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Ecosystem services in the National Adaptation Programmes of Action

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The extent to which ecosystem services have been considered in the National Adaptation Programmes of Action (NAPAs) and the proposed adaptation projects is assessed. By August 2010, 44 least developed countries had prepared their NAPAs in response to climate change. The NAPAs constitute a starting point for planning adaptation nationally and sub-nationally, but need to be evaluated and improved as new knowledge emerges. Ecosystem-based adaptation (EbA) is an emerging approach that recognizes that ecosystem services play an important role in reducing people's vulnerability to climate change. The importance of ecosystem services is acknowledged in more than 50% of the NAPAs. Approximately 22% of the proposed projects include ecosystem activities for social well-being or adaptation, with most of them in support of other adaptation measures (e.g. infrastructure). These projects deal mainly with regulating services (soil rehabilitation, erosion control and water regulation) and provisioning services (food, fibre and fuel wood). They also have the potential to promote integrative and cross-sectoral adaptation, as many of them consider multiple ecosystem services and beneficiary sectors. However, more technical, political and financial support is needed to foster the role of ecosystem services in adaptation.

Keywords: adaptation; ecosystem-based adaptation; ecosystem services; least-developed countries; National Adaptation Programmes of Action (NAPAs)

La mesure dans laquelle les services écosystémiques ont été considérés dans les programmes d'action nationaux d'adaptation (PANA) et les projets d'adaptation proposés est évaluée. En août 2010, 44 des pays les moins avancés avaient préparé leurs PANA, en réponse au changement climatique. Les PANA constituent un point de départ pour la planification de l'adaptation à l'échelle nationale et sous-nationale, mais doivent être évaluées et améliorées en fonction de l'évolution des connaissances. L'adaptation fondée sur les écosystèmes (EbA) est une approche émergente qui reconnaît que les services écosystémiques jouent un rôle important dans la réduction de la vulnérabilité des populations au changement climatique. L'importance des services écosystémiques est reconnu dans plus de 50% des PANA. Environ 22% des projets proposés comprennent des activités écosystémiques liées au bien-être social ou à l'adaptation, et la plupart d'entre eux proposent d'autres mesures d'adaptation (par exemple dans l'infrastructure). Ces projets portent principalement sur les services de régulation (réhabilitation des sols, lutte contre l'érosion et régulation de l'eau) et les services d'approvisionnement (alimentation, fibres et bois de chauffage). Ces projets ont le potentiel de promouvoir une adaptation intégrée et transversale, car beaucoup d'entre eux couvrent les multiples services écosystémiques et secteurs bénéficiaires. Cependant, un soutien plus technique, politique et financier est nécessaire pour favoriser le rôle des services écosystémiques dans l'adaptation.

Mots clés : Adaptation; adaptation fondée sur les écosystèmes; services écosystémiques; pays les moins avancés; Programmes d'Action Nationaux d'Adaptation (PANA)

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1. Introduction

Human and natural systems are influenced by climate variability and climate change, and the adverse effects will be most severely felt by societies in developing countries (IPCC, 2007). As the impacts of climate change threaten development gains, there is an urgent need for efficient and sustainable adaptation to climate change, an issue that is appearing with increasing frequency on the agendas of researchers, practitioners and decision makers (Adger et al., 2003). Local adaptation is crucial for reducing the vulnerabilities of communities and their surrounding ecological systems (Tompkins and Adger, 2004). As national policies influence local adaptive capacity, the mainstreaming of adaptation into wider national development agendas is also of critical importance (Huq et al., 2003; Mitchell et al., 2006).

