



ASEAN Regional Guidelines for Sustainable Agriculture in ASEAN

**Adopted at the 44th Meeting of the AMAF
on 26 October 2022**



one vision
one identity
one community



ASEAN Regional Guidelines for Sustainable Agriculture in ASEAN

The ASEAN Secretariat
Jakarta

The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967. The Member States are Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam.

The ASEAN Secretariat is based in Jakarta, Indonesia.

For inquiries, contact:

The ASEAN Secretariat
Community Relations Division (CRD)
70A Jalan Sisingamangaraja
Jakarta 12110, Indonesia
Phone: (62 21) 724-3372, 726-2991
Fax: (62 21) 739-8234, 724-3504
E-mail: public@asean.org

Catalogue-in-Publication Data

ASEAN Regional Guidelines for Sustainable Agriculture in ASEAN
Jakarta, ASEAN Secretariat, April 2023

630.059

1. ASEAN – Agriculture – COVID-19
Food Security – Sustainable Development – SDG

ISBN 978-623-5429-24-3 (PDF)



ASEAN: A Community of Opportunities for All.



This publication was prepared with the support of the Promotion of Sustainable Agricultural Value Chains in ASEAN (ASEAN AgriTrade) and Climate Smart Land Use (CSLU) in ASEAN project which is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and funded by the Federal Ministry for Economic Cooperation and Development (BMZ) of Germany.

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General information on ASEAN appears online at the ASEAN Website: www.asean.org.

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Glossary and Abbreviations

AEC	ASEAN Economic Community
AIFS	American Institute for Foreign Study
AMAF	ASEAN Ministers on Agriculture and Forestry
AMS	ASEAN Member States
ASEAN	Association of Southeast Asian Nations
BCA	Biological Control Agents
BMPs	Best Management Practices
CA4SH	Coalition of Action 4 Soil Health
CMASC	Carbon Management and Sequestration
EAA	Economic Accounts for Agriculture
EFB	Empty Fruit Bunch
EUREGAP	Euro-Retailer Produce Working (Good Agricultural Practices)
FAO	Food and Agriculture Organization of the United Nations
GAP	Good Agricultural Practices
GAqP	Good Aquaculture Practices
HHPs	Highly Hazardous Pesticides
IPM	Integrated Pest Management
NUE	Nutrient use efficiency
OECD	Organization for Economic Co-operation and Development
OPF	Oil Palm Fronds
OPT	Oil Palm Trunk
RECSOIL	Decarbonization of Global Soil
SAFA	Sustainability Assessment of Food and Agriculture Systems
SCPI	Sustainable Crop Production Intensification
SDGS	Sustainable Development Goals
SOC	Loss of Soil Organic Carbon
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TOC	Total Organic Carbon

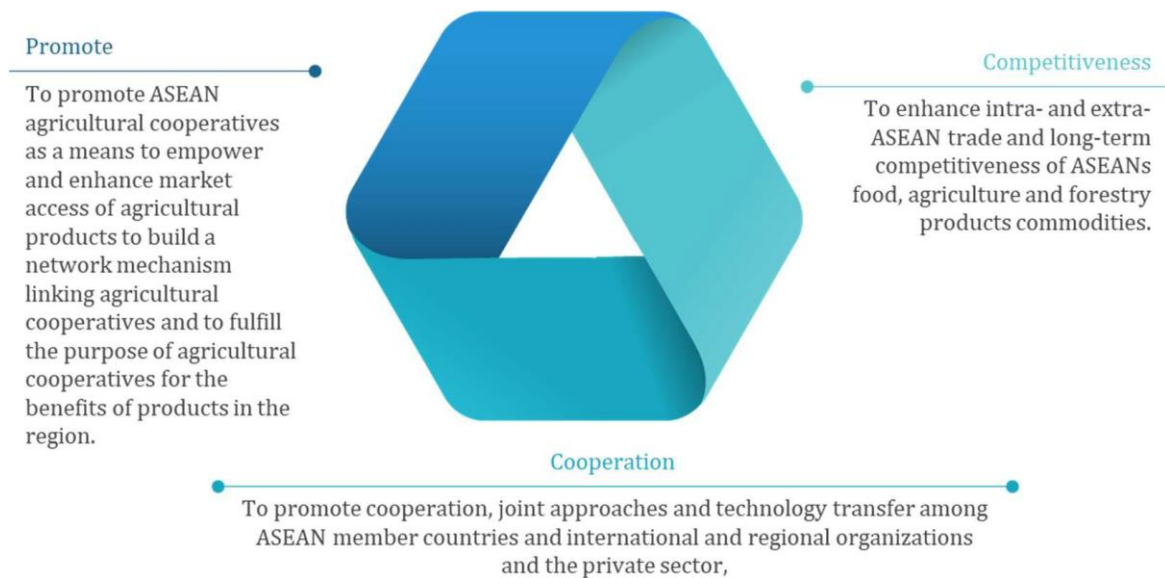
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Executive Summary

The commitments to the ASEAN common identity: The 4th ASEAN Summit in 1992 ended with the ASEAN Ministers of Agriculture & Forestry (AMAF) identifying 7 priorities for the agriculture sector and 5 strategic thrusts for the forestry sector. In 2007, the AEC compiled these into the following objectives:



Furthermore, the 23rd ASEAN Summit on 9th Oct 2015 in Bandar Seri Begawan declared that the ASEAN post-2015 vision should enhance:

- Peace and stability.
- Promote common prosperity in the region.
- Strengthen ASEANs institutional framework by enhancing the effectiveness and efficiency of ASEAN organs and institutions.

Agriculture is a way of life in ASEAN with 8 out of 10 countries in ASEAN dependent on agriculture and its production. In Myanmar and Lao PDR, this sector accounts for more than 40% of the GDP. The region is a major producer and exporter of palm oil, crude rubber, rice, sugar, seafood and fruits. However, the sustainability of the sector – and plates of millions of South East Asians is currently at a threat from climate change, overfishing, unsustainable farming methods, food wastage and other problems in which effort is required to ensure the regions agriculture sector, as a key source of food and income continue with the wise stewardship of earth’s resources (Food Security and Sustainable Agriculture – ASEAN CSR, 2022).

The global food system is at a crossroads. A profound transformation is needed at all scales in the face of demographic changes, increased pressure and competition over renewable resources, increasingly severe consequences of climatic changes and the loss of biodiversity. Such a transformation in what is produced and how it is produced, processed, transported and consumed is required to achieve Sustainable Development Goal 2 (SDG2) to “end hunger and all forms of malnutrition” by 2030, building on the four pillars of Food Security and Nutrition (FSN) (HLPE, 2019).

The global agricultural and food systems are currently not meeting the world’s expectations for sustainability. Beyond declines and rises and despite a global increase in food availability, the number of people suffering from hunger has not significantly changed during the last 40 years. Worldwide, 821 million people were undernourished in 2018. This is all the more difficult to accept when one realizes that the majority of them are food producers and workers in precarious and difficult working conditions, affected by direct and indirect economic impacts of food systems. In addition, malnutrition, in its different forms (undernutrition, micronutrient deficiencies, overweight and obesity), now affects all countries.

One person in three is malnourished and, if current trends continue, one person in two could be malnourished by 2030 (HLPE, 2019).

These tensions are likely to be exacerbated as food systems will continue to face complex and mounting challenges, including demographic and climatic changes, political instability, conflicts and increased pressure on natural resources (land, water, biodiversity, etc.) and ecosystem functions. Sustainable food systems are needed to ensure appropriate food production and reduce losses and waste, while also safeguarding human and environmental health, political stability and better livelihoods with less environmental consequences (The Future of Food and Agricultural Trends and Challenges, FAO, 2017).

Agroecological and other innovative approaches are thus increasingly called upon to play a greater role in contributing to achieve global Food Security and Nutrition (FSN). They are becoming increasingly prominent in debates around sustainable development because of their ambition to connect environmental sustainability and social innovation, production and consumption, global concerns and local dynamics through the support to locally adapted solutions based upon participation and the mobilization of local knowledge (HLPE, 2019).

THE UNSUSTAINABLE AGRI-FOOD SYSTEM

Modern monocrop-intensive, industrial-scale agriculture fuels a global agri-food system that causes agrochemical pollution, desertification, deforestation, drought, aquifer depletion, biodiversity loss, land degradation and more (IPES-Food, 2016; UNEP, 2012). Agriculture, forestry and other land uses together are responsible for at least one-third of all global anthropogenic greenhouse gas emissions, and may be the world's greatest contributors to climate change (Smith et al., 2014). Climate change also threatens crop yields and creates food insecurity (FAO, 2015). Moreover, this mainstream agri-food system depends on natural resources, yet many policies and practices undermine the ecological foundations of food and nutritional security (UNEP, 2016).

The system encourages agrochemical dependency, and existing extension services tend to push farmers' reliance on often costly, unsafe and unnecessary external inputs (Nelles and Visetnoi, 2016) instead of promoting sustainable approaches. This system does not adequately enable self-sufficiency or serve smallholder farmers, poor families and rural communities. Recent data suggest that around 64.7 million people in Southeast Asia (9.8% of the population) were undernourished or food insecure in 2019, with farmers and rural communities most vulnerable. Moreover, projections suggest that the region, despite some modest progress since 2015, is off track to meet UN agreed global Sustainable Development Goals (SDGs) for zero hunger by 2030 with the COVID-19 pandemic creating further vulnerabilities and uncertainties (FAO et al., 2020, Nelles & Ferrand, eds. 2020).

PARADIGM SHIFT NEEDED TO MEET SDGS AND CREATE SUSTAINABLE AGRI-FOOD SYSTEMS

One major practical challenge is to understand and enable policies, knowledge and skills necessary to increase viable alternatives for a widespread, significant and measurable transformation towards genuine sustainable agriculture and agri-food systems (SAFS). The International Panel of Experts on Sustainable Food systems (IPES-Food) argued for a paradigm shift towards a "fundamentally different model of agriculture based on diversifying farms and farming landscapes, replacing chemical inputs, optimizing biodiversity and stimulating interactions between different species, as part of holistic strategies to build long-term soil fertility, healthy agroecosystems and secure livelihoods" (IPES-Food, 2016, p.3). FAO suggests that agroecology is a viable, transformative approach based on "ecological and social concepts and principles to the design and management of a sustainable and fair food system" and which contributes to multiple Sustainable Development Goals (SDGs) (FAO, 2018, p.8, Nelles & Ferrand, eds. 2020).

The development of modern Agritech systems will also be an important component in the drive to sustainable agriculture and food production. New technology trends like augmented reality and IoT are gradually making agricultural processes more precise, profitable and sustainable. The advancement in

Agritech have elevated the global economy for good. Agritech solutions like high-tech drones (used to monitor farm water levels, humidity, temperature and fertilizer requirements), IoT devices (with sensors to track farm data in real time) and data analytics (to deduce trends and patterns based on real farm numbers) are leading the way to address the above-mentioned challenges (AgriTech: The Future of Food Production “The Cable”, 26 October 2021). It is hoped that The ASEAN Sustainable Agriculture Guidelines will serve the following purpose:

- I. Provide policymakers with a general outline of the importance and relevance of new sustainable and circular agriculture policies which will need to be drafted and implemented according to each AMS national circumstances.
- II. Provide a transition mechanism where policies can be translated into strategies, which in turn can be turned into practical implementation plans.
- III. Serve to guide and promote the increasing strategies in sustainable circular agriculture.
- IV. Provide examples of strategies to the public sector, governmental bodies overlooking management, direction, regulation, supervision, on the types of strategies which may be employed in order to develop agricultural sustainability.
- V. Encourage the development of sustainable and circular agriculture industries and all other stakeholders in the sustainable agriculture industry to integrate their operations to create a stronger sustainable ASEAN agriculture.
- VI. These ASEAN sustainable agriculture guidelines encompass the universal sustainability goals of:
 - a. **Environmental integrity**
 - b. **Economic resilience**
 - c. **Social Well Being**
 - d. **Good Governance**
 - e. **Food Security, and**
 - f. **Poverty Alleviation**

The ASEAN Sustainable Guidelines demonstrate cognizance of the lessons that COVID-19 has taught Agricultural Industries in the region and the world, some of which are:

- The effects on the drastic downturn of the fisheries industry, when fishermen could not fish, encouraging training and development of sustainable, non-destructive aquaculture among fishing communities to supplement their incomes due to a rapidly diminishing catch from the overfished ASEAN waters.
- The need for availability of local cost-effective agricultural inputs.
- The need for some rethinking on the design and operation of farms to lessen the possibility of virus proliferation transfer of pathogenic strains of viruses/bacteria/other microbes especially in animal husbandry and aquaculture.
- The importance of clean processing systems, sustainable disinfection and delivery.
- The importance of food security to every country in the world, including AMS.
- The greater need for the development of a circular agricultural economy within ASEAN, to utilize available resources and then consequently reduction on the dependance on imported agricultural inputs within the region.

The onset of the Covid-19 pandemic has exposed a significant weakness in ASEAN farming: The large and unsustainable imports of raw materials for feeds and for fertilizers from other parts of the world. The recent increase in prices for these commodities have further exacerbated the problem. The guidelines for sustainable agriculture in ASEAN emphasize the need for the sustainable production of these agricultural inputs from available resources within ASEAN such as agriculture biomass and food wastes, promoting circularity in agriculture, cheaper farming inputs and leading to the greater competitiveness of ASEAN agricultural produce.

- The ASEAN Sustainable Agriculture Guidelines remain relevant to the main agricultural species and climatic conditions within ASEAN.
- These guidelines encourage the integration of the use of sustainable renewable energy in agriculture.
- These guidelines point to cost-effective and practical agricultural solutions which are meant to galvanize and encourage the practical and functional transition to sustainable agriculture.

It is hoped that these sustainable agriculture guidelines will galvanize the development of an ASEAN sustainable food market, in the face of an increasing number of trade barriers, tariffs and other restrictions imposed on ASEAN agricultural and food products. These guidelines converge with other sustainable agriculture guidelines and Good Agricultural Practices (GAP) and will build increased trust and confidence in global supply chains on the quality and value of the agricultural produce from ASEAN. Meeting these challenges will be an immense task, but this report proposes a "menu of solutions" under key strategies (3.3), that, together, could help point the way to deliver a sustainable food future. We must produce more food, but we must also slow the rate of growth in demand—especially demand for resource-intensive foods such as beef.

The guidelines look at specific obstacles that must be overcome and identifies the most promising solutions that are currently available or show promise in the near term. It also identifies the policies, practices, and incentives necessary to implement the solutions at the necessary scale. A common thread in many of the solutions is the urgent need to "produce, protect, and prosper." The world must act decisively to intensify production on agricultural land. The world must also act decisively to protect natural ecosystems that store carbon, support biodiversity, and provide the many ecosystem services on which humanity depends. Food production and ecosystem protection must be linked at every level—policy, finance, and farm practice — to avoid destructive competition for precious land and water. And this combination must— and can—result in greater prosperity to lift people out of poverty and sustain political will.

We do not argue for full implementation of every strategy listed, in every country, as some solutions will not be relevant or feasible in some AMS. Interested governments, businesses, and stakeholders across food supply chains will need to decide which menu items are relevant for them.

The guidelines proposes that large changes are possible and that a sustainable food future is achievable. The strategies proposed in this report can help to create a world with sufficient, nutritious food for everyone. It also offers the chance to generate the broader social, environmental, and economic co-benefits that are the foundation of sustainable development. But such a future will only be achieved if governments, the private sector, and civil society act upon the list of strategies quickly and with conviction.

1. Introduction, Origins and the Background of the Guidelines

The world population is currently estimated at present (March 2022) as more than 7,939,000 million people (World population review, March 2022). It has been estimated that we need to produce more food in the next 35 years than we have ever produced in human history, given the projected increase in world population, and on the basis that rising incomes will continue to change diets. However, there is a good reason to work on the approximation that there will be no new land for agriculture and increasing competition from urbanization (the world will be 70% urbanized by 2050). In addition, sea level rise will reduce land availability and there is a growing need for land bioenergy, carbon capture and storage to remove greenhouse gases from the atmosphere. This implies sustainable intensification of agriculture on the land that is available (ie: produce more without expanding the agricultural area) (Global Food Security, 2021 – The Challenge – Global Food Security Programme). Society worldwide faces an enormous challenge – How to produce clean, healthy and nutritious food while preserving the environment, providing an equitable distribution of the economic wealth generated to all groups of society while also ensuring the health and safety of not just the food produced but also the health and safety of the farming communities. The way forward will require all major sectors to work together including policy makers, academics, private industry and farming communities.

