Ecosystem-based Adaptation (EbA)

"Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change."

CBD 2009

I Introduction and Institutional Background

People worldwide depend on functioning ecosystems and the services they provide, such as soil fertility, clean water and food. This is especially true for poor people in developing countries, whose livelihoods are closely linked to natural resources. Climate change is one of the major causes of changes and deterioration in ecosystem services and its impact will most likely increase in the future (Millennium Ecosystem Assessment 2005). At the same time, functioning ecosystems help people to mitigate and more importantly to adapt to climate change – this is referred to as "ecosystem-based adaptation" (EbA). For instance, moors act as natural water storages, buffering increasing amounts of sudden rainfalls and mangroves act as natural barriers against storms and floods in coastal regions. In the UK, for example, more than 3.000 ha of farmland were converted back into moors and wetlands as a means of reducing flooding events.[1]

History of EbA

While humans have always benefited from nature and used ecosystem services to adapt to changing conditions, the concept of EbA is fairly new. The related "ecosystem based management" rose in relevance and gained support after the Millennium Ecosystem Assessment (2005). The idea of ecosystem-based adaptation originally arose in NGO and intergovernmental organization circles as "natural solutions to climate change".

1 www.greatfen.org.uk

EbA has evolved into an important link between the three Rio Conventions: the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD) and the United Nations Convention to Combat Desertification (UNCCD). Of the three Rio conventions, the CBD concerns itself the most with EbA. Parties to the **CBD** first committed to adaptation activities during COP 5 held in 2000. In particular, decision V/3 on marine and coastal biodiversity included adaptation to climate change within the framework of 'priority areas for action on coral bleaching'. Another important milestone is the agreement on the Aichi Biodiversity Targets in 2010, which include the commitment to minimize "the multiple anthropogenic pressures on vulnerable ecosystems" (target 10) and enhance "ecosystem resilience and the contribution of biodiversity to climate change mitigation and adaptation" (target 15). The concept of EbA was first introduced into the **UNFCCC** in 2008 at the COP 14, with the issue being pushed by NGOs such as IUCN, TNC and others. Under the Cancun Adaptation Framework (2010) parties are encouraged to build the resilience of ecological systems,

EbA in international environmental negotiations	
2000	First commitment of CBD parties to adaptation activities during COP 5
2005	Millennium Ecosystem Assessment highlights importance of ecosystem based management
2008/9	Concept of EbA introduced to UNFCCC COP 14
2009	CBD COP 9, Bonn Germany: decision on integrating climate-change activities within the programmes of work of the Convention
2010	Agreement on Aichi Biodiversity Targets under CBD Strategic Plan for Biodiversity 2011-2020

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

and slow onsetting events such as biodiversity loss, forest degradation and desertification are addressed. In this context, UNCCD has been engaged in enhancing the adaptive capacities of dryland populations to highly variable environmental conditions.

After several years of discussion on definitions and content, current efforts strive to provide information on the implementation and financing of EbA measures and to fill knowledge gaps on the links between climate change and biodiversity (see recent decisions at CBD COP 10). A database on EbA approaches was mandated in the context of the UNFCCC Nairobi work programme in 2011. Under the same programme a workshop on ecosystem-based approaches for adaptation is to be held in 2013 in cooperation with the CBD and UNCCD, which will consider the synergies and lessons learned through the implementation of the three Rio Conventions.

EbA in GIZ

The most important donors for EbA-related activities in Germany are the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Ministry for Economic Cooperation and Development (BMZ). Adaptation to climate change is part of the **BMZ** portfolio on "climate policy and climate financing" and of growing interest due to its strong interlinkage with poverty alleviation. Funding is mostly provided by the Energy and Climate Fund (EKF) and the International Climate Change Initiative (IKI). Within IKI the **BMU** has focused on the "green sector" since 2008 and EbA was consequently introduced to the funding portfolios as a priority area in 2010 and 2011 (see selection procedure).

In GIZ the implementation of EbA varies from EbA as a cross-sectoral issue in mainstreaming adaptation to climate change into development to single EbA components, measures or specific EbA projects. Already several ongoing GIZ projects practice EbA measures in the context of natural resource management without labelling them as such (see section "Must haves and nice to haves").

