Mainstreaming Biodiversity for Food and Agriculture in ASEAN: The Need for Effective

Inter-sectoral Linkages and Collaboration

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2019



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Citation

Sajise, Percy E. 2019. Mainstreaming Biodiversity for Food and Agriculture in ASEAN: The Need for Effective Inter-sectoral Linkages and Collaboration. ASEAN Centre for Biodiversity and Southeast Asian Regional Center for Graduate Study and Research in Agriculture, Los Baños, Laguna, Philippines.

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ISBN:

Front and back cover photos from Dr. Dicky Simorangkir and the ASEAN Centre for Biodiversity's Zooming in on Biodiversity Photo Contest entries from Mar Lar Winn, Rita dela Cruz, Zulkarnaen Syri Lokesywara, and Ansbert Bidol

Printed and Published

ASEAN Centre for Biodiversity D. M. Lantican Avenue University of the Philippines Los Baños Laguna, Philippines 4031

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ACKNOWLEDGEMENTS

The kind assistance in gathering needed references for this concept paper by Ms. Erica Villavelez and Ms. Guia Paula Acabal of the ASEAN Centre for Biodiversity (ACB) is gratefully acknowledged. For the editing and formatting of the paper, the author would like to thank Dr. Mariliza V. Ticsay, Ms. Monalinda B. Cadiz, and Ms. Zara Mae C. Estareja of the Knowledge Resources Unit (KRU) and Knowledge Management Department (KMD) of the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA), as well as staff of the Programme Development and Implementation (PDI) and Communication and Public Affairs (CPA) units of the ACB. Comments on all the drafts received from the ACB and SEARCA, which improved the original version of this concept paper, is also acknowledged. Gratefully recognised also is the financial assistance provided by the ACB through the ASEAN Development Fund and the European Union-funded Biodiversity Conservation and Management of Protected Areas in ASEAN (EU-BCAMP) project, and SEARCA in the development and final reproduction of this paper.

ACRONYMS

ACB	ASEAN Centre for Biodiversity
AEC	ASEAN Economic Community
AIFSF	ASEAN Integrated Food Security Framework
AISF-AgB	ASEAN Inter-Sectoral Framework for Agrobiodiversity
AMAF	ASEAN Ministers on Agriculture and Forestry
AMME	ASEAN Ministerial Meeting on the Environment
AMS	ASEAN Member States
APSC	ASEAN Political-Security Community
ASCC	ASEAN Socio-Cultural Community
ASEAN	Association of Southeast Asian Nations
ASEC	ASEAN Secretariat
ASPEN	ASEAN Strategic Plan on Environment
ATWGARD	ASEAN Technical Working Group on Agriculture Research and Development
BCAMP	Biodiversity Conservation and Management of Protected Areas in the ASEAN
BFA	Biodiversity for food and agriculture
CBD	Convention on Biological Diversity
COP	Conference of Parties
CSAP	Consolidated Strategic Action Plan
EU	European Union
FAF	Food, Agriculture, and Forestry
FAO	Food and Agriculture Organization
GEF	Global Environment Facility
ICRAF	World Agroforestry Centre
IPM	Integrated Pest Management
KMD	Knowledge Management Department
KRU	Knowledge Resources Unit
MOAC	Ministry of Agriculture and Cooperatives, Thailand
MONRE	Ministry of Natural Resources and Environment, Thailand
MoU	Memorandum of Understanding
NASAP	National Agrobiodiversity Strategy and Action Plan

NBSAP	National Biodiversity Strategy and Action Plan
NTFP-EP	Non-Timber Forest Products-Exchange Programme
PoW	Programme of Work
RAP-AMCSU	Regional Action Plan for Mainstreaming, Conservation, and Sustainable Use of Agrobiodiversity
RECOFTC	The Center for People and Forests
SDGs	Sustainable Development Goals
SEAMEO	Southeast Asian Ministers of Education Organization
SEAMEO BIOTROP	Southeast Asian Regional Centre for Tropical Biology
SEARCA	Southeast Asian Regional Center for Graduate Study and Research in Agriculture
SESAM	School of Environmental Science and Management
SOM	Senior Officials Meeting
SRI	System of Rice Intensification
TABI	The Agrobiodiversity Initiative, Lao PDR
UNEP	United Nations Environment Programme

Preface

As a subset of biodiversity, agricultural biodiversity or agrobiodiversity relies heavily on sound and sustainable conservation and management of all biological resources. Threats and challenges to biodiversity, such as habitat loss, overexploitation, pollution, invasive alien species. increasing demand, and impacts from climate change. among others. inevitably have consequent damaging impacts on agriculture. If biodiversity and agriculture are to thrive, then the two sectors have to work together to address common challenges and achieve shared management goals.

Agrobiodiversity, which embodies the link between biodiversity and agriculture. is thus increasingly important to sustain sources of food and agriculture as the foundation of food, livelihood, and economic security. Biodiversity and agriculture, however, are traditionally managed as separate sectors. Agrobiodiversity will help bridge the gap between the two and facilitate multi-sectoral collaboration to raise awareness of agrobiodiversity, streamline cooperation, and support planning and decision-making efforts.

This is the context behind the Memorandum of Understanding (MoU) between the ASEAN Centre for Biodiversity (ACB) and SEARCA (Southeast Asian Regional Center for Graduate Study and Research in Agriculture). The ACB and SEARCA signed the MoU for institutional cooperation on 1 July 2016 to pursue the common objective of building capacities of the ASEAN Member States (AMS) in biodiversity conservation as it relates to agriculture and food. The MoU signifies an agreement to cooperate in project development and implementation, information exchange, and capacity development on sustainable agriculture and biodiversity.

This paper explains the significance of agrobiodiversity and highlights efforts of the ACB and SEARCA, along with relevant regional and international partner organisations and representatives of environment and agriculture ministries of the AMS, to forge a common understanding of and cooperation on agrobiodiversity in the region. Two regional workshops have been conducted, resulting in a draft Regional Action Plan for Mainstreaming, Conservation, and Sustainable Use of Agrobiodiversity (RAP-AMCSU) and proposed priority actions, options for facilitating these actions within ASEAN institutional structures, and a set of monitoring and evaluation criteria to assess progress. The RAP-AMCSU takes its direction from the Convention on Biological Diversity Programme of Work on Agrobiodiversity, Sustainable Development Goals 2030, and the ASEAN Vision and Community Pillars.