- These guidelines apply to sustainability in agriculture, aquaculture and animal husbandry systems, the incorporation of renewable energy systems, the interaction between the farmers, inputs, land, water and the environment as well as the greater total sustainability of the farms, the communities, and the economy.
- Circular economies. The inculcation of circular agriculture strategies within these guidelines complements sustainable agriculture, integrating valorized biomass waste to make use of all byproducts and waste products from agriculture, valorized to feeds and fertilizers.
- Educational & Training Courses for Sustainable Technologies have to be an integral part of the development of sustainable strategies in the region.
- Factors which have influenced the adoption of sustainable farming practices in SE Asia according to various research papers include farmers and farming communities, environmental and economic knowledge as well as their sources of information which have had a strong effect on the adoption or non-adoption of sustainable farming methodologies.
- Sustainable agriculture should begin with the sustainable production of as many agricultural inputs as possible from available resources within ASEAN, such as agricultural biomass waste and food waste, promoting circularity in agriculture, and creating cost effective farming inputs leading to the greater competitiveness of ASEAN produce.
- The sustainable agriculture strategies listed are developed from the sustainable guidelines to point towards how the guidelines may be realized in implementing the projects.
- The strategies in turn point to the possible implementation projects for ASEAN's future as well as some which are already being planned.
- These guidelines, strategies and implementation plans can be supported by a logical, application-based Navigator function, to help guide policymakers and farmers in the sustainability process. Such as a Navigator Function is attached in the appendix (**Appendix A**).
- The "ASEAN Green Foods Platform" is a suggestion of one way in which ASEAN may encourage the adoption of sustainable food marketing systems. Sustainable food production reduces the negative impacts of the food system on the environment. The World Bank estimates that the negative impacts produced by this system such as food loss, waste, food safety, land degradation and GHG emissions from agricultural practices are responsible for costs of at least USD 6 trillion worldwide, "a bill that is simply too high for USD 8 trillion worth food. Martien Van Nieuwkoop, Director, Agriculture Global Practice at the World Bank, "Do the costs of the global food system outweigh its monetary value?" 2019. It is a suggestion to value food more precisely, on a platform which may reward and encourage sustainable practices in food production with sustainable labelling and better prices for producers engaged in

sustainable practices. “Realigning budgets which currently drive producers towards environmentally-damaging practices to deliver public goods and services for healthier and sustainable outcomes.” - Martien Van Nieuwkoop, World Bank, 2019.

1.1 COVID-19 and Agriculture

- Both lives and livelihoods are at risk in this pandemic and equally urgent in the compounding threat of the pandemic on existing crises – such as conflicts, natural disasters, climate change, and pests & animal diseases that are already stressing our food systems and triggering food insecurity around the globe.
- Blockages to transport routes are particularly destructive to fresh food and feed supply chains.
- Markets for fresh food produce can be severely impacted by the sudden closing or shrinking of domestic and international markets.
- Food commodity prices can increase because of logistical problems or import difficulties.

To minimize Covid-19’s damaging effect on food security and nutrition while transforming global food systems to make them more resilient, sustainable, and equitable, the FAO called for immediate action in 7 key priority areas:

- Reinforce a global humanitarian response plan for Covid-19.
- Improve data for decision making.
- Ensure economic inclusion and social protection to reduce poverty.
- Bolster trade and food safety standards.
- Boost smallholder resilience for recovery.
- Prevent the next zoonotic pandemic through a strengthened one health approach, and
- Trigger food systems transformation.

“The Covid-19 pandemic is a global health crisis that is already having devastating impacts on the world economy – both directly and through necessary measures to contain the spread of the disease.” These impacts are also being felt by the food and agriculture sector. While the supply of food has held up well to date, in many countries, the measures put in place to contain the spread of the virus are starting to disrupt the supply of agrofood products to markets and consumers, both within and across borders. The sector is also experiencing a substantial shift in the composition and for some commodities, the level of demand.

How damaging these impacts turn out to be for food security, nutrition and the livelihood of farmers, fishers, and others working along the food supply chain will depend on a large part on policy responses over the short, medium, and long term. In the short term, governments must manage multiple demands – responding to the health crisis, managing the consequences of the shock to the economy, and ensuring the smooth functioning of the food system. While the pandemic poses some serious challenges for the food system in this short term, it is also an opportunity to accelerate transformations in the food and agriculture sector to build its resilience in the face of a range of challenges, including climate change” [Organization for Economic Cooperation and Development (OECD), Covid-19 and the Food and Agriculture Sector: Issues and Policy Responses – April 2020].

1.2 ASEAN – Strategic Plan of Action on Food Security in the ASEAN Region (Spa-Fs) 2021 – 2025

Between the years of 2009 – 2020, ASEAN formulated and implemented the ASEAN Integrated Food Security (AIFS) Framework. The AIFS then agreed to extend the AISF framework to 2025 and focus on the following:

- Continue to ensure long term food security and nutrition to improve the livelihoods of the farmers in the region.
- Create a favorable environment where AMS can integrate, operate and cooperate in various aspects related to food production, processing and trade.
- Continue to provide a forum for information exchange, transfer of new technology, knowledge sharing with various stakeholders, including Government authorities, private industry, scientists, research institutes and farmers / farming communities creating a strong regional network.

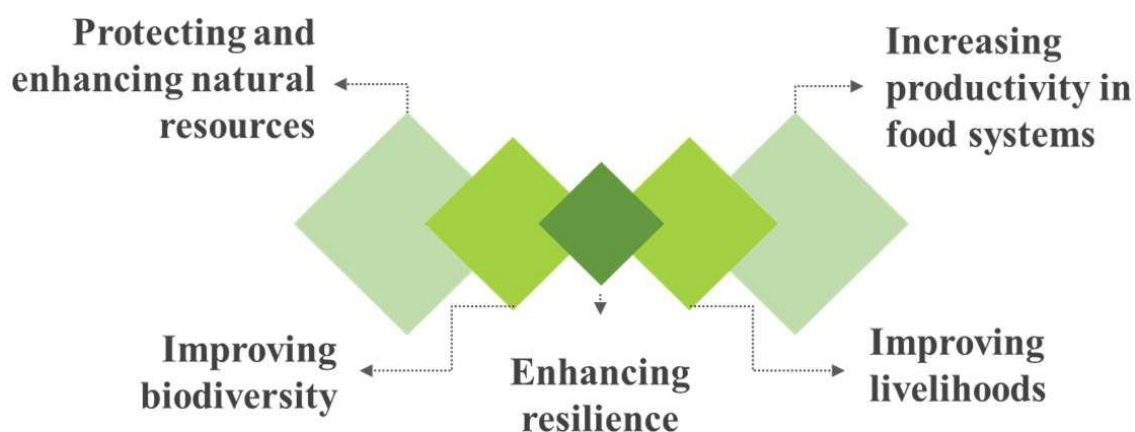
To identify constrains and opportunities and new strategies for 2021 – 2025 and provide guidance to relevant sectoral working groups as well as stakeholders on how to enhance efficiency and contribute in promoting long-term food security in ASEAN.

1.3 UN Sustainable Development Goals (SDGS)

The United Nations 17 Sustainable Development Goals (SDGs) aim to develop and to achieve decent lives for all as a healthy planet by 2030 (The 2030 Agenda for Sustainable Development - United Nations, 2015). By 2020, only 3 of the 21 Sustainable Development Goals Targets had been met. With the current forecast being that, the majority of the goals will be missed by 2030 (Hitting the targets, population matters.org).

The UN SDGs were and are an urgent call for action by all countries, developed and developing to a global partnership. Sustainable Development has been described with 5 main principles:

:



The area of focus for sustainable farming includes, the problems of how to increase food production productivity and reproducibility to ensure food security whilst

- Protecting environmental and biodiversity concerns
- Creating economic returns for all groups involved
- Ensuring the health and safety of both the farming community and the food produce
- Providing more equitable economic solutions to all the communities involved
- The UN SDGs have been further challenged by Covid-19 pandemic as well as severe disruptions to our weather patterns in the past years (UN Sustainable Outlook, 2020).

THE UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS



“While its (Covid-19) impact for many prosperity-related SDGs was negative, its impact for many planet-related SDGs has been positive: greenhouse gas emissions declined; air and water quality improved and a process of regeneration of nature could be witnessed in many areas. These opposite effects of Covid-19 demonstrate yet again that the current ways of achieving prosperity are in conflict with the health of the planet. The upheavals caused by the Covid-19 crisis therefore create the opportunity for recognizing this conflict in a more profound way and for putting in more energetic efforts during the decade of action to reach the SDGs by 2030” ... *Liu Zheming Under Secretary General for Economic and Social Affairs United Nations.*

1.4 Sustainable and Circular Agriculture and the UN SDGs: Application of the SDGs to ASEAN Sustainable Agriculture Development

SDGs 1,2,3,6,7,8,9,11,12,13,14,15,17

THE UN SDGS:	How These Guidelines Relate to ASEAN Sustainable Development
SDG 1	End poverty in all its forms everywhere.
SDG INDICATOR 1.4	By 2030, ensuring that all men and women in particular the poor and vulnerable have equal rights as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services including microfinance.
SDG 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
SDG TARGET 2.3	By 2030, double the agricultural productivity and incomes of small-scale food producers in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.
SDG TARGET 2.4	By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help to maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

SDG TARGET 2.5	By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels and promote access to fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge as internationally agreed.
SDG INDICATOR 2.6	Correct and prevent trade restrictions and distortions in world agricultural markets.
SDG INDICATOR 2.9	Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock seed gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries.
SDG TARGET 3.9	By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil contamination and pollution.
SDG TARGET 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Supports quality education for all communities.
SDG TARGET 6.3	By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
SDG TARGET 6.4	By 2030, substantially increase water use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
SDG TARGET 6.6	By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.
SDG GOAL 7	Ensure access to affordable, reliable, sustainable, and modern energy for all.
SDG TARGET 7.2	By 2030, increase substantially the share of renewable energy in the global energy market.
SDG GOAL 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. Reducing losses, encouraging reuse and recycling and promising sustainable consumption
SDG TARGET 8.2	Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labor-intensive sectors.
SDG TARGET 8.3	Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, encourage the formalization and growth of micro-, small- and medium-sized enterprises including through access to financial services.
SDG TARGET 8.4	Improve progressively through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programs on sustainable consumption and production, with developed countries taking the lead.
SDG TARGET 8.8	Protect labor rights and promote safe and secure working environments for all workers, including migrant workers in particular women migrants and those in precarious employment.
SDG GOAL 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG TARGET 9.2	Promote inclusive and sustainable industrialization and by 2030, significantly raise industry's share of employment and gross domestic product in line with national circumstances and double its share in least-developed countries.
SDG TARGET 9.4	By 2030, upgrade infrastructure, and retrofit industries to make them sustainable with increased resource-use efficiency and greater adoption of clean and environmentally-sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.
SDG TARGET 9.5	Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending.
SDG TARGET 9.6	Support domestic technology development, research and innovation in developing countries, including by ensure a conducive policy environment for inter alia, industrial diversification and value-addition to commodities.
SDG11	Make cities and human settlements inclusive, safe, resilient and sustainable.
SDG TARGET 11.3	By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning, and management in all countries.
SDG TARGET 11.4	Strengthening efforts to protect and safeguard the worlds' cultural and natural heritage.
SDG TARGET 11.6	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to our quality and municipal and other waste management.
SDG TARGET 12.1	Implement the 10-year framework of programs on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development capabilities of developing countries.
SDG TARGET 12.2	By 2030, achieve the sustainable management and efficient use of natural resources.
SDG TARGET 12.3	By 2030, halve per capital global food waste at all the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses.
SDG TARGET 12.4	By 2020, achieve the environmentally-sound management of chemicals and all wastes throughout their life-cycle, in accordance with agreed international framework and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.
SDG TARGET 12.5	By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.
SDG TARGET 12.6	Encourage companies, especially large and transnational companies to adopt sustainable practices and to integrate sustainability information into their reporting cycle.
SDG TARGET 12.8	By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.
SDG TARGET INDICATORS 12A	Support developing countries to strengthen the scientific and technological capacity to move towards more sustainable patterns of consumption and production.

SDG 13	Take urgent action to combat climate change and its impacts.
SDG TARGET 13.1	Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
SDG TARGET 13.2	Integrate climate change measures into national policies, strategies and planning.
SDG TARGET 13.3	Improve education, awareness raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.
SDG TARGET INDICATOR 13B	Promote mechanism for raising capacity for effective climate change-related planning and management in least developed countries and small island developing states, including focusing on women, youth and local and marginalized communities.
SDG 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
SDG TARGET 14.1	By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.
SDG TARGET 14.2	By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience or take action for their restoration in order to achieve healthy and productive oceans.
SDG TARGET 14.3	Minimize and address the impact of ocean acidification including through enhanced scientific cooperation at all levels.
SDG TARGET 14C	Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS which provides the legal framework for the conservation of the sustainable use of the oceans and their resources, as recalled in Paragraph 158 of The Future We Want.
SDG GOAL 15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss.
SDG TARGET 15.1	By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services in particular, forests, wetlands, mountains and drylands, in line with obligations under international agreements.
SDG TARGET 15.2	By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and sustainably increases afforestation and reforestation globally.
SDG TARGET 15.3	By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods and strive to achieve a land degradation-neutral world.
SDG TARGET 15.4	By 2030, ensure the conservation of mountain ecosystems, including their biodiversity in order to enhance their capacity to provide benefits that are essential for sustainable development.
SDG TARGET 15.5	Take urgent and significant action to reduce the degradation of natural habitats, half the loss of biodiversity and by 2020, protect and prevent the extinction of threatened species.
SDG TARGET 15.9	By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts.

SDG TARGET 15A	Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems.
SDG GOAL 17	Strengthen the means of implementation and revitalize the global partnership for sustainable development.
SDG TARGET 17.11	Significantly increase the exports of developing countries, in particular with a view to doubling the least developed countries' share of global exports by 2020.
SDG TARGET 17.14	Enhance policy coherence for sustainable development.
SDG TARGET 17.16	Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources to support the achievement of the sustainable development goals in all countries in particular developing countries.
SDG TARGET 18	Strengthening Innovation Systems.

1.5 Supporting Quality Education for All Communities

As reported by Nelles et al in their 2020 report, Higher Educational Institutions in the region (HEIs) can play a much better part in disseminating the ever-growing information and practices of sustainable agriculture to the participant groups but “have still not reformed teaching, research, learning or extension relationships with smallholder farmers to serve rural communities, continuing to favour the dominant (i.e. conventional) model of agriculture, thus preventing a transition to more sustainable food systems” (HLPF, 2019; Nelles and Ferrand, eds, 2020).

Higher Education Institutions (HEIs): Challenges and Responsibilities for a Sustainable Future

Higher education institutions (HEIs) in general, but agriculture universities especially, have contributed to the growth and modernization of production agriculture, but have often failed to adjust their curricula to rural concerns (Atchoarena and Holmes, 2004). Beginning in the 1960s, many HEIs and scientists embraced knowledge and applied research about Green Revolution technologies that were based on monocropping systems with modern breeds and a high reliance on chemical fertilizers and pesticides, without adequately protecting genetic crop diversity or ecosystems. Conventional HEIs, along with their inadequate curricula and narrow research specializations, paid little attention to social or environmental sciences. In addition, their top-down technology transfer models typically discounted participatory, interdisciplinary and ecological approaches (Ison, 1990; Nelles, 2011). HEIs have still not adequately reformed teaching, research, learning or extension relationships with smallholder farmers to serve rural communities (Acker and Gasperini, 2008; Nelles, 2016), and continue to favor the dominant (i.e. conventional) model of agriculture, thus preventing a transition to more sustainable food systems (HLPF, 2019, Nelles, W. & Ferrand, P., eds. 2020). More HEIs within ASEAN will need to adapt their curricula to cover more sustainable and circular agricultural technologies.

“Investing in youth is the best way to guarantee sustainable National Growth Creating the right environment, including by developing skills and offering incentives can help build the capacities, innovation and entrepreneurial potential of a country’s leaders and producers of the future”

“Specific intervention should target women and youth living in rural locations and vulnerable groups including indigenous people migrants and refugees who are often disadvantaged in access to information, opportunities and resources. Addressing gender groups and generational discrimination in legal framework is likely to have a major impact on reducing inequalities” (Transforming Food and Agriculture, UN). It is needed to promote agriculture sector to the millennial generation, and Indonesian government through Ministry of Agriculture has created a program to support millennial farmers. Moreover, the introduction of agricultural technology is expected to be more massive, related to this Ministry of Agriculture also encourages millennial farmers with the introduction of technology, so this

younger generation is interested in working or creating business in the agricultural sectors. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all and accelerating progress towards the SDGs through education. Innovation is a key driver of agricultural and rural transformation.