In general, the EbA approach under the **BMZ** is usually part of a broader adaptation strategy, visible in EbA components in **mainstreaming** or pilot projects. For example in the project "Capacity Building for Collaborative Management of Coastal Wetlands in Soc Trang" in Vietnam, EbA is mainstreamed within cross-sectoral cooperation while further local measures for wetlands conservation have been piloted.

EbA projects commissioned by the **BMU**-IKI are generally **projects** with a specific focus on EbA measures for climate change adaptation. Examples include projects such as "Coastal and marine biodiversity and capacity development for adaptation to climate change" in Costa Rica, "Biodiversity and climate change in the Atlantic Forest Biome in Brazil" and the currently planned "Flood and drought prevention through ecosystem-based adaptation in watersheds" project in Thailand.

EbA related GIZ projects

In February 2012 over 40 EbA related projects have been registered – with the number still growing.

EbA projects are distributed around the globe; however currently predominant regions are Asia, the Pacific and Latin America.

Most frequent 'sectors' in which the projects are implemented are "Biodiversity and Natural Resource Management", "Adaptation to Climate Change" and "Water". The ecosystems mainly concerned are forest, coastal and marine ecosystems, but agricultural and mountainous ecosystems as well as wetlands and inland waters are among the project sites as well.

Overview of EbA promoting institutions at international level

A large number of actors have taken up EbA in their measures and approaches and their numbers are steadily growing as awareness for EbA is increasing. These range from donors, international, national and regional NGOs, to implementing agencies, research institutions and global networks.

Some actors have integrated EbA as a core activity. The International Union for the Conservation of Nature (**IUCN**), Conservation International (**CI**), the Centre for International Forestry Research (**CIFOR**) and the Nature Conservancy (**TNC**), for example, support various projects, research studies and mainstreaming of EbA. In response to the 2010 UNFCCC Cancun Agreements, a €10 million EbA flagship program in mountain ecosystems is being funded by the BMU (see above). The program was initiated as a joint effort with **IUCN**, **UNEP** and **UNDP** looking at the impacts



of climate change on Mountain Ecosystems in Nepal, Peru and Uganda and reducing their vulnerability by promoting EbA options.

The Ecosystems and Livelihoods Adaptation Network (**ELAN**) partnership (IUCN, **WWF**, **CARE**, **IIED**) is active in different areas: (1) informing policy (guidelines); (2) good practices; (3) capacity building (training materials and workshops); (4) strengthening science and knowledge; and (5) developing networks (see Social Networking Analysis Report 2011). Furthermore, a new 'EBA Decision Support Framework' is under development by UNEP and partners to assist national planners and decision makers select, design, implement and track EbA approaches as part of a wider adaptation strategy (Ecosystem based Adaptation Guidance).

Universities and research institutes like CIFOR, the International Centre for Tropical Agricultural Research and Higher Education (CATIE) and UN World Conservation Monitoring Centre (**UNEP-WCMC**) play an important role in the collection of evidence for EbA and filling knowledge gaps. Together with GIZ, for example, the Centre for Economics and Ecosystem Management at the Eberswalde University for Sustainable Development has developed the MARISCO methodology, which aims to assess the vulnerability of conservation sites. In coordination with the International Union of Forest Research Organizations (IUFRO), GIZ published the study "Enhancing Adaptation of Forests and People in Africa".

GIZ is also implementing EbA measures in cooperation with other international institutions such as "Strategies to Climate Change in Ecuador and Colombia" which is currently planned together with GIZ and IUCN. This is particularly applicable in the context of BMU-IKI projects.

II Concept and Methodology

Conceptual Background

Ecosystem-based adaptation was defined as reducing the vulnerability to climate change of people through the sustainable use and conservation of ecosystems. In contrast to common natural resources and biodiversity management approaches, EbA purposefully assesses and selects measures in the context of an overall **adaptation strategy**.

Although EbA measures use ecosystems to adapt to climate change, EbA still is an **anthropogenic approach** which particularly utilizes the ability of ecosystems to provide so called ecosystem services. They are also referred to as "Green Infrastructure" and can be seen as complementary to or substitutes of hard ("grey") infrastructural measures. For example, ecosystems are able to generate direct services such as food and building material, as well as indirect services like water purification or pollination. An overview of ecosystem services as described by The Economics of Ecosystems and Biodiversity, TEEB[2], is given in Table 1.

