

Issues and Challenges in Tackling Climate Change through Nature-Based Solutions in ASEAN: Mainstreaming Nature-based Solutions Framework, Financing, Advisory Services and Knowledge Tools

ASEAN Socio-Cultural Community Trend Report No. 8 (2025)

ASCC Research & Development Platform on Climate Change





ASEAN Socio-Cultural Community Trend Report

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Executive Summary

Climate action failure, extreme weather, and biodiversity loss are seen to be the critical global risks in the coming decades. Particularly, climate change has a wide range of implications, such as loss of productivity in the agriculture sectors, increased flood risk, and loss of livelihood in the region.

The detrimental climate change impacts fall largely upon the agriculture and livestock sector, affecting food security and livelihood opportunities in the region.

Nature-based solution (NbS) is viewed as an alternative option in managing climate change effects. In ASEAN, there is still a need for the ASEAN Member States to identify a detailed scope that would indicate the progress and challenges encountered in adopting the NbS approach.

Four critical challenges of NbS adoption include lack of understanding of NbS, lack of clear policy and institutional arrangement, lack of adequate financial resources, and limited technical capacity to design & implement solutions.

Moving forward ASEAN should focus on creating awareness, building technical capacity, and leveraging extension services. Moreover, strengthening policy and institutional framework for mainstreaming NbS and establishing funding, finance, and investment schemes are crucial.



1. Introduction

The Global Risks Perception Survey indicates climate action failure, extreme weather, and biodiversity loss as the most severe risks at a global scale over the next decade (World Economic Forum, 2022) (Table 1). Accordingly, climate action failure continues to worsen during the COVID-19 crisis. Five of the most severe risks are related to the environment. Likewise, the societal risk is very much linked to those related to the environmental risk. For instance, climate action failure, extreme weather, and biodiversity loss are interlinked to societal risk related to livelihood crises and infectious diseases. Debt crises can be a consequence of high government borrowing to address environmental negative externalities prevalent during the pandemic and extreme weather which causes massive flood and other natural disasters. On a time scale of 0 and 2 years, extreme weather and climate action failure are anticipated to pose a critical threat to the world. Between 2 and 5 years, climate action failure, extreme weather, human environmental damage, and biodiversity loss are identified to pose serious threats. And between 5 and 10 years, the threats continue to be related to climate action failure, extreme weather, biodiversity loss, natural resource crises, and human environmental damages (Table 1). Importantly, environmental risks will grow from short-term (0-2 years) to long-term threats globally and for ASEAN, in particular.

Table 1. The 10 most severe risks over the next 10 years at global scale

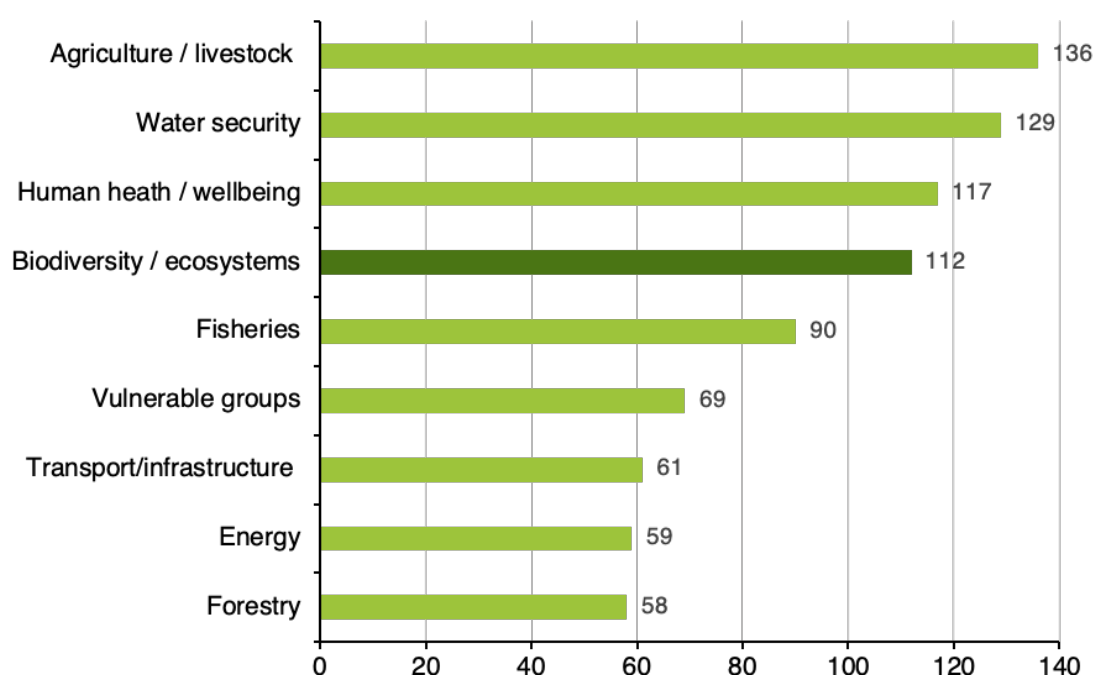
Global Risk
Climate Action Failure (Environment)
Extreme Weather (Environment)
Climate Action Failure (Environment)
Biodiversity loss (Environment)
Social cohesion (Societal)
Livelihood crises (Societal)
Infectious diseases (Societal)
Human environmental damage (Environment)
Natural resource crises (Environment)
Debt Crises (Economic)
Geoeconomic confrontation (Geopolitics)
Environmental Risk Projections Between 0 to 10 years
0-2 years • Extreme Weather • Climate Action Failure
2-5 years • Climate Action Failure • Extreme Weather • Human Environmental Damage • Biodiversity loss
5-10 years • Climate Action Failure • Extreme Weather • Biodiversity loss • Natural Resources Crisis • Human Environmental Damage

