ECOSYSTEM-BASED ADAPTATION THROUGH SOUTH-SOUTH COOPERATION

Enhancing Capacity, Knowledge and Technology Support to Build Climate Resilience of Vulnerable Developing Countries

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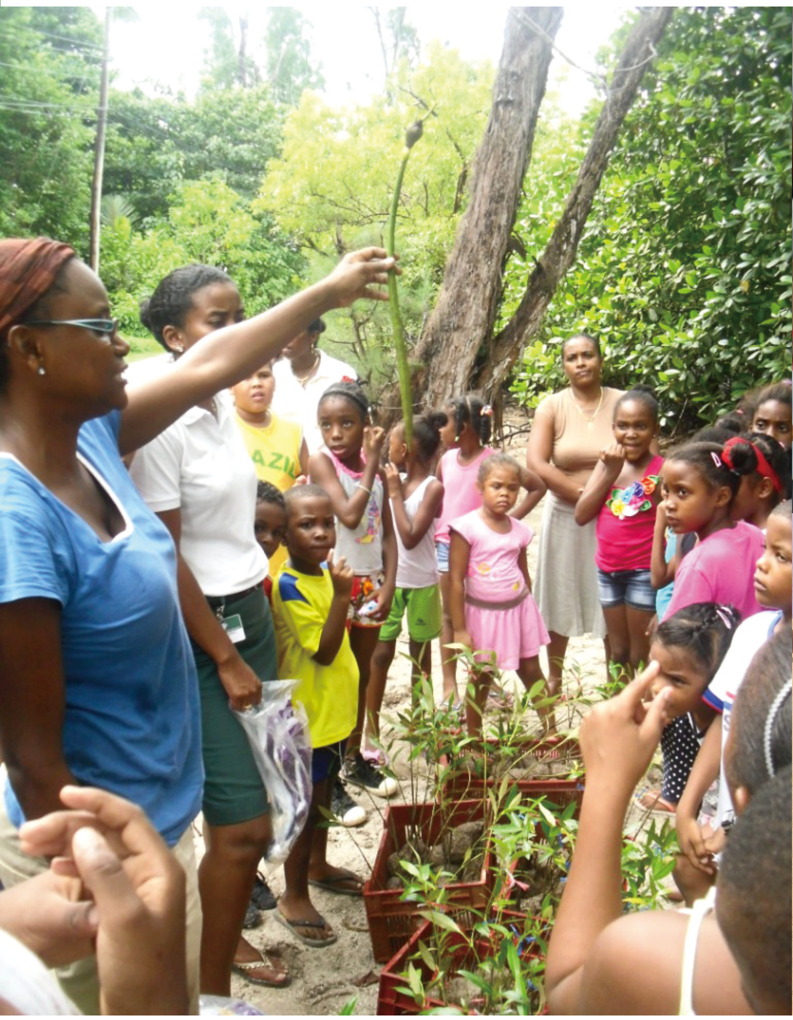
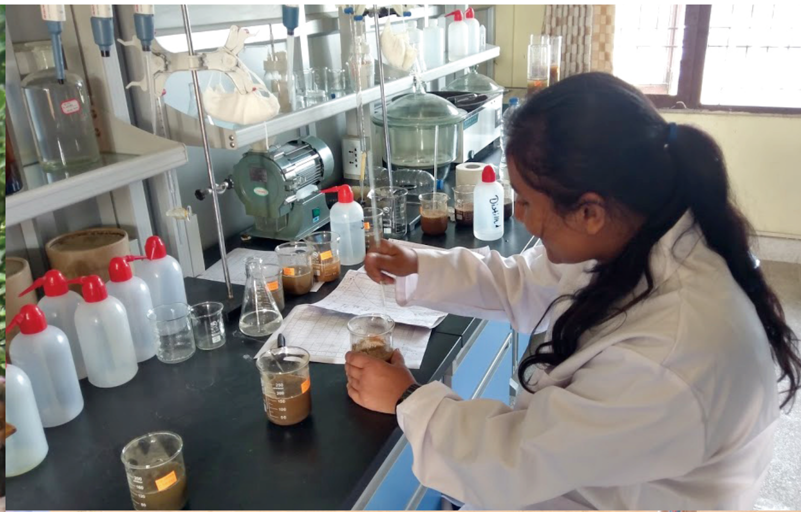
International Ecosystem Management Partnership

国际生态系统管理伙伴计划

Integrating Ecosystem-based Adaptation in Education Curriculum: A Resource Guide





Ecosystem-based Adaptation through South-South Cooperation (EbA South)

EbA South is a full-sized GEF project, funded through the Special Climate Change Fund. Officially known under the title "Enhancing Capacity, Knowledge and Technology Support to Build Climate Resilience of Vulnerable Developing Countries", the project is implemented by UN Environment and executed by the National Development and Reform Commission of China (NDRC) through the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences (IGSNRR, CAS). The UN Environment-International Ecosystem Management Partnership (UNEP-IEMP) is a UN Environment collaborating centre based in China. It is the first centre in the South for the South and provides overall project management services, technical support and fosters South-South linkages for the project. This reference guide is a product of the EbA South project. For more information about EbA South, please visit: www.ebasouth.org

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Suggested citation:
UNEP-IEMP. (2019). Integrating Ecosystem-based Adaptation in Education Curriculum: A Resource Guide. Document produced as part of the GEF-funded EbA South project.

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ABBREVIATIONS

CBD	Convention on Biological Diversity
CBA	Community-based adaptation
DRR	Disaster risk reduction
EbA	Ecosystem-based adaptation
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
MEA	Millennium Ecosystem Assessment
TEEB	The Economics of Ecosystems and Biodiversity
UNFCCC	United Nations Framework Convention on Climate Change

1 INTRODUCTION

Part I consists of an introduction to Ecosystem-based Adaptation (EbA) and a rationale on the importance of integrating it in formal and non-formal education as a strategy to achieve change and address pressing climate-related challenges. Following this, the introductory section presents the purpose and scope of the guide as well as its target audience and structure.

1.1 Learning about Ecosystem-based Adaptation

Climate change and variability will have worldwide impacts on ecosystems and people. The increase in the average temperature of the planet, the changes in rainfall patterns, the rise in sea level and the frequency of extreme weather events (storms, droughts, etc.) are already happening (IPCC, 2014). As a result, ecosystems have already experienced changes and are expected to undergo an irreversible transformation in their structure and functions, if no measures are taken. This directly will affect human well-being and economic sectors such as agriculture, access to water availability, among others.

Healthy ecosystems offer multiple benefits such as the prevention and reduction of risks associated with extreme weather and climate events like flash floods, droughts, heat waves, and extreme temperatures. Consequently, the deterioration of ecosystem services is already threatening human well-being especially of the most vulnerable communities, who depend on ecosystem goods and services.

Acknowledging the benefits provided by healthy ecosystems in the context of a changing climate, the value of adaptation solutions that integrates an ecosystem approach – known as Ecosystem-based Adaptation[1] – is increasingly recognised and promoted. Learning about climate change and EbA requires knowledge from different disciplines. Therefore, it cannot be done in isolation from other subjects that deal with environmental, economic, social, cultural, ethical, political, scientific and technological variables. This makes it important to integrate EbA related principles and elements into other educational subjects. An existing curriculum may allow for the direct inclusion of EbA; for example, ecosystem functions can be covered in biology and ecology, while climate change and its impacts can be included in geography and physics. That will present a direct opportunity for enhancing the curriculum by also looking at the role of ecosystems and solutions to reduce vulnerability and strengthen the resilience in the community. Facilitating environmental education in the learning of all subjects, rather than isolating it, provides the awareness for students on how the environment is connected to their daily lives and relationships within their communities.

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[1] EbA is described as the "use of biodiversity and ecosystem services as part of adaptation strategy to help people adapt to the adverse effects of climate change." (CBD, 2009).

1.2 The need for integrating EbA in education

An EbA approach has demonstrated how it can effectively reduce climate risks, while providing additional benefits to the communities. Therefore, EbA needs to be widely promoted and accepted as a viable strategy to reduce vulnerability and build resilience of both the social and ecological systems.

As a key component of adaptive capacity, education should incorporate EbA into school and university curriculum to promote a thorough understanding of the role of ecosystems and enable students to take action.

This guide consists of two main sections, as outlined below, which may be consulted individually according to the user's interests and needs.

- **Section I** provides three steps as a general guidance on determining the focus of the curriculum. The steps include: (1) Planning for EbA curriculum development; (2) Preparing the EbA curriculum; and (3) Including field activities for EbA education. Furthermore, it provides guiding notes on different aspects and steps for the design of a curriculum, which reflects the principles of EbA. This section focuses on a range of approaches for the integration of EbA in different subjects in the curriculum, also at educational levels and development of learning outcomes.
- **Section II** consists of five education modules on selected topics: (1) Ecosystem services and their role in supporting livelihoods; (2) Ecosystem-based Adaptation; (3) EbA in forests and mountain ecosystems; (4) EbA in marine and coastal ecosystems; and (5) EbA in dryland ecosystems. These modules serve as a guide to facilitate the integration of EbA in education subjects. Each module includes key definitions, defined learning objectives and teaching materials to support education specialists in the preparation of the curriculum.

