan. Pendekatan ini menjadikan sistem pertanian lebih lestari dan berdaya saing, mengurangkan kebergantungan kepada makanan ternakan konvensional yang mahal. Projek ini bukan sahaja menyediakan peluang pekerjaan kepada penduduk, tetapi juga membantu mengurangkan kadar pengangguran di kawasan tersebut (SDG 8). Dengan ayam, mereka bukan sahaja menghasilkan telur, tetapi juga memanfaatkan sisa makanan yang ada. Lalat askar hitam memainkan peranan penting dalam menguraikan sisa organik dan menukarkannya menjadi makanan bergizi untuk ayam.

Projek Food Forest di SJKC Yoke Chuan, Sekinchan

Projek *food forest* di SJKC Yoke Chuan merupakan salah satu projek inspirasi di bawah penyeliaan Seeds Malaysia dan diusahakan sebagai sebahagian daripada inisiatif Matlamat Pembangunan Mampan APPGM-SDG. Pada awalnya, tujuan utama sekolah hanyalah untuk mengatasi masalah bangunan yang terlalu panas akibat pancaran cahaya matahari, di mana mereka merancang untuk menanam sekitar 20 hingga 30 pokok sahaja sebagai penyejuk. Namun, setelah guru mereka melihat sendiri plot hutan makanan di Seeds Malaysia, mereka terpesona dengan konsep tersebut dan segera beralih kepada idea yang lebih besar dan berimpak tinggi.

Melihat kesuburan, keunikan, dan kepelbagaian ekosistem dalam hutan makanan tersebut, mereka memutuskan untuk memperluaskan projek ini, bukan sahaja sebagai penyelesaian bagi suhu panas tetapi juga sebagai ruang pembelajaran alam sekitar dan amalan lestari. Kini, Sekolah Cina Sekinchan bukan sahaja mempunyai kawasan hijau yang memberikan teduhan, tetapi juga sebuah ekosistem kecil yang kaya dengan pelbagai jenis tanaman. Pelajar di sekolah ini turut mendapat manfaat melalui pengalaman langsung menguruskan tanaman, memahami proses ekologi, dan melihat sendiri bagaimana konsep regeneratif mampu meningkatkan kesuburan tanah (SDG4).

Keindahan konsep ini ialah ia boleh diterapkan di sekolah-sekolah lain dengan penyesuaian mengikut keperluan setempat. Projek ini bukan sahaja mengurangkan haba bangunan tetapi juga memberi ruang kepada pelajar untuk belajar tentang pertanian regeneratif dan kepentingan menjaga alam sekitar secara praktikal.

Seeds Malaysia kini dalam perancangan untuk memperluaskan konsep hutan makanan ini ke tiga lagi sekolah di Besut, Terengganu.

Kami berharap kejayaan di Sekolah Cina Sekinchan dapat menjadi inspirasi kepada lebih banyak institusi pendidikan untuk menerapkan hutan makanan sebagai langkah pendidikan lestari dan kesejahteraan komuniti.

FOOD FOREST: FLOATING RAISED BEDS DI KAMPUNG ORANG ASLI ROYAL BELUM

Di Kampung Orang Asli Royal Belum, Perak, beberapa wakil komuniti orang asli telah berpeluang menghadiri kursus *food forest* di Seeds Malaysia. Mereka sangat terinspirasi dengan konsep *food forest* ini dan ingin membawanya pulang untuk memperkayakan kehidupan kampung mereka. Namun, mereka menghadapi satu cabaran besar – ancaman gajah yang sering datang dan boleh memusnahkan tanaman mereka dalam sekelip mata. Ketika perbincangan diadakan mengenai cabaran ini, timbul idea yang unik dan kreatif, iaitu membina *floating raised beds*, inspirasi daripada Sistem Chinampas masyarakat Aztec. Dengan cara ini, mereka berharap tanaman mereka dapat dilindungi daripada gajah, yang biasanya hanya mencari makan di daratan.

Keesokan harinya, mereka dengan semangat berkobar-kobar memulakan kerja membina prototaip *floating raised bed* ini. Mereka meletakkannya di atas air dan memerhatikan bagaimana tanaman boleh bertahan di persekitaran tersebut. Setibanya mereka di kampung masing-masing, tiga buah kampung memulakan percubaan pertama menggunakan bahan asas yang tersedia di sekitar mereka. Dengan memanfaatkan buluh, mereka berjaya membina *floating raised bed* ini dan mula menanam menggunakan konsep *food forest*, memastikan setiap lapisan tanaman memainkan peranan dalam ekosistem.

Floating Raised Bed ini bukan sahaja berfungsi sebagai kawasan tanaman yang terlindung tetapi juga mesra alam, kerana buluh yang digunakan mudah diperoleh di sekitar kampung dan boleh digantikan jika rosak. Mereka hanya perlu membuang buluh lama dan menggantikannya dengan buluh baru. Ternyata, prototaip ini berjaya di ketiga-tiga kampung, dan hasilnya sangat memberangsangkan. Bukan sahaja tanaman dapat tumbuh subur di atas air, tetapi mereka juga terlindung daripada serangan gajah yang tidak mendekati kawasan air SDG 9 (Inovasi dan Infrastuktur).

Apabila berita kejayaan ini tersebar, kampung-kampung lain mula berminat untuk menerapkan sistem yang sama. Namun, untuk menjayakan prototaip ini, kami telah mengeluarkan dana sendiri sebanyak RM7,000, suatu jumlah yang besar bagi komuniti kecil ini. Oleh kerana kekurangan dana, projek ini terpaksa dihentikan. Kini, kami berharap dapat memperoleh sokongan kewangan dari pihak luar yang sudi menyumbang agar projek inovatif ini dapat diteruskan dan memberi manfaat kepada lebih banyak kampung di sekitar Royal Belum.

PENUTUP

Food forest adalah contoh nyata bagaimana pertanian dan alam semula jadi dapat diharmonikan untuk kelestarian. Dengan meniru ekosistem hutan, pendekatan ini bukan sahaja memulihkan tanah dan meningkatkan biodiversiti tetapi juga menyediakan sumber makanan yang sihat dan bebas kimia. Ia memperkukuh ikatan komuniti, membuka peluang ekonomi, dan mendidik generasi muda tentang tanggungjawab terhadap alam sekitar.

Namun, persoalannya: adakah kita hanya mahu melihat dari jauh? Tidakkah kita mahu turut serta dalam mencipta perubahan dan membina dunia yang lebih hijau? Bayangkan impak jika setiap individu dan komuniti memulakan *food forest* mereka sendiri. Beranikah kita mengambil langkah pertama untuk memastikan generasi akan datang hidup dalam dunia yang lebih sejahtera?

Inilah masanya untuk bertindak. Mari kita mulakan *Food Forest* di komuniti kita, sebarkan kesedaran, dan jadi sebahagian daripada transformasi hijau yang akan membawa perubahan berpanjangan. Masa depan lestari bermula dengan kita – adakah kita bersedia untuk menyahut cabaran ini?

Chapter 14

A Commentary on Alternative Feed for Chicken Farming

Angelina Ho Mei

ABSTRACT

This paper highlights the importance of developing alternative, low-cost, and sustainable feeds for poultry farming, particularly in rural communities where traditional chicken rearing remains small-scale. High dependence on commercial feeds mainly soybean meal and yellow corn, has limited large-scale production due to rising costs and import dependency. Exploring locally available feed ingredients such as rice bran, Napier grass, moringa leaves, Azolla, earthworms, and Black Soldier Fly larvae provides a viable solution to reduce production costs and enhance food security. The paper discusses different poultry production systems (traditional, semi-commercial, and commercial) and emphasises how nutrition balanced in energy, protein, minerals, and vitamins is key to poultry health and productivity. It also examines the potential of natural feed additives like herbs and plant-based supplements as antibiotic alternatives. Promoting alternative feed practices can empower rural farmers, improve sustainability, and strengthen national poultry self-sufficiency and food resilience.

INTRODUCTION

The rural community have been rearing chickens that roam freely around their village. However, these are mainly for their own consumption. The main issues that prevented large scale chicken farming in these rural villages are due to high cost of commercial feeds, marketing and logistic, and high mortality rate due to predators and lack of technical know-how. Among these three issues, feed is regarded as the most expensive component of poultry production. Feed processing also raises the price of feed, in addition to the cost of ingredients. Therefore, it is crucial that low-cost, high-quality feeds be easily accessible if poultry production is to remain competitive and grow to meet the world's demand. Soybean meal and yellow corn are conventional feedstuffs used as the main ingredients in poultry feeds due to their high nutrients' availability. Food security especially in the developing countries would be threatened due to dependency on these two ingredients. Therefore, the use of alternative feedstuffs to replace soybean and yellow corn in poultry diets and the alternative feedstuffs that can be used in poultry feeds are both being pursued (Abbas B.A., 2023). Among the alternative sources of feeds that can be used are a mixture of ingredients like fish meal, rice bran, Napier grass, Black Soldier Fly larvae, earthworms, moringa leaves, variety of fruits, vegetables, herbs and others. Some of these ingredients can be planted or produced locally within the farming community. By making our own formulated feed, the production cost can be greatly reduced. We can also ensure the quality of the chicken by feeding them a well-balanced diet.

PRODUCTION SYSTEMS AND FEEDING

Historically, the poultry sector has evolved through three phases: i) traditional systems, which include family poultry consisting of scavenging birds and backyard raising; ii) small-scale semi commercial systems; and iii) large-scale commercial systems. Each of these systems is based on a unique set of technologies. They differ markedly in investment, type of birds used, husbandry level and inputs such as feeds. The feed resources, feeding and feed requirements required to raise poultry also vary widely, depending on the system used (Ravindran, 2013).

The traditional system is the most common type of poultry production in most developing countries. Possible feed resources for the local birds raised in this system include: i) household wastes; ii) materials from the environment (insects, worms, snails, greens, seeds, etc.); iii) crop residues, fodders and water plants; and iv) by-products from local small industrial units (cereal by products, etc.). The survival and growth of extensive poultry systems are determined by the competition for feed resources in villages. This system works well where biomass is abundant, but in areas with scarce natural resources and low rainfall, the competition for natural resources with other animals can be extreme.

Between the two extremes of traditional and commercial production systems is the semi commercial system, which is characterized by small to medium-sized flocks (50 to 500 birds) of local, crossbred or “improved” genotype stock, and the purchase of at least part of their feed from commercial compounders. Several feeding strategies may be used in this system: i) on-farm mixing of complete rations, using purchased and locally available feed ingredients: ii) dilution of purchased commercial feeds with local ingredients; and iii) blending of a purchased concentrate mixture with local ingredients or whole grains.

The large-scale commercial system is the dominant production system in developed countries, and this sector has also recently expanded in many developing countries. Commercial systems are characterized by large vertically integrated production units and use high-producing modern strains of birds. In these systems, feed is the most important variable cost component, accounting for 65 to 70 percent of production costs. High productivity and efficiency depend on feeding nutritionally balanced feeds that are formulated to meet the birds’ nutritional requirements.

NUTRIENT REQUIREMENTS

For maximum growth and good health, intensively reared poultry need a balanced array of nutrients in their diet. The nutrients required by birds vary according to species, age and the purpose of production – whether the birds are kept for meat or egg production. Poultry require nutrients to maintain their current state (maintenance) and to enable body growth (weight gain) or egg production. Birds need a steady supply of energy, protein, essential amino acids, essential fatty acids, minerals, vitamins and, most important, water. Poultry feeding represents the highest cost in producing poultry. Constitute about 60-75% of total cost from hatchlings till marketing. Thus, principle in producing is to build feeding in lowest prices to get lowest cost of feeding used to realize revenue in production process. Aim of nutrition is to provide poultry body with food used to get energy, build body tissues, and renew them preserve body cells and fluids in coordinated stillness. Carbohydrates represent basic source of energy in poultry feeding. Body uses aminic acids in feeding protein after digesting in building protein tissues. To release energy from food and build body proteins vitamins and minerals must exist (Myszograj, 2012). Table 14.1 provides a summary of recommended minimum levels of selected nutrients for meat chickens of different ages and for layers. To meet these specific needs, different classes of poultry have to be fed different types of diets. These recommendations should only be considered as guidelines and used as the basis for setting dietary nutrient concentrations in practical diets.

Table 14.1. Recommended minimum requirements of meat chickens and laying hens, as percentages or units per kilogram of diet (90 percent dry matter)

	Unit	MEAT CHICKENS			LAYING HENS
		0-3 weeks	3-6 weeks	6-8 weeks	
Nutrient					
Metabolizable energy	Kcal/kg	3,200	3,200	3,200	2,900
	MJ/kg	13.38	13.38	13.38	12.13
Crude protein	%	23	20	18	15
Amino acids					
Arginine	%	1.25	1.10	1.00	0.70
Glycine + Serine	%	1.25	1.14	0.97	-
Histidine	%	0.35	0.32	0.27	0.17
Isoleucine	%	0.80	0.73	0.62	0.65
Leucine	%	1.20	1.09	0.93	0.82
Lysine	%	1.10	1.00	0.85	0.69

	Unit	MEAT CHICKENS			LAYING HENS
		0-3 weeks	3-6 weeks	6-8 weeks	
Methionine	%	0.50	0.38	0.32	0.30
Methionine + Cysteine	%	0.90	0.72	0.60	0.58
Phenylalanine	%	0.72	0.65	0.56	0.47
Phenylalanine + Tyrosine	%	1.34	1.22	1.04	0.83
Thronine	%	0.80	0.74	0.68	0.47
Tryptophan	%	0.20	0.18	0.16	0.16
Valine	%	0.90	0.82	0.70	0.70
Fatty acid					
Linoleic acid	%	1.00	1.00	1.00	1.00
Major minerals					
Calcium	%	1.00	0.90	0.80	3.25
Chlorine	%	0.20	0.15	0.12	0.13

	Unit	MEAT CHICKENS			LAYING HENS
		0-3 weeks	**3-6 weeks**	**6-8 weeks**	
Non-phytate phosphorus	%	0.45	0.35	0.30	0.25
Potassium	%	0.30	0.30	0.30	0.15
Sodium	%	0.20	0.15	0.12	0.15
Trace minerals					
Copper	Mg	8	8	8	-
Iodine	Mg	0.35	0.35	0.35	0.04
Iron	Mg	80	80	80	45
Manganese	Mg	60	60	60	20
Selenium	Mg	0.15	0.15	0.15	0.06
Zinc	Mg	40	40	40	35

Source: National Research Council (1994)

Energy

Protein, fat, and simple carbs are all sources of energy for poultry. They can't digest and use several types of complex carbohydrates, such fiber, hence feed formulation should be done using an energy-based strategy. The traditional unit of measurement for the amount of energy present in feed ingredients and the needs of poultry is called "metabolizable energy" (ME). This accounts for the energy losses in the pee and faeces. When the food contains enough of the other necessary nutrients, birds eat solely to meet their energy needs. Therefore, a key factor affecting the amount of energy used by poultry is the diet's energy content. Varied kinds of chickens require varied quantities of energy for metabolic reasons, and a deficiency will influence productive performance. When the dietary energy level changes, the feed consumption will alter (Ravindran, 2013).

