Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy

Research results from the Ecosystems Protecting Infrastructure and Communities project, Senegal

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Summary

Ecosystem-based adaptation (EbA) is the use of biodiversity and ecosystem services as part of an overall strategy to help people to adapt to the adverse effects of climate change. Under the 'Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy' project, IIED, IUCN and the UN Environment World Conservation Monitoring Centre (UNEP-WCMC) are working at 13 sites in 12 countries to gather practical evidence and develop policy guidance for governments on how EbA can best be implemented. The project has developed a definition of effective EbA and a framework for assessing EbA effectiveness which has been applied at all 13 sites, and the results will be collated and compared to draw conclusions that are based on more than single case studies. This report presents the findings from a literature review and interviews with a wide variety of stakeholders conducted by IUCN at the project site in Djilor District in Senegal, where EbA measures including the construction of anti-salt bunds, nursery establishment, applying assisted natural regeneration techniques, reforestation, introducing new roosters, vegetable gardening and establishing mechanisms for regulating the exploitation of natural resources were implemented. Various trainings to strengthen community and government implementation and scaling up capacity were also conducted.

The report concludes that the project activities have improved the resilience of local communities, improved their adaptive capacity and reduced their vulnerability, with the benefits being felt by a range of social groups and a number of social co-benefits also emerging. People in the project area are now self-reliant and are able to implement assisted natural regeneration techniques and build their own bunds to keep land salinisation in check, for example. The use of participatory processes had clearly supported implementation of the EbA project, and because of knowledge transfer, future generations will enjoy the benefits of improved ecosystem services. The initiative had also improved ecosystem resilience and maintained, restored or improved ecosystem services provision at the project site and further afield. However, capacity levels and policy and institutional support levels were not considered sufficient for the EbA initiative to be sustainable over the long term, and although perceptions of the cost-effectiveness of the initiative were positive, local community understanding of whether the initiative is financially and economically effective remains poor.

Acronyms

ANCAR	Agence Nationale de Conseil Agricole et Rural (National Agency of Agricultural and Rural Council)
ANR	Assisted natural regeneration
ARD	Agence Régionale de Développement (Regional Development Agency)
BMU	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
CADL	Centre d'Appui au Développement Local (Support Centre for Local Development in Djilor)
CNRF	Centre National de Recherches Forestières (National Research Institute of Forestry)
COMNACC	Comité National sur les Changements Climatiques (National Committee on Climate Change)
COMRECC	Comité Régionale du Changement Climatique (Regional Committee on Climate Change)
CSE	Centre de Suivi Écologique (Centre of Ecological Monitoring)
DEEC	Direction de l'Environnement et des Etablissements Classés (Directorate of Environment and Classified Establishments)
DPN	Direction des Parcs Nationaux (National Parks Directorate)
DRR	Disaster risk reduction
DWTV	Deutsche Welle TV
EbA	Ecosystem-based adaptation
Eco-DRR	Ecosystem-based disaster risk reduction
ENDA	Environment and Development Action
EPIC	Ecosystems Protecting Infrastructure and Communities
IED	Innovation Environnement Dévéloppement
IIED	International Institute for Environment and Development
IKI	International Climate Initiative
ISE	L'Institut des Sciences de l'Environnement (Institute of Environmental Sciences)
ISRA	Institut Sénégalais de Recherches Agricoles (Senegalese Institute of Agricultural Research)
IUCN	International Union for Conservation of Nature
NGO	Non-government organisation
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNEP-WCMC	United Nations Environment World Conservation Monitoring Centre

Introduction

The global climate is changing rapidly, and as nations and the international and bilateral organisations and processes that support them plan how best to adapt to climate change, they need evidence on where to focus efforts and direct financial resources accordingly. The main approach to climate change adaptation to date has tended to involve investment in engineered interventions, such as sea walls or irrigation infrastructure (Jones et al. 2012). There is growing realisation, however, that ecosystem-based adaptation (EbA) may sometimes provide the optimal adaptation solution, particularly for poorer countries where people are more dependent on natural resources for their lives and livelihoods. A growing number of organisations and countries are implementing EbA and integrating it into emerging climate change policy responses (Seddon et al. 2016a; 2016b).

EbA is defined by the United Nations Convention on Biological Diversity (CBD) as the "use of biodiversity and ecosystem services to help people adapt to the adverse effects of climate change as part of an overall adaptation strategy" (CBD 2009). This definition was later elaborated by the CBD to include "sustainable management, conservation and restoration of ecosystems, as part of an overall adaptation strategy that takes into account the multiple social, economic and cultural co-benefits for local communities" (CBD 2010). Examples of EbA include: restoring coastal ecosystems to lower the energy of tropical storms and protect local communities against erosion and wave damage; wetland and floodplain management to prevent floods and to maintain water flow and water quality in the face of changing rainfall patterns; conservation and restoration of forests and natural vegetation to stabilise slopes and prevent landslides and to regulate water flows preventing flash flooding; and, the establishment of diverse agroforestry systems to help maintain crop yields under changing climates. Box 1 describes some of the key attributes of effective EbA, derived from a review of relevant literature (taken from Seddon et al. 2016b).

Box 1: Key attributes of effective ecosystem-based approaches to adaptation (EbA)

1. **Human-centric.** EbA emphasises human adaptive capacity or resilience in the face of climate change.
2. **Harnesses the capacity of nature to support long-term human adaptation.** It involves maintaining ecosystem services by conserving, restoring or managing ecosystem structure and function, and reducing non-climate stressors. This requires an understanding of ecological complexity and how climate change will impact ecosystems and key ecosystem services.
3. **Draws on and validates traditional and local knowledge**. Humans have been using nature to buffer the effects of adverse climatic conditions for millennia. Traditional knowledge about how best to do this should thus be drawn upon when implementing EbA.
4. **Based on best available science**. An EbA project must explicitly address an observed or projected change in climate parameters, and as such should be based on climatic projections and relevant ecological data at suitable spatial and temporal scales.
5. **Can benefit the world's poorest**, many of whom rely heavily on local natural resources for their livelihoods.

6. **Community-based and incorporates human rights-based principles.** Like community-based adaptation (CBA), EbA should use participatory processes for project design and implementation. People should have the right to influence adaptation plans, policies and practices at all levels, and should be involved with both framing both the problem and identifying solutions. EbA initiatives should be accountable to those they are meant to assist and not simply those providing support (ie donors or governments). EbA should consistently incorporate non-discrimination, equity, the special needs of the poor, vulnerable and marginalised groups, diversity, empowerment, accountability, transparency, and active, free and meaningful participation.
7. **Involves cross-sectoral and intergovernmental collaboration.** Ecosystem boundaries rarely coincide with those of local or national governance. Moreover, ecosystems deliver services to diverse sectors. As such, EbA requires collaboration and coordination between multiple sectors (eg agriculture, water, energy, transport) and stakeholders. EbA can complement engineered approaches, for example combining dam construction with floodplain restoration to lessen floods.
8. **Operates at multiple geographical, social, planning and ecological scales**. EbA can be mainstreamed into government processes (eg national adaptation planning) or management (eg at the watershed level), provided that communities remain central to planning and action.
9. **Integrates decentralised flexible management structures** that enable adaptive management.
10. **Minimises trade-offs and maximises benefits with development and conservation goals** to avoid unintended negative social and environmental impacts. This includes avoiding maladaptation, whereby adaptation 'solutions' unintentionally reduce adaptive capacity.
11. **Provides opportunities for scaling up and mainstreaming** to ensure the benefits of adaptation actions are felt more widely and for the longer term.
12. **Involves longer-term 'transformational' change** to address new and unfamiliar climate change-related risks and the root causes of vulnerability, rather than simply coping with existing climate variability and 'climate-proofing' business-as-usual development.

Sources: Travers et al. (2012); Jeans et al. (2014); Faulkner et al. (2015); Reid (2014a); Reid (2014b); Girot et al. (2012); Ayers et al. (2012); Anderson (2014); Andrade et al. (2011); GEF (2012); ARCAB (2012); Bertram et al. (2017); Reid et al. (2009).