Source: World Economic Forum, 2022

Climate change will impact the most vulnerable sectors of ASEAN. The agriculture and livestock sectors (Figure 1) will suffer detrimental climate change impacts, including food security and livelihood opportunities. For instance, Asia accounts for 67% of global agricultural production (Mendelsohn, 2014) and a large employment is dependent on the agriculture and livestock sectors. Grain yield can decline more than 5% by 2050 (Woetzel, et al., 2020) which could affect the livelihood of many Asian farmers who are smallholders. The changes in rainfall which can affect water availability can threaten irrigation systems and lead to a decrease in agricultural productivity. This will further impact low-income rural population who depends on traditional agriculture system. In ASEAN, despite data limitations on actual impacts of climate change, available data

shows that climate change has resulted in yield losses as shown in Table 2. Rise in temperature by 1-degree C decreases rice production between 5% to 15% in most ASEAN Member States (AMS) (Table 2). For instance, between 1984 and 2013, the impact of climate change caused rice yield loss within the range of < 50 kg ha⁻¹ per decade in the Mun River basin, northeast Thailand (Prabnakorn et al., 2018). In the Philippines, a study on the association between seasonal rainfall, agricultural production, and civil conflict suggested that severe rainy season and dry season will increase civil conflict (Croset et al., 2018) that could affect food and human security. Higher impact is predicted on workability given that most AMS are dependent on outdoor and labour-intensive sectors (Woetzel et al., 2020).

Figure 1. Climate change impacts and the most vulnerable sectors



Source: Seddon et al. (2020)

Table 2. Climate change impact projection on agriculture commodity

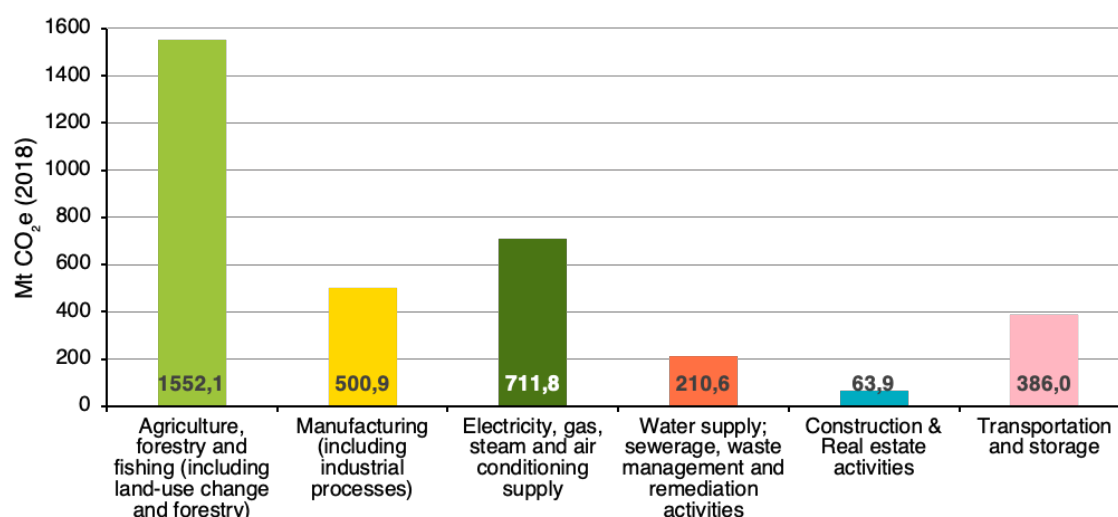
Country/Region	Commodity	Temperature	Prec.	Impact on production yield	Projected year
Cambodia	Rice	+1°C		Decrease (45%)	2080
North West Viet Nam	Agricultural	+1°C		Decrease	2050 & 2100
Viet Nam	Rice	+1°C		Decrease (5.5-8.5%)	2050 & 2100
North East Thailand	Rice	+	+	Decrease Decrease (14%) Decrease (10%)	2080
Philippines	Crops	+1°C		Decrease	Yes
SE Asia (5 Countries)	Livestock			Decrease	2080

Source: Shaw et al., 2022

The linkages between climate change and agriculture can also be bilateral as progress in the sector can contribute to climate change. In Southeast Asia, the agriculture and livestock sector are found to be the largest contributor to climate change while the agriculture, forestry, and fishing sector were found to be the largest contributor to greenhouse gases (GHG) emissions in 2018, with 1,552 Mt CO₂ eq (Figure 2).

Areas in the region that will be susceptible to climate change include mountainous and flood prone areas. Extreme weather patterns such as typhoon and monsoon rains will continue to pose threats to the agricultural landscapes, calling for mitigation and adaptation strategies towards managing climate change impacts.

Figure 2. GHG emissions



Source: ASEAN Taxonomy Board, 2021, data from Climate Watch.