Innovation in sustainable and circular agriculture will see the establishment of:

- Modern and New Biotechnologies
- More Agroecological Practices
- Public-private partnerships in sustainable agriculture
- Farming cooperatives working with Public, R&D and SMEs on innovation in sustainable agriculture systems and greater collaboration between public research and development facilities, SMEs and farming communities

1.6 Strengthening Innovation Systems

- The development of effective sustainable and circular systems in agriculture will be made possible with the development of newer, innovative input production systems and technology as well as modern innovative sustainable farming systems and solutions, coupled with sustainable processing solutions. This will be an important step which can be incentivized by Government policies and strategies which encourage private industry and farming communities to get involved in sustainable fertilizer and feed production at local levels.
- The valorisation and circularisation of agricultural and food wastes, including oil palm and rubber agricultural biomass waste in ASEAN will be a key component in developing sustainability and circularity in agriculture. (See 2.1) In addition, the development of the accompanying Biological Control Agent (BCA) industry in the region can be given a boost by Governmental incentives and programs.
- The Global Loss of food, food waste and agriculture waste is very large, with ASEAN alone producing more than 257.5 million tons of food wastes in 2020 (FAO, 2020).
- In addition, agricultural biomass wastes, which, taking Oil Palm Biomass alone, for Indonesia, Thailand and Malaysia, adds to 854.1 million tons/year. (Availability use and removal of oil palm biomass in Indonesia (Christopher Teh, 2016; Transitioning to a sustainable development framework for bioenergy in Malaysia. Policy suggestions to catalyze the use of palm oil residues- Siti Fatimah Salleh et al, 2020; The availability and assessment of potential agricultural residues for the regional development of 2nd generation Bioethanol in Thailand- P.Jusakulvijit, 2021
- Food and agricultural wastes are a resource which should be tapped into to produce cost effective agricultural inputs while reducing the stress on the ecosystem and the detrimental effects on the environment caused by biogenic emissions resulting from decaying biomass.

1.7 The Importance of Our Soil: Enhancing Soil Health and Restoring Land

- Soil, like our air and water is vulnerable to pollution and can be damaged by unsustainable farming practices. Soil can also be amended through sustainable practices.
- Managing soils sustainably is cheaper than rehabilitating or restoring soil functions.
- Soils are living, with an interwoven biology.
- Soil organic matter management is a must. As a source of energy for living organisms in the soil, it also contributes to improving soil health.
- Unsustainable agricultural practices such as the excessive use of chemical fertilisers and pesticides damage the soil health and consequently produces detrimental effects on the environment. A reduction of organic matter, or altering the effective soil microbiome composition can alter the carbon holding capacity of soil.

- Nitrogen is a major limiting nutrient in sustaining crop yields and quality. As a result, Nitrogen (N) fertilizers are usually applied in large quantities to increase crop production throughout the world. However, the excessive application of N Fertilizers beyond the crops demand has resulted in undesirable consequences such as the degradation of soil, water and air quality.
- Proper management of nitrogen fertilizers is needed to reduce the nitrous oxide (N₂O) emissions from field crops.
- Healthy soil does not only produce healthy food and better nutrition. Soil health is the most important foundation of a healthy farm ecosystem.

1.8 Good Agricultural Practices (GAP)



“Food safety hazards may occur at different stages of the food chain beginning right from agriculture input production to primary production and extending to secondary and tertiary processing, storage and distribution. It is therefore very important to address food safety starting from the farm level. Implementing food practices during on-farm and post-production processes is of immense importance for ensuring safe food supply.

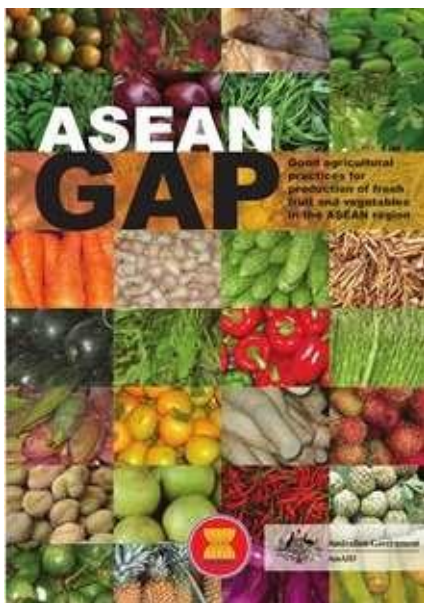
Good Agricultural Practices (GAP) as defined by FAO, are a “collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products while taking into account economic, social and environmental sustainability.” (FAO, 2016). GlobalG.A.P began in 1997 as EUREPGAP and as such the principles of Good Agricultural Practices has been discussed and put into practice at different levels over the last couple of decades worldwide. The four principles of **Good Agricultural Practices** are:

1. **Economic Viability:** Viable farming enterprises contributing to sustainable livelihoods.
2. **Environmental Stability:** Necessary to sustain and enhance the natural resource base:
 - Documenting and recording production practices.
 - Managing degraded land areas.
 - Utilising production practices selected for suitability for the soil type and not increase the risk of environmental degradation.
 - Water management plans, optimising water usage and reduce water waste.
 - Recording fertiliser and soil additive details including rate and method application.
 - A more selective approach to the selection of chemicals used for crop protection to minimise the impact on the environment.
 - Appropriate time management of planting and input application
 - Waste management procedures to minimise waste generation, reuse, recycle waste and dispose of waste generated during harvesting, production and handling.
 - Complying to all national regulations on protected plant and animal species.
 - Minimising the impact on neighbouring properties and surrounding areas.
 - Training farmers and workers to have appropriate knowledge in their related areas related to GAP, keeping training records.
 - Keeping GAP records and reviewing it.
3. **Social Acceptability:**
 - Meeting cultural and social demands of society.
 - Protecting agricultural workers’ health from the hazards brought about by improper use of chemical and pesticides.
 - Training farmers on the appropriate knowledge and skills for correct handling and application of agricultural input and hazardous materials.
4. **Food Safety and Quality**
 - Economically and efficiently produce sufficient, safe and nutritious food.

1.9 ASEAN GAP

ASEAN Good Agricultural Practices (GAP) is a regional standard to prevent the risks associated with production, harvesting and post-harvest handling of fresh fruit and vegetables and to facilitate the trade within and beyond the region. It sets the standard practice of on-farm production activities as well as that of local industries where agricultural produce are both processed and packed for delivery and sale.

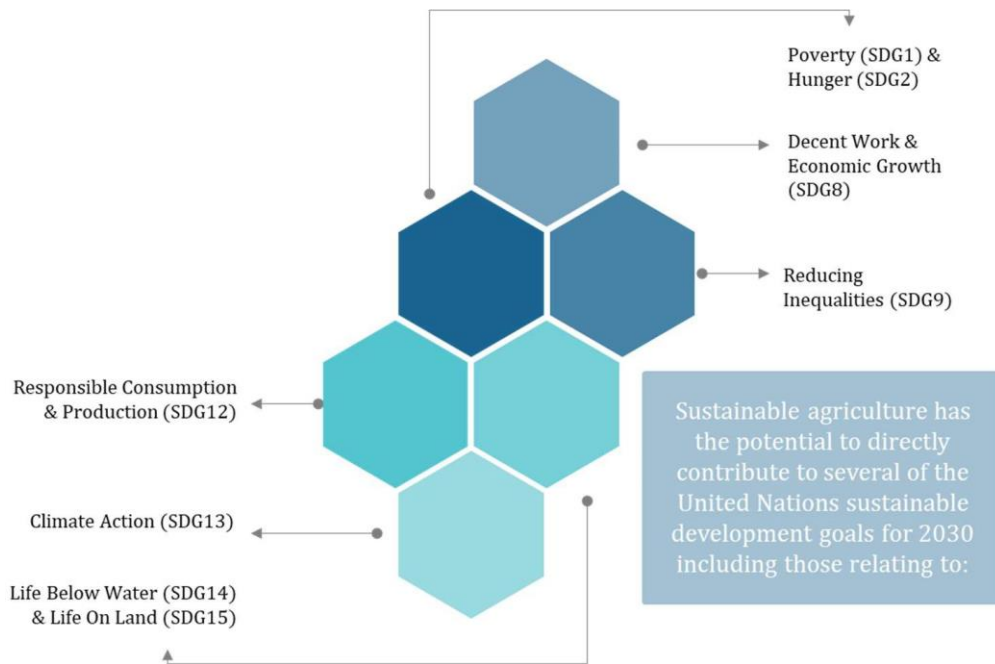
The practices in ASEAN GAP are aimed at preventing or minimizing the risks of hazards occurring. The hazards covered by ASEAN GAP include:



- **Food safety**
- **Environmental impacts**
- **Workers health**
- **Safety and welfare, as well as**
- **Produce quality**

These critical focus points are now also a central component of the sustainable and circular agriculture guidelines. In addition to the previous works on sustainability done by ASEAN workgroups and studies, studies like the FAO SAFA Guidelines on Sustainability Assessment of Food and Agricultural System and many other sustainable agriculture guidelines have helped to form the basis for the new ASEAN guidelines, with a relevance, emphasis and practicality in the guidelines particularly for AMS.

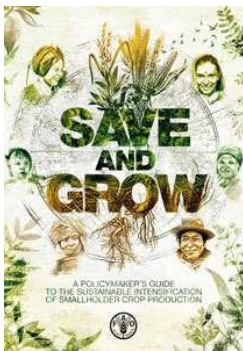
- Helping to facilitate creation of agriculture value chains that will remain competitive as well as sustainable in the face of the impacts of climate change as well as the challenges of long lasting and challenging pandemics.
- Promoting a common vision and strategy for ASEAN agricultural food and forestry sectors that takes into account sustainable and circular agricultural and forestry practices as well as climate change mitigation procedures.
- “The general aim of sustainable agriculture policies is that they ensure environmental sustainability while enhancing or at least maintaining farm productivity”.
- The thought of the importance of establishing cooperation, especially in agriculture is one of the efforts to respond to various challenges in the era of globalization where each country in the Asia Pacific region has its advantages and disadvantages.
- Although most ASEAN countries' agricultural export products still require efforts to improve competitiveness, the prospects for cooperation in the Asia-Pacific region are still very promising. More open trade and investment cooperation in agricultural products in the Asia Pacific region will open up market opportunities for agricultural products of ASEAN countries to encourage high economic growth, as well as improve the living standards of countries in the Asia Pacific region.
- With the increasingly open international cooperation opportunities in the Asia Pacific region, the agricultural sector must be prepared by making many improvements, especially focused on efforts to increase production capacity, increase the diversity of derivative product variations, and increase the depth of down-streaming rates of agricultural products. This is possible with the implementation of Good Agricultural Practices (GAP) on various improvement efforts as long as the cost is cheap but effective, considering the number of low- and middle-class agricultural businesses in ASEAN countries.



- Sustainable agriculture has to simultaneously consider social, economic and environmental issues.
- The implementation of sustainable development requires a continuous optimization process. However, implementation of newer sustainable practices in practice has been shown to be difficult and faces numerous obstacles and challenges. To establish sustainable agriculture in a broader and more effective scale, we have paired sustainable agriculture guidelines with strategies which in turn can be linked to implementation plans, thereby bridging the gap to implementation. This is expected to lend clarity to policy makers on the new policies, regulations and laws which will need to be developed in support of this important transition.
- It is necessary to understand sustainable agriculture as a concept that requires adaptation and flexibility.
- Therefore, we need a well-defined process applicable in practice that is understandable and transparent.
- GUIDELINES – STRATEGIES – IMPLEMENTATION PLANS.

1.10 Sustainable Crop Production Intensification (SCPI)

2011: FAO: SAVE AND GROW: SCPI



In 2011, the FAO published “Save and Grow”: A policymakers’ guide to the sustainable intensification of smallholder crop production. This ecosystem approach to crop production regenerates and sustains the health of farmland. This was a new paradigm of intensive crop production, both highly productive and environmentally sustainable.

The FAO recognized that over the past half century, agriculture based on the intensive use of inputs has increased global food production and average per capita food consumption. In the process, however, it has depleted the natural resources of many agro-ecosystems, jeopardizing future productivity and added to the greenhouse gases responsible for climate change.

The challenge of the “Save and Grow” sustainable intensification system was in its call for the “Greening” of the Green Revolution through “an ecosystem approach that draws on nature’s contributions to crop growth, such as soil organic matter, water flow regulation, pollination and biocontrol of insect pests and diseases. Sustainable crop production intensification (SCPI) introduced in

“Save and Grow”, produces more from the same area of land while conserving resources, reducing negative impacts on the environment and enhancing natural capital and flow of ecosystem services.

1. To feed a growing world population, we have no option but to intensify crop production. But farmers face unprecedented constraints. In order to grow, agriculture must learn to save.
2. Crop production intensification will be built on farming systems that offer a range of productivity, socio-economic and environmental benefits to producers and to society at large.
3. Agriculture must literally return to its roots by rediscovering the importance of healthy soil, drawing on natural sources of plant nutrition and using mineral fertilisers wisely.
4. Farmers will need a genetically diverse portfolio of improved crop varieties according to market preference that are suited to a range of agro-ecosystems and farming practices and resilient to climate change.
5. Sustainable intensification requires smarter, precision technologies for irrigation and farming practices that use ecosystem approaches to conserve water.
6. Pesticides kill pests but also kill natural enemies of insect pests and their overuse can harm farmers, consumers and the environment. The first line of defence is a healthy agro-system.
7. To encourage smallholders to adopt sustainable crop production intensification, fundamental changes are needed in agricultural development policies and institutions.

1.11 Organic Certification

ASEAN: ORGANIC STANDARDS

ASEAN organic standards were introduced in 2014 and were guided by the following objectives:

1. **Employing long term, sustainable ecological, systems-based organic management.**
2. **Assuring long term, biologically based soil fertility.**
3. **Avoiding/minimising synthetic inputs at all stages of the production chain and exposure of people and the environment to persistent, potentially harmful chemicals.**
4. **Minimising pollution and degradation of the production/processing unit and surrounding environment from production/processing activities.**
5. **Excluding certain unnatural technologies from the system (e.g., products derived from genetic modification, irradiation and other technologies).**
6. **Avoiding pollution from the surrounding environment.**
7. **Maintaining organic integrity throughout the supply chain.**
8. **Providing organic identity in the supply chain.**

From the advent of the development of Good Agricultural Practices (GAP) through the FAOs SCPI (Sustainable Crop Product Intensification) systems, through to the development of ASEANs Organic Agriculture guidelines, and to the present-day ASEAN Sustainable and Circular Agriculture Guidelines, common central themes in these guidelines remain:

- **Economic sustainability**
- **Social sustainability, and**
- **Environmental sustainability**

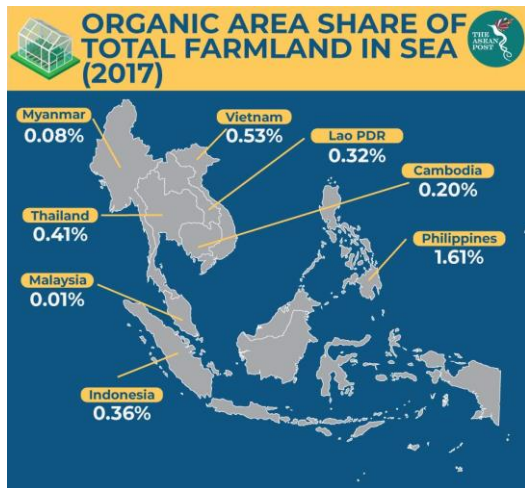
The development of the recent Covid-19 pandemic and other climate change factors such as global warming have pushed the need for sustainability and circularity in agriculture to the fore. Sustainable farming has been a well-accepted central principle for the future of farming and food production but the understanding of the need for circularity in agriculture is a more recent concept which has come about as a result of the weaknesses of the linear economic model.