If properly implemented, EbA can meet objectives under all three Rio Conventions (Seddon et al. 2016b). For example, its emphasis on restoring natural ecosystems and increasing habitat connectivity helps countries meet their commitments under the Convention on Biological Diversity (CBD). EbA often involves maintaining the ability of natural ecosystems to control water cycles, or supports effective management regimes for dry areas, and thus aligns with the goals of the United Nations Convention to Combat Desertification (UNCCD). Many EbA activities sequester carbon and some prevent the greenhouse gas emissions that would be emitted from hard infrastructure-based approaches to adaptation thus helping meet mitigation targets under the United Nations Framework Convention on Climate Change (UNFCCC). EbA promotes sustainability across a range of sectors, including agriculture, forestry, energy and water, and as such could help countries meet their Sustainable Development Goals (SDGs) (Seddon et al. 2016b). Lastly, by increasing the resilience of vulnerable communities to extreme events such as flooding and landslides, EbA helps countries to meet the goals of the Sendai Framework for Disaster Risk Reduction (Renaud et al. 2013).

Despite its strong theoretical appeal, many positive anecdotes from around the world, and the acknowledged multiplicity of co-benefits, EbA is not being widely or consistently implemented, or sufficiently mainstreamed into national and international policy processes. Relative to hard infrastructural options, EbA currently receives a small proportion of adaptation finance (Chong 2014) There are four major explanations for this (Biesbroek et al. 2013; Ojea 2015; Vignola et al. 2009; Vignola et al. 2013; Seddon et al. 2016b).

1. First, there is uncertainty around how best to finance EbA. International climate finance, through mechanisms such as the Green Climate Fund or the Adaptation Fund, is one possibility, but this will not provide enough to address adaptation challenges at the scale required to meet the needs of the world's poorest. Payments for ecosystem services (PES) is another possibility and may provide an alternative source of funding, or large-scale government social protection, employment generation, or environmental management programmes. However, in the context of providing finance for adaptation, both are in their infancy.
2. Second, many climate change impacts will be long-term, but this does not sit well with what are usually short-term political decision-making processes often based on standard electoral cycles. Photogenic engineered adaptation solutions with immediate but inflexible benefits are thus often favoured over the long-term flexible solutions offered by EbA under which benefits may only be apparent in the future.
3. Third, the evidence base for the effectiveness of EbA (especially its economic viability) is currently weak. Much evidence is anecdotal and comes from single case studies, and often the costs, challenges and negative outcomes of EbA activities are under-reported. More robust quantitative evidence, or at least consistently collated qualitative evidence, on the ecological, social and economic effectiveness of EbA projects relative to alternative approaches is needed (Doswald et al. 2014; Travers et al. 2012; Reid 2011; Reid 2014a; UNEP 2012).
4. The final major challenge to EbA relates to issues around governance. EbA necessitates cooperation and communication across multiple sectors and varying administrative or geographical scales. This is challenging for most models of governance, where decision making is often strongly based on sectors and administrative boundaries, and opportunities for supporting participation and locally driven approaches are limited.

Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy

The 'Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy' project was conceived to address the third (and fourth) challenge in the above list. The project aims to show climate change policymakers when and why EbA is effective, the conditions under which it works, and the benefits, costs and limitations of natural systems compared to options such as hard, infrastructural approaches. It also aims to promote and provide tools to support the better integration of EbA principles into policy and planning. The project is supported by the International Climate Initiative (IKI). The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supports IKI on the basis of a decision adopted by the German Bundestag. The project is being implemented by the International Institute for Environment and Development (IIED), International Union for Conservation of Nature (IUCN) and the United Nations Environment World Conservation Monitoring Centre (UNEP-WCMC) in collaboration with 13 in-country partner organisations in 12 countries across Asia, Africa and the Americas (see Table 1). The project runs from July 2015 to September 2019.

Table 1: 'Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy' project countries, partners and case studies

Project partner country	In-country partner institution	Project case studies
China	Centre for Chinese Agricultural Policy, Chinese Academy of Science	Participatory plant breeding and community-supported agriculture in Southwest China
Nepal	IUCN	Ecosystem-based adaptation in mountain ecosystems programme (Nepal)
Bangladesh	Bangladesh Centre for Advanced Studies	Economic incentives to conserve hilsa fish in Bangladesh – a supportive research project to the incentive-based hilsa

		fishery management programme of the Department of Fisheries
Kenya	Adaptation Consortium; Kenya Drought Management Authority	Adaptation Consortium – supporting counties in Kenya to mainstream climate change in development and access climate finance
South Africa	Conservation South Africa	Climate-resilient livestock production on communal lands: rehabilitation and improved management of dryland rangelands in the Succulent Karoo
Uganda	IUCN	Ecosystem-based adaptation in mountain ecosystems programme (Uganda)
Burkina Faso	IUCN	Ecosystems protecting infrastructure and communities (EPIC): strengthening local climate change adaptation strategies in West Africa
Senegal	IUCN	Ecosystems protecting infrastructure and communities (EPIC)
Peru	IUCN	Ecosystem-based adaptation in mountain ecosystems programme (Peru)
	ANDES	Indigenous people biocultural climate change assessment, Potato Park
Chile	IUCN	Ecosystems protecting infrastructure and communities, South America geographical component (EPIC Chile)
Costa Rica	IUCN	Livelihoods and adaptation to climate change of the Bri Bri indigenous communities in the transboundary basin of Sixaola, Costa Rica/Panama
El Salvador	IUCN	Mangrove ecosystem restoration and responsible fishing

In order to address the weak evidence base for EbA, the project has developed a definition of effective EbA and a framework for assessing EbA effectiveness. Effective EbA is defined as “an intervention that has restored, maintained or enhanced the capacity of ecosystems to produce services. These services in turn enhance the wellbeing, adaptive capacity or resilience of humans, and reduce their vulnerability. The intervention also helps the ecosystem to withstand climate change impacts and other pressures” (Reid et al. 2017, based on Seddon et al. 2016). This definition generates two overarching questions that need to be addressed in order to determine whether a particular EbA initiative is effective:

1. Did the initiative allow human communities to maintain or improve their adaptive capacity or resilience, and reduce their vulnerability, in the face of climate change, while enhancing co-benefits that promote wellbeing?
2. Did the initiative restore, maintain or enhance the capacity of ecosystems to continue to produce services for local communities, and allow ecosystems to withstand climate change impacts and other stressors?

By definition, EbA should also be financially and/or economically viable, and for benefits to materialise it needs support from local, regional and national governments and to be embedded in an enabling policy, institutional and legislative environment (Seddon et al. 2016b; Reid et al. 2017). This leads to two further overarching questions:

1. Is EbA cost-effective and economically viable?
2. What social, institutional and political issues influence the implementation of effective EbA initiatives and how might challenges best be overcome?

These questions encompass much important detail regarding how to assess and compare effectiveness in ecological, social and economic terms. They lead to a further set of nine more specific

questions (Table 2) that reflect the growing consensus around the key characteristics of effective EbA (Box 1).

This framework is being applied in 13 project sites in 12 countries and results from all sites will be collated and compared during 2018 to draw conclusions that are based on more than single case studies and help answer the question of whether EbA is effective or not. Detailed guidance on the way that researchers and project managers can use the framework to draw conclusions about the effectiveness of an EbA project, or to shape project design or assess the progress of an ongoing EbA project or a project that has ended are provided in Reid et al. (2017).

Research conducted under the project will then be used to help climate change policymakers recognise when EbA is effective, and where appropriate integrate EbA principles into national and international climate adaptation policy and planning processes. An inventory of EbA tools and a 'tool navigator' are also being developed to support this process.