Protein and amino acids

For the synthesis of egg protein as well as for the maintenance and growth of muscles, dietary protein serves as a supply of amino acids. The 20 amino acids required for the synthesis of protein in eggs and muscles are all biologically required. Ten of them are categorized as essential dietary components because they are either completely absent or produced too slowly to satisfy metabolic needs. They must be included in the diet. Other amino acids can be used to synthesize the balance; these are referred to as dietary non-essential ingredients and are not need to be taken into account when formulating feed. However, from a physiological perspective, all 20 amino acids are necessary for the body to synthesize the various proteins. Lysine, methionine, threonine, tryptophan, isoleucine, leucine, histidine, valine, phenylalanine, and arginine are the necessary amino acids for poultry. Some people also believe that glycine is crucial for young birds. Because methionine and phenylalanine can be used to make cysteine and tyrosine, respectively, these amino acids are regarded as semi-essential. The three limiting amino acids in the majority of poultry diets are lysine, methionine, and threonine (Ravindran, 2013).

Fats and fatty acids

In order to reach the required nutritional energy concentration, poultry diets typically incorporate fats due to the higher energy density of fat compared to carbs and protein. The majority of realistic diets contain between 3 and 5 percent fat. Additional advantages of employing fats include greater palatability of diets and better dust management in chicken houses and feed mills. Although there is no established requirement for fats as a source of energy in poultry, linoleic acid has been shown to be necessary. The only necessary fatty acid that hens require is linoleic acid, and practical diet fed birds rarely show signs of insufficiency in this nutrient. Egg size is the primary effect of linoleic acid in laying birds (Ravindran, 2013).

Minerals

The creation of the skeletal system, general health, general metabolic activity, and preservation of the body's acid-base balance all depend on minerals. Along with sodium, potassium, chloride, sulphur, and magnesium, calcium and phosphorus are considered macro-minerals since they are the most prevalent mineral components in the body. Macro-minerals are substances that must be consumed in diets at amounts greater than 100 mg/kg. For the development and upkeep of the skeletal system as well as for the production of eggs with acceptable shell quality, calcium and phosphorus are essential (Ravindran, 2013).

Vitamins

Vitamins are divided into water-soluble (vitamins B complex and C) and fat-soluble (vitamins A, D, E, and K) groups. All vitamins, with the exception of vitamin C, must be consumed through food. Since it can be produced by birds, vitamin C is often not regarded as a dietary necessity. However, dietary vitamin C supplements may be helpful in challenging situations like heat stress. Compared to other nutrients, vitamins have more intricate metabolic functions. Vitamins are players or mediators in all of the body's metabolic pathways, not just simple body building components or energy sources (Ravindran, 2013).

Water

Animal productivity and a number of physiological processes depend on water (El Sabry *et al.,* 2023). The most crucial but frequently ignored component in poultry nutrition is water. Almost every physiological function of the bird is influenced by water. (1) The digestion of feed requires a steady stream of water. (2) Nutritional absorption. (3) The elimination of waste. (4) Controlling one's body temperature. About 80% of the body is made up of water. In contrast to other animals, chickens constantly eat and drink. Even a brief water shortage has an irreversible impact on their ability to produce and thrive. Therefore, water must always be accessible. The amount of feed consumed and the rate of growth are closely connected. It is challenging to pinpoint a bird's exact water needs because they depend on a number of variables, including the environment, the bird's age, and its physiological condition. In most cases, it is believed that water consumption will be twice as great as feed intake. Drinking water should be between 10 and 25 °C in temperature. Consumption will decline at temperatures over 30 °C.

Water quality is similarly crucial; poor water quality can result in low productivity and significant financial losses. Water is the perfect carrier for impurities like chemicals and minerals as well as the growth of dangerous bacteria. In dry and semi-arid areas with limited water supplies, water quality for poultry can be a significant problem. Particularly, the subsurface water in these regions sometimes contains a lot of salt. Birds can handle saline drinking water with less than 0.25 percent salt, however limiting water intake can result in sodium poisoning (Ravindran, 2013).

Natural feed additives to poultry feeding

Producers of poultry are looking for alternatives to antibiotics, have the potential effects to reduce the enteric pathogen bacteria and ability to enhance growth performance in birds and reduce contamination of poultry meat (Ocak *et al.,* 2008). Plant-based feed additives are often known as phytogenic or phytobiotic substances. Antibiotics could be replaced with herbs in poultry diet because of their antibacterial properties. A wide range of plants' bioactive components have antibacterial properties (Cross *et al.,* 2007). Windisch & Kroismayr (2006) outlined plant derived foods that poultry added to their diets to increase productivity. According to various researchers, adding medicinal and aromatic plants to broiler diets has been linked to gains in body weight, weight gain, feed conversion efficiency, and feed costs (Sabir *et al.,* 2023).

Herbs and substances of plant origin (garlic, oregano, thyme, anise, rosemary, and cinnamon) are defined as photobiotic or botanical natural feed additives. Numerous studies on such substances in poultry production have shown more beneficial effects such as antimicrobial, antiviral, antioxidant, and enhancing gut function (Mohamed and Hassan, 2023). Natural plants taken the interest are given to pollution-free, safe, and natural additives to feeding. Feedings in turn act like natural alternatives for antibiotics because they have good features, in toxic, chemical residues free, increase appetite, enzymes of digestive system produce antibiotics as well as antigerm, anti virus and antioxidants. Main effect of herbal additives comes from good effect on microbial environment of digestive system, to control potential causes of diseases. improvement of digestion in intestines to suck main nutrients allowing poultry to grow faster, lessen harmful microbes inside intestines, decrease intestines' diseases, to achieve most benefit of food for the bird. Using some plants like coriander and kurkomic helped to enhance microbial environment by decreasing harmful microbes and increase good ones (Fanatico, 2005). Azolla is a small-leaf floating fern. Is commonly found in stagnant or slow-moving water in ponds, lakes, marshes, swamps, and streams (Taghilou *et al.,* 2023). The aquatic and floating fern Azolla belongs to the Azollaceae family. It has a crude protein content of 25–35%, 10-15% minerals, and 7–10% amino acids, particularly lysine (El-Ghany, 2020). Due to its protein, crude fiber, and mineral content, Azolla can be used as a bio-fertilizer or as a feed supplement for aquatic and terrestrial animals. Azolla grows in natural water bodies to form a mat that can help reduce the evaporation of water from them, making water available year-round (Jayasundara, 2022). Azolla can increase growth performance in poultry by up to 5% when added to their diet (Shambhvi *et al.,* 2021).

According to some studies, potato peels may be used in small amounts in the diets of broiler chickens due to their favorable qualities that encourage their inclusion in the diets due to the significant nutrients they contain, as it contains energy represented by (2043 kcal/kg) and crude protein 10.5%. Contains a number of important amino acids, including lysine and methionine (Al
Ani, 2018).

Nontraditional Feedstuffs in Poultry Feed

Feed manufacturers have constantly looked for alternative, highly nutritious, and affordable feed components (Ghayas *et al.,* 2023). The term "nontraditional feedstuffs" refers to feed substances that haven't been used in chicken diets in a traditional or commercial way. Soybean meal and yellow maize have the ability to completely or largely replace the non-traditional feedstuffs in chicken meals. Soybean meal and yellow maize are common feedstuffs in chicken feeds due to their high nutritional levels. Furthermore, other animals place a significant demand on these two dietary elements. Currently, attempts are being conducted worldwide to replace soybean meal and yellow maize in monogastric animals like poultry with alternate sources of protein and energy (Alshelmani *et al.,* 2021)

It is common knowledge that some developing nations produce a significant amount of alternative feedstuffs, including wheat bran, rice bran, cotton seed meal, copra meal, and palm kernel cake, which are classified as agricultural waste byproducts. Many of these agricultural wastes by products, however, contain anti-nutritional elements including nonstarch polysaccharides (NSPs) such xylan and mannan. According to research, NSPs are the primary cause of the birds' small intestines becoming more viscous, which raises the moisture content of their excreta. Consequently, the health and productivity of the hens may be impacted. As a result, there are restrictions on using these agricultural waste byproducts in poultry feed (Alshelmani *et al.,* 2016).

Alternative feeds for yellow corn

In the diets of chickens, yellow corn serves as a major source of energy (Alshelmani *et al.,* 2016). Yellow maize can be replaced in the diet of chickens with a few non-traditional feed components. The availability of these nutrients and their composition are unknown because there aren't any research facilities in developing nations, which limits the utilization of these feeds (Alshelmani *et al.,* 2021).

Table 14.2. Alternative energy sources that can be used in place of yellow corn in chicken diets

Ingredient	Limitation
Sorghum	High level of tannins
Wheat bran	Low metabolizable energy and high fiber content
Distillers dried grains with solubles (DDGS)	Variability and availability of nutrients
Date wastes	Date pits have a high fiber content, little lysine, methionine, leucine or isoleucine
Millets	High fiber and tannins

Source: Alshemani et al. (2021)

Alternative feeds for soybean

Soybeans are frequently utilized as the primary source of protein in poultry diets (Leeson & Summers, 2005). Certain amounts of soybean meal in the diets of chickens can be replaced by several non-traditional feed components. There are some restrictions, though, like the existence of anti-nutritional substances that lower feed intake and growth performance (Alshelmani *et al.,* 2021).

Table 14.3. Other sources of protein that can be used in place of soybean meal in chicken diets

Ingredient	Limitation
Canola meal	Presence of glucosinolates, senapine, phytate, fibers, tannins and low metabolizable energy
Peanut (groundnut) meal	Trypsin inhibitors, potential aflatoxin contamination
Peas	Lack of sulfur containing amino acids and moderate energy levels
Lupins	High fiber, low metabolizable energy
Sesame meal	High levels of phytate
Blood meal	Palatability and low growth rate
Palm kernel meal	High fiber, course texture and high NSPs
Cottonseeds meal	High fiber, gossypol, dry and dusty nature, phytate, sterculic acid
Feather meal	Low in amino acids availability
Insects and worms	Microbial deterioration and lipid oxidation during storage
Earthworms	High fat (PUFA) and lipid oxidation during storage
Algae	High fat (PUFA) and lipid oxidation during storage
Azolla	High fiber content
Single-cell protein	High fat (PUFA) and lipid oxidation during storage

Source: Alshemani et al. (2021)

CONCLUSION

In order to increase the economic return, it is important to improve the quality and lengthen the productive life of the chicken by using balanced feed rations and feed additives that promote the health and production of the poultry, particularly those that improve the environment and health of the alimentary canal. The usage of lower cost alternative feedstuffs in the chicken farming will encourage rural communities to evolve from traditional systems of raising chicken in the backyard to small-scale semi-commercial systems. This will in turn help improve their livelihood and increase food security for the nation because of their high nutritional value and affordable cost as a source of energy, protein, minerals and vitamins.

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Chapter 15

Strengthening the Roots of Tradition and Innovation: Borneo Fertilyst's Journey with Rural Communities in Tandek, Kota Marudu, Sabah

Siti Subailah binti Suod

ABSTRACT

In the heart of Tandek, Kota Marudu, Sabah, Borneo Fertilyst embarked on a journey with local farmers to preserve and uplift their traditional practices while introducing sustainable agricultural techniques. This collaboration with the rural community is rooted in respect for heritage, combined with a shared vision for a sustainable future. Together, we blend the wisdom of the past with organic innovations, transforming both the land and the lives of those who call Tandek home. This journey aligns with the United Nations Sustainable Development Goals, particularly SDG 2: Zero Hunger and SDG 4: Quality Education, nurturing a resilient community for generations to come.

LISTENING TO THE LAND AND ITS PEOPLE

When we first arrived in Tandek, we weren't there to tell anyone what to do. Instead, we listened. The villagers here have cultivated their land for generations, each plant and plot holding stories, practices, and values.

> *"We have always known that the soil is our lifeline,"* said one elderly farmer. *"But times change, and sometimes we need help to protect what we have."*

With this openness, Borneo Fertilyst began its journey, guided by the farmers' deep connection to the land and their desire for sustainable change. Our mission was not just to introduce organic techniques but to do so in a way that respects the knowledge and traditions already embedded in the community.

BUILDING ON TRADITIONAL WISDOM: NATURAL SOLUTIONS FROM THE LAND

Many of the farming practices here are naturally sustainable, passed down from parent to child. Families rely on crop rotation, and some have long used local plants for pest control. Together, we explored ways to expand these techniques. One of our first projects was learning to create fertilizer from local plants, such as moringa, which is rich in nitrogen and helps control pests. The community discovered that lemongrass could serve as a natural insect repellent, providing an eco-friendly solution right in their backyards.

This alignment with SDG 2, Target 2.4 for sustainable food production systems, didn't just mean teaching a new practice but enhancing existing ones. Through demonstrations and hands-on training, we showed how these organic alternatives could reduce dependency on chemical inputs, benefiting both the environment and their health. Slowly, what began as a small experiment grew into an entire community rethinking how to nurture their land.

CHALLENGES AND SMALL TRIUMPHS

Change isn't easy, especially when it requires unlearning practices that have been common for decades. In Tandek, chemical fertilizers and pesticides were once introduced as quick-fix solutions. Now, we were asking people to trust organic methods instead. It was no surprise when some villagers met these ideas with a mix of interest and scepticism.

"Chemical fertilizer is fast. Are you sure this will work?" a farmer asked during one of our workshops. His question was one we heard often, especially from farmers who had faced tough harvests and leaned on chemicals as a lifeline.

Rather than dismissing these concerns, we addressed them openly, running small experiments and sharing results. We saw breakthroughs in the community's mindset as farmers experienced firsthand the benefits of natural fertilizers. In a beautiful moment, one farmer said, *"I see now that this is better for my soil and my family."* Their acceptance marked a shift, showing how openness to change could lead to healthier practices and stronger connections to their land.

ECONOMIC EMPOWERMENT THROUGH CROP DIVERSIFICATION

In many rural communities, reliance on a single crop can be a risk. To counter this, we introduced the concept of crop diversity. Farmers began experimenting with coriander or *ketumbar jawa*, okra, and other cash crops that could be grown alongside staples like corn. This new diversity didn't just improve soil health but also provided additional income streams for families. A farmer who initially doubted the value of diversification shared, *"I didn't realize how much these crops could bring in. Now we have a little extra for things like my children's school needs."*

Income from these new crops allowed families to feel more secure, with something extra to rely on. This contribution to SDG 2, Target 2.1, which addresses food security and nutrition, became not just about reducing hunger but ensuring that families could reinvest in their future. A more diverse harvest became a source of hope and pride, showing how small changes could ripple through their lives.

INSPIRING THE NEXT GENERATION: THE KEBUN MINI KIDS PROGRAM

The desire to pass on these practices led us to launch the Kebun Mini Kids Program in June 2024. With children as young as six joining, this program wasn't just about teaching them how to plant or compost; it was about connecting them to the values of sustainable farming and honoring their heritage. They learned how to identify plants, prepare soil, and work with nature rather than against it.

"I planted this!" a young girl exclaimed, holding up a small sprout with a grin. For many of these children, growing a plant from seed to sprout was their first tangible connection to farming. These small moments laid the groundwork for a new generation to carry on their community's values and commitment to sustainability, fulfilling SDG 4, Target 4.7, which aims to ensure that all learners acquire the knowledge and skills needed for sustainable development.