Although ASEAN introduced Organic Agriculture Guidelines in 2014, there have been many reasons put forward for the slow adoption of organic agriculture within ASEAN. Principal among these are the difficulties of adhering to the organic regime, and lower farm productivity compared to conventional agriculture as well as the problem of obtaining cost-effective organic inputs or having the time and area to produce one’s own organic farming inputs, in addition to the costs and time involved in certification. Achieving sustainability and circularity is envisaged and planned as a much simpler and achievable

process, producing healthy food crops which demonstrate productive resilience, financial competitiveness, and matching outputs per hectare with the optimization and balance of inputs, both synthetic and organic.

There is an opportunity today to not just respond effectively to the current crisis, but to roll back distortive, inefficient, and environmentally harmful support, thereby freeing up financial resources for investments in a more productive, sustainable, and resilient food system able to meet the new challenges. This together with accompanying regulatory reforms, can help build an enabling environment for the entire food system that is aligned with natural resource limits, and changing climate, market demand, technological developments, and “low probability, high impact” catastrophe risks. The unanticipated shock of Covid-19 underscores the need for a shift from “business as usual” policies to a more forward-looking policy package that invests in the productivity, sustainability, and the resilience of the global food system.

Issues and Concerns: Sustainable farming is certainly not the principal form of farming presently within ASEAN. A short look at the following table on Organic Agriculture will give an overall idea of the practical adoption of organic farming within SE Asia, at present:-



Source: Research Institute of Organic Agriculture (FiBL). *Organic farming in Southeast Asia. The ASEAN Post.* (Hasnan, L. (2019)

2. Circularity

2.1 Circular Agriculture for Sustainable Rural Development: UN/DESA (United Nations Department of Economic and Social Affairs) Policy Brief #105

The environmental, social and economic costs of the “linear” nature of the modern food production system are significant. Food-related CO₂ emissions could double by 2050 without changes to the current unsustainable food systems and consumption patterns. Circular agriculture is a way to farm sustainably, while making use of scientific advances, innovations and new technologies. Mixed crop livestock and organic farming, agroforestry and water recycling and wastewater reuse are key elements of circular agriculture.

The adoption of circular agriculture practices is particularly suited for labor intensive smallholder farming and contributes to more inclusive and gender sensitive economic development in rural areas. The strengthening of institutions and incentives such as water use associations and secure water and tenure rights along with enhanced international cooperation can spur greater application of circular approaches in agriculture. The huge increase in global food production in recent decades has come at a high cost for the environment. Half of the habitable land is now used for agriculture.

2.2 Circular Agriculture: Dealing with Agricultural and Food Wastes in ASEAN

Thailand, Indonesia, Philippine and Viet Nam produce more than 38 million tons of rice husks and 34 million tons of bagasse every year “Agricultural Wastes in Asia could be an important route to increased Sustainability” (Teysha Technologies, 2020). In addition, large amounts of biomass wastes are produced by the oil palm and rubber industries. This both represents a challenge and a major opportunity for the development of a circular economy using innovative technologies and profitable business practices to address the utilization of agricultural wastes, by products and co-products. The development of circular agriculture requires the adoption of a closed loop system which works towards the goals of improved economic and environmental sustainability.

Furthermore, food waste is one of the most pressing environmental and social problems facing the world today. A study done by Future Directions International, a non-profit institute found that 50% of South East Asia’s waste is food waste. “A Complete Overview of the Food Waste Crisis in South East Asia” (Adam Fortier, 2021). Circular agriculture develops models which have no net effect on the environment, ensuring that there is a reduction in resource use and waste production. It effectively reduces the wastes produced in agricultural and food systems and designs their use into other agricultural systems as other valuable coproducts. It is expected that circularization will provide mechanisms to increase recycling and valorization of agricultural waste by maximizing the use of by-products and coproducts via the creation of new sustainable value chains. With the recent UN report from COP26 identifying that 31% of all man-made GHGs originate from the agrifood system, we should develop future circular systems to valorize our agrifood wastes and lower the GHG production from the agrifood industry (UN.ORG, 2020).

2.3 Circularizing the System: The Importance of Circular Agriculture

Minimizing the use of external inputs, generating cost-effective valorized inputs from wastes.

- Closing nutrient loops, circularizing the system.
- Regenerating soils, increasing soil health and the effectiveness the soil microbiome.
- Minimizing environmental impacts, reducing greenhouse gases while improving the carbon trapping ability of soil.

2.4 Circular Agriculture: An Example from Europe

In the production of sustainable and circular agriculture inputs, ASEAN may learn from a similar project developed and operated by the European Union from 2017 to 2020, **AgroCycle**, which was carried out to valorize the 700 million tons/year of agricultural & food waste produced in Europe. Funds were provided from the EU and the Chinese Government. It involved 26 research Institutions including Research Institutions from China, as well as numerous private institutions in Europe as well as private industries and government institutions.

- Circular sustainable agriculture can and should be implemented in the various countries of ASEAN as part of the sustainable agriculture drive in ASEAN, a major part of this can be in valorizing agricultural and food waste. Principles of nature-inspired circular economy and sustainable economies can materialize the benefits of the circular economy into business opportunities, making it much more attractive than the sole concept of sustainable development which is often criticized for lacking a balance between environmental and economic objectives.

The Ellen McArthur Foundations' definition of the **circular economy** is based on 3 principles:

- ✓ Designing out waste and pollution
- ✓ Keeping products and materials in use, and
- ✓ Regenerating natural systems

3. Sustainable Agriculture

THE KEY GUIDING PRINCIPLES FOR THE ASEAN SUSTAINABLE AND CIRCULAR GUIDELINES:

- **Increasing productivity, employment and value addition in food systems**
- **Protecting and enhancing natural resources**

SUSTAINABLE GUIDELINES

The world urgently needs to change the way it produces and consumes food. In the coming decades, the global agricultural system must find ways to meet pressing but sometimes competing needs. Farmers must provide enough food for a population that is expected to reach nearly 10 billion people by 2050. Employing around 2 billion people today, agriculture must continue to be an engine of inclusive economic and social development that contributes to poverty reduction, even as many small farmers transition into other forms of employment. At the same time, agriculture must lighten its environmental footprint. The impacts of agriculture are large and growing, where they are already undermining food production through land degradation, water scarcity, and adverse impacts of climate change.

As the global population grows and incomes rise across the developing world, overall food demand is on course to increase by more than 50 percent by mid-century, and demand for animal-based foods by nearly 70 percent. Yet even today, hundreds of millions of people remain undernourished as local agricultural systems fail to provide enough nutritious food, and economic factors prevent equitable distribution of available food. This report is the product of a multiyear collaboration between World Resources Institute, the World Bank Group, the United Nations Environment Programme, the United Nations Development Programme, the Centre de coopération internationale en recherche agronomique pour le développement, and the Institut national de la recherche agronomique. Creating a Sustainable Food Future defines and quantifies three specific challenges facing the global food system:

- **Food supply.** If consumption trends continue as projected, the world will need to increase food production by more than 50 percent to feed nearly 10 billion people adequately in 2050.
- **Land use.** To protect natural ecosystems critical to biodiversity and climate change mitigation, the additional food must be produced with no net expansion in the area of agricultural land. Without action, cropland and pastureland are projected to increase by nearly 600 million hectares by 2050.
- **Greenhouse gas emissions.** Agriculture has not been a major focus of emissions mitigation, other than as a potential source of carbon sequestration in soils. Yet farming is a significant and growing source of emissions. To limit agriculture to its "fair share" of total allowable emissions in a world where global temperatures have risen by 2 degrees Celsius, the sector must address the demand for 50 percent more food while reducing emissions by two-thirds from 2010 levels. And to stay under a 1.5-degree Celsius rise in temperature, these emissions will need to be further reduced by reforesting at least 585 million hectares of agricultural land freed up by productivity gains and reductions in demand.
- **Water scarcity.**

Achieving that level of production from an already seriously depleted natural resource base will be impossible without profound changes in our food and agriculture systems. We need to expand and accelerate the transition to sustainable food and agriculture which ensures world food security, provides economic and social opportunities and protects the ecosystem services on which agriculture depends.

We must strive to develop a common vision and a coordinated approach towards sustainable food and agriculture that is comprehensive and knowledge-based while being responsive to the needs and expectations of ASEAN Member States.

ASEAN SUSTAINABLE AGRICULTURE:

3.1 Guidelines

The 5 key principles that balance the social, economic and environmental dimensions of sustainability:

1. **Improving efficiency in the use of our resources.**
2. **Conserving, protecting, enhancing natural ecosystems, promoting and enhancing nature resources and communities.**
3. **Protecting and improving rural livelihoods and social well-being.**
4. **Enhancing the resilience of people, communities and ecosystems, and**
5. **Promoting good governance of both natural and human systems.**

These five principles provide a basis for developing national policies, strategies, programmers, regulations and incentives that will guide the transition to an agriculture that is highly productive, economically viable, environmentally sound, and which is based on the principles of equity and social justice.

Cost effective sustainable fertilizers and feeds are very much a part of the solution for cost-effective sustainable agriculture in ASEAN. The majority of ASEAN countries import an unsustainable amount of chemical mineral fertilizers and raw materials for feeds into ASEAN for use in most aspects of our farming operations. As an example, Malaysia imported 749.47 million USD worth of mineral fertilizers in 2020 as well as 90% of the raw materials (soybean meal, wheat and corn) for its animal and aquatic feed production. Grain corn import in 2017 was 737 million USD. (Trading Economics.com, 2021, The Edge Markets)

- It is clear that the use of mineral fertilizers is a costly unsustainable practice with the increasing use of mined natural minerals being extracted from the earth and at the same time, large quantities of agricultural biomass which may have been valorised into cost-effective fertilizers have been left to decompose and worsen environmental pollution. ASEAN produces large amounts of agricultural biomass wastes within the rubber, oil palm, rice and other industries. Sustainable production of fertilizers and feeds from agricultural biomass waste is a subject which has been studied by researchers from many angles through many years, and many feeds and fertilizers produced from these valorised agricultural biomass wastes been successfully researched and produced (a partial list of these valorisations are provided in Appendix C). In addition, many companies now have begun to provide valorised wastes and systems into the market.
 - Composts from various agricultural waste and food wastes.
 - Liquid fertilisers from agricultural wastes.
 - Feeds and fertiliser input materials from food wastes.
 - Automated vegetable food production systems using cost-competitive valorised agrifood wastes.
- ASEAN's Sustainable Agriculture Guidelines emphasize and support effective and practical sustainable measures to valorize this biomass waste produced within ASEAN into cost effective production of sustainable farming inputs for a sustainable ASEAN food industry, while creating a greater range of jobs for sustainable input production. It is hoped that guidelines will lead to greater cooperation amongst AMS towards the development of the cost-effective sustainable and circular fertilizer and feed inputs, making the adoption of sustainable agriculture in the region profitable for both the industry and the farmers adopting sustainable strategies. The ASEAN Sustainable Agriculture Guidelines further act to encourage agricultural cooperatives to take further part in sustainable agriculture encouraging many private companies, SME's and agricultural cooperatives to be involved in the production needed to develop the cost-effective sustainable fertilizer and feed inputs needed for the industry.
- The carbon footprint of importing such large amounts of mineral fertilizers as well as feed raw materials such as soya bean meal, wheat and corn should be reduced. Additionally, the cost

involved in the purchase and shipping of these materials from markets in the Americas has continued to reduce the cost effectiveness of ASEANs agriculture, aquaculture and animal husbandry. The ASEAN Sustainable Guidelines focus on relevant species cultured within ASEAN and encouraging the development of ASEAN biodiversity, integrating all aspects of sustainable agriculture. The present overuse of mineral fertilizers could be lessened to reasonable levels with increased use of valorized organic fertilizers to increase TOC levels in the soil. Sustainable alternatives will have to be developed.

GENERAL NEEDS

- Sustainable agriculture input production is an important component in this drive for ASEAN sustainable agriculture. Market-based incentives can encourage behavioural change by providing economic incentives.
- New supportive policies can help to develop these sustainable agriculture strategies.
- Available funding as needed for the development of strategies and implementation plans for sustainable agriculture development, while
- Governmental Bodies and Departments need to be organized to encourage the establishment and expansion of sustainable agriculture solutions and technologies.

3.2 Strategies: Key Strategies

1. **Improving overall soil health: Reducing overfertilization of the soil base, applying of targeted organic fertilizers and amendments, and reducing the over application of agrochemicals to meet optimum soil productivity.**

Soils are the vital source of most of our food. If we are to ensure global food security and nutrition, it is crucial that the soil microbiome be nurtured and protected.

Ensuring a Healthy Soil Base

- Soil Health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. Healthy soil gives us clean air and water, bountiful crops and forests, productive grazing lands, diverse wildlife, and beautiful landscapes. Soil does all this by performing five essential functions:
 - Regulating water
 - Sustaining plant and animal life
 - Filtering and buffering potential pollutants
 - Cycling nutrients, and
 - Providing physical stability and support
 - The main principles to manage for soil health are:
 - Maximise the presence of living roots
 - Minimise any soil disturbance
 - Maximise soil cover
 - Maximise the soil biodiversity
2. **Reducing greenhouse gases from agriculture-related activities:**
 Agriculture emits 24.8% of Global Greenhouse Gases (GHGs) (Greenhouse gas emissions from cropping and grazed pastures are similar: a simulation analysis in Australia – Elizabeth A. Meier, et. al., Jan 2020). The agrifood section produces a total of 31% of the anthropogenic GHG emissions (UN, COP26, 2021).
 - 16.5 billion tonnes of GHG emissions from global total agri-food systems in 2019.
 - billion tonnes from within the farm gate
 - 3.5 billion tonnes from land use change, and
 - billion tonnes from supply chain processes (UN, COP26, Nov 2021)

Employing effective strategies to reduce GHG production in agrofood systems. These strategies include:

- Enhancing soils as a carbon sink
- Technologies and materials to reduce crop-related emissions and to reduce and capture livestock emissions
- Employing renewable energy systems on as many farms as possible
- Valorizing agricultural and food wastes
- Development of novel farming systems

3. Closing nutrient cycles/loops and Valorisation of agricultural waste biomass and food waste foods into cost-effective feeds and fertilisers:

- Promoting circular agriculture, valorising agriculture and food wastes into cost-effective feed and fertiliser inputs
- Reducing the need for imported mineral fertilisers
- Preventing contamination of the environment by biodegradation of agriculture and food wastes.
- ASEAN produces a large amount of food wastes a year (53,228,198 tonnes per year) – (Food Waste Index Report, ASEAN, 2021).
- In addition, just 3 ASEAN Member States: Indonesia, Malaysia and Thailand produce 854.1 million tons of agriculture biomass waste from the oil palm industry alone. ASEAN produces a large quantity of agricultural waste with the oil palm industry alone in three countries (Indonesia, Thailand, and Malaysia) being responsible for more than 850 million tons of biomass waste per year (Transitioning to a Sustainable Development Framework for Bioenergy in Malaysia. Policy Suggestions to catalyze the use of Palm Oil Mill Residues – Siti Fatimah Salleh, et. al., 2020) (The Availability and Assessment of Potential Agricultural Residues for the Regional Development of 2nd Generation Bioethanol in Thailand – P. Jusakulvijit, 2021) (Availability, Use and Removal of Oil Palm Biomass in Indonesia – Christopher Teh, 2016).
- Much of this is not utilised, instead adding to the environmental pollution with GHG formation resulting from biogenic emissions from decaying biomass.
- The science of the valorisation of these biomass wastes has been developed by both government research bodies and private industry but the lack of supportive policies and legislation have discouraged the expansion of the industry.

4. Collaborations along the agriculture and food chains

- Encouraging the linkage between governmental bodies, private industry and farming communities.
- Encouraging more research and development on practical, cost-effective technologies and systems. Bridging the gap between research bodies and the farming communities.

5. Improving biodiversity

“Biodiversity is essential for sustainable development and human well-being. It underpins the provision of food and water: It mitigates and provides resilience to climate change: it supports human health, and provides jobs in agriculture, fisheries, forestry and many other sectors. Without effective measures to conserve biodiversity and use its components in a sustainable manner, the 2030 Agenda for Sustainable Development will not be achievable.” (“Biodiversity at the Heart of Sustainable Development”, Secretariat of the Convention on Biological Diversity, April 2018)

- Nutrient cycling
 When plant communities are made up of many different plant species, they make better use of the available soil nutrients than plant communities made up of fewer species.

This has been named complementarity, which means different plant species access the

available nutrients in different ways, for example from different soil depths.