As part of the Paris Agreement, all AMS have committed to the nationally determined contributions (NDCs) which is a climate strategy towards reducing GHG emissions. Within ASEAN, Cambodia, Indonesia, the Lao PDR, Myanmar, the Philippines and Viet Nam have reported links between mitigation

and adaptation actions (Table 3) while only Singapore and Viet Nam reported quantifiable adaption and time bound targets, respectively. Details in the adaptation plan varies among AMS and there is still a need to strengthen AMS' reporting of adaptation costs. z

Table 3. AMS Nationally Determined Contributions (NDCs)

Name	Level of detail in NDC	Links between mitigation & adaptation actions	Adaptation targets & costs
Brunei Darussalam	No details in adaptation plan	-	No quant. Targets, No time-bound targets, No adaptation costs estimated
Cambodia	Detailed adaptation plan	Explicit/strong mitigation-adaptation link	No quant. Targets, No time-bound targets, No adaptation costs estimated
Indonesia	Detailed adaptation plan	Explicit/strong mitigation-adaptation link	No quant. Targets, No time-bound targets, No adaptation costs estimated
Lao PDR	Detailed adaptation plan	Explicit/strong mitigation-adaptation link	No quant. Targets, No time-bound targets, No adaptation costs estimated
Malaysia	Some detail in adaptation plan	-	No quant. Targets, No time-bound targets, No adaptation costs estimated
Myanmar	No details in adaptation plan	Explicit/strong mitigation-adaptation link	No quant. Targets, No time-bound targets, No adaptation costs estimated
Philippines	Some detail in adaptation plan	Explicit/strong mitigation-adaptation link	No quant. Targets, No time-bound targets, No adaptation costs estimated
Singapore	Some detail in adaptation plan	-	Two quant. Targets, No time-bound targets, No adaptation costs estimated
Thailand	Some detail in adaptation plan	-	No quant. Targets, No time-bound targets, No adaptation costs estimated
Viet Nam	Detailed adaptation plan	Explicit/strong mitigation-adaptation link	Two quant. Targets, No time-bound targets, No adaptation costs estimated

Source: Nature-based Solutions Policy Platform, 2022. As of 2020.

Under these circumstances, nature-based solution (NbS) is viewed to offer feasible options towards managing climate change effects. The term nature-based solutions evolved from what was first introduced by the World Bank in 2008 (World Bank, 2008) to the European Commission (2015 and 2022) official definition (European Commission, 2015) which states that NbS are actions inspired by, supported by, or copied from nature and aims

to address environmental, social, and economic challenges affecting societies in a sustainable way. The other popular definition of NbS is from the International Union for Conservation of Nature which states “actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits” (IUCN, 2020).

2. Nature-based Solutions in ASEAN

The adoption of NbS was explicitly mentioned by Brunei Darussalam, the Lao PDR, Malaysia, Myanmar, and Viet Nam in their respective adaptation to climate change vision (Figure 3). These country visions, however, still need to indicate the progress and challenges encountered towards adopting the NbS approach. Similarly, several AMS recognise the role of NbS in managing climate change despite not having explicitly mentioned NbS in their adaptation vision. Indeed, the lack of integration of the NbS across sectors is prevalent.

Figure 3. NbS adaptation vision of AMS

Brunei Darussalam	Cambodia	Indonesia
Protecting both terrestrial and marine biodiversity of the country's ecosystem and the adoption of a nature-based solution approach	Recognizes the role of ecosystems and natural protection assets in preventing losses due to climate change, as well as helping to build adaptive capacity	Protects and sustains environmental services by taking an integrated, landscape-based approach in managing its terrestrial, coastal and marine ecosystems
Lao PDR	Malaysia	Myanmar
Nature-based solutions shall be prioritized as effective lower cost options to counter climate-induced disasters such as floods, landslides and droughts	Commits to continuously promote the adoption of nature-based solutions and green-gray infrastructures	Building climate resiliency by adopting nature-based solutions to minimize exposure of its people and natural capital, increase resilience and safeguard its economy
Philippines	Singapore	Thailand
Development of climate and disaster-resilient ecosystem(s)	Tracking its rich urban biodiversity in a manner that can integrate conservation and adaptation actions	Enhancing the conservation, rehabilitation, and sustainable use of natural resources and biodiversity and strengthening public participation
Viet Nam		
Implement adaptation measures, including ecosystem-based adaptation and nature-based solutions to minimise damage associated with climate change in each sector in the future.		

Source: Nature-based Solutions Policy Platform, 2022. Note: The information is as of 2020.

ASEAN's rich natural resources provide opportunities which are of great importance to NbS. It is crucial to incorporate the NbS approach in climate change mitigation and adaptation initiatives by emphasising the socio-ecological balance based on social, environmental, and economic domains. NbS can address societal challenges in an effective and adaptive manner by complementing the "grey infrastructures" aimed at biodiversity conservation (Sowińska-Świerkosz, & García, 2022). In this case, NbS can play a complementary role in incorporating conservation norms and principles. NbS can also be integrated with other solutions, such as technology and engineering, to address societal challenges. In addition to climate change adaptation and mitigation, NbS has also been applied in a variety of areas such as forest conservation, food and energy security support. At the same time, NbS can also be critical to green recovery mechanisms that need to focus on sectors that are more sustainable, resilient to climate change, and in line with the "do no harm" principle. Significantly, NbS can improve the quality and resilience of ecosystems, create new livelihood opportunities in rural areas, ensure adequate water and energy supplies, and support low-carbon economic development. AMS use of ecosystem services to address societal challenges can be an evident application of certain forms of the ecosystem approach in specific areas such as disaster risk reduction, coastal management, forest management, and others.