Additionally, Annex 1 provides a comprehensive list of definitions of key terminology and Annex 2 offers a list with relevant teaching materials.

1.3 Purpose and scope of the guide

The main objective of this guide is to position EbA as an approach to address the challenges related to climate variability and change globally. The reference guide is designed to support teachers and environmental educators to incorporate the key aspects of EbA into formal[2] or

[2] Formal education - Education that is institutionalised, intentional and planned through public organisations and recognised private bodies and - in their totality - constitute the formal education system of a country. Formal education typically takes place in educational institutions that are designed to provide full-time education for students in a system designed as a continuous educational pathway (UNESCO, 1973).

non-formal[3] education curriculum. It promotes awareness of the key role that ecosystems play for communities to adapt to climate change. This guide is designed to enable educators at the different education levels (primary, secondary, university) from diverse subject areas to introduce EbA across curriculum.

1.4 Target audience

The resource guide is designed to inform teachers, educators and policy makers interested in integrating EbA in formal and non-formal education at primary and secondary levels and also undergraduate level. The target groups include:

- Decision makers in the education sector responsible for developing and implementing educational programmes and initiatives;
- Primary, secondary and undergraduate level teachers/youth educators;
- Teacher training institutions;
- Non-governmental organisations (NGOs) involved in the development and implementation of non-formal education programmes;
- Interested citizens/youth/students.

The readers need to have basic knowledge on climate change and ecosystems to inform and guide them in the process for preparation of formal or non-formal education curriculum integrating EbA. The readers will need to have a good understanding of teaching approaches to be able to effectively implement the steps.

[3] Non-formal education - Education that is not institutionalised. The defining characteristic of non-formal education is that it is an addition, alternative and/or complement to formal education. It is often provided in order to guarantee the right of access to education for all. It caters to people of all ages but does not necessarily apply a continuous pathway structure; it may be short in duration and/or low-intensity; and it is typically provided in the form of short courses, workshops or seminars (UNESCO, 1973).

2 INTEGRATING EBA IN THE EDUCATION CURRICULUM

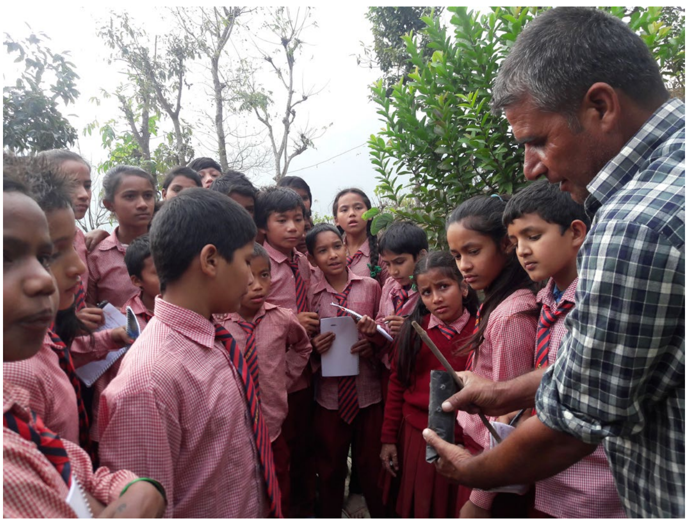
Part II aims to provide practical steps for the integration of EbA in the education curriculum and is divided into two sections. Section 1 focuses on the adoption of EbA as part of formal and non-formal education curriculum while Section 2 presents examples of selected EbA education modules.

Section 1. Integrating EbA as part of formal and non-formal education curriculum

Step 1. Planning for EbA curricula development

This step considers the initial planning process for the development of EbA curricula. It is fundamental to first explore the possibilities of how to integrate the aspects related to EbA in different learning objectives and activities. General steps to consider during the planning process include:

- **Identify local resources and information:** Search for information in your locality on ecosystem and biodiversity status (e.g. environmental degradation, protected areas, indigenous fauna and flora species), major livelihoods (e.g. agriculture, fishing, tourism), demographic characteristics (e.g. urban or rural, income and education levels).
- **Look for local case studies:** Experience has demonstrated that students will often refer to examples close to their homes and communities. This is especially relevant for EbA, where the measures aim to address the local context and needs. Analyse the situation of your country with regards to climate change and its past and future likely impacts on communities and ecosystems. Ideally, consider specific impacts on surrounding ecosystems (e.g. mountain, coastal zone, forest).



- **Seek collaboration with other actors:** Contact environmental organisations in your country, region and local community to request relevant materials and for speakers.

Step 2. Preparing the EbA curriculum

This step aims to provide guideline for the preparation process of EbA curriculum. It includes recommendations on how to integrate EbA in social and natural science subjects. In addition, it outlines criteria about defining the learning objectives for the students.

2.A Integrating EbA in the curricula

The roadmap towards integrating EbA into curricula will depend on the unique situation of each educational institution. Integrating EbA into the formal or non-formal learning curriculum is an essential way of developing a sustained culture of awareness about the role of ecosystems in supporting livelihood pathways that can better adapt to the effects of climate change. Suggested steps for the design of contents and objectives of the EbA curriculum as an integral part of social and natural science topics are described below.

To integrate EbA in school subjects such as chemistry, physics and ecology it is important that there is emphasis on understanding the climate system and the impacts of climate change, while exploring the relationship with the ecosystem functions. For example, in **ecology** the role of ecosystem goods and services is important for climate change adaptation and mitigation and even for reducing disaster risks. Tree planting activities in coastal areas, for example, offer multiple benefits such as carbon sinks (mitigation), buffer against coastal floods and erosion, and protection of watershed or water catchment areas. In **physics**, it can increase the understanding of how the climate system functions, the drivers of climate change and the difference between climate variability and climate change. While in **chemistry** it can analyse the problems arising from climate change and causing ocean acidification to inform EbA coastal solutions.

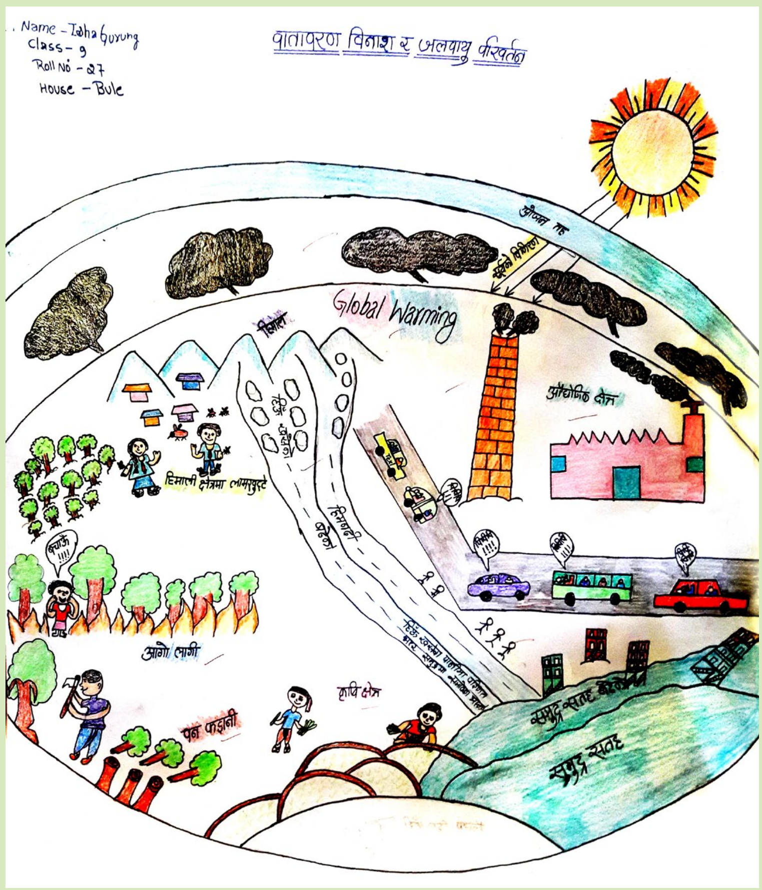
On the other hand, school subjects such as geography, history and economics, EbA can be integrated through analysis of the interactions between human beings in both their temporal and spatial dimensions. This can be done by highlighting the role of ecosystems for people well-being and linking it with climate change. For example, in **geography**, students can be introduced to the importance of land-use planning, like mapping of climate impacts and identifying EbA measures. In **history**, EbA aspects can be integrated by exploring the historical management of natural resources and ecosystems in cases of crisis. In **economics**, economic valuation of ecosystem goods and services could be integrated into EbA projects/interventions. Table 1 presents a list of examples on ways to mainstream EbA in natural and social science curricular subjects.