- **Habitat provisioning**
This covers the functional and structural quality of habitats and their communities as a basis for multiple human uses.
- **Pollination**
Is one of the most important mechanisms in the maintenance and promotion of the biodiversity and in general, life on earth. Many ecosystems, including many agro-ecosystems depend on pollinator diversity to maintain overall biological diversity.
- **Erosion control**
Studies show that plant biodiversity decreased soil erosion over monoculture. Increasingly pronounced degradation of the environment and its biodiversity in today's society, a common concern more than ever remains the conservation or restoration of its (the environment) quality "Reconciling erosion control and flood prevention with restoration of diversity is an important challenge for our societies today" (Harmonizing erosion control and flood prevention with restoration of biodiversity through ecological engineering used for co-benefits Nature based solutions – Freddy, R. 2021).
- **Climate regulation**
"We cannot address biodiversity loss without tackling climate change, but it is equally impossible to tackle climate change without addressing biodiversity loss. Protecting and restoring ecosystems can help us reduce the extent of climate change and cope with its impact. Protecting biodiversity can help us to adapt to climate change. "Climate change could undermine our efforts for the conservation and sustainable use of biodiversity. We need to help biodiversity adapt to changing temperature and water regimes and we have to prevent, minimize and offset any potential damages to biodiversity arising from climate change adaptation and mitigation measures" (European Commission Biodiversity and Climate Change.2021).

6. Ensuring Food Security:

- Examining the large-scale adoption of sustainable technologies and systems in cereal production, vegetable, and fruit production within ASEAN. Increasing food production without expanding agricultural land, protect and restore natural ecosystems, increase fish supply through improved wild fisheries management and aquaculture and reduce GHG emissions from agriculture and food processing.

7. Promoting the use of smart and precision agriculture systems in sustainable food production:

- Adoption of sensors, probes, and monitoring systems to increase the speed, accuracy, and efficiency of sustainable farming.
- Increasing soil productivity and crop production
- Reducing food losses through precision handling

8. Facilitating funding with productive resources finance and services

Increased funding needed for more:

- Research and development in sustainable food production and agriculture in ASEAN.
- Pilot-scale testing of methodologies
- Farm-scale systems
- Farming incentives / grants / loans
- Incentives for ecosystem services – packages of measures that aim to support farmers in the adoption of sustainable agriculture practices that will benefit the environment and improve long-term food security.

9. Connecting smallholders to markets:

- ASEAN could discuss and adopt policies which would improve market access for smallholder farmers for sustainable agricultural produce. Smallholder farmers often lack access to profitable, value-added markets. In the absence of critical supporting functions – such as infrastructure and service provision, farmers struggle to shift from the less-demanding local markets to higher-value sustainable markets.
- Markets with a higher purchasing power, like sustainable higher-value agricultural markets, offer opportunities for smallholder farmers to move out of poverty. Logically, production for these higher-value markets require a different set of farm resources than the basic factors of production like land and labour. “Smallholder producers in developing countries require to increase their competitiveness and sustain their participation in higher-value markets”: “Towards achieving sustainable market access by South African smallholder deciduous fruit producers: the road ahead” (Grwambi, et al, 2016).

Stricter and increasing requirements of higher-value markets place smallholder producers at a competitive disadvantage relative to larger farmers. Smallholder farmers limited access to key resources (including cultivable land, irrigation and financial resources) inhibits investment required for participation in high-value markets and farm productivity (McCullough and Ota, 2002). The lack of infrastructure, key production assets, information, and/or collective action act to constrain smallholder entry to high-value markets and threaten the sustainability of such participation over time.

10. Encouraging diversification of production and income:

- Encouraging farming cooperatives, farmers, and management to diversify their agricultural products via education and training.

11. Building farmers and food production personnel knowledge base and developing their capacity:

- Providing education and practical training for all levels of the food production cycle.
- Enabling the seamless connectivity between education and research facilities through to the farming community, processing, and marketing.
- Certifying sustainable agriculture graduates.

12. Encouraging more research and development on sustainable and circular agriculture and food production:

- Providing more funding for institutions of higher learning as well as educational facilities for knowledge development in all aspects of sustainable and circular agriculture and food production.
- Encouraging and providing for knowledge enhancement and training of graduates, farmers, technicians, and researchers of all related disciplines in purpose-driven educational agriculture and food courses.
- Developing model farms for the purpose of hands-on training of participants from farming communities, private industry, and government bodies.

13. Promoting the set-up of new sustainable and circular initiatives:

- Supporting both farming cooperatives and private industry initiatives to develop new novel, sustainable farming, and food production systems, with supportive structures, and incentives.

14. Aligning ASEAN agricultural standards with those of our major export markets.

- Assuring compliance with health and safety rules as well as compliance with set MRL pesticide limits on agricultural goods, reducing and ultimately removing the need for the use of Highly Hazardous Pesticides (HHPs) which are already banned in the European Union (EU) for agricultural products exported to the EU. The EU is planning to ban all imported agricultural products made with banned pesticides.

15. Strategizing to replace Highly Hazardous Pesticides (HHPs), broad spectrum pesticides and neonicotinoids in ASEAN agriculture:

- Following from the need to align ASEAN agricultural standards with our export markets, and the need to protect farming communities and the environment, ASEAN should take steps to reduce and to replace the use of HHPs, broad spectrum pesticides, and neonicotinoids in ASEAN agriculture. The use of broad-spectrum pesticides results in reduced biodiversity on farms (Lundgen and Fausti, 2015). The importance of biodiversity and ecosystem services in agriculture is paramount to enable biological control of pests by natural enemies (Oerke, 2006). Reducing the use of neonicotinoids reduces the damaging effects on pollinator bees.

16. Encouraging private sector research participation in new, modern, smart technologies in sustainable food production.

- Sustainable food production must be productive. The development and use of modern, efficient productive food systems which support sustainability and circularity in food production is a key component in this strategy in the roadmap for towards sustainability and circularity. It is also a key strategy in attracting young farmers and entrepreneurs to engage and participate in sustainable and circular food production.

17. Developing / setting aside the necessary funding for the research and development of practical sustainable and circular agricultural technologies.

The broad areas of R&D include:

- Sustainable fertiliser, feed and other input production.
- Sustainable and circular agriculture and food production and processing systems.
- Various community incentive schemes for sustainable and circular agriculture initiatives can be developed.

Sustainable and circular agriculture targets can be supported by a budget which promotes and fund the many necessary changes in infrastructure, R&D, educational, and implemental plans (more on this is discussed on a section on funding) towards the road to sustainability.

18. Reducing the reliance on the use of agrochemicals in agriculture, balancing the use of organic and chemical fertilisers.

The overuse of agrochemicals, including pesticides, chemical fertilisers within ASEAN is detrimental to both environmental health as well as to the competitiveness of ASEAN agricultural and food produce. Recent increases in the prices of imported pesticides and fertilisers have exacerbated this.

AMS together produce large volumes of agricultural wastes as well as food wastes and these agrifood wastes can and should be valorised to form cost-effective organic inputs. A proper balanced application of mixtures of organic and chemical fertilisers will result in reproducible, sustainable, productive agriculture.

19. Encouraging the development of sustainable, environmentally-friendly farming input alternatives within ASEAN.

- Incentivising and promoting the valorisation of our agricultural and food wastes, from research and development initiatives to the adoption of valorised inputs in agriculture, aquaculture, and animal husbandry.
- Encouraging discussions and implementation plans between government bodies, farming communities, and the private sector.

20. Encouraging the participation and training of targeted marginalised communities to be involved in sustainable agriculture systems:

- Developing policies, strategies, and implementation plans to empower the rural communities as well as to organise education and practical training of the rural communities, including indigenous communities. "Rural populations are among the most

marginalized people in society. Their limited access to knowledge, information and resources, and restricted organizational capacity and bargaining power often leave them ill prepared and unable to benefit from opportunities arising from the rural transformation. As the world food producers and natural resources managers attributing a fair value to their work as part of a sustainable food system is central to addressing inequality and attaining multiple objectives of the 2030 agenda” – Transforming Food and Agriculture, UN.

21. Improving the participation of women and youth in sustainable smart systems:

- More participation of women in modern smart sustainable systems, both in food production and processing. Sustainable modern smart systems provide more opportunities for equal participation of women in agriculture and attract more youth to participate in smart systems.

22. Adopting policies and strategies to reduce the development of antimicrobial resistance within ASEAN.

- Antimicrobial resistance is a large and growing problem in the world as well as ASEAN and several newer and safer strategies can replace the use of antibiotics in aquaculture and animal husbandry. The use of Biological Control Agents (BCA) is one of these strategies. Policies and regulations for the use of BCA within ASEAN have to be reviewed and should be harmonised within ASEAN.

23. Reducing the environmental impact of agricultural and food production.

- Recently, the FAO announced that a detailed study had shown that 31% of human-caused GHG emissions originate from the world’s agrifood systems, with 7.2 billion tonnes of GHG emissions alone from the farm gate. Much more needs to be done to reduce the level of GHG emissions from the agrifood industry.

24. Improving the health and well-being of the farming community in ASEAN.

- Agriculture is a vital sector for the ASEAN community, accounting for over 25% of the GDP in some member states and providing more than 40% of vital employment in Myanmar (Invest in ASEAN, Jan 2022).
- A major component of sustainable agriculture is the focus on the social health of the farming community as well as greater equitable sharing of the economic returns with farming communities.
- Reducing and replacing the use of HHPs as well as other more toxic chemicals as well as better health monitoring of agricultural chemical applicators are encouraged.

25. Supporting and setting up the support policies, rules and regulations necessary for the development of the entire sustainable and circular industry:

- Input production
- Farming systems and technologies
- Processing technologies
- Marketing
- Education and training, and
- Research and development

26. Discouraging and disallowing any further clearing of primary jungles, mangrove areas, peat lands, and other areas deemed environmentally valuable.

- Focusing on the development of more integrated farming to integrate various farming systems into large areas of monoculture oil palm, rubber, and other large monoculture plantations. In order to achieve increased food production, and food security within the ASEAN Member States, AMS should look to sustainably maximise the production of food from within the areas which have already been cleared. Maximising food production and developing food security in the ASEAN Member States should be focused on increasing sustainable food productivity within presently available arable land area. Preserving the existing biodiversity and integrity of the natural habitats like the mangroves and tropical rainforest systems is an essential component.

27. Developing and encouraging various sustainable urban agriculture initiatives to provide food within urban areas.

- Urban farming is a response to food and livelihood insecurity and has the advantage in that locally-grown food requires less transportation and therefore reduces the ecological footprint.
- Separate from community gardening, the ultimate goal is to produce food for food trade and sales. Much of this developing area is dominated by the use of hydroponic systems and hydroponic chemicals. However, the latest agricultural systems launched during the MOSTI MCY 2021 (Ministry of Science and Technology and Innovation of Malaysia) also include automated systems utilising cost-effective valorised agriculture waste fertilisers (Organoponix MMS System).

28. Developing new sustainable and circular agriculture legislative frameworks.

- Putting into place the necessary framework which will support and incentivise the establishment of a truly sustainable and circular agriculture industry. The management of the transition processes to sustainability and circularity is critical to the establishment of an orderly program towards sustainability and circularity (**Appendix B**)

3.3 The Need for Sustainability in Agriculture

The global landscape is rapidly changing with environmental and health challenges and the world faces an uphill challenge of ensuring food supply for everyone on the planet today and in the future. Increasing global food production in a sustainable manner will be possible only if a complex set of factors are taken into account and put into place, putting soil health management first – an objective that can be achieved only with a balanced and rational use of both fertilizers, pesticides and organic farming.

Agricultural intensification has been a major key factor in boosting global food production in the past 50 years and this has fed the rapid population growth. The global per capita food supply has similarly increased rapidly, with yield per hectare nearly double in a 20-year period. This remarkable achievement in food production has contributed to hunger reduction and improved nutrition and has been primarily the result of technological advancements and increased inputs—fertilizer, water, pesticides, drugs, new crop varieties, and high-producing livestock breeds, products of the Green Revolution. The boost in food supply and agricultural technologies advancement has at a high cost to the society and the environment.

However, this increase in production alone has not been sufficient to eradicate hunger, as one out of eight people in developing countries still suffers from chronic hunger, mostly in Africa and Asia. From 2013 to 2050, global food production must increase by 50 percent in order to cope with increasing demand for food from population growth.

Included amongst these detrimental consequences are land degradation, including increasing desertification, soil erosion, soil fertility decline, soil acidification, increasing salinization and over-extract of groundwater in irrigated lands, pollution of groundwater and watersheds—resulting in human and environmental health impacts, and climate change due to greenhouse gas emissions from fertilizer and fossil fuel for machines in agricultural activities.

The ability of our world to feed itself will be threatened unless there is a deliberate effort to restore, conserve and manage the existing agro-ecosystems in a sustainable way. This challenge is enormous and multifaceted, considering that the global soil health is already overstretched, and further made worse by the increasing threats posed by climate change. The need for sustainable and circular food production to meet food security needs as well as to meet tightening export requirements.

The case for agricultural production intensification in the 21st century is generally based on two premises:

- 1) The world needs to produce more food to feed the growing global population;
- 2) The available arable land cannot be expanded without compromising the planet's resources through more deforestation.

Increasing food production without expansion of agricultural lands means increasing production on the existing agricultural lands. This increase of food production should be based on sustainable systems of food production. This need to increase production is also normally the argument for justifying high-input, industrial-oriented monoculture models, with inadequate consideration to the impact on the environment and the socioeconomic dimensions of sustainability. Numerous studies, especially in the last few years have shown that intensification of the farming systems alone without concern for sustainability is counterproductive.

The sub-optimal use of inputs as well as the insufficient adoption of technically productive technologies, including that of Biological Control Agents and Integrated Pest Management (BCA/IPM) strategies has left opportunities for increasing productivity in a sustainable way. Any production system that does not create income, address social aspects and contribute to improving the livelihood of the farming community cannot be considered sustainable. Farming systems need to be cost effective, productive and at the same time be deemed sustainable for future food production.

AGRICULTURAL SUSTAINABILITY

3.4 Soil Carbon:

Intensification of agricultural production in the past century has seriously undermined the sustainability of the farming sector, resulting in widespread degradation of key environmental resources, such as land, and water. One pernicious side effect of intensified farming is a nutrient surplus, which is defined as a positive difference between the amount of nutrients added to the soil (e.g., via fertilization), and the amount of nutrients taken or removed (European Environment Agency, Agricultural Land, Nitrogen Balance, 2018).

“Towards a global scale soil climate integration strategy” – the 4 per 1000 initiative: Soils have become part of the global carbon agenda for climate change mitigation, and adaptation through the launch of these high-level initiatives including the “4p1000” initiative which was launched at CoP 21 in 2015. The name of the initiative reflects that a comparatively small proportional increase (4%) of the global Soil Organic Carbon (SOC) stocks in the top 0.3 → 0.4m of all non-permafrost soils would be similar in magnitude to the annual global net atmospheric CO₂ growth. (Rumpel C., et. al., Put more carbon in soils to meet Paris climate pledges – Nature, 2018). The second soil carbon initiatives were the Koronivia workshops on agriculture which included soils and SOC for climate change mitigation and were initiated at CoP 23 in 2018. Then in 2019, the FAO launched RECSOIL, a program for the re-carbonization of soils (FAO, 2019).

Once again, at the global climate change Conference of the Parties (COP26) on the 4th November 2021, numerous leaders and experts issued a warning that soil care and health must be part of the Global Climate change agenda.

The Coalition of Action 4 Soil Health (CA4SH) was created in Sept. 2021 during the UN Food Systems Summit and is an amalgamation of multiple private and public sector actors for the purpose of improving soil health at the global level by addressing:

- Critical implementation
- Monitoring
- Policies, and
- Public and private investment barriers that restrict farmers' attempts to adopt healthy soil practices.

Kelly Witkowsky, the introducer of the program commented that,

- ✓ “Eighty percent of carbon is stored in our soils, which presents both a problem and an opportunity. We usually place more focus on trees, but we must give greater visibility to soils which are the source of 25% of biodiversity.”
- ✓ “We must work with farmers in the field to find out about the obstacles that they face, understand their needs and facilitate their training.”
- ✓ “Soil has been the source of life and prosperity for all civilisations throughout history and soil health is a determining factor for at least seven of the sustainable development goals (SDGs) that were adopted by the UN Member States.”
- ✓ “Life essentially depends on soil health. Today, more than 40% of the Earth’s surface is degraded and 840 million people are suffering from food insecurity. We must restore the health of our soils through healthy, carbon negative agricultural practices.” (Rattan Lal, Carbon Management and Sequestration Centre (CMASC) – COP26, Nov. 2021)
 - Maintaining and increasing soil organic carbon stocks have multiple co-benefits.
 - Soil organic carbon stocks are finite, reversible and fragile.
 - We need inclusive and structured consultation processes for policy-making decisions.

