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Empowering Communities and Countries to Conserve Biodiversity at the National and ASEAN Levels: Status, Challenges, and Ways Forward

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Abstract: *The importance of biodiversity conservation and its sustainable use for the realisation of the ASEAN vision of promoting sustainable development and a green economy is well recognised. However, the current state of biodiversity in general, and agro-biodiversity in particular, in the region is a matter of serious concern. There has been significant progress in the expansion of Protected Areas in the region, as well as the setting up of both in situ and ex situ biodiversity conservation programmes. Nonetheless, urgent steps still need to be taken at the community, national and regional levels to ensure biodiversity conservation and its sustainable use. This paper provides an analysis of the opportunities and constraints of biodiversity conservation in natural and agricultural ecosystems. This analysis has been used to identify important strategies and initiatives to promote community empowerment, as well as national strengthening and regional collaboration to enhance biodiversity conservation and its sustainable use for the realisation of the ASEAN vision.*

Keywords: biodiversity, agro-biodiversity, resilience, sustainability, International Treaty on Plant Genetic Resources for Food and Agriculture, Convention on Biological Diversity

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‘Biodiversity is the heart of sustainable agricultural systems’ – GEF

‘Biodiversity is the life insurance of LIFE itself’ – McNeill and Shei

‘Biodiversity which is the library of LIFE is on fire and we must put it out’ – Gro Harlem Bruntland

1. What Is Biodiversity and Why Is It Important?

‘Biodiversity’ started as a seemingly esoteric term of ecological jargon, which was later transformed into a modern day component of international treaties and conventions, most notably the Convention on Biological Diversity (CBD). This transformation was a result of the combined forces of a burgeoning human population with increasing basic needs and ecological services, against a backdrop of natural habitat destruction and dwindling natural resources. This transformation also came about with the realisation that biodiversity provided tremendous benefits to human society stemming from a myriad of living organisms in various ecosystems. There was also a dawning realisation that biodiversity supported life and was life itself!

The Rio+20 Outcome Document (2012), The Future We Want, ‘reaffirms the intrinsic value of biological biodiversity as well as its ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values as well as its critical role in maintaining ecosystems that provide essential services which are important foundation for sustainable development and human wellbeing. It also supports mainstreaming the consideration of the socio-economic impacts and benefits of the conservation and sustainable use of biodiversity and its components as well as ecosystems that provide essential services into relevant programmes and policies at all levels in accordance with national legislation, circumstances and priorities’.

The issue of biodiversity conservation and sustainable use will continue to challenge humankind not only today but more so in the coming years. This arises from the fact that biodiversity is the basic foundation for food security, human health, ecological services and also as a buffer against, and a coping mechanism for, climate change.

Biodiversity, based on the CBD definition, refers to the variability amongst living organisms from all sources including, amongst other things, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species and of ecosystems. The moment this natural biodiversity is transformed as a result of human modifications and interventions related to agricultural production or to generate human needs, one begins to deal with agro-biodiversity or biodiversity of agricultural ecosystems or agro-ecosystems (Conway, 1984).

Agro-biodiversity is a subset of biodiversity and represents the variability of plants, animals and micro-organisms at the genetic, species and ecosystem levels. This variability is necessary to sustain key functions in the agro-ecosystem, its structure and processes, and to support food production and food security. In this context, the technical definition of biodiversity becomes complicated by the fact that various stakeholders choose to interpret this in many different ways and at various hierarchical levels. To fisherfolk, farmers and other local resource users, biodiversity means food, clothing and shelter, as well as the provider of other basic needs and human welfare. To some conservationists and policymakers, biodiversity means conservation of rare and endangered species and habitats. To others, biodiversity is the conservation of the natural heritage and the beauty of nature. Obviously, given this reality, all biodiversity decisions, including those based on science, are value-laden. The legitimacy of stakeholders' claims will always be debatable, with political and economic power dynamics providing the major influence in making decisions on access, use and benefit-sharing of biodiversity (Vermuelen, 2004). This is the main reason why it took so long and so many arduous international debates before an access and benefit-sharing (ABS) accord, referred to as The Nagoya Protocol or simply the Protocol, to be finalised and agreed under the CBD. This was similarly the case with the legally binding International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) governing access and benefit-sharing for the most important food crops and forage species that preceded the Protocol.

Biodiversity, as an element of the natural resource base and in concert with technological and socio-cultural factors, will continue to be relevant in a rapidly changing and increasingly globalised world. However, referring to the sustainable

livelihood framework, biodiversity—by itself and as a component of natural capital—cannot alleviate poverty if nothing is done with other livelihood assets, such as physical, human, financial and social capital (Sajise, 2014).

One important lesson gleaned from the analysis of biodiversity research is that not all biodiversity is good (Sajise, 2006). The key is to better understand the interactions of biodiversity elements at various levels and how these can be harnessed into positive interactions to produce a productive, stable and sustainable resource base. Another emerging lesson is that biodiversity can often be conserved in agro-ecosystems if poor resource users can be helped to use it to improve their assets in the context of the sustainable livelihoods framework. The effective management and conservation of agricultural biodiversity can be achieved through product value addition and linked to markets, germplasm enhancement, and participatory plant breeding.

Biodiversity, when thought of only in terms of the kinds and number of species—as is the usual way of quantitatively measuring it—is of little use if not related to the functions and services that it provides. As such, biodiversity needs to be interpreted in terms of **functional biodiversity**. Functional biodiversity is the kind of biodiversity that provides more available options for livelihoods in the social system, whilst at the same time maintaining ecosystem services of the natural-resource base, or a transformed natural system to enhance sustainability. For example, habitat complexity and the specialised niches available to animals provide functional biodiversity that characterises tropical forest ecosystems. Loss of canopy cover, loss of epiphytes that provide microhabitats for some species, lower relative humidity and elevated substrate temperature have been identified as proximate contributors to biodiversity loss, along with forest fragmentation and edge effects (Suarez and Sajise, 2010). This observation provides the rationale for forest biodiversity assessments using four surrogate parameters to delineate the extent of useful biodiversity: (i) area of primary forest; (ii) forest area designated primarily for conservation of biodiversity; (iii) area of forest designated as Protected Areas; and (iv) tree species composition (Global Forest Resources Assessment, 2010).

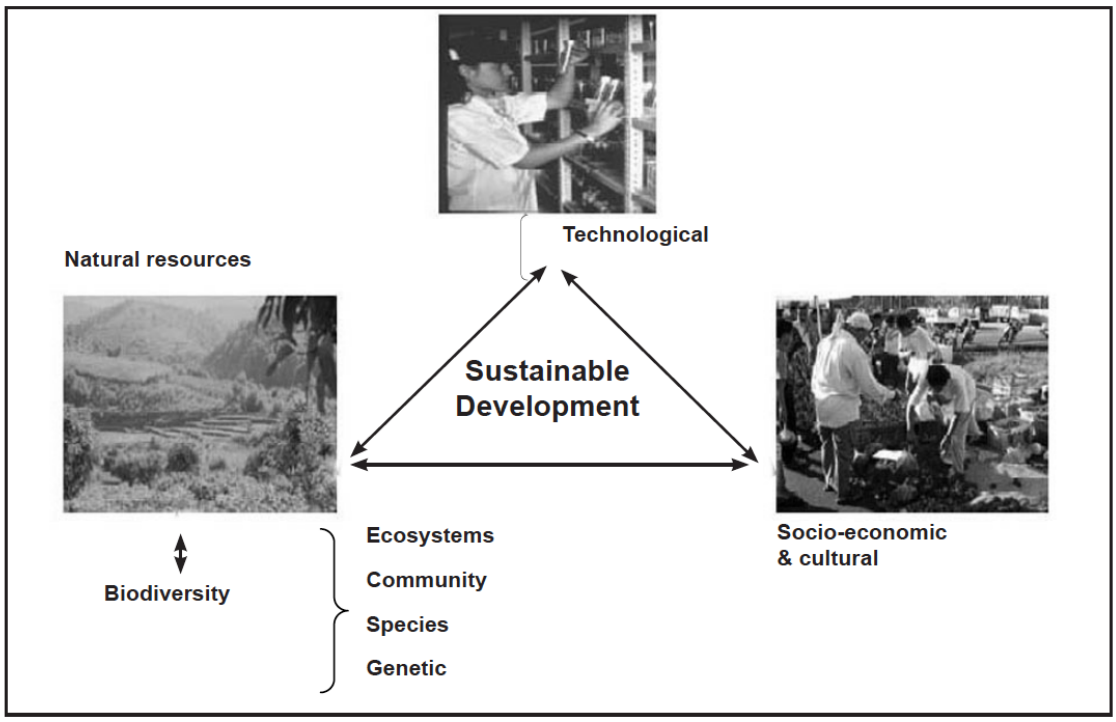
Biodiversity in forest and other natural ecosystems is linked to and underpins the resilience of this ecosystem. A capacity for resilience and ecosystem stability is required to maintain essential ecosystem goods and services over time and space

(Thompson et al., 2009). Resilience needs to be viewed as the capacity of natural systems to self-repair based on their biodiversity. Hence, a loss of biodiversity could mean a reduction of this capacity, leading to a lack of sustainability.