There is a growing concern on rapid urbanisation with direct encroachment of forest land and increasing the ecological footprint in ASEAN (Lechner et al., 2021) as these are also becoming key policy challenges in ASEAN countries. The NbS approach can initiate better urban design and planning in AMS cities by holistically considering biodiversity conservation, environmental challenges, and human well-being. Therefore, the government can limit the negative consequences of urbanisation in terms of environmental impacts and align the initiatives with its climate adaptation and mitigation plans. Overall, the inclusion of NbS would be an essential component of urban planning and urbanisation management in limiting the negative impacts of climate change.

ASEAN also recognises its growing population which puts pressure on food and agricultural systems, including the demand of increasing food supply to match population needs. The challenges of climate change are exacerbated by increasing competition for natural, human, and financial resources. The growing share of total agricultural water use vis-a-vis water demand is a key concern in many AMS. It is estimated that 70% of global water use is for agricultural irrigation (OECD, 2022). NbS offer a promising contribution to improving the availability and quality of water for productive purposes and human consumption, while preserving the integrity and intrinsic value of ecosystems. It can have a positive impact on food production and water security, but it is important to be aware of trade-offs. NbS can potentially contribute to meeting low-carbon energy needs through the production of nature-derived solutions, i.e. wind, wave, and solar energy.

Although NbS has yet to be defined and institutionalized in AMS, some of the ecosystem-based initiatives that take advantage of ecological processes have already been implemented in various aspects. NBS can further enhance the notion of co-benefits which arises from addressing environmental concerns and NbS can lead to various benefits in terms of ecosystem services such as biodiversity, air quality, flood control, and general human well-being. For example, a well-managed irrigation system for rice production in ASEAN countries can provide a wide range of ecosystem services such as food, energy, and livelihood provision. It can also maintain and regulate biodiversity and provide supporting services, such as soil erosion, biological pest control, carbon flow, and soil fertility. In the case of oil palm plantations, measures such as planting mixed crops can reduce the loss of ecosystem services. Specifically, the implementation of NbS can be divided into five categories (Chee et al., 2021).

- i. A restoration remedy that refers to the restoration of ecology and forest landscapes. This restoration activity should also aim to involve local communities, share the benefits and potentially enable regeneration, and promote the protection and better management of ecology and forest landscapes.
- ii. Issue-specific initiatives related to ecosystem-based adaptation, ecosystem-based mitigation, ecosystem-based disaster risk reduction, and climate adaptation services (UNFP, 2022). For example, protection of coastal habitats such as mangroves provides natural protection against floods from high tides, sea level rise, or tsunamis.
- iii. Natural and green infrastructure wherein natural infrastructure involves an active management approach that aims to ensure restoration functions, ecosystem building, and the provision of ecosystem services, with critical benefits for climate resilience, clean water, and biodiversity, while green infrastructure involves a conservation values approach related to land development and infrastructure planning. It differs from traditional “grey infrastructure”, such as pipes, tunnels, and factories, which are entirely man-made.
- iv. Resource management, such as integrated coastal zone management and integrated water resource management, where the aim is to better manage the use, development, and protection of coastal and water resources by involving different stakeholders and agencies.
- v. Conservation, such as area-based conservation approaches, which are proving to be the most effective way to conserve biodiversity. Well-connected systems of protected areas and other effective area-based conservation measures can preserve the integrity of natural ecosystems.

Over the period of 1980-2020, ASEAN population increased from 355.1 million to 661.8 million, with an average annual growth of 1.3%. ASEAN Secretariat (2021) ASEAN Key Figures 2021, ASEAN stats database.

ASEAN is addressing the NbS implementation in relevant initiatives (see Table 4) namely sustainable natural capital investment in ASEAN, supporting greening policies and commitments to biodiversity as well as conservation efforts by the ASEAN Centre for Biodiversity and the launching of the ASEAN Catalytic Green Finance Facility. These initiatives can be further scaled up to promote NbS activities in ASEAN.