After it was internationally recognized that the least developed countries (LDCs) are among the most vulnerable to the impacts of climate change, the National Adaptation Programmes of Action (NAPAs) were established during the Seventh Session of the Conference of Parties (COP 7) of the United Nations Framework Convention on Climate Change (UNFCCC) in Marrakesh (UNFCCC, 2002). With the NAPAs, the LDCs identify and communicate their most urgent adaptation needs (i.e. 'those for which further delay would increase vulnerability and/or costs at a later stage'[1]) and prioritize actions to respond to them. According to the UNFCCC NAPAs website, by August 2010, 44 LDCs had submitted their NAPA documents to the UNFCCC Secretariat with the purpose of advancing the implementation of proposed projects. Although the quality of the NAPAs is sometimes questioned, especially regarding their effectiveness, feasibility and sustainability (DANIDA/GEF, 2009), it must be acknowledged that they constitute a starting point both for planning adaptation at the national level and defining projects at the sub-national level (Osman-Elasha and Downing, 2007). Almost a decade after having been established, the NAPAs need to be reevaluated and improved in the light of new discoveries and as new approaches emerge.

Ecosystem-based adaptation (EbA) is an emerging approach that recognizes that ecosystem services play an important role in reducing the vulnerability of people to climate change (CBD, 2009; Turner et al., 2009; World Bank, 2009). Its main objectives are to promote societal resilience through the management or conservation of ecosystems (Andrade Pérez et al., 2010). Examples include the restoration of mangroves for protecting coastal settlements against storm surges, the conservation of upstream forests to regulate water flow and control erosion for the benefit of vulnerable communities, and sustainable forest management for the provision of safety nets to livelihoods (CBD, 2009). Although EbA can provide opportunities for sustainable adaptation, it has been largely missed in the design of national adaptation strategies, which have focused on technological and infrastructure developments such as the construction of dams and irrigation facilities (CBD, 2009).

The extent to which ecosystem services have been considered in NAPAs is assessed by analysing the content of the submitted documents to determine, first, whether the importance of ecosystem services is considered in the national economic and socio-ecological analyses and vulnerability assessments of each NAPA and, second, whether the proposed adaptation projects encompass those activities (and if so, which ones) that are related to ecosystem services.

2. Background

2.1. The National Adaptation Programmes of Action

The rationale behind the NAPAs rests on the LDCs' high level of vulnerability and low adaptive capacity. The NAPA process allows these countries to assess and report their vulnerability and

immediate adaptation needs, proceed with national adaptation planning, and define priority projects for implementation and funding. In principle, the NAPAs should build upon national development goals and frameworks, and promote synergies with sectoral plans and multilateral environmental agreements. The NAPAs guidelines advocate the use of readily available information and impact assessments, through a bottom-up approach that gives prominence to stakeholder and community-level inputs. Institutional and community stakeholder consultation is central to identifying existing coping strategies, current and potential vulnerabilities, possible adaptation responses, and criteria for prioritizing these responses (LEG, 2002).

Developing the NAPAs is also intended to build capacity by raising awareness and enhancing preparedness among the institutions, sectors and communities involved. In each LDC, a national NAPA team, composed of a lead agency and stakeholder representatives, guides the preparation of the action plan. Even though the NAPAs are designed to respond to the most urgent and immediate adaptation needs, they constitute a first step towards medium- and long-term adaptation. They are also expected to be 'living documents' (LEG, 2002) in which sectoral and community vulnerabilities, and the relevance and urgency of the proposed activities, are reviewed and revised periodically. Furthermore, the capacity built within NAPA teams and other networks during the process of preparing the plans can facilitate and catalyse the design of broader national policies or programmes of action.

2.2. Ecosystem-based adaptation

Societies derive benefits from ecosystem structures and functioning, for example through food and fibre production, water filtration, climate regulation and maintenance of soil fertility. Ecosystem services are those aspects of ecosystems that are consumed or utilized to yield human well-being (Turner and Daily, 2008), and are distinguished by the Millennium Ecosystem Assessment (MEA) into four broad categories: provisioning (e.g. timber), regulating (e.g. water filtration), cultural (e.g. spiritual grounds) and supporting (e.g. nutrient cycling) (MEA, 2005). Provisioning, regulating and cultural services directly contribute to all components of human well-being (Figure 1), and supporting