Sustainable development is the call of the times, as a result of a deteriorating environment and unsustainable exploitation of the natural resource base. Sustainable development is a complex, multi-dimensional and highly contextual state or condition which, in general, adheres to the basic principle of utilising the natural resource base in a manner that the ability of this natural resource base to provide current and future goods and services useful to human society is not impaired. It is a type of development that is economically viable, environmentally appropriate and socially acceptable. Conceptually, sustainable development can be represented as in Figure 1. It is made up of three major and interacting elements, namely the natural-resource base, socio-economic factors, and technology (Sajise and Sajise, 2006). To attain sustainable development, these three major elements must work in a symbiotic and complementary manner, such that goods and services needed by human society are produced on a sustainable basis. Biodiversity in this context is an important component of the natural resource base (Sajise, 2006).

Biodiversity and climate change are interrelated in two ways. First, biodiversity is expected to serve as a buffer against climate change by providing resilience and sustainability. Second, biodiversity will be impacted by climate change, especially if the time frame is short. There is a need to identify **functional biodiversity** that could be responsible for climate change resilience and sustainability, and deploy this for the mitigation of, and adaptation to, climate change.

Figure 1: Conceptual Model of the Relationship between Plant Genetic Resources and Sustainable Development



Source: Sajise (2006).

2. Biodiversity and the ASEAN Vision of Sustainable Development

The ASEAN vision of sustainable development is described as 'an ASEAN Socio-Cultural Community that is inclusive, sustainable, resilient, dynamic, and engages and benefits the people'.

The central elements of this vision are: (i) enhanced commitment, participation and social responsibility of ASEAN peoples through accountable and inclusive mechanisms for the benefit of all; (ii) equal access and opportunity for all, and the promotion and protection of human rights; (iii) balanced social development and a sustainable environment that meet the current and future needs of the people; (iv) enhanced capacity and capability to collectively respond and adapt to emerging trends and challenges; and (v) strengthened ability to continuously innovate and be a proactive member of the global community.

Biodiversity will play a critical role in achieving this vision of the ASEAN Socio-Cultural Community (ASCC), primarily in supporting one of the major pillars of the UN Post 2015 Sustainable Development Agenda: the ecological pillar that will promote resilience and the use of green technology, as expressed in the Nay Pyi Taw Declaration of 12 November 2014. This will be achieved through a people-oriented and people-centred process as espoused in the same declaration. The declaration of this important process requires giving priority to people empowerment and people-centred goals in biodiversity conservation and its sustainable use.

ASEAN Member States (AMS) comprising Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, Lao PDR, Thailand, the Philippines, Singapore, and Viet Nam, whilst occupying just 3 percent of the earth's surface, contain over 20 percent of all known plant, animal and marine species. Amongst these are a large number of endemic species found nowhere else in the world. The more than 7,000 islands that constitute the Philippines, for example, hold the world's fifth-highest number of endemic mammals and birds.

This region is characterised by high levels of biodiversity, where 3 of the 17 mega-biodiverse countries of the world are located (Malaysia, the Philippines, and Indonesia). These countries are also viewed as biodiversity 'hotspots' because of the rapid rate of loss of this valuable biodiversity. Southeast Asia is also home to many of the world's most important crops, such as rice, mango, banana and coconut, as well as a wealth of crop-wild relatives (CWR). Hence, the Southeast Asian perspective on the conservation and sustainable use of biodiversity, especially agricultural biodiversity or agro-biodiversity, for food and agriculture is important.

Biodiversity and natural ecosystems also contribute significantly to the region's socio-economic growth. They provide goods and ecosystem services to which the well-being of human populations is intimately linked.

In this context, without the proper conservation and sustainable use of biodiversity in the region, it will be difficult to achieve the ASEAN Vision 2020 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 the high quality of life of its peoples'. Sustainable development as emphasised in Rio+20 should be returned to the core of the development process and

can only be attained if it stands on three strong pillars: social, economic and environmental. Biodiversity, especially **functional biodiversity** at the genetic, species, community and ecosystem levels, will be a key component of the environmental pillar. Sajise (2015) defined **functional biodiversity** as characterised by, and comprising, species and communities arranged over time and space that have the characteristics of productivity, stability, equity and resilience. Functional biodiversity, in the immediate and longer-term context, is needed to realise the ASEAN vision and to sustain the momentum gained through the major regional programmes in the Greater Mekong Subregion, the Heart of Borneo, the ASEAN Heritage Parks (AHP), Sulu Sulawesi, and soon to be included the Marine Hotspots in Southeast Asia through a mapping initiative by The Worldfish Center-Philippines. These programmes have resulted in significant headway in terms of gathering political support for regional initiatives facilitated by the ASEAN Center for Biodiversity (ACB). Greater emphasis has to be placed also on mainstreaming biodiversity conservation into various sectors—government, corporate, economic, education, tourism, trade, food production, amongst many others—to ensure that everyone will be aware of the need for individual and collective action to conserve what is left of our biodiversity. Unless we all have a full grasp of the crucial connection between biodiversity in general, and **functional biodiversity** in particular, and on our survival, we will continue to fall short of achieving the CBD-Aichi biodiversity targets.

3. Status and Capacity of Achieving ASEAN Biodiversity Conservation and Sustainable Use Targets

The status of biodiversity in the ASEAN region is well described in the ASEAN Biodiversity Outlook, 2010. In general, the dire situation is summarised as follows:

- Loss of 555,587 square km of forests in the period 1980–2007;
- Decline of mangroves by 26 percent in the period 1980–2005;
- Highest loss of coral reefs by 40 percent in the period 1994–2008;
- Significant loss of sea-grass, especially in Indonesia, the Philippines, Singapore, and Thailand; and

- Increase in invasive and alien species that displace native biodiversity.

3.1. Problems and Challenges in Biodiversity Conservation and Sustainable Use in the Region

One major reason for the rapid loss of biodiversity in many countries of the region is poverty, whereby the food security and livelihood requirements of the poor often result in the destruction of natural habitats and the over-exploitation of natural resources. Other major causes include the following (Sajise, 2011):

- rapid modernisation of agriculture that strongly favours monoculture and high-yielding varieties vis-à-vis traditional varieties and land-races;
- changing consumer tastes that tend to lessen biodiversity in favour of just a few crops, breeds of animals, and other biological entities ;
- rapid urban population increase partly as a result of migration from rural areas;
- the youth leaving farming, causing discontinuities in the practice of traditional agriculture that favours biodiversity; and
- infrastructure development, pollution, and rapid land conversion resulting in the loss of agricultural land, natural forest and aquatic areas.

In the long term, food security and sustainable development not only in the Southeast Asian region but globally will not be attained if present trends continue. The focus areas of the Global Plan of Action for Plant Genetic Resources for Food and Agriculture (GPA) and the National Biodiversity Strategic Action Plan (NBSAP) gain more importance and even more urgency in Southeast Asia because the demands placed on agriculture and other natural-resource base components will increase significantly. Such an increase will stem from ever-increasing population pressure, unabated ecosystem degradation, and the frequent occurrence of disasters associated directly or indirectly with climate change. Meeting these demands will only be possible if we continue to have access to the genetic diversity of crops and animals, as well as their wild relatives that provide breeders and farmers with the raw material required to sustain and improve their crops. There is an urgency to fully implement the updated NBSAP, given the Aichi Targets by countries in the region to conserve remaining intact ecosystems (forests, grasslands, wetlands and aquatic-marine

ecosystems). These serve not only as repositories of high biodiversity but also continue to generate the ecosystem services needed by human societies locally, as well as at the national, regional and global levels. The ASEAN region remains slow in making progress, particularly in preventing invasive alien species, addressing the impact of biodiversity on species and ecosystems, abating pollution, and the exploitation of forests and wetlands.

At the institutional level, the weak coordination between the Ministries of Environment, Agriculture and Fisheries, as well as the lack of strong support by local government units and the private sector, enhances the problem of natural resource exploitation and slow regeneration or rehabilitation of degraded ecosystems. This is because natural biodiversity is the responsibility of the Ministry of Environment, whilst the Ministries of Agriculture and Fisheries cover the biodiversity materials for food and agriculture.

3.2. Biodiversity Status, the National Biodiversity Strategy and Action Plan (NBSAP), and the Aichi Targets in Support of CBD Goals

The country status of biodiversity, as well as targets for its conservation and sustainable use, is well described in the National Biodiversity Strategy and Action Plan (NBSAP). This now needs to be updated in view of the Aichi Biodiversity Targets for 2015–2020 agreed by the Conference of Parties of the Convention on Biological Biodiversity (CBD).

The NBSAP, once updated in line with the Aichi Biodiversity Targets, will contain national strategies, plans and programmes for the conservation and sustainable use of biological diversity. The NBSAP currently includes the following elements:

- ways to carry out and update assessments of the status and trends of national biodiversity;
- procedures for identifying the priority issues for the NBSAP;
- establishing and monitoring measurable national goals and targets;
- legislative measures and public policy development;
- NBSAP management and oversight arrangements ;

- funding strategies; and
- national framework of action for communication, education, and public awareness activities of biodiversity.