Table 4. NbS initiatives in ASEAN

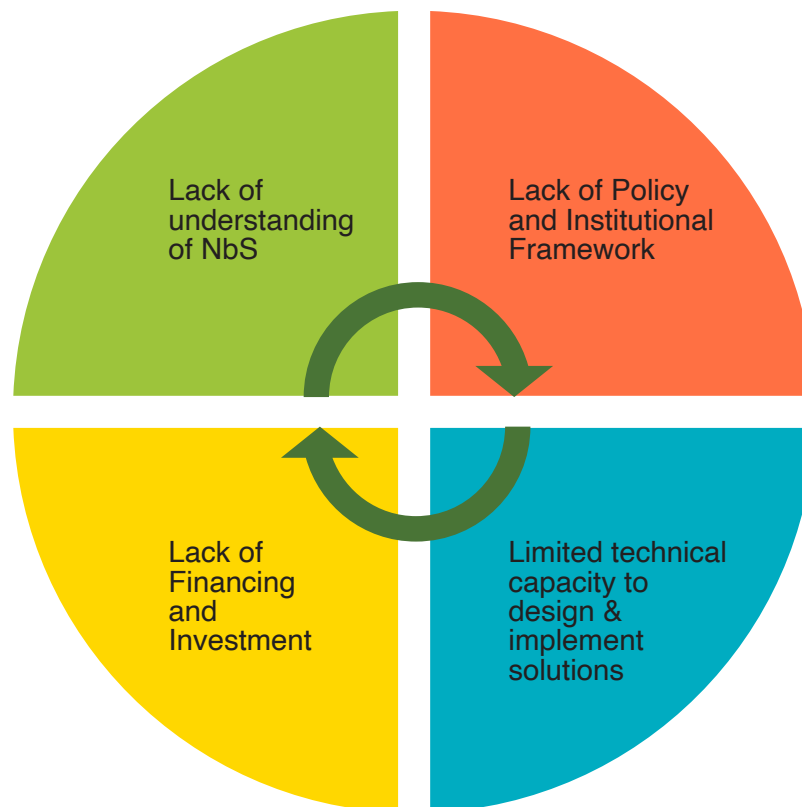
Investing in Sustainable Natural Capital in ASEAN	ASEAN Centre for Biodiversity	ASEAN Catalytic Green Finance Facility
Nature-based solutions such as carbon sequestration need to be designed and implemented in a way that is inclusive and enhances biodiversity, even as it promotes climate response. Nature-based solutions need to be inclusive by strengthening collaboration with the finance industry so that it can contribute to sustainable natural capital.	Emphasising on ASEAN Green Initiatives such as: 1. Represents the collective response and commitment of the ASEAN region to reverse the catastrophic erosion of biodiversity and forests in the region. 2. Recognises, supports and replicates the region's outstanding greening activities. 3. Helps balance biodiversity conservation with sustainable development. 4. Supports national greening policies and programmes in ASEAN countries.	The ASEAN Catalytic Green Finance Facility (ACGF) - an initiative of the ASEAN Infrastructure Fund (AIF) - was launched in April 2019 to accelerate the ASEAN region's investment in green infrastructure. The ACGF provides ASEAN member states with technical assistance as well as access to loans from co-financing partners amounting to approximately US\$1 billion. While ACGF loans are used to finance capital expenditure, the technical assistance provided by the ACGF helps governments discover and prepare economically viable green infrastructure projects. The ACGF focuses on initiatives that support sustainable, natural capital-based projects, namely renewable energy, energy efficiency, sustainable urban transport, water supply and sanitation, waste management and climate-resilient agriculture. The ACGF provides expertise and training programmes to ASEAN governments to improve the regulatory environment and build institutional capacity for scaling up green infrastructure projects.

Source: World Economic Forum, 2022

3. NbS Implementation Challenges

Four factors were identified as challenges faced by the AMS towards adopting NbS approach as shown in Figure 4 (ASEAN Secretariat, 2021). These challenges show that there exists a gap between policy and action. Synchronizing and harmonizing efforts to implement NbS uniformly in the region proved to be difficult since AMS have different levels of economic development coupled with varied social, environmental, technological, political, and legal structures. However, this can also be seen as an opportunity for each AMS to formulate a strategic action plan towards adopting NbS.

Figure 4. Challenges of adopting NbS in AMS



Source: ASEAN Secretariat, 2021

3.1 Lack of understanding of Nature-based Solutions

Knowledge and awareness are crucial for initiating plans and actions to implement NbS. Given the complexity of the NbS approach, there is a need to work with different stakeholders in addressing variety of issues and approaches to overcome the lack of understanding of NbS as a solution to climate change challenges. Understanding how to use NbS as an effective approach by integrating ecosystem services and other current initiatives into adaptation and mitigation plans is also limited. For example, understanding NbS in agriculture necessitates communicating NbS principles and concepts that requires a multi-stakeholder approach on the

application of NbS across the ecosystem. A multi-stakeholder approach would allow the AMS to work closely with different departments and create broader awareness and information sharing on NbS. Crucially, NbS needs to be seen as a long-term approach to tackling climate change, and understanding and awareness of nature's services is essential for successful implementation among policymakers. The establishment of an institutional framework on disseminating knowledge and information on NbS could potentially enable the provision of such information on NbS.

3.2 Lack of policy and institutional framework

The lack of strategic policies and institutional arrangements limits the implementation and understanding of NbS approaches, and also limits funding and investment in NbS approaches. There is a need for regulatory framework which involve multiple stakeholders for such efforts. A policy environment that specifically addresses NbS should be flexible and able to overlap different sectoral policies to ensure adequate implementation of NbS. Consolidating the uneven ecosystem initiatives through better policy coordination can be crucial to achieve greater benefits for societal changes. Complementing and consolidating policies through better communication

and coherent efforts among different cross-sectoral stakeholders can enable joint NbS initiatives. Institutional frameworks and arrangements for clearly defined standards and certification are needed to ensure that policy provides clear guidance on NbS definitions, principles and approaches, as well as appropriate coordination and application of NbS approaches. Institutional arrangements are also needed to ensure long-term management and monitoring of NbS that supports implementation of NbS based on scientific evidence. Overall, the role of a clear policy and institutional framework is important in creating an enabling environment for NbS,