Parents, too, began to see the value of this program. A mother shared, "My son now knows more about our land than I did at his age. This program is giving our children something we never had." The Kebun Mini Kids Program became more than just a learning opportunity; it became a point of pride, a way for the community to envision a sustainable future in the hands of their children.

DOCUMENTING AND PRESERVING TRADITIONAL KNOWLEDGE

As our work progressed, we realized that much of the community's wisdom was undocumented. We began collaborating with elders to create a record of traditional farming practices. These included methods for pest control, seasonal planting patterns, and ways to keep the soil fertile. Each story, each practice shared became part of a growing collection to be preserved for future generations.

This process created a legacy that goes beyond any single season or harvest. For the people of Tandek, it represented a way to keep their heritage alive, ensuring that the knowledge passed down through generations will continue to guide future farmers. It was also a powerful step toward SDG 4, Target 4.7, which promotes global citizenship education and the integration of cultural knowledge.

A SUSTAINABLE FUTURE ROOTED IN TRADITION

Looking back, the partnership between Borneo Fertilyst and Tandek's rural community reflects a journey that transcends mere agriculture. It's a story of resilience, a willingness to learn, and the courage to try something new while honoring the past. By blending tradition with innovation, Tandek's farmers are not only building a sustainable agricultural model but also strengthening their social and economic well-being.

Today, the fields of Tandek are more than just land—they are living, thriving reflections of a community's resilience. The partnership has transformed not only how they farm but how they see their future. As one farmer put it, "We are not just growing crops; we are growing a future."

This journey is part of a broader global mission, addressing both SDG 2: Zero Hunger and SDG4: Quality Education. It shows that when we respect tradition and embrace sustainable innovation, we don't just change lives—we create a foundation for future generations to grow, thrive, and protect the world they inherit.

Chapter 16

Rumah Cendawan: Empowering Indigenous Community in Kg. Sg. Mok, Rompin through Sustainable Mushroom Farming

Khairul Rizal Kheli Kuzzaman

ABSTRACT

This paper highlights the Rumah Cendawan project in Kg. Sg. Mok, Rompin, Pahang, an initiative by Aspirasi Lestari supported by APPGM-SDG to empower the Orang Asli Jakun community through sustainable oyster mushroom farming. The project begins with a Free, Prior, and Informed Consent (FPIC) process to ensure community agreement and involvement before selecting oyster mushroom farming. It revitalises an abandoned teachers' quarters into a Community Learning Centre, addressing key challenges of economic marginalisation, underutilised infrastructure, and environmental degradation. By introducing mushroom cultivation, the project equips indigenous participants, especially women and single parents, with practical farming skills, production resources, and access to local markets. Implemented through phases of infrastructure rehabilitation, training, stakeholder engagement, market development, and monitoring, it fosters inclusive participation and long-term livelihood resilience. The project contributes to SDGs 1, 2, 8, 12, and 15 by promoting income generation, food security, and environmental sustainability. Looking forward, block production and agro-tourism integration are planned to scale Rumah Cendawan as a replicable model for sustainable rural development in Malaysia.

INTRODUCTION

The Orang Asli Jakun in Peninsular Malaysia, particularly those residing in Pahang, represent one of the most marginalised communities in the nation. Falling predominantly within the bottom 40% income bracket, they continue to face systemic challenges such as limited access to quality education, persistent discrimination, and exclusion from mainstream economic opportunities. This marginalisation contributes not only to economic struggles but also to the erosion of their cultural heritage and indigenous languages, leaving them increasingly vulnerable. Historically, the Jakun relied heavily on forest products to sustain their livelihoods. However, with the decline in the availability and economic viability of forest-based resources, these communities have experienced worsening financial insecurity. Today, most Jakun live in settled villages and practice traditional agriculture, but their marginalisation continues, and the opportunities for upward mobility remain scarce.

ABANDONED STRUCTURES

A further challenge within many Orang Asli villages is the existence of abandoned government-owned buildings, such as teachers' quarters, community halls, and offices. Due to poor maintenance and lack of adaptive use, these structures often fall into ruin. Over time, they become not only an eyesore but also a safety hazard, sometimes serving as habitats for dangerous wildlife. In Kg. Sg. Mok, Rompin, for example, the teachers' quarters had been abandoned for nearly 17 years, symbolising both lost resources and lost opportunities.

COLLECTIVE EFFORTS

Recognising this, Aspirasi Lestari, in partnership with the local community, applied for the right to repurpose the abandoned teachers' quarters into a Community Learning Centre. After years of negotiation, the approval was finally granted by the Pahang State

Education Department in 2024. The site was then cleaned and restored, marking the beginning of a new chapter. Subsequently, Aspirasi Lestari successfully pitched the idea to the All-Party Parliamentary Group Malaysia–Sustainable Development Goals (APPGM-SDG), which approved the proposal immediately. This provided the platform for the development of Rumah Cendawan — a project designed to transform abandoned infrastructure into productive spaces for sustainable mushroom farming, community learning, and livelihood empowerment.

WHY OYSTERS MUSHROOM?

Mushroom farming was chosen as the centerpiece of this initiative for two reasons.

Firstly, A decision matrix developed to evaluate and rank options, making complex decisions simpler—ideal for designing solutions for the Orang Asli community.

No.	Activities	Low Cost & Quick Turnover	High Cost & Normal Turnover	Human Wildlife Conflict	Depletion Natural Resources	Environment Threat
1	Livestock	✗	✓	✓	✗	✓
2	Aquaculture	✗	✓	✗	✗	✗
3	Cash- crops modern farming	✓	✗	✗	✗	✗
4	Mushroom farming	✓	✗	✗	✗	✗
5	Handycraft	✓	✗	✗	✓	✗

Secondly, mushroom farming offers a **three-in-one solution**: (1) repurposing abandoned buildings and giving them a new lease of life, (2) creating sustainable economic opportunities for indigenous communities, and (3) reducing the need for forest exploitation, thereby contributing to conservation efforts. Additionally, mushroom farming is relatively low-cost, requires limited land, and is well-suited to the humid tropical climate of Malaysia.

By connecting abandoned assets, indigenous empowerment, and environmental stewardship, Rumah Cendawan is an innovative model that bridges sustainability, repurposing abandoned structures, food security, and rural economic development.

OBJECTIVES OF THE PROJECT

The overarching goal of Rumah Cendawan is to empower indigenous communities by providing sustainable livelihood opportunities through mushroom farming thereby enhancing their economic resilience and food security.

Specific Objectives:

1) Provide Training
   Equip 10 indigenous participants with the skills and knowledge required for mushroom cultivation through comprehensive hands-on training.

2) Supply Resources
   Distribute essential farming materials, including mushroom blocks, infrastructure (growing houses), and access to water and electricity, to support the first production cycle.

3) Increase Income Generation
   Enable participants to earn sustainable income by connecting them with local markets such as groceries, restaurants, and weekend markets.

4) Promote Sustainable Farming
   Introduce environmentally friendly practices that align with traditional values, minimise ecological impact, and promote long-term stewardship of the environment.

5) Monitor Progress and Provide Support
   Continuously track participants' progress while providing technical assistance, troubleshooting support, and ongoing training to ensure farm productivity and long-term viability.

METHODOLOGY AND IMPLEMENTATION

The Rumah Cendawan project adopts a phased implementation strategy involving infrastructure preparation, capacity building, stakeholder engagement, and business development.

1) Phase 1: Infrastructure Development
   The Rumah Cendawan project begins with infrastructure development, focusing on site selection and evaluation to ensure optimal conditions such as temperature, humidity, ventilation, and environmental safety, followed by clearing and cleaning the abandoned teachers' quarters to prepare the site for mushroom farming.

2) Phase 2: Capacity Building
   In the capacity-building phase, participants are selected and undergo a two-day training session that includes theoretical lessons, practical demonstrations, and farm visits to equip them with mushroom farming skills, while mushroom blocks are purchased from local suppliers to initiate the first cultivation cycle.

3) Phase 3: Stakeholder Engagement
   Stakeholder engagement involves collaborating with JAKOA Putrajaya, Jabatan Pertanian Rompin and Pahang, BS Freshmart, AsyikFM from RTM and Forestry Pahang to secure necessary approvals, obtain technical guidance, and ensure compliance with regulations and marketing for the project's smooth implementation.

4) Phase 4: Market Development
   The market development phase includes Aspirasi Lestari overseeing daily operations and assisting with record-keeping, scouting potential buyers in Kuala Rompin and Kuantan (such as goreng pisang stalls, restaurants, fresh markets, and wholesalers), training participants in small business marketing and digital promotion using platforms like TikTok with influencer support, arranging periodic visits by mushroom experts to troubleshoot issues, and collecting data from participants, stakeholders, and government agencies for project evaluation.

5) Phase 5: Monitoring & Reporting
   The monitoring and reporting phase involve monthly meetings between Aspirasi Lestari and participants for Q&A and feedback, compilation of operational data and submission of reports to APPGM-SDG, maintenance of regular progress reports and yield records.

KEY STAKEHOLDERS

- JAKOA (Jabatan Kemajuan Orang Asli) – Community facilitation and approvals.
- Jabatan Pertanian Rompin & Jabatan Pertanian Pahang – Technical expertise and agronomist support.

- Forestry Pahang – Guidance on sustainable resource use.
- Local buyers (BS Freshmart, restaurants, hawkers) – Market access.
- TikTok influencers – Branding and digital marketing support

EXPECTED OUTCOMES AND IMPACT

Social Impact

The project empowers indigenous Jakun communities through skill development, while simultaneously revitalising abandoned government properties into productive community assets. By fostering collaborative farming practices, it strengthens social cohesion within the community and contributes to improved food security through the increased availability of nutritious mushrooms.

Economic Impact

The project generates new income streams for participants, reducing their reliance on unsustainable forest extraction, while also building local supply chains that connect producers with restaurants, markets, and wholesalers. In addition, it opens opportunities for value-added enterprises such as producing and marketing processed mushroom products, thereby diversifying the community’s economic base and strengthening financial resilience.

Environmental and ESG Impact

The project reduces deforestation by shifting dependence away from forest extraction toward sustainable mushroom farming, while simultaneously repurposing abandoned infrastructure to minimise land clearing. It further aligns with ESG principles by ensuring social inclusion, promoting environmental sustainability, and maintaining transparent reporting practices.

Contribution to UN SDGs

- SDG 1 (No Poverty): Providing sustainable livelihoods reduces poverty among Orang Asli communities.
- SDG 2 (Zero Hunger): Enhancing food security through local mushroom production.
- SDG 8 (Decent Work and Economic Growth): Promoting inclusive rural entrepreneurship.
- SDG 12 (Responsible Consumption and Production): Encouraging sustainable agricultural practices.
- SDG 15 (Life on Land): Supporting Forest conservation by reducing dependency on natural resources.

CHALLENGES AND MITIGATION STRATEGIES

Challenges

The project faces several challenges, including marketing risks due to limited access to larger markets and low brand visibility, financial risks as indigenous participants encounter barriers to credit and financial assistance linked to land rights and lack of collateral, environmental risks from possible contamination of mushroom blocks and climatic variability, as well as institutional risks arising from lengthy approval processes with government agencies.

Mitigation Strategies

The project's mitigation strategies include continuous marketing support from NGOs complemented by collaborations with social media influencers to boost visibility, coupled with strong advocacy for financial assistance through JAKOA and targeted grants to ease credit barriers. Training participants in farm hygiene and risk management strengthens resilience against environmental risks, while early and proactive engagement with government agencies helps streamline approval processes and reduce institutional delays. Together, these measures ensure that challenges are systematically addressed and that the project remains sustainable in the long term.

CONCLUSION AND WAY FORWARD

Rumah Cendawan represents a transformative model that reimagines abandoned infrastructure as centers of livelihood and community empowerment. By equipping the Orang Asli with skills, resources, and market connections, the project strengthens social resilience, enhances food security, and supports conservation efforts. Looking ahead, two key strategies are envisioned for scaling:

1) Block Production: Investing in mechanical block-making machines to enable the community to produce mushroom blocks at lower costs, ensuring greater self-sufficiency.
2) Agro-tourism Integration: Building on the eco-tourism framework established by Orang Asli communities in 2023, the Rumah Cendawan initiative introduces a strategic enhancement to village tourism by integrating sustainable mushroom farming. This innovative project adds significant value to the existing tourism ecosystem by offering an engaging agro-tourism experience that showcases local agricultural practices. Specifically designed to address the economic marginalization of single parents and mid-aged Orang Asli women, Rumah Cendawan provides a viable income-generating opportunity tailored to their unique circumstances. By leveraging flexible, community-based cultivation activities, the initiative enables these women to overcome barriers such as caregiving responsibilities and limited access to distant tourism sites. Through hands-on training in oyster mushroom production, marketing, and value-added product development, participants are empowered to contribute to household income while enhancing the appeal of

their villages as sustainable tourism destinations. This integration not only strengthens the local economy but also promotes inclusive, community-driven development within the broader eco-tourism landscape.

Chapter 17

Community Based Sustainable Farming Practices, Involvement and Impact on Indigenous Communities

Simon Anak Joseph

ABSTRACT

Communities play an important role in making decisions related to agricultural practices, protecting natural resources, and sharing local knowledge that can improve agricultural sustainability. Community based sustainable farming practices refer to an approach where local communities are actively involved in the development, implementation, and management of sustainable agricultural systems. This approach focuses on environmental, economic, and social sustainability taking into account the interests of communities that depend on natural resources for their survival. Furthermore, community based sustainable farming practices involve an approach where the local community, especially the Orang Asal community, plays an important role in the management, implementation, and sustainable care of the gardens. This practice not only prioritizes environmental sustainability but also focuses on the well-being and survival of the community. This paper highlights some farming practices, commonly applied in community-based sustainable farming.

INDIGENOUS COMMUNITY INVOLVEMENT

Use of Traditional Knowledge and Expertise

Indigenous people usually have a deep knowledge of the environment and natural resources, such as how to sustainably manage forests and crops. Their involvement in sustainable farming enriches modern practices with traditional knowledge, including how to manage the land without destroying the ecosystem.

The natives have deep knowledge of local ecosystems, medicinal plants, and natural farming techniques. This can be combined with modern farming practices to create a more resilient and environmentally friendly farming system.

Management of Land and Forest Resources

Indigenous peoples often have social structures that favor community cooperation. This makes them important in implementing sustainable agricultural practices that require joint management of natural resources.

Indigenous communities often play a role in making decisions about land and water resources. As well as practicing techniques such as rainwater catchment and efficient irrigation systems to ensure more sustainable water use and reduce waste. Their involvement can ensure that these resources are used wisely for the long term and not just for short term gains.

Indigenous communities are often involved in the protection of forests and watersheds. By practicing agroforestry and integrated natural resource management, they can protect the area from erosion, global warming, and loss of biodiversity.

Improving the Economy

Sustainable farming practices can increase the income of the *Orang Asal* community. When they are actively involved in the process from cultivation to marketing of agricultural products, they are more competitive in the market and can benefit from the produce of the earth more fairly and equally.