Table 2: Framework for assessing EbA effectiveness

1) Effectiveness for human societies *Did the initiative allow human communities to maintain or improve their adaptive capacity or resilience, and reduce their vulnerability, in the face of climate change, while enhancing co-benefits that promote long-term wellbeing?*
1. Did the EbA initiative improve the resilience and adaptive capacity of local communities, and help the most vulnerable (eg women, children and indigenous groups)? If so, over what time frames were these benefits felt, and were there trade-offs (or synergies) between different social groups?
2. Did any social co-benefits arise from the EbA initiative, and if so, how are they distributed and what are the trade-offs between different sectors of society?
3. What role in the EbA initiative did stakeholder engagement through participatory processes and indigenous knowledge play? Did/does the use of participatory processes support the implementation of EbA and build adaptive capacity?
2) Effectiveness for the ecosystem *Did the initiative restore, maintain or enhance the capacity of ecosystems to continue to produce adaptation services for local communities, and allow ecosystems to withstand climate change impacts and other stressors?*
4. What were/are the factors threatening the local ecosystem(s)? How did/do these pressures affect the resilience of the ecosystem(s) to climate change and other stressors and their capacity to deliver ecosystem services over the long term?
5. After the EbA initiative, which ecosystem services were restored, maintained or enhanced, and did the resilience of the ecosystem change? Over what geographic scale(s) and time frame(s) were these effects felt, and were there trade-offs (or synergies) between the delivery of different ecosystem services at these different scales?
3) Financial and economic effectiveness *Is EbA cost-effective and economically viable over the long term?*
6. What are the general economic costs and benefits of the EbA initiative? How cost-effective is it, ideally in comparison to other types of interventions, and are any financial or economic benefits sustainable over the long term?
4) Policy and institutional issues *What social, institutional and political issues influence the implementation of effective EbA initiatives and how might challenges best be overcome?*
7. What are the key policy, institutional and capacity barriers to, or opportunities for, implementing EbA at the local, regional and national levels over the long term?
8. What, if any, opportunities emerged for replication, scaling up or mainstreaming the EbA initiative or for influence over policy, and how?
9. What changes in local, regional and/or national government or in donor policies are required to implement more effective EbA initiatives?

Ecosystems protecting infrastructure and communities (EPIC) in Senegal

The Ecosystems protecting infrastructure and communities (EPIC) project aimed to build community resilience by implementing nature-based solutions to disaster risk reduction (DRR) and climate change adaptation. Using pilot projects in six countries (Burkina Faso, Chile, China, Nepal, Senegal and Thailand), EPIC has strengthened the evidence base on the effectiveness of nature as a solution to disasters and climate change. Working with multiple stakeholders, EPIC has informed policy and built capacities for better integration of ecosystems into disasters and climate change management strategies (Buyck 2017; Monty et al. 2017; Rizvi et al. 2014). EPIC was implemented by IUCN and funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany, through IKI.

EPIC project activities in Senegal ran from 2012 to 2017. Their overall goal was to reinforce local adaptation strategies to climate change. Specific objectives were to:

- assess the risks and effects of climate change on poor people, and
- demonstrate the economic benefits of EbA.

Project activities were implemented in Djilor District, Foundiougne Department, in the Fatick Region of Senegal. Djilor District is about 40 kilometres from the sea in the protected area of the Saloum Delta Biosphere Reserve. Six villages within Djilor District, totalling about 6,700 people, were selected for EPIC interventions: Djilor, Gagué Cherif, Goudème Sidy, Kamatane Bambara, Péthie and Sadioga (Monty et al. 2017). Livelihoods in these villages mostly depend on agriculture, livestock rearing and fisheries. Ecosystems in the project area are mainly tropical and subtropical grasslands, savannas and shrublands, and also mangroves on the large river delta ecosystems in the area.

EPIC project activities in Senegal included project implementation, research, training, policy influence at a variety of levels, and the creation of two videos to share through the media. The project targeted various socioeconomic groups (including pastoralists and fishers) and also local government and technical services. Box 2 describes the project activities implemented to tackle key climate hazards facing communities in the area.

Box 2: Activities implemented under the EPIC project, Senegal

- Some 76 traditional anti-salt bunds (called ‘diguettes’ or ‘fascines’) were constructed. These are small structures made of bundles of sticks (deadwood) and built into the earth along the contours of a slope to reduce salt intrusion and soil erosion and increase water infiltration. These bunds reduced the risk of land salinization and helped reclaim land that was already salinised.
- Two nurseries were established in the villages of Gagué Cherif and Péthie. Under the EPIC project, these have produced some 1,766 plants, which have been planted on degraded lands. The community’s nursery production capacity has increased, improving plant cover in agroforestry areas.
- Assisted natural regeneration (ANR) techniques have been applied to conserve forest resources and restore vegetation cover using local species to combat water and wind erosion. Some 7,192 saplings are now growing on 232 hectares of cultivated land. A training handbook for establishing and maintaining nurseries to produce forest and fruit plant seedlings for planting in degraded land, was also produced.
- In the villages of Kamatane Bambara and Péthie, reforestation on one hectare in each village has begun.

- Some 120 roosters of the stronger and better Blue Holland variety have been introduced as an income-generating livelihood strategy for women. This provides income for purchasing gas for cooking instead of collecting fuelwood from forested areas and further degrading them, and it increases the resilience of communities that are vulnerable to disaster risks. The introduction has resulted in the production of 450 cross-breeds in two months. The value of these cross-breeds is five times higher than that of a local chicken.
- Vegetable gardening has diversified and improved livelihoods.
- Mechanisms for regulating the exploitation of natural resources for sustainable use were established. These included the development of action plans detailing the actors involved and their roles, the list of activities (eg stone collection and stone bund construction), strategies for training and exchange visits, timelines and expected results.

Source: Monty et al. (2017).

Knowledge on the risk and determinants of soil salinisation was enhanced. Several training events were also organised to strengthen the capacities of communities and government officials to facilitate EPIC implementation as well as to promote scaling up of the approach (see Box 3).

Box 3: Training organised under EPIC to promote capacity building and scaling up

- Some 82 community members comprising village development committees for the six villages were trained to strengthen their capacities in organisational dynamics, project management and project monitoring.
- Two training sessions covering three modules (ANR, establishing a nursery for salt-tolerant and drought-tolerant species, and the recovery of salinised soils) were conducted and were followed by practical hands-on learning sessions for 90 people (community members, rural council officers, women's groups, youth groups, farmers, fishers and government officers from the Department of Water and Forests, the Regional Division for the Environment and Classified Establishments, and the Centre for Support to Local Development).
- A training workshop on Eco-DRR was conducted and attended by 40 stakeholders involved in risk management, including civil society, NGOs, international institutions and projects and programmes in the field of climate change, and local decision makers, including 15 heads of regional services and local elected representatives.
- An exchange visit to Kaffrine, for sharing experiences on and understanding of the economic benefits of ANR, was held for five local decision makers, ten representatives from technical departments and 20 cultivators.
- Six Senegalese cultivators visited the department of Ouahigouya in Burkina Faso to observe and learn from EPIC interventions there.
- EPIC Senegal has been showcased on the German television channel DWTV (Deutsche Welle TV) and at other international fora, such as the World Conservation Congress.

Source: Monty et al. (2017).

Methodology for assessing effectiveness

The methodology applied for assessing EbA effectiveness is detailed in Reid et al. (2017). This guidance describes a process – based around asking a detailed set of questions – that can be used to draw conclusions about the effectiveness of an EbA project that has ended such as the EPIC project. Table 3 describes the EPIC project stakeholders in Senegal interviewed for this case study report using this methodology. Surveys were prepared and group discussions were organised with different respondents interviewed using a questionnaire. Data analysis was undertaken using SPSS statistics

software. Results expressed as percentages represent the percentage of respondents that chose a single dominant viewpoint out of the various viewpoint options provided.