3.3 Lack of financing and investments

Research shows that there is a huge lack of investment and financing for NbS to address climate change. Only 2.1% of global climate finance is currently spent on NbS for climate change adaptation (World Resource Institute, 2021). For instance, in 2018, out of the total climate finance, only 0.6% of public donor finance is accounted for NbS while 1.5% of public climate finance is through grants. It is noted that several factors contribute to the uneven distribution of financing for NbS and these include the lack of common definitions and guidelines for NbS, the lack of standard measures and methodologies, and the lack of capacity to plan and schedule investments according to the NbS approach. Financing NbS requires the engagement of multiple parties, namely the inclusion of blended finance that can catalyse the participation of public, private, and philanthropic investment and financing. This can also mean that different financing instruments must

be developed and used at different stages of NbS project implementation. It is equally important to ensure that viability and bankability are enhanced to support the successful implementation of NbS. In addition, supporting NbS based on proof of concept and establishing a monitoring and review system are crucial to ensure access to future funding.

The lack of improvement in the commercial potential of NbS through innovative solutions also limits private funding. Therefore, promoting and designing new business models and support systems for NbS innovations that address societal challenges would be crucial to drive private funding. It is equally important to ensure that the regulatory framework enables the application of NbS innovations. Knowledge and evidence are also important to promote the business case for deploying NbS approaches that will drive financing and investment.

3.4 Limited technical capacity to design & implement solutions

Technical capacity in the design and implementation of NbS is crucial, as NbS often relies on scientific knowledge to ensure the sustainability and success of the NbS approach. It is also important to tap local and traditional knowledge and expertise as these are significant source of resources. Collaboration with universities, research institutions and other knowledge providers is crucial for the implementation of NbS. An institutional framework to support NbS initiatives can be used to promote collaboration, joint research and other activities under NbS plans. For example, NbS may require site-specific knowledge

to identify opportunities and optimise NbS solutions, and this knowledge may exist in universities, local communities and other relevant parties. Technical capacity is also required to plan, evaluate and monitor NbS projects. The sources of this technical knowledge, standards and best practises need to be documented and well understood. There is a need for the AMS to engage with various stakeholders, strengthen the support of the scientific community and create platforms to generate relevant technical knowledge and disseminate information for NbS decision-making.

4. Way Forward for ASEAN

C Given the critical importance of NbS as a key approach to climate change adaptation strategies among AMS, ASEAN should consider aligning efforts and initiatives to scale up the financing and awareness of such approach. Among them can include the following:

4.1 Creating Awareness, Building Technical Capacity, and Leveraging Extension Services

Promoting awareness and understanding of NbS through appropriate education, training, and knowledge sharing is crucial in addressing the limited understanding of this approach. Case studies that provide evidence can also be important. Similarly, building technical capacity and knowledge of NbS requires a strong partnership with various organisations. This goal must include, but is not limited to:

- Creating awareness of the importance and benefits of NbS among various stakeholders.
- Pooling resources among AMS to implement NbS at the regional level and promote sharing of experts in specific application areas of NbS and to support learning of strategies and experiences.
- Build human capacity by working with partners/ organisations that have the capacity and resources to plan, implement, monitor, and evaluate programmes/ projects.

In this aspect, leveraging the intermediary organisations in providing the extension services would be beneficial to address the gaps in expertise and understanding on the NbS. One such example is the initiatives by the Centre for Agriculture and Biosciences International (CABI). The case of CABI illustration how extension services would provide more insights on how NbS can be implemented, and challenges, specifically related to lack of understanding and lack of expertise, can be addressed.

Case Study: Extension Services by CABI

CABI is a not-for-profit science-based intergovernmental organisation, established by a United Nations treaty-level agreement. It is owned by 49-member countries which have an equal role in the organisation's governance, policies and strategic direction. CABI has over 450 staff across more than 20 locations worldwide and addresses issues of global concern such as food security and food safety through research and international development cooperation. Indeed, CABI is a major provider of scientific information through publication of books, eBooks, digital learning, compendia, and online information resources. CABI services can help end users such as policy makers, researchers, extension officers, farmers in identifying the most reliable and valuable information to be used for decision-making. Therefore, there is also a need to support smallholder farmers to adopt, adapt and apply NbS in mitigating climate change impact including the reduction of food losses in agricultural production. Extension services are critical to provide farmers the information they require to reduce crop losses, increase income and attain food security.

CABI-led global programme established the Plantwise (Beverley & Takur, 2021) (2011-2020) in 2011, with an aim to increase food security and improve rural livelihoods by reducing crop losses. Plantwise gives farmers better access to practical and research-based knowledge at village level to help them enhance productivity and food safety via reduction of pesticide residues. Plantwise was introduced in 34 countries in Africa, Asia and the Americas. The Plantwise approach replicates the concept of a human health clinic (Figure 10). It provides diagnosis and recommendation on any problem and/or crop. The plant doctors, come from the public, private and non-governmental sectors and are trained comprehensively covering field diagnostics and plant clinic operation (module 1) and giving NbS-based pest management recommendations (module 2) (Beverley & Takur, 2021). CABI staff or partners delivers the agricultural advisory services and training as well as Training of Trainers (TOT) programme.