2 TEEB is a global Initiative hosted by UNEP: www.teebtest.org

Regulating Services	› Local climate and air quality regulation › Water regulation › CO_2 sequestration and storage › Moderation of extreme events › Wastewater treatment › Erosion prevention, maintenance of soil fertility › Pollination, biological control	Those services can influence the **exposure** of the human-environment system to the effects of climate change, particularly on the local level, and help to increase the **adaptive capacity** of ecosystems and reduce **ecological sensitivity**.
Supporting Services	› Habitats for species › Nutrient cycle › Photosynthesis › Maintenance of genetic diversity	
Provisioning Services	› Food, raw materials, fresh water, medicine	Those services support **societies in adapting** to climate change, and **reduce societal sensitivity** towards the negative effets of climate change.
Cultural Services	› Recreation, mental and physical health › Tourism › Aesthetic appreciation, inspiration of art culture and design › Spiritual experience and sense of place	

Table 1: Examples of Eco-System Services and their influence on the components of vulnerability

Soc Trang Region

Apart from the intended outcomes, EbA measures tend to generate additional **co-benefits** such as carbon sequestration or biodiversity conservation, improved livelihood conditions and are generally considered no-regret options.

To determine the specific requirements of maintaining or restoring an ecosystem and its services, EbA ideally draws on studies of climate change impacts or **integrated climate analyses**, which make use of climate scenarios and models.

Worldwide surveys have shown that restoration and conservation of ecosystems are generally very **cost effective** and highly profitable for maintaining ecosystem services. In comparison to the economic loss caused by loss of ecosystem services, the cost-benefit ratio of return of investment of appropriate restoration of ecosystems may be as high as 3 to 75, depending on the ecosystem context and the measures taken (UNEP 2010, 6). For example, a study in Vietnam shows that planting or maintaining mangrove forests to act as breakwaters for coastal protection is significantly cheaper (costing 1.1 million USD for 12,000 hectares) than mechanical repair of wave-induced dike erosion (costing 3.7 million USD annually) (IFRC: World Disasters Report 2002, 95).

Climate change manifests itself in many different ways, such as changed patterns in temperature, precipitation or seasons. Adaptation approaches therefore have to regard the interdependencies between the climatic, ecological, social and economic dimensions. The proposed EbA approach, being based on elaborate cause-and-effect chains, as explained in the following section, enables the **integration of adaptation benefits right from the planning phase.** Thus it is drawing adaptive capacity from ecosystem and ecosystem services as well as strengthening their resilience against climate change.

It is important to differentiate between utilizing ecosystem services for an adaptation purpose (EbA) and adapting ecosystems and ecosystem management to climate change in order to maintain their services (adaptation of ecosystems). The latter can be neccessary to sustain ecosystem services under the pressure of a changing climate.

Analytical Framework

EbA measures need to be founded on a sound analysis of the complex interdependencies between ecosystems, the flow of ecosystem services and dependent communities. In order to distinguish the cause-and-effect relationships of driving forces, pressures, states, impacts and responses within these spheres, the DPSIR conceptual framework[3] is being applied (see Figure 1).