Training and Education
Engaging in sustainable practices requires new skills and knowledge. Therefore, training on modern, organic farming techniques, the use of natural fertilizers, as well as water and soil conservation methods is provided to the Indigenous community. This also opens up opportunities for young people to continue contributing to the survival of their communities in the future.

Through training and education, indigenous people can expand their skills in sustainable farming. With this, they can improve agricultural yields without damaging the land and natural resources.

Agroecology
Integrating various types of crops and livestock to create a more balanced and productive agricultural ecosystem, while reducing dependence on harmful chemicals.

Organic Farming
Using compost, green manure, and biological pest management without the use of synthetic chemicals, which helps maintain soil fertility and biodiversity.

Appropriate Tree Planting (Agroforestry)
Utilizing a combination of agricultural crops and trees to improve soil productivity, reduce erosion, and store carbon to address climate change.

Social Entrepreneurship and Involvement in Sustainable Product Markets:
Focusing on community economic development, through enterprises based on sustainable agricultural products, such as organic products, local products, or ecotourism related to agriculture.

This approach not only improves the well-being of the community but also helps preserve the environment better for future generations. Agricultural products produced by indigenous people through sustainable practices have the potential to be exported or sold in premium markets such as organic products or ecotourism, at the same time this can improve the economy of their communities.

Overall, the involvement of indigenous peoples in sustainable farming not only benefits the environment, but also contributes to their economic, social, and cultural empowerment.

IMPACT ON INDIGENOUS COMMUNITIES

The involvement of indigenous peoples in sustainable farming practices has a significant impact on the environmental, economic, and social sustainability of their communities. Indigenous people often have a deep connection with the environment and traditional knowledge that can enrich sustainable farming practices. Here are some forms of involvement and their impact on the indigenous community:

Economic Empowerment and Quality of Life Improvement

Sustainable farming practices can provide additional income to indigenous people, especially through local entrepreneurship such as the production of organic products or handicrafts produced from sustainable forest resources.

By engaging in sustainable practices, indigenous communities can access new technologies that are more environmentally friendly, increase crop yields and overall well-being, such as better water management and more resilient agricultural products.

Involvement in sustainable farming can improve the quality of life of the community by providing healthier food, improving the environment, and increasing family income.

Preserving Cultural Identity and Traditional Knowledge
Involvement in sustainable farming encourages the appreciation and preservation of traditional knowledge passed down through generations. This will undoubtedly help preserve the identity and cultural heritage of the original people.

Sustainable farming practices provide space for Indigenous communities to continue their traditional way of life closer to nature, while preserving their customs and cultural values. This is important to maintain their identity in the midst of the current of modern development so as not to be swallowed up by time.

Environmental Sustainability and Natural Resource Survival
Indigenous people often depend on the land and natural resources for survival. Sustainable farming practices help ensure that these resources can be used sustainably without the risk of long-term depletion or damage.

With more sustainable resource management, plantation areas can be maintained without affecting the natural habitat, flora, and fauna. This practice can also reduce deforestation and pollution; this is very important for the Aboriginal community since the Aboriginal community is very dependent on natural resources in their daily lives.

Land Conflict Reduction
Community involvement in sustainable farming can help reduce conflicts related to land ownership. When communities are given the

right and responsibility to manage their own land, they tend to defend their land ownership from encroachment by outsiders.

Adaptation to Climate Change

Through sustainable farming, indigenous communities can reduce the effects of climate change, such as floods and droughts. This is important for their survival which is highly dependent on the stability of the local ecosystem.

CONCLUSION

Overall, community-based sustainable farming has the potential to have a positive impact on the *Orang Asal* community, whether in economic, social, cultural or environmental aspects.

Part VI:
Innovations in Farming Techniques and Technologies

Chapter 18

Automated Nutrient Dosing System in Precision Hydroponics: Advancing Sustainable Agriculture Through Automation and Internet of Things

Azmi Aminordin, Hamdan Sulaiman, Ismail Rakibe, Fairuz Khalid, Muhammad Aliuddin Bakar, Syahrizan Syahlan & Anwar Farhan Zolkeplay

ABSTRACT

Hydroponics is a soilless cultivation technique where crops receive nutrients from irrigation water rather than regular soil cultivation. Continuous monitoring and periodic control of the Potential of Hydrogen (pH) level and Electrical Conductivity (EC) are required to ensure these variables stay within the control threshold. This study investigates the impact of two nutrient dosing methods, 1) manual dosing and 2) an automated hydroponic nutrient dosing system, on the growth performance of Bok Choy (Brassica rapa subsp. chinensis) over a 20-day period. The experiment was designed to maintain a constant electrical conductivity (EC) level of 2.0 mS/cm and a pH level of 6.2, with manual dosing conducted twice daily at 7:30 am and 6:30 pm, while the automated system continuously monitored and adjusted nutrient levels in real-time. The automated dosing system integrates Internet of Things (IoT) technology for remote monitoring and controlling capability to achieve optimum nutrient management for Nutrient Film Technique (NFT) hydroponics. The system is based on an ESP32 microcontroller with WiFi that will communicate with the Blynk IoT platform. Key plant phenotypic traits, including fresh weight, plant height, canopy size, and root length, were measured as responses to the two dosing methods. The results showed that plants grown with the automated system exhibited significantly superior

growth across all measured parameters. Fresh weight increased by 36.56%, height by 31.97%, canopy size by 22.19%, and root length by 19.64% compared to manually dosed plants. Statistical analysis confirmed that these differences were significant ($p < 0.05$). These findings highlight the potential of automated nutrient dosing systems to enhance plant growth by providing more consistent and optimal nutrient delivery, contributing to improved resource efficiency and crop productivity. This research aligns with several Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), SDG 8 (Decent Work and Economic Growth), and SDG 12 (Responsible Consumption and Production), by promoting sustainable agricultural practices through automation. This study demonstrates the possible role of automated hydroponic methods in improving sustainable agriculture practices as a promising solution for an efficient, high-yield production system and a means to enhance the global sustainability framework.

INTRODUCTION

Hydroponics is an innovative agricultural technique that has revolutionized the way we grow plants. In recent years, hydroponics has gained considerable traction in both commercial and domestic settings. It is now widely used to cultivate a diverse range of crops, including leafy greens, herbs, fruits, and even some root vegetables. This soilless cultivation method involves growing plants in nutrient-rich water solutions, optimizing resource use and maximizing yields. The term "hydroponics" originates from the Greek words "hydro" (water) and "ponos" (labor), aptly describing the water-based nature of this cultivation approach[1]. At its core, hydroponics is a method that eliminates the need for soil by directly delivering nutrients to plant roots through water-based solutions. This approach offers precise control over plant nutrition, allowing growers to tailor nutrient mixes

[1] R. de Sousa, L. Bragança, M. V. da Silva, and R. S. Oliveira (2024).

to specific crop requirements. Hydroponic systems typically use inert growing media such as peat moss, charcoal, gravel, rock wool, perlite, coco peat, or coconut coir to support plant roots[2]. The advantages of hydroponics over traditional soil-based agriculture are numerous and significant. Hydroponic systems can use up to 90% less water than conventional farming methods, making them highly water efficient[3]. They also allow for greater crop density and vertical farming techniques, optimizing space utilization and increasing yields per unit area. Furthermore, the controlled environment of hydroponic systems enables year-round crop production, regardless of external weather conditions or seasonal limitations. Thus, it increases yields and more efficient use of resources, contributing to more sustainable food production methods[4].

The integration of advanced technologies in hydroponic systems has revolutionized modern agriculture, offering unprecedented precision and efficiency in plant cultivation[5]. Smart hydroponics, characterized by the incorporation of Internet of Things (IoT) devices, sensors, and automation, has emerged as a groundbreaking approach to sustainable farming[6]. This technological synergy enables meticulous monitoring and control of crucial environmental parameters, including potential of hydrogen (pH) levels, electrical conductivity (EC), and water levels, thereby optimizing plant growth and resource utilization[7]. The implementation of IoT in hydroponic systems facilitates real-time data collection and analysis, allowing for swift adjustments to maintain optimal growing conditions. Microcontrollers, such as Arduino, ESP32 and Raspberry Pi, play a

[2] Ibid; M. Rakshitha, Roopa, H. L. Shwetha, and R. Tejashwini (2018).
[3] G. Kaur, P. Upadhyaya, and P. Chawla (2023).
[4] G. Rajaseger (2023); A. M. S. Ardina *et al* (2022).
[5] P. Juneja, P. Yadav, M. Dhingra, and V. Bhagauli (n.d.).
[6] S. Arya, S. Tripathi, A. Srivastava, S. Aggarwal, N. Soni, and S. A. Ansar (2023).
[7] N. Shruthi, K. N. Lavanya, M. Pooja, V. Prerana, and N. A. Rachana (2023); L. Rusdiyana, Suhariyanto, B. Sampurno, and T. A. Pratama (2024).

pivotal role in this process by interfacing with various sensors and actuators to regulate the hydroponic environment[8]. This level of automation not only enhances productivity but also significantly reduces the need for manual intervention, making hydroponics more accessible to a broader range of practitioners[9].

The alignment of precision hydroponics with the United Nations Sustainable Development Goals (SDGs) represents a significant intersection of agricultural innovation and global sustainability objectives. This advanced cultivation method demonstrates relevance to SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), SDG 8 (Decent Work and Economic Growth), and SDG 12 (Responsible Consumption and Production). Precision hydroponics contributes to food security (SDG 2) by enabling year-round crop production, increasing yields, and enhancing nutritional quality, thereby addressing hunger and malnutrition challenges[10]. Furthermore, the integration of smart technologies in hydroponics creates new employment opportunities and fosters economic growth (SDG 8) through the development of high-tech agricultural sectors[11]. The water-efficient nature of hydroponic systems aligns with SDG 6, as it significantly reduces water consumption compared to traditional agriculture, promoting sustainable water management[12]. Precision hydroponics also supports SDG 12 by optimizing resource use, minimizing waste, and reducing reliance on chemical inputs, thus promoting responsible production patterns[13]. The potential of hydroponics to produce high-quality crops in urban environments and areas with limited arable land further underscores its contribution to

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[8] A. Kumar and P. Savaridassan (2023).
[9] A. Promwee, S. Nijibulat, and H. H. Nguyen (2024).
[10] S. Indurthi, I. Sarma, and D. V. Vinod (2024).
[11] Ibid.
[12] M. Farooq (2023).
[13] Ibid.

sustainable food systems[14]. As global food demand increases and environmental pressures intensify, the alignment of precision hydroponics with these SDGs positions it as a crucial component in the pursuit of sustainable agricultural practices and global food security [15].

The study aims to compare the growth performance of plants cultivated hydroponically using manual dosing versus the newly developed automated dosing system. This significance of the study lies in its potential to revolutionize modern agriculture through the development of smart nutrient dosing systems for precision hydroponics. By integrating IoT technology, the research aims to enhance agricultural efficiency, reduce environmental impact, and improve crop yields. The automated nutrient dosing system represents a significant step towards sustainable agriculture, addressing key challenges in resource management and food production. This innovative approach aligns with global sustainability goals, particularly in enhancing food security and promoting responsible consumption. Furthermore, the comparative analysis between manual and automated dosing methods provides valuable insights into the tangible benefits of smart agricultural technologies. Ultimately, this research contributes to the broader field of precision agriculture, paving the way for more sustainable and efficient food production systems in an era of increasing environmental pressures and growing global food demand.

LITERATURE REVIEW

Automated Nutrient Dosing System

An automated hydroponic dosing system represents a significant advancement in sustainable agriculture, leveraging the power of

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[14] S. Jain *et al* (2023).
[15] G. Rajaseger (2023); M. Farooq (2023); E. K. Donner, A. Meißner, and S. Bort (2024).

technology to optimize plant growth without the use of soil. This system integrates IoT technology and various sensors to precisely control the nutrient levels in hydroponic solutions, ensuring that plants receive the exact nutrients they need for optimal growth. The primary components of such systems typically include microcontrollers like NodeMCU, which interface with sensors such as TDS meters for nutrient concentration and ultrasonic sensors for water level monitoring[16].

Dosing Parameter

In hydroponics, the pH is a critical parameter that must be carefully controlled to ensure optimal plant growth. The pH level affects the solubility and availability of essential nutrients within the nutrient solution. Maintaining the pH within an optimal range, typically between 5.5 and 6.5, is crucial for preventing nutrient lockout and ensuring efficient nutrient uptake by plants[17]. Fluctuations in pH can occur due to unbalanced ion absorption by plants, making regular monitoring and adjustment necessary. Automated systems, often utilizing Arduino or similar microcontrollers, have been developed to continuously monitor and adjust pH levels. These systems employ sensors to detect pH variations and actuators to add pH adjusters, ensuring precise control over the nutrient solution[18]. Other than that, the EC is a crucial parameter in hydroponic nutrient solutions, as it provides an indication of the total ion concentration, which is essential for maintaining optimal nutrient levels for plant growth. High EC levels can hinder nutrient absorption by increasing the osmotic pressure of the nutrient solution, potentially leading to nutrient stress and reduced plant growth. Conversely, very low EC levels can result in

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[16] E. K. Donner, A. Meißner, and S. Bort (2024); A. Z. Purwalaksana, T. E. Gurning, E. Silaen, P. Tobing, A. O. Silalahi, and F. Simatupang (2022); U. Arora, S. Shetty, R. Shah, and D. K. Sinha (2021)

[17] G. Kudirka, A. Virs ile , R. Sutuliene , K. Lauz ike , and G. Samuoliene (2023).

[18] G. J. Prasunambika, N. Angadala, P. G. Alajangi, and S. Reddy Vanga (2023).

nutritional deficiencies, affecting plant health and yield[19]. Managing EC involves regular monitoring and adjustments to ensure it remains within an optimal range specific to the crops being grown. For instance, studies have shown that medium EC levels (such as EC = 1.8 mS/cm to 2.4 mS/cm) are ideal for certain plants like pakchoi, promoting better growth and quality[20].

The integration of IoT and smart technologies enhances hydroponic systems by providing real-time data and remote monitoring capabilities. This allows for quick adjustments, reducing the need for manual intervention and improving efficiency and precision. By maintaining stable pH and EC levels, these automated systems play a crucial role in promoting healthier plants and achieving higher yields, ultimately contributing to more successful hydroponic cultivation. In hydroponic systems, temperature variations can lead to misinterpretations of nutrient solution parameters, potentially compromising plant health and growth[21]. To address this issue, advanced sensor systems incorporate temperature compensation factors, ensuring more reliable and consistent measurements of pH and EC across varying temperature conditions. The integration of temperature sensors alongside pH and EC probes allows for real-time adjustments, enhancing the overall accuracy of nutrient solution monitoring in hydroponics. Table 1 shows the recent developments of automated hydroponics nutrient dosing system.

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[19] A. P. M. do Carmo *et al.* (2024).
[20] X. Ding *et al.* (2018).
[21] A. E. Pakzad and A. A. Pakzad (2018).

Table 18.1 Inclusion of dosing parameters across various research.