Table 3: EPIC project stakeholders interviewed

Level of interviewees	Those interviewed
National	Two officials from the National Committee on Climate Change (Comité National sur les Changements Climatiques - COMNACC), two from the Directorate of Environment and Classified Establishments (Direction de l'Environnement et des Etablissements Classés - DEEC), one from the National Parks Directorate (Direction des Parcs Nationaux - DPN), and one from the Centre of Ecological Monitoring (Centre de Suivi Écologique - CSE).
Local authority	Officials from the Regional Committee on Climate Change (Comité Régionale du Changement Climatique - COMRECC), the Support Centre for Local Development in Djilor (Centre d'Appui au Développement Local - CADL), Regional Development Agency (Agence Régionale de Développement - ARD), Djilor District officials and departmental authorities.
EPIC project implementers	Representatives from the Senegalese Institute of Agricultural Research (Institut Sénégalais de Recherches Agricoles - ISRA), the National Research Institute of Forestry (Centre National de Recherches Forestières - CNRF), the Centre of Ecological Monitoring (Centre de Suivi Écologique - CSE) the Institute of Environmental Sciences (L'Institut des Sciences de l'Environnement - ISE), the National Agency of Agricultural and Rural Council (Agence Nationale de Conseil Agricole et Rural - ANCAR) and World Vision.
Project beneficiaries	Four head community members were interviewed and focus group discussions were held with groups representing women, men, the elderly and the young in the five EPIC project villages (Sadioga, Péthie, Kamatane Bambara, Djilor and Goudème Sidy).

Along with the interviews and focus group discussions, published literature was also used to assess the characteristics of EPIC project activities that contribute to EbA effectiveness. The results of this assessment are described in the following results section.

Research results

Effectiveness for human societies: did the initiative allow human communities to maintain or improve their adaptive capacity or resilience, and reduce their vulnerability in the face of climate change, while enhancing co-benefits that promote long-term wellbeing?

Did the EbA initiative improve the resilience and adaptive capacity of local communities, and help reduce vulnerability?

Project vulnerability and capacity assessments identified the following key climate change risks in the project area: droughts, floods following heavy rainfall, and soil or land salinisation. These hazards, exacerbated by human activities, are a major concern for the socioeconomic development of the region. A scientific baseline risk assessment was also conducted in the project area in partnership with the School of International Agro-development and the Institute of Environmental Sciences (ISE). This mapped disaster risks and climate hazards, assessed the impacts of climate change on different sectors, determined the potential for ANR and characterised soil salinity. The results of the various

baseline scientific studies were shared during various workshops. This increased awareness of the challenges that the area was facing (Monty et al. 2017).

All community-level interviewees felt that the EPIC project had improved the resilience of local communities, improved their adaptive capacity and reduced their vulnerability. Monty et al. (2017) provide further detail by explaining that qualitative information collected through focus group discussions (six focus groups consisting of a total of 85 men and 76 women) conducted in 2017, as well as opportunistic observations and collection of information during three field visits in 2016 and 2017, provided anecdotal evidence that the practices implemented were improving soil quality and water availability and increasing crop yields. Community testimonies linked ANR and anti-salt bunds to an increase in the amount of land that could be cultivated, as well as the re-appearance of grasses in degraded land. It was difficult, however, to isolate 'cause and effect' relationships and to attribute documented changes to project interventions. Monty et al. (2017) also note that investing in capacity building and sensitising a range of stakeholders to ecosystem-based approaches to natural hazards and climate change was essential for project success (Monty et al. 2017).

Which particular social groups experienced changes in resilience, adaptive capacity or vulnerability as a result of the initiative?

Community-level interviewees felt that improvements in resilience, adaptive capacity or vulnerability as a result of the EPIC project were felt by a range of social groups. Some 37% felt all social groups had benefitted, 22% confirmed that the poorest and most vulnerable people experienced improvements, 16% believed that indigenous groups had benefitted, 14% said women and children were the most advantaged, and 11% felt that men and young people experienced the most improvements in resilience, adaptive capacity or vulnerability.

In the Fatick Region selected for EPIC interventions, poverty is overwhelming – about 20% higher than the national average of 68.1% (Monty et al. 2017). The site was selected in part due to its vulnerability to climate change. Nearly half the population of the six project villages (around 3,200 people) were involved in EPIC interventions. The traditional anti-salt bunds benefitted everyone in the six villages (around 6,700 people). This demonstrates the ability of the project to provide adaptation benefits to a wide range of very vulnerable social groups.

Trade-offs in terms of who experiences changes in resilience, adaptive capacity or vulnerability, where changes occur and when

Trade-offs in terms of *who* experiences changes in resilience, adaptive capacity or vulnerability as a result of the project were not apparent, although some may have benefitted more than others. Although 89% of community interviewees declared that most of the changes in resilience and adaptive capacity from the EPIC project are experienced by engaged communities or farmers who really dealt with environmental problems on their land, some 11% of community interviewees believed that the changes in resilience benefitted all in the area, as people can now share different project experiences and technologies with each other. In addition, focus group discussions revealed that some respondents felt that adults benefitted the most. However, respondents stated that women experienced more gains in resilience and adaptive capacity than men because most of the degraded land being restored – especially rice fields in the valley – belongs to them, which makes them particularly vulnerable to threats such as increases in soil salinity.

Trade-offs in terms of *when* changes in resilience, adaptive capacity or vulnerability occur as a result of the project were not apparent, although local authority interviewees and nearly all community-level interviewees (98%) felt that improvements in resilience, adaptive capacity or vulnerability as a result of the project were long term. Community-level interviewees explained that project knowledge strengthening, strategies to address salinisation and land degradation, tree protection and ANR all have long-term impacts. These strategies must all be sustained, however, in order to maintain the positive results observed. Only 2% of community-level interviewees considered the duration of the observed changes to be short term because of a lack of follow-up on salt bund establishment. Local authority interviewees explained that improvements were long term, because lands abandoned due to salinity were becoming suitable for cultivation and grazing again. As with community-level interviewees,

however, they felt that for improvements to be sustained, the local population should continue to apply EbA methods.

Social co-benefits from the EbA initiative

Community-level interviewees described a number of social co-benefits emerging from the EbA initiative in the municipality of Djilor. The five most important ones were:

1. disaster risk reduction
2. food security
3. improved knowledge with the local population
4. enhanced social cohesion and
5. the provision of livelihoods or means of livelihood diversification.

Other less important social co-benefits mentioned by community-level interviewees included the supply of drinking water, health benefits, climate change mitigation, and improved policies and governance.

Distribution and trade-offs relating to social co-benefits

Some 86% of community-level interviewees felt these social co-benefits were experienced by all social groups in the villages concerned. Although social co-benefits primarily affect project participants, non-participants also benefit directly or indirectly. Women and men are both considered beneficiaries. For example, reclaimed land belongs to men, but women whose husbands have died or left the area also have land rights, as demonstrated by the rice plots frequently cultivated by women in the area.

Some 14% of community-level interviewees felt, however, that there were cases where co-benefits affected some categories of people to the detriment of others. Reasons for this included the determination and commitment of some participants to benefit more than others from project activities.

The role of participatory processes and local/indigenous knowledge

Local knowledge or practices were taken on board during EPIC project implementation. About 84% of community-level interviewees explained that practices originating locally to fight against land degradation or to manage natural resources were taken into account. Monty et al. (2017) also describe how traditional soil stabilisation techniques were used.

Knowledge of the construction and maintenance of bunds was limited, however, and the project found that integrating local practices with new techniques was effective. At the start of the project, several dissemination and awareness-raising activities were developed and training workshops were organised. These provided a platform for exchanging and sharing knowledge and experiences. This approach facilitated the integration of local practices into project activities, while building capacities on bund construction and maintenance, reforestation, ANR and good local resource governance. Project activities were therefore based on local knowledge, which was then strengthened technically, with additional materials and financial support also provided. An example of this is provided by the people of Péthie, who fought against gullying and salinisation by constructing bunds.