3 The European Environmental Agency recommends the use of this framework for integrated environmental assessment.

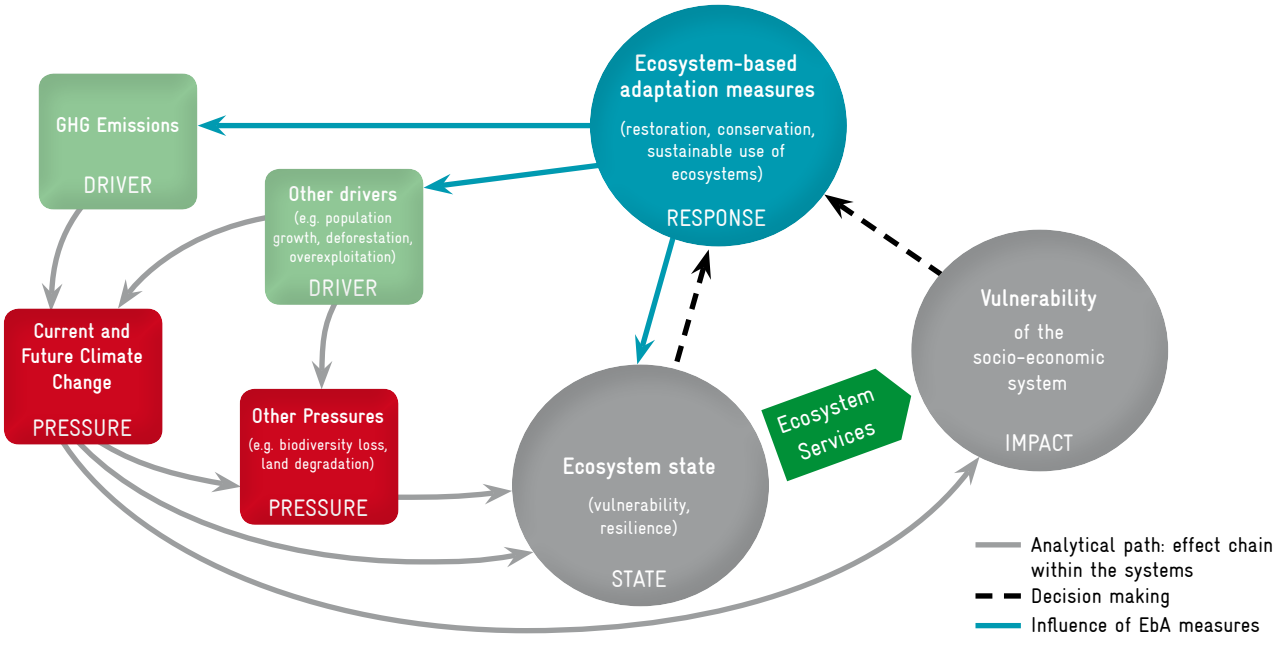

Figure 1: Analytical framework for EbA measures (adapted from the DPSIR framework)

Eroded foreshore, Vinh Tan, Mekong Delta

Hands-on school programmes create environmental awareness

In the following, this framework will be explained and illustrated with the aid of two GIZ projects from Vietnam. The example is simplified for better understanding.

The projects "Sustainable Management of Coastal Forest Ecosystems in Bac Lieu Province" (2009-2011) and "Management of Natural Resources in the Coastal Zone of Soc Trang Province"[4] (ongoing since 2007) contain exemplary EbA measures and have already shown positive results. Both projects support the protection of coastal zones through the restoration and management of coastal mangrove forests.

The **pressure of climate change** threatens the coastal regions of Vietnam with a sea level rise of up to 0.6 m by 2100, increased temperatures, changed seasonal patterns, and more intense and more frequent tropical cyclones. **Additional anthropogenic pressures** are economical (intensive rice farming, rapid expansion of lucrative shrimp farms directly bordering on mangrove sanctuaries), political (overlapping responsibilities and lack of administrational capacities of authorities) and social (poverty, lack of cooperation of different actors) causes.

In a healthy **state**, coastal mangrove forests provide nurseries and habitats for fish, molluscs, crustaceans, birds, insects, mammals and reptiles, protection of the landward zone, flood mitigation and stabilization of the groundwater level. The special root system of mangrove trees slows the water flow, traps sediment, thus stabilizing the soil and alleviating storm and wave damage. Further, they shelter bacteria which break down ammonium and nitrate, allowing for a higher stocking density of shrimps without the use of chemical additives and consequently reduce the total default risk. Their shade also helps to moderate heat spells in shrimp ponds. However, due to anthropogenic and climate-related pressures, the mangrove ecosystem is partially degraded and increasingly vulnerable, subsequently causing the ecosystem services to decline.

The **impact** is present in the decreased protection of settlements and agriculture, the receding shoreline, the advance of salty sea water further inland, causing groundwater and soil to become saline and eventually leading to hypersaline flats. In turn, the production of biomass as well as growth and seedling recruitment are declining, likely leading to a change in species composition. The continuous decline of mangrove forests and resulting salination of agricultural land pushes land use changes from rice to shrimp farming. The already little diversified local economy is even more at risk of income losses through shrimp epidemics.

As a **response**, in Vietnam the EbA measures focus on rehabilitation and conservation activities as well as the promotion of sustainable management practices. The rehabilitation of degraded coastal forests through afforestation and seedling protection restores declined ecosystem services. The indication of protected zones where logging and shrimp farming is not allowed, contributes to conserves the ecosystems. Further, management schemes for mangrove forests and shrimp farms have been introduced. They include fishing regulations and promote alternative income opportunities for local communities. These measures strengthen the resilience of local communities by reducing the drivers of ecosystem degradation and maintaining the ecosystem services.

