Food and Agriculture Organization of the United Nations

ECOSYSTEM-BASED ADAPTATION IN THE AGRICULTURE SECTOR: A NATURE-BASED SOLUTION (NBS) FOR BUILDING THE RESILIENCE OF THE FOOD AND AGRICULTURE SECTOR TO CLIMATE CHANGE

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Manar Abdelmagied and Molefi Mpheshea

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CONTENTS

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The synthesis of knowledge from the lessons learned of FAO's work on ecosystem-based approaches to climate change adaptation was initiated in response to the UNFCCC call for submissions in the area of ecosystems and interrelated areas such as water resources and adaptation under the Nairobi work programme (NWP). Subsequently, to enhance the knowledge base and support the uptake of good practices for ongoing work on adaptation planning, implementation, and monitoring and evaluation of best adaptation practices, FAO organized a series of webinar sessions on ecosystem-based adaptation (EbA) in the agriculture sector in 2017 and 2018. This document serves to outline the priority nature-based interventions for adaptation in the food and agriculture sector as articulated in countries' nationally determined contributions (NDCs), and as illustrated through the best case practices showcased during the EbA webinar series. More information on the webinar series as well as presentations and videos are available here: http://www.fao.org/in-action/kore/news-and-events/news-details/en/c/1052870/

The introductory session on EbA in the agriculture sector focused on context, approaches and lessons learned, and was presented by Selvaraju Ramasamy of the Office of Climate Change, Biodiversity and Environment, FAO; Petra Wolter and Luca Fè d'Ostiani of the Forestry Department, FAO; and Rémi Cluset of the Agriculture and Consumer Protection Department, FAO. The second session, elaborated on the methods and tools to support implementation of EbA in the agriculture sector and was presented by Joseph Anania, Kagera River Basin Project; Lucy Garrett, Incentives for Ecosystem Services Expert, FAO; and Anass Toudert, ExAct Analyst, FAO.

The third session on opportunities for integrating EbA in agriculture into national adaptation planning was presented by Ninni Ikkala Nyman, Monitoring and Evaluation Expert, UNDP; Luna Bharati, Principal Researcher–Hydrology and Water Resources at the International Water Management Institute (IWMI); and Jaruwan Ngamsing, NAP Advisor, German Agency for International Cooperation (GIZ).

A session elaborating on the opportunities for EbA in aquatic ecosystems was presented by Tarub Bahri and Merete Tandstad, of FAO's Fisheries and Aquaculture Department; Iris Monnereau of FAO's Subregional Office for the Caribbean; Birane Sambe of the Canary Current Large Marine Ecosystem (CCLME) project; and Nick Caputi of the Department of Primary Industries and Regional Development, Western Australia.

The fifth session on nature-based solutions (NbS) for agricultural water management and food security was presented by Amani Alfarra, Land and Water Division, FAO; Ben Sonneveld, Amsterdam Centre for World Food Studies/Athena Institute; Stefan Uhlenbrook, UN World Water Assessment Programme (WWAP, UNESCO programme); Dr. David Cooper, Deputy Executive Secretary, CBD; Lisa Janishevski, Programme Officer for Biodiversity and Climate Change of CBD; and Hiroyuki Ono of Globally Important Agricultural Heritage Systems, FAO.

A session elaborating on the potential for EbA to build agricultural livelihood resilience in dryland ecosystems was presented by Sara Marjani Zadeh, Land and Water Division, FAO; Makhmud Shaumarov, FAO's Country Office in Kazakhstan; Nora Berrahmouni, Senior Forestry Officer, Regional Office for Africa (FAORAF); and Claire Ogali, Global Drylands Initiative at the International Union for Conservation of Nature (IUCN). The session on actions related to EbA in the forestry sector was presented by Simmone Rose and Andrew Taber, Forestry Officers, FAO; and Karen Podvin, Programme Officer, IUCN. Maria Felicia Arnal provided assistance for selected webinar sessions. We would like to give an additional thank you to Bernardete Neves (FAO), Lucy Garret (FAO), Xuechan Ma (FAO) and Diana Fernández de la Reguera Tayà (FAO) and Theresa Wong (FAO) for their additional input during the finalization of this booklet. Editorial support was provided by Catherine Simes. Layout and graphic design work was carried out by Art&Design srl.

ABBREVIATIONS AND ACRONYMS

CBD	Convention on Biological Diversity
CCLME	Canary Current Large Marine Ecosystem
DRR	Disaster Risk Reduction
EAA	Ecosystem approach to aquaculture
EAF	Ecosystem approach to fisheries
EbA	Ecosystem-based approaches to climate change adaptation or Ecosystem-based adaptation
Eco-DRR	Ecosystem-based Disaster Risk Reduction
GGW	Great Green Wall Initiative
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
ICZM	Integrated Coastal Zone Management
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWRM	Integrated water resource management
NAP	National Adaptation Plan
NbS	Nature-based solution
NDC	Nationally determined contribution
PRMP	Participatory Rangeland Management Planning
SFM	Sustainable Forest Management
SLM	Sustainable Land Management
SIDS	Small Island Developing States
SRI	System of Rice Intensification
UNFCCC	United Nations Framework Convention on Climate Change
WWAP	UN World Water Assessment Programme

Introduction

Through the continued provision of ecosystem services, nature has a critical role to play in maintaining human well-being. Specifically, the long-term sustainability of food production is intrinsically linked to the wise management of agro-ecosystems and biodiversity for food and agriculture. Ecosystem services, such as water flow regulation, nutrient cycling, pollination, pest and disease regulation, and seed dispersal are critical for agriculture and food security. However, climate change can affect the functioning of ecosystems – limiting the potential of the agriculture, forestry and fishery sectors – while undermining the benefits and services these sectors provide to people.

The negative impacts of climate change on agriculture are becoming increasingly severe. They are manifested directly, through the loss and damage of productive assets, associated with the increased occurrence of extreme weather and climate events, and indirectly through the disruption of ecosystem functioning (FAO, 2016a). Healthy ecosystems have a major part to play in increasing the resilience of the agriculture sector to climate change: they can help vulnerable communities adapt to climate change as well as reduce climate-related risks and vulnerability by providing the vital environmental services that sustain agricultural livelihoods and human well-being.

Ecosystem-based adaptation (EbA) is part of a family of ecosystem-based approaches and practices known as nature-based solutions (NbS). NbS represent actions to protect, sustainably manage and restore natural or modified ecosystems with the aim of addressing societal challenges (e.g.: climate change, food and water insecurity or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits (Cohen-Shacham *et al.* 2016). These approaches and practices are categorized as NbS because they are inspired and supported by nature and use, or mimic, natural processes to contribute to the improved management of natural resources for societal benefits (WWAP/UN-

Water 2018). NbS can involve conserving or rehabilitating natural ecosystems; the enhancement or creation of natural processes in modified or artificial ecosystems; or they can be integrated with grey infrastructure to advance the most optimal solutions (WWAP/UN-Water, 2018; Sonneveld *et al.*, 2018). EbA, a key NbS, is the use of biodiversity and ecosystem services as part of an **overall adaptation strategy to help people adapt to the adverse effects of climate change** (CBD, 2009).

What are the impacts of climate change on agro-ecosystems and their goods and services?