The actions undertaken so far are major steps forward to mainstreaming agrobiodiversity in ASEAN. Understandably, there is a long way to go in institutionalising agrobiodiversity in ASEAN structures and processes, but the paper covers significant accomplishments towards increasing collaboration among AMS on the sustainable conservation and management of agrobiodiversity.

Executive Summary

Photo by Mark Anthony Agtay Entry from the Zooming in on Biodiversity Photo Contest

The importance of biodiversity for food and agriculture (BFA) in ASEAN is directly related to the phenomenon of "double squeeze", described as the continuing need to feed an expanding population on one hand, and on the other, a dwindling natural resource base, which includes biodiversity. This double squeeze is exacerbated by climate change and the shifting demographic landscape, characterised by expanding urban areas, increasing middle class, changing diet patterns in favour of more meat that requires more grain for animal feed, migration, and a rural area that often faces shortage of farm labour. Biodiversity for food and agriculture or agrobiodiversity also becomes very relevant to the attainment of the ASEAN vision statement of "an ASEAN Socio-Cultural Community that is inclusive, sustainable, resilient, dynamic, and engages and benefits the people." Furthermore, it is relevant to the ASEAN Vision 2020, aiming to achieve "a clean and green ASEAN" with fully established mechanisms for sustainable development and ensure that protection of the region's environment and natural resources are sustained, as well as high quality of life for its people.

Biodiversity for food and agriculture is a subset of biodiversity that contributes in one way or another to agriculture and food production. It includes the domesticated plants and animals, raised in crop, livestock, forest, and aquaculture systems, harvested forests, and aquatic species; other wild species harvested for food and other products; and what is known as "associated biodiversity", the vast range of organisms that live in and around food and agricultural production systems, sustaining them and contributing to their output: the variety and variability of animals, plants, and microorganisms at the genetic, species, and ecosystem levels that sustain the functions, structure, and processes of the agro-ecosystem" (FAO, 2019; CBD, 1992).Technically, BFA is synonymous to agricultural biodiversity or agrobiodiversity. This diversity, together with its associated knowledge system, has been largely maintained by smallholder farmers over many generations. The synergistic and complementary relationships of biodiversity and agriculture must be clearly recognised. As the importance of agrobiodiversity being a component of biodiversity is widely demonstrated at the farm and landscape levels in promoting productive and sustainable agricultural production systems, the expected consequence is to enhance the conservation and sustainable management of natural biodiversity, which serves as its key reservoir.

The multi-functionality of agro-ecosystems as determined by agrobiodiversity will relate directly to the need for sustainable agricultural intensification, while providing the ecosystem functions of provisioning, regulating, supporting, and socio-cultural values. Maintenance of these agro-ecosystem functions requires less external inputs and primarily depends on harnessing agroecological processes. These important attributes are evidently present in various types of biodiversity-rich agro-ecosystems, many of which already exist in the region, exemplified by the following generic categories: croplivestock, crop-fisheries, and forest-crop-livestock production systems, which include agroforestry. Benefits for ecosystem services derived from this multi-functionality of agro-ecosystems as determined by agrobiodiversity include: (1) **Provisioning**: sustainable high yields and diverse products; (2) Regulating: climate change mitigation and adaptation, air and water quality, soil-water conservation, natural disasters, and pest and disease control; (3) Supporting: promotes nutrient-cycling and organic matter build-up, habitat for other species, and pollination; (4) Socio-cultural: promotes nonmaterial benefits to people such as aesthetic, spiritual, cognitive, reflective, recreational, inclusiveness (gender and small farmers), value of indigenous knowledge, and reduction of social risk.

However, BFA or agrobiodiversity in particular, and biodiversity in general, as well as its associated agro-ecosystems in the region, is vanishing at an alarming rate. Key components of BFA at the genetic, species, and ecosystem levels are in decline. The drivers of this loss of biodiversity for food and agriculture are mainly changes in land and water use, loss and degradation of forest and aquatic ecosystems, and transition to intensive production of less number of species mainly as a result of climate change, demographic changes, and the pull of the international market (FAO, 2019). The urgency to conserve and sustainably utilise this important resource base and asset of the ASEAN Members States (AMS), as well as the knowledge system associated with it, is a race against time, which must be won if ASEAN is to achieve its vision. A key to winning this race is the effective mainstreaming of biodiversity for food and agriculture or agrobiodiversity in various relevant key sectors (i.e., crops, animals, and fisheries in agriculture, and protected and conservation areas in forestry) and at various hierarchical levels (local. national, and regional). Mainstreaming biodiversity, or BFA in particular, aims to "embed biodiversity for considerations into policies, strategies, and practices of key public and private sectors that impact or rely on biodiversity so that it is conserved and sustainably used locally and globally" (Huntley and Redford, 2014). It also involves the integration of the conservation and sustainable use of biodiversity in cross-sectoral plans such as poverty reduction, sustainable development, climate change adaptation/mitigation, trade and international cooperation, as well as sector-specific plans such as agriculture, fisheries, forestry, mining, energy, tourism, transport, and others (CBD, 2001).

Priority strategies and action plans in ASEAN to mainstream, conserve, and sustainably utilise agrobiodiversity are anchored in the Convention on Biological Diversity (CBD) Programme of Work (PoW) on Agrobiodiversity,

as well as the blueprints of the three ASEAN Community Pillars. The CBD PoW on Agrobiodiversity consists of three aims and four elements, which can impact on the multi-functionality of agro-ecosystems. These aims are to promote the following: (1) positive effects and mitigation of negative impacts of agricultural practices on agrobiodiversity, (2) conservation and sustainable use of genetic resources of value for food and agriculture, and (3) fair and equitable sharing of benefits arising out of the utilisation of genetic resources. The elements involved are: (1) assessment; (2) identification of adaptive techniques, practices, and policies; (3) capacity building, increasing awareness, and promoting responsible action; and (4) mainstreaming national plans and strategies for the conservation and sustainable use of agrobiodiversity. The multi-functionality of agro-ecosystems can then relate directly to the blueprints of the three ASEAN Community Pillars and consequently, to seven of the 17 UN Sustainable Development Goals (SDGs) 2030.