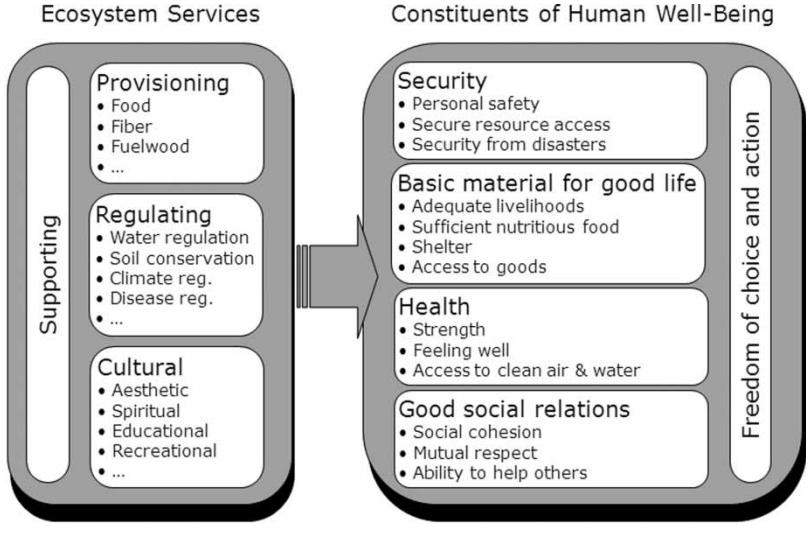

FIGURE 1 Examples of ecosystem services and their links to human well-being

services are necessary for the production of all other services. Hence, losses in the quantity, quality and flow of ecosystem services can impact societies negatively (MEA, 2005).

The constituents of human well-being (Figure 1) directly relate to the dimensions of social vulnerability to climate change: that is, exposure, sensitivity and adaptive capacity (Locatelli et al., 2008). For instance, personal safety and security are related to people's exposure and sensitivity to climate-induced disasters. Adequate livelihoods and sufficient nutritious food (e.g. derived from non-timber forest products and fish) can determine the sensitivity and adaptive capacity of a society facing a climate-related threat (e.g. drought, which affects agricultural yields).

A secure flow of ecosystem services has the potential to reduce social vulnerability to climate variability and change (Turner et al., 2009). For example, mangroves protect coastal areas against storms and waves, which may become more intense in the future with climate change and climate-induced sea level rise (Adger et al., 2005; Das and Vincent, 2009). Forest products can provide safety nets to local communities when climate variability causes crop failures (Paavola, 2008; Fisher, Chaudhury et al., 2010), and urban forests reduce temperatures during heat waves (Gill et al., 2007). Hydrological ecosystem services (e.g. storm flow regulation, base flow conservation) can play an important role in buffering the impacts of climate change on water users (Brauman et al., 2007). Although the role of forest cover for storm flow reduction, especially during extreme rainfall events and large-scale floods, is debated (FAO/CIFOR, 2005; Bradshaw et al., 2007), its role in preventing average and most frequent floods should not be underestimated (Locatelli and Vignola, 2009).

In this sense, EbA is an anthropocentric approach and focuses on the use of ecosystem services for the adaptation of people to climate change. Accordingly, the Convention on Biological Diversity (CBD) defines EbA as

> the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change. Ecosystem-based adaptation uses the range of opportunities for the sustainable management, conservation, and restoration of ecosystems to provide services that enable people to adapt to the impacts of climate change. It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change. (CBD, 2009, p.41)

In addition to preparing communities for future hazards, EbA strategies can also result in immediate benefits. For example, although watershed conservation and wetland restoration can act as buffers to the future impacts of floods and mudslides caused by the extreme events associated with climate change, it can, in the present, stabilize slopes surrounding the relevant communities and ensure a continuing supply of drinking water (Heath et al., 2009). To ensure that ecosystems can both contribute to the adaptation of the broader society and provide multiple benefits, EbA strategies aim to reduce both the current threats to ecosystem services (e.g. land-use change and over-harvesting) and ecosystem vulnerability to future climate change. EbA thus constitutes an overarching framework for both ecosystems and societies, one in which strategies that aid the adaptation of ecosystems (i.e. 'adaptation for ecosystems') are needed to ensure the role of ecosystems for social adaptation (i.e. 'ecosystems for adaptation') (Locatelli et al., 2008).