Agriculture is dependent on the continued delivery of an ecosystem's goods and services. Climate change is already disrupting the healthy functioning of ecosystems, and the impacts of this on agricultural production, food security and livelihoods are expected to intensify over time and to vary across countries and regions (FAO, 2016a).

The Intergovernmental Panel on Climate Change (IPCC) asserts that climate change poses a high risk of abrupt and irreversible regional-scale change in the composition, structure and function of terrestrial and freshwater ecosystems, including wetlands (IPCC, 2014). Climate change can overwhelm the capacity of ecosystems to mitigate extreme events and disturbances, such as wildfires, floods and drought. Additionally, projected warming could greatly increase the rate of species extinction. Increased tree mortality and associated forest dieback is projected to occur in many regions due to increased temperatures and drought. Forest dieback poses risks for carbon storage, biodiversity, water quality and economic activities dependent on the forestry subsector.

The adverse impacts of sea level rise on coastal ecosystems and low-lying areas will lead to increased submergence, coastal flooding and coastal erosion. Furthermore, the redistribution of global marine species and reduction in marine biodiversity in

vulnerable regions will challenge the sustained provision of fisheries productivity and other ecosystem services. Spatial shifts of marine species due to projected warming will cause high-latitude invasions and high local extinction rates in the tropics and semi-enclosed seas. Similarly, species richness and diversity and fisheries catch potential are projected to decrease at tropical latitudes. Ocean acidification also poses substantial risks to marine ecosystems, especially coral reefs. Specifically, ocean acidification alters the physiology, behaviour and population dynamics of individual species, from phytoplankton to aquatic animals.

In tropical and temperate regions, climate change, without adaptation, is projected to negatively impact production of the major cereal crops (wheat, rice and maize) for local temperature increases of 2°C or more, although individual locations may benefit (IPCC, 2014). Shifts in the distribution of pollinators and natural enemies will adversely affect pest and disease regulation. Temperature increases and rising carbon dioxide (CO_2) concentrations may also be favourable to some weeds and cause smothering of crops, which reduces crop establishment and quality of the produce. In addition, the increased vulnerability of terrestrial ecosystems may lead to soil erosion, slope destabilization and landslides, all of which cause low water, low nutrient retention and loss.

The IPCC's Climate Change and Land report (2019), illustrates the interconnectedness between land use, human systems and the climate system, underscoring the role of integrated and sustainably managed landscapes in both addressing the impacts of climate change and in supporting adaptation, mitigation and sustainable development goals. The report contends with high confidence that all modelled development pathways that limit warming to 1.5°C, or well below 2°C, require land-based mitigation and land-use change, with most including different combinations of nature-oriented interventions such as reforestation, afforestation, reduced deforestation and bioenergy (IPCC, 2019).

Ecosystem-based adaptation in the food and agriculture sector

Building the resilience of our food and agriculture sector to climate change will require a comprehensive nature-focused transformation of our food system (FAO, 2016a). NbS provide an opportunity to sustainably optimize the potential for nature to transform agriculture from a problem into a solution for climate change. For instance, the people-centered focus of EbA links biodiversity and ecosystem conservation approaches with sustainable socio-economic development. This makes the approach unique in its potential to deliver adaptation, mitigation and disaster risk reduction co-benefits.

The concept of an ecosystem provides a valuable framework for analysing and acting on the linkages between people and their environment; therefore the key principles of the ecosystem approach[1] to conservation and development inform EbA. For any management approach to qualify as EbA and to avoid maladaptation, the following criteria should fulfilled: a) reduces social and environmental vulnerabilities; b) generates societal benefits in the context of climate change adaptation; c) restores, maintains or improves ecosystem health; d) is supported by policies at multiple levels; and e) supports equitable governance and enhances capacities (FEBA, 2017). Figure 1 illustrates a wide range of existing ecosystem-based approaches and practices that, when integrated into an adaptation strategy, can provide a guiding framework for the implementation of EbA in the agriculture sector, with a focus on: ❶ protecting and enhancing the functioning of these agro-ecosystems and biodiversity for food and agriculture; ❷ increasing agricultural productivity and the resilience of agricultural livelihoods; and ❸ ensuring food security in the context of climate change. Identifying and incorporating the most appropriate ecosystem-based approaches and practices into broader adaptation strategies and

[1] The CBD defines the **ecosystem approach** as follows: *The Ecosystem Approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.*

agricultural planning processes can help support people whose livelihoods depend on agriculture, forestry, fisheries and aquaculture.

In the agriculture sector, EbA works to protect and restore the natural resource base with the overall aim of maintaining and enhancing the agro-ecosystem services and biodiversity for food and agriculture that enable farmers, herders, fishers and forest-dependent communities to adapt to the impacts of climate change and to sustain longer-term food security. The approach can generate multiple benefits

Figure 1

MULTIPLE BENEFITS OF ECOSYSTEM-BASED ADAPTATION IN AGRICULTURE SECTORS

Improving ecosystem functions, goods and services

Sustainable management, conservation and restoration of natural resources and ecosystems that support and protect agricultural livelihoods (e.g.: land, water, genetic, species and ecosystem, diversity); improve ecosystem health, ecological functions and processes that are vital for agricultural livelihoods such as buffering capacities, nutrient cycling, soil formation, water infiltration, pollination, pest and disease regulation, carbon sequestration, etc.

ECOSYSTEM-BASED APPROACHES TO CLIMATE CHANGE ADAPTATION IN AGRICULTURE SECTORS

Improving agricultural productivity

Improving crop, animal, fishery and aquaculture productivity in the face of climate variability and climate change; reducing the impacts of extreme weather and climate events (heavy rainfall, floods, drought, high temperatures, strong winds, etc.) on crops, animals, aquatic species and farming systems; reducing pest and disease incidences on crops, livestock, forests, fisheries and aquaculture.

Increasing livelihood and food security

Increasing livelihood and food security and nutrition of smallholder farmers, livestock herders, and forest-dependent communities; increasing or diversifying income generation, taking advantage of local or traditional knowledge; use of locally available and low-cost renewable inputs; avoiding or reducing dependence on external inputs such as pesticides, inorganic fertilizers.

including: enhancing water availability and quality; improving nutrient availability and cycling; sustaining yield stability; ensuring pollination and pest and disease regulation; improving buffering capacities against extreme weather and climate events; and increasing the potential for carbon sequestration.

Nature-oriented adaptation priorities: Ecosystem-based adaptation in Nationally Determined Contributions

An analysis of ecosystem and biodiversity considerations in the nationally determined contributions (NDCs), climate change mitigation and adaptation country commitments submitted to the United Nations Framework on Climate Change Convention (UNFCCC) in 2015, illustrates the nature-oriented vision that many countries have for both mitigating and adapting to climate change.