These relationships are shown in the following conceptual diagram.



Figure 1. Conceptual model to relate the importance of Biodiversity for Food and Agriculture to the Blueprints of the three Community Pillars of ASEAN and to seven of the 17 SDG 2030 A regional workshop on *Mainstreaming Biodiversity in Agriculture for Sustainable Development and Food Security in Southeast Asia* was held at Maejo University, Chiang Mai, Thailand on 12–14 September 2017. Organised by the ASEAN Centre for Biodiversity (ACB) and the Southeast Asian Ministers of Education-Regional Center for Graduate Study and Research in Agriculture (SEAMEO-SEARCA), it was attended by 64 experts and representatives from different sectors in the AMS working around the theme of agrobiodiversity, as well as representatives from the academe and international organisations.

The outputs of this workshop were identified actions needed for this mainstreaming process based on stated aims and the various elements of the CBD PoW on Agrobiodiversity. These aims and elements were transformed into strategies needed to attain the overall goal "to conserve and sustainably utilise biodiversity for food and agriculture, together with its associated knowledge system, to ensure the attainment of the ASEAN vision of sustainable and resilient communities." These components, strategic thrusts, and identified activities/actions from the regional workshop constituted the suggested Regional Action Plan for Mainstreaming, Conservation, and Sustainable Use of Agrobiodiversity (RAP-AMCSU). For details, please refer to the ACB-SEARCA report of the workshop.

A follow-up regional workshop was conducted on 4–6 December 2018 in Bangkok, Thailand to prioritise activities from the long list, which constitute the proposed RAP-AMCSU. It was organised by the ACB and SEARCA and hosted by the Ministry of Natural Resources and Environment (MONRE) and Ministry of Agriculture and Cooperatives (MOAC) of Thailand. The *ASEAN Multi-Sectoral Workshop on Mainstreaming Biodiversity for Food and Agriculture* was attended by 60 representatives of the environment and agriculture ministries of Cambodia, Indonesia, Lao PDR, Myanmar, the Philippines, Singapore, and Thailand, as well as representatives from the Environment Division and Food, Agriculture, and Forestry Division of the ASEAN Secretariat. Also present were representatives from regional organisations, such as NIRAS, Non-Timber Forest Products-Exchange Programme (NTFP-EP), The Centre for People and Forests (RECOFTC),



Participants of the stocktaking workshop, Mainstreaming Biodiversity in Agriculture for Sustainable Development and Food Security in Southeast Asia

Southeast Asian Regional Centre for Tropical Biology (SEAMEO BIOTROP), and The Agrobiodiversity Initiative (TABI) in Lao PDR, and international organisations such as the World Agroforestry Centre (ICRAF) and Bioversity International. For details, please refer to the ACB report of the Bangkok Meeting.

The main objective of the second regional workshop was to provide a platform for the environment and agriculture sectors in the AMS, as well as relevant ASEAN sectoral bodies, to identify and define possible areas of collaboration and supportive processes and institutional arrangements to mainstream biodiversity in agriculture. The option which must be adopted must consider the elements of success earlier identified among AMS cases presented, the experiences of international organisations, and the lessons learned from 17 years of implementation of the global projects of the Global Environment Facility (GEF) involving 36 partner countries. It must also be doable in the context of the prevailing political and institutional framework of ASEAN.

Finally, a set of monitoring and evaluation criteria and parameters with suggested indicators was also presented drawn along the identified principles of agroforestry consisting of the following general categories: institutional, economic, socio-cultural, and communications cum wide- and/or upscaling. The suggested indicators reflect and are direct outputs and outcomes of the identified activities embedded in the RAP-AMCSU as well as the identified priority joint activities and actions at the regional and national levels. A way forward was also suggested by participants of the multi-sectoral workshop.

What is biodiversity for food and agriculture and why is it important?

Photo by Zulkarnaen Syri Lokesywara Entry from the Zooming in on Biodiversity Photo Contest

There is an urgent and continuing need for food to feed a growing population, and to increase food production, while ensuring its sustainability. This need is exacerbated by a degraded environment, increasing urbanisation causing a decline in productive land and increasing the demand for food in a highly concentrated population, increasing shift to the middle class of the population and corresponding diet shift, and climate change. The population of ASEAN by 2035 is projected to reach 747 million, 538 million of which will be in Indonesia, the Philippines, and Viet Nam, accounting for 72 per cent of the total population (Zen, 2017). Estimates indicate the need for a 60 per cent increase in production to meet the demand for safe and nutritious food of a growing global population (Buinsma, 2009). This condition will be compounded by increasing and competitive demands for land, water, and energy. Among the AMS, severe food insecurity is currently ranging from 0.9 per cent to 18.7 per cent of its population (ESCAP, 2017). Recently reported statistics on malnutrition status of children under five years old in the AMS indicate that 31.5 per cent or 17.7 million are stunted, 4 million are wasted, and 4.5 million are overweight or obese (ASEAN, 2016).

The above context highlights the importance of being able to ensure the ability of countries to supply the needed nutritious, safe, and adequate food for its population. The role of biodiversity for food and agriculture, consequently, becomes very important. Biodiversity for food and agriculture is a subset of biodiversity that contributes in one way or another to agriculture and food production. It includes the domesticated plants and animals in crop. livestock, forest and aquatic species, the wild relatives of domesticated species, other wild species harvested for food and other products, and what is known as "associated biodiversity", the vast range of organisms that live in and around food and agricultural production systems sustaining them and contributing to their outputs: the variety and variability of animals, plants and microorganisms at the genetic, species, and ecosystem levels that sustain the functions, structure, and processes of the agro-ecosystem (FAO, 2019; CBD, 1992). However, this BFA at the global level is declining but its assessment and monitoring as reported by countries are uneven and often limited, which also limits planning and prioritisation of effective remedial measures to alleviate this decline in BFA (FAO, 2019).