References	Years	Main author	Dosing parameter		
			pH	EC	Temp
[24]	2020	Saaid	✓		
[25]	2020	Lenni	✓	✓	✓
[26]	2020	Yue		✓	✓
[27]	2021	M Shetty	✓	✓	
[28]	2021	Fitria	✓	✓	
[29]	2021	Hartanto		✓	✓
[30]	2021	Wibisono	✓		
[31]	2021	Pelayo Lind	✓		
[5]	2022	Ardina	✓		✓
[32]	2022	Yaqin	✓		
[33]	2022	Agrawal	✓		✓
[34]	2022	Safira	✓		✓
[35]	2022	Mendon	✓	✓	✓
[3]	2023	Kaur	✓		
[36]	2023	Susanti	✓		
[37]	2023	Nandhini	✓	✓	
[38]	2023	Sharmila	✓	✓	
[39]	2023	Vineeth	✓		✓

Dosing Framework

The conventional feedback loop is a widely used framework in hydroponic nutrient dosing systems, offering a reliable method for maintaining optimal nutrient concentrations in the solution. This approach involves continuously monitoring key parameters such as EC and pH levels in the nutrient solution, with sensors regularly measuring these values in the nutrient reservoir. When these parameters deviate from the desired range, the system automatically adjusts the nutrient dosage to bring them back to optimal levels, often through automated processes that introduce pH-up or pH down solutions or dilute the solution with water[22]. The conventional feedback loop provides precise control over nutrient concentrations,

[22] T. Sangeetha and E. Periyathambi (2024).

ensuring that plants receive the exact amount of nutrients they need for optimal growth and development[23].

One of the primary advantages of this framework is its ability to make real-time adjustments to nutrient levels based on the current conditions in the hydroponic solution, which helps maintain a stable growing environment crucial for plant health and productivity[24]. By dosing nutrients based on actual plant needs and solution conditions, the conventional feedback loop can significantly reduce waste and improve resource efficiency, which is particularly important in urban hydroponic systems where space and resources may be limited. The feedback loop allows for a high degree of automation in nutrient management, reducing the need for constant manual intervention, which not only saves time and labor but also minimizes the risk of human error in nutrient dosing. Furthermore, this framework can be easily adapted to different crop types and growth stages, as it responds to the changing nutrient requirements of plants throughout their lifecycle, making it suitable for a wide range of hydroponic applications, from small-scale urban gardens to large commercial operations[25].

METHODOLOGY

Development Of Nutrient Dosing System

The development of the hydroponic nutrient dosing system is an advanced setup integrating various electronic components to automate the nutrient management process as depicted in Figure 18.1. At the core of the system is an ESP32 microcontroller, which serves as the central processing unit, coordinating data collection and control operations. The system includes an EC sensor and a pH

[23] T. I. Ahn *et al.* (2021).
[24] T. Sangeetha and E. Periyathambi (2024).
[25] E. Fathidarehnijeh, M. Nadeem, M. Cheema, R. Thomas, M. Krishnapillai, and L. Galagedara (2024).

sensor, both connected through an analog isolator module and an ADS1115 analog-to-digital converter, ensuring accurate readings of the nutrient solution's properties. A temperature sensor is also included to monitor environmental conditions, providing additional data for optimizing plant growth.

The ESP32 processes the sensor data and triggers a 5V 4-channel relay module, which controls peristaltic pumps responsible for dosing pH-up, pH-down solutions, and nutrient solutions labelled EC A and EC B. These pumps adjust the nutrient concentrations and pH levels in real-time, maintaining optimal conditions for plant health. Power is supplied by a 12V 5A power supply, with an LM2596 module regulating voltage to the required levels for different components. This automated system minimizes manual intervention while ensuring precise nutrient delivery, enhancing resource efficiency and crop productivity in hydroponic setups.

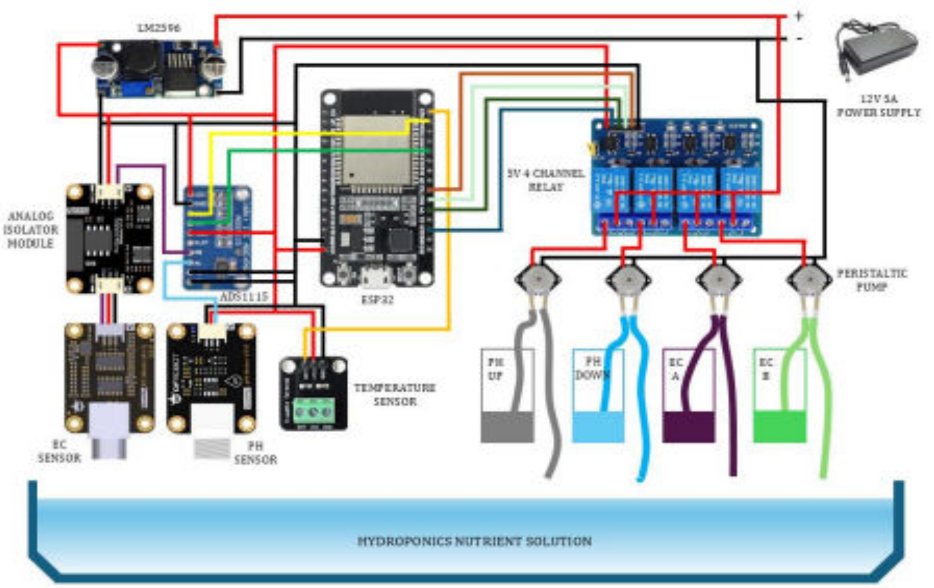

Figure 18.1. Wiring and connections of automated hydroponics nutrient solution

Experimental Setup

The experimental setup involves comparing two nutrient dosing methods for growing Bok Choy (Brassica rapa subsp. chinensis) over a 20-day period. The first method employs manual dosing, where nutrients are regulated manually at 7:30 am and 6:30 pm daily. The second method utilizes an automated hydroponics nutrient dosing system, as depicted in the provided schematic. The system maintains EC at 2.0 mS/cm and pH at 6.2, using potassium hydroxide for pH increase and phosphoric acid for pH decrease. The EC is adjusted using two solutions, EC A and EC B. The experiment measures several plant traits responses, including fresh weight, plant height, canopy size, and root length. These parameters provide insights into the efficacy of each dosing method in promoting optimal growth conditions for Bok Choy under controlled hydroponic conditions. This setup allows for a comprehensive evaluation of manual versus automated nutrient management in hydroponic systems.

RESULTS AND DISCUSSION

Plant Traits PERFORMANCE

The experimental results, as depicted in Table 2, show significant differences in the growth of Bok Choy plants using manual versus automated hydroponic nutrient dosing systems. These plants have fresh weights of 124 g, 130 g, and 118 g, respectively, with heights of 17.4 cm, 17.7 cm, and 16.8 cm. Their canopy sizes measure 21.5 cm, 22.3 cm, and 21.1 cm, and root lengths are recorded at 11.9 cm, 12.4 cm, and 12.8 cm. These plants exhibit superior growth metrics, with fresh weights of 175 g, 168 g, and 165 g. Their heights are notably greater at 24.1 cm, 22.1 cm, and 22.4 cm. Canopy sizes for these samples are larger as well, measuring 27.1 cm, 26.3 cm, and 25.9 cm. Root lengths are also enhanced in the automated system, recorded at 14.4 cm, 14.9 cm, and 15.1 cm. These figures clearly demonstrate that the automated nutrient dosing system provides more consistent and optimal conditions for plant growth compared to manual dosing methods, resulting in improved plant phenotypic traits across all measured parameters.

Table 18.2. Plant traits grown hydroponically under different dosing method

Method	Plant sample	Fresh weight (g)	Height (cm)	Canopy (cm)	Root (cm)
Manual	A	124	17.4	21.5	11.9
	B	130	17.7	22.3	12.4
	C	118	16.8	21.1	12.8
Automated	D	175	24.1	27.1	14.4
	E	168	22.1	26.3	14.9
	F	165	22.4	25.9	15.1

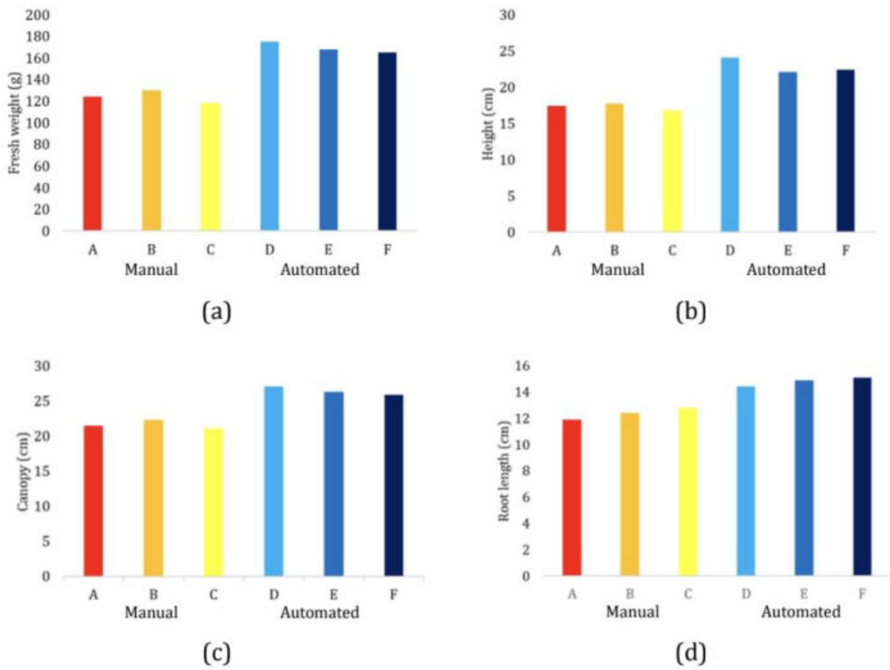

Figure 18.2. Comparison of plant traits between manual and automated hydroponic nutrient dosing methods (a) Fresh weight (b) Height (c) Canopy and (d) Root length

STATISTICAL ANALYSIS

The parameters analyzed include fresh weight, plant height, canopy size, and root length. Descriptive statistics, including means, were calculated for each parameter. Additionally, independent sample t-tests were performed to assess whether the differences between the two groups were statistically significant as shown in Table 18.3.

Table 18.3. Comparison of plant traits' mean and significance

Plant traits	Mean Manual	Automated	Increment (%)	Significance P-value
Fresh weight (g)	124.00	169.33	36.56	0.01
Height (cm)	17.33	22.87	31.97	0.01
Canopy (cm)	21.63	26.43	22.19	0.01
Root length (cm)	12.37	14.80	19.64	0.02

The average fresh weight of plants grown using the automated system was 169.33 g, significantly higher than the 124.00 g observed in the manual dosing group, representing an increase of 36.56%. The t-test for fresh weight yielded a p-value of 0.01, indicating that the difference is statistically significant at the 95% confidence level. For plant height, the automated system resulted in an average height of 22.87 cm, compared to 17.33 cm for manually dosed plants, showing an increase of 31.97%. The t-test for height also produced a p-value of 0.01, confirming a significant difference between the two methods. In terms of canopy size, the automated system produced plants with an average canopy size of 26.43 cm, while the manual system resulted in an average of 21.63 cm, reflecting an increase of 22.19%. The t-test for canopy size showed a p-value of 0.01, further supporting the statistical significance of this difference. Lastly, root length was also greater in plants grown with automated dosing, averaging 14.80 cm, compared to 12.37 cm for manually dosed plants, representing an increase of 19.64%. The t-test for root length yielded a p-value of 0.02, indicating statistical significance.

In summary, all measured plant traits (fresh weight, height, canopy size, and root length) showed statistically significant improvements under the automated hydroponic nutrient dosing system compared to manual dosing. These results demonstrate that automation provides more consistent and optimal nutrient management, leading to enhanced plant growth and development. These findings are visually supported by Figure 18.3, where plants grown with automated nutrient dosing (D, E, F) clearly exhibit larger sizes and more robust root systems compared to those grown with manual dosing (A, B, C).

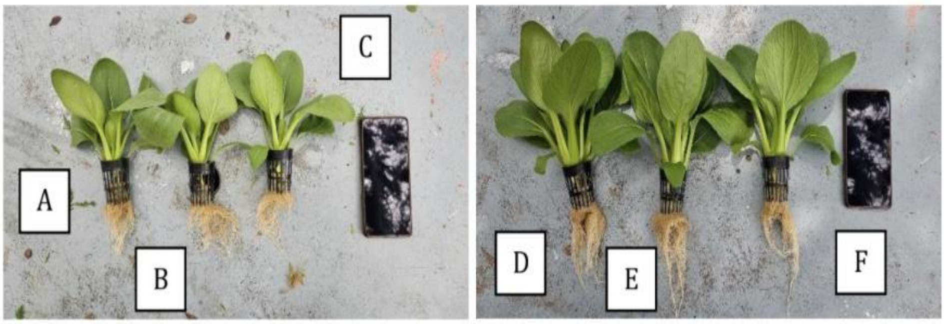

Figure 18.3. Comparison of plants grown hydroponically between manual and automated dosing operation

CONCLUSION

The results of this study demonstrate the significant advantages of using an automated hydroponic nutrient dosing system over manual dosing for the cultivation of Bok Choy (Brassica rapa subsp. chinensis). Across all measured plant phenotypic traits—fresh weight, height, canopy size, and root length—plants grown with the automated system exhibited superior growth compared to those grown with manual dosing. Specifically, fresh weight increased by 36.56%, plant height by 31.97%, canopy size by 22.19%, and root length by 19.64% under automated nutrient management. These findings highlight the potential of automation in hydroponic systems to optimize plant growth by providing more consistent and precise control over critical factors such as pH and electrical conductivity (EC). The improved resource efficiency and reduction in manual labor also align with several Sustainable Development Goals, particularly SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), SDG 8 (Decent Work and Economic Growth), and SDG 12 (Responsible Consumption and Production). By enhancing crop yields while minimizing resource waste, the automated nutrient dosing system offers a promising solution for sustainable agriculture, contributing to global food security and environmental sustainability. This study underscores the importance of integrating advanced technologies into agricultural practices to meet the increasing global demand for food while promoting responsible resource management. The application of such systems is not only beneficial for large-scale commercial operations but also holds potential for urban farming and small-scale growers, further contributing to sustainable food production systems worldwide.

ACKNOWLEDGEMENT

This research was supported by the All-Party Parliamentary Group Malaysia.

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Chapter 19

Aquaponik Harmoni Alam dalam Satu Sistem

Kogilavani Supermaniam

ABSTRAK

Pengalaman dalam projek komuniti telah mendedahkan potensi sistem akuaponik—gabungan akuakultur (ternakan ikan) dan hidroponik (pertanian tanpa tanah)—sebagai penyelesaian pertanian yang inovatif dan lestari. Sistem ini menggunakan air kaya nutrien daripada kolam tilapia untuk menyuburkan pelbagai sayuran seperti sawi, kangkung, dan herba, yang seterusnya membersihkan air untuk ikan, mewujudkan ekosistem yang saling berkait. Projek ini, yang dimulakan dengan sokongan pakar dan Alora Aquaponik Solution, melibatkan pembinaan pelbagai sistem (Vertical, NFT, Ebb and Flow) dan melibatkan komuniti melalui latihan komprehensif. Walaupun menghadapi cabaran seperti penyakit, sistem ini menunjukkan keberhasilan dengan mengurangkan penggunaan air hingga 90% dan mengelakkan baja kimia. Kejayaan projek ini bukan sahaja menjana pendapatan tambahan dan menyediakan makanan segar yang sihat, tetapi juga secara langsung menyumbang kepada Matlamat Pembangunan Lestari (SDGs), khususnya SDG 2 (Sifar Kelaparan), SDG 6 (Air Bersih dan Sanitasi), dan SDG 12 (Pengeluaran dan Penggunaan Bertanggungjawab). Pengalaman ini mengesahkan akuaponik sebagai cara hidup lestari yang harmoni dengan alam sekitar, memberi inspirasi kepada komuniti lain untuk mengamalkan pertanian berkelanjutan.