Community-level interviewees characterised the types of participatory processes[1] applied by the project as functional (34% of interviewees), interactive (25%), self-mobilisation (17%), information giving (16%)

[1] Participatory approaches can be characterised according to the following typology: (1) passive, where people are told what is going to happen or has already happened; (2) information giving, where people answer questions posed by extractive researchers (they cannot influence proceedings and research findings may not be shared with them); (3) consultation by external professionals who define both problems and solutions (decision-making is not shared, and professionals are under no obligation to take on board people's views); (4) for material incentives, where people provide resources, for example labour, in return for food, cash or other material incentives; (5) functional, where people form groups to meet predetermined objectives related to the project. Such involvement tends to be during later project cycle stages after major decisions have been made; (6) interactive, where people participate in joint analysis, which leads to action plans and the formation of new local institutions or the strengthening of existing ones (groups take control over local decisions so people have a stake in maintaining emerging structures or practices); and (7) self-mobilisation, where people take initiatives independent of external institutions, develop contacts with external institutions for the resources and technical advice they need, but retain control over how resources are used. Adapted from Adnan et al. (1992) and Dazé et al. (2009).

and for material incentives (8%). Examples of different participatory approaches applied under the project are include the following:

- A consultative project inception workshop was convened to assess the main climate change threats that people face as well as to identify local adaptation strategies. Vulnerability and capacity assessments identified key risks. The workshop took place over four days and convened representatives from the concerned communities, government technical officers in charge of rural development, local NGOs and technical partners, and IUCN staff (Monty et al. 2017; Buyck 2017).
- Using the 'Climate Resilience Evaluation for Adaptation through Empowerment' tool at these consultative workshops, IUCN worked with local communities and partners to identify the vulnerabilities of communities and sectors in Fatick. Local strategies to cope with climate change impacts were identified, and options for diversifying livelihoods or generating income, while restoring ecosystems, regenerating forests and reducing soil degradation were documented (Buyck 2017).
- The 'Promoting Local Innovations' tool was also used to elicit traditional solutions (innovations) to risks identified under the vulnerability and capacity assessments (Monty et al. 2017).
- Two exchange visits between project beneficiaries from Burkina Faso and Senegal were held in 2016 and 2017 (Monty et al. 2017).
- Training was provided to community members for successful project implementation (Monty et al. 2017).

All community-level interviewees felt that the use of participatory processes fully supported the implementation of the EbA initiative. This included the sharing of knowledge and practices between different stakeholders. They explained that the participatory approaches adopted by the project had won the support of the local population. These approaches had helped to generate determined and full community engagement, resulting in the provision of labour for activities such as bund construction, ANR and nursery operation, village woodlot creation, and construction of wells and poultry houses. Self-mobilisation and ownership of the project by the local population contributed to its success. One interviewee explained that people are now self-reliant and able to implement ANR in their fields and build their own bunds to keep land salinisation in check. Monty et al. (2017) reinforce this view, arguing that a key lesson emerging from the EPIC project relates to the importance of adopting participatory and iterative approaches to ensure continued commitment from communities. They argue that keeping communities at the heart of adaptation activities is essential for their success. Working at the local level has created awareness about EbA, and involving communities in decision making, project management and implementation, in addition to strengthening their capacity, has led to community ownership (Monty et al. 2017). Buyck (2017) also argues that participatory mapping and analysis of vulnerabilities was important for ensuring that the nature-based solutions implemented aligned with the needs of the local community. Involving communities in defining priorities for action (solutions) and not just defining their vulnerabilities (problems) ensured a strong commitment for implementation from all project stakeholders. Using traditional knowledge also helped make the case for EbA (Buyck 2017).

Effectiveness for the ecosystem: did the initiative restore, maintain or enhance the capacity of ecosystems to continue to produce ecosystem services for local communities, and allow ecosystems to withstand climate change impacts and other stressors?

Factors threatening local ecosystem resilience and service provision

Community-level interviewees listed a number of factors threatening the ecosystem in Djilor District, many of which are linked. Some 45% of interviewees declared that climate change was the main threat, while 29% felt that land degradation through salinisation and erosion was the most important threat. These were followed by overexploitation of natural resources (11%) and land conversion leading to habitat modification (7%). Bushfires and invasive species were each listed by 4% of interviewees as the main threat to the ecosystem. Monty et al. (2017) confirm that the main drivers of ecosystem change are land salinisation and acidification, coastal erosion, and the destruction and fragmentation of ecosystems due to the construction of roads, dams and human settlements.

In the context of climate change, community-level interviewees described how rainfall deficits have caused the infiltration of saline water into cultivated lands and contaminated freshwater wells and boreholes. Land salinisation has reduced the size of arable and pasture areas. Monty et al. (2017) confirm that climate change and changes in land cover lead to salinisation of water and land. Because of low freshwater inputs during droughts, deforestation and inland freshwater extraction, salt-affected areas are more common and have expanded in size, particularly in the lowlands and valleys. Land salinisation has significantly reduced the quality of soil and vegetation cover, thus facilitating water and wind erosion and subsequent cereal crop shortfalls and food insecurity (Monty et al. 2017). Community-level interviewees described how high temperatures also result in evaporation and cause plant wilting and stunting. Monty et al. (2017) add that high temperatures accelerate the drying of grass and cause massive mortality in the traditional poultry farming industry. Community-level interviewees further described how water erosion and wind erosion have negative impacts on ecosystems and contribute to the depletion of soil nutrients. Deforestation and bushfires lead to the degradation of vegetation cover and the exposure of cropland that then becomes more vulnerable to water and wind erosion. Monty et al. (2017) reiterate that more frequent bushfires, facilitated by violent winds, lead to forage deficits. Finally, community-level interviewees described how land degradation affects the ecosystem's ability to deliver services. This is felt on agricultural land (with a decline in soil fertility, a reduction in agricultural yields and land loss), in forests (with a scarcity of firewood and wood for other uses, and degradation of vegetation cover), and in sea inlets or 'bolongs' (where certain fish species are becoming rarer).

Boundaries influencing ecosystem resilience

Most community-level interviewees (75%) felt there were natural barriers that affected the resilience of the ecosystems in their community. These were:

- mangroves that mitigate the advances of salt and water contamination and
- forests such as Baba Samaké and Djifa, and village woodlots in Kamatane Bambara and Sadioga, which protect the land against erosion.

Thresholds influencing ecosystem service provision

Most community-level interviewees (91%) felt that there were thresholds beyond which ecosystems could no longer provide services. These were based on:

- the over-salinity and acidification of the land that leads to its abandonment and
- deforestation which leads to a scarcity of firewood and wood for other uses.

EbA initiative impacts on ecosystem resilience and services provision

All community-level interviewees felt the EbA initiative had improved ecosystem resilience and maintained, restored or improved ecosystem services provision. Interviewees felt that provisioning and supporting services were maintained, restored or enhanced more than regulatory or cultural services.

Geographic scale of ecosystem services provision and trade-offs or synergies between geographical scales

Some 55% of community-level interviewees felt that ecosystem services had been maintained, restored or improved at the village level, 28% at the watershed level and 17% at the forest level.

No trade-offs between geographical scales were noted by community-level interviewees. Instead, they described various synergies in the provision of ecosystem services at different geographical scales as a result of project activities. For example, reforestation and ANR activities also protect the lowlands from siltation caused by water and wind erosion. ANR has played an important role in reclaiming soil, but also in regenerating vegetation in agro-forestry parks. Bund construction has helped to mitigate the rise of saline water in arable, pastoral and forest lands, and these bunds also make it possible to slow down mudflat siltation, resulting in mangrove regeneration. Mangrove density is thus increasing and people are witnessing the return of, and a greater diversity of, fish species in the estuarine ecosystem.

Time frame over which ecosystem services are provided, and trade-offs or synergies between timescales

Some 41% of community-level interviewees felt that ecosystem services would be restored for a period of five to ten years, while 32% considered this period to be two to five years. Some 25% felt the period was ten or more years and only 2% said that restored services would last only one to two years.

Community-level interviewees described how improvements in ecosystem service provision are currently being experienced by people in project intervention areas, and they noted no trade-offs between timescales in the context of services provided. Instead, community-level interviewees described various synergies in the provision of ecosystem services at different timescales as a result of project activities. For example, because of knowledge transfer, future generations will enjoy the benefits of these improved services, including those provided by the trees and from reclaimed land. Children are involved in some project activities. They have been introduced to ANR and bund construction and they have been sensitised not to cut the young plants that grow in the fields during ploughing. Sustainability will be ensured as new methods are mastered.