Table 1. List of examples for integrating EbA in education subjects (P - Primary school; S – Secondary school; U – Undergraduate level)

Subject	P	S	U	Examples
Ecology	🍃	🍃	🍃	• Learn how a healthy ecosystem, such as forest or mangrove swamp, can protect a community from hazards like landslides and tsunamis • Examine the role of wetlands in absorbing excessive rainwater and preventing floods downstream; identify EbA measures for restoration and conservation of wetlands • Understand the role of soil fertility maintenance and watershed conservation for the reduction of landslides triggered by soil erosion and increased runoff • Explore the types of protected areas, the ecosystem services they provide to local communities
Geography	🍃	🍃	🍃	• Map certain areas (e.g. at national level) to show the effects of different degrees of rise in sea level on coastlines; shift of ecotones in mountain area; change in snowline, snowpack, glacier in high mountain areas • Study impacts of natural disasters on urban and rural communities • Identify ecosystems and their characteristics according to geographical location • Analyse changes in land use as a means of building resilience and as a source of hazard
Economics		🍃	🍃	• Learn about different perceptions of the value of ecosystem services and goods • Explore the economic value of certain ecosystem services • Understand the economic benefits from EbA • Understand the functioning of socio-ecological systems
History		🍃	🍃	• Explore impacts of natural hazards and climate change periods on past civilisations • Study past major national/community disasters and identify lessons to be drawn • Research indigenous/traditional DRR wisdom/practice and consider its present applicability • Identify Traditional Ecological Knowledge (TEK) systems, its application and inter-generational transfer of such knowledge systems

2.B Determining learning outcomes for the EbA curriculum

It is important to determine the expected learning objectives in the curriculum preparation process. Learning outcomes refer to the results obtained from a structured learning process. You may describe the outcomes of your learning programme highlighting the specific knowledge, understanding, skills and attitudes that learners obtain regarding EbA. Learning outcomes themselves should be considered in a sequence through the grade levels so that an outcome achieved earlier in a learner's development paves the way for learning directed towards improvement. Examples of the possible learning outcomes from an EbA learning programme for primary and secondary education and also for students at undergraduate level in the university are presented below.



Learning outcomes on EbA for students in primary education: Students in primary education (6 – 10 years) think in fairly concrete terms and have a limited capacity for abstract thinking. Thus, learning can be focused on basic building blocks of and linkages between climate change, ecosystems and livelihoods. These students also are very curious about the world around them as they constantly seek answers to its functioning. The EbA curriculum should offer them opportunities to focus on simple observation and exploration of nature and the environment rather than on more complex issues that might require advanced knowledge of the environment and its functioning. Table 2 presents a summary of the learning outcomes.

Table 2. Examples of learning outcomes for students from primary education

Learning outcomes for primary education	
Knowledge *The learner will know and understand…*	• basic concept of atmosphere and climate • similarities and differences among a wide range of living organisms • basic concept of habitat and how organisms relate to each other and their surroundings • basic principles of the man-environment interaction • geographic locations differ in their physical and human characteristics • plants and animals have different characteristics, and many are inherited • values provided by ecosystems and the need to conserve those ecosystems (e.g. mangroves)
Skills *The learner will be able to...*	• understand changes and differences in the physical environment • locate, collect and organise simple information on nature, communities and environmental topics

Learning outcomes on EbA for students in secondary education: Students in secondary education (11 – 17 years) can think more abstractly and engage in more creative thinking in general. They are developing more sophisticated cognitive abilities that let them understand the interrelationships of scientific, environmental and human systems which are essential to the understanding of climate change science, societal implications and EbA. They can learn about basic climate change scenarios, risks and impacts. This is a period in which students are well suited to investigate local environments and to learn about the underlying complexity of ecosystems and their role in adaptation solutions. This is also a suitable level when understanding of climate change science can be combined with an understanding of what it means to be a responsible citizen who has problem-solving skills, can communicate effectively on EbA aspects and can put in practice theoretical knowledge. Table 3 shows a summary of the learning outcomes for secondary education.

Table 3. Examples of learning outcomes for students from secondary education

Learning outcomes for secondary education	
Knowledge *The learner will know and understand…*	• the basics of the physical processes that shape the Earth and relate differences in physical patterns to their causes • climate change and its causes • intermediate knowledge on the principles that guide the man-environment interaction • that biotic communities are made up of plants and animals that are uniquely adapted to live in particular environments that can be affected by, among others, a change in climate • that human-induced changes have consequences for the immediate environment as well as for other places and future times • the human ability to shape and control the environment that links with our ability to create knowledge and develop new technologies • a range of basic EbA interventions
Skills *The learner will be able to...*	• develop, focus and explain questions that help them learn about the environment and ability to conduct environmental assessments • assess and evaluate the strengths and weaknesses of the information and data (e.g. climate and ecosystem data) they are using • identify climate change impacts on different economic sectors (e.g. agriculture, health) and regions (e.g. mountains, coastal areas) and actions to address them • identify and plan for EbA interventions

Learning outcomes on EbA for students in undergraduate level: Students in undergraduate level at university are able to understand the complexity of many environmental subjects and related issues, and importantly, how to address them. Table 4 shows the summary of learning objectives for undergraduate level students in the university.

Table 4. Examples of learning outcomes for students in undergraduate level university

Learning outcomes for undergraduate level university students	
Knowledge *The learner will know and understand…*	• large-scale critical cycles that occur in nature, including: distribution of solar energy and albedo, the water cycle, changing seasons and atmospheric movement patterns, ocean currents, the carbon cycle, volcanism and tectonics, and overall familiarity with the basic elements and interactions of the Earth's atmosphere, land and oceans • basic population dynamics and the importance of diversity in living systems • that the living environment is comprised of interrelated, dynamic systems • the functioning of socio-ecological systems, feedbacks from such systems and how to design interventions that counter negative feedbacks • that humans are able to alter the physical environment to meet their needs and there are limits to the ability of the environment to absorb impacts or meet human needs
Skills *The learner will be able to...*	• design research and answer particular questions about climate change and adaptation solutions • locate and collect reliable information for environmental and climate change-related research, including EbA measures • apply basic logic and reasoning skills to evaluate the completeness and reliability of the information sources • organise and display information in ways appropriate to different types of environmental research and EbA interventions • assess the relative value and efficacy of solutions based on natural resource and human adaptation as well as emission reductions and sequestration

Step 3. Including field activities for EbA education

This step provides practical examples for integrating field activities in the education process for EbA. It is highly encouraged to design and promote field and extra-curricular activities to enhance the understanding of the approach and its effective implementation. A case study from the Seychelles illustrates the process and benefits of extra-curricular activities.

Box 1. Example of extra-curricular activities as part of awareness campaign in the Seychelles

The Seychelles, along with Mauritania and Nepal, was one of the pilot countries of the GEF-funded project 'Ecosystem-based Adaptation through South-South Cooperation' (EbA South, 2013-2019), implemented by the United Nations Environment Programme. The main EbA interventions undertaken in the Seychelles were mangrove restoration in order to buffer against flooding and enhance the security of coastal livelihoods. The national project team, led by the Ministry of Environment, Energy and Climate Change, also involved youth participation in many of the capacity building and restoration activities on the ground. At least ten schools participated in planting mangroves and other coastal restoration programmes, including:

- Visiting an EbA South project site at Anse Royale and learning how to propagate plants (especially coastal plants) that were later on used in coastal restoration;
- Surveying in the community to assess environmental issues and later taking action to remedy, such as beach clean ups, water quality tests, community education, forest and coastal planting activities, as part of an overall restoration and adaptation programme.

Moreover, three of the schools participated in a special school project initiative.

- *Plaisance Secondary School* launched their annual public speaking competition with the theme "Ecosystem-based Adaptation: finding natural solutions to fight against climate change issues", where the students presented their own views on how to address the issues in their neighbourhoods.
- *Anse Boileau Secondary School* organised the Science Fair Competition, that later on was consolidated as a school project focusing on "climate change impacts on the coastal erosion and with EbA as a solution to coastal degradation" as exhibition materials at the national celebration of the World Wetlands Day 2017.
- *English River Secondary School* supported the local awareness raising and understanding of EbA, wetlands and climate change concepts within the school community by designing and modelling a wetland on the school compound surrounded by native trees, mural paintings and informative messages about the topic.

All the three schools worked in collaboration with the EbA South national project team to learn about the project, to participate in national activities and to successfully achieve the objectives of their extra-curricular activities.

Section 2. EbA education modules

To support the development of EbA curriculum, five education modules are provided. Each module presents a specific topic relevant to EbA in a theoretical and practical manner. Table 5 presents a summary of the modules and the principle learning outcomes. The modules can be used for primary, secondary and undergraduate university level students engaged in both formal and non-formal education processes. The educator can decide how to prepare the modules and align with the expectations of all education levels. Each module consists of three parts:

MODULE INFORMATION: Each module starts with an introduction that contains general information. The learning objectives give an outline of what the students will achieve at the end of the module for each of the learning groups (P – Primary school; S – Secondary school; U – Undergraduate level).