4 http://czm-soctrang.org.vn/en/home.aspx

Helpful Documents on EbA

- BfN (2011): Ecosystem-based approaches to adaptation and mitigation – good practice examples and lessons learned in Europe.
- IUCN (2009): Ecosystem-based Adaptation: A natural response to climate change.
- Jones, Hole and Zavaleta (2012): Harnessing nature to help people to adapt to climate change, in Perspective. Nature climate change, 504-509.
- Proact Network (2008): The Role of Environmental Management and eco-engineering in Disaster Risk Reduction and Climate Change Adaptation.
- UNEP, SREP (2012): A comparative analysis of ecosystem-based adaptation and engineering options for Lami Town, Fiji.
- UNEP (2012): Ecosystem-Based Adaptation Guidance, Moving from Principles to Practice.
- UNEP, UNDP, IUCN, BMU (2012): Making the case for ecosystem-based adaptation. Building resilience to climate change.
- Worldbank (2009): Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change.

Mainstreaming of EbA

The **EbA mainstreaming cycle** explains how to integrate EbA into a project, policy or planning process. Following the different steps is closely related to the step-by-step approach of the tool "Climate Proofing for Development", pinpointing the particularities of EbA. Figure 2 visualizes the EbA mainstreaming cycle and gives some examples of tools, methods and approaches that can be utilized at each step (still work in progress). In the beginning, the exposure unit (region, sector, etc.) is screened by **applying a climate lens**. To be able to sustain development efforts also in a context of climate change, adaptation needs are being assessed in step 2. **The vulnerability assessment** considers exposure, sensitivity and adaptive capacity. To identify interdependencies the DPSIR framework can be of help. EbA specifies are most prominent in the following steps: **identification, selection and implementation of adaptation options**. In step 3 EbA options should be considered next to other adaptation options. In step 4 decision makers will need arguments for choosing EbA measures. A proactive communication concept for EbA will be helpful in familiarizing stakeholders with potential advantages. Once EbA options have been chosen another question arises for the implementation (step 5). Only functioning ecosystems and their services can be used for the purpose of adaptation. However, they are often affected by anthropogenic pressures and there might be additional threats from climate change which are becoming more and more important. Thus, within an EbA approach, activities to adapt ecosystems to the effects of climate change can be of importance to secure the EbA options which have been chosen. The **evaluation** concludes the cycle. **Monitoring** instead is a process coherent in every stage (see "Adaptation made to measure").

III EbA in Practice

Must haves and nice to haves

The knowledge on EbA implementation is constantly being refined and complemented. While some elements in project design are seen as a necessity in EbA measures and must be included ("**must haves**"), others are additional steps that complement the measure ("**nice to have**"), a categorisation which is still to be elaborated further. In the following, EbA "must haves" and "nice to have" will be explained with the aid of a concrete project example, the project "Adaptation to climate change by promoting the biodiversity in province Bac Lieu", Vietnam". The Mekong Delta was identified by the Worldbank and the IPCC as one of the regions most threated by climate change. Different climate scenarios predict increasing flooding events, tropical storms, a rise in sea level and soil salination in the near future. At the same time, natural protection systems against these threats, such

Table 2: EbA "Must haves", Example: Adaptation to climate change by promoting the biodiversity in province Bac Lieu

EbA as a part of an overall adaptation strategy	The project is part of the Vietnamese national program on wet areas and the Framework Action Plan on Climate Change Adaptation. This ensures that results are integrated and institutionalized.
Data on future climate change; climate scenarios	The project did not need to collect its own climate data or modelling, since elaborate studies on the impact of climate change in Vietnam and the Mekong Delta had already been available.
Vulnerability analysis (quality standards)	Vulnerability analyses were carried out by various organizations beforehand, whose results are used by the project. These identified the rural poor and the agricultural sector as the most vulnerable.
Territorial and cross-sectoral approach and participation	Key products target different sectors and promote an integrated approach at both national and local levels: Coastal Management strongly influences the local economy of rice and shrimp farming which again effects land use and land use change in coastal areas. This again is interlinked to water management and public policies. Decentralized land-use planning, co-management, training on the local level and the involvement of stakeholders from administration, industry and civil society promote cross-sectoral planning and participative decision making.
Respect the 12 principles of the ecosystem approach	With its aim of sustainable resource management, participatory character and inclusion of different sectors and decision-making levels, the projects heeds the CBD's ecosystem approach principles.