Myanmar

Photo by Dwight Ronan Entry from the Zooming in on Biodiversity Photo Contest

This diversity has been maintained by farmers and communities for millennia and remains a key element of the livelihood strategies of poor, small-scale farmers throughout the world. It can be used synonymously with agrobiodiversity or agricultural biodiversity, which is a sub-component of total biodiversity modified and managed by human beings to generate the needed requirements for food, clothing, and shelter, as well as ecosystem services. Agrobiodiversity underpins food security, sustainable livelihoods, ecosystem resilience, coping strategies for climate change, adequate nutritional requirements, insurance for the future, and the management of biological processes needed for sustainable agricultural production. Strategies, actions, agricultural practices and approaches, and an enabling environment that promotes the conservation and the sustainable use of BFA, are of paramount importance.

Multi-functionality of agro-ecosystems as determined by agrobiodiversity has been related to pest control, increasing yield and functionality, pollination, and food and nutritional security. Today, some of these high-biodiversity agro-ecosystems in Southeast Asia are known for their generic categories of: (1) multi-species cropping, (2) crop-livestock production, (3) crop-fish production, and (4) forest-crop-livestock production systems, among others. In contrast, monoculture agro-ecosystems with less biodiversity will have one often dominant function of high productivity of a commodity, but less or none of the other functional attributes. Its sustainability is, therefore, also low and dependent upon external inputs such as inorganic fertilisers, pesticides, high energy, and others to augment the missing agro-ecological processes. Also, as a consequence of this type of high external input agriculture, the cost of its off-site or externality is high in terms of both ecosystem health and human well-being.

Given this importance of biodiversity for food and agriculture, ASEAN has the utmost opportunity to realise its vision of promoting resilience and sustainability by harnessing this asset of the region. The AMS occupy only 3 per cent of the earth's surface but contain 20 per cent of all known plant and animal species, including marine species of the world. Among these are a large number of endemic species found nowhere else in the world. It also has three of the 17 mega-biodiverse countries in the world. However, sustaining this high biodiversity is a race against time as the rate of biodiversity loss in the region is also very high (ACB, 2010). This challenge is enormous considering the fact that the current form of agriculture is also one of the major causes of biodiversity loss and a balance between these two must be achieved for sustainable development.



Camarines Sur, Philippines

Photo by John Samuel P. Nuñez Entry from the Zooming in on Biodiversity Photo Contest

Some existing practices of biodiversity deployment in support of sustainable production systems

As earlier indicated, a number of approaches have already been developed that use biodiversity for food and agriculture to achieve sustainable increases in productivity and provide a sound ecological basis for agriculture. These practices are well documented in two recent reports describing the State of Global Biodiversity for Food and Agriculture (FAO, 2019; Kenmore and Collette, 2017). The brief summary of benefits derived from the deployment of biodiversity for food and agriculture as exemplified in various types of agro-ecosystems is shown in **Figure 1**.

The use of multi-species and multi-breed of crops and animals is one strategy that many traditional farmers use to maintain high diversity in onfarm niches, and to buffer against climatic and economic adversities. Species combinations also enhance productivity and yields in aquatic systems. Crop rotations, intercropping, and growing different varieties of a single crop have all been shown to have beneficial effects on crop performance, nutrient availability, pest and disease control, and water management. Multicropping, intercropping, alley farming, rotations, and cover cropping are all ways of combining crop species that have positive effects on productivity and yield stability.



types of agro-ecosystems

Below-ground biodiversity is also important and is strongly influenced by management practices, such as tillage, crop combinations, organic-matter inputs, and application of fertilisers and pesticides. All management practices that use complex ecologically-grounded approaches, rather than applying off-farm inputs to achieve short-term high outputs, provide great care to nurturing soil biodiversity. In doing so, they benefit from positive cascading effects on the efficiency and productivity of the entire system, as in the case of conservation agriculture and organic agriculture. Some types of effective biodiversity deployment for food and agriculture with many examples already existing among AMS are the following:

Integrated Pest Management (IPM) Practices. These practices 1. are well-established and have been adopted by millions of farmers throughout the world. Successful programmes have shown, for example, that conserving arthropod biodiversity by helping increase local understanding of how agro-ecosystems function is a key ingredient of effective pest management in rice production. Intercropping of corn and peanut will reduce corn borer infestation, as peanut is a good habitat for the spider predator of the corn earworm. Another example is the intercropping of hybrid rice varieties, which are shorter than the traditional rice varieties, to reduce infestation of rice blast because of an unfavourable microclimate created by the "rough" rice canopy. These diversity-rich approaches, together with others such as increased use of agroforestry species, further development of home gardens, use of fish-rice systems, and the improved maintenance of pollinator diversity, demonstrate the contributions that biodiversity for food and agriculture can make. At the same time, a richer diversity of products from diverse production systems can make a significant contribution to improving the nutritional status and health of both the urban and rural population.

Multi-Species Farming. The use of multi-crop species and multi-breed 2. herds and flocks (interspecies) is one strategy that many traditional livestock farmers use to maintain high diversity in on-farm niches and to buffer against climatic and economic adversities (Hoffmann, 2003; FAO, 2009b). Different breeds and species make different contributions to livelihoods through provision of food, fiber, fertiliser, cash income, draught power, and transportation. Generally, the more complex, diverse, and risk-prone peasant livelihood systems are, the more they will need animal genetic resources that are flexible, resistant, and diverse to perform the required functions. Further development of tolerance to abiotic stress can be achieved by using a range of adaptive strategies, both behavioural and physiological (Hall, 2004). For example, goat species in hot climates have greater ability to control their body temperature, whereas other breeds originating from northern climates lose appetite and body weight if not given shade (Mualem et. al., 1990). Maintaining a diversity of crops (both temporally and spatially) is also an established part of good agronomic practice. Crop rotations, intercropping, and growing different varieties of a single crop have all been shown to have beneficial effects on crop performance, nutrient availability, pest and disease control, and water management. Agroecological studies have investigated the impact of regimes based on combining various species occupying different niches in time and space. Multi-cropping, intercropping, alley farming, rotation, and cover crops are all ways of combining crop species in ways that have positive effects on productivity and yield stability.