The 20 quantifiable targets under five Strategic Goals aim to address underlying causes of biodiversity loss, reduce the pressure on these causes, safeguard ecosystems, enhance benefits from biodiversity, and promote participatory processes in planning and implementation. The progress status in achieving the 2010 biodiversity target in the ASEAN region is described in the ASEAN Biodiversity Outlook, 2010 and is summarised as follows:

<u>Goal 1.</u> Promote the conservation of the biological diversity of ecosystems, habitats and biomes.

At least 10 percent of each of the world's ecological regions to be effectively conserved. Up to 12.6 percent of the ASEAN region's terrestrial land has been designated as Protected Areas (PA). Six ASEAN Member States (AMS) have exceeded the 10 percent target, of which Brunei Darussalam, Cambodia, and Thailand have set aside more than one fifth of their total land area for protection and conservation. However, efforts need to be directed towards improving management effectiveness of PAs and focus should also be given to establishing more marine PAs given the region's vast marine and coastal-based resources. Areas of particular importance for biodiversity conservation, as well as key ecosystems in the ASEAN region, were accorded priority conservation status (e.g., Heart of Borneo, Coral Triangle, Greater Mekong Subregion, Sulu Sulawesi, and the ASEAN Heritage Parks).

There is a need to expand the planning of key biodiversity areas that could enhance the protection of areas that are known to have populations of wild and endemic plant and animal species, whilst at the same time improving the management effectiveness of already existing ones. ACB has conducted a 'Review and Analysis of the Management Effectiveness of ASEAN Heritage Parks' involving 30 ASEAN Heritage Parks (AHPs) and came up with the finding that 85 percent experience problems of poaching, illegal wildlife trade, illegal fishing, and illegal extraction of non-timber forest products (NTF). There were also problems with tenure conflicts and in securing

boundaries. Eutrophication and pollution were also encountered as problems affecting water bodies. A common problem is a lack of funds and human resource capacity for the effective management of PAs. Hence, there is a need for re-engineering and re-tooling to strengthen the common weaknesses identified, and to create PAs that are effective not only in name but also in the real essence of an *in situ* reservoir of functional biodiversity for current and future generations.

Goal 2. Promote the conservation of species diversity. The decline in populations of species of selected taxonomic groups needs to be reversed, or at the very least reduced. Partial efforts have been undertaken but these have not been sufficient to significantly avert the decline in populations of some selected species under protection. Initiatives are continuously pursued with the view of sustaining efforts and including other targeted species.

Whilst the status of threatened species has improved, current efforts are inadequate to avert the possible extinction of threatened species. Whilst further declines of a number of protected and threatened species have been arrested in some countries, the challenges of sustaining the initiatives remain daunting. Ecosystem degradation as a result of deforestation and conversion of mangroves and wetlands in many parts of the region will aggravate the current situation further.

Goal 3. Promote the conservation of genetic diversity.

Genetic diversity of crops, livestock, and harvested species of trees, fish, and wildlife and other valuable species to be conserved, and associated indigenous and local knowledge to be maintained. Little effort has been made in the region to protect the genetic diversity of crops, livestock, trees, fish and wildlife. Although some *ex-situ* initiatives have been attempted, most have been small projects and have not taken on a programmatic basis. Several countries amongst the AMS have well-established plant gene banks, as well as cryo-conservation units for animal genetic resources, such as in the Philippines. Initiatives to record indigenous and local knowledge on the conservation of genetic diversity have been started in a few AMS.

Goal 4. Promote sustainable use and consumption

Biodiversity-based products to be derived from sources that are sustainably managed, and from PAs that are managed in ways consistent with the conservation of biodiversity. In a number of countries, certification systems for forest and fishery products have been applied. However, this approach is not widespread in the region and further efforts need to be made to promote and connect sustainable consumption and production patterns with the conservation of biodiversity resources. Mainstreaming biodiversity into national development plans and sectoral plans has been slow.

Unsustainable consumption of biological resources, or consumption that has an impact upon biodiversity, to be reduced. Regional efforts to address this are rather slow.

No species of wild flora or fauna to be endangered by international trade. Significant efforts are being pursued, in acknowledgement of the fact that the illicit wildlife trade is a major problem in many countries. Many AMS are signatories to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and are committed to curbing the illegal trade in wildlife. Capacity-building activities on wildlife enforcement are being pursued by AMS to combat the illegal wildlife trade.

Goal 5. Pressures from habitat loss, land use change and degradation, and unsustainable water use, to be reduced

The rate of loss and degradation of natural habitats to be decreased. Significant efforts are being made in the region, but the challenge of halting the rate of loss and degradation of natural habitats remains formidable. Although significant progress has been made in certain ecosystems (e.g., forests) in some countries, overall the region faces serious problems in reducing the rate of habitat loss.

<u>Goal 6.</u> Control threats from invasive alien species

Pathways for major potential alien invasive species to be controlled. Efforts to address this matter are still in their nascent stages.

Management plans in place for major alien species that threaten habitats, ecosystems or species to be put in place. Efforts to address this matter are in their early stages. Management plans for a few economically threatening invasive species were initiated to prevent further assaults on the environment.

<u>Goal 7.</u> Address challenges to biodiversity from climate change and pollution.

The resilience of the components of biodiversity to adapt to climate change to be maintained and enhanced. Countries are fully aware of the need to adapt to climate change. Most AMS have already initiated programmes to address this issue, including activities that will enhance the resilience of ecosystems to possible impacts of climate change.

Pollution and its impact on biodiversity to be reduced. Pollution reduction has been one of the cornerstone activities for environmental management in all AMS. However, linking pollution reduction with biodiversity conservation has only recently been recognised as important. Efforts are underway in many countries to explore this connection.

<u>Goal 8.</u> Maintain the capacity of ecosystems to deliver goods and services and support livelihoods.

The capacity of ecosystems to deliver goods and services to be maintained. The notion of ecosystem services is now being recognised in the region. Whilst the pressure on many of the critical ecosystems that provide public goods to society is clearly escalating, there are efforts to ensure that these services are continuously provided and maintained.

Biological resources that support sustainable livelihoods, local food security and health care, especially of the poor, to be maintained. The AMS acknowledge that many communities, particularly the marginalised sectors and the poor, rely heavily on biological resources for their well-being. As such, many programmes have been developed to respond to these issues. Whilst a number of countries face challenges in sustaining these initiatives, programmes now build in designs to ensure that communities will have the capacity to continue relying on these resources, through more sustainable means. These necessitate strong community-based approaches and incentive systems.

<u>Goal 9.</u> Maintain socio-cultural diversity of indigenous and local communities.

Traditional knowledge, innovations and practices to be protected. Given the cultural diversity of the region, many AMS are taking actions to protect their traditional knowledge and practices. For most countries, the protection of traditional knowledge is a major source of income (e.g., ecotourism and cultural tourism). In PAs with populations of indigenous people, the income from this kind of tourism could be used to enhance the management and protection of these PAs.

The rights of indigenous and local communities pertaining to their traditional knowledge, innovations and practices, including their rights to benefit sharing, to be protected. Most AMS have specific laws and activities that recognise the rights of indigenous and local communities, including their cultures and ways of life. Initiatives are underway to develop processes that include indigenous communities in the negotiation of their rights for the benefits derived from biological resources and ecosystems services in their areas.

<u>Goal 10.</u> Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources.

All transfers of genetic resources to be in line with the Convention on Biological Diversity, the International Treaty on Plant Genetic Resources for Food and Agriculture, and other applicable agreements. Some countries have clear laws regarding the transfer of genetic materials which conform to the Bonn Guidelines.

Others are starting to develop their respective regulations and/or are awaiting developments on the ABS regime. For international organisations operating in the region, e.g., the International Rice Research Institute, these agreements are closely being adhered to. Transactions that are commercial in nature are subject to existing laws and agreements of the host country. Benefits arising from the commercial and other utilisation of genetic resources should be shared with the countries providing such resources.

<u>Goal 11.</u> Parties have improved financial, human, scientific, technical and technological capacity to implement the Convention.

New and additional financial resources to be transferred to developing country parties to allow for the effective implementation of their commitments under the Convention, in accordance with Article 20. Many countries in the region, particularly the developing countries, have been recipients of numerous overseas development assistance aimed at improving their capacity to meet their commitments to the CBD and other biodiversity-related conventions. Although it is acknowledged that the resources are insufficient, it is significant enough to start a number of critical activities supporting biodiversity conservation.

Technology to be transferred to developing country parties to allow for the effective implementation of their commitments under the Convention, in accordance with its Article 20, paragraph 4. Access to technology continues to be a key challenge for many AMS. Although some countries have been able to access particular technologies, additional effort is needed to expand the access of developing countries to technologies that would significantly support their efforts in conserving biodiversity resources in the region.