On current trajectories, up to 90% of the soil, upon which we rely on our food production and water management, will be degraded by 2050 (CoP26, Nov. 2021). Sustainability in agriculture should not be interpreted as advocating a return to the original farming methodologies without use of fertilizers or pesticides, nor a promotion of pure organic farming alone. Rather, there is a need to promote a vision of sustainable agriculture that ensures improved soil productivity and soil health, and reduced and more efficient use of inputs, with conscious effort to conserve the natural resources base and maintaining the plants productivity. This warrants an integrated approach and combination of responses, as there is no magic bullet. No single approach or technology can provide all the solutions for specific soil fertility constraints that prevail in different locations. The future of agriculture will depend on a healthy balance of combining mineral fertilizers with organic, mainly biological nutrient sources.

Sustainable crop production intensification aims at producing more from the same area of land and other natural resources while conserving resources, reducing negative inputs on the environment and enhancing natural capital and the flow of ecosystem services. In order for food and agricultural systems to be sustainable, they must equally and simultaneously address the social, economic and environmental dimensions. Neglecting any one aspect jeopardizes the attainment of sustainability in the other dimensions.

The challenge of producing enough food for the world should not be focused at intensification of food production at any cost, but to ensure sustainability of agricultural production systems; otherwise, it will be tantamount to mortgaging the resources needed by the future generation in order to meet the current needs. Soil fertility depletion cannot be addressed simply by pumping more and more chemical fertilizers in to the soils, it should consider to soil nutrient balance and crop requirement. Efforts that reduce and optimize the use of chemical fertilizers without compromising soil productivity, maintaining the natural resource base and human health, are the future of agriculture.

There is great urgency and perils of deferment as we transition to a more sustainable agriculture. Food and nutrition security strategies must ensure that the soil is healthy to produce healthy plants, nutritious diets and enrich human health. This requires viewing the crop production with a focus on soil health, nutrition and with sustainability perspective, within the wider context of food systems.

3.5 Maintaining Soil Health

Soils are fundamental for the production of food, crops, feed, fibre, fuels and many essential ecosystem services, and regulates water resources and climate. Most of global human food production depends on the health of soil. Farming practices through the ages have led to accelerated soil fertility depletion through erosion and nutrient removal. Scientists have warned that modern agriculture is increasingly transforming the planet and is gradually throwing the soil’s cycle out of balance. Studies show that about

33 percent of global soils and more than half of agricultural soils are moderately or highly degraded due to unsustainable management practices (FAO and ITPS, 2015).

On a global scale, an annual loss of 75 billion tons of soil from arable land is estimated to cost about USD 400 billion each year in lost agricultural production (FAO, 2017). Soil is the world's major storehouse for carbon, which also helps to regulate CO₂ and other greenhouse gases emissions. Soil organic matter is the principal sources of other nutrients. It is a good indication of good soil health, and crop response to fertilizers. In general, soil organic matter levels are declining and the use of chemical inputs is intensifying. As stated by Patrick et al (2013), the soil organic carbon threshold for sustaining soil quality is widely suggested to be about 2% below which deterioration may occur. There is need to promote sustainable soil management practices that can build up the soil organic carbon capital.

The future of sustainable agriculture is through integrated nutrient management that ensures soil health and increased soils and plants productivity. We need to find the right balance on intensification that manages the use of chemicals input in balanced amounts, reduce soil compaction and maintain soil health.

3.6 The Crucial Role of Soil Biodiversity

Agricultural sustainability requires effective and suitable management of the soil, water and crop. The soil is the planet's most biologically diverse ecosystem. Soil biodiversity plays a central role in maintaining soil organic matter, soil fertility and soil health dynamics. Recent studies have shown that microbial biodiversity is responsible for 77% of carbon mineralization activities. Soils organisms act to decompose organic residues in soil aeration, and in the storage of water, reducing erosion, breaking down of organic matter and increasing plant nutrition. The soil microbiome can also suppress disease-causing soil organisms, and soil-borne plant pathogens to lead the production of healthy crops by reducing the use of agrochemicals. Sustainable soil management practices conserve the ecological processes, reduce/lessen the negative environmental impacts.

3.6.1 Problems with Usage/Misuse and Overuse of Agriculture Inputs

3.6.1.1 Wastes in Fertilizer Usage, Misuse and Overuse

In the last 50 years, the global fertilizer use has increased by 500 percent (and over 800 percent for nitrogen alone!). The world fertilizer nutrient (N+P₂O₅ +K₂O) consumption has increased from 162 million tonnes in 2008 and 201 million tonnes in 2020 [World Fertilizer Trends and Outlook to 2020 (FAO)]. Overall, mineral fertilizers have estimated to have been responsible for the 40 percent of the increase in food production. This is due to the fact that, nitrogen availability is the most important determinant of yield in most major crops. However, several environmental problems are associated to the input-intensive monoculture-led, industrial and commodity-based agriculture model that now dominate food production while mineral fertilizers still have a part to play in the production of food. Nitrogen use efficiency (NUE) is generally low, usually less than 50 percent and averaging 33 percent globally. More of concern it that the NUE is also declining, from 80 percent in 1960 to 30 percent in 2000. Approximately 67 percent of N applied to crops are uncaptured for in form of N loss through gaseous emissions, soil leaching, surface run-off, as well as through volatilization and denitrification. As a result, farmers have to apply far more N fertilizer than is needed, and most of it is wasted.

The excessive use of chemical fertilizers, specifically phosphorus and potassium, which have to be mined from reserves held in rocks and minerals, poses major threats to future food security. Furthermore, energy required for production of synthetic fertilizers make agriculture and soil fertility, in particular, large GHG producers. Fertilizer contamination also poses the danger of eutrophication of lakes, rivers, and coastal waters with damaging consequences on aquatic systems. With all these facts, it is compulsory to use fertilizers in appropriate amounts and the use of natural source (with no chemical process) such as rock phosphate could be an option as a nutrient source.

3.7 Implementation Programs and Monitoring Evaluation

In a review of 5 Climate-Smart Agriculture Programs (ASEAN CRW) program which have been carried out in ASEAN, Nicole Anschell of the Stockholm Institute, in summary of these ASEAN programs, concluded with the strong suggestions that:

- Guidelines should be produced with a concrete implementation plan that involves relevant stakeholders and provides adequate funding.
- A workable and suitable monitoring, evaluation (M&E) and learning framework needs to be developed to assess regularly how guidelines are being used. If this is not possible, M&E should at least be built into existing sectoral frameworks within ASEAN by specifically asking how the different guidelines are used.
- Guidelines are viewed as an important policy tool to steer thematic areas of work by distilling global, regional and national best practices into a compendium that is accessible to AMS.

The ASEAN Programs will have steps on the Preparation of guidelines:

- 1) Preparation of guidelines;
- 2) Understanding guidelines and making relevant stakeholders take ownership of the guidelines;
- 3) Distilling global, regional and national best practices into a compendium;
- 4) Develop implementation and funding plans;
- 5) Monitoring and evaluation.

Monitoring evaluation and learning from the implementation of the guidelines will provide insight especially given the fact that the guidelines serve as an important policy vehicle to ASEAN's objective. Guidelines are sometimes produced without the intention of supporting implementation or monitoring but rather to compile existing practices or standards and act as a reference document.

However, these guidelines have been designed to lead to strategies and practical implementation plans in sustainable and circular agriculture. One very important observation and conclusion put forward by Nicole Anschell of the Stockholm Institute in her 2020 summary report on the review of effectiveness of various ASEAN was that: "In order to be implemented effectively, relevant stakeholders must take ownership of the guidelines and they must be paired with a concrete implementation plan or roadmap as well as adequate funding." Furthermore "A workable and suitable monitoring, evaluation and learning framework needs to be developed to assess regularly how guidelines are being used. Insight from M&E may be used to update or develop a follow-up guideline.

The following are some of the implementation plans and projects suggested which support some of the major areas of focus in sustainable and circular agriculture:

1. The Soil Health Card Portal:

The Soil Health Card was developed by the National Informatics Centre of India to providers.

This was designed to help policy makers in the following areas:

- Policy recommendations to climate resilience, soil and nutrient management.
- Help policy makers make the best decisions on soil and nutrient management.
- Enhance food security through sustainable agricultural production.

The Supporting Programs:

- The Soil Health Card Portal (SHC Portal)
- SHC: The centrality of Soil Health - Supporting Sustainable Agriculture in ASEAN

Soil is a central theme of all sustainable food production and a critical understanding of the functioning of soil and its interactions between soil, plants, animals and the environment as well as the inter-related functions of the soil microbiome is essential in order to develop and operate sustainable agriculture. The Soil Health Card Portal was developed by the National Informatics Centre of the Ministry of Electronics and Information Technology of India to help to provide farmers with knowledge and status of their land and give more recommendations on more precise dosages of fertilizers needed, curtailing overfertilization and promoting soil health.

2. Fertilizer recommendation book guidance for food crop, horticulture, plantation and feed crop
 - These recommendations are produced by Indonesia Agency of Research and Development under Ministry of Agriculture which represent 10 soil order in whole of Indonesia. This integrated information could be found in Kalender Tanam (Katam-Cropping Calender) System Information, which can be accessed via Android and web base by agriculture extension worker and policy maker.
 - Besides that, there are tools such as test kit for measures nutrient content and fertilizer recommendation for lowland, swampland and upland in Indonesia and Thailand.
3. The problem of the increased development of Antimicrobial Resistance in ASEAN and the world. The widespread use of antibiotics in Aquaculture and Animal Husbandry is fuelling the increase in antibiotic resistance. Alternative sustainable systems and products are needed. The food and agriculture division of the ASEAN Secretariat is working on developing programs for this.
4. Valorisation methods and systems for agriculture and food wastes to create cost-effective inputs (fertilisers and feeds) to replace expensive imported input raw materials and finished products.

Recycling Food and Agricultural Wastes

Recycling food and agricultural wastes as animal feeds or fertilizers should be done in properly-defined systems which reduce and remove the risk of transfer of any health hazards from the waste to the valorized feeds and fertilizers. For example, the use of cooked kitchen and table wastes as pig “swill” in pig feed in Europe caused severe animal disease outbreaks, including the outbreak of African Swine Fever (ASF) in the Netherlands in 1986 (Terpstra and Wensvoort, 1986) and food and mouth disease (FMD) in the United Kingdom in 2001 (Davies, 2002). Feeding swill was therefore banned in these countries, followed by a ban across the EU in 2002 (European Commission, 2002; Ministerie van Landbouw Natuur en Voedselkwaliteit, 2003 and Ministerie van Landbouw Natuur en Voedselkwaliteit, 2018). Since then, the EU legislation prohibits the use of animal products, catering wastes, and feeds which cause intra-species recycling (i.e. cannibalism) (Zu Ermqassen, et al, 2018).

Theoretically, the microbial safety of feeding waste to animals should be sufficient when it is heated and handled properly. (Duo et al, 2018). The use of heat-treated food waste is proven successful in countries such as Japan and South Korea where about 40-45% of food waste is reused as feed for livestock such as pigs (Zu Ermqassen, et al, 2018; Zu Ermqassen, et al, 2016).

However, systems used and deployed to recycle food and agricultural wastes also need to take into account microbial, chemical and physical contaminants which might be risk factors, and need to be well thought-out. The use of insect meal in animals and fish feed such as that from Black Soldier Flies (BSF), mealworms and crickets have, from 1st July 2017, been permitted in the European Union. These insects have been raised on both food wastes and agricultural wastes, and are also allowed to be used in animal and aquaculture feeds in the United States and Canada. In fish aquaculture, Thai companies are looking to replace unsustainable fish meal with insects (Dao, 2020) and this trend is the same in most Asian countries.

“In many cases, food waste residues are difficult to utilize for the recovery of value-added products due to their biological instability, potentially pathogenic nature, high water content, rapid autooxidation and high level of enzymatic activity. On the other hand, this biomaterial comprises a huge nutrient stock and could be valorized through biodegradation by various edible insect species in a mass-production system.” – Foodwaste as a potential new source for edible insect mass production for food and feed, a review – Vassileois Varelas, Aug 2019. Supporting the development and introduction of modern, smart, sustainable circular technologies. Promoting and incentivizing the research and development as well as the deployment of new innovative technologies needed to valorize agri-food wastes.

5. Supporting projects aimed at the reduction of greenhouse gases (GHGs) produced in agri-food systems. Supporting the use of renewable energy in agriculture and soil health projects. Supporting integrated projects such as agrivoltaics and decarbonisation.
6. Development of appropriate policies and regulations for sustainable and circular agriculture, and the deployment of Biological Control Agents (BCA) in Agriculture, Aquaculture, and Animal Husbandry.
7. Strategies to encourage private industry to participate in sustainable and circular agriculture initiatives.

ASEAN Member States should be encouraged to discuss possible sustainable and circular agriculture targets and timelines together. These targets and timelines can help as goals and targets for the AMS to gauge the progress of sustainable and circular agriculture development. These could be, for example targets to reduce the usage of agrochemicals, or adoption of strategies to lower the usage of antibiotics in aquaculture and animal husbandry by a set date.

4. The Importance of Funding in the Development of Sustainable Agriculture

4.1 Funding: The Role of Policy Making

Farming needs to be profitable. Farmers and smallholders must be able to afford inputs. Cost-effective sustainable inputs should be made available in order for sustainable agriculture to become a reality. Farmers need to be sure of making a reasonable income from their crops/produce. Funding must be developed and set aside for the development of sustainable agriculture programs in ASEAN.

Some countries protect income by fixing a minimum price for commodities, others explore “smart subsidies” on inputs, targeted to low-income producers. Policymakers also need to devise incentives for small-scale farmers to use natural resources wisely. This can be through payments for environmental services and land tenure that entitles them to benefit from increases in the value of natural capital, and also reduce the transaction cost of access to credit, which is urgently needed for investment. Major investment will also be needed to develop research and development and technology transfer capacity, as well as education and training in sustainable and circular technologies and farming methodologies.

ASEAN Member States will need to develop increased funding to investments in agriculture R&D addressing the growing problems of:

- Climate changes and global warming and more severe weather patterns.
- Reduced freshwater availability
- Depleting supplies of freshwater for agriculture
- Increased insect prevalence and resistance.
- Increased disease prevalence and antimicrobial resistance
- Decreased land availability
- Decreased soil productivity and depletion of soil health
- The need for more economically equitable and inclusive farming systems
- The need for circularity in Agriculture – maximizing the use of all agriculture and food byproducts and wastes.
- The need for more educational and practical training programs to engage farming communities, the private sector and governmental bodies in the new technologies and farming methodologies involved in sustainable and circular agriculture.

The need for sustainable agriculture development funding is paramount as discussed previously for the achievement of the ASEAN sustainable targets, while the process of transition and management of the agricultural economy from a linear, non-sustainable agriculture economy to a circular sustainable economy will need to be a well thought-out one. Funding will be needed to carry out operations and developments in:

- Optimising present systems to the most efficient levels, to be at its most sustainable and efficient food production systems.
- Developing multiple research and pilot scale and farm scale alternative systems which will supplement and eventually replace some of the standard linear and environmentally-polluting agricultural systems.
- Engaging various targeted and marginalised communities in sustainable agriculture education and practical training in successful alternative technologies and systems.
- Engaging and working with private industry to encourage and provide financial incentives to develop newer, modern, smart, and sustainable technologies.
- The training and equipping of government departments and regulatory bodies with relevant and accurate, up-to-date equipment to monitor and assess the level of compliance with the critical parameters assigned to sustainable and circular agriculture.

- The development of model farms throughout ASEAN which demonstrate and teach local farmers how to adopt the new sustainable agriculture technologies.
- Increased sustainable agriculture stakeholder workshops in ASEAN.

4.2 ASEAN and the European Union (EU) the Green Deal and the Farm to Fork Strategy: A Strategy in Developing a Sustainable Agrifood System

Everything in nature is connected. Our actions have an impact on our environment that is tangible, albeit indirect, not just in our immediate vicinity but also on the other side of the world. Thus, fertilizers spread within ASEAN have an influence on the natural balance of the oceans and the atmospheric level of greenhouse gases of the world which may help cause ecological catastrophe in other areas of the world. It is imperative that all food production for the future of the world is carried out within a vision of a common clean safe production system which itself produces clean safe food for populations in both developing and developed countries. The use or overuse of chemical inputs (fertilizers, feeds and pesticides) can create negative effects throughout the ecosystem, which itself can create numerous long-lasting effects on the environment, and by extension, the economy and society.