Di sebuah taman yang dikelilingi rumah-rumah berbatu, saya menyaksikan satu fenomena yang menarik perhatian saya – sistem aquaponik. Di tengah-tengah impian saya, terbayang sebuah projek aquaponik yang inovatif, di mana kolam ikan bersih berisi tilapia berenang dengan riang, sementera tanaman sayuran hijau subur tumbuh. Saya membayangkan suasana yang harmoni, di mana air kaya nutrien mengalir dari kolam ikan ke akar tanaman, menciptakan ekosistem yang saling berkait. Saya terlibat dalam sebuah projek komuniti yang bertujuan untuk memperkenalkan dan mempromosikan sistem ini, yang bukan sahaja berpotensi untuk meningkatkan hasil pertanian tetapi juga menyokong kelestarian alam sekitar. Melalui pengalaman ini, saya dapat memahami bagaimana aquaponik dapat menyumbang kepada matlamat Pembangunan Lestari (SDGs).

Aquaponik adalah gabungan antara akuakultur (ternakan ikan) dan hidroponik (pertanian tanpa tanah). Dalam sistem ini, air yang kaya dengan nutrien daripada kolam ikan digunakan untuk menyuburkan tanaman, sementara tanaman pula membantu menapis dan membersihkan air untuk ikan. Saya mula memahami bahawa sistem ini bukan sahaja efisien, tetapi juga mampu menghasilkan makanan dalam persekitaran yang berkelanjutan.

Ketika kami memulakan projek ini, kami mengumpulkan penduduk sekitar untuk sesi penerangan mengenai aquaponik. Banyak yang teruja, tetapi ada juga yang skeptikal / ragu ragu. Mereka bimbang tentang keberkesanan dan kelangsungan sistem ini. Namun, kami bertekad untuk menunjukkan bagaimana aquaponik boleh menjadi penyelesaian kepada isu isu pertanian tradisional seperti penggunaan air yang berlebihan dan pencemaran

Kami memulakan langkah pertama dengan membina sistem aquaponik di kawasan lapang di desa. Kami menggunakan bahan-bahan yang mudah didapati dan mesra alam. Dengan bantuan pakar pertanian dan sokongan daripada pihak Alora Aquaponik Solution, Tuan AK Murugan yang berfokus pada pembangunan lestari, kami membuat reka bentuk sistem yang sesuai dengan keperluan tanaman dan ikan tempatan.

Sistem ini terdiri daripada kolam ikan, tangki penapis, Sistem Vertical, Sistem Nutrient Film Technique (NFT), Sistem Ebb and Flow (Flood and Drain). Kami memilih ikan tilapia kerana ia mudah dibesarkan dan tahan lasak. Sementara itu, kami menanam sayuran seperti sawi, kangkung, ketumbar, bayam, pak choi, herba dan banyak lagi. Melalui proses ini, kami tidak hanya membina sistem pertanian tetapi juga membentuk satu komuniti yang berkerjasama untuk mencapai matlamat yang sama.

Semasa pembinaan sistem, kami mengadakan sesi latihan untuk komuniti sekitar. Kami mengajar mereka tentang cara membian sistem, menjaga sistem aquaponik, termasuk cara memberi makan ikan, memantau kualiti air, dan menjaga tanaman. Pendidikan adalah kunci untuk memastikan keberlangsungan projek ini. Kami juga melibatkan anak-anak sekolah, memberikan mereka peluang untuk belajar tentang pertanian lestari.

Melalui program pendidikan ini, kami menyebarkan kesedaran mengenai pentingnya pemeliharaan alam sekitar. Kami menjelaskan bagaimana aquaponik dapat mengurangkan penggunaan air hingga 90% berbanding pertanian konvensional, serta mengelakkan penggunaan baja kimia yang merugikan ekosistem. Ini membantu membangkitkan minat dan penglibatan komuniti dalam menjaga alam sekitar.

Seiring berjalannya waktu, kami mula melihat hasil positif dari sistem aquaponik ini. Tanaman tumbuh subur, dan ikan pun berkembang dengan baik. Komuniti terasa bangga dapat menghasilkan makanan mereka sendiri, dan mereka juga mula merasakan manfaat kesihatan dari sayuran segar yang ditanam. Kami menjual hasil pertanian kepada penduduk setempat dan pasaran berdekatan, memberikan pendapatan tambahan kepada keluarga.

Namun, tidak semuanya berjalan lancar. Kami menghadapi beberapa cabaran, termasuk serangan penyakit pada tanaman dan ikan. Dalam menghadapi kesukaran ini, kami belajar untuk bekerjasama dan mencari penyelesaian secara kolektif. Kami mengadakan sesi perbincangan untuk berkongsi pengalaman dan strategi, merangsang semangat kerjasama dalam komuniti.

Projek aquaponik ini secara langsung menyokong beberapa Matlamat Pembangunan Lestari (SDGs). Pertama, ia menyumbang kepada SDG ke-2, yang menumpukan kepada pengakhiran kelaparan, mencapai keselamatan makanan dan pemakanan yang lebih baik. Dengan menghasilkan makanan secara berkelanjutan, kami membantu memastikan akses kepada makanan yang sihat untuk semua.

Selain itu, kami juga menyentuh SDG ke-6, yang berkaitan dengan air bersih dan sanitasi. Dengan menggunakan air secara efisien dan mengurangkan pencemaran, kami menyokong usaha untuk menjaga sumber air bersih. Aquaponik juga berhubung dengan SDG ke-12, yang menumpukan kepada pengeluaran dan penggunaan yang bertanggungjawab. Sistem ini mempromosikan pertanian yang lestari dan penggunaan sumber yang bijak.

Pengalaman ini telah mengubah pandangan saya tentang pertanian dan kelestarian. Saya menyaksikan bagaimana aquaponik bukan sahaja memberi manfaat secara ekonomi tetapi juga meningkatkan kesedaran tentang pentingnya menjaga alam sekitar. Projek ini membuktikan bahawa dengan kerjasama dan pengetahuan, kita dapat mencipta sistem pertanian yang harmoni dengan alam.

Saya percaya bahawa setiap langkah ke arah pertanian lestari adalah penting dalam usaha mencapai matlamat pembangunan yang lebih besar. Aquaponik bukan hanya satu sistem, tetapi satu cara hidup yang menghargai dan menjaga alam. Dengan meneruskan usaha ini, kami berharap dapat memberikan inspirasi kepada komuniti lain untuk mengamalkan pertanian yang berkelanjutan dan harmoni dengan alam.

Chapter 20

Pertanian Digital: Transformasi Kebun Komuniti Melalui Teknologi IoT (Projek Kebun Komuniti)

Hamnah Jusri

ABSTRAK

Sektor pertanian menghadapi pelbagai cabaran, termasuk perubahan iklim, kekurangan sumber dan keperluan untuk peningkatan produktiviti. Teknologi Internet of Things (IoT) menyediakan penyelesaian transformatif dengan keupayaan pemantauan masa nyata, pengumpulan data dan automasi dalam amalan pertanian. Melalui projek kebun komuniti yang dijalankan, kami mengambil peluang meneroka aplikasi IoT dalam pertanian, memfokuskan kepada potensinya untuk mengoptimumkan pengurusan sumber, meningkatkan hasil tanaman dan menggalakkan kemampanan.

Pertanian berasaskan IoT menggunakan rangkaian penderia *(sensor)* dan peranti yang saling berhubung untuk memantau faktor persekitaran utama seperti kelembapan tanah, suhu, kelembapan udara, keamatan cahaya dan tahap nutrien. Penderia ini menghantar data ke platform pusat, di mana ia dianalisis untuk memberikan pandangan yang boleh diambil tindakan untuk petani. Sistem automatik kemudiannya boleh melaraskan jadual pengairan, mengoptimumkan pembajaan, dan mengawal pengurusan perosak, berdasarkan data masa nyata, dengan itu mengurangkan pembaziran sumber dan memastikan kesihatan tanaman yang lebih baik.

Dengan menggabungkan IoT, pekebun boleh membuat keputusan berasaskan data yang meningkatkan kecekapan operasi dan produktiviti. Tambahan pula, teknologi IoT membolehkan

pemantauan dan pengurusan ladang dari jauh, mengurangkan keperluan untuk campur tangan manual dan meningkatkan kebolehskalaan operasi ladang. Pendekatan ini juga menyumbang kepada amalan pertanian mampan dengan meminimumkan penggunaan air, baja, dan racun perosak dan mengurangkan kesan buruk kepada alam sekitar dari aktiviti pertanian.

Antara faedah IoT dalam pertanian, termasuk kualiti hasil yang lebih baik, mengurangkan kos operasi dan kelestarian alam sekitar. Penemuan ini menekankan kepentingan mengguna pakai teknologi pertanian pintar untuk memenuhi permintaan makanan global yang semakin meningkat sambil menggalakkan amalan pertanian yang lebih cekap dan mesra alam.

PENGENALAN

Pertubuhan Ikram Cawangan Pahang telah menubuhkan SRI Al-Amin Paya Besar pada tahun 2013 bagi memberi sokongan kepada sistem pendidikan kebangsaan. Dalam usaha menjadikan penanaman sebagai salah satu kebitaraan sekolah, pihak kami berbesar hati diberi peluang mengendalikan kebun komuniti ini.

Penglibatan SRI Al-Amin Paya Besar di bawah Pertubuhan IKRAM Negeri Pahang dalam projek kebun komuniti yang merupakan salah satu Projek Solusi SDG ini telah mewujudkan peluang perkongsian ilmu pertanian moden dengan peserta, meningkatkan keupayaan, kemahiran dan hasil cili dan sayuran organik kepada warga sekolah dan komuniti sekitar. Peserta yang terlibat seramai 10 orang terdiri daripada staf sekolah dan juga pesara yang tinggal berhampiran sekolah. Projek ini terdiri daripada 250 polibeg cili bara dan beberapa jenis sayur-sayuran. PM Mohd Syahmi Salleh yang merupakan pensyarah Kuliyyah Sains, Universiti Islam Antarabangsa Malaysia telah dijemput sebagai penasihat teknikal untuk projek ini.

Dalam masa yang sama ia bukan sahaja memberi impak kepada peserta sahaja, malah ia turut membuka mata seluruh warga sekolah terutamanya persepsi positif kepada bidang pertanian. Suasana hijau dapat memberi motivasi dan aura positif kepada murid-murid, pengetahuan dan teknologi dapat dipelajari oleh peserta dan murid secara tidak langsung. Penglibatan murid sebagai salah satu aktiviti praktikal di sekolah di mana murid-murid didedahkan dengan pelajaran amali di kebun ini, selari dengan subjek Reka Bentuk dan Teknologi dan Sains yang diajar dalam kelas. Di samping memberi kesedaran kepada murid tentang pentingnya berbudi kepada tanah dan juga menjaga alam sekitar.

PERNYATAAN MASALAH DAN PELUANG

Pertanian sentiasa menjadi asas tamadun manusia, tetapi dalam menghadapi cabaran masa kini-seperti pertumbuhan penduduk, perubahan iklim, kekurangan sumber, dan keperluan untuk pengeluaran makanan yang mampan-kaedah pertanian tradisional tidak lagi mencukupi. Memandangkan populasi dunia dijangka mencecah hampir 10 bilion menjelang 2050, terdapat keperluan mendesak untuk meningkatkan pengeluaran makanan sambil meminimumkan kesan alam sekitar. Di sinilah teknologi Internet of Things (IoT) berperanan, menawarkan penyelesaian transformatif yang boleh merevolusikan cara kita mendekati dan mengurus pertanian.

Masalah keterjaminan makanan di Malaysia menjadi tumpuan utama negara selari dengan meningkatnya jumlah penduduk negara saban tahun. Ini juga menyebabkan kadar sara diri (SSR) tanaman makanan seperti cili masih pada tahap yang sangat rendah iaitu 29.7% pada tahun 2022. Malaysia bergantung kepada kadar kebergantungan import (IDR) cili yang sangat tinggi iaitu 74% pada tahun 2022. Hal ini ditambah juga dengan kurangnya pengetahuan dan kesedaran kepada betapa pentingnya penanaman bermula dari skala kecil demi membantu keterjaminan makanan Malaysia.

OBJEKTIF

Projek ini bertujuan untuk meningkatkan ilmu pertanian moden kepada peserta, memberikan sumber pendapatan tambahan kepada peserta dan sekolah dan juga menyediakan sumber sayuran dan cili yang selamat dan berkualiti kepada warga sekolah dan komuniti sekitar.

Projek fertigasi secara berkelompok dengan penggunaan IoT ini menyasarkan peserta daripada kumpulan petugas sekolah seramai 10 orang dan dapat mewujudkan peluang perkongsian ilmu pertanian moden dengan peserta, meningkatkan keupayaan, kemahiran serta pendapatan.

PELAKSANAAN PROJEK

Projek ini dilaksanakan dengan menjalankan beberapa aktiviti daripada penanaman pokok hingga peringkat penuaian. Projek ini melibatkan aktiviti berikut:

1. Pembajaan dan pengairan menggunakan sistem fertigasi.
2. Meracun secara manual menggunakan tangki racun elektrik.
3. Penggunaan racun organik sahaja - cuka kayu, garlic oil dan neem oil.
4. Jadual tugasan pemantauan dan kerja-kerja berkaitan secara tersusun.
5. Penggunakan teknologi IoT. Mengawal proses pembajaan dan siraman dengan menggunakan telefon pintar.