Upon completion of the training farmers can seek free, practical and immediate crop pest diagnostic and management advice via plant doctors that has set up demand-driven plant clinics. Indeed, farmers can visit the plant health clinics with crop samples for plant doctors to provide a science-based diagnosis and recommendation to manage the crop problems and future prevention advice. Plant doctors are also supported by Plantwise Knowledge Bank with resources that include diagnostic tools, factsheets and pest management decision guides, which can be freely accessed online and offline. Since the launch 5000+ plant clinics were established, 13,200+ plant doctors were trained and 54,000,000+ farmers reached, accumulatively (CABI Plantwise Annual Report, 2020).

Within the ASEAN context, Plantwise approach was introduced in Cambodia, Myanmar, Thailand and Viet Nam and the key outcome between 2011 and 2020 is:

- 195 plant clinics were established, and 50% of them are still active in 2020. Only Myanmar had new plant clinics established (15) in 2020.
- 1,199 plant doctors were trained, and only 15% of them are still active in 2020. A total of 433 new plant doctors were trained in 2020, in which 91% are from Thailand and 9% are from Myanmar.
- 144 pest management decision guides were drafted.
- 194 factsheets were drafted, and 10 new versions were drafted in Myanmar.

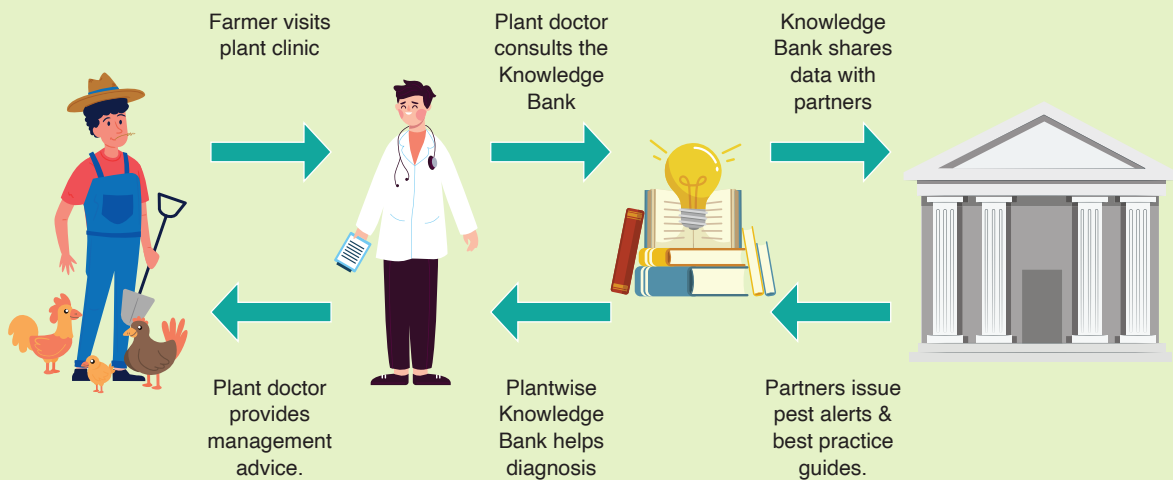
The programme created various impacts in ASEAN as follows:

- In Cambodia: the agro dealer advice became less reliable after CABI plant clinic intervention. Further 14% of farmers spend less on high-cost pesticides.
- In Vietnam: agro input dealers rely on CABI plant clinics for their sales. Additionally, the awareness on safe use of pesticide increased.
- In Myanmar: reduction in number of spraying chemical pesticides.

Nevertheless, key challenges and lessons from CABI-Plantwise in ASEAN include the following:

- In Cambodia: Difficulty in sustaining Plantwise programme nationally once global project funding stopped as local partners had no funding to continue activities, locally.
- In Myanmar: Plantwise was aligned with National Plant Health System Strategy but encountered challenges in implementation because of the lack of coordination and connectivity among different plant health stakeholders. Also limited budget and staff limits the operation of the plant clinics. Other challenges in sustaining Plantwise programme include lack of IT infrastructure, high extension staff turnover and limited staff capacity.
- In Thailand: Without donor support, the plant clinic model is halted. While the Department of Agriculture Extension will continue with the plant doctor training via their own state funds, the operation of plant clinics is deemed as additional work and therefore, was not integrated into official duties. Further, with lack of participation from farmers due to poor coordination and promotion of clinic sessions, the environment to operate the plant clinics was deemed inadequate.
- In Viet Nam: No budget was secured to support the plant clinics and official policy for plant clinics do not exist.

Figure 5. Plantwise Approach



Source: CABI ²

From 2021, CABI Plantwise+ will assist countries to predict, prevent and prepare for crop health threats by responding to the needs of farmers and the systems that support them. It will scale up regenerative agricultural solutions among smallholder farmers through the delivery of digital advisory tools, training of public and private actors, and development of content suited to different channels and audiences. All these will be carried out to promote nature-based solutions (CABI Plantwise+ Annual Report, 2021).