Of the 162 countries that submitted NDCs, 140 address both mitigation and adaptation[2]. Of the 140 NDCs with an adaptation component, 23 countries explicitly mention EbA or ecosystem-focused approaches to climate change adaptation, while 132 countries implicitly mention EbA by referring to ecosystems and biodiversity[3]. Most of the 23 countries (82 percent) that explicitly mention EbA as an adaptation approach are developing and least developed countries. Of the 132 countries that make reference to ecosystems and biodiversity, 32 percent (43 countries) are

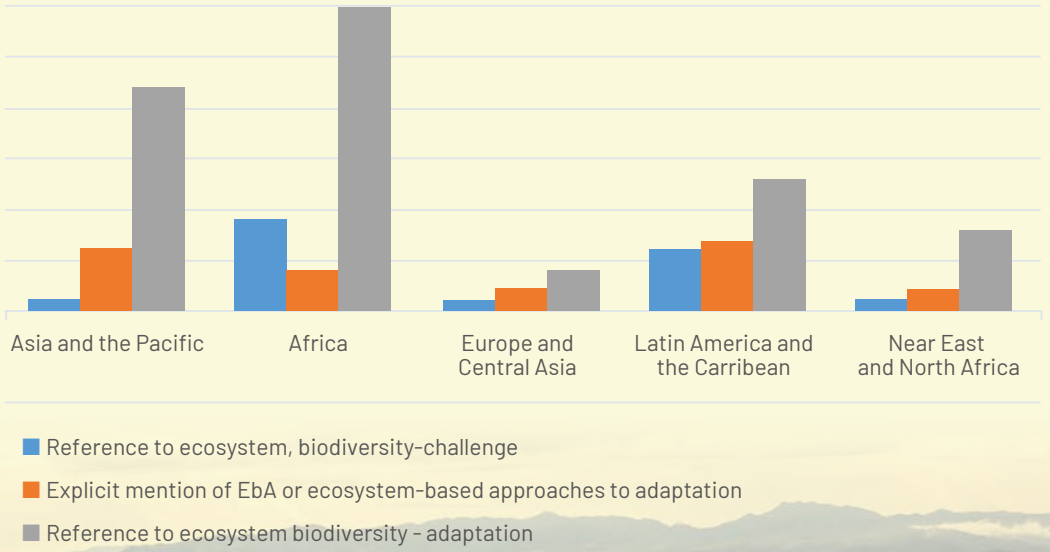
[2] Countries without a distinct adaptation component: Albania, Andorra, Australia, Azerbaijan (references adaptation element, but no specific section), Bosnia and Herzegovina, the Democratic People's Republic of Korea, Iceland, Japan, Kazakhstan, Latvia and the European Union, Monaco, Montenegro, New Zealand, Norway, Oman, the Russian Federation, San Marino, Serbia (linked to EU NDC), Switzerland, The Former Yugoslav Republic of Macedonia, Trinidad and Tobago, Turkey, Ukraine (references adaptation element, but no specific section), and the United States of America.

[3] The following sixteen countries explicitly reference both Ecosystem-based Adaptation and/or ecosystem-based approaches to adaptation, and refer to ecosystems and biodiversity in their adaptation components: Colombia, Costa Rica, the Democratic People's Republic of Korea, Dominican Republic, Lao People's Democratic Republic, Madagascar, Maldives, Myanmar, Peru, the Republic of Moldova, Seychelles, South Sudan, Tajikistan, United Arab Emirates, Viet Nam and Yemen.

developing countries, while 24 percent (32 countries) are least developed countries. As shown in Figure 2, more countries in Africa and Asia and the Pacific refer to either ecosystems or biodiversity as a component of their adaptation priorities compared to other regions.

Figure 2

Considerations of ecosystem-based approaches to adaptation in nationally determined contributions by region.



Most of the African countries which refer to ecosystems and biodiversity in their NDCs are in East Africa (11)[4] and West Africa (9)[5], both regions with a high degree of vulnerability to climate change (IPCC, 2014).

Many African countries' adaptation components also highlight the importance of the sustainable land management (SLM) approach, an ecosystem-based management approach defined by the United Nations Earth Summit as *the use of land resources, including soil, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions* (1992). Similarly, some countries seek to mainstream other ecosystem-based management approaches into their national planning, including integrated coastal zone management and sustainable forest management , which increase the buffering capacities and services provided by ecosystems to coastal communities in Small Island Developing States (SIDS).

Enhancing carbon sinks through the reforestation of degraded land and forest area is the primary nature-based intervention for mitigating the impacts of climate change, accounted for in 64 NDCs. This is followed by conservation and natural regeneration, accounted for in 44 NDCs. Of these mitigation commitments, least developed countries account for the largest number of countries to target restoration (57 percent) and conservation (39 percent) of forest ecosystems, followed by developing countries (34 percent and 22 percent). Efforts to restore and conserve forest ecosystems are primary mitigation components in Africa (60 percent and 30 percent) and in Latin America and the Caribbean (45 percent and 30 percent). Furthermore, 37 countries (19 percent) have set reforestation and

4 East Africa: Djibouti, Ethiopia, Madagascar, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, South Sudan, Uganda and Zambia

5 East Africa: Djibouti, Ethiopia, Madagascar, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, South Sudan, Uganda and Zambia.

conservation goals for 2030. The highest level of reforestation and conservation commitments identified were among the least developed countries (30 percent).

The IPCC (2019) reports with very high confidence that ecosystem-based approaches such as SLM and Sustainable Forest Management (SFM) can prevent and reduce land degradation, maintain land productivity and have the potential to reverse the impacts of climate change on land degradation. The report also contends with high confidence that both SLM and SFM approaches support both mitigation and adaptation.

The following sections further outline nature-oriented adaptation priorities as identified in country NDC adaptation component.

Water use and management

Sustainable water use and management and integrated water resources management are priority adaptation areas for the agriculture sectors, particularly in crop and livestock production. Ecosystem-based approaches, such as integrated watershed management, can harness freshwater resources. Countries, such as Indonesia, referenced the need to promote landscape approaches and integrated watershed management approaches, while Viet Nam made reference to transboundary water management and the need to strengthen international cooperation in addressing transboundary water issues (Socialist Republic of Viet Nam, 2015). Mongolia seeks to expand its state protected areas, especially river headwater areas where 70 percent of the country's water resources originate; while the Seychelles is in the process of implementing an ecosystem-based approach to watershed management with the aim that it will contribute to food supply and water quality (The Mongolian People's Republic, 2015; The Republic of the Seychelles, 2015).

Incorporating efficient water use and management into policy and regulatory frameworks is necessary to enhance ecosystem services. Building institutional and technical capacities to implement integrated water resources management, hydrological monitoring, and risk and vulnerability assessments were also identified as critical to scaling up the use of ecosystem-based approaches for adaptation in water use and management in the agriculture sector.

Sustainable crop production

Improved land, water and agrobiodiversity management are priority areas for adaptation in sustainable crop production, intensification and diversification. This includes ecosystem-based approaches and practices that promote resilient agricultural production systems (sustainable land management, conservation agriculture, organic agriculture, soil and water conservation), and integrated farming systems (crops, livestock, forestry, fisheries and aquaculture). In this context, EbA is closely linked to the concepts of agroecology and provides opportunities to diversify cropping systems, livelihoods and empowering local communities while at the same time increasing their resilience to climate change and variability. Several countries have prioritized these ecosystem-based approaches in their NDC adaptation components. For example, Myanmar aims to adopt sustainable land and water management practices through agroforestry to improve soil quality and irrigation (Republic of the Union of Myanmar, 2015). Eritrea has set a target to rehabilitate 250 000 hectares of degraded land for agriculture (State of Eritrea, 2015); while the Republic of Burundi (2015) aims to gradually replace 100 percent of mineral fertilizers with organic fertilizers by 2030.