MODULE CONTENT: This part contains a brief thematic description to guide the educators about the important definitions and key messages for each module. It is organised according to the key topics for each module and learning groups.

TEACHING MATERIALS: This part provides a list of relevant resources to support the teachers in the preparation of the curriculum regarding concepts, methods and tools relevant to EbA.

Table 5. Overall description of the EbA education modules

Module	Title	Description
1	**Ecosystem services and their role in supporting livelihoods**	Concept of ecosystem services and their important role for human well-being; major threats to ecosystems and sustainable management solutions
2	**Ecosystem-based Adaptation**	Climate change impacts on people and ecosystems; vulnerability and adaptation options; concept and principles of EbA and examples
3	**EbA in mountain and forest ecosystems**	Key characteristics of mountain and forest ecosystems; climate change impacts and vulnerability of the ecosystem and population; role of EbA in these ecosystems and examples of practical solutions
4	**EbA in marine and coastal ecosystems**	Key aspects of marine and coastal ecosystems; climate change impacts and vulnerability; role of EbA in these ecosystems and examples of practical solutions
5	**EbA in dryland ecosystems**	Key aspects of dryland ecosystems; climate change impacts and vulnerability; role of EbA in the ecosystems and examples of practical solutions

Module 1: Ecosystem services and their role in supporting livelihoods

MODULE INFORMATION

Objective: This module aims to introduce the concept of ecosystem services and their important role for human well-being and to address the major threats posed to ecosystem services. Students will learn why different categories of ecosystem goods and services are important for livelihoods and what the sustainable ways to manage them are.

Learning goals: Overall learning objective for this module is that students will be able to identify potential ecosystem services provided by different ecosystems and their role for human well-being. Specifically, students at different levels will be able to:

Primary level **(P)**	• Recognise the different ecosystems • Understand basic threats to ecosystems
Secondary level **(S)**	• Classify ecosystem services according to the four categories in the Millennium Ecosystem Assessment • Relate ecosystem services and goods to components of human wellbeing • Identify threats to ecosystems and measures for their conservation
Undergraduate level **(U)**	• Analyse threats to ecosystems • Propose measures for their conservation • Identify ecosystem services provided by different ecosystems

MODULE CONTENT

This section contains the specific content of the curriculum organised according to the key topics and learning groups.

Key topics	P	S	U
1.1 Ecosystem services			

What are ecosystem services?

Ecosystem goods and services are the result of the ecological functions or processes, which directly or indirectly contribute to human well-being. The concept of ecosystem services has existed for a long time, but it was made popular by the Millennium Ecosystem Assessment (MEA). In short, ecosystem services are the benefits that humans receive from nature (MEA, 2005). These benefits underpin most aspects of human well-being, including our food and water, security, health, and economy. In the last decade, ecosystem services have been recognised that they can contribute to sustainable development as well as to the opportunity to increase public awareness of environmental problems.

1.2 Classification of ecosystem services

What types of ecosystem services are delivered by the ecosystems?

To gain a better understanding of the different types of ecosystem services, you can refer to the MEA classification (MEA, 2005):

- **Provisioning services:** The goods obtained from ecosystems, including food, fibre, fuel, genetic resources, natural medicines, pharmaceuticals, ornamental resources and freshwater.
- **Regulating services:** The benefits obtained from the regulation of ecosystem processes, including air quality regulation, climate regulation, water cycle regulation, soil erosion regulation, water purification, disease regulation, pollination and natural hazard regulation.
- **Cultural services:** The non-material benefits that people obtain from ecosystems and landscapes such as spiritual well-being, recreation, educational and aesthetic value.
- **Supporting services:** The services that are necessary for the production of all other ecosystem services, including soil formation, photosynthesis, primary production, nutrient cycling and water cycling.

1.3 Ecosystem services and human well-being

How do ecosystem services support livelihoods?

Ecosystem services contribute to all components of human well-being. According to the MEA, these components include basic material for good life (e.g. food, shelter, access to sufficient and clear water), health (e.g. strength), good social relations (e.g. mutual respect), security (e.g. personal safety, protection from disasters), and freedom of choice and action (MEA, 2005). The strength of the linkages between the well-being components and ecosystem services differ in different ecosystems and regions. Moreover, one should note that the relationship between human well-being and ecosystem services is not linear. This means, for instance, that the abundant supply of an ecosystem service does not guarantee that it will contribute significantly to human well-being and vice versa. However, when the provision of services is scarce, it can substantially reduce human well-being.

1.4 Threats to ecosystems and their services

What are the threats to ecosystems and their services?

Over the past 50 years, changes have taken place in the ecosystems as a result of anthropogenic activities, causing ecosystem degradation and biodiversity loss. This resulted in decreased provision of ecosystem goods and services. Two-thirds of the services that nature provides to humankind are nowadays rapidly declining and continues to threaten the resource base (MEA, 2005). The natural or human-induced causes that directly or indirectly cause a change in an ecosystem include (MEA, 2005):

- Direct drivers - change in land use and cover, climate change, fertiliser input, resource consumption influence ecosystem processes.
- Indirect drivers - demographic, economic, socio-political factors affect one or more direct drivers.

1.5 Sustainable ecosystem management

How to manage ecosystems sustainably?

We face a major challenge to reverse the degradation of ecosystems, while responding to increasing demand for their services and goods. However, experience shows that with the right attitude and knowledge, this challenge can be tackled, and ecosystems can be managed sustainably while those that are degraded can be restored. One option is to take an ecosystem approach to conservation. This approach is a strategy for integrated management of land, water and living resources that promotes conservation and the sustainable use of biodiversity in an equitable way among peoples (CBD, 2004). It is based on the application of appropriate conservation methods to various levels of biological organisation (e.g. genetic, species-based and ecosystem-based) and, if necessary, the restoration of natural processes, functions and basic interactions between organisms and their environment. It provides comprehensive management of ecosystems, emphasising the continuous links between all components, including humans in terms of cultural diversity.

TEACHING MATERIALS

Ecosystem services and human well-being: Synthesis

Type of material: Report	**Organisation:** Millennium Ecosystem Assessment (MEA)	**Year:** 2005

The assessment focuses on the linkages between ecosystems and human well-being and, in particular, on "ecosystem services". The report examines how changes in ecosystem services influence human well-being. The report synthesises information from the scientific literature and can act as a reference to develop comprehensive class sessions on ecosystem services.

Nature's Services – A guide for primary school on ecosystem services

Type of material: Handbook	**Organisation:** WWF	**Year:** 2013

This handbook explains the concept of ecosystem services in a clear and intuitive way and suggests various exercises suitable for students at primary school level.

Science and Policy for People and Nature

Type of material: e-Learning modules	**Organisation:** Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)

Online learning modules on designing, implementing and understanding assessments of biodiversity, ecosystems and their contributions.

Module 2: Ecosystem-based Adaptation

MODULE INFORMATION

Objective: This module aims to discuss the potential climate change impacts on people and ecosystems, their vulnerability and potential for adaptation as well as to introduce the concept and principles of EbA and its benefits to people and nature to address climate change challenges. Additionally, it includes examples of practical EbA solutions.

Learning goals: Overall learning objective for this module is that students will be able to understand the role of ecosystem services for climate change adaptation and to identify and distinguish EbA measures from other adaptation or conservation measures. Specifically, students will be able to:

Primary level **(P)**	• Understand the role of ecosystems for adaptation to climate change impacts
Secondary level **(S)**	• Provide examples of how ecosystems help people adapt to climate change • Understand the concept and criteria of EbA measures
Undergraduate level **(U)**	• Distinguish EbA from other measures for adaptation and conservation • Propose an EbA measure in different contexts

MODULE CONTENT

Key topics	P	S	U
2.1 Climate change			

What is climate change?

Studies show that the average global temperature today is the highest of the last 11,300 years. The global temperature is closely related with the concentration of greenhouse gases in the atmosphere and burning of fossil fuels emits carbon dioxide, one of the main greenhouse gases. Since the 1950s when scientists started being concerned that carbon dioxide concentration in the atmosphere might increase rapidly and affect the global climate, hundreds of scientists had studied the effects of greenhouse gas concentration to the climate system. In 1988, the World Meteorological Organisation with the support of the United Nations Environment Programme established the Intergovernmental Panel on Climate Change (IPCC) to study and provide scientific opinion on the issue. According to the IPCC 5th Assessment Report (published in 2014), after the industrial revolution at the end of the 18th century, humankind increased significantly the concentrations of greenhouse gases in the atmosphere. In 2011, the concentration of the three main greenhouse gases in the atmosphere, i.e. carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), exceeded the pre-industrial levels by about 40%, 150% and 20%, respectively. Moreover, the IPCC has published overwhelming evidence that these changes are responsible for the respective increase of the global temperature, and that human-produced emissions are responsible for these increases.

2.2 Climate change impacts on people and ecosystems

What are the key climate change impacts on people and ecosystems?