Proactive adaptive strategies that allow for social learning and flexibility in responding to environmental feedbacks are essential to promote long-term resilience for socio-ecological systems (Olsson et al., 2004) and, consequently, adaptive management should be a central component of EbA (Andrade Pérez et al., 2010). Furthermore, EbA must involve the multiple sectors that are concerned with ecosystem management or the benefits of ecosystem services at multiple scales (Vignola et al., 2009).

3. Materials and method

The NAPA documents were retrieved from the UNFCCC website on 1 August 2010 and the content of the 44 NAPAs submitted to the UNFCCC by this date was examined (UNFCCC, 2010). The content of these documents was analysed quantitatively and qualitatively with regards to EbA.

Two distinct content sections were included in the analysis: the NAPA background sections and the NAPA project profiles. The NAPAs background sections describe the national circumstances, the main climate change impacts, main sectors and regions impacted, vulnerabilities and urgent adaptation needs. The content was examined for references related to the importance of ecosystem services, following the fourfold classification of the MEA (Figure 1). References were selected only when an explicit link between ecosystem services and human well-being or societal adaptation was identified (e.g. mangrove ecosystems and their regulating and provisioning services mentioned as important for the protection of human settlements against storms and for providing goods, such as fish or wood). Supporting services, such as nutrient cycling, were omitted from the analysis in order to focus on those final ecosystem services that directly contribute to human well-being and adaptation. Although supporting services and their evaluation are extremely important, conceptual and methodological issues still remain regarding their assessment. Boyd and Banzhaf (2007) propose that the assessments of ecosystem services focus on final services.

From the 44 NAPA documents, 468 project profiles were analysed. Detailed information, including their priority index, was available in the documents themselves or on the UNFCCC NAPAs website itself. The proposed adaptation projects were examined using a predefined classification tree including four project categories (Figure 2):

1. 'Projects without ecosystem activities' are those that do not include any direct ecosystem management activities (conservation, restoration, sustainable management). Examples include the development of early warning systems or meteorological stations, research and awareness campaigns, dam building, and infrastructure development for coastal protection or disaster risk reduction.