Livestock and rangeland management

Improved livestock and rangeland management is a nature-oriented priority for the subsector and a primary ecosystem-based management approach, as better management can improve rangeland and pastureland productivity, protect

transhumance corridors, diversify livelihood options, rehabilitate degraded land, and improve water and soil management. The Republic of South Sudan (2015) aims to employ ecosystem-based and community-focused approaches in an effort to "promote sustainable agriculture and livestock production and management through utilizing traditional knowledge and community-based adaptation". Similarly, Bolivia is seeking to transition to semi-intensive systems of livestock management and integrated management of agroforestry and silviculture techniques (Plurinational State of Bolivia, 2015).

Sustainable forest management

The restoration and sustainable management of forests is a nature-oriented priority for adaptation in the forestry sector. Sustainable forest management (SFM), a central ecosystem-based management approach in the sector, can take the form of afforestation and reforestation integrated with other sustainable ecosystem-based management approaches and practices, including watershed management and the diversification of forest livelihoods. For example, Nepal has a strategy that aims to have forests cover at least 40 percent of the country's total area, and it promotes the afforestation of both public and private lands (Federal Democratic Republic of Nepal, 2016). By 2030, Rwanda aims to implement public–private partnerships to sustainably manage forestry plantations through multi-year contracts with cooperatives that will plant and maintain young plantations until they reach their commercial maturity (Republic of Rwanda, 2015).

Moreover, biodiversity conservation is critical to maintaining the healthy ecosystems that provide essential goods and services for human well-being. Conservation measures vary in nature and purpose within the NDCs, from the protection of coastal forests and mangroves in Viet Nam (Socialist Republic of Viet Nam, 2015), natural regeneration in Mali (Republic of Mali, 2015), to the preservation of forests to combat dust storms in Kuwait (The State of Kuwait, 2015).

Ecosystem-based approaches for fisheries and aquaculture

Improving the management of aquatic ecosystems through integrated management and ecosystem-based interventions is a nature-oriented priority in the fisheries and aquaculture sector. More support is needed for the development and implementation of participatory and community-led aquatic resources management. The conservation and restoration of aquatic ecosystems are vital to maintaining ecosystem integrity in the fisheries and aquaculture sector. Ecosystem and biodiversity conservation play a particularly important role in improving the resilience of coastal communities in SIDS. The Seychelles, for example, has created biodiversity conservation frameworks and made explicit reference to biodiversity and ecosystems across a wide range of sector-specific adaptation interventions, including fisheries and aquaculture and water resources management (Republic of Seychelles, 2015).

Nature-based crop management: Ecosystem-based adaptation in cultivated ecosystems

The impacts of climate change on cultivated ecosystems are evident in several regions of the world, with the negative impacts outweighing the positive (FAO, 2016b). Increasing temperatures combined with variable and erratic rainfall patterns have led to reduced crop yields, species loss and outbreak of pests and diseases. Drops in wheat and maize yields in many regions following extreme weather and climate events have also been linked to food price spikes (FAO, 2016a). In the agriculture sector, extreme weather and climate events, as well as slow onset events, cause the degradation of ecosystems: soil erosion and salinization, declining rangeland productivity, deforestation and biodiversity loss (FAO, 2016a and 2019a). Convergent research results from globally consistent, multi-model climate change assessments for major crops show that, for local temperature

increases of 2°C or more above late twentieth-century levels, climate change without adaptation is projected to have negative effects on production, although individual locations may benefit (IPCC, 2014).

Successfully tackling land degradation is closely dependent on how land resource users respond to climate change. EbA in cultivated ecosystems fosters opportunities for optimizing the role of nature in sustainably managing crop production systems and increasing the resilience of livelihoods that depend on them. When integrated into planning processes for climate change adaptation, existing and relevant ecosystem-based management approaches, such as agroecology, sustainable land management (SLM), integrated plant nutrient management, conservation agriculture, and agroforestry can provide guiding frameworks for the application and scaling of up of EbA in cultivated ecosystems.

Integrating these approaches into wider adaptation strategies and management plans should be targeted at improving the management of ecosystems in an effort to enhance the resilience of agricultural livelihoods to climate change. Moreover, as part of an adaptation strategy, these approaches should also be targeted at diversifying agricultural income and reducing the need for costly ex post coping measures (Pender et. al, 2009). The nature-based interventions encompassed in these approaches include improving soil surface cover through residue retention, and mulching and cover crops, which help to improve water infiltration rates and result in reduced soil erosion and soil moisture loss. For example, conservation agriculture can improve soil conditions, reduce land degradation and increase yields through nature-based interventions such as minimal soil disturbance, permanent soil cover and crop rotations. Other best practices include soil and water conservation measures (contour farming, terracing, infield water harvesting and run-off regulation), and integrated soil fertility management (manuring and composting through crop–livestock integration and agroforestry).

EbA: Cultivated ecosystems in summary:

- There is no universal blueprint for EbA in cultivated ecosystems – rather adaptation planning processes should work at a landscape level and strive to balance biodiversity and ecosystem conservation approaches with sustainable socio-economic development, with the overall aim of strengthening the resilience of agricultural livelihoods and food security (Pender et al, 2009).

- By working at a landscape level and building on tested ecosystem-based approaches (such as SLM and agroecology), EbA allows for more holistic and inter-sectoral planning with regard to natural resource management for adaptation (FEBA, 2017). Relevant technologies and practices for various land uses can be combined, optimizing on-site and off-site impacts in relation to conservation, restoration, productivity and sustainable livelihoods (taking into consideration trade-offs, costs and benefits, and impacts on upstream and downstream communities) (FAO, 2017a).

- When planning for EbA in cultivated ecosystems, the following should be taken into account: climate risks to ecosystem services; land uses and priorities; and socio-economic contexts including resilience, livelihoods and food security.

Considerations for scaling up EbA in cultivated ecosystems

- Understand and articulate, both scientifically and through perceptions of local users, the linkages between land degradation, biodiversity and climate change.

- Systematically assess the impacts of climate risks on yield reductions in cropping systems and identify the best EbA approaches and suitable practices for restoring and maintaining the ecosystem services that agricultural livelihoods depend on.

- Promote participatory testing, adoption and wider demonstration of various locally relevant EbA approaches and practices through existing innovation systems.
- Develop an enabling environment to facilitate EbA implementation, providing farmers with positive incentives and developing mechanisms to create awareness and empower communities.
- Promote coordinated action and collaboration in policy at national level and community-based participatory planning and technology development at local level to benefit the most vulnerable people and promote greater ownership of improved management practices.

Reducing risks and building the resilience of coastal and riparian communities to climate change through nature: Ecosystem-based adaptation in aquatic ecosystems

FAO (2016c) estimates that 800 million people – about 10–12 percent of the world's population – rely on fisheries and aquaculture for their livelihoods. About 60 million people were engaged in the primary sector in 2018, and women accounted for fifty percent of the people engaged in the primary and secondary sector, such as processing and trading (FAO, 2020). Although the economic value of marine and inland services is not well quantified, fisheries and aquaculture contribute significant revenue to many developing countries including SIDS. In 2018, fish exports of developing countries were valued at USD 88 billion, and their net fish export revenues (exports minus imports) reached USD 38 billion, higher than those of other agricultural commodities (such as meat, tobacco, rice and sugar) combined (FAO, 2020).