3.3. Agro-biodiversity Status and the Global Plan of Action (GPA), the National Information Sharing System (NISM) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)

Another means of assessing the status of biodiversity in the region will be in terms of the conservation and sustainable use of agro-biodiversity in accordance with the **Global Plan of Action (GPA) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).** Legally binding, the ITPGRFA establishes the framework for access and benefit sharing within a multi-lateral system for most of the world's major food crops. It includes 35 genera of food crops and 29 forage species, including all major Consultative Group for International Agricultural Research (CGIAR) crops and a number of minor ones. The identified food and forage crops in the Multi-lateral System (MLS) are to be exchanged using a Standard Material Transfer Agreement (SMTA). The MLS provides uniform condition for access and benefit-sharing (ABS) and reduced transaction costs for users under streamlined conditions**.**

The GPA will be supported by a National Information Sharing Mechanism (NISM) for the countries initiated and developed by the Food and Agriculture Organization of the United Nations (FAO). The NISM is designed to monitor the extent of implementation of the Global Plan of Action (GPA) for the conservation and sustainable use of plant genetic resources for food and agriculture. In a survey conducted by FAO in 2000, the GPA priority activity for the Southeast Asian region was *ex situ* conservation and the top three activities were: Activity 5 (sustaining existing *ex situ* collection), Activity 7 (collecting PGR) and Activity 8 (expanding *ex situ* collection) (Tao and Anishetty, 2001). Since then, there have been significant progress and efforts on *in situ* conservation and development not only in terms of protected areas, but also on-farm conservation as gathered from country reports which served as inputs to the State of the World Report on PGRFA-2 (SOW-2). There has also been considerable progress in developing and strengthening national programmes, including the setting up of a **National Information Sharing System (NISM) on Plant Genetic Resources for Food and Agriculture (PGRFA) in several countries in the region.**

This NISM provides the necessary data to assess the progress of the implementation of the GPA and also allow the classification of countries in the region into those having a more coordinated conservation and sustainable use of the PGRFA programme, complemented by a network of gene banks. Sajise (2011) conducted a regional assessment of the status of GPA implementation and came up with some typologies of countries in the region based on capacity to conserve and sustainably use plant genetic resources. For example, one type is countries with a well-established and effectively working national gene bank providing national coordination, such as those in Viet Nam and more recent ones such as Myanmar and the Philippines. Another type is those with dispersed gene bank systems, some by crops or commodities, and a less coordinated national system of PGRFA conservation and sustainable use programme, such as those in Cambodia, Malaysia, Thailand, Lao PDR, and Indonesia.

In this context, it may be possible to classify the countries in Southeast Asia as follows:

- **Type A** – well-established organisational structure for effective coordination in the conservation and sustainable use of PGRFA exist; relatively adequate support for human resources and infrastructure for PGRFA conservation and sustainable use; collection of PGRFA is substantial through a long history of exploration, collection, characterisation and evaluation, as well as exchanges with the outside; good links between gene banks and breeders and other users of the PGRFA materials.

  Example country of this type: Viet Nam.

- **Type B** – organisational structure for effective coordination of national PGRFA programme is not well established; relatively less adequate support for human resources and infrastructure needed for PGRFA conservation and sustainable use; collection of PGRFA is less substantial and requires more exploration, collection, characterisation and evaluation, as well as exchanges both from within as well as from the outside; needs more linkages between gene banks and users of the PGRFA.

  Example countries of this type: Cambodia, Lao PDR, and Myanmar

- **Type C –** organisational structure for effective coordination is less well established but strong crop specific gene banks; requires additional support in terms of human resources and infrastructure needed for PGRFA conservation and sustainable use; requires more focused collection of PGRFA especially in strategic crops and crop wild relatives, as well as priority areas where rapid loss of biodiversity is taking place; has existing linkages but requires greater strengthening between gene banks and users of PGRFA.

  Example countries of this type: Indonesia, Malaysia, the Philippines, and Thailand

This classification is useful because it can bring together within regional PGR and crop networks the complementarities and sharing of the strengths of countries that belong to various categories, i.e., for countries in Categories A and B or Categories A and C. Sharing of strengths and complementary interest can take place in human resources and infrastructure development, as well as technologies for conservation and sustainable use. These can build up linkages and confidence that can lead to collaboration in the exchanges of PGR, joint exploration and the conduct of research for mutual benefits. Eventually, this could lead to the functional expansion of the Annex 1 list of crop species of the International Treaty on PGRFA (ITPGRFA) and ASEAN has the opportunity to pave the way for this to be realised. It could be made operational through the Southeast Asia PGR networks, since all these networks already exist and have, in many cases, a long history of existence but with varying levels of effectiveness and sustainability. Similarly, it could take place for crop-specific PGR networks such as coconut, banana and rice and others, which are more active because of common interests and problems being pursued with relatively more funding in partnership with some CGIAR centres. There is also a need for more effective coordination and functional linkages between the existing PGR networks and the various crop networks.

Several countries belonging to Categories B and C have expressed the need for better coordination at the national level of various agencies and stakeholders involved in PGRFA conservation and sustainable use. The mechanisms and strategies to bring this about can be shared by countries belonging to Category A within ASEAN, as well

as those actively collaborating with ASEAN such as Japan, Peoples Republic of China and Republic of Korea. On the other hand, several countries belonging to Categories B and C have successful experiences in promoting and implementing on-farm conservation of PGRFA. These experiences can be shared with countries belonging to Category A if this capacity is not yet present and where the context is similar. The basic principle involved is to enhance complementarities and synergy for effective PGRFA conservation and sustainable use, specifically and biodiversity in general, at the national and regional levels.

3.3.1. In Situ Biodiversity Conservation – Protected Areas (Terrestrial and Marine)

The past decade has seen an increase in PA coverage amongst AMS. New PAs were declared in Lao PDR, the Philippines, Myanmar, Thailand, Malaysia, and Viet Nam, reflecting efforts to contribute to the achievement of the 2010 Convention of Biological Diversity (CBD) target to protect at least 10 percent of the world's major forest types and other ecologically significant habitats. Cambodia and Thailand have PA coverage of over 20 percent of their respective landmasses, whilst PA coverage in Brunei Darussalam, Indonesia, Lao PDR and the Philippines was over 10 percent each. PA coverage in Indonesia alone accounts for 42 percent of ASEAN's total. This positive trend highlights increasing attention and recognition by AMS of the importance of conserving biodiversity. However, the need for effective and sustainable management of these PAs has been repeatedly brought up.

3.3.2. In Situ or On-Farm Agro-biodiversity

The common gaps identified by countries in the ASEAN region are the following:

- insufficient number of staff and weak technical capacity;
- lack of or insufficient funding;
- lack of incentives for farmers for on-farm conservation and participation in protected area (PA) protection;
- In some countries lack of well-developed infrastructure and equipment; and
- lack of, or weak, coordination.

As regards needs, the following were identified:

- documentation of indigenous knowledge (IK) associated with the PGRFA;
- enhanced networking/partnership/stakeholder participation; and
- public awareness.

There is considerable experience in several countries in the region in the implementation of *in situ* conservation of crops and fruits. This experience is the result of multi-country research and development projects implemented by CGIAR centres such as Bioversity International, the World Agroforestry Centre (ICRAF) and the International Center for Forestry Research (CIFOR), as well as NGOs involved in on-farm conservation, home gardens and traditional multi-layered tree farming. Common gaps identified included: (i) a lack of coordinated approach; and (ii) sustainability that is not yet ensured. The needs expressed were: (i) for the development of markets for products from under-utilised crops (UUC) and traditional varieties, land-races and farmers' varieties; and (ii) the promotion and development of value-addition for traditional varieties and land-races.

Assisting farmers in disaster situations to restore agricultural systems. This is a very important activity in GPA for the region, which is often affected by different forms of natural and human-induced disasters. The needs identified for this GPA priority activity were: (i) to establish a network of community gene banks linked with national gene banks for disaster response; and (b) to establish community seed banks, such as in the Philippines and other countries in the region. The latter need was also included in SOW–2. Improved understanding of the local seed system was also identified as important in order to bolster the disaster response to restore agricultural systems. A common gap identified in the country reports is the lack of baseline data for disaster rehabilitation.

Surveying and inventorying plant genetic resources for food and agriculture

The common gap in this area as expressed by countries often falling under Categories B and C is in terms of the lack of capacity (human, physical and financial). The nature of the terrain and the occurrence of social disturbances in some countries in the region have led to the identified gap of giving priority for survey and collection in remote and disturbed areas, especially for Crop-Wild Relatives (CWR). The need

expressed for this priority activity was the mapping of priority crops and CWR, and the upgrading of inventories.

Promoting in situ conservation of wild crop relatives and wild plants for food production.

The State of the World Report on Plant Genetic Resources-2 (SOW–2) recognises that *in situ* conservation of wild crop relatives and wild plants occurs in PAs. However, PGRFA concerns and jurisdiction over PAs usually fall under separate sectors of government in most countries in the region. To bring about improved *in situ* conservation of wild plants and CWR for PGRFA, there is a need for better coordination between these concerned sectors of government in partnership with local stakeholders. This need was expressed in the various country reports as the need to develop stronger networking and partnerships of various stakeholders. A gap also identified in some country reports was the lack of proper incentives for communities to be involved in forest protection and *in situ* conservation in PAs.

3.3.3. Ex Situ Conservation

This conservation area broadly encompasses gene banks, field banks, botanic gardens, in vitro conservation and cryopreservation. Basic conservation activities which are essential to maintain and make available an existing collection over the long-term include:

- storage and maintenance (seed, in vitro, field);
- safety-duplication;
- regeneration;
- characterisation;
- documentation;
- health of germ plasm;
- distribution/links to users; and
- acquisition.