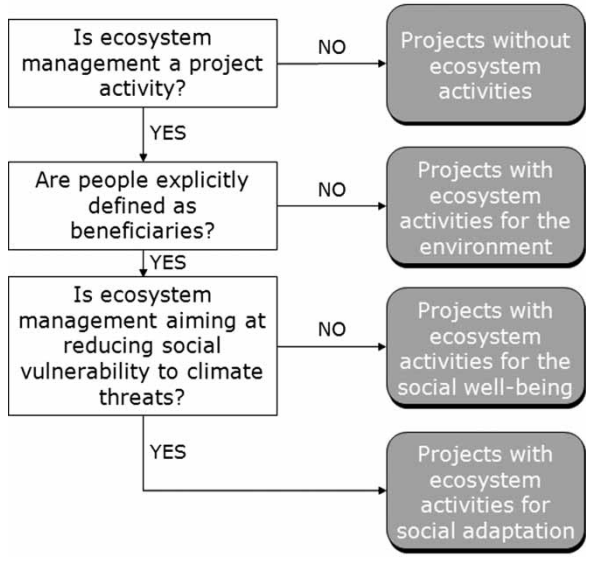

FIGURE 2 Classification tree for the analysis of projects

The introduction of improved crop varieties is included in this category, unless accompanied by ecosystem management (e.g. for soil erosion control).
2. 'Projects with ecosystem activities for the environment' aim at conserving or restoring ecosystems (including reducing threats to ecosystems, such as land-use change, over-harvesting and climate change), but do not explicitly indicate how local people or society (at the national level) will benefit from ecosystem services. Carbon projects, which aim at mitigating climate change through carbon sequestration, are also included in this category (unless social benefits from ecosystem services other than carbon are mentioned).
3. 'Projects with ecosystem activities for social well-being' aim at conserving or restoring ecosystems and explicitly indicate the potential social benefits from ecosystem services (e.g. livelihood diversification, food security, water flow regulation). These projects do not explicitly refer to social vulnerability to climate threats and how ecosystem services will reduce this vulnerability.
4. 'Projects with ecosystem activities for social adaptation' aim at conserving or restoring ecosystems by reducing social vulnerability to climate threats. These projects clearly describe the adaptation benefits, for example, reduced social vulnerability to expected floods, droughts or heat waves.

Although many of the projects appear to utilize the same ecosystem management activities (especially those in categories 3 and 4), projects were categorized only according to whether they made explicit reference to climate risks and impacts (e.g. drought) and the predicted project outcomes (e.g. increased water security under drought). Project descriptions were thus not interpreted; that is, no assumptions were made regarding the intentions of the project planners.

4. Results

4.1. Background sections

Ecosystem services (and their role) were mentioned at least once in 30 of the 44 NAPAs evaluated, and 10 of these mentioned the importance of such services six[2] or more times (Table 1). The importance of ecosystem services is mostly mentioned in relation to providing the basic materials for a good life (70% of the total 154 references), such as sufficient nutritious food and adequate livelihoods. For example, in their NAPA, Tanzania stated that 'wildlife forms an important source of food and income for some local communities' (URT, 2007, p.12), while Lao PDR mentioned that 'access to a range of "common" natural resources represents a safety net or "insurance policy" for rural households. It follows then

TABLE 1 Number of references to ecosystem services in the NAPA background content sections

Number of NAPAs	Countries	Number of references
10	Comoros, Central African Republic, Djibouti, Eritrea, Gambia, Lao PDR, Maldives, Tanzania, Tuvalu, Uganda	6 or more
8	Haiti, Guinea-Bissau, Kiribati, Lesotho, Samoa, Solomon Islands, Vanuatu, Zambia	3–5
12	Burkina Faso, Burundi, Cambodia, Cape Verde, Liberia, Madagascar, Malawi, Mali, Mauritania, Sierra Leone, Togo, Yemen	1–2
14	Afghanistan, Bangladesh, Benin, Bhutan, Chad, Democratic Republic of Congo, Ethiopia, Guinea, Mozambique, Niger, Rwanda, Sao Tome and Principe, Senegal, Sudan	0

that any loss of these resources or loss of access to them represents a significant threat to household security and forces families into a vulnerable situation' (Lao PDR, 2009, p.36).

Security from disasters, both personal security and having secure access to vital resources, is also considered in 23% of the references. In the NAPA of Comoros, for instance, the importance of regulating forest ecosystem services is emphasized, and deforestation is mentioned as a cause of river flooding, landslides and associated damages to settlements and infrastructure. The nine references (6%) related to the importance of ecosystem services for human health mention the provision of medicinal plants from ecosystems such as forests. For example, Gambia's NAPA states that 'forest resources are an important or supplementary source of livelihood for the poor, and constitute the bedrock for traditional medicines' (Gambia, 2007, p.24). The few references related to good social relations (2%) touch upon the importance of ecosystems as sacred grounds and as foundations of cultural heritage.