Many of the drivers affecting fisheries and aquaculture today are familiar: pollution (fertilizers, pesticides, heavy metals, persistent organic pollutants); habitat degradation (through filling, dredging, habitat conversion, disruption of freshwater flow, interruption of migratory paths); and overfishing (Barange et al., 2018). However, some drivers affecting the sector are unfamiliar, such as coastal erosion due to rising sea levels, extreme weather events and competition for fresh water. The impacts of climate change on fisheries and aquaculture are already visible, with reported modifications of the geographic distribution of species moving towards the poles, changes in productivity and in the seasonality of processes, ocean acidification, and changes in coastal conditions which affect ecological habitats. In addition, climate change is likely to increase disaster risk, adversely affecting lives, productive equipment, infrastructure, transport and housing.

Without careful planning, aquatic ecosystems, which include fisheries and aquaculture, can potentially suffer as a result of adaptation measures applied by other sectors. For example, in the case of inland fisheries, short-term decisions over water allocation to agriculture or power generation may have long-term negative impacts, such as the decline of freshwater fisheries resources. More support is needed for the development and implementation of participatory and community-led aquatic resources management. The conservation and restoration of aquatic ecosystems are vital to maintaining ecosystem integrity in the fisheries and aquaculture sector, and they play a particularly important role in climate-related risk reduction and in improving the resilience of coastal and riparian communities in developing countries including SIDS.

The fisheries and aquaculture sector needs coordinated and synergistic adaptation strategies and tools. EbA can be a crucial part of the solutions needed to tackle the adverse impacts of climate change in this sector. In the sector, the approach promotes measures that reinforce the restoration and conservation of aquatic ecosystems and the management of human activities relying on them as well as maintaining the

ecosystem services they provide, such as provisioning (e.g.: food and employment), regulating (e.g.: climate regulation and moderation of extreme events), cultural (e.g.: recreational fishing), and supporting (e.g.: nutrient cycling) services.

EbA: Aquatic ecosystems in summary:

- Healthy aquatic ecosystems are more than ever important to cope with climate change implications. They are not only a necessary condition for fisheries and aquaculture to fully realize their potential for growth in food production, but are also a basic foundation for dependent communities to absorb changes due to global warming or to recover from the more abrupt impacts such as extreme events or disasters.

- Capture fisheries are the only food production system that relies entirely on wild resources and their natural production cycle. The productivity of fisheries is closely tied to the health and biodiversity of marine and freshwater ecosystems, which provide food, habitats and nursery areas for fish. Thus, conservation and restoration of natural ecosystems such as wetlands, mangroves, coral reefs and seagrass meadows are particularly important.

- Many aquaculture systems rely on modifying the natural system to maximize production. The focus of EbA intervention in aquaculture is mainly on maintaining ecosystem structure and function to support food provisioning while minimizing impacts, rather than restoring ecosystems to an initial state before aquaculture started.

Considerations for scaling up EbA in aquatic ecosystems

- Strengthen the governance of the fisheries and aquaculture sector to enable the application of EbA and their wider adoption.

- Improve and reinforce technical capacities in fisheries and aquaculture management institutions, especially at decentralized levels for effective implementation of EbA.
- Utilize the existing guidelines and tools of the ecosystem approach to fisheries (EAF) (see Box 1) and to aquaculture (EAA) to support the planning and implementation process of EbA.

BOX 1 ECOSYSTEM APPROACH TO FISHERIES AND TO AQUACULTURE (EAF/EAA): OPPORTUNITIES TO SUPPORT CLIMATE CHANGE ADAPTATION IN AQUATIC ECOSYSTEMS

The EAF/EAA strive to balance diverse societal objectives by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions, and by applying an integrated approach to fisheries and to aquaculture within ecologically meaningful boundaries (FAO, 2003). The three fundamental requirements of the EAF/EAA are: ecological well-being (bio ecology), human wellbeing (socio-economy), and the ability to achieve (governance).

The four steps of the EAF/EAA are: (1) initiation and planning; (2) identification and prioritization of issues; (3) development of management plans; and (4) application and monitoring. The EAF/EAA are frameworks for fisheries and aquaculture management, which use a holistic and participatory approach based on the pillars of sustainability (social, economic and environmental). The implementation of EAF/EAA is an opportunity to identify ecological and socio-economic issues in relation to climate change impacts, and formulate management measures to undertake actions across the pillars of sustainability, thus offering opportunities to support climate change adaptation.

EbA relates to the issues identified under the ecosystem well-being component of the EAF/EAA. These issues would require the adoption of measures aimed at preserving or restoring ecosystems (including their genetic and species diversity) and ecosystem services of relevance to fisheries and aquaculture (e.g.: rehabilitation of aquatic habitats such as mangrove or coral reefs, landscape management and river rehabilitation) and creating buffers against the adverse impacts of climate change.

Nature-based solutions for resilient forests and forest-dependent people: Ecosystem-based-adaptation in forest ecosystems

Forests act as a source of food, medicine and fuel for more than a billion people living in extreme poverty and hunger (FAO and UNEP, 2020). Forests also provide a habit for more than 80 percent of the world's terrestrial biodiversity. They are key in protecting watersheds and ecosystems, which are critical for the supply of clean water and other services. Forests also support the livelihoods of more than a billion people living in extreme poverty and hunger, and climate change is posing challenges to forest ecosystems and forest-dependent communities (FAO, 2015a; FAO, 2018a).

Forests are critical to stabilizing the climate. Maintaining healthy forests is instrumental to enhancing their potential to sequester carbon and to reduce the vulnerability of ecosystems and communities to climate change. In the context of disaster risk reduction (DRR) and adaptation, forest goods tend to be more climate-resilient than traditional crops. When disasters strike or crops fail, forests act as safety nets, protecting communities from the loss of food sources and income. Furthermore, sustainably managed forests can enhance landscape resilience to climate change through soil protection, slope stabilization and the modification of micro-climatic conditions in cultivated ecosystems.

In the forest sector, adaptation encompasses changes in management practices designed to decrease the vulnerability of forests to climate change and interventions intended to reduce the vulnerability of people to climate change (FAO, 2013). Harnessing the potential of nature to provide climate change solutions for forests and forest-dependent people can be achieved by promoting ecosystem-based approaches, such as sustainable forest management (SFM), that when integrated into broader adaptation strategies aim to bridge the gap between forest management and adaptation policy. Such integrated landscape management approaches can

help communities adapt to climate change while providing key mitigation co-benefits (FAO, 2013). EbA that prioritizes the sustainable management of forests can also strengthen social resilience by diversifying revenue sources and product supplies. Employment opportunities can also be created through nature-based interventions such as forest restoration, forest conservation, wood production and wood-based manufacturing (FAO, 2018a; FAO and UNEP, 2020).

EbA: Forest ecosystems in summary:

- Climate change represents an additional challenge for the management of forests. Forest managers will need to adopt "no regrets" options – focused on maximizing positive and minimizing negative aspects of EbA approaches and strategies – which will yield climate change adaptation and mitigation co-benefits (FAO, 2013).
- Trees and forests have the potential to support adaptation across many sectors, including: agroforestry; the restoration of degraded agricultural land; the provision of sustainable energy, and the use of urban forests to regulate temperatures, water quality and supply (FAO, 2018a; FAO and UNEP, 2020).