Financial effectiveness: is EbA cost-effective and economically viable over the long term?

How cost-effective is the EbA initiative?

No formal project cost-benefit analysis had been conducted, and interviewees found it difficult to assess the economic costs and benefits of the EbA initiative. For many, whether there is evidence of profitability remains an enigma. Despite this, perceptions about whether the EbA initiative was cost-effective were overwhelmingly positive.

All national-level interviewees felt there was evidence that the EbA initiative was cost-effective. This was because of the recovery of degraded lands due to the installation of dikes or bunds; improvements in the productivity of agricultural systems, in particular by preserving soil quality; and reforestation of the mangroves and with halotolerant trees that slowed the advance of salt into cropland and water sources. The mangroves also preserve wildlife nesting areas.

Local authority-level interviewees also felt there was evidence that the EbA initiative was profitable. All chiefs of the villages where the project interventions occurred concurred with this view. Project beneficiaries listed many financial benefits emerging from the project, including the availability of fodder, restoration of local vegetation cover and increases in agricultural yields. These benefits stem from the installation of bunds, the enrichment of agro-forestry parks using local forest species, and ecosystem restoration using ANR.

The majority of implementing partner interviewees also felt that the project was cost-effective. They explained that the project had restored ecosystems at various sites.

How did the EbA approach compare to other types of intervention?

All national-level interviewees felt that when comparing the EbA approach with other intervention types or approaches, the conclusion was that EbA approaches were the most cost-effective. Local authority-level interviewees concurred with this view, as did implementing partner interviewees. Economic costs and benefits exist but are difficult to quantify. Benefits include the recovery of salty land, restoration of vegetation cover, improvements in local poultry breeds and development of market gardening.

Formal effectiveness and cost-effectiveness comparisons between anti-salt bunds and hard infrastructure (concrete dams) as two alternative ways of addressing land degradation in the area have not been undertaken. However, discussions with the communities and field visits described by Monty et al. (2017) show that concrete dams have been unsuccessful in restoring the land. Indeed, communities in the area studied have had to abandon traditional rice cultivation due to land degradation despite the establishment of dams in several areas (Monty et al. 2017).

Broader economic costs and benefits from the EbA initiative

Interviewees from different stakeholder groups noted a range of broader economic benefits from the EbA project, as well as some opportunity costs. Benefits included decreased losses from disasters, improvements in land or service value or local income, and other avoided costs. Details according to each stakeholder group are described below.

Half of the national-level interviewees surveyed felt there were broader economic benefits and costs linked to the EbA initiative. In order of importance, these benefits were:

- increased value of plots or service value (prioritised by 32% of interviewees)
- decreased losses due to disaster risk (25%)
- improvements in local income (25%) and
- avoided costs of using artificial systems instead of ecosystem services (13%).

Some 75% of local authority interviewees felt there were wider economic benefits and costs from the EbA initiative. In order of importance, these were:

- a reduction in losses (prioritised by 50% of interviewees)
- increased plot value (33%) and
- improvements in local income (17%).

Implementing partner interviewees also felt there were wider economic benefits and costs from the EbA initiative. In order of importance, these benefits were:

- a reduction in disaster risk losses (prioritised by 29% of interviewees)
- local income improvements (21%)
- avoided costs of using artificial systems instead of ecosystem services (21%) and
- increased value of land parcels or service value (7%).

Around 99% of local community interviewees reported that the EbA initiative had generated broader economic costs and benefits. In order of importance, these benefits were:

- improvements in local income (prioritised by 36% of interviewees)
- reduced disaster risk (33%).
- increased value of plots or services (27%) and
- avoided costs of using artificial systems instead of ecosystem services (4%).

In terms of broader economic costs emerging from the project, some 21% of implementing partner interviewees felt there were opportunity costs when other land use options went untapped. A small proportion (6%) of national-level interviewees also felt this way.

Changing financial and economic benefits and costs over time

National-level, local authority-level and implementing partner interviewees felt the financial benefits of the EbA initiative would be long term. National-level interviewees justified this by explaining how the strategies used originated locally, and were easily replicable (notably those relating to land reclamation and conservation) and sustainable (eg all defence and soil restoration activities). Local authorities explained that benefits were long term because lands abandoned because of salinity have become suitable for cultivation and grazing again. They noted, however, that efforts to combat land salinisation do need to continue. Most national-level interviewees (83%) said that the financial or economic benefits and costs from the project change over time.

Policy and institutional issues: what social, institutional and political issues influence the implementation of effective EbA initiatives and how might challenges best be overcome?

Local-level barriers to implementing EbA

Different stakeholder groups had very different perspectives on what the key political, institutional and capacity barriers to EbA implementation at the local level were. Across the different groups, insufficient implementation capacity and the unavailability of technical skills and financial resources, weak institutions and insufficient institutional collaboration, and a lack of stakeholder power, were raised as key issues. Local community understanding of whether the EbA initiative is financially and economically effective remains poor, indicating a need for capacity building around these key concepts. Interviewee responses relating to institutional weakness and the unavailability of knowledge and skills reflect the need for communities to be better prepared and equipped on concepts and tools relating to EbA through training and access to information. Monty et al. (2017) also comment on the EPIC work lacking a strong scientific assessment of impact, which was partly limited by capacity, and the lack of quantitative data on project effectiveness. They also note challenges emerging from a lack of constant presence in the project area because the main IUCN office was far from the project villages (Monty et al. 2017).

Political, institutional and capacity-related barriers to EbA implementation at the local level noted by national-level interviewees (listed in order of importance) were insufficient implementation capacity (prioritised by 24% of interviewees), insufficient institutional collaboration (19%), low government or donor priority (15%), unavailability of financial resources (14%), unavailability of technical skills (10%), the main stakeholders not having the power to take the necessary or planned actions (7%), unclear mandates (6%) and weak institutions (5%).

The main barriers listed by local authority interviewees were weak institutions (37%) and the unavailability of financial resources (18%). Some 9% also listed each of the unavailability of knowledge, insufficient technical skills, insufficient implementation capacity, a lack of political support from donors or government, and low donor or government prioritisation as barriers.

Insufficient implementation capacity, a lack of stakeholder power, and the unavailability of technical skills were each identified by some 17% of implementing partner interviewees as the most critical constraints for local-level EbA implementation. Secondary obstacles were unsupportive government and donor policy, weak or non-collaborative legal frameworks, weak institutions, and insufficient institutional collaboration, each listed by 11% of implementing partners. Only 6% of implementing partners mentioned unclear mandates as a barrier.

Community-level interviewees said that the main barriers to implementing EbA at the local level were (in order of importance) the unavailability of financial resources (33%), weak institutions (27%), the unavailability of technical skills (25%), insufficient implementation capacity (7%), the lack of power of key stakeholders to take action (5%) and the unavailability of knowledge (3%).

Provincial-level barriers to implementing EbA

The main political, institutional and capacity-related barriers to implementing EbA at the provincial level listed by interviewees related to institutional weaknesses and inadequate interdepartmental or inter-sectoral collaboration. National-level interviewees said that the main barriers were (in order of importance) insufficient institutional collaboration (29%), low prioritisation by government or donors (18%), the unavailability of knowledge (12%), the unavailability of technical skills (12%), a lack of clarity on mandates (12%), unavailability of financial resources (12%), and insufficient implementation capacity (6%). Local authority-level interviewees identified six barriers: weak institutions (30%), unavailable financial resources (20%) and unavailable knowledge (20%) were the most important of these. The unavailability of technical skills, insufficient implementation capacity and unsupportive donor or government policy were also named by some 10% of local authority-level interviewees each as key barriers. Implementing partner interviewees said that the key barriers were interdepartmental or inter-sectoral institutional inadequacy (29%), and low government or donor priority (18%). The unavailability of technical skills, the unavailability of financial resources and the unavailability of knowledge were also

listed by some 12% of implementing partner interviewees. Only 6% felt insufficient implementation capacity was a barrier.