Climate change affects us all. Its potential impact on the planet can be irreversible with projections of lack of drinking water, large changes in the conditions for food production, melting of the poles and, as a result, sea level rise, coastal erosion, loss of food security and increase in mortality rates due to floods, storms, droughts and heat waves (IPCC, 2014). Other impacts generated by climate change can possibly be the extinction of species due to the rapid change that habitats will have to face, the threat to the health of people due to the increase of tropical diseases and malnutrition. In short, climate change is not just an environmental phenomenon but one with profound economic and social consequences.

2.3 Climate change adaptation

How to adapt to climate change?

Adaptation to climate change is defined as the adjustments in ecological, social or economic systems that are developed in response to current or expected climate stimuli and their effects or impacts (IPCC, 2014). It refers to changes in the processes, practices and structures to minimise potential harms or to benefit from the opportunities associated with climate change. The type of adaptation measure to adopt depends on the characteristics of the local climatic threats and the vulnerability of the system to these threats.

2.4 Ecosystem-based Adaptation (EbA)

What is EbA?

Ecosystems are both affected by climate change and have an important role to play in helping vulnerable people adapt, particularly in developing countries where livelihoods are dependent on natural resources. Such an approach to climate change is known as ***Ecosystem-based Adaptation***. EbA integrates the use of biodiversity and ecosystem services into an overall adaptation strategy. It can be cost-effective and generate social, economic and cultural co-benefits and contribute to the conservation of biodiversity. EbA includes the sustainable management, conservation and restoration of ecosystems to provide services that help people adapt to the adverse effects of climate change (CBD, 2009).

EbA measures include coastal habitat restoration, agroforestry, soil and water conservation interventions, livelihood diversification, and sustainable forest management interventions that use nature to reduce vulnerability to climate change. More examples of EbA measures are provided in module 3, 4 and 5.

2.5 Benefits from EbA

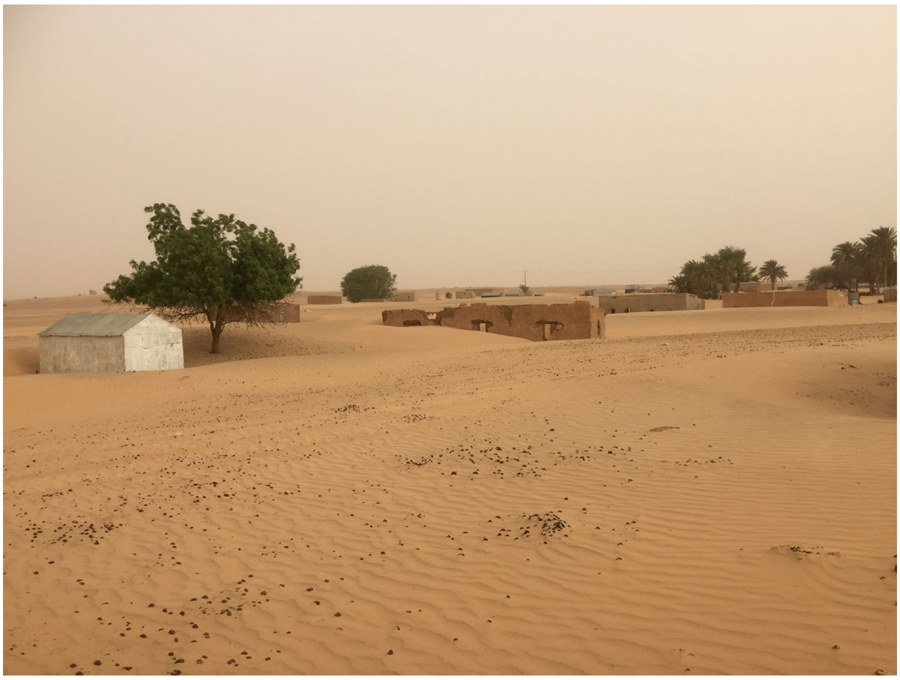
What are the benefits of EbA for the people and the ecosystems?

EbA offers multiple benefits both for the people and the ecosystems. It reduces the vulnerability of people to climate change through the sustainable use of biodiversity and ecosystems. EbA measures strengthen the capacity of people who directly depend on natural resources to respond adequately to changes in climate and protect themselves from climate-related risks and hazards. EbA provides direct or indirect benefits that increase peoples' resilience to climate change such as food security, shelter, disaster risk reduction and provision of freshwater, among others.

While EbA delivers benefits to people, such measures also support the stability, resilience, connectivity and multiple roles of ecosystems. As climate change affects ecosystem composition and structure, it is important that the health and stability of ecosystems and their services are maintained and improved. Therefore, EbA promotes sustainable use of natural resources and restoration of degraded ecosystems and, as a result, increase their resilience to climate change.

TEACHING MATERIALS

Making Ecosystem-based Adaptation Effective: A Framework for Defining Qualification Criteria and Quality Standards		
Type of material: Guidelines	**Organisation:** Friends of EbA (FEBA)	**Year:** 2017
This document provides a practical assessment framework for designing, implementing and monitoring EbA measures by proposing a set of 3 elements, 5 qualification criteria and 20 quality standards and example indicators.		
Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change		
Type of material: Report	**Organisation:** The World Bank	**Year:** 2009
This report presents a comprehensive introduction of the concept of EbA and its role for reducing the vulnerability of people. It can be used as a reference material to develop the modules.		



Module 3: EbA in forest and mountain ecosystems

MODULE INFORMATION

Objective: Module 3 focuses on the key ecosystem services provided by the forest and mountain ecosystems and why they are so vulnerable. It further addresses how climate change and other non-climatic factors affect forests and what potential EbA solutions are.

Learning goals: Overall learning goal for this module is that students will be able to identify key ecosystem services delivered by forest and mountain ecosystems, the climate impacts on ecosystems and people in the area. Students will understand and be able to analyse the importance of ecosystems in reducing the vulnerability and risks of disasters using EbA solutions. Specifically, students will be able to:

Primary level **(P)**	• Explain the key characteristics of forest and mountain ecosystems • Understand how these ecosystems provide food and shelter to people
Secondary level **(S)**	• Define the key ecosystem services delivered by forests and how they relate to human well-being • Understand mountain specificities and resources and its linkages with people's livelihood • Gain understanding of processes that affect mountain ecosystems • Determine key climate change risks for forests and communities living there
Undergraduate level **(U)**	• Define potential EbA solutions to increase the resilience of forests and communities • Discuss potential co-benefits from the EbA solutions

MODULE CONTENT

Key topics	P	S	U
3.1 Mountain ecosystems			

Why mountain ecosystems are important for human well-being?

At present, more than 915 million people live in mountain ecosystems (Romeo et al., 2015). Mountains support vast biodiversity and livelihoods. Therefore, they provide vital ecosystem services such as freshwater, food and fibre, energy and medicinal plants, as well as habitat for wild fauna and flora. Water is one of the most critical ecosystem services provided by mountains, supplying major cities in mountain areas and in lowlands often located far away. Agriculture and livestock grazing in pastures at higher altitudes are often the main sources of livelihoods in mountain ecosystems. Mountain forests and vegetation, in turn, function as physical barriers to prevent or slow landslides and avalanches. They also prevent soil erosion, reduce flood risk, enhance water provision and contribute to local food security. Additionally, mountains provide important cultural services, such as spiritual well-being for indigenous mountain communities, recreation and tourism (Swiderska et al., 2018).

3.2 Climate impacts and vulnerability of mountain and forest ecosystems

What are the climate vulnerability and impacts on mountain ecosystems and communities?

Mountain regions have rugged topography and often experience harsh climates. They are among the most sensitive ecosystems to climate change impacts. One of the key climate challenges is rising temperatures, especially in the 20th century (IPCC, 2014). Mountain regions have already experienced increased temperatures resulting in melting of the glaciers which, in turn, are linked to extreme events such as landslides and mudflows (IPCC, 2014). The majority of mountain communities depend on rainfed agriculture and traditional water sources such as natural springs and ponds for irrigation and drinking. Many water sources are diminishing as temperatures rise and rainfall becomes more erratic. One of the main concerns about the effects of climate change on mountain ecosystems is the present and future of water flows and bodies, both for their availability and their quality.

What are the climate vulnerability and impacts on forest ecosystems and communities?

Forests are vulnerable to climate change and implementing forest adaptation measures can reduce the negative impacts for both forests and communities. Rainfall variability and changes in rainfall pattern are likely to affect different forest types based on their water requirements for growth. Climate change is expected to cause significant shifts in the distribution of tropical forests and disturbance patterns. Non-climatic pressures, such as forest conversion and fragmentation, increase the vulnerability of tropical forests. Deforestation, caused by the conversion of forest land to agriculture and livestock areas, threatens not only the livelihoods of forest communities and indigenous peoples but also the biodiversity. Land-use changes result in loss of valuable habitats, land degradation, soil erosion, decrease in clean water and release of carbon into the atmosphere. How to increase agricultural production and improve food security without reducing forest area is one of the great challenges of our times especially in developing countries (FAO, 2018). This is because of the relatively low inputs into agriculture (fertilisers, improved seed varieties, mechanisation, sustainable land management interventions, etc.) that often result in low productivity per hectare with farmers expanding their fields into forest areas as a way to augment farm productivity.