Considerations for scaling up Ecosystem-based adaption in forest ecosystems

- Adaptation needs should be reflected in and mainstreamed into forest policies, while at the same time forests and trees should be adequately reflected in adaptation plans and policies.
- The implementation of EbA in the forestry subsector should be based on scientific evidence such as climate change impact and vulnerability assessments learning and the use of participatory approaches involving stakeholder engagement.

- Selected EbA approaches and practices should be integrated, work at a landscape level and be linked to regional and global environmental agendas.
- When implementing EbA in Forest ecosystems, the rights of indigenous peoples and local communities dependent on forests must be taken into consideration through the adoption of rights-based approaches such as free, prior and informed consent to land and natural resources tenure, which build on local knowledge.
- Forest managers will need to be aware of the incentives available for climate change adaptation and mitigation measures. They will also need to understand the evolving climate-related policy, and legal and regulatory environment (which is likely to change) in order to comply with new laws and regulations and to capitalize on financial opportunities for the benefit of forest communities.

Community-led nature-based solutions: Ecosystem-based adaption in dryland ecosystems

Drylands encompass grasslands, agricultural lands and forests. They provide livelihood opportunities and support 44 percent of the world's food and 50 percent of the world's livestock production. Dryland ecosystems have a major role to play in global biophysical processes by reflecting and absorbing solar radiation and maintaining the atmospheric energy balance. Globally, drylands cover 6.1 billion hectares of land, constitute 41 percent of the land area and are home to 38 percent of the global population (FAO, 2016d). Recurrent climatic shocks, conflicts, socio-economic crises and high-impact transboundary plant pests and animal diseases profoundly impact the vulnerability of the poorest dryland smallholder farming, agro pastoralist and pastoralist households, particularly in arid and semi-arid areas of sub-Saharan Africa (FAO, 2018b).

Dryland ecosystems are characterized by extreme climatic variability with low and erratic precipitation and water scarcity. They are highly susceptible to land degradation – including desertification, soil erosion and biodiversity loss – which can lead to food insecurity in dryland communities (FAO, 2016d). However, improved productivity and increased resilience to climate change can be achieved through targeted ecosystem-based management approaches, including the rehabilitation of degraded drylands and the restoration of ecosystem services.

Well managed grasslands as part of dryland ecosystems hold enormous potential for adapting to and mitigating the impacts of climate change. When integrated into a broader adaptation strategy, improved grassland management can increase productivity and food security, provide development opportunities in resource-poor drylands and reduce the impacts of drought and climate change (FAO and GDP, 2018). Well-managed grasslands provide societal benefits such as increased water infiltration and retention, nutrient cycling, biomass and the diversity of which are critical for adaptation and resilience building (FAO, 2017c; FAO and GDP, 2018).

Improved livestock management also plays an important role in carbon sequestration. Improved grassland management is inclusive of managed grazing that takes into account an understanding of how to use grazing to stimulate grasses for growth and healthy root systems. This is achieved by using the grazing process to feed livestock and soil biota through maintaining soil cover; managing plant species composition to maintain feed quality, providing adequate rest from grazing without over resting pasture; and understanding the impacts of and adapting to climate change (FAO, 2017c; FAO and GDP, 2018).

Trees and forests in drylands are also valuable and provide a wide range of important services including: protection against water and wind erosion and desertification; providing habitats for biodiversity; supporting water infiltration into soils; and improving soil fertility (FAO, 2016d; FAO, 2019). If well managed

and properly valued, dryland trees and forests have the potential to help tackle such global challenges as poverty and climate change.

EbA: Drylands in summary:

- People-centred approaches are critical for the uptake of EbA across the agriculture sector. In dryland ecosystems, as in other ecosystems, multi-stakeholder processes should strive towards inclusivity and dialogue at all levels to ensure that the interests of all stakeholders are considered and captured. For example, in the Great Green Wall of the Sahara and the Sahel Initiative, local people are included in the selection and appraisal of different grass and tree species used in restoration interventions, which has proven to enhance ownership of the initiative and active community participation (Berrahmouni, 2018).

- Building on existing and equitable governance mechanisms at community level can enhance the effectiveness of EbA in rangelands. In Kenya, for example, the success of participatory rangeland management planning (PRMP) was mainly due to the fact that it was built on existing community governance structures (Ogali, 2018).

Considerations for scaling up EbA in dryland ecosystems

- Promote strong institutional, policy and regulatory frameworks for integrated natural resource management at the landscape level to scale up EbA in drylands.

- Increase targeted investments in research and human capacity for implementing EbA, and build the capacity of local agro-pastoral and pastoral communities to implement improved land management practices.

- Strengthen local institutions and their functioning, including for women and youth, geared towards climate change adaptation, to pave the way for better and more coordinated natural resource management.
- Develop and implement people-centred approaches that involve local institutions and community-level agreements to promote the sustainable use and management of dryland ecosystems.
- Adopt incentive mechanisms to encourage communities to allocate their own resources to manage dryland ecosystems.

BOX 2 AFRICA'S GREAT GREEN WALL INITIATIVE: RESTORING DRYLAND ECOSYSTEMS

Africa's Great Green Wall (GGW) initiative aims to build prosperity and resilience in over 20 countries around the Sahara. Conceived as a mosaic of green and productive landscapes, the GGW has the potential to address climate change adaptation and mitigation; prevent and combat desertification; eradicate poverty; end hunger; and boost food and nutrition security. The GGW works at the landscape scale and across land uses and production systems (forests, agroforestry, croplands, grasslands, and pastoral and fishery systems) by putting communities and their livelihoods at the centre of the initiative. Ecosystem restoration is planned and tackled along the entire value chain, from land and seed to end products and markets. The success of this initiative lies in supportive policies, good governance, sufficient technical, operational and financial capacities, and incentives for the communities to adopt new practices.

Specifically, the GGW promotes community managed natural regeneration of native species in forests, croplands and grasslands. Investment in large-scale land preparation and enrichment planting is also necessary where degradation is so severe that vegetation cannot regenerate on its own. Engaging local communities is critical to select, establish and protect the native woody and grass species adapted to semi-arid and arid environments and used to fight sand encroachment.

For more information on Africa's GGW initiative, see: www.fao.org/3/a-i6476e.pdf

Nature-based Solution for Sustainable mountain development: Ecosystem-based adaptation in mountain ecosystems

Covering 22 percent of the world's land surface, mountains are home to some 915 million people, and represent 13 percent of the global population. FAO (2015b) reports that mountains provide between 60 and 80 percent of the earth's fresh water, storing water in various ways, such as by forming snow and ice that melts during warmer periods. In semi-arid and arid regions, over 70 to 90 percent of river flows come from mountains, while in temperate areas, 30 to 60 percent of fresh water come from highland watersheds.

Mountains are fragile ecosystems with marked topography and highly differentiated climatic conditions. Mountain slopes with steep and differing elevations often make the soil shallow, poor in micronutrients, limited and difficult to cultivate, and unsuitable for mass agricultural production. There is growing evidence that many mountain regions have become increasingly disaster-prone over the past few decades. The occurrence and extent of extreme climatic events, including avalanches, landslides, volcanic eruptions, earthquakes and glacial lake outburst floods, which tend to be higher in mountains and are increasing as a result of climate change (FAO, 2011).