National-level barriers to implementing EbA

The main political, institutional and capacity-related barriers to implementing EbA at the national level listed by interviewees related to insufficient implementation capacity and financial resources, weak institutions and insufficient interdepartmental or inter-sectoral collaboration. Interviewee responses relating to institutional weakness and the unavailability of knowledge and skills reflect the need for national institutions to be better prepared and equipped for concepts and tools relating to EbA through training and access to information. National-level interviewees said that the main barriers (in order of importance) were insufficient institutional collaboration (21%), insufficient implementation capacity (21%), low prioritisation by government or donors (16%), unavailability of financial resources (16%) and unavailability of knowledge (11%). Unavailability of technical skills, weak institutions and weak inter-sectoral or non-collaborative legal frameworks as barriers were also listed by some 5% of national-level interviewees each. Local authority-level interviewees said that the main barriers were the unavailability of financial resources (23%), weak institutions (22%), low prioritisation by government or donors (11%), the main stakeholders lacking the power to take the necessary or planned steps (11%), insufficient implementation capacity (11%), unsupportive government or donor policies (11%), and unavailable technical expertise (11%). Insufficient interdepartmental or inter-sectoral institutional collaboration, and insufficient implementation capacity were named by some 24% of implementing partner interviewees each as main barriers, while some 18% named the low priority of EbA amongst government and donors and the unavailability of financial resources. Some 6% mentioned each of weak institutions, unavailable technical resources and weak interdepartmental legal frameworks as barriers.

Local-level opportunities for implementing EbA

The main political, institutional and capacity-related opportunities for implementing EbA at the local level listed by interviewees related to strong local institutions, strong local governance and regulations, and EbA 'champions.' Local-level understanding about EbA is now good, as EPIC has been active at the project sites since 2013, and Monty et al. (2017) describe how the project has contributed to the establishment of new local committees for risk reduction. National-level interviewees said that the main opportunities for implementing EbA at the local level were (in order of importance) strong local governance and regulations (33%), strong local institutions (27%), government prioritisation (20%), EbA 'champions' (13%) and appropriate incentives in place to motivate action (7%). Some 57% of local authority-level interviewees said that EbA 'champions' provided the main opportunity for implementing EbA at the local level, followed by strong local institutions (43%). Implementing partner interviewees said that the main opportunities were strong local governance and regulations (40%), strong local institutions (27%) and government prioritisation (20%). Some 7% of implementing partner interviewees felt that having the appropriate incentives in place to motivate action and EbA 'champions' each provided opportunities. Community-level interviewees said that the main opportunities were EbA 'champions' (49%), strong local institutions (23%), government prioritisation (11%) and strong local governance and regulation (11%). Just 6% of community-level interviewees felt that having the appropriate incentives in place to motivate action was a key opportunity. Although interviewees from different stakeholder groups didn't generally consider the presence of appropriate incentives in place to motivate action to be an important opportunity for implementing EbA at the local level, Monty et al. (2017) note that integrating eco-DRR or adaptation projects with livelihood development activities helps to provide incentives for action.

Provincial-level opportunities for implementing EbA

The main political, institutional and capacity-related opportunities for implementing EbA at the provincial level listed by interviewees related to strong governance and regulations, strong institutions, government prioritisation of the issue and EbA 'champions.' For example, a Committee for Prevention and Disaster Risk Management and Humanitarian Affairs was established in the Department of Foundiougne. This comprised of a range of regional officers from various technical services, and also served as EPIC's steering committee (Monty et al. 2017). National-level interviewees said that the main opportunities for implementing EbA at the provincial level were (in order of importance) strong

governance and regulations (31%), strong institutions and government prioritization (both 23%), EbA 'champions' (15%) and appropriate incentives in place to motivate action (8%). Some 50% of local authority level interviewees said that EbA 'champions' provided the main opportunity for implementing EbA at the regional level, followed by strong institutions (33%) and government prioritisation of the issue (17%). Implementing partner interviewees said that the main opportunities were strong governance and regulations (31%), strong institutions and government prioritization of the issue (both 23%). Some 15% and 8% of implementing partner interviewees, respectively, felt that EbA 'champions and having the appropriate incentives in place to motivate action provided opportunities.

National-level opportunities for implementing EbA

The main political, institutional and capacity-related opportunities for implementing EbA at the national level listed by interviewees related to EbA 'champions' and government prioritisation of the issue, strong institutions, and strong governance and regulations. Box 4 describes some of the key policies relating to climate change, disaster risk reduction and the environment in Senegal. National-level interviewees said that the main opportunities were (in order of importance) strong governance or regulations (29%), EbA 'champions' (24%), government prioritisation and appropriate incentives in place to motivate action (each 18%) and strong institutions (12%). Local authority-level interviewees identified EbA 'champions' (60%), strong institutions (20%) and government prioritisation (20%) as key opportunities. Implementing partner interviewees said that the main opportunities were strong institutions (27%), government prioritisation (27%), EbA 'champions' (27%), strong local governance or regulations (9%) and appropriate incentives in place to motivate action (9%).

Box 4: Policies relating to climate change, disaster risk reduction and the environment in Senegal

- The **Emergent Plan for Senegal (2014-2035)** promotes the prevention and reduction of major disaster risks through the development of contingency plans at national and regional levels, and the promotion of a culture of disaster risk prevention and management.
- The **Plan for National Organisation of Relief (2013)** facilitates the rapid mobilisation and engagement of exceptional means when public emergency services are overstretched because of the extent of a disaster.
- Senegal's **Intended Nationally Determined Contribution (2015-2020)** falls within the framework of the emergent plan for the country, as well as its sectoral management programmes. This tracks Senegal's progress on climate change adaptation and mitigation.

Source: Monty et al. (2017).

Is the EbA initiative sustainable?

Some 83% of national-level interviewees, 75% of local authority interviewees and 70% of implementing partner interviewees felt that capacity levels and the policy and institutional support available at the local level were not sufficient for the initiative to be sustainable in the long term. Reasons for this given by national-level interviewees included shortages of technical skills, finances and materials, notably the inadequacy of financial resources provided to transfer skills to local authorities. More capacity building is needed and awareness levels also need to increase. Local authority interviewees explained that stronger institutional capacities and technical skills amongst local people were needed for the initiative to be sustainable. Implementing partner interviewees felt a lack of monitoring of project implementation (including installed infrastructure) inhibited sustainability.

Similarly, at the provincial level, 67% of national-level interviewees, 75% of local authority interviewees and 67% of implementing partner interviewees declared that capacity levels and the policy and institutional support available were not sufficient for the initiative to be sustainable in the long term. National-level interviewees felt this was because of the lack of available technical and financial support, whereas local authority interviewees felt it was because the capacity of beneficiaries had not been sufficiently strengthened. A lack of manpower, a need for more capacity building amongst different

stakeholder groups and a need for further institutional support were cited by implementing partner interviewees by way of explanation.

However, 33% of national-level and implementing partner interviewees said that the policy and institutional support available and capacity levels present at the provincial level were sufficient for the initiative to be sustainable over the long term. National-level interviewees said this was because regional-level stakeholders have been trained to support the EbA initiative and regional directorates also provide support. These stakeholders must share what they have learned, however. Implementing partner interviewees qualified their opinion by stating that sustainability at the provincial level was only likely in the medium term, because of limits to financial, technical and institutional support.

At the national level, 83% of national-level interviewees, 75% of local authority interviewees and 67% of implementing partner interviewees felt that capacity levels and the policy and institutional support available were not sufficient for the initiative to be sustainable over the long term. National-level interviewees cited the inadequacy of budgets and resources allocated to national structures, particularly transmission to technical and capacity-related structures at the local level, as the main reason for this. Local authority interviewees felt it was because the government had not prioritised EbA. Implementing partner interviewees believed that a lack of financial resources combined with a lack of technical and institutional support contributed to the unsustainability of the initiative.

However,17% of national-level interviewees did feel that institutional support at the national level facilitated EbA implementation and meant that the initiative could be sustainable over the long term.