The maintenance of *ex situ* collections, in particular, requires a stable, sustainable and perpetual funding stream, which is now partly provided by the Crop Diversity Trust. Furthermore, *ex situ* conservation has seen a considerable reduction in

development-partner support in recent years, in favour of funding for *in situ* conservation. However, the complementarities between *in situ* and *ex situ* conservation are also more important than just an emphasis on one of the other, as both need to exist side by side to bring about sustainable conservation, evolution and sustainable use of plant genetic resources. In this regard, the Crop Diversity Trust emphasises adopting a rational conservation system for *ex situ* conservation.

Base collections were established in the Philippines and Viet Nam. Modern facilities have been established in Thailand and the moving of materials from dispersed collections into these facilities is under way. In the rest of the countries in the region, the conservation facilities are in relatively poor condition. The active collections are usually maintained in the provinces or substations of national agricultural research systems in medium-term gene banks, and also in research institutes, universities and experimental stations with varied storage conditions. These gene banks and institutions are responsible for germ plasm regeneration, characterisation, distribution and utilisation.

For vegetatively propagated crops, the field gene banks are used to maintain the diversity collected in the region. The crop species, for example fruit trees, cannot be stored as seed samples and are stored in the fields with proper protection facilities. However, in many cases, such as in the Philippines, field gene banks are not adequately protected and subject to anthropogenic and natural disasters. For safety of germ plasm collections of vegetatively propagated crop species, in vitro techniques are used to maintain the viability of these crop species in the tubers that are maintained in controlled conditions. New opportunities for *ex situ* conservation are in terms of improving the value and use of molecular characterisation for understanding genetic diversity and germ plasm collections. Security of *ex situ* collections has also been enhanced through arrangements with some CGIAR centres and more recently with the Svalbard Global Seed Vault in Norway.

It is in *ex situ* conservation where differentiation between countries in the three categories earlier described becomes clearly visible. Across all categories of countries in the region, the more common need expressed is for strengthened and focused collecting activities, with greater attention for CWR. The common needs identified were for greater and stronger institutional linkages and documentation. For countries

in Category B, the common need expressed was the lack of a focused approach in planning and policy development. The need for interdisciplinary teams to work on PGRFA and upgrading of facilities, identification of duplicates and improved regeneration protocols were also identified.

Sustaining existing ex situ collections/regenerating threatened ex situ accessions.

A common need indicated in the country reports already mentioned in the SOW–2 is a strengthened and focused collecting activity with particular attention given to CWR and under-utilised crop (UUC) species. Similarly, the need for better coordination at the national level for the identification of duplicates and improved regeneration protocols, as well as increased efforts to regenerate accessions, were also identified. Identification of duplicates in and between collections, including safety duplication and processing of backlogs in collections, was also identified as existing needs in several country reports.

Given that many countries in Categories B and C have no reliable electric power supply, this need was clearly identified and has to be alleviated to sustain existing *ex situ* collections in gene banks.

Supporting planned and targeted collecting of PGRFA.

The gaps reported by countries in the region for this activity are: (i) lack of focused approach, planning and policies; (ii) inadequate funding; (iii) lack of clonal repositories; and (iv) lack of interdisciplinary teams to conduct targeted collecting. There is a need for upgrading of facilities and equipment, improved technologies for *ex situ* conservation and better institutional linkages both within and between countries to promote exchanges of germ plasm materials.

Expanding ex situ conservation activities.

Priority activities to promote the expansion of *ex situ* conservation activities were also agreed by national focal points that are primarily responsible for national gene banks for the various PGR subregional networks. These *ex situ* conservation activities were:

- improving the management of collections of identified crop;

- monitoring of seed viability and seed health in accessions held in gene banks for long term storage;
- strengthening field gene banks for conservation of perennial wild relatives;
- capacity-building and upgrading gene bank facilities;
- enhancing knowledge on database management, in vitro conservation and cryopreservation, molecular characterisation and seed processing and gene bank management through training programmes;
- regeneration of materials in critical danger of loss of viability;
- targeting collecting from specific areas for specific traits, inventory and mapping of genetic diversity;
- improving the management of collections of identified crop;
- monitoring of seed viability and seed health in accessions held in gene banks for long term storage;
- strengthening field gene banks for conservation of perennial wild relatives;
- conserving, characterising and documenting genetic diversity of identified priority crops;
- evaluating germ plasm for nutritional traits;
- molecular characterisation;
- capacity-building and upgrading gene bank facilities;
- enhancing knowledge on database management, molecular characterisation and seed processing and gene bank management through training programmes;
- regenerating materials in critical danger of loss of viability; and
- using identified materials with desirable traits for base broadening towards utilisation.

Sustainable Use and Conservation of PGRFA – Participatory Plant Breeding, Community Seed Banks.

For all categories of countries in the region, the common gap identified was on evaluation and documentation of PGR, and the need to enhance linkages between users of PGRFA and the gene banks. These gaps were also identified in SOW–2. For

countries belonging to Category B, the common gap identified was weak human resource capacity. The common needs identified were for greater understanding of seed systems, policy development and attention to core collections. These needs were also reported in SOW–2.

The opportunity exists and should be encouraged for harnessing the strengths of countries in Category A belonging to various subregional networks for responding to the gaps in human resource capacity and the lack of facilities and equipment, especially in the use of molecular tools for characterisation and evaluation of conserved germ plasms. This is already taking place through centres of excellence designated by Bioversity International, with China providing staff training in molecular tools for PGR; India on in vitro and cryo-preservation techniques; and Korea on gene bank management. What is still needed, however, is financial support to allow staff from countries of Categories B and C to make use of this staff development and training.

Expanding the characterisation, evaluation and number of core collections to facilitate use.

As indicated in SOW–2, there is a need for more effort in characterisation and evaluation of germ plasms collected in gene banks and to have them at a manageable level through the establishment of core and mini-core collections. Many countries belonging to Categories B and C also indicated the desire to develop capacities for the use of molecular tools to conduct these activities, as well as in developing and using an effective documentation system. Many countries in the region in Categories B and C identified the need for increased human capacity, i.e., staff training for the above tasks. The opportunity to link gene banks and enhance networking support to bring this about exists in the region as earlier indicated.

Increasing genetic enhancement and base-broadening efforts.

A major concern expressed in many country reports deals with increasing crop uniformity as a function of increasing industrialisation of agriculture and the influence of export markets. This trend is known to undermine agricultural sustainability and increase vulnerability to pests and diseases, as well as to environmental disturbances.

However, in the Southeast Asia region, there are good examples of using agricultural biodiversity for managing this trend of reduction in crop diversity, such as in the case of home gardens in Indonesia, Viet Nam, Thailand and others. The recognition of the importance of base broadening is a need expressed by many countries in the region. This highlights the importance of collecting and characterising wild-crop relatives, as well as under-utilised species as a means of coping with climate change and environmental disasters, which are commonplace in the region. The need for enhanced linkages between breeders, researchers, traditional and private sectors, and national and international institutes, were also clearly identified by many countries in the region.

Promoting sustainable agriculture through diversification of crop production and broader diversity of crops.

The ASEAN region is well known for its diverse cropping system, which has co-evolved with its many cultures and types of farming systems, such as subsistence, low inputs, multiple and multi-purpose cropping. This has given way, in many instances, to commercial mono-cropping with its attendant economic advantages but accompanied by greater vulnerability to pests and diseases, as well as disasters. In fact, disasters are more common and a greater current concern than climate change for countries in the region, although these two phenomena are inter-related over time and space. SOW–2 has probably indicated more emphasis on climate change than coping with disasters. SOW–2 has also emphasised the 'growing efforts to strengthen the relationships between agriculture and provision of ecosystem services'. This was not prominently emphasised in the country reports from the region.

Promoting development and commercialisation of UUC and species.

The need to develop systems for neglected/under-utilised crops, and enhance crop diversification through market development and incentive systems were identified by several countries in the region. However, it is worth noting that this was identified only by countries usually in Categories B and C. If countries in Category A have already developed this type of incentive system, it could be an area for cross transfer or sharing of lessons learned through a networking process.

Supporting seed production and distribution.

Many countries in the region reported the need to develop improved seed systems through participatory selection, public sector seed systems, and growers' associations. The importance of responding to this need with an appropriate strategy has been demonstrated in connection with the success of participatory plant breeding in the Philippines, Viet Nam and other ASEAN countries. Country reports indicated that a lack of seeds is a major reason for the inability to promote cultivation of UUC species. However, the lack of institutional support to identify, recognise and officially register farmers' varieties is working against providing economic incentives to commercially grow farmers' varieties. Countries in the region recognise the need for seed policy development. This will support and facilitate mainstreaming of farmers' varieties by providing the needed incentive system for seed production as similarly indicated in SOW–2.

Developing new markets for local varieties and 'diversity-rich' products.

ASEAN local and traditional markets are known to favour diverse-rich products from wild crops and under-utilised species, for example '*ulam*' in Malaysia, and village markets in the Philippines, Thailand, Viet Nam, Lao PDR, and many more countries. These diversity-rich products from local markets are disappearing because of changing lifestyles, where most people now buy uniform and less diverse products from supermarkets. SOW–2 identified need to promote these diversity-rich products is very appropriate for the ASEAN region. Thailand's example of developing local products from indigenous species, e.g., *Garcinia cowa* to cater to the needs of local tastes and food preference, is a good example of this collective effort. This has the potential to provide value-added and markets to farmer varieties in support of on-farm conservation through the promotion of diversity-rich products.