Forest and woodlands are the most-often cited providers of ecosystem services (45% of the references, Figure 3). For example, Lesotho's NAPA asserts that 'forests resources play a critical role in the vulnerable zones; in particular for fuel wood, prevention of soil erosion, income generation, scenery for tourist attraction, building material, forage and shelter' (Lesotho, 2007, p.4). Coastal and marine ecosystems are also often mentioned (28% of the references). In the Maldives NAPA, coral reefs are associated with the two major national economic sectors of tourism and fishery, providing for more than 80% of the total revenues of the country. Coral reefs are also mentioned for their role in protecting the vulnerable islands against sea forces. Species diversity is also mentioned several times in relation to economic, cultural and scientific values (22% of the references). Biodiversity is referenced as essential for tourism-related livelihoods in a number of NAPAs (26 references) and as the foundation of traditional medicinal practices (five references).

In the NAPAs of the Central African Republic, Gambia, the Maldives and Uganda, the importance of ecosystem services is mentioned more than 10 times. The Central African Republic's NAPA links food security and the vulnerability of forest-based livelihoods to current and projected levels of forest degradation due to climate change and other pressures. It is thought that forest degradation will lead to a decrease in employment opportunities, eco-tourism revenues and the availability of non-timber

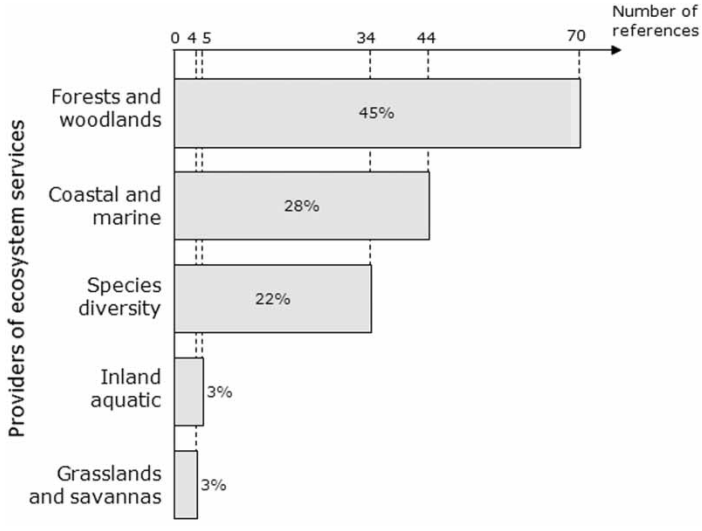

FIGURE 3 Number of references to ecosystem services per service provider

forest products, and an increase in forest and agricultural product prices, biodiversity loss and poverty in general. Uganda's NAPA associates forest ecosystem services to almost all aspects of human well-being. The important role that forest products (e.g. timber, poles, rattan, bamboo, food, fodder, medicine and firewood) and forest services (e.g. biodiversity habitat, moderating of micro climate, erosion and desertification control, shade and wind breaks for enhancing agricultural productivity) play in the social and economic development of the country is frequently mentioned.

4.2. Project profiles

Thirty-one per cent (144/468) of the NAPAs projects analysed encompass ecosystem activities that aim at conservation, restoration or sustainable management (Figure 4). Of these, 37 projects do not explicitly indicate how local people or society at the national level will benefit from ecosystem services. For example, Sierra Leone includes a project targeting the establishment of new forest reserves, protected areas and national parks. The main objectives of this are to conserve biodiversity, limit deforestation and increase forest cover. The ecosystem service of carbon sequestration is mentioned, but no other services that benefit local communities or society at the national level are described. A project in Guinea focuses on protecting forests against fire and deforestation through fire management and fencing. This project can potentially aid the adaptation of the country's forest ecosystems, but no benefits are planned for the adaptation of society.

Projects with ecosystem activities for social well-being represent 6% of the total (30 projects). For example, the Central African Republic's NAPA proposes promoting urban and suburban forestry to enhance the incomes of local people (through the production of shea oil and butter) and providing urban centres with firewood and timber. Sierra Leone's NAPA proposes rehabilitating degraded coastal areas by establishing mangrove plantations to restore the ecological integrity of the coastal zones and improve community livelihoods.

Projects with ecosystem activities for social adaptation represent 16% of the total (77 projects). For instance, Bangladesh's NAPA suggests protecting vulnerable communities from natural hazards by community