The European Green Deal provides us with an insight into a sustainable food production strategy which has been implemented by a group of countries to chart their sustainable growth together. It maps a “sustainable and inclusive growth strategy to boost the economy, improve peoples’ health and quality of life, care for nature and to leave no one behind.” (European Commission, Brussels, 2020).

The Farm to Fork strategy is at the heart of the green deal and “addresses comprehensively the challenges of sustainable food systems and recognizes the inextricable links between healthy people, healthy societies, and a healthy planet.” (European Commission, Brussels, 2020). The Covid-19 pandemic has underlined the importance of a robust and resilient food system that functions in all circumstances, and is capable of ensuring access to a sufficient supply of affordable food for all citizens. It has also made us acutely aware of the interrelations between our health, ecosystems, supply chains, consumption patterns, and planetary boundaries. COP26 highlighted the fact that a full one third (31%) of all anthropogenic greenhouse gas production results from activities within the agriculture and food production systems. New FAO analysis reveals carbon footprint of agrifood supply chain. (UN, 8th Nov 2021) The increasing recurrence of droughts, floods, forest fires and new pests are a constant reminder that our food system is under threat and must become more sustainable and resilient.

Under the Farm to Fork Strategy, the food chain, food production, transport, distribution, marketing and consumption is targeted to have a neutral or positive environmental impact, preserving and restoring the land, freshwater and sea-based resources on which the food systems depend, helping to mitigate climate change and adapting to its impacts. Protecting land, soil, water, air, plant and animal health and welfare and reversing the loss of biodiversity (European Commission, Brussels, 2020).

The sustainability of food systems is a global issue and food systems will have to adapt to face diverse challenges. The main goal of the European Green Deal is to achieve climate neutrality by the year 2050. In addition, the European Green Deal includes a circular economy action plan while the Farm to Fork Strategy and program aims to:

- Make 25% of the EU agriculture organic by the year 2030.
- Reduce by 50% the use of pesticides by the year 2030.
- Reduce the use of fertilizers by 20% by the year 2030.
- Reduce nutrient loss by at least 50%.
- Reduce the use of antimicrobials in agriculture and antimicrobials in aquaculture by 50% by 2030.
- Create sustainable food labelling, and
- Reduce food waste by 50% by 2030.

THE ADOPTION OF THE BCG ECONOMY BY THAILAND (2021-2026)

It is also relevant to note the adoption of the Bio-Circular-Green (BCG) economic model by Thailand as the new economic model for inclusive and sustainable growth. The BCG model is targeted to focus on promoting four industries:

- Agriculture and Food
- Medical and the wellness industry
- Bioenergy, Biomaterials, and Biochemicals, and
- Tourism and the creative economy

(NSTPA and the Bangkok Post, Thailand, 2021)

Included in the BCA-targeted areas for food and agriculture are strategies for:

- Migrating from low-value commodities to value-added and premium products as well as to diversify products.
- Reducing wastes from the agrifood sector, valorizing wastes.
- Smart farming technologies.
- A focus on food and product safety, and
- Development of higher-value agrifood products.

All these conform with the United Nations' sustainable development goals as well as the ASEAN guidelines for sustainable agriculture proposed in this document. Thailand's target via the National Plan for organic farming is to attain 208,000 hectares of organically farmed land, by 2021 (The ASEAN Post, Nov 2019).

4.3 The Halal Market in ASEAN: The Move towards Sustainability

While not in the scope of this paper to examine the development of the Halal Food industry itself, it is worthwhile to note the move towards sustainability within the Halal industry itself as the Halal-Tayibban or Tayyib-Halal industry and to acknowledge the importance of the developing Halal market in the world and the growing importance the Halal Food industry could be to ASEAN.

4.3.1 Halal and Tayyib-Halal Tayyiban Systems

- The Halal worldwide market is USD1.9 trillion and growing.
- ASEAN is home to 42% of the world Muslims (275 million).
- Malaysia and Indonesia are looking at playing a bigger part in the lucrative Halal industry.
- The concept of Halal-Tayibban (Clean and Pure) takes into account protection of health, food safety, animal rights, the environment, social justice, and welfare in food production, fair business practices and ethics. (Halal-Tayibban and Sustainable Development Goals: A SWOT Analysis – (Rozaidah Idris, et. al., 2021).
- There is a growing demand from Muslim consumers and markets for a broader definition of Halal that encompasses healthy food for humans, animals and the earth. This has been labelled as the quest for Tayyib-Halal food. This industry holds a very large potential within ASEAN.

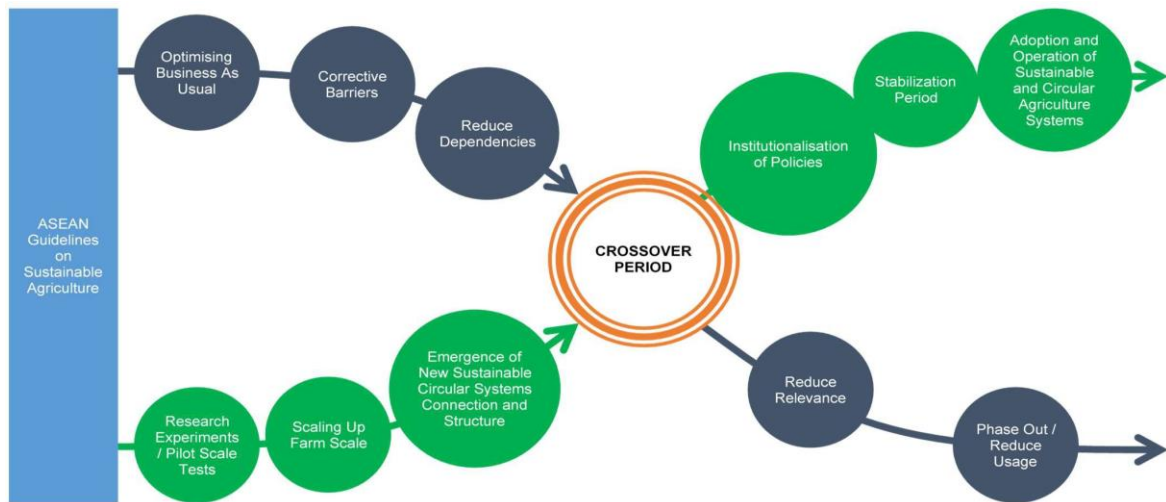
5. The Transition Process to Sustainability and Circularity

5.1 Transition Management to Sustainable and Circular Agriculture

The process of transitioning to a sustainable and circular agricultural system has to be well thought out and planned.

- Firstly, targets have to be discussed and set by the various ASEAN Member States. It would be mutually beneficial if ASEAN Member States could discuss and agree on specific targets, to be reached by a specific date or dates. This is to encourage the AMS to be able to schedule the necessary discussions and provide a timeline to the various AMS to work on towards sustainability. It is hoped that these targets will be harmonized throughout ASEAN Member States to enable efficiency and supportive efficiency between AMS.
- The pathways then diverge into two pathways – one pathway being the current pathway. In this case, an example can be given in the present use of Highly Hazardous Pesticides (HHPs). Broad spectrum pesticides and neonicotinoids in AMS. Applying the guidelines would target the reduction in use of these pesticides to lower the health risk to pesticide applicators (improving social sustainability) as well as reduce the deleterious effect on the environment (improving environmental sustainability) and increasing biodiversity while using safer, more cost-effective methods and products (e.g. Biological Control Agents, BCA) would make the farming method also more economically sustainable. In order to achieve this, the use of HHPs and other damaging chemicals may be discouraged with legislation discouraging the use of these chemicals (increasing duties, etc.) while decreasing the duties on safer BCAs.
- In addition, farmers could be trained and monitored to not over-apply pesticides to their farms and to protect themselves better while applying pesticides, while safer alternatives are being tested and field-tested. Thus, while the R&D and pilot testing of safer pesticides / systems are being tested and finalized, steps can be already enacted to make a positive step forward to replacing the Highly Hazardous Pesticides.
- Reducing the dependence of pesticides will lead to a crossover period. New replacement products and strategies will meanwhile have been developed from the R&D strategies worked on along the recommended pathways.

6. The Route to Sustainability: Transition Processes and Management



Adapted from "Circular Agriculture, Progress in Knowledge Development – To Support the Implementation." Wageningen University and Research, Dr. Saskia Visser, et. al., 2021.

These two pathways will meet in a crossover period which may well result in a temporary period of confusion in which one process is being substituted with another. The adoption of safer sustainable agriculture methodologies will result in the institutionalization of policies and further to a period of stabilization and the general adoption of the new sustainable and circular guidelines.

7. Harmonising AMS Strategies: The Need for a Common Platform

7.1 Harmonising AMS Strategies to Sustainability

The need for sustainability and circularity is central to the development of reproducible and productive agriculture for the future of ASEAN and it is hoped that AMS will agree to harmonizing strategies to achieve a strategic advantage for the region. Funding is required to ensure nationwide implementation. In addition, “successfully implemented guidelines that are actively rolled out in AMS usually have a project or programme supporting them, with clear funding.” – ASEAN Guidance for Climate-Smart Land Practices: A Review – Nicole Anschell, et. al., 2020.

7.2 Sharing Experiences, Ideas and Harmonizing Strategies and Policies

- It is important for ASEAN Member States to continually share country experiences, ideas, approaches and to harmonize strategies in developing and encouraging the adoption of appropriate technologies for sustainable and circular farming systems, and in light of these experiences examine the efficacy of efficient policy approaches and instruments.
- Improve understanding of the sustainability of farming systems and technology particularly in the context of future demand for food and other agricultural products. Supporting Research and Development of Sustainable Technologies.
- Increase discussion on the roles for governments and markets in stimulating the adoption of appropriate technologies that can improve sustainability at the farm level, and
- Identify policy approaches for stimulating the adoption of technologies that can improve sustainability at the farm level.
- There is a need for reinforcing positive behaviour change to effect this change to sustainable agriculture within ASEAN. This can be achieved with positive rewarding policies to promote the establishment of sustainable strategies and practices.
- The smallholder rubber/latex industry, latex waste and oil palm waste valorisation and modern smart sustainable agriculture system deployment throughout these well-established industries throughout South East Asia.
- Coordinating and organizing sustainable agriculture programs for various targeted groups.
- Incentivising the sustainable agriculture industry, producing clean food and reducing environmental pollution.
- Making agricultural supply chains economically, socially, and environmentally sustainable.
- Engaging in continuous development of more sustainable agricultural practices, treating farmers and workers fairly, reducing all negative environmental impacts, protecting natural capital and supporting more economically-equitable benefits for farming communities.
- Aligning AMS approaches in sustainable agriculture would enable the focus on common agricultural strategies and strengthen a common sustainable foods marketing approach for ASEAN.

An important consideration of sustainable agriculture is to promote inclusivity amongst all stakeholders in the agriculture and food industries.

8. The Need to Develop and Set Strategies Targets for Sustainable Agriculture Developments

In this transition process, the guidelines address the current pathway and it will be essential to adopt final targets to be achieved; for example, the European Union's Green Deal and Farm to Fork Strategy has the following targets for sustainable food production to be achieved by 2030:

- Reduce by 50% the overall use and risk of chemical pesticides and reduce use by 50% of more hazardous pesticides.
- Reduce nutrient losses by at least 50% whilst ensuring no deterioration in soil fertility, reducing the use of fertilizers by at least 20%.
- Reduce sales of antimicrobials for farmed animals by 50%, and
- Achieve at least 25% of the EU's agricultural land under organic farming and an increase in organic agriculture.

However, these figures serve to show the direction of the EU on its agriculture policy, while ASEAN Member States could set their own sustainability targets and time period criteria for the development of sustainable agriculture within ASEAN. It would be meaningful for ASEAN Member States to jointly discuss these important sustainability criteria which are necessary for the development of a sustainable food industry within ASEAN. Furthermore, a harmonized approach would lead to a much stronger solution. The targets would act to guide the speed and flow of sustainable agriculture development within ASEAN and set-in motion the twin processes of optimization of the current pathway as well as research and pilot programs in the recommended sustainable pathway.

Newer modern sustainable technologies already developed can be the first in line to be taken to final assessments in pilot and farm-scale tests and when criteria for sustainability and cost-effectiveness are met, enter into a crossover period where both sustainable and non-sustainable systems are being operated. After this, national policies may be drafted and harmonization of the ASEAN policies may be addressed, leading to the stabilization and adoption of newer sustainable agricultural systems.

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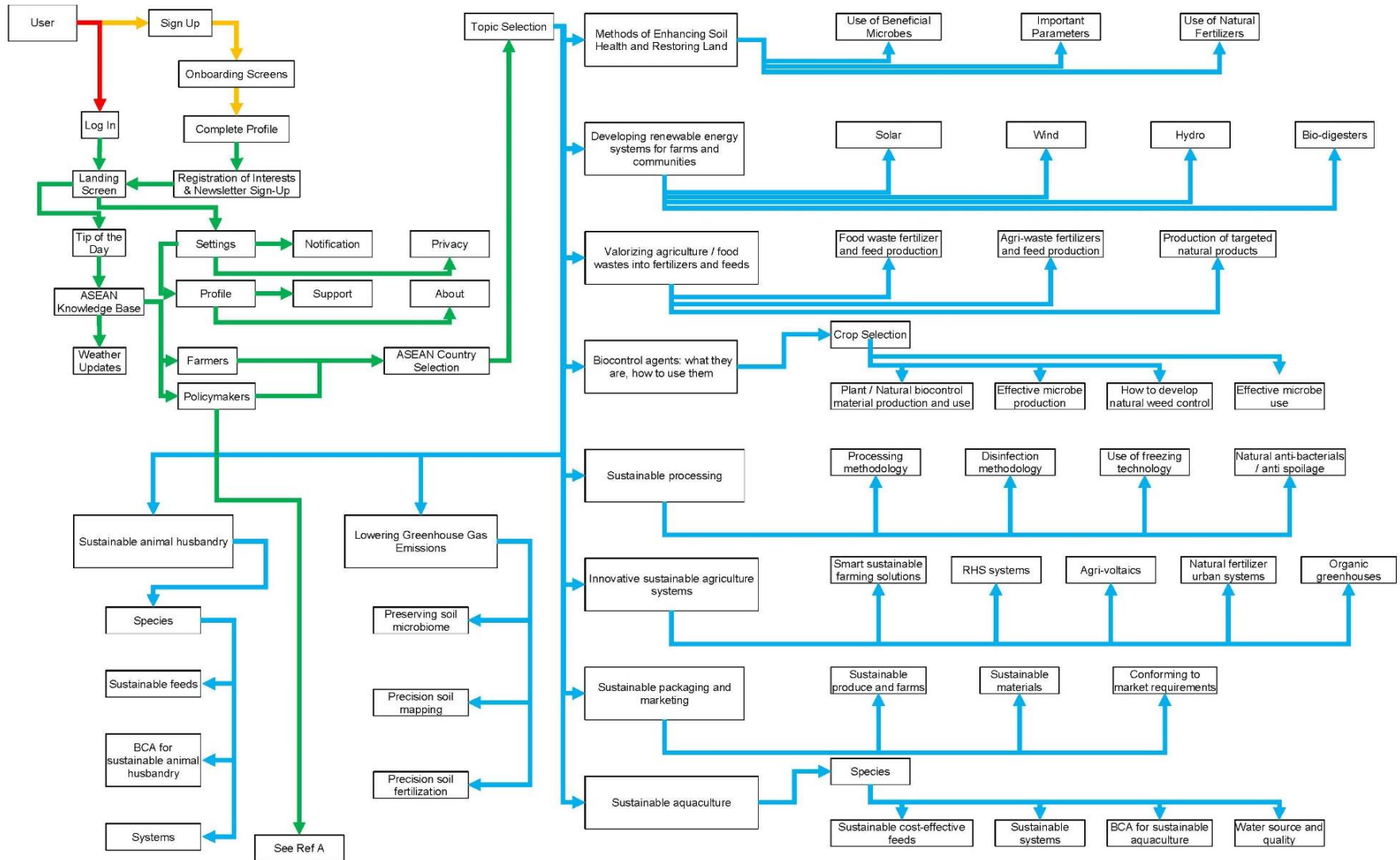
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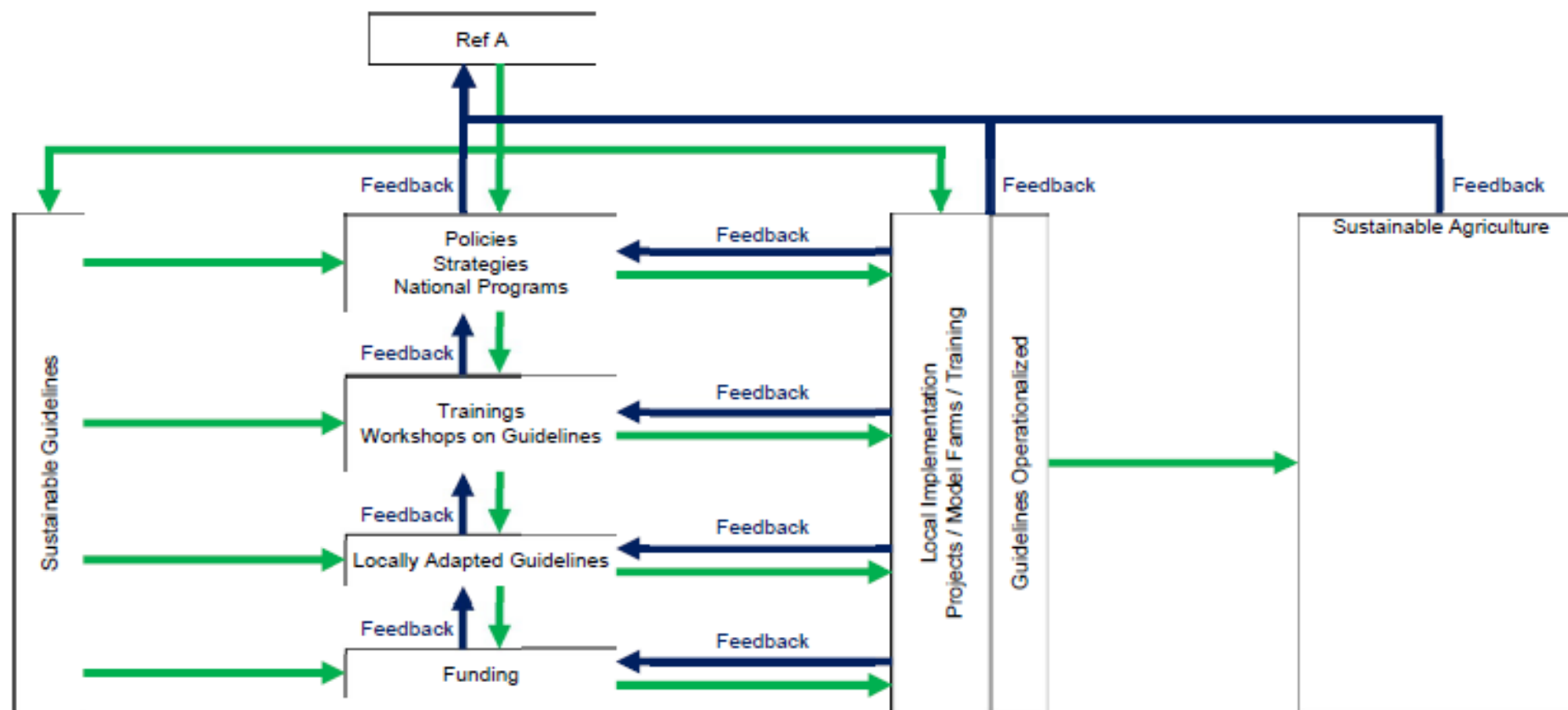
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Appendix A: Navigator