Institutions and Capacity-Building.

A common need expressed by the majority of countries is that of staff training, database development, and educational training on PGR.

National programmes on PGRFA in the region vary in terms of strength and levels of coordination. For countries in Category A, there is a well-defined structural organisation that facilitates coordination for all PGRFA activities. For countries in Categories B and C, other forms of organisations that are not as strong also exist, such as National Committees on PGRFA. For countries with weaker national coordination on PGRFA programmes, the common manifestations are weak policy development regarding access to, and sharing of, benefits on the use of PGRFA and in information sharing and coordination. These indicated weaknesses were listed in SOW–2. The gaps identified were: (i) a limited number of staff and a heavy workload; (ii) a lack of financial resources and PGRFA that is often not seen as a national priority; (iii) PGR networks poorly managed; and (iv) limited international cooperation.

During the past five years, several countries in the region have been assisted to develop their NISM on the GPA priority activities. The establishment of the NISM in several countries in the region, which is still being expanded, has greatly helped to assist the monitoring and evaluation of the GPA implementation in the region and has improved the quality of contributions to SOW. At the country level, the NISM outputs can be used to develop a 'national rolling plan/strategy' for PGRFA conservation and sustainable use. NISM feeding into GPA can be the basis for a National Strategic and Action Plan for PGRFA. The country strategic and action plan can be used to identify and share responsibilities, create awareness, promote research and action on gaps, and to invite and facilitate long-term financing for the action plan. NISM will promote national and regional networking, capacity-building for members of the network, and directly feed into GPA implementation, monitoring and evaluation. It will also improve the quality of the data and information used for the status and progress assessment of GPA implementation. SOW–2 can feed into the updating of rolling GPA, whilst other countries without NISM can be assisted to set one up. There are now several AMS with NISM in place. Given that NISM is a country-driven process, once it proves its usefulness, countries will commit to its maintenance and sustainability, and this will draw more stakeholders into the process.

4. Opportunities in Biodiversity Conservation and Sustainable Use in the Region

4.1. Institutions and Networks on Biodiversity and Plant Genetic Resources

A most notable and significant positive factor in ASEAN is the existence of a formal regional institution, the ASEAN Center for Biodiversity, which has the mandate to 'facilitate cooperation and coordination amongst AMS and with relevant national government, regional and international organisation on the conservation and sustainable use of biological diversity and equitable sharing of benefits ensuing from the use of such biodiversity in the ASEAN region' (http://www.aseanbiodiversity.org). This started as a project funded by the European Union (EU) in 1999 and was formally launched on 27 September 2005 as a formal regional organisation known as the ASEAN Centre for Biodiversity (ACB) with its Establishment Agreement signed by representatives of AMS. It has served the important function as a clearing house of information related to biodiversity conservation and sustainable use for ASEAN. The ACB continues to support AMS to achieve international targets for biodiversity conservation and management through various programmes and initiatives such as, amongst others, the AHP Programme, Biodiversity and Climate Change Project (BCCP), and Taxonomic Capacity Building for Sustainable Use of Biodiversity Resources (Report of the ASEAN Socio-Cultural Council to the 25th ASEAN Summit, 2014). It has also engaged in capacity-building for developing regionally harmonised national processes for implementing CBD provisions on ABS for genetic resources. Other activities of the ACB are in the areas of agro-biodiversity and biosafety, biodiversity information management, climate change and biodiversity, business and biodiversity, ecotourism and biodiversity conservation, global taxonomic initiative, invasive and alien species, payment for environmental services, peatland management and biodiversity and wildlife enforcement. The ASEAN Socio-cultural Community blueprint calls for the 'enhancement of the role and capacity of ACB to function as an effective regional center of excellence in promoting biodiversity conservation and management'. The target would be the full ratification of the establishment agreement by all AMS and the building up of the ASEAN Biodiversity Fund for the ACB to

ensure its sustainability and strengthened capacity for excellence, efficiency and effectiveness in the service of AMS, which it hopes to achieve in 2020.

4.2. Promoting Networks for Plant Genetic Resources for Food and Agriculture

Collaborative arrangements are facilitated through networking. Networks provide a mechanism for sharing information/knowledge and germ plasm, and transferring technology and standardising procedures, as well as undertaking collaborative R&D programmes, including capacity-building. The crop germ plasm networks facilitate the standardisation of germ plasm collection, maintenance, evaluation and documentation, and also enhance capacity-building that includes the exchange of experts/scientists and the upgrading of facilities. Most countries in the region are members of several commodity-based PGR networks with linkages to international institutions, such as the various CGIAR centres. The PGRFA network in ASEAN is the Regional Cooperation for Plant Genetic Resources in Southeast Asia (RECSEA-PGR), which is mostly composed of heads of their national gene banks as national focal points. This PGR network has conducted joint activities and meetings that are of mutual benefit to members. The main purpose of these meetings is to review the progress of activities relating to different aspects of PGR and to develop plans for collaborative activities. Despite the lack of major funding, the networks help the countries to develop individual national programmes, as well as conduct some joint activities such as PGR collection, evaluation and limited bilateral exchanges of the collected materials.

For a regional system of conservation to be efficient and to ensure links to users, it has to be under the aegis of a formal regional inter-governmental organisation, such as ASEAN, backed up with government commitments to share financial or material contributions in the operation of the network. For organised dissemination of improved rice germ plasm and information, the International Network for Genetic Evaluation of Rice (INGER) facilitates the unrestricted, free and safe exchange of rice germ plasm and the free sharing of information not only amongst National Agriculture and Extension System (NARES) and International Agriculture Research Centers (IARC) partners, but also with the private sector.

For bananas, the International Network for the Improvement of Banana and Plantain (INIBAP) coordinates a global research effort on Musa and promotes and strengthens research collaboration at national and global levels. Regional collaboration is enhanced through the Banana Asia Pacific Network (BAPNET). Bioversity International/INIBAP facilitates BAPNET activities in the following areas: germ plasm management, information development and exchange, banana resource development, and strategic planning. Thus, regional priorities are established and reviewed regularly by the BAPNET secretariat. INIBAP also upgrades the capacity of scientists/researchers and banana growers through training, particularly on production and utilisation aspects.

For sweet potato, collaborative arrangements are established through the International Potato Centre's (CIP) Asian Network for Sweet Potato Genetic Resources (ANSWER). CIP supports germ plasm conservation at national and global levels by monitoring duplicate collections, supplying clones as potential parent material for national breeding, and providing training and expertise support in germ plasm characterisation. ANSWER also employs various strategies (e.g., *ex situ*, in vitro, cryopreservation, and others) for the conservation of sweet potato genetic resources. ANSWER has also initiated capacity-building amongst member-countries with regard to maintenance, characterisation, evaluation and the documentation of their respective sweet potato genetic resources.

For coconut, the International Coconut Genetic Resources Network (COGENT) of Bioversity International (formerly IPGRI) has subregional networks for South Asia, Southeast Asia and the Pacific. The coconut accessions of Asia and the Pacific are listed in the Coconut Genetic Resources Database (CGRD) established by Bioversity International-Coconut Genetic Resources Network (COGENT).

In the above context, a key objective of the Crop Diversity Trust is to contribute to the development of an efficient and effective global system of *ex situ* conservation of PGRFA. A willingness to collaborate with others, for example through the willingness to share facilities, resources and information, is essential to achieve this objective. Partnership may also be important for carrying out certain essential services that may be performed better somewhere other than at the institution where the

collection is held. For developing and implementing an effective conservation strategy at the regional level, the following are critical:

- Credibility and trust amongst the collection holders in the region;
- Willingness to collaborate with partners within and outside of the region;
- Links with existing collaborative frameworks such as networks;
- Adequate funding to support the system;
- Agreed conservation standards; and
- Sharing of conservation responsibilities amongst partners for activities.

Country reports indicated that collaboration for evaluation, characterisation, policy development and joint exploration are high priorities. However, there is a prevailing perception that PGR networks are poorly managed, that the benefits derived from networking are not clear, and that bilateral arrangements are felt to be more advantageous.

4.3. Constructing Comprehensive Information Systems for Plant Genetic Resources for Food and Agriculture

Several country reports indicated the need for improved database and database management for PGRFA. This was similarly pointed out in SOW–1 and SOW–2.

Characterisation and documentation are carried out by the national programmes in each country. The data on accessions are recorded and documented with computerised information systems accessible by breeders and other researchers. Most ASEAN countries have established national PGR documentation systems. Standard descriptors for passport data were used by all the institutes involved in PGR activities for documenting accessions. It is important to point out again at this point that several countries in the region have set up and are maintaining a NISM, which is providing the much needed inputs for assessing and updating the implementation of the GPA. This is a very distinct advantage of the region. However, at present, there is no assurance of the sustainability of the NISM unless countries find it useful and commit to sustain its existence as part of a National Strategy for PGRFA. There is also the need to develop a NISM for the region.