Species-rich communities also deliver other ecosystem benefits, such as greater water retention in the upper soil (Caldeira et. al., 2001), greater diversity among complementary and associated species (including pest-controlling organisms above and below ground), and overall greater resource use efficiency than in species-poor communities (Loreau et. al., 2002). In Southeast Asia, where large tracts of marginal and regularly burned grasslands of *Imperata* (cogon or *Ialang*) dominate

upland landscapes, the introduction of leguminous and viny species, such as *Stylosanthes* and *Centrosema*, could outcompete this grass species, and at the same time, improve soil fertility, eventually replacing cogon with more diverse secondary forest species as well as diverse tree-based agroforestry systems.

Intraspecies diversity can also be directly beneficial in cropping systems. Traditional farmers often return to genetically heterogeneous local varieties to help recover from extreme weather events, such as flooding, droughts, and storms and to cope with specific additional stresses, such as climate change (PAR, 2010) or civil conflict (Richards and Ruivenkamp, 1997). Under stress conditions, the risk of crop failures is lower with landraces than with modern varieties. For example, yield under stress of barley landraces was between 25 and 61 per cent higher than non-landraces (Ceccarelli, 1996). This leads farmers to perceive landraces and intraspecific diversity as an additional instrument for ensuring stability and productivity under unpredictable climatic conditions. Modern varietal mixtures of many crops can also outyield the mean of their monocultures: wheat mixtures, for instance, have proven to have a yield advantage of 19 per cent over monocultures (Burdon and Jarosz, 1990). Whereas scientific evidence is available for the benefits (both in yield and in preventing disease) of spatial and temporal mixtures of a wide range of crop species, the evidence from large-scale testing is limited. It becomes clear from these examples that deployment of functional agrobiodiversity based on the understanding of these complex interrelationships of components is key to sustainable agricultural intensification.

Agroforestry is one common and popular form of multi-species farming, which is another example of niche complementarity. Described as the use of shrubs and trees in crop or annual production, it comes in many forms: improved fallows, planting of multi-purpose trees and shrubs, boundary planting, woodlots, orchards, shelterbelts, windbreaks,



Nakorn Sithamarat, South of Thailand

Photo by Ronnakorn Entry from the Zooming in on Biodiversity Photo Contest

conservation hedges, and other forms of agriculture and fisheries with trees. It is known to promote efficient nutrient cycling, increase production and diversity of products, contribute to food security, improve ecosystem services, and increase efficiency of land use.

3. Multi-species Aquaculture. Species combinations also enhance productivity and sustainability in aquatic systems. The integration of small indigenous fish species into polyculture systems—for example, Amblypharyngodon mola with commercial carp species—can increase overall pond fish production (Roos et. al., 2007); and since these small species command high prices (Ahmed, 2009; Saha,2003), they provide a source of supplementary income to rural households. Self-recruiting species also contribute significantly to aquatic resource production. For example, three self-recruiting fish species (*Channa striata, Clarias brachatus*,and *Anabas testudineus*) contributed more than 40 per cent of total household catch by weight in Cambodia and Thailand (Amilhat, 2006). Diversification of fish species and breeds in aquaculture also

enhances resource use efficiency and reduces waste. For this reason, four types of carp are commonly raised in the same pond in China: the silver carp that filters phytoplankton, the grass carp that feeds on planteating microorganisms, the common carp that is an omnivorous bottom feeder, and the bighead carp that filters zooplankton (Naylor et. al., 2000).

- 4. Crop-Livestock Production System. This type of production system enables the integration of different enterprises on the farm. Livestock provides draught power and manure, while crop residues are fed to livestock, thereby providing opportunities for diversification, nutrient cycling, and greater energy efficiency. The diversification process, representing interspecific agrobiodiversity, also has positive effects on soil and water retention, protection from soil erosion, and increasing soil organic matter. It can also serve as buffer from market fluctuations and changes in weather.
- Pollination Management. Animal and insect pollination bring about 5. production of seed and fruit with better guality and guantity. Pollinators contribute to the yield and quality of output of at least 70 per cent of the major crops used for food. Around the globe, three out of four crops producing fruits or seeds for human use as food depend, at least in part, on pollinators. Pollinators affect 35 per cent of the world's total crop production by volume, supporting the production of 87 per cent of the leading food crops worldwide. The volume of agricultural production dependent on pollinators has increased by 300 per cent in the past 50 years (FAO, 2016). Some common pollinator agents are different species of bees, bats, wasps, and others. For example, under natural conditions, bats are the natural pollinators of durian because the pollination receptivity of durian flowers is during early morning hours, which coincides with the time when bats are active. However, as more limestone caves that are the habitats of some bat pollinators are destroyed for the extraction of limestone, the pollination of durian has to be substituted by other means; otherwise, there will be less durian fruits especially for durian species that depend on these cave-dwelling bat pollinators.



Davao del Norte, Philippines

Photo by Arturo De Vera Jr. Entry from the Zooming in on Biodiversity Photo Contest

Good practices of agrobiodiversity deployment and management for pollination occur at a variety of scales: field, farm, and landscape. At the field scale, pollinator-friendly practices include minimising the use of farm chemicals through organic production, integrated pest management, sound application techniques, set-aside areas, or finding alternatives to agrochemicals. A reduction in the use of herbicides and other pesticides, at least in parts of the field, are recognised as having benefits for keeping pollinators in the crop fields. At the farm level, the way farmers organise different land uses across their farm can influence pollination services. For example, pollinator populations can be encouraged by conserving diverse cropping patterns on farms, i.e., by combining mixed cropping, including cover crops, kitchen gardens, and agroforestry systems, and providing habitat for bees. At the landscape level, areas of natural vegetation in close proximity to farmland are beneficial for crop production; such habitat patches provide flowering resources and nesting sites that sustain pollinators. Many more cases, globally, are documented in a recent report of the Food and Agriculture Organization (FAO, 2019).