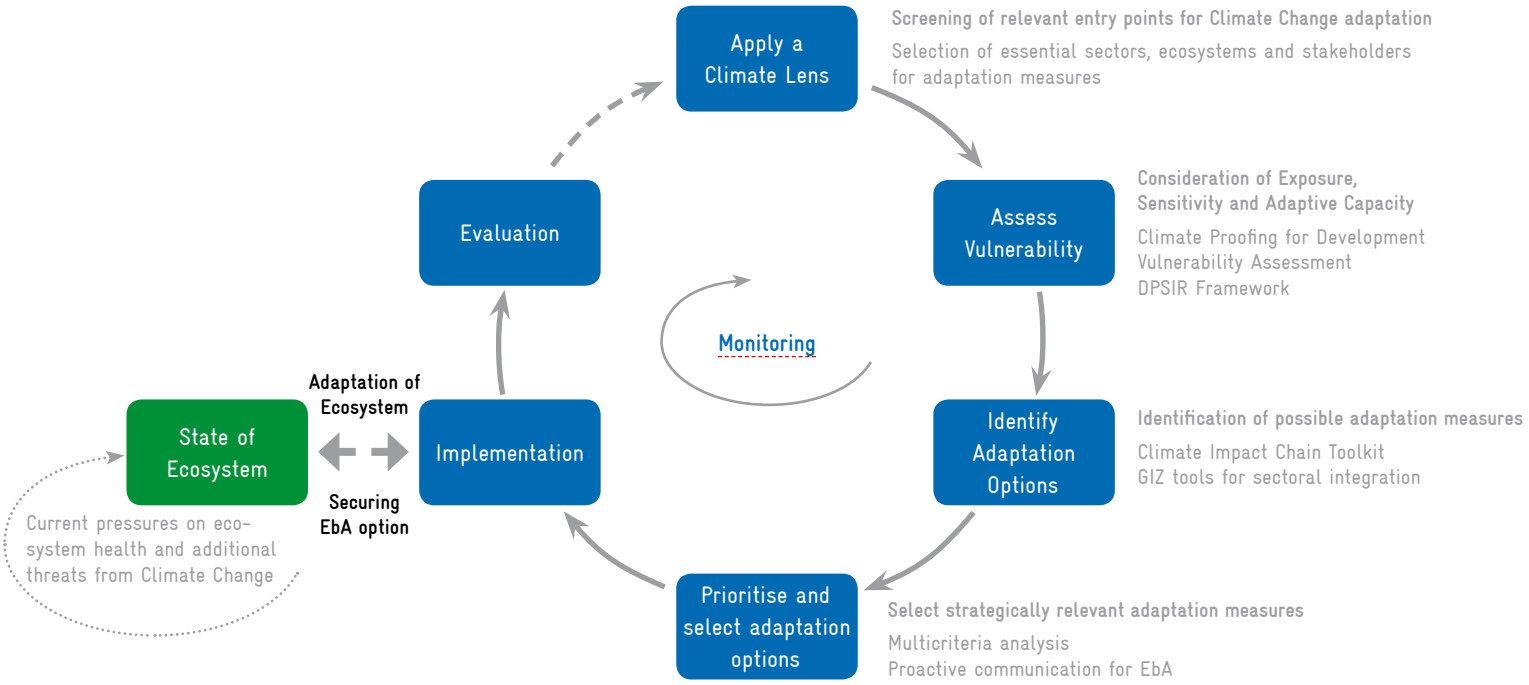

Figure 2: EbA Mainstreaming Cycle, EbA components and respective tools (work in progress)

as mangrove forests, are heavily degraded through intensive monocultures, shrimp farming and unsustainable use of resources. The main objective of the project is to increase the protective function of the coastal forests through sustainable resource management and the promotion of biodiversity.

Moreover, additional complementary measures can be taken, so-called "nice to haves". These include:

- **Quantification of ecosystem services and cost-benefit analyses** (for more information see manual Integrating Ecosystem Services into Development Planning).
- **Examples for opportunity costs (EbA ⇔ infrastructure measures)**: Mangrove reforestation and renaturation, for example, greatly reduces costs of dike construction and maintenance.
- **Sustainably functioning financing mechanisms, for instance Payments for Ecosystem Services** (PES): landowners and users are offered monetary or non-monetary incentives in exchange for managing their land to provide certain quantity or quality of ecosystem services, e.g. payments of downstream river users to upstream users for proper waste management to reduce river pollution.