3.3 Forests and ecosystem services

What are the ecosystem goods and services delivered from the forests?

Forest ecosystems are diverse across the globe and play an important role for climate change adaptation to forest-dependent communities by providing ecosystem goods and services. Forest products act as safety nets for local communities when agricultural crops fail due to climatic events and other factors. Hydrological ecosystem services (e.g. base flow conservation, storm flow regulation and erosion control) are of utmost importance for buffering the impacts of climate change on water users. Many communities live in forests and depend on forest derived products and ecosystem services. Agriculture is a common livelihood strategy in forest ecosystems. Forests and trees conserve and regulate soil, water and microclimate in agricultural lands. Forests directly contribute to the livelihoods of more than 1.6 billion people in 2018 and around 40% of the rural poor live in forest and savannah areas (FAO, 2018). Additionally, more than 75% of the world's freshwater for agriculture, domestic, urban, industrial and environmental use comes from forests (FAO, 2018). Forests also act as carbon sinks – a mitigation potential that reduces the amount of carbon dioxide in the atmosphere.

3.4 EbA measures in mountain and forest ecosystems

What are the EbA measures in the mountain and forest ecosystems?

Given the serious threats to mountain and forest ecosystems posed by climate change, EbA can help promote climate change adaptation for both ecosystems and people. The EbA interventions suitable for mountains can vary depending on altitude, topography and local livelihoods. Possible EbA measures that can be implemented in mountain ecosystems include (Swiderska et al., 2018):

- **Water conservation and management: formation of terraces** - Slow-forming terraces can be constructed from a combination of infiltration ditches, hedges and walls of earth or stone. The terraces reduce surface runoff and increase water infiltration; they are used to reduce erosion, increase soil moisture and retain organic and mineral fertilisers in order to improve conditions for agricultural production.
- **Agroecology and diversification** – Crop diversification can be done through an introduction of new cultivated species and improved varieties in order to enhance the productivity, quality, health and nutritional value of the plant and increase the resilience to pests, diseases and climate change. Agroecology has multiple benefits such as improving yields and increasing resilience to drought, pests and diseases.
- **Restoration** - Reforestation of degraded/deforested areas with appropriate indigenous (local) and/or exotic tree species creates a wide range of benefits, for instance stabilised land that decreases risk of landslides.
- **Agroforestry** - Agroforestry is the production of trees and non-arboreal crops or animals on the same plot of land. Agroforestry can increase the land productivity and at the same time improve the resilience of agricultural production through the use of trees for the intensification and diversification of agricultural systems.

TEACHING MATERIALS

Ecosystem-based adaptation: a handbook for EbA in mountain, dryland and coastal ecosystems.

Type of material: Handbook	**Organisation:** UNEP-IEMP and IIED	**Year:** 2018

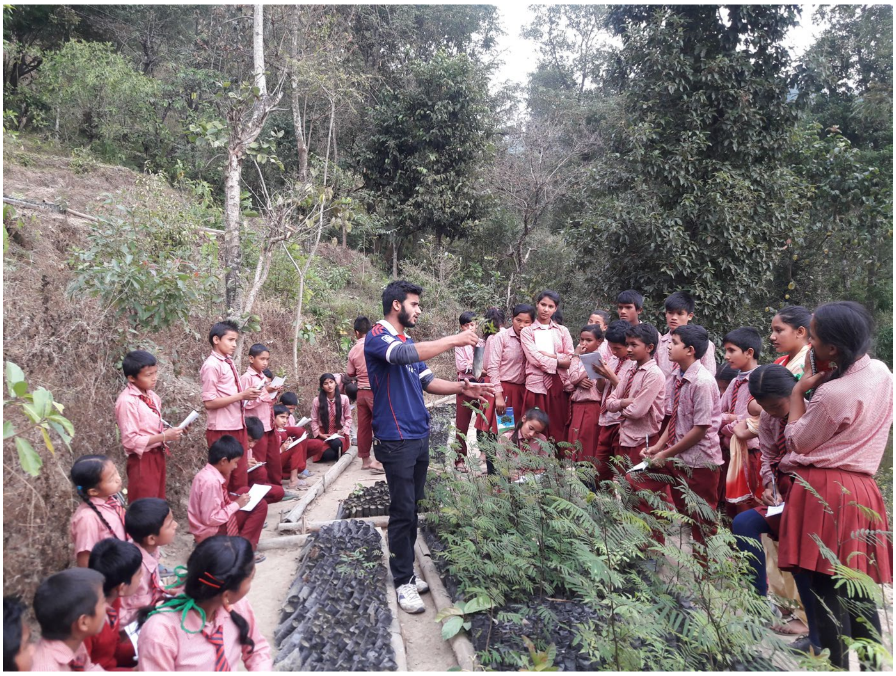
The handbook provides practical guidance for EbA in mountains, drylands and coastal zones. For each type of ecosystem, it sets out the steps to take when planning and implementing EbA interventions in order to increase the resilience of vulnerable people through ecosystem management and biodiversity conservation. The handbook provides links to useful resources and tools (both generic and ecosystem-specific) for each step in the project cycle.

A creative approach to environmental education. A teaching resource kit for mountain countries

Type of material: Toolkit	**Organisation:** UNESCO	**Year:** 2010

The kit includes a manual for teachers and an activity book to be completed by pupils, using a fun and engaging approach so that 10 to 15 years old living in mountainous areas can learn about their environment and its specific issues, such as soil erosion. Its contents have been designed as part of the activities for the United Nations Decade of Education for Sustainable Development (2005-2014). The kit is available in English, Spanish and French.

Mountain ecosystem services and climate change: a global overview of potential threats and strategies for adaptation		
Type of material: Report	**Organisation:** UNESCO	**Year:** 2017
This publication presents a review of potential climate change and anthropogenic pressures on mountain ecosystem services, particularly focusing on water resources scarcity and increasing water demand due to rapid increases of population and use of mountain ecosystem services. Adaptation strategies are also presented.		
The State of World Forests 2018		
Type of material: Report	**Organisation:** FAO	**Year:** 2018
The report seeks to examine evidence about the contribution that forests and trees – and the people who use and manage them – can make to sustainable development. It also identifies information and data gaps and areas where more work is needed to improve understanding of these interlinkages. The objective is to strengthen forest pathways to sustainable development as part of the transformational change needed to implement the 2030 Agenda. The report can be used as supplementary information to create factsheets for the module.		



Module 4: EbA in marine and coastal ecosystems

MODULE INFORMATION

Objective: Module 4 presents the key ecosystem services from marine and coastal areas and addresses how climate change affects coastal ecosystems and why they are so vulnerable. It further addresses how climate change and other non-climatic factors affect marine and coastal ecosystems and what the potential EbA solutions are.

Learning goals: Overall learning goal for this module is that students will be able to identify key ecosystem services delivered by coastal areas, the climate impacts on ecosystems and people in these areas. Students will understand the importance of ecosystems in reducing the vulnerability and risks of disasters using EbA solutions. Specifically, students will be able to:

Primary level **(P)**	• Indicate the key benefits from coastal – marine ecosystems
Secondary level **(S)**	• Define the key ecosystem services delivered by marine and coastal areas and how they relate to human well-being • Determine key climate change risks for marine and coastal ecosystems and communities living there
Undergraduate level **(U)**	• Broadly understand concepts and principles about sea water chemistry, climate change effects on oceans and coastal areas, how ecosystems and their services are affected • Define potential EbA solutions to increase the resilience of ecosystems and communities

MODULE CONTENT

Key topics	P	S	U
4.1 Marine and coastal ecosystems			

Why marine and coastal ecosystems are important for human well-being?

The marine and coastal ecosystems are important for people and the planet. More than one-third (37%) of the world's population live in coastal zones in 2017. The marine and coastal areas have biological, social and cultural importance for people. Coastal wetlands, such as marshes, mangroves and forested swamps, provide multiple benefits to the coastal populations and the biodiversity. Healthy coral reefs are among the most biologically diverse ecosystems and provide important services to coastal communities. Both mangroves and coral reefs provide a range of critical ecosystem services. Beyond basic food products, coastal and marine ecosystems also recycle nutrients, provide habitats to migratory birds, regulate natural risks, protect against floods and sustain spiritual and cultural values, including recreation and tourism.

Mangrove forests exist in 123 countries and cover more than 150,000 km^2 globally (Spalding et al., 2010). They provide multiple provisioning services not only acting as habitats for fish nurseries, which support food security for coastal communities, but also a source for timber and medical purposes (UNEP, 2006). On the other hand, mangrove forests provide regulating services and act as a natural defence of the coastal zone against inundation and erosion from waves, storms or sea level rise (UNEP, 2006; MEA, 2005). Mangrove forests also provide cultural ecosystem services to coastal populations, including recreation services (tourism, recreation, education) and spiritual services (cultural heritage, aesthetics, sense of place) (UNEP, 2006; MEA, 2005).