Context of mainstreaming agricultural biodiversity cooperation for food and nutrition security in pursuit of sustainable development

Mainstreaming agrobiodiversity means enhancing and accelerating recognition, understanding, and sustainable use of this component of biodiversity in support of food and nutrition security for sustainable development and well-being. In addition, a holistic understanding of the synergistic relationships of biodiversity-agrobiodiversity will provide the long-term basis for this mainstreaming process. This can be achieved by selecting areas of priority among the ASEAN pillars, as well as through existing national and local programmes and policy platforms, where agrobiodiversity is needed and could play an important role in achieving the ASEAN vision.

In the global context, the use of biodiversity for food and agriculture is anchored in several Conference of Parties (COP) Decisions of the Convention on Biological Diversity: COP 3 in Buenos Aires in 1996 (Decision 11/3), COP 5 in Nairobi, COP 10 in Nagoya, Japan (Decision X/34), and the Cancun Declaration on Mainstreaming the Conservation and Sustainable Use of Biodiversity for Well-Being (Cancun, Mexico, 3 December 2016). This declaration, signed by 190 countries, manifest the global commitment to maintain biodiversity because of its important role in the agriculture, forestry, fisheries, and tourism sectors, as well as their impacts on biodiversity itself. The call is for the signatory countries to undertake specific actions in all identified sectors.

On the other hand, recognising the strong linkages between agriculture and biodiversity, the CBD PoW on Agricultural Biodiversity was adopted. It was designed to promote the positive effects and mitigate the negative impacts of agricultural practices on agro-ecosystems and their interface with other ecosystems, promote conservation and sustainable use of genetic resources of value for food and agriculture, and promote fair and equitable sharing of benefits from the utilisation of these genetic resources. To bring this about, it has identified four interacting elements of assessment, identification of adaptive techniques, practices, and policies, capacity building for increasing awareness and positive actions, and mainstreaming into national plans and strategies. The experience of the GEF-funded projects on conservation, sustainable use, and mainstreaming of agrobiodiversity, which were implemented over 17 years with 36 partner countries, is a good source of lessons learned for inter- and cross-sectoral collaboration (Mijatovic et. al., 2018). The consolidated results of all these project lessons indicated that there were factors that promote successful mainstreaming: (1) application of relevant knowledge, (2) presence of organisational and institutional capacity, (3) effective communication with all stakeholders, and (4) an enabling policy framework and will. The interrelated necessary strategies comprise the following: (1) generating knowledge and increasing understanding of the contribution of biodiversity to sustainability, productivity, ecosystem services, income, nutrition, and climate change adaptation; (2) identifying and promoting practices for enhanced conservation and sustainable use of biodiversity; (3) increasing awareness and capacity of stakeholders; and (4) strengthening policy and legislative frameworks.

At the regional level, the recently drafted guidelines on responsible investments¹ in Food, Agriculture, and Forestry (FAF) recognises the importance of agrobiodiversity in the following ways:

- **Chapter 4:** Recognition of its importance in the areas of food security, climate change, and environment.
- Chapter 5: Contribution to food security, safety, and better nutrition; conserve and sustainably manage natural resources and ASEAN forest.
- **Chapter 6:** Identifying and understanding roles and responsibilities of stakeholders where gender is very relevant for agrobiodiversity maintenance and deployment.

The ASEAN Guidelines for Agroforestry Development² considers agrobiodiversity enhancement as one of the benefits from agroforestry.

¹ The document was adopted during the Special Senior Officials' Meeting (SOM)-39th ASEAN Ministers on Agriculture and Forestry (AMAF) on 26-31 August 2018 in Pattaya, Thailand, and for further submission to AMAF for endorsement.

² Endorsed by the AMAF during its 40th Meeting on 11 October 2018 in Hanoi, Viet Nam.



South Sulawesi, Indonesia

Agrobiodiversity is also a key element in some areas of the existing blueprints of the ASEAN pillars:

ASEAN Political-Security Community (APSC) Blueprint 2025. "Paying attention to both traditional and non-traditional security challenges, understanding their links while exploring new innovative approaches to comprehensive security and common security." Examples include transboundary problems of alien and invasive species, spread of human diseases, impacts of fire, marine territorial boundaries, and illegal extraction of natural resources, including biodiversity.

ASEAN Economic Community (AEC). Sustainable economic development (i.e., FAF); good agricultural and forestry management practices; ensuring food security, food safety and better nutrition; increasing resilience to climate change, natural disasters and other shocks; and tourism science and technology for environmental protection and climate change.

ASEAN Socio-Cultural Community (ASCC). Conservation and sustainable management of biodiversity and natural resources; environmental education; green lifestyle; public-private partnership; enhanced capacities for climate change; sustainable management of biodiversity for marine and coastal areas, wetlands, and peatlands; policy; capacity building; attainment of Aichi Biodiversity Targets; and regional and global networking.



Photo by Ismail Amin Entry from the Zooming in on Biodiversity Photo Contest

In an FAO framework document on climate change and food security, the link between agrobiodiversity and food security is through the impact of climate change on food systems assets and food systems activities (FAO, 2007). This is because agrobiodiversity can be considered as a food production asset, as well as a means of providing a buffer against climate change. Sustainable use of agricultural biodiversity is likely to be more beneficial for dominant small-scale farmers in the AMS who need to optimise available resources with limited access to financial and infrastructural support. It will empower small-scale food producers and transform current food systems to make them more sustainable.

The current barriers to bring this about are commitment to lower food prices and some form of subsidy to big commercial farms. Biodiversity for food and agriculture to promote food and nutrition security will require two key elements: (1) holistic knowledge (both traditional and technical) of agrobiodiversity components and their uses and importance, as well as understanding of the interactions of these components associated with its system properties of provisioning, controlling, regulating, and socio-cultural values; and (2) enabling environment, such as policies, which will promote knowledge systems and a fair, inclusive, and transparent sharing of its benefits derived from both the components and its agro-ecosystem properties.