To enhance the awareness and uptake of biocontrol and biopesticide products by growers and advisors, CABI developed a Bioprotection Portal (<https://bioprotectionportal.com/>, 2022), a free online resource that enables users to correctly identify, source and apply registered biocontrol and biopesticide products against agricultural pests. It also provides general

information on biological control and integrated pest management via blogs and other resources. The portal was launched in February 2020 and now live in 32 countries. It is available in local languages and English, online and offline versions are available. There are approximately more than 3,600 registered products in the database and over 700,000 users have used it since its launch. The information on this portal is sourced directly from national governments' lists of registered plant protection products and permission is obtained from the national authority that is responsible for plant protection product registration to use the data set. Through improved advisory services and knowledge tools, knowledge and awareness of growers and advisors as well as the uptake of NbS (i.e. biocontrol products) in crop management practices will be significantly enhanced.

² CABI Bioprotection Portal. <https://bioprotectionportal.com/> ; CABI Plantwise+ Annual Report. 2021. <https://www.cabi.org/wp-content/uploads/PlantwisePlus-Annual-Donor-Report-2021.pdf> ; CABI Plantwise Annual Report. 2020. https://www.cabi.org/wp-content/uploads/Plantwise-Annual-Donor-Report-2020_PUBLIC.pdf and CABI Plantwise Annual Report. 2019. https://www.cabi.org/wp-content/uploads/Plantwise_Annual_Donor_Report_2019_PUBLIC.pdf

The need for clear policies and regulations is important to establish the basic principles of NbS in ASEAN. As all AMS are part of the Convention on Biological Diversity, which sets the global framework for biodiversity for the post-2020 period (UNEP, 2021) that targets the ecosystem-based approaches, AMS can use this framework as a starting point and move forward in developing the NbS guidance and policy framework that goes beyond the ecosystem approach of mere biodiversity conservation and addressing societal challenges (ASEAN Secretariat, 2021). Mainstreaming NbS in national and regional policies is important to scale up current initiatives and gain greater benefits from NbS. In designing NbS policies and institutional frameworks, ASEAN can use the International Union for Conservation of Nature (IUCN) core definition and principles and compare them with existing policy and institutional arrangements for ecosystem-based approaches, e.g. in the areas of ecological and forest landscape restoration, ecosystem-based adaptation, ecosystem-based mitigation, ecosystem-based disaster risk reduction, climate adaptation services, natural and green infrastructure, integrated coastal

zone management and integrated water resource management, and conservation efforts such as area-based conservation approaches. Furthermore, in 2022, there is an agreed multilateral resolution on the definition and description of NbS among its members (UNEP, 2022). The ASEAN region can create a common policy and institutional framework to guide such efforts by pooling its resources under the AMS. These efforts can also be linked to the other initiatives within ASEAN such as the circular economy, sustainability and environmental, social and governance (ESG) standards requirements. The common policy and institutional framework that outlines the NbS approach should be mainstreamed to ensure that the core principles are integrated into various sectoral policies, programmes, and practices. The policy and institutional framework should also provide guidelines for the governance of different stakeholders within NbS to ensure accountability. The ASEAN-level framework should identify common societal challenges, opportunities in the use of NbS and actionable strategic solutions for the implementation of NbS.

Public financing can be used to support existing restoration activities under NbS activities (e.g. mangrove restoration that improves the livelihoods of local people). Nevertheless, the fiscal constraints of the AMS may limit such efforts. Better financing and investment plans are needed. To this end, it is critical to align NbS approaches to climate change financing in the context of NDC targets and sustainability financing initiatives in different sectors. Leveraging and aligning the already formulated

NDCs and NbS vision, combined with the adoption of a holistic approach of science, policy, and practice, would enable the adoption of a tailored NbS in each AMS which could ultimately contribute to the larger ASEAN's NbS vision. The focus should be on the critical need for funding criteria to enable greater participation of NbS implementers on the ground. In summary, the following aspects need to be considered:

- Political will to adopt NbS initiatives with adequate budgets.
- Provision of internal funds to continue and sustain NbS projects with external funding support.
- Align NbS funding, financing, and investment with NDC and sustainability initiatives via
 - Active participation of various stakeholders, i.e., public, private, non-profit and private sectors.
 - A transdisciplinary approach where knowledge exchange between different disciplines is smooth and local and traditional knowledge is incorporated.
 - Integration of different sectors, i.e. landscapes and seascapes, technological solutions and others.
 - Mainstreaming funding and investments in different sectors for NbS such as urban planning, agricultural development, and the like.
 - Promote blended finance and identify clear entry points for different stakeholders.
 - Promote private engagement in financing and investing in NbS activities.

5. Conclusion

ASEAN will continue to bear the brunt of extreme climate events, and the impacts are exacerbated by high poverty rates and dependence on climate-vulnerable sectors such as agriculture. Therefore, ASEAN's climate resilient pathways require commitment from all stakeholders at all levels to deepen and accelerate efforts to mitigate and adapt to climate change, and to bring sustainability to the region's development. Highlighting awareness, good regional cooperation, cross-sectoral collaboration, and financing are key in bring the needed collaborations among the AMS. NbS encompasses a suite of actions or policies harnessing the power of nature to address the most pressing environmental, societal, and economic issues. The concept has evolved over time. Therefore, current challenges should be considered when formulating climate policies that use NbS in order to achieve meaningful impacts. Combined with local knowledge and science, it could bring benefits to the planet, people, and the economy. In a nutshell, there is huge potential for the implementation of NbS in the ASEAN region. In view of this, ASEAN should focus on rapidly implementing NbS that are readily available and cost-effective to address climate change mitigation and adaptation at the regional

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