Opportunities for replication, scaling up or mainstreaming the EbA initiative or for influencing policy

National-level, local authority-level and implementing partner interviewees described various opportunities that had emerged for replicating, scaling up or mainstreaming the EbA initiative, for example through influencing government or donor policy:

- ***Inclusion in climate change policies***, such as the intended nationally determined contribution or the national adaptation plan.
- ***Complementary national policy change***, which can lead to widespread national deployment. For example, ecosystem-based approaches for DRR and climate change adaptation have been included in the National Wetland Policy (2015), integrating wetland conservation into disaster risk reduction (Monty et al. 2017).
- ***Changes in the attitudes of decision makers or planners***. For example, EPIC has been working at the project site since 2013, so there has been continuity and local understanding of EbA is now good. Community-level interviewees in particular were positive about EbA.
- ***Closer links between relevant government agencies***, to support cross-sectoral planning. For example, at the local level (the Foundiougne Department) a Committee for Prevention and Disaster Risk Management and Humanitarian Affairs has been established to ensure horizontal linkages amongst departments and the development of an operational plan, the first of its kind in Senegal (Monty et al. 2017).
- ***Collaboration amongst NGOs***. For example, a national platform to promote ANR has been established. This involves collaboration between IUCN, Word Vision, Environment and Development Action (ENDA) and Innovation Environnement Dévéloppement (IED) Africa (Monty et al. 2017).
- ***Capacity building and training activities*** (described in Box 3). These all contribute to wider scaling up of project interventions. For example, two south-south exchange visits were organised between project beneficiaries in Senegal and Burkina Faso to explore the potential for exporting different local innovations to each country. Project beneficiary communities have since expressed great interest in and adopted the practices they observed in other communities in both Burkina Faso and Senegal (Monty et al. 2017). The project also built capacity relating to EbA of the local Committee for Prevention and Disaster Risk Management and Humanitarian Affairs, which is in charge of disaster prevention and disaster risk management in the Fatick Region (Monty et al. 2017).

- ***New tools developed*** to support replication.
- ***Changes to donor policies,*** and thus possible financing.

Conclusions

Ecosystems protecting infrastructure and communities (EPIC) project activities in Senegal aimed to assess the risks and effects of climate change on poor people, and to demonstrate the economic benefits of EbA. Project activities implemented in Djilor District included the construction of anti-salt bunds, nursery establishment, applying assisted natural regeneration (ANR) techniques, reforestation, introducing new roosters, vegetable gardening and establishing mechanisms for regulating the exploitation of natural resources. Several types of training were also organised to strengthen the capacities of communities and government officials to facilitate EPIC project implementation as well as to promote scaling up of EbA approaches.

Effectiveness for human societies

EPIC project activities have clearly improved the resilience of local communities, improved their adaptive capacity and reduced their vulnerability. These improvements were felt widely and by a range of social groups in the Fatick Region (selected for EPIC interventions in part due to its overwhelming poverty levels and high vulnerability to climate change). Most community-level interviewees felt that those engaged with the project had experienced more improvements than others, but a few felt that improvements in resilience were widespread. Some felt women experienced more gains in resilience and adaptive capacity than men because they own most of the degraded land, which makes them particularly vulnerable. There was consensus amongst interviewees that improvements were long term.

A number of social co-benefits emerged from the EbA initiative. As above, these were experienced by all social groups, although project participants may have benefitted more than others. Some 14% of community level interviewees, however, felt there were cases where co-benefits affected some groups of people to the detriment of others.

Local knowledge or practices were taken on board during EPIC project implementation, but in some instances these needed to be integrated with new techniques to improve effectiveness.

A range of types of participatory processes were applied by the project, many of which were categorised as ‘functional,’ whereby people formed groups to meet predetermined objectives related to the project. The use of participatory processes had clearly supported implementation of the EbA initiative – they helped it win local support and commitment, raised awareness and led to a feeling of ownership and to self-reliance and mobilisation.

Effectiveness for the ecosystem

Climate change and land degradation through salinisation and erosion are the main threats to the local ecosystem in Djilor District. Natural barriers relating to the mangroves (that mitigate the advances of salt contamination) or forests (that protect the land against erosion) may have affected the resilience of local ecosystems. Thresholds related to salinisation and deforestation beyond which ecosystems could no longer provide services may be important for ecosystem resilience and ecosystem services provision.

The EbA initiative had improved ecosystem resilience and maintained, restored or improved ecosystem services provision at the project site and also further afield. For example, reforestation and ANR activities at the project sites also protected lowland areas from siltation. Bund construction helped prevent the salinisation of community arable, pastoral and forested land but also slowed down mudflat siltation, thus resulting in mangrove regeneration. Improvements in ecosystem service provision are already being experienced by people in the project intervention areas, and could be much longer term.

Financial effectiveness

No formal project cost-benefit analysis had been conducted, and interviewees found it difficult to assess the economic costs and benefits of the EbA initiative. Despite this, perceptions about whether the EbA

initiative was cost-effective were overwhelmingly positive amongst all stakeholders interviewed. All those interviewed also felt that on comparing the EbA approach with other intervention types or approaches, EbA approaches were the most cost-effective.

A range of broader economic benefits, as well as some costs, emerged from the EbA project. Benefits included decreased losses from disasters and other avoided costs, and improvements in land or service value or local income. Opportunity costs may have accrued when other land use options went untapped. Interviewees felt that the financial benefits of the EbA initiative would be long term.

Policy and institutional issues

Different stakeholder groups had very different perspectives on what the key political, institutional and capacity barriers to EbA implementation at the local level were. Across the different groups, insufficient implementation capacity, the unavailability of technical skills and financial resources, weak institutions, insufficient institutional collaboration, and a lack of stakeholder power were raised as key issues. Understanding of whether the EbA initiative is financially and economically effective remains poor, and communities need to be better prepared and equipped for concepts and tools relating to EbA. EPIC lacked quantitative data on project effectiveness and a strong scientific assessment of impact.

The main barriers to implementing EbA at the provincial level listed by interviewees related to institutional weaknesses and inadequate interdepartmental or inter-sectoral collaboration. At the national level, interviewees felt insufficient implementation capacity and financial resources, weak institutions and insufficient interdepartmental or inter-sectoral collaboration were key barriers.

The main opportunities for implementing EbA at the local level listed by interviewees related to strong local institutions, strong local governance and regulations, and EbA ‘champions.’ Local level understanding about EbA is now good, as EPIC has been active at the project sites since 2013, and the project has helped establish new local committees for risk reduction.

The main opportunities for implementing EbA at the provincial level listed by interviewees related to strong governance and regulations, strong institutions, government prioritisation of the issue and EbA ‘champions.’ At the national level, interviewees felt the main opportunities were provided by EbA ‘champions’ and government prioritisation of the issue, strong institutions, and strong governance and regulations.

Despite enthusiasm for the concept of EbA and a belief in its ability to provide long-term social, ecosystem-related and financial benefits, the majority of interviewees at all levels felt that capacity levels and the policy and institutional support available at local, regional and national levels were not sufficient for the EbA initiative to be sustainable over the long term. Reasons given for this related mainly to shortages of technical skills, institutional capacities, awareness levels, funding and materials. Some interviewees felt, however, that sustainability was likely thanks to the institutional support that was available at regional and national levels and the training provided by the project.

A number of opportunities had emerged for replicating, scaling up or mainstreaming the EbA initiative: inclusion in climate change policies and complementary national policy change, changes in the attitudes of decision makers or planners, closer links between relevant government agencies, collaboration amongst NGOs, capacity building and training activities, new tools and changes to donor policies.

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Ecosystem-based adaptation (EbA) is the use of biodiversity and ecosystem services as part of an overall strategy to help people to adapt to the adverse effects of climate change and promote sustainable development. This report presents the results of using our Framework for Assessing EbA Effectiveness at the Ecosystems Protecting Infrastructure and Communities project, Senegal. The findings will be combined with those from 12 other sites in 11 other countries to help show climate change policymakers when and why EbA is effective.

Project Report

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