Background and some basic guiding principles for inter-sectoral collaboration on mainstreaming agrobiodiversity in ASEAN

At the global level, Parties to the CBD have given priority to mainstreaming the conservation and sustainable use of biodiversity in sectoral and cross-sectoral policies, plans, and programmes establishing an effective institutional, legislative, and regulatory framework and incorporating an economic and socially inclusive approach as reflected in their National Biodiversity Strategies and Action Plans (NBSAPs).

At the regional level, the ASEAN Strategic Plan on Environment (ASPEN) 2016–2025, in its Strategic Plan 1 – Nature Conservation and Biodiversity, defines the structure and mechanisms for mainstreaming biodiversity into different sectors, including agriculture, by developing guidelines, promoting coordination, and documenting best practices. ASPEN is anchored on the ASEAN Cooperation on Environment guided by ASEAN 2025 and the ASCC Blueprint. The ASEAN Policy Framework on Food, Agriculture, and Forestry Sectors is also guided by the AEC Blueprint, AEC 2025, Consolidated Strategic Action Plan (CSAP), Strategic Action Plan for FAF Sector 2025, and the Strategic Plan of Action for the ASEAN Cooperation in Agriculture Research and Development (2016–2025).

On the other hand, the ASEAN Inter-Sectoral Framework for Agrobiodiversity (AISF-AgB) linkages and collaboration for mainstreaming agrobiodiversity can also be regarded as being rooted on the CBD PoW on Agrobiodiversity and the ASEAN Integrated Food Security Framework (AIFSF) and Strategic Plan of Action on Food Security 2015–2020, specifically on Strategic Thrust 4: Promote sustainable food production, and Strategic Thrust 6: Identify and address emerging issues related to food security. Output 6.2 directly specifies introducing climate-smart agriculture in the AMS; and Activity 6.2.1 indicates pilot testing of technologies and practices related to agrobiodiversity deployment, i.e., conservation agriculture, system of rice intensification (SRI), integrated crop-livestock, organic agriculture, drought and flood tolerant varieties of crops, and others in ASEAN.

In terms of the context described above and for this paper, a **proposed** vision for agrobiodiversity in ASEAN can be stated as "competitive, inclusive, resilient, and sustainable Food, Agriculture, and Forestry, through the conservation and sustainable use of agrobiodiversity as a subset of total biodiversity, towards alleviating poverty, ensuring economic development, promoting ecosystem services, and attaining food and nutrition security."

This is aligned and supportive of the ASEAN vision and goals for FAF 2016–2025, which envisage a "competitive, inclusive, and sustainable Food, Agriculture, and Forestry sector integrated with the global economy based on a single market and production base contributing to food and nutrition security and prosperity in the ASEAN Community" (ASEAN, 2015).

Some basic guiding principles for its formulation and implementation have already been elucidated in the Guidelines for Agroforestry Development for the primary reason that agroforestry represents a form of agrobiodiversity deployment and management. These are:



Shan State, Myanmar

- **1.** Institutional. Create an enabling environment and ensure organisational capacity.
- **2.** Economic. Recognise the value of goods and ecosystem services; maintain or enhance ecosystem services at farm and market levels.
- **3. Socio-cultural.** Recognise and respect local knowledge, traditions, and choices; support gender equity and social inclusion.
- Communication and Scaling. Plan for effective scaling up and sustainability.

The aims and elements of the CBD PoW on Agrobiodiversity provide the strategic guiding principles for promoting the role of agrobiodiversity in enhancing the multifunctional role of agro-ecosystems to provide the services classified as provisioning, regulating, supporting, and cultural values. Provisioning will encompass values of agrobiodiversity related to production outputs of the agro-ecosystem of direct value to human society, i.e., food, wood and fiber, fuel, freshwater, medicine, and others. Regulating functions refer to the role of agro-ecosystems for climate, flood, and disease regulation, as well as water purification. Supporting functions will



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include nutrient cycling, soil formation, pollination, and primary production, while cultural functions will include aesthetic, spiritual, educational, and recreational values.

This multi-functionality of agro-ecosystems, as determined by its agrobiodiversity component, can then be related to the various elements of the Blueprints 2025 of the three community pillars of ASEAN and SDG 2030 (Ministry of Foreign Affairs, 2016):

AEC (B.8, C.5, C.6). Sustainable economic development (i.e., FAF), good agricultural and forestry management practices, ensuring food security, food safety, and better nutrition, increasing resilience to climate change, natural disasters and other shocks, tourism, science, and technology for environmental protection and climate change.

ASCC (C.1, C.4, D.3). Conservation and sustainable management of biodiversity and natural resources, environmental education, green lifestyle, public-private partnership, enhanced capacities for climate change, sustainable management of biodiversity for marine and coastal areas, wetlands, and peatlands, policy, capacity building, attainment of Aichi Biodiversity Targets, and regional and global networking.

AP-SC (B6.2, B3.1). Maritime cooperation in the protection of marine resources and biodiversity, and combating transnational crimes, i.e., wildlife and timber.

SDG2030 goals that these ASEAN Community Blueprints are related to are the following:

- Goal 2: Zero Hunger
- Goal 6: Clean Water and Sanitation
- Goal 12: Sustainable Consumption and Production
- Goal 13: Climate Action
- Goal 14: Life below Water
- Goal 15: Life on Land
- Goal 17: Partnership for the Goal

These relationships are summarised in Figure 3.



Figure 3. Conceptual model to relate the importance of Biodiversity for Food and Agriculture to the Blueprints of the three Community Pillars of ASEAN and to seven of the 17 SDG 2030

Identification of the elements of an ASEAN regional action plan, priority activities and institutional arrangements for agrobiodiversity mainstreaming conservation, and sustainable use

The ACB and SEARCA, in collaboration with Maejo University, conducted a regional workshop on 12–14 September 2017. This regional workshop entitled "Mainstreaming Biodiversity in Agriculture for Sustainable Development and Food Security in Southeast Asia" was held at Maejo University, Chiang Mai, Thailand. This activity was part of an Memorandum of Understanding (MoU) between the ACB and SEARCA to forge an institutional cooperation for building capacities of AMS in biodiversity conservation for food and agriculture.