Rajah 20.1. Penerangan dan taklimat oleh pengurus projek

Rajah 20.2. Latihan oleh penasihat teknikal

Rajah 20.3. Pembersihan kawasan penanaman dengan bantuan murid

Raja 20.4. Penyediaan kawasan penanaman

Rajah 20.5. Penyusunan polibeg

Rajah 20.6. Pemindahan anak pokok

Rajah 20.7. Memasang pancang di polibeg untuk meyokong pokok

Rajah 20.8. Aktiviti meracun di kawsan penanaman

Rajah 20.9. Pemantauan bacaan baja

Rajah 20.10. Pemantauan sistem perpaipan

Rajah 20.11. Pokok yang telah mengeluarkan hasil

Rajah 20.12. Hasil yang sedia untuk dituai

Rajah 20.13. Baja sebatian yang digunakan

Rajah 20.14. Nutrien tambahan yang digunakan

Rajah 20.15. Sebahagian peserta yang terlibat

PERJALANAN PROJEK

Jadual 20.1. Siraman Baja AB Fertigasi

HARI SELEPAS TANAM	ANGGARAN KADAR BACAAN EC	KADAR SIRAMAN / HARI (ML)	KEKERAPAN SEHARI
1	1.8	500	5 (8/10/11/3/5)
7	2.0	500	5 (8/10/11/3/5)
14	2.2	600	5 (8/10/11/3/5)
21	2.4	800	5 (8/10/11/3/5)
28	2.6	900	5 (8/10/12/2/4)
35	2.8	1000	5 (8/10/12/2/4)
42	3.0	1000	5 (8/10/12/2/4)

HARI SELEPAS TANAM	ANGGARAN KADAR BACAAN EC	KADAR SIRAMAN / HARI (ML)	KEKERAPAN SEHARI
49	3.2	1200	5 (8/10/12/2/4)
56	3.2	1400	5 (8/10/12/2/4)
64	3.2	1600	5 (8/10/12/2/4)
71	3.2	2000	5 (8/10/12/2/4)

HASIL DAN PERBINCANGAN

Fertigasi adalah sistem pertanian moden dengan penggunaan penyiraman berkala (pengairan) dan penggunaan baja. Perkataan fertigasi sebenarnya adalah gabungan baja dan pengairan. Dalam sistem fertigasi, baja digunakan dalam bentuk baja cecair, yang dikenali sebagai baja AB. Baja digunakan bersama-sama dengan pengairan secara berkala menggunakan sistem automatik yang terdiri daripada pam air, pemasa dan sistem pengairan titisan. Sistem fertigasi menggalakkan pertumbuhan akar yang pesat, pengambilan nutrien optimum dan hasil tanaman keseluruhan.

Integrasi IoT dalam pertanian sering dirujuk sebagai "pertanian pintar" atau "pertanian ketepatan." Matlamatnya adalah untuk menggunakan cerapan dari data untuk mengoptimumkan penggunaan sumber, meningkatkan hasil, mengurangkan pembaziran dan menggalakkan kemampanan. Sebagai contoh, penderia kelembapan tanah boleh menentukan bila pengairan diperlukan, meminimumkan penggunaan air; penderia suhu dan kelembapan membantu mengesan kesihatan tumbuhan, memastikan tanaman tumbuh dalam keadaan optimum; manakala peranti berdaya GPS membenarkan kawalan tepat ke atas penanaman, pembajaan dan penuaian.

Faedah Utama IoT dalam Pertanian:

1. Ketepatan dan Kecekapan: IoT membolehkan pemantauan tepat keadaan tanaman, membolehkan pekebun menggunakan sumber seperti air, baja dan racun perosak dengan lebih cekap. Dengan menyesuaikan input kepada keperluan khusus tanaman, petani boleh mengoptimumkan hasil dan meminimumkan pembaziran.
2. Pemantauan dan Automasi Masa Nyata: Melalui penggunaan penderia IoT dan peranti yang disambungkan, pekebun boleh menjejaki faktor persekitaran (seperti kelembapan tanah, suhu dan kelembapan) dalam masa nyata, menjadikannya mungkin untuk mengautomasikan proses seperti pengairan dan pembajaan berdasarkan data sebenar.
3. Membuat Keputusan Berdasarkan Data: IoT menyediakan pekebun untuk mengambil tindakan melalui analisis data yang dikumpul daripada bidang mereka. Cerapan ini membantu pekebun membuat keputusan mengenai pengurusan tanaman, kawalan perosak, masa menuai dan banyak lagi, akhirnya meningkatkan produktiviti dan keuntungan.
4. Kemampanan: Dengan mengurangkan penggunaan berlebihan sumber seperti air dan bahan kimia, teknologi IoT menyumbang kepada amalan pertanian yang lebih mampan. Ini membantu meminimumkan kesan alam sekitar, mengurangkan kesan karbon dan memulihara sumber semula jadi yang berharga.
5. Pengurusan dan Pemantauan Jauh: Sistem berasaskan IoT membolehkan pekebun memantau ladang mereka dari jauh melalui aplikasi mudah alih atau website. Ini amat bermanfaat untuk ladang atau ladang berskala besar di kawasan terpencil, di mana kehadiran fizikal yang berterusan mungkin tidak dapat dilaksanakan.

6. Peningkatan Hasil dan Kesihatan Tanaman: IoT boleh membantu mengesan tanda awal penyakit atau serangan perosak, membolehkan campur tangan tepat pada masanya dan meminimumkan keperluan untuk racun perosak spektrum luas. Selain itu, dengan menjejaki keadaan pertumbuhan optimum, IoT boleh membantu pekebun meningkatkan kesihatan keseluruhan dan hasil tanaman mereka.

Penggunaan IoT dalam pertanian semakin meningkat di seluruh dunia, didorong oleh kemajuan dalam teknologi penderia, saling berhubungan dan analisis data. Daripada ladang keluarga berskala kecil kepada operasi pertanian komersial yang besar, IoT membolehkan pekebun menjadi lebih tangkas, cekap dan mampan dalam amalan mereka.

Walau bagaimanapun, di sebalik banyak kelebihannya, penyepaduan IoT dalam pertanian datang dengan cabaran, termasuk kos pemasangan, kemahiran teknikal yang diperlukan untuk pengurusan sistem, dan keperluan untuk sambungan internet yang boleh dipercayai di kawasan luar bandar. Namun begitu, faedahnya jauh melebihi halangan ini, dan dengan inovasi dan sokongan yang berterusan, IoT bersedia untuk menjadi pemboleh utama dalam masa depan pertanian.

Buat masa ini penggunaan IoT bagi kebun kami adalah bagi mengawal sistem fertigasi secara automatik.

Rajah 20.16. Hasil cili bara

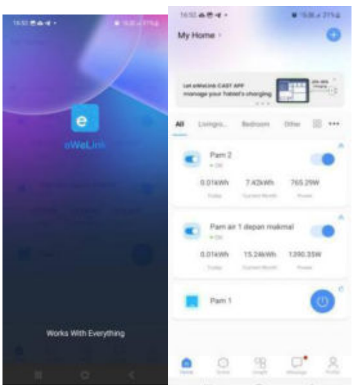
Rajah 20.17. Hasil sayuran

Rajah 20.18. Pembungkusan 100g

Rajah 20.19. Pembungkusan 1 kg

Kelebihan projek kebun komuniti ini ialah:

1. Penggunaan IoT untuk untuk siraman dan pembajaan



Rajah 20.20. Aplikasi eWeLink

Rajah 20.21. Suis Pintar

Rajah 20.22. Skematik Susunan Rangkaian IoT Fertigasi


Rajah 20.23. Kawasan tangki dan pam air

2. Penggunaan racun organik untuk tanaman

Rajah 20.24. Cuka Kayu

Rajah 20.25. Minyak daun Semambu (Neem Oil)

Rajah 20.26. Minyak bawang putih (Garlic Oil)

3. Kawasan penanaman menjadi tarikan

Rajah 20.27. Anak-anak Tadika Permata Hidayah melawat kawasan kebun

Rajah 20.28: Logo Pelekat Jualan

PERANCANGAN AKAN DATANG

Untuk memastikan kemampanan projek kebun ini secara berterusan, perancangan seperti berikut telah dikenalpasti.

1) Terus mempergiatkan lagi penanaman sayur dan cili bara
2) Mengenalpasti pasaran.
3) Menyediakan ruangan solusi jika ada isu berkaitan yang berbangkit dengan pihak berkaitan.
4) Melibatkan peserta dengan rangkaian kebun solusi berhampiran.
5) Menawarkan kursus-kursus berkaitan dengan kerjasama jabatan pertanian kawasan.
6) Mengembangkan lagi peluang seperti projek kelulut sebagaimana yang dicadangkan oleh pegawai jabatan pertanian yang melawat.
7) Mendapatkan sijil myGAP
8) Integrasi IoT bagi kebun yang efisien dan produktif.

PENUTUP

Dengan keterlibatan dalam kebun komuniti ini, ia dapat menyokong matlamat kedua (2) SDG dengan meningkatkan produktiviti pertanian pada kawasan sekitar yang ada, matlamat keempat (4) SDG dengan membuka peluang kepada guru dan murid memperoleh pengalaman praktikal dalam menguruskan penanaman secara tersusun matlamat kelapan (8) SDG dengan memberikan pendidikan keusahawanan dan menjalinkan jaringan sokongan daripada agensi kerajaan seperti Jabatan Pertanian. Selain itu, ia juga menyokong matlamat ke tujuh belas (17) SDG dengan kerjasama antara semua pihak demi mencapai objektif yang telah ditetapkan.

Part VII:
Community Mobilization

Chapter 21

Empowering Communities through Vertical Farming: Mobilizing Underrepresented Groups for Resilient and Sustainable Food Security in Malaysia

Gary Law

ABSTRACT

This paper details the mission and impact of Victory Farm at Rooftop (VF@RM) in pioneering a sustainable food system revolution in Malaysia through localized, technology-driven agriculture. Established in 2019, VF@RM addresses the challenges of rapid urbanization, climate change, and food insecurity by operating on two distinct but complementary pathways: the VGROW HEXA system for AgroSTEM education and the VGROW Commercial system for large-scale community food production. The VGROW HEXA system, an accessible, modular vertical farming solution, has successfully integrated AgroSTEM principles and Environmental, Social, and Governance (ESG) awareness into educational settings, engaging over 2,000 students and demonstrably increasing science engagement and sustainability literacy. Simultaneously, the solar-powered VGROW Commercial system—capable of producing 30,000 kg of fresh produce annually—focuses on community empowerment, training agropreneurs and generating sustainable livelihoods. A comparative analysis demonstrates the VF@RM's vertical farming superiority, requiring 16 times less land and producing 4 times more yield per acre than traditional farming. Looking ahead, VF@RM's future is committed to integrating Artificial Intelligence (AI), Internet of Things (IoT), and SMART farming technologies to further optimize resource efficiency and scalability. By reducing water usage by up to 90%, avoiding

significant CO_2 emissions, and promoting inclusive community ownership, VF@RM provides a scalable, zero-waste blueprint that actively contributes to Malaysia's Sustainable Development Goals (SDGs 2, 4, 11, and 13), fostering a more resilient, equitable, and greener future.

INTRODUCTION: PIONEERING URBAN FOOD RESILIENCE

In 2019, a mission was launched to transform urban spaces into vibrant, sustainable farming hubs, embedding the critical values of environmental stewardship and food security into the fabric of everyday life. This vision materialized as Victory Farm at Rooftop Malaysia (VF@RM), a pioneering project in Malaysia designed to address the interconnected challenges of urbanization, climate change, and food insecurity through innovative agricultural technology. The VF@RM strategy is founded on a dual-pillar approach: the promotion of AgroSTEM education using the VGROW HEXA vertical farming system, and the empowerment of communities to achieve food resilience through large-scale, solar-powered VGROW Commercial farming projects. By mobilizing underrepresented groups and leveraging cutting-edge technology, VF@RM aims to cultivate a new generation of environmentally conscious citizens and agropreneurs, thereby securing a resilient and sustainable food future for Malaysia.

VGROW HEXA: The Foundation for AgroSTEM Education and ESG Awareness

The VGROW HEXA system was meticulously developed as an accessible and modular vertical farming solution, transforming ordinary urban spaces—such as school courtyards, community centre rooftops, and even indoor classrooms—into dynamic living laboratories. Its design is specifically tailored for seamless integration into schools, community centers, and special education institutions, requiring only a minimal footprint and simple maintenance. This makes it an ideal pedagogical tool for fostering hands-on learning in agriculture, life sciences, engineering, and sustainability. This educational outreach directly addresses core Environmental, Social, and Governance (ESG) priorities, providing students and educators with tangible, real-world impact metrics across all three domains.

ENVIRONMENTAL IMPACT AND STEWARDSHIP

The system's design immediately addresses two critical environmental challenges facing urban Malaysia: emissions and water scarcity. By facilitating hyper-localized food production, each HEXA tower is estimated to reduce transportation-related emissions by approximately 50 kg of $CO2$ annually. This teaches students the concept of food miles and the tangible climate benefits of consuming locally grown produce. Furthermore, utilizing a closed-loop hydroponic system, the HEXA towers use up to 90% less water compared to traditional soil-based farming methods, a critical lesson in sustainable resource management necessary for water-stressed urban areas.

SOCIAL INCLUSION AND AGROSTEM ENGAGEMENT

The social metrics of the VGROW HEXA system underscore its role as a powerful tool for community building and inclusive education. The initiative has successfully engaged over 2,000 students in more than 20 schools, promoting the interdisciplinary application of Science, Technology, Engineering, and Mathematics (STEM) through agriculture. Crucially, VGROW HEXA fosters inclusivity through dedicated partnerships with special-need schools, such as SKPK Pulau Pinang, empowering students of all abilities. The hands-on nature of vertical farming enhances practical skills, teamwork, and self-confidence through shared environmental stewardship.

GOVERNANCE AND PROGRAM SUSTAINABILITY

The long-term success and scalability of the VGROW HEXA initiative are secured by robust governance structures and clear impact tracking. Collaboration with public schools, NGOs, and private sector sponsors ensures financial and operational stability. Impact tracking surveys conducted at participating schools validate the program's effectiveness, reporting a significant 40% increase in student engagement in science subjects and a 25% improvement in sustainability literacy based on post-program assessments.

VGROW Commercial: Scaling Sustainable Agriculture for Communities

Complementing the educational focus of HEXA, the VGROW Commercial system is designed for larger-scale food production, directly targeting community empowerment and economic development. This outdoor, solar-powered vertical farming solution consists of 100 towers capable of growing 10,000 plants at a time, serving as the cornerstone for agropreneurship training programs and sustainable income generation.

ENVIRONMENTAL EFFICIENCY AND CARBON REDUCTION

The commercial scale dramatically increases the positive environmental impact. A single VGROW Commercial project avoids 2 metric tons of CO_2 annually, an impact equivalent to planting 100 mature trees. Integrated solar panels reduce dependency on grid electricity, saving an estimated 30% in operational energy costs. By producing fresh, hyper-local food, the system cuts supply chain emissions, reducing "food miles" and associated carbon footprints by approximately 70% compared to imported produce.

SOCIAL AND ECONOMIC EMPOWERMENT

The social impact is focused on creating sustainable livelihoods and enhancing food security. Each VGROW Commercial project is designed to train 20 agropreneurs annually, creating pathways to self-reliance and sustainable income. Critically, the system generates 30,000 kg of fresh produce annually, which is enough to support approximately 150 households or community food banks, directly tackling food insecurity at the local level.

CIRCULAR ECONOMY AND COMMUNITY GOVERNANCE

Governance in the commercial context is defined by community co-ownership, where local stakeholders actively participate in farm operations, fostering a sense of ownership and ensuring long-term project viability. The system promotes a circular economy by composting residual plant biomass for soil enrichment, achieving a functional zero-waste system.


THE SUPERIORITY OF VGROW VERTICAL FARMING

A critical examination of the output metrics reveals the revolutionary efficiency of VGROW's vertical farming technology compared to traditional methods. For example, growing 10,000 plants requires approximately 40,000 square feet (0.92 acres) using traditional farming techniques, but only 2,500 square feet (0.06 acres) with VGROW's vertical towers. This translates to the use of 16 times less land to produce the same quantity.