A food security vulnerability analysis of mountain communities – carried out by FAO in collaboration with the Mountain Partnership Secretariat – found that 39 percent of mountain populations (both urban and rural combined) in developing countries were considered vulnerable to food insecurity (FAO, 2015b). Over generations, mountain people have learned how to live with the threat of natural hazards and have developed sophisticated techniques for farming, livestock breeding, forestry and water use that are adapted to life on steep slopes and in harsh, unpredictable conditions (FAO, 2011; Manuelli, Manuelli et al., 2015) however, climate change and variability is challenging these management systems.

Promoting local and traditional ecosystem-based approaches and practices, supported by increased community involvement is particularly important for scaling up EbA in mountain ecosystems. When incorporated into a broader adaptation strategy, integrated ecosystem-based approaches, such as sustainable mountain development and integrated watershed management, provide an opportunity to bridge the nexus between climate risks and traditional management systems. Working to assess risks and solutions from small-scale mountain watersheds to river basin landscapes, both approaches encourage coordinated actions within mountain watersheds and provide opportunities to assess the benefits to upstream and downstream environments and populations (FAO, 2017c).

EbA: Mountain ecosystems in summary

- Maintaining healthy mountain ecosystems – through diversified and well-adapted traditional land-use systems – is essential for building the resilience of mountain ecosystems and mountain communities.

- Incorporating integrated landscape approaches, such as sustainable mountain development and integrated watershed management, into wider adaptation planning processes and management approaches, targeted at restoring vital ecosystem services and biodiversity for food and agriculture, can build the resilience of mountain ecosystems to climate change while strengthening linkages between upstream and downstream communities (FAO, 2017c).

Considerations for scaling up ecosystem-based adaptation in mountain ecosystems

- Promote risk-driven and participatory sustainable mountain development and integrated watershed management as frameworks targeted for sustainable development at all levels of implementation.

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- Encourage integration of sustainable mountain development and integrated watershed management into national climate change policies and strategies.
- Conduct participatory analysis and design of watershed management programmes by linking socio-economic, environmental, and institutional dynamics, with a more unified vision a resilient territorial development.
- Develop an evidence base for economic, environmental and broader social benefits for specific goods and services provided by mountains to encourage investment in mountain ecosystems.

BOX 1 INTEGRATED WATERSHED MANAGEMENT: AN ECOSYSTEM-BASED APPROACH FOR ADAPTATION IN MOUNTAINS

The integrated watershed management approach aims to conserve the soil, plant and water resources of a catchment, while benefiting vulnerable communities and incorporating environmental, social and economic concerns. Watershed management involves any human action aimed at ensuring the sustainable use of watershed resources. It is an integrated and people-centred approach, in which human needs inform management choices and human actions sustain the use of watershed resources. The approach has an explicit spatial focus and reflects upstream-downstream linkages, processes, interactions and effects, both on-site and off-site. It combines local traditional knowledge and scientific knowledge through action research and joint learning, and seeks innovative and low-cost solutions, combining them to obtain multiple benefits for ecosystem conservation and livelihoods. Watershed management promotes a flexible, adaptive, long-term perspective to management, planning and financing, including the monitoring and evaluation of ecosystem services, health and stability.

Watershed management has the potential to mainstream adaptation, especially ecosystem-based adaptation, by applying a climate lens and incorporating climate-related data, tools and methods. This includes assessing climate vulnerabilities and risks, as well as existing adaptive capacities and needs among stakeholders. When identifying adaptation options, priorities are given to low-cost, ecosystem- based approaches and practices that restore, maintain or improve ecosystem health and promote adaptation co-benefits.

For more information on Watershed Management in Action: Lessons from FAO field projects, see: www.fao.org/3/a-i8087e.pdf

Nature-based agricultural water management: Ecosystem-based adaptation in freshwater ecosystems

With the rising demand for food, fodder, fibre and bioenergy, the agriculture sector faces competition from households and industry over increasingly scarce water resources. For many countries, their prospects of improving water availability under changing climatic conditions remain bleak, as both droughts and flood hazards are expected to increase. A report by the United Nations World Water Assessment Programme (WWAP) and UN-Water (2018) highlights the promising contribution of nature-based solutions in enhancing the quantity and quality of water for productive purposes and human consumption, while simultaneously striving to preserve the integrity and intrinsic value of the ecosystems. These NbS build on and encompass ecosystem-based management approaches and practices that, when scaled-up as part of a wider adaptation strategy, have the potential to generate social, economic and environmental co-benefits, including human health and livelihoods, food and energy security, sustainable economic growth, decent jobs, ecosystem and biodiversity rehabilitation and maintenance.

- Two-thirds of national wetlands worldwide have been lost due to unsustainable water use and management, including the drainage of wetlands for crop production. There is strong evidence that unsustainable water management practices contribute to the destruction of ecosystems (WWAP, UN-Water; 2018).

- When integrated into adaptation planning processes, ecosystem-based approaches and practices can sustainably improve water quantity and quality. Examples of nature-based interventions, encompassed in ecosystem-based management approaches, include zero or minimum tillage techniques that can increase water infiltration and soil water holding capacity, as well as riparian bugger strips, which help prevent nutrients from washing into aquatic systems and recycle them back to crop fields. Rainwater harvesting and conservation

through these techniques has been estimated to increase global crop production by 20 percent (WWAP, UN-Water; 2018).

- EbA in freshwater ecosystems can also reduce the risks associated with water-related extreme events by restoring natural floodplains, which can provide additional storage and safeguard biodiversity.

- Green infrastructure can provide cost-effective and efficient interventions, preserving the integrity of ecosystems, especially in the long term. Despite this, green infrastructure accounts for less than 5 percent of the total investment in water-related infrastructure, as water management continues to be heavily dominated by traditional and human-built grey infrastructure (WWAP, UN-Water; 2018).

Considerations for scaling up Ecosystem-based adaptation in freshwater ecosystems

- Sustainably addressing current and future agricultural water concerns will require finding the most appropriate blend of green and grey investments (in natural infrastructure and human-engineered infrastructure), thus maximizing benefits and efficiency while minimizing costs and trade-offs (WWAP,UN-Water; 2018).

- Nature-based solutions are not a panacea, and scaling-up EbA that target freshwater ecosystems be based on local contexts and needs.

- Where possible, policymakers should try to integrate EbA into ongoing policy processes that target freshwater ecosystems, including regional and national agricultural and food security development frameworks and national biodiversity strategies.

- Incentive mechanisms are needed to scale-up EbA in freshwater ecosystems. For example, upstream communities providing clean water to downstream communities should benefit from the services provided.
- Full stakeholder involvement is indispensable when promoting the uptake of EbA for resilient and adapted freshwater ecosystems. By improving cross-sectoral collaboration, public participation and the knowledge base, different groups of stakeholders can be brought together under a common agenda.

Nature in policy: Integration of Ecosystem-based adaptation priorities into agriculture, food security and climate change planning processes

Understanding when EbA is an economically preferable approach requires the benefits of EbA activities to be examined relative to their costs in a number of ecological, institutional and social settings. Strengthening the impact of EbA requires that it is assessed, planned and applied within the context of a broader adaptation strategy.