The main objective of the regional workshop was to undertake a stocktaking of the CBD agenda of strengthening and mainstreaming biodiversity into agriculture. Specifically, the aims were to: (1) share status of trends and issues on agrobiodiversity in the region, (2) level off on understanding of agrobiodiversity, (3) facilitate exchange of knowledge and best practices, and (4) recommend mechanisms and platforms to strengthen cooperation in the region. The regional workshop was attended by 64 experts and representatives from different sectors and institutions working around the theme of agricultural biodiversity in the AMS. There were also representatives from international institutions who provided technical support to the regional workshop, including Nagoya University, International Center for Tropical Agriculture, ICRAF, and Bioversity International. Key outputs of this workshop were the identified elements and activities, which constitute the Regional Action Plan for Mainstreaming, Conservation, and Sustainable Use of Agrobiodiversity (RAP-AMCSU).



Mainstreaming Biodiversity in Agriculture for Sustainable Development and Food Security in Southeast Asia, 12–14 September 2017, Maejo University



Group discussion during the Mainstreaming Biodiversity in Agriculture for Sustainable Development and Food Security in Southeast Asia



Dr. Rosliza Binti Jajuli, Senior Scientist, Center of Agrobiodiversity and Environment Research, Malaysia

A second regional workshop focusing on multi-sectoral collaboration in ASEAN was organised by the ACB and SEARCA and hosted by the Ministry of Natural Resources and Environment and Ministry of Agriculture and Cooperatives of Thailand with funding from the ASEAN Development Fund and the EU-funded Biodiversity Conservation and Management of Protected Areas in the ASEAN (BCAMP). The main objective of this regional workshop was to provide a platform for the environment and agricultural sectors in the AMS and relevant ASEAN sectoral bodies to identify and define possible areas of collaboration and supportive processes and institutions towards mainstreaming biodiversity in the agriculture sector. There were 60 participants composed of representatives of the environment and agriculture ministries of Cambodia, Indonesia, Lao PDR, Myanmar, the Philippines, Singapore, and Thailand; Environment and Food, Agriculture and Forestry Divisions of the ASEAN Secretariat; ASEAN Technical Working Group on Agriculture Research and Development (ATWGARD); and regional and international organisations, i.e., Biodiversity International, ICRAF, SEAMEO BIOTROP, NIRAS, NTFP-EP, RECOFTC, and TABI in Lao PDR. Key outputs of the workshop were identification of common factors or drivers for success in multi-sectoral and inter-ministerial collaboration for mainstreaming of biodiversity for food and agriculture, prioritised regional activities, and recommended institutional arrangements for coordination. For details of the regional workshop process and activities, please refer to the ACB report of the Bangkok meeting.



ASEAN Multi-Sectoral Workshop on Mainstreaming Biodiversity for Food and Agriculture, 4–6 December 2018, Bangkok, Thailand



Preparatory Meeting for the ASEAN Multi-Sectoral Workshop on Mainstreaming Biodiversity for Food and Agriculture



Field Visit to the Royal-initiated Wat Mongkol Chaipattana Area Development Project

Monitoring for assessment of progress and feedback for improvement

There is a need to set up a multi-hierarchical monitoring and evaluation system as the priority joint activities and eventually the RAP-AMSU is being implemented. Necessarily, the system must include feedback mechanisms at all hierarchical levels for improved decision making on the refinements of the RAP-AMSU as it is being implemented.

It is important to identify indicators along four areas, which are critical for the implementation, as well as effectiveness, of the RAP-AMCSU to attain specific objectives, as well as its overall goal. These areas are the following, including some suggested key indicators that are direct outputs and outcomes of the various activities of the RAP-AMCSU:

1. Institutional

- Organising and setting up functional national and regional committees/working groups
- Formulation of the National Agrobiodiversity Strategy and Action
 Plan
- Inclusion of agrobiodiversity in the NBSAP for the environment sector and agricultural policies, plans, and programmes for the agriculture sector as well as inter-sectoral bridging; and both being included in the country reporting system
- Networking and others

2. Economic

- Establishment of value chains for biodiversity for food and agriculture
- Stimulation of markets for underutilised and neglected species
- Incentives for biodiversity conservation and sustainable use in farming systems
- · Public-private partnerships to promote biodiversity products
- Payment for environmental and other ecosystem services for biodiversity in agro-ecosystems and others
- Economic valuation of externalities of less diverse versus more diverse agro-ecosystems

3. Socio-Cultural

 Documentation of indigenous and formal knowledge systems associated with biodiversity for food and agriculture for both smallholders and commercial farms

- Number of agrobiodiversity sites used as platform for ecotourism
- Number of national and regional agrobiodiversity cultural fairs and others

4. Communications and Scaling

- Number and kind of good practices in biodiversity deployment for food and agriculture documented at the national and regional levels
- Number of pilot sites for biodiversity conservation through sustainable use documented and scaled at the national and regional levels
- Number of agrobiodiversity curricula developed and adopted in ASEAN

Applicable parameters and baseline information on the identified monitoring and evaluation indicators must be established before these indicators can be used as the joint regional and national activities and actions are being implemented.



Indonesia

Photo by Dedi Suwidiantoro Entry from the Zooming in on Biodiversity Photo Contest

Way Forward

Photo by Arjanmar Rebeta Entry from the Zooming in on Biodiversity Photo Contest

In the way forward, the ACB and SEARCA underlined the need to operationalise the proposed actions that were outlined from both the Chiang Mai workshop in 2017 and the recently concluded multi-sectoral workshop in Bangkok. The five-point proposed actions will be circulated to both the ASEAN sectoral bodies on environment and food, agriculture, and forestry (FAF) for endorsement. Thailand commended the workshop implementation as indeed, it served its purpose of developing a cross-sectoral mechanism among and between relevant bodies in ASEAN for agrobiodiversity conservation and sustainable management.

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