4.4. Developing Monitoring and Early Warning Systems for Loss of Plant Genetic Resources for Food and Agriculture

Early warning may also need to include rapid responses before the loss of PGRFA becomes irreversible. It is worth noting that whilst many countries indicated the concern for loss of genetic resources for various reasons including disasters and climate change, there was no mention of the need to develop tools and methods of assessing this loss, although there was mention of the need for indicators. This may be because of the difficulties in assessing this loss over time. One country, Thailand, indicated the need to monitor ecosystems and populations. The NISM can also serve this function especially if clear and commonly accepted indicators are identified and used.

4.5. Expanding and Improving Education and Training

Many countries in the region reported for all priority areas of GPA the need for more and better trained human resources to carry out the various activities in PGRFA conservation and sustainable use. It is worth noting that in the recent past there was a surge of interest in human resource capacity development, in the areas of plants to molecular aspects of PGRFA, and from the field to the laboratory. Specialists in basic areas of PGRFA, such as taxonomy or crop specialists, are very scarce and need to be aware of their obligation to mentor their replacements.

Other than plant breeding and basic fields of taxonomy, there now exist higher levels of education in PGRFA from various academic institutions in Malaysia and the Philippines. These formal degree programmes are offered at the MSc level but some core courses are also offered at the undergraduate level, where they can either be an elective course or part of a major course. The enrolment for these graduate programmes in PGRFA is rather limited as the current market for graduates is also limited. However, demand for some core courses in PGRFA degree programmes from other curricula is high. In addition, Bioversity International in collaboration with strong institutions on specific areas of PGRFA, have developed centres of excellence that offer short-term courses on key areas of PGRFA on a regular basis. Despite the availability of training on PGRFA, formal degree and short-term training courses, the need for human resources capacity-building was still identified clearly as common to

many countries in ASEAN. This was also indicated in SOW–2. Why this is so was revealed in a survey conducted by IPGRI in 1995 and repeated in a commissioned study by the University of the Philippines at Los Baños, Philippines in 2002. The gaps identified that prevented the build-up of human resources capacity as needed in the region were: (i) the inability of countries to obtain financial support for their prospective staff; and (ii) the shortage of human resources that prevents them from sending their staff for postgraduate training for a minimum of two years. To help provide a solution to these difficulties and to broaden the potential coverage of enrolment to the PGRFA programme, the offering of the MSc PGR programme in a distance-learning mode was envisioned. The survey, which involved most countries in the region, indicated a willingness of respondent institutions to employ graduates of MSc PGR in the distance-learning mode. This study showing demand for the course programme by distance-learning, led to the offering of a training programme on PGRFA at the University of the Philippines at Los Baños Open University.

4.6. Promoting Public Awareness of the Value of Plant Genetic Resources for Food and Agriculture Conservation and Use

There has been steady progress in enhancing public awareness of the value of PGRFA. Country reports indicated that public awareness on PGRFA can facilitate policy and financial support from government and the public sector. Public awareness of PGRFA is also integral with environmental issues that are often in the limelight. Similarly, many countries in ASEAN are signatories to international platforms such as the International Treaty on Plant Genetic Resources for Food and Agriculture, the Convention on Biological Diversity, the International Union for the Protection of New Varieties of Plants (UPOV) and others. This highlights the importance of PGRFA, so that when these platforms are discussed, such awareness also comes to surface. The Declaration of the United Nations of the Year for Biodiversity (2010) is one good example of a strategy to enhance public awareness at the local, regional and global levels. A need expressed for enhancing public awareness of the value of PGRFA is better information coordination and the need for the right materials to be used for public awareness campaigns. At the local level, biodiversity fairs, cross farmer visits and recognition of local biodiversity keepers, including women and their role, have

been successfully employed for this purpose, especially if the vehicle makes use of existing culture and communication mechanisms.

4.7. Using Existing Research Consortia in AMS on Climate Change as Initial Core Institutions to Integrate Biodiversity as It Relates to Climate Change Adaptation or Mitigation

There are existing National Research Consortia on Climate Change such as the one in Thailand comprising of six universities (Jintrawet et al., 2012) involved in joint research on different aspects of climate change. Other universities in the region, such as the University of the Philippines at Los Baños and others, also have ongoing climate change research programmes. They can come together and contribute resources with seed funding from ASEAN to tackle an agreed national and regional research agenda on climate change. This platform and model can be used to create and establish an 'ASEAN Research Consortium on Climate Change and Biodiversity'. This can also link and collaborate with the efforts of regional organisations such as ACB or SEAMEO-SEARCA, as well as that of the CGIAR-led programme on Climate Change for Agriculture and Food Security (CCAFS). The best arrangement would be to bring in these three regional organisations (ACB, SEAMEO-SEARCA and CGIAR-CCAFS) together to provide a joint umbrella for the ASEAN Research Consortium on Climate Change and Biodiversity.

4.8. Linking Biodiversity Conservation and Sustainable Use with New Approaches

At the landscape level, FAO has developed a network of Globally Important Agricultural Heritage System (GIAHS), which can be used as a vehicle for biodiversity conservation and its sustainable use, including the ecosystem services associated with it. GIAHS are defined as 'remarkable land use systems and landscapes which are rich in globally significant biological diversity evolving from the co-adaptation of a community with its environment and its needs and aspirations for sustainable development' (Koohafkan and Altieri, 2011). The interventions used and the effectiveness of this landscape approach to biodiversity conservation need to be

considered in the region, especially for those PAs AHPs that have a long history of human occupancy. Currently, there are already more than eight GIAHS-declared pilot areas globally, including the Bontoc Rice Terraces Landscape in Ifugao, the Philippines.

5. Ways Forward

There is no other way to stave off the continuing loss of precious biodiversity in the region than to maximise the current gains in lessons learned from programmes, institutional arrangements and national commitments to global targets set by CBD and the GPA for PGRFA. If this is not done now, the pillar of a sustainable, inclusive, resilient and vibrant ASEAN community will continue to remain as just a vision. Worst still, with the Damocles sword of climate change hanging over biodiversity, this vision of the future for the region will slip further and further away.

The most practical way forward for ASEAN's goal of empowerment of communities and strengthening of national and regional platforms for biodiversity conservation and sustainable use would be to make use of existing institutions, programmes and mechanisms as existing platforms or nuclei to create and install **more effective linkages and networks.** These can respond more effectively to the needs and opportunities earlier identified in the analysis of the state of biodiversity and agro-biodiversity conservation and sustainable use in the region. These existing but separate organisations and programmes could be joined together under the ASEAN umbrella to create a more coherent and region-wide platforms for greater impact, together with activities in priority areas identified below:

5.1. Enhancing the ASEAN Agenda on the Characterisation of Protected Areas as food and nutrition baskets and as a watershed of ecosystem services for the country and the region by linking this to the ITPGRFA implementation, as well as the GIAHS Program of FAO.

The aim is to highlight the value of PAs as providers of ecosystem services through better assessment of these ecosystem services and attempts at quantification and incorporated in the scheme of Payment for Environmental Services (PES). The funds generated can be put into a national or regional **PA Environmental Fund** that can be used for the effective management of PAs. This agenda will strengthen and complement the increased efforts of AMS to designate PAs, whilst also recognising the need for better management and protection. These PAs can be piloted through a joint ASEAN regional effort carried out by the Ministries of Agriculture, Forestry, Natural Resources, and governments at local, national and regional levels. At the global level, ASEAN can collaborate with FAO to declare and manage GIAHS areas using the ecosystem and landscape approach, which could include already declared PAs and AHPs. This is a **high priority agenda** and needs to be implemented within the next two years in order to avoid losing areas with natural biodiversity that have already been designated by AMS as PAs and AHPs. The efforts to place a value on ecosystem services of these PAs and AHPs could use a scoping study of ACB on ecosystem services under the project entitled 'The Economics of Ecosystems and Biodiversity in Southeast Asia (ASEAN TEEB)'. This scoping study involved four ecosystems (mangrove, coral reefs, forest and marine protected area). There is already human capacity in ASEAN to conduct this kind of assessment through the Economics and Environment Program in Southeast Asia (EEPSEA). It will also build stronger inter-sectoral linkages that are very much needed in effectively pushing for biodiversity conservation and sustainable use. Whilst this effort is going on, there is also the need to set up an **ASEAN-wide management standard for PAs and AHPs,** which is needed to ensure an acceptable level of good management for different ecosystems. This can be initiated under the umbrella of ACB.

Suggested Target: At least two PAs in two AMS will be piloted every year for exploration of CWR and animal species, as well as assessed in terms of ecosystem services values for payment of environmental services. The funds generated could be used to build up a PA Environmental Development Fund to partially support their protection and management. The exploration of CWR and animal species will be prioritised in terms of their potential for adding value as materials for

crop and animal breeding, as well as value-added. As this strategy becomes effective, more PAs and AHPs, to include coastal and marine areas, as envisioned by ACB (Oliva, personal communication)**.**

5.2. Supporting and monitoring the enhanced exchanges of biodiversity materials under the Nagoya Protocol and plant genetic resources for food and agriculture under the ITPGRFA through existing ASEAN networks.