Coral reefs provide spawning and nursery grounds that are important for fish populations. At least 500 million people rely on coral reefs for food, coastal protection and livelihoods (Wilkinson et al., 2014). Coral reefs provide regulating services by forming natural barriers that protect nearby shorelines from the waves, thereby protecting coastal livelihoods, agricultural land and beaches. More than 150,000 km of shoreline in 100 countries and territories receive coastal protection from coral reefs (Burke et al., 2011).

4.2 Climate impacts and vulnerability of marine and coastal ecosystems

What are the climate vulnerability and impacts on marine and coastal ecosystems and the communities?

In spite of the important role that marine and coastal ecosystems have for sustaining and protecting communities, these ecosystems are among the most threatened in the world. Both climatic and non-climatic causes are responsible for the degradation of these ecosystems. At present, nearly 75% of reefs are threatened by climate change, destructive fishing, pollution and unsustainable tourism (Burke et al., 2011). Climate change results in increased temperatures, causing ocean acidification and as a result increased coral bleaching.

Although mangrove ecosystems are valuable for coastal communities and biodiversity, they are being destroyed at alarming rates. Human threats to mangroves include overexploitation of forest resources for agriculture, aquaculture, salt extraction, urban development and infrastructure. The greatest human threat to mangroves is the establishment of shrimp aquaculture ponds. Climate change is another factor that threatens mangroves, specifically changes in temperature, CO_2, precipitation, storms and sea level rise. Sea level rise is the greatest climate change challenge for mangrove ecosystems (IUCN, 2006).

The people dependent on marine and coastal ecosystems will be directly affected negatively due to reduced food provision. Moreover, sea level rise can cause coastal flooding and loss of livelihoods. Extreme weather events such as storms, flooding and heat waves impact on both aquatic and land-based coastal resources.

4.3 Examples of EbA measures in marine and coastal ecosystems

What are EbA measures for marine and coastal areas?

EbA practices can improve the resilience of coastal ecosystems, produce more ecosystem services to help coastal people have better livelihoods, increase their adaptive capacity and reduce exposure to certain climatic hazards. Examples of EbA solutions for the marine and coastal ecosystems and the communities include (Swiderska et al., 2018):

- **Dune and beach restoration and conservation (dune stabilisation)** - Rehabilitation of dunes refers to the restoration of natural or artificial dunes from a state of greater deterioration. The construction of artificial dunes and the rehabilitation of dunes are aimed at reducing both coastal erosion and flooding in the adjacent lowlands, therefore reducing the impacts of erosion and providing coastal habitats for many plants and animals.

- **Restoration and conservation of mangrove and other coastal habitats** - Restoration and conservation of mangroves and other habitats, such as marshes and seagrasses, aim to provide a natural barrier against coastal erosion and flooding by absorbing wave energy, reducing flooding and capturing sediment. It can also contribute significantly to the conservation of biodiversity.

- **Coral reef restoration and conservation** - Rehabilitation and restoration of coral reefs help the recovery of a coral reef ecosystem that has been degraded, damaged or destroyed, through partial or total replacement of a structural or functional feature of a reef system. As a result, this improves the structure and functioning of the ecosystem and increases productivity (e.g. for fishing).

TEACHING MATERIALS

Indian Ocean Factsheet: Communicating the Economic and Social Importance of Coral Reefs for Indian Ocean Countries South East Asia Factsheet: Communicating the Economic and Social Importance of Coral Reefs for South East Asia Countries Caribbean Factsheet: Communicating the Economic and Social Importance of Coral Reefs for Caribbean Countries		
Type of material: Factsheets	**Organisation:** International Coral Reef Initiative	
The factsheets provide key facts regarding the importance of coral reefs for Indian Ocean countries, South East Asia countries and Caribbean countries. These factsheets can be used to complement lesson materials providing specific information regarding the state of coral reefs and their social and economic importance for island and coastal communities.		
Options for Ecosystem-based Adaptation (EbA) in Coastal Environments: A Guide for environmental managers and planners		
Type of material: Guidebook	**Organisation:** UNEP	**Year:** 2016
The guidebook focuses on taking account of and managing ecosystems to help people adapt to climate change in coastal areas, i.e. coastal EbA. It aims to provide a broad understanding of the principles and concepts of coastal EbA, present a range of different coastal EbA options with existing examples, and discuss the issues and challenges that need addressing in EbA implementation.		
Coral reef resilience and resistance to bleaching		
Type of material: Report	**Organisation:** IUCN & TNC	**Year:** 2006
This report summarises scientific knowledge on coral reef resistance and resilience to bleaching, a possible major effect of climate change. It provides a brief overview of coral bleaching and what is meant by resistance and resilience, highlights a variety of resistance and resilience factors. It also gives an overview of the tools and strategies that can be used to enhance coral reef resilience.		

Managing mangroves for resilience to climate change		
Type of material: Report	**Organisation:** IUCN & TNC	**Year:** 2006
This report provides key considerations for conservation practitioners as they design conservation strategies for mangroves. It provides a brief overview of the threats to mangrove forests. It also gives an overview of the tools and strategies that can be used to enhance mangrove resilience.		

Coastal Ecosystem-based Adaptation	
Type of material: Website	**Organisation:** UNEP
The website aims to provide a broad understanding of the principles and concepts of coastal EbA. It presents a range of different coastal EbA options with existing examples and key resources, as well as discusses the issues and challenges that need addressing in EbA implementation.	

Reef Resilience Network	
Type of material: Website	**Organisation:** Reef Resilience Network, led by TNC
The website provides free online courses on strategies for managing coral reefs in a changing climate. Some of the courses are available in three languages: English, Spanish and French. The programme also frequently hosts webinars on new management techniques, current events and publications that are relevant to coral reef managers and practitioners.	

Module 5: EbA in dryland ecosystems

MODULE INFORMATION

Objective: Module 5 focuses on the key ecosystem services provided by dryland ecosystems and why they are vulnerable. It further addresses how climate change and other non-climatic factors affect drylands and what the potential EbA solutions are.

Learning goals: Overall learning goal for this module is that students will be able to identify key ecosystem services delivered by drylands and how vulnerable they are to climate and non-climate factors. Students will understand the importance of ecosystems in reducing the vulnerability and risks of disasters using EbA solutions. Specifically, students will be able to:

Primary level **(P)**	• Indicate the key benefits from dryland ecosystems
Secondary level **(S)**	• Define the key ecosystem services delivered by dryland areas and how they relate to human well-being • Determine key climate change risks for dryland ecosystems and communities living there
Undergraduate level **(U)**	• Broadly understand concepts and principles about dryland areas, climate change effects on dryland ecosystems, how ecosystems and their services are affected • Define potential EbA solutions to increase the resilience of ecosystems and communities

MODULE CONTENT

Key topics	P	S	U
5.1 Dryland ecosystems			

Why dryland ecosystems are important for human well-being?

Dryland ecosystems cover 40-45% of the land surface and are inhabited by more than 2 billion people (UNCCD, 2017). Key characteristics of dryland ecosystems include low rainfall and high evaporation, hence limited soil moisture. Drylands can be divided in four dryland subtypes, i.e. dry sub-humid, semiarid, arid and hyper-arid. This classification is made on the basis of level of aridity and moisture deficit.

Extensive livestock production systems in drylands support the livelihoods of farmers and pastoralists by an array of provisioning services. Examples of such ecosystem services include the provision of spring water, food products and fuels (Adeel et al., 2005). Regulating and supporting services ensure that water and nutrient cycles are well regulated. Water regulation is the overarching dryland ecosystem service. Dryland ecosystems also provide cultural services that are important to livelihoods and recreational and spiritual values.

5.2 Climate impacts and vulnerability of dryland ecosystems			

What are the climate vulnerability and impacts on dryland ecosystems and communities?

Drylands are characterised by extreme climates and are vulnerable to climate change. Existing water shortages in drylands are projected to increase over time due to population increase, land cover change and global climate change. Some of the climate change impacts on drylands have already been observed such as shifts in seasons and increased drought (IFAD, 2016; Pedrik et al., 2012). Along with the climate change risks, another issue of greatest concern is land degradation in the drylands.

5.3 Examples of EbA measures in dryland ecosystems			

What are EbA options for the dryland ecosystems?

EbA interventions in drylands should be based on the knowledge and experiences of people living there. Following are examples of EbA measures in drylands (Swiderska et al., 2018):

- **Implementation of traditional water and land management practices** - The objective is to manage the uneven spatial and temporal distribution of water. Traditionally, dryland communities have used practices involving harvesting rainwater during rainy seasons. The practices include large terraced systems, subsurface dams, gravity-fed channel and tank systems.
- **Conservation/restoration of landscapes** - The practices for conservation of resilient vegetation and tree planting include reforestation, agroforestry and arboriculture. For sand dune stabilisation, an EbA option of using plants compares favourably to other methods (e.g. using concrete).