On an equivalent one-acre plot, the impact is even more profound. Traditional farming on one acre can yield only 10,890 plants, resulting in an estimated 54 metric tonnes of greens annually. In contrast, VGROW can deploy 1,800 towers on the same acre, growing 180,000 plants and producing 216 metric tonnes of greens annually. This efficiency means that VGROW produces 16.5 times more plants and achieves 4 times greater yield per acre than conventional agriculture. This data unequivocally demonstrates that VGROW provides a highly scalable solution for achieving large-scale food security with minimum resource consumption.

VF@RM's Vision: Integrating AI, SMART Farming, and IoT

To maintain its leadership in sustainable agriculture and continually optimize resource use, VF@RM is committed to a strategic expansion that integrates cutting-edge digital technologies into its systems. This focus on SMART farming represents the next essential phase of the green revolution.

The future of VGROW systems will be driven by the deployment of Internet of Things (IoT) sensors, creating a network of interconnected devices that continuously monitor critical environmental parameters such as pH levels, Electrical Conductivity (EC), temperature, and humidity. This continuous, real-time, granular data will be fed into Artificial Intelligence (AI) models. The AI will then utilize predictive analytics to offer highly accurate insights for managing nutrient adjustments, identifying early signs of pests or disease, and determining optimal harvesting schedules, maximizing yield while minimizing resource waste.

By leveraging these SMART farming principles, the systems will be equipped with automation capabilities, ensuring plants receive the precise amount of water and fertilizer required. This synergy between AI, IoT, and automation will further enhance efficiency, reduce operational complexity, and build greater resilience against climate volatility. Critically, this technology integration will also enrich the AgroSTEM curriculum by providing students with hands-on exposure to advanced agricultural technology, preparing them for the future digital economy.

CONCLUSION: A GREEN REVOLUTION FOR A RESILIENT FUTURE

VF@RM is more than a farming initiative; it is a movement dedicated to cultivating ecosystems that thrive sustainably. By successfully deploying the educational VGROW HEXA and commercial VGROW Commercial systems, and by committing to the forward-looking integration of AI, IoT, and SMART farming, VF@RM has established a robust blueprint for a green revolution, turning small, localized steps into lasting national change. The project contributes significantly to

Malaysia's Sustainable Development Goals (SDGs), specifically addressing Zero Hunger (SDG 2), Quality Education (SDG 4), Sustainable Cities (SDG 11), and Climate Action (SDG 13). With a vision to reach 100,000 students nationwide by 2030 and deploy 1,000 VGROW Commercial systems by 2035, VF@RM is leading the way in demonstrating how technology, community empowerment, and robust ESG alignment can build a greener, more equitable, and highly resilient future for Malaysia.

Chapter 22

Mobilisasi Komuniti – Strategi Dan Perlaksanaan Pertanian Mampan Di Kalangan Penagih Dadah Dan Komuniti Terpinggir

Khalid Hashim, Salehuddin Saadan, Mohd Ferdaus Mohd Sai &, Sazura Sariff

ABSTRAK

Masalah penyalahgunaan dadah merupakan masalah yang membimbangkan banyak pihak kerana ia menggugat kesejahteraan dan keharmonian negara dan masyarakat. Masalah ini sering berkait dengan mereka yang berada di kumpulan mudah terjejas seperti golongan gelandangan. Oleh itu, suatu pendekatan perlu diketengahkan untuk mengatasi permasalahan ini seperti program intervensi pemulihan dan membuka ruang dan peluang kepada mereka untuk terus berdaya saing di dalam masyarakat seperti penyediaan projek-projek pekerjaan dalam bidang pertanian, penternakan, khidmat dan integrasi sosial. Metodologi: Mengenalpasti golongan sasar dari kalangan penagih dadah di jalanan, membuat saringan kesihatan dan semakan maklumat pengenalan diri dengan jabatan berkaitan, menempatkan mereka di rumah rawatan dan penjagaan untuk langkah intervensi dan membuka peluang kepada mereka untuk menyertai projek jana pendapatan untuk kelangsungan hidup. Pelaksanaan projek: 50 orang penagih dadah kekal aktif telah diserapkan ke projek-projek janaan pendapatan yang dikelola oleh KOMITED Malaysia (Komuniti Intervensi Dadah Malaysia). Kesimpulan: Mobilisasi komuniti ini dapat dilihat dalam melestarikan projek yang telah disediakan.

PENGENALAN

Isu penyalahgunaan dadah merupakan suatu masalah nasional yang dihadapi oleh semua negara di dunia. Pelbagai pendekatan intervensi digunapakai untuk memastikan golongan ini dapat kembali kepada norma kehidupan yang normal. Ditubuhkan pada tahun 2001, KOMITED Malaysia adalah sebuah pertubuhan bukan kerajaan berdaftar yang tidak berorientasikan keuntungan, dianggotai dan diterajui oleh penagih dadah kekal pulih bagi menangani masalah berkaitan penagihan dadah di Malaysia. KOMITED Malaysia merupakan satu-satunya organisasi (NGO) di Malaysia yang mengetengahkan konsep *Malaysia One Stop Drugs Intervention Centre* (MOSDIC). Suatu pendekatan yang komprehensif dengan konsep model *From Womb to Tomb* dalam menawarkan kepelbagaian perkhidmatan dan penjagaan di bawah satu bumbung berdasarkan keperluan komuniti.

METODOLOGI

Golongan terpinggir yang terlibat dengan penyalahgunaan dadah dapat dikenalpasti dan golongan ini akan melalui beberapa fasa pemulihan bermula dengan fasa rawatan, penjagaan dan seterusnya fasa terapi pekerjaan. Selepas menjalani program intervensi, penagih dadah kekal aktif yang terpilih akan ditempatkan ke projek-projek janaan pendapatan seperti projek pertanian dan penternakan dalam komuniti.

Golongan penagih dadah kekal pulih ini akan meneruskan fasa terapi pekerjaan dengan pemantauan dari KOMITED Malaysia. Seramai 50 orang yang terpilih ditempatkan di projek kebun komuniti seperti projek penternakan kambing (Y23-KK098, Y24-KK080), projek penternakan pelbagai; ayam, angsa dan itik (Y23-SP059), projek *Car Wash* (Y23-KK058) dan Projek Warung 22222 KOMITED.

PELAKSANAAN

Antara pelaksanaan mobiliti untuk golongan terpinggir terutamanya penagih dadah kekal pulih ini adalah dengan menempatkan mereka ke dalam projek-projek ini bagi melatih mereka menjadi manusia normal tanpa pengaruh dadah. 10 orang telah ditempatkan untuk mengendali dan menguruskan projek penternakan kambing, 12 orang ditempatkan ke projek penternakan pelbagai; ayam angsa dan itik, 10 orang ke projek *Carwash* dan 18 orang diserapkan ke projek Warung 22222. Penempatan ini penting bagi memastikan golongan dari kumpulan rentan ini dapat bergaul dan dapat menempatkan diri ke dalam masyarakat sambil dapat meningkatkan taraf kehidupan dengan hasil pendapatan dari penempatan kerja. Strategi yang diketengahkan dan diperkenalkan oleh KOMITED Malaysia dalam program intervensi, terapi kerja dan penempatan kerja ini dilihat berjaya dalam memberi peluang kepada golongan sasar untuk terus releven dan diterima oleh masyarakat. Berikut merupakan maklumat ringkas tentang pengalaman penglibatan komuniti, kebun komuniti dan penternakan :

PENGALAMAN	KEPAKARAN (TEMPOH)	PENCAPAIAN
Mengendalikan projek Janaan Pendapatan melalui geran APPGM untuk penternakan pelbagai (itik/angsa/ayam)	KOMITED Malaysia mempunyai pengalaman di dalam penternakan pelbagai sejak November 2022 sehingga kini.	Sejak perlaksanaan projek ini, KOMITED Malaysia berjaya melatih peserta seramai 12 orang dengan pendapatan keseluruhan berjumlah RM16,163.
Mengendalikan projek Carwash di bawah geran Kebun Komuniti APPGM	KOMITED Malaysia mempunyai pengalaman di dalam projek Carwash ini sejak ogos 2023	Projek Carwash ini telah menjana pendapatan berjumlah RM8,897 pada 3 bulan pertama dan KOMITED Malaysia berjaya melatih seramai 10 orang peserta dalam meningkatkan pendapatan bulanan mereka.
Mengendalikan projek penternakan kambing melalui geran Kebun Komuniti APPGM	KOMITED Malaysia mempunyai pengalaman dalam melaksanakan projek penternakan kambing sejak oktober 2023	Projek ini telah berjaya melatih seramai 10 orang klien KOMITED Malaysia untuk kekal pulih dari penagihan dadah. Peserta telah berjaya menyiapkan fasiliti penternakan kambing dengan pengawasan minima. Projek ini juga telah dinilai oleh pegawai veterinar Kuantan untuk menjadi projek contoh kepada penduduk setempat yang sedang dan akan menjalankan penternakan kambing.

KESIMPULAN

Para peserta ini merupakan penagih dadah kekal pulih, yang mempunyai permasalahan lampau samada masalah keluarga, pekerjaan dan masyarakat. Dengan adanya projek penternakan ini, ianya dapat menjadi medan latihan kepada peserta dalam penyediaan diri dan dapat mengurangkan jurang sebelum kembali kepada masyarakat. Melalui projek yang disediakan, peserta dapat belajar cara-cara bagi menjana pendapatan untuk kelestarian kehidupan akan datang, disamping memberi peluang kerjaya kepada mereka. KOMITED Malaysia yakin ianya dapat memberi manfaat kepada kumpulan sasar dan juga kepada pertubuhan.

Antara faktor yang menjadikan projek kebun komuniti ini berjaya adalah dengan pendekatan yang holistik yang dirancang dan dijalankan oleh KOMITED Malaysia. Golongan ini dapat menjalankan projek yang disediakan dengan selesa kerana keperluan asas telah disediakan oleh pihak pertubuhan. Ini termasuk penempatan yang selesa, makanan, pakaian, rujukan kesihatan dan kebajikan yang dijaga bagi memastikan golongan rentan ini percaya bahawa dengan projek yang disediakan, mereka dapat keluar dari masalah penagihan dadah. Secara tidak langsung, ianya menyumbang kepada kelestarian projek yang diusahakan dalam memastikan keterjaminan makanan yang berterusan.

Golongan ini mempunyai latar belakang yang pelbagai. Mereka mempunyai kelebihan dan kemahiran dalam bidang seperti pertanian, penternakan, pertukangan dan pengurusan. Dengan adanya inisiatif projek dalam komuniti ini, golongan ini dapat membina jaringan dan hubungan sosial antara mereka dan masyarakat setempat. Melalui projek pertanian dan penternakan dalam menjana pendapatan ini, mereka lebih yakin berhadapan dengan masyarakat dan secara tidak langsung, produktiviti projek dapat dimaksimumkan dan kelangsungan dalam kelestarian projek dapat diteruskan. Ianya selaras dengan Matlamat Pembangunan Lestari SDG iaitu;

- Matlamat 3: Memastikan kehidupan sihat dan menggalakkan kesejahteraan pada semua peringkat umur,

- Matlamat 8: Pertumbuhan Ekonomi Dan Pekerjaan Yang Baik – Menggalakkan pertumbuhan ekonomi yang berterusan, inklusif dan mampan, guna tenaga penuh dan produktif serta kerja yang bersesuaian untuk semua.

IMPLIKASI DAN CADANGAN

Golongan rentan terutamanya komuniti dari kalangan penagih dadah ini dapat kembali ke dalam masyarakat setelah melalui proses dan fasa rawatan dan pemulihan di KOMITED Malaysia. Penyediaan program dan projek yang lebih komprehensif perlu ditambahbaik dan projek-projek terapi kerja perlu diteruskan dan diluaskan demi memastikan matlamat utama dapat terus dimobilisasikan. Dicadangkan agar projek pertanian dan penternakan dalam komuniti ini mendapat tajaan yang berterusan bagi memastikan golongan ini tidak lagi dipinggirkan dan kelestarian projek dapat diteruskan.

PENGHARGAAN

KOMITED Malaysia ingin mengucapkan jutaan terima kasih kepada pihak APPGM-SDG kerana tidak putus-putus memberi bantuan dan tajaan kepada kami untuk memastikan projek yang dirancang dapat dilaksanakan dan matlamat utama dalam menggerak komuniti kearah kehidupan mampan dapat diteruskan. KOMITED Malaysia juga berterima kasih kepada sekritariat kebun komuniti APPGM-SDG yang sering memberi sokongan dan panduan dalam menguruskan projek di bawah geran kebun komuniti.

Faces of Resilience: Diverse Voices and Stories through Food Security Initiatives presents twenty-two papers and reflective essays drawn from the Food Security Conference 2024 and ongoing APPGM-SDG initiatives. It offers an overview of Malaysia's evolving food ecosystem and the innovative, community-driven efforts advancing sustainable and inclusive food systems.

Part 1: Income Generation Strategies highlights small-scale community projects that enhance livelihoods and improve access to nutritious food, such as backyard egg production in Perak and vegetable farming initiatives in rural Sabah.

Part 2: Best Practices in Sustainable and Regenerative Farming showcases ecological approaches that restore soil health and encourage environmental learning through projects like SJK(T) Sungai Ara Agro School, Empowerment and Transformation of Beneficiaries via Community Farming and Strategies to Ensure Food Security Through the Transformation of Garden Waste into Biochar-Compost (KOMBI) for Enhanced Crop Productivity.

Part 3: The Role and Achievements of Women-Led Initiatives in Agriculture celebrates women's leadership in community based agriculture, featuring Wanita Bertani, Sejahtera Hayat and Cikgu Norlia's Community Transformation Project, which exemplify empowerment and inclusive participation.

Part 4: Agribusiness and Product Downstreaming examines innovation and value addition efforts through Pegaga Sabah & Tuhau Development, Madu Kelulut Agribusiness, and Chili Fertegasi for B40 Youth, Framework for Agricultural Development.

Part 5: The Involvement and Impact on Indigenous Communities explores traditional farming wisdom and environmental stewardship through projects such as Orang Asli Involvement in Agriculture, Food Forest, Alternative Chicken Feed, Borneo Fertilyst, Kg. Sg. Mok Empowerment, and Community-Led Sustainable Agriculture.

Part 6: Innovations In Farming Techniques and Technologies highlights modern approaches such as hydroponics, aquaponics, and IoT-based systems, including Automated Nutrient Dosing in Precision Hydroponics, IoT-Driven Community Gardens, and Integrated Aquaponics Systems.

Part 7: Community Mobilization emphasises the power of collective action through vertical farming and rehabilitation projects that foster empowerment, inclusion, and social cohesion among communities involved Empowering Communities through Vertical Farming and Sustainable Agriculture Implementation Through Community Mobilisation in Marginalised and Drug-Dependent Communities.

The book serves as both documentation and inspiration, affirming the resilience, creativity, and solidarity that define Malaysia's pursuit of a just and sustainable food future.

Persatuan Promosi Matlamat Pembangunan Lestari

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ISBN 978-629-7752-24-2
9 786297 752242 >