The development of a framework and guidelines for the implementation of the Protocol on ABS under CBD must be implemented across all AMS and exchanges of biodiversity materials monitored. The development, degree of harmonisation and putting in place of the national ABS framework following the Protocol must be a priority for AMS, which **can be used as an indicator at the country and regional levels. ACB can serve as a clearing house for this particular initiative in ASEAN.** Currently, only two countries in ASEAN have an established and approved ABS framework and guidelines in accordance with the Protocol. Biodiversity materials and germ plasm exchanges under the ITPGRFA can be monitored through existing regional networks, such as the RECSEA-PGR, and other biodiversity materials not covered by the ITPGRFA through the networks of ACB. The rate and movement of biodiversity materials, in general and PGRFA in particular, can indicate the level of collaboration and trust amongst AMS and the usefulness of these materials in human and economic development in the region.

Target: At least an increase of five percent of all biodiversity materials are exchanged amongst AMS every year. A baseline survey needs to be conducted amongst AMS as well as region-wide.

5.3. Providing Mechanisms for Enhanced Coordination between the Ministries of Natural Resources, Agriculture and Forestry, Local Government Units and Academe in a fully integrated NBSAP, including enhanced coordination at all political levels.

The recommendation is to set up or use existing mechanisms under ASEAN to bring this about at the regional and national levels. This can be achieved through a Coordinating Committee, a Task Force or any other appropriate mechanisms. In this way, the integration between programmes under the CBD and the ITPGRFA can take place at the local, national and regional levels. **This can facilitate the earlier recommendation on PAs providing support for the GPA and the ITPGRFA implementation**. It can be initiated and piloted as a requirement for Recommendation No. 1.

Target: The inter-sectoral platforms of collaboration should follow the target for Recommendation No. 1

5.4. Strengthening capacities for biodiversity conservation and sustainable use, especially in coping with climate change through networking of various seed banks at the regional, country and community levels.

This can be achieved by effectively linking national gene banks with CGIAR gene banks and national gene banks with each other at the regional level to respond to the need for increased capacity (human resources, physical and infra-structure) of the AMS. Community seed banks should be linked with national gene banks for more effective disaster response. There is also the need to provide protection of Intellectual Property Rights (IPR) at the community level, especially to farmers involved in participatory plant breeding and varietal selection. This recommendation is complementary to Recommendation 5.8. which supports the formation of a research network on biodiversity and climate change.

Since many AMS are experiencing natural disasters brought about by climate change, this strategy must be put in place and piloted in the most climate change-vulnerable

areas of ASEAN **within the next two years** to assess the effectiveness of these seed-bank networks down to the community level and with the most vulnerable groups in the region. **There is a need to provide human capacity development and infrastructure support down to the community seed banks in order to make this more functional.** The role of regional and national NGOs, as well as the academe and CGIAR centres can be tapped for this purpose.

Target: The seed-bank networks from the community, national and global levels should be initiated in at least one of the most climate-vulnerable AMS every year and assessed in terms of experiences, in its role in alleviating food and nutrition insecurity associated with rehabilitation and restoration after natural disasters associated with climate change.

5.5. Recognition of outstanding programmes for biodiversity conservation at the community, country and regional level through ASEAN. This involves recognising and providing incentives to outstanding farmers/fisherfolk; outstanding community seed-banks; outstanding community biodiversity managers; and biodiversity research and others. This is in line with the current ASEAN activity in recognising ASEAN Biodiversity Champions but encompassing specific areas that are highly relevant to biodiversity conservation and sustainable use for food and nutrition security (Status of Implementation of the ASCC Blueprint, 2009-15).

Target: ASEAN to recognises at least one outstanding Biodiversity-Farmer (B-Farmer), Biodiversity-Fisherfolk (B-FF), Community Biodiversity Caretaker (B-CC) and Community Biodiversity Seed-bank (CB-SB) every year. This can be highlighted to serve as a model for others to follow.

5.6. Capacity-building for farmers, fisherfolk and forest users through participatory processes such as the model of the farmer field school developed by FAO and development partner countries and NGOs. This can be applied to promote participatory plant breeding and enhancing the enactment of legislation to promote farmers' rights, which should also consider the role of gender in biodiversity

conservation and its sustainable use. Cross visits to highlight lessons learned should be encouraged and promoted in ASEAN (Report of the ASEAN Socio-cultural Council to the 25th ASEAN Summit, 2014).

Target: At least one ASEAN Biodiversity-Field School established and made functional every two years to train community leaders. Cross visits can also be arranged and linked to those awards in Recommendation 5.5.

5.7. Markets and Adding Value to Promote UUC for Enhancing the Value of Biodiversity

This can be linked to the assessment of forests and other natural ecosystems declared as PAs to enhance their values and to effectively link conservation with sustainable use. It is recommended that ASEAN develop and promote a regional market to promote processing and adding value for under-utilised species for food, nutrition, energy, pharmaceuticals-neutriceuticals and other basic uses.

Target: Examples of adding value can be identified in ASEAN and enhanced by linking with markets at the local, national and regional levels. There are already good examples in Thailand for some under-utilised species, such as *Garcinia cowa.* More of these examples should be identified and linked together in developing a more effective market for UUC species at all levels. At least 10 of these examples should be identified every year in AMS, which should be the starting point for developing a regional market for UUC.

5.8. Developing an ASEAN Consortium on Research for Biodiversity and Climate Change (AC-BCC).

This can be initiated by starting with the existing University Research Consortium in Thailand as a nucleus and expanding to include a network of universities in ASEAN. The Thailand research network on climate change comprise of six universities (Chiang Mai University, Chulalongkorn University, Khon Kaen University, Prince of Songla University, Mahidol University, and Thammasat University) (Jintrawet et al, 2012). There are also other universities in the AMS that have a similar focus, i.e., University of the Philippines at Los Baños in the Philippines (UPLB). ACB has recently initiated a 'Scoping Study on Climate Change and Biodiversity of Protected Areas and Key Ecosystems in Southeast Asia', which was primarily conducted by researchers from UPLB.

The suggested scheme is for ASEAN, through ACB, to inject seed money or financial resources, with the members of the Consortium to provide counterpart contributions to fund an agreed research agenda linking biodiversity concerns with climate change. This regional initiative can also be linked to the CGIAR programme on Climate Change for Agriculture and Food Security (CCAFS).

Some possible research questions that can be developed as a research agenda for the regional consortium on biodiversity and climate change are as follows:

- What kind of biodiversity needs to be conserved and for what purpose?
- How do you begin to associate and assess the values of nutrition, food security, and income and ecosystem services associated with various types of biodiversity? What are the tradeoffs?
- How do we balance the need for access, whilst ensuring fair accruals of benefits to those who conserve this biodiversity, especially small farmers and fisherfolk in the region?
- How can the various global agendas and platforms that directly impinge on biodiversity conservation and sustainable use complement the national agenda and policy landscape?

- What biodiversity parameters should be used to assess ecosystem sustainability at various hierarchical levels?
- What kinds of biodiversity in various ecosystems are important for climate-proofing and how can they be deployed appropriately?

Target: An ASEAN Consortium for CCC and Biodiversity Research should be put in place within two years and at least two common research agenda identified and implemented every year. Generating a research fund pool should also be in place during the formation of the research consortium.

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APPENDIX

Abbreviations and Acronyms

ABS	Access and Benefit-Sharing
ACB	ASEAN Center for Biodiversity
AC-BCC	ASEAN Consortium on Research for Biodiversity and Climate Change
AHP	ASEAN Heritage Park
AMS	ASEAN Member States
ANSWER	Asian Network for Sweet Potato Genetic Resources
ASCC	ASEAN Socio-Cultural Community
BAPNET	Banana Asia Pacific Network
BCCP	Biodiversity and Climate Change Project
CBD	Convention on Biological Diversity
CCAFS	Climate Change for Agriculture and Food Security
CGIAR	Consultative Group for International Agricultural Research
CGRD	Coconut Genetic Resources Database
CIFOR	International Center for Forestry Research
CIP	International Potato Center
CITES	Convention on International Trade in Endangered Species of Wild Fauna
COGENT	International Coconut Genetic Resources Network
CWR	Crop-Wild Relatives
EEPSEA	Economics and Environment Program in Southeast Asia
ERIA	Economic Research Institute for ASEAN and East Asia
FAO	Food and Agriculture Organization
GIAHS	Globally Important Agricultural Heritage System
GPA	Global Plan of Action
ICRAF	World Agroforestry Centre
IK	Indigenous Knowledge
INGER	International Network for Genetic Evaluation of Rice
INIBAP	International Network for the Improvement of Banana and Plantain
IPR	Intellectual Property Rights
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
MLS	Multilateral System
NARES	National Agriculture and Extension System
NBSAP	National Biodiversity Strategic Action Plan
NISM	National Information Sharing System
NTF	Non-Timber Forest
PA	Protected Area
PES	Payment for Environmental Services
PGRFA	Plant Genetic Resources for Food and Agriculture
RECSEA	Regional Cooperation for Plant Genetic Resources in Southeast Asia
SEARCA	Southeast Asia Regional Center for Graduate Study and Research in
SMTA	Standard Material Transfer Agreement
SOW	State of the World
TEEB	The Economics of Ecosystems and Biodiversity in Southeast Asia Project
UPLB	University of the Philippines at Los Baños
UUC	Under-utilized Crop

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