TEACHING MATERIALS

[A creative approach to environmental education. A teaching resource kit for dryland countries]

Type of material: Toolkit	**Organisation:** UNESCO	**Year:** 2008

This environmental education kit for dryland countries is intended for secondary (and late primary) school teachers and their pupils in countries affected by desertification. The kit offers a creative approach to environmental education and is designed to elicit pupils' curiosity, appeal to their artistic sensibilities and provide leverage for better transmission of scientific information and environmental knowledge. Free online versions are available in Arabic, English, French and Spanish.

[Global Drylands Initiative](#)

Type of material: Website	Organisation: IUCN

This is the webpage of the Global Drylands Initiative, which has the goal to restore, sustainably manage and protect dryland ecosystems for multiple environmental, economic and social benefits. The Initiative supports countries to adapt ecosystem management policy and practice to the unique conditions of the drylands and to the evolving challenges that the drylands face. The webpage includes activities under the initiative and its publications.

Climate change mitigation and adaptation in drylands: actions by Drynet members

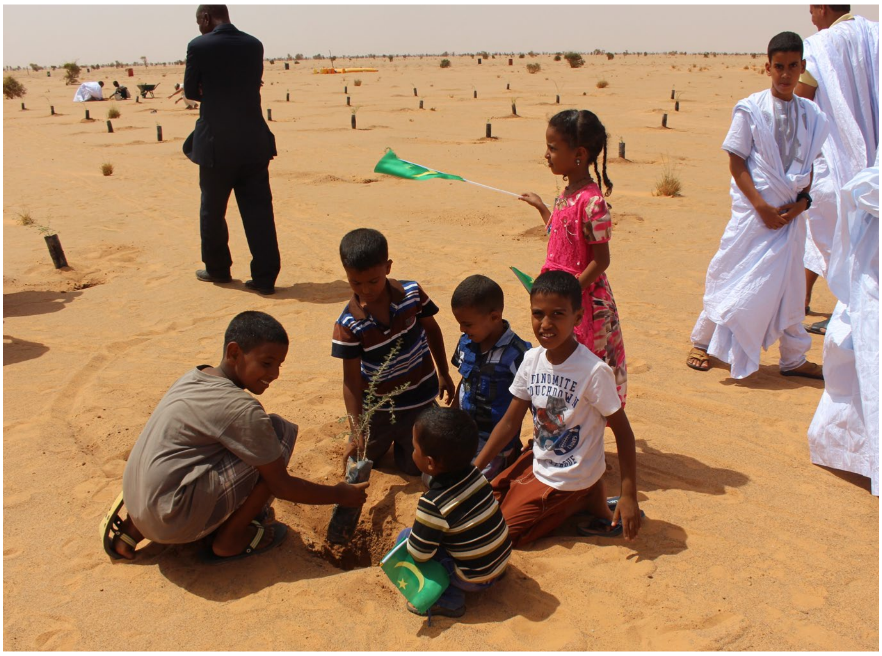
Type of material: Report	**Organisation:** Drynet	**Year:** 2015

This report compiles examples from the projects implemented by Drynet members together with local communities to demonstrate a range of sustainable land use strategies that are based on local adaptation to climate change, adoption of more sustainable practices and innovation. They demonstrate ways of producing food and improving incomes while safeguarding agricultural heritage, protecting (agro) biodiversity, conserving and restoring soils, and adapting to climate change.

Synthesis Report on Experiences with Ecosystem-Based Approaches to Climate Change Adaptation and Disaster Risk Reduction

Type of material: Report	**Organisation:** Convention for Biological Diversity (CBD)	**Year:** 2016

The report presents examples of how both EbA and Eco-DRR are being addressed nationally, regionally and globally, drawing from a wide variety of contexts (environment, conservation, humanitarian and rural and urban development). Challenges in implementation and lessons learned, opportunities for synergies and areas for further research are discussed.



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ANNEX 1: GLOSSARY OF TERMS

Climate change - Refers to a change in the state of the climate that can be identified (i.e. by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces, such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC, 2014:4).

Climate change adaptation - Adjustments in natural or human (social and economic) systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2014:4).

Ecosystem - A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit where humans make an integral part (UN, 1992). Ecosystems can be categorised by a set of biological (e.g. species composition, surface cover), climatic (e.g. climatic zones), social (e.g. land use, resource management) factors.

Ecosystem approach - A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It recognises that humans, with their cultural diversity, are an integral component of many ecosystems (CBD, 2014).

Ecosystem-based Adaptation (EbA) - An approach that integrates the use of biodiversity and ecosystem services into an overall adaptation strategy. It can be cost-effective and generate social, economic and cultural co-benefits and contribute to the conservation of biodiversity. EbA includes the sustainable management, conservation and restoration of ecosystems to provide services that help people adapt to the adverse effects of climate change (CBD, 2009).

Ecosystem functioning - Ecosystem functions are the ecological (biological, chemical and physical) mechanisms that support the integrity or maintenance of ecosystems. Ecosystem functions, such as primary production or decomposition, result from interactions between ecosystem structures and processes (Ansink et al., 2008).

Ecological processes - The complex interactions between the biotic and abiotic elements of ecosystems that underpin fluxes of information (e.g. stimuli), energy (e.g. sunlight) and matter (e.g. nutrients, gases, water) (Mace et al., 2012).

Ecosystem services - The benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other non-material benefits (MEA, 2015).

Resilience - The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation (IPCC, 2014).

Vulnerability - The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC, 2014). **Sensitivity** is the degree to which a system is affected, either adversely or beneficially, by climate change, either directly or indirectly. **Adaptive capacity** is the ability of a system to adjust to climate change, to moderate potential damage, to take advantage of opportunities, or to cope with the consequences. The combination of exposure and sensitivity to climate change also determines the potential climate change impact (IPCC, 2014).

ANNEX 2: RESOURCES FOR TEACHING

Manuals and resource kits

Climate Change Starter's Guidebook: An Issue Guide for Education Planners and Practitioners

Type of resource: Guidebook

The aim of this guide is to serve as a starting point for tackling and mainstreaming climate change education into school curriculum. The document has been created to enable education planners and practitioners to understand the issues at hand and to review and analyse their relevance to particular national and local contexts.

Climate Change and Environmental Education: A Companion to the Child Friendly Schools Manual

Type of resource: Guidebook

This guidebook provides in-depth information on how climate change and environmental education can be integrated into the design, implementation and practice of child-friendly schools, including reorienting existing curriculum.

Education Kit on Climate Change and Child Rights - How to Defend Child Rights Affected by Climate Change: A Teacher's Guide for Exploration and Action with Children 11-16 Years Old

Type of resource: Toolkit

This toolkit was developed for use in industrialised countries for exploration and action activities with young people on the issue of climate change and its impact on child rights. It can be used in different school subjects, such as geography, citizenship education, science, mathematics and language(s).

Teaching and Learning for a Sustainable Future: A Multimedia Teacher Education Programme

Type of resource: Multimedia programme

This education programme provides professional development for curriculum developers on education for sustainable development. It includes a section on curriculum rationale and a section on integrating sustainable development across the curriculum. Module 19 focuses specifically on climate change. The contents can be adapted to different national and regional contexts.

Online training and education materials

Nature Detectives - This website provides a range of outdoor activities for different age groups to stimulate interest and curiosity in the surrounding nature.

TEEB Training Resource Material - These pages show material developed within the Economics of Ecosystems and Biodiversity project (TEEB). The training package is tailored for national level implementers and practitioners. Also included in the training package is an overall document for guidance on training implementation.

TEEB@YALE Lecture Series - Contributing authors to the TEEB reports and other experts taught a graduate-level course related to valuation at Yale University in 2011. The whole series of lectures can be viewed on these pages.

WBCSD's Business Ecosystems Training (BET) course - The course is a freely-available capacity building programme to increase the knowledge and understanding of the links between ecosystems and business.

Training on Valuation and Mainstreaming of Biodiversity and Ecosystem Services - This online training is developed by Conservation Training – a free learning community that offers conservation-based training materials from The Nature Conservancy and other partners.

The Economics of Land Degradation Massive Open Online Course (ELD MOOC) – This free online course focuses on the economic dimension of land degradation and sustainable land use management, and on how the foundations of ecosystem services assessments can be communicated to a wide range of stakeholders.

NOS Education - The National Ocean Service (NOS), which is part of the US National Oceanic and Atmospheric Administration (NOAA), has developed this platform with training material on ocean, coastal and climate issues for students and teachers. It contains several components related to ecosystem services.

The Conservation Bridge - The purpose of this material, developed by Cornell University, is to bring real life cases into education on ecosystem services. Teachers can help build case studies, choose existing case studies to use in their courses, and assign students to answer practitioner-directed questions. A workspace is provided that allows students to collaborate with each other and with practitioners to answer research questions.

ECOSYSTEM-BASED ADAPTATION THROUGH SOUTH-SOUTH COOPERATION

Enhancing Capacity, Knowledge and Technology Support to Build Climate Resilience of Vulnerable Developing Countries

ebasouth.org

UNEP

International Ecosystem Management Partnership

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