Bearing these aspects in mind when designing and implementing an EbA project is an important step towards avoiding pitfalls, such as the accidental introduction of non-native invasive species, inadequate integration of stakeholders and socio-economic issues or improper and partial restoration resulting in monocultures with little ecosystem service capacity.

EbA measures

The implementation of EbA measures can be based on either a certain ecosystem service (e.g. water retention), part of an ecosystem or one or several ecosystems. Each sector, on the other hand, should regard its relevant ecosystem services and the underlying ecosystems in the water sector, for example groundwater recharge can be provided by a range of ecosystems such grassland, peatlands or rivers. All of those should be included in the process of selecting the best measures for adaptation. In general the type and state of the ecosystem as well as the intended outcome determine the measures to choose. The following table gives an overview of some ecosystems, a selection of services they provide, measures that can be applied and outcomes they may achieve.



Ecosystem	Examples of Ecosystem services	Examples of EbA Measures and resulting benefits
Agricultural and grasslands	› Provisioning (e.g. food, medicine) › Reduced runoff (flood retention) › Erosion prevention › Maintenance of soil fertility (incl. soil formation)	› Techniques of sustainable agriculture (soil and water conservation, rainwater harvesting, crop diversification), agro-forestry, rangeland rehabilitation, agrobiodiversity promotion » Improving groundwater recharge » Maintaining productivity, prevented soil salinity
Coast	› Buffering of inundation and storms › Shoreline stabilisation › Habitats and nurseries › Provisioning (e.g. firewood, food)	› Beach nourishment, dune rehabilitation, construction and flood proofing › Bush mattressing, revegetation with native flora » Increasing dune stability, reduced turbidity and dune and shoreline erosion » Restoration and conservation of habitats » Storm and flood protection
Forests	› Provisioning (e.g. construction material, energy) › Water storage/retention › Air and water quality regulation › Erosion prevention, maintenance of soil fertility and soil formation	› Community-based forest management » Buffering of perturbations to maintain productivity
Lakes, Rivers	› Groundwater recharge › Provisioning (e.g. food, fresh water) › Habitats and nurseries	› Natural water retention measures, catchment thinning, vegetative erosion control for river banks, artificial recharge of groundwater resources, renaturation of flood plains » Improvement of ability to retain water, groundwater recharge » Buffering of dry spells
Mountainous areas	› Water provision › Erosion prevention, maintenance of soil fertility and soil formation › Reduced risk of flash floods, avalanches and landslides	› Community-based forest management, restoring wetlands/terraces » Reducing risk from avalanches and land slides » Improvement of ability to retain water
Peatlands	› Water storage, groundwater recharge › Flood retention › Climate regulation (i.e. storage/sequestration of GHG)	› Renaturation, water logging, natural water retention measures, construction of artificial wetlands » Increasing abruption of rainwater, decreasing runoff and flood mitigation » Increasing water storage capacity

Guidebooks and manuals for EbA measures

- AAK Net (2013): Using Ecosystem-based Adaptation to tackle Food insecurity
- Envirocare (2008): Training Manual on Good Forest Governance at Community Level
- IUCN (2006): Coral Reef Resilience and Resistance to Bleaching.
- USAID (2009): Adapting to coastal climate change – a guidebook for development planners.
- Schuhmann, M., Joosten, H. (2008): Global Peatland Restoration Manual.
- Trees for the Future (2008): Agroforestry Training Program.
- GIZ (2012): Integrating Adaptation Measures into Forest Management (internal working document)

Imprint

Published by:

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn/Germany
T +49 6196 79-0
F +49 6196 79-1115
E info@giz.de
I www.giz.de

Authors:

Daniela Göhler, Flora Müller, Carolin Mytanz,
Julia Olivier, Isabel Renner, Klemens Riha,
Karen Tscherning

Photos:

GIZ, IISD (p.2: Climate Conference, p.3: COP10 CBD)

January 2013

Contact:

Julia Olivier
E julia.olivier@giz.de

Maike-Christine Potthast
E maike-christine.potthast@giz.de

Isabel Renner
E isabel.renner@giz.de