Appendix A: Navigator (Continued from the previous page)



Appendix B: Sustainable Agriculture: Innovative Governance and Technologies that Sustainably Increase Agricultural Production: Strategies

A) Improving the Efficiency in the Use of Our Resource

Crops

1. Genetically diverse portfolio of varieties
2. Valorization of agriculture and food wastes, practice conservation agriculture
3. Judicious use of organic and inorganic fertilizers, improved soil moisture management, improved soil organic carbon content
4. Improved water productivity, precision irrigation
5. Integrated pest management (IPM) deployment
6. Improved soil health

Livestock

1. Genetically diverse base of breeds
2. Improved resource use efficiency
3. Balanced and precision animal feeding and nutrition
4. Integrated animal health control

Aquaculture

1. Aquafeed management
2. Integrated multi-trophic aquaculture
3. Robust biosecurity/aquatic animal health
4. Use of best management practices (BMPs), ASEAN good aquaculture practices (GAqP)
5. Domestication of aquaculture species
6. Aquaculture certification for animal health and welfare, and food safety
7. Implementing the Ecosystem Approach to Aquaculture (EAA)

B) Conserving, Protecting and Enhancing Natural Ecosystems

Crops

1. Use better practices for biodiversity, such as in-situ and ex-situ conservation of plant genetic resources, IPM...
2. Use better practices for soil: land rehabilitation, appropriate cropping systems...
3. Use better practices for water management: deficit irrigation, preventing water pollution...
4. Set payments for using and for providing environmental services such as pollinators, carbon sequestration...
5. Set policies, laws, incentives, and enforcement to promote the above

Livestock

1. Conserve animal genetics in-situ and ex-situ
2. Protect and encourage biodiversity, carbon storage, and water services
3. Protect water from pollution through waste management
4. Use better practices for reduced emission intensity
5. Provide environmental services
6. Set policies, laws, incentives, and enforcement to promote the above
7. Encourage the use of safer Biological Control Agents (BCA)

Aquaculture

1. Conserve aquatic genetic resources
2. Promote aquaculture certification for environmental protection
3. Ensure biosecurity: pathogens, escapees, invasive species, biodiversity
4. Use integrated aquaculture-agriculture systems

5. Implementing the Ecosystem Approach to Aquaculture (EAA)
6. Encourage the use of safer Biological Control Agents (BCA)

C) Protecting and Improving Rural Livelihoods and Social Well-Being

Crops

1. Increase/protect farmers' access to resources, e.g. through equitable land and water tenure systems
2. Increase farmers' access to markets through capacity-building, credit, infrastructure
3. Increase rural job opportunities e.g. in small and medium enterprises sustainability and related activities
4. Improve rural nutrition: production of more and affordable nutritious and diverse foods, including fruits & vegetables

Livestock

1. Increase/protect farmers' access to resources, such as pasture, water, credit
2. Increase farmers' access to markets through capacity-building, credit, infrastructure
3. Increase rural job opportunities e.g. in small and medium enterprises sustainability and related activities
4. Improve rural nutrition: production of more and affordable nutritious and diverse foods, including fruits & vegetables

Aquaculture

1. Aquaculture business-model, especially for small-scale producers
2. Aquaculture certification including gender considerations
3. Cooperative marketing
4. Mainstream aquaculture into rural development processes
5. Technological, trade, institutional, infrastructure, capacity development, investment and other support services
6. Aquaculture and nutrition programmes
7. Implementing the Ecosystem Approach to Aquaculture (EAA)

D) Enhancing the Resilience of People, Communities, and the Ecosystem

Crops

1. Generalize risk assessment/management and communication
2. Prepare for/adapt to climate change
3. Respond to market volatility, e.g.: encouraging flexibility in production systems, and savings
4. Contingency planning for droughts, floods, and pest outbreaks; development; social safety nets

Livestock

1. Generalize risk assessment/management and communication
2. Prepare for/adapt to climate change
3. Respond to market volatility, e.g.: encouraging flexibility in production systems, and savings
4. Contingency planning for droughts, floods, and pest outbreaks; development; social safety nets

Aquaculture

1. Assess risks in aquaculture (pathogens, food safety, ecological, environmental (including climate change), genetic, social and financial)
2. Set early warning, preparedness, surveillance systems and contingency plans for aquatic emergencies
3. Implementing the Ecosystem Approach to Aquaculture (EAA)

E) Promoting Good Governance of Both Natural and Human Systems

Crops

1. Increase effective participation of stakeholders
2. Encourage formation of associations and farming cooperatives
3. Increase frequency and content of consultations among stakeholders – (Government bodies, private industry and farming communities)
4. Develop decentralized capacity

Livestock

1. Increase effective participation of stakeholders
2. Encourage formation of associations and farming cooperatives
3. Increase frequency and content of consultations among stakeholders – (Government bodies, private industry and farming communities)
4. Develop decentralized capacity

Aquaculture

1. Compliance with international treaties, standards, agreements on sustainable aquaculture, animal health, food safety
2. Voluntary adoption of BMPs, ASEAN GAqP
3. Contribution and impact assessments
4. Implementing the Ecosystem Approach to Aquaculture (EAA)

(Modified from “Building a common vision for sustainable food and aquaculture, principles and approaches, FAO, 2014”)

Appendix C: List of Valorisations

Studies has been conducted on the valorisation of feeds and fertilizers produced from valorised agricultural biomass wastes that have been successfully tested within ASEAN

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- Zero-Waste Technologies for Sustainable Development in Palm Oil Mills. (Teow Yeit Haan, et al, 2021)
- Revolutionising Agriculture: Biofertilisers from Palm Oil Empty Fruit Bunches. (Jason Loh, 2021)
- The Oil Palm Wastes in Malaysia. (N. Abdullah, et al, 2013)
- Mushroom Cultivation Using Agricultural Wastes. (Fatimah Hafifah binti Mohd Hanafi, 2018)
- Improved Biofertiliser Properties of Digestate from Co-Digestion of Brewers Spent Grain and Palm Oil Mill Effluent by Manure Supplementation. (Uduak U. Nalubuisi-Nnaji, et al, 2020)
- Reducing Fertiliser and Avoiding Herbicides in Oil Palm Plantations – Ecological and Economic Valuations. (Kevin S. A. Darras, et al, 2019)
- Effect of Adding Palm Oil Mill Decanter Cake Slurry with Regular Turning Operation on the Composting Process and Quality of Compost from Oil Palm Empty Fruit Bunches. (Azmi Yahya, 2010)
- Converting Palm Oil Wastes into Bioproteins. (UPM, 2016)
- Integrated Algal and Oil Palm Biorefinery as a Model System for Bioenergy Co-generation with Bioproducts and Biopharmaceuticals. (Mohd Azmuddin Abdullah, et al, 2021)
- Effects of de-Oiled Palm Kernel Cake-based Fertilisers on Sole Maize. (P. E. Ogbonna, et al, 2012)
- Feeding Behaviour of Lactating Cows-Fed Palm Kernel Cake in the Diet. (L. R. Pimentel, 2015)
- Carcass Characteristics and Meat Quality of Lambs That Are Fed Diets with Palm Kernel Cake. (Rozilda da Conceição Dos Santos, et al, 2017)
- Palm Kernel Cake Obtained from Biodiesel Production in Diet for Goats, Feeding Mechanism and Physiological Parameters. (R. L. de Oliveira, et al, 2017)
- Bioconversions of Palm Kernel Cake and Rice Bran Mixtures by *Trichoderma Viride* Towards Nutritional Content. (Yana Sukaryana, 2010)
- Nutritional Evaluation of Fermented Palm Kernel Cake using Red Tilapia. (F. B. Iluyemi, et al, 2010)
- The Utilisation of Endopower β in Commercial Feed which Contains Palm Kernel Cake on Performance of Broiler Chicken. (S. S. A. Purba, et al, 2018)
- Quality Improvement of Palm Kernel Cake as Broiler Feed Using Pre-cleaning System. (Rohaya Mohamed Halim, et al, 2021)
- Is Palm Kernel Meal a Suitable Alternative Feed Ingredient for Poultry. (Mohammad Naeem Azizi, et al, 2021)
- Utilisation of Palm Kernel Cake as a Ruminant Feed for Animal: A Review. (Ahmed Mahmoud Abd El Tawab, et al, 2018)
- Design Formulation of Freshwater Fish Feed from Palm Kernel Cake (PKC). (Mohd Fakaruddin bin Abdul Rahman, 2010)
- Researching the Use of Palm Kernel Cake in Aquaculture Feeds. (Wing Ng, 2004)
- Valorisation of Palm Oil (Mill) Residues. (H.W. Elbersen, et al, 2013)
- Oil Palm Frond As A Sustainable and Promising Biomass Source in Malaysia, A Review. (Zhong Xian Ooi, et al, 2017)
- Microalgae Cultivation in Palm Oil Mill Effluent (POME) Treatment and Biofuel Production. (Sze Shin Low, et al, 2021)
- Aerobic and Anaerobic Co-Cultivation of *Nannochloropsis Oculata* with Oil Palm Empty Fruit Bunch for Enhanced Biomethane Production and Palm Oil Mill Effluent Treatment. (Ashfaq Ahmad, 2014)

- The Role of Oil Palm Biomass Recycling on Soil Health in Oil Palm Plantations. (R. S. Tarigan, et al, 2019)
- Oil Palm Biomass, Its Utilisation Potential. (The Malaysia Biomass Industry Confederation, 2017)
- From Waste to Food: Optimising the Breakdown for Oil Palm Waste to Provide Substrate for Insects Farmed as Animal Feed. (Elizabeth Dickinson, et al, 2019)
- Waste Water Minimisation: Utilisation of Rubber Latex Residue and Swine Dung as Fertiliser for Para Rubber-Seeding Growth. (Thanya Uttraporn, et al, 2012)
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- Current Trends of Rice Milling Byproducts for Agricultural Applications and Alternative Food Production Systems. (Aaron R. Bodie, et al, 2019)
- Potential Utilisation of Rubber Seed Meal as Feed and Food. (Lukman Abiola Olundo, et al, 2018)
- Use of Sugarcane Industrial By-Products for Improving Sugarcane Productivity and Soil Health. (M. L. Dotaniya, et al, 2016)
- Utilisation of Sugar Industry Wastes in Agriculture. (Nagendra Gowda M. S, 2020)
- The Effect of Waste Bagasse (*Saccharum* sp) Fertilizer Toward Growth Of Peanuts (*Arachis hypogaea* L.). (Wening Dwi Prastiwi, 2017)
- Australian Research Looks for Ways to Use Sugar Cane Waste as Feed. (Jackie Linden, 2018)
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- Creating Wealth from Waste: Towards a Sustainable Agriculture. (Yasmeen Siddique, et al, 2019).
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Appendix D: Some Examples of Sustainable Strategies in Other Blocs and Countries

MAJOR AIMS OF THE EUROPEAN UNION: THE EUROPEAN GREEN DEAL

- To reach “climate neutrality” by 2050.
- Development of a circular economy, and
- Farm to fork strategy for healthy food produced in a sustainable manner.

FARM TO FORK STRATEGY (EUROPEAN COMMISSION)

- Ensuring that the food chain, covering food production, transport, distribution, marketing and consumption has a neutral or positive environmental impact, preserving and restoring the land, freshwater and sea-based resources on which the food system depends, helping to mitigate climate change and adapting to its impacts, protecting land, soil, water, air, plant health and animal health and welfare, and reversing the loss of biodiversity.
- Ensuring food security, nutrition and public health, making sure that everyone has access to sufficient, nutritious and sustainable food that upholds high standards of safety and quality, plant health and animal health and welfare, while meeting dietary needs and food preferences.
- Preserving the affordability of food, while generating fairer economic returns in the supply chain so that ultimately the most sustainable food also becomes the most affordable (A Farm to Fork Strategy for a Fair, Healthy and Environmentally-Friendly Food System – European Commission, Brussels, 20 May 2020).

Appendix E: The Netherlands: World's 2nd Largest Agricultural Exporter

A) **COMMITMENT TO CIRCULAR AGRICULTURE**

- Improving soils and water quality
- Reducing emissions and pollutants
- Closing nutrient cycles
- Collaboration at regional level
- Collaboration along the agriculture and food supply chain.

B) **POLICY EFFORTS TO SUPPORT CIRCULAR AGRICULTURE**

- Promote precision agriculture and farm innovations
- Creating more possibilities for experimentation
- Focus common agricultural policy on vision targets
- Utiliser public land
- Promote re-usage of food nutrients by adapting regulations
- Reward sustainable farming practices
- Support short supply chains

C) **FOCUS**

- A solid economic base for producers
- A commitment to knowledge and innovation
- Reciprocity between agriculture and nature
- A strong international market position and capacity to innovate
- Favourable legislation and regulation

THAILAND: THE BIO-CIRCULAR-GREEN (BCG) ECONOMIC MODEL

- Four distinct industries: Food and agriculture, medical and wellness, bioenergy, biomaterials and biochemicals, as well as the tourism and creative economy.
- Focus on research and development and technologies, reusing waste streams, smart farming technologies, traceability, food and product safety and development of higher value and novel food products.



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