Specifically, agricultural planning processes need to explicitly address the key elements of the interrelationship between ecosystem services, ecosystem health and community-level benefits. Similarly, successful climate change adaptation and mitigation planning processes should prioritize ecosystem management to address the complex and dynamic nature of ecosystems (FAO, 2017b). By not excluding other management and conservation approaches, EbA has the potential to integrate diverse approaches to manage complex situations, and more specifically in the agriculture sectors, when it is integrated into new or existing adaptation plans (FAO, 2017b).

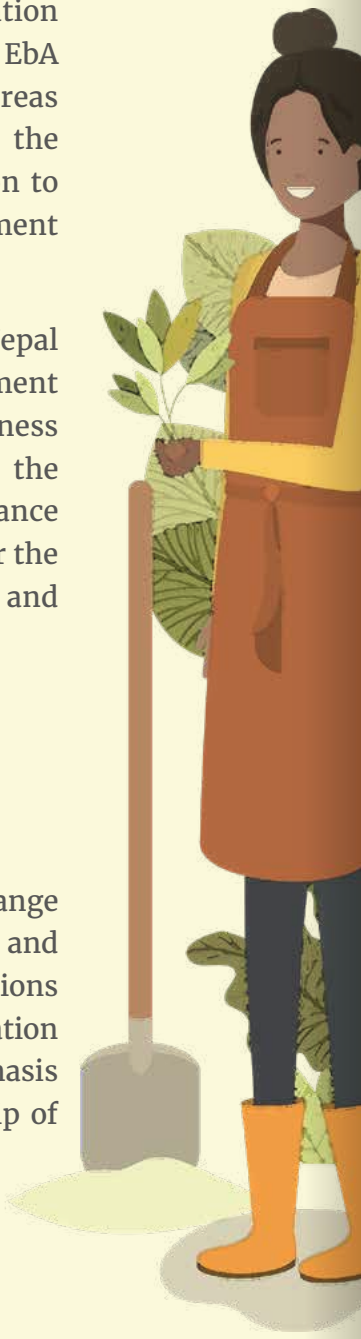
Given countries' adaptation commitments in the NDCs, there is an opportunity for EbA to be integrated into the update and/or implementation of these commitments. One instrument for effectively mainstreaming these approaches into medium to long-term strategies, in a coherent way that engages a whole-of-government approach, is the National Adaptation Plan (NAP) planning process. Lessons learned from integrating EbA into NAPs serve to illustrate how the approach can be mainstreamed into policy and management planning tools. As a key climate change planning tool for countries, the NAP process provides a means to: (1) identify medium and long-term adaptation needs; and (2) develop and implement strategies and programmes to address those needs (Least Developed Countries Expert Group, 2012). In so doing, EbA could become part of a policy or planning objective and a means for implementation (FAO, 2020b). Integrating ecosystem-based approaches for adaptation into NAPs should be based on a continuous, progressive and iterative planning process that is country driven and specific, as well as transparent and participatory.

The first stage of integrating EbA into the planning process should lay the groundwork by identifying EbA as a medium to long-term goal. Existing strategies and policies should be assessed, and mechanisms identified, to integrate EbA activities (such as sustainable land management and reforestation) into the planning process. An inventory of coordination mechanisms and lessons learned from existing EbA actions could be beneficial.

In the second stage, vulnerability assessments should be used to gain a better understanding of which ecosystems, communities and sectors are most vulnerable. Following this, an appraisal of adaptation actions should be completed. Within this prioritization, the feasibility of EbA actions must be assessed, including the financing mechanisms, institutional frameworks and coordination mechanisms needed to implement them. The monitoring of EbA needs to be addressed throughout the planning process and implementation.

Many countries have already integrated EbA into their National Adaptation Plans (NAPs). In Thailand, the formulation of the country's NAP has seen EbA mainstreamed into components that target agriculture sectors. Major areas of concern were identified through a detailed vulnerability assessment of the country and possible ecosystem-based measures were proposed for selection to stakeholders. Capacity development and participatory stakeholder engagement were crucial to the process of integrating EbA in the country's NAP.

Barriers to scaling up EbA in the agriculture sector do exist. For example, in Nepal major constraints to integrating landscape planning in watershed management include a lack of qualified specialists and insufficient data on the effectiveness of potential interventions. Proper institutional coordination is key to the implementation of EbA strategies. Inter-agency mechanisms can also enhance synergies and commitments at all levels. Moreover, establishing pilot sites for the demonstration of EbA good practices can advance upscaling at landscape level and provide case studies for knowledge sharing and lessons learned.



Nurturing smallholder stewardship of nature-based solutions: scaling up ecosystem-based adaptation in the agriculture sector

The potential for nature-oriented approaches to support the climate change adaptation of small-scale food producers and to transform the agriculture and food sector into a climate change solution lies in shaping the investment decisions and patterns of smallholder farmers, foresters and fishers. The transformation of our agriculture and food systems needs to happen at farm level with emphasis on building and nurturing the potential for smallholder producer stewardship of improved management practices.

Concerted efforts are needed to scale up NbS as part of the broader climate change strategy to achieve greater resilience among smallholder farmers, fisher folk and forest-dependent people against climate shocks. More specifically, overcoming these challenges in the agriculture sector will require policymakers and adaptation practitioners to promote the use of ecosystem-based approaches and practices both in climate change adaptation and agricultural development. Key strategies for supporting the uptake of ecosystem-based approaches for adaptation among smallholders include:

- Deepening the understanding of the impacts of climate change on ecosystems and their specific functions.
- Enhancing the effectiveness of different EbA practices by addressing the barriers of their adoption through systematic exchange of experiences, evidence-based results and tools to foster joint learning and cross-fertilization among different stakeholders.
- Creating an enabling environment by promoting supportive and integrated agriculture and climate change policies that specifically promote EbA as part of a broader adaptation strategy.
- Establishing and maintaining strong innovation systems by engaging multiple actors and institutions, including participatory testing, evaluation and co-development of location-specific and gender-sensitive adaptation strategies and options.
- Providing support for strategic planning and institutional coordination processes and multi-stakeholder action platforms with the capacity to assess, prioritize, implement, monitor and evaluate EbA.

- Developing strategic partnerships for joint action on investments and integrating the co-benefits of EbA into climate-financing proposals to broaden funding opportunities. Adaptation solutions that integrate ecosystem-based approaches should support long-term, flexible and adaptive management.

Incentives are vital to ensuring the adoption of improved practices by smallholder food producers. Incentives should be relevant to local contexts, address the short-term needs of smallholders, and support long-term transitions towards more resilient food systems and livelihoods. Such incentives can encourage the adoption of innovative practices and the diversification of livelihoods through increased market opportunities. Creating enabling environments for incentives and for the wider adoption of ecosystem-based approaches in agricultural adaptation planning processes requires greater collaboration between public and private entities and civil society.

The integrated and cross-sectorial processes encompassed in NBS, and more specifically in EbA, can foster opportunities for better coordination of existing incentives from local initiatives, existing and new private–public–producer partnerships. This can also allow for integration between sectors and different stakeholders through strengthened enabling environments. The integrated nature of such policy frameworks can further mobilize finance from different sources to support the incentive packages needed to maximize the adoption and scaling-up of EbA in the food and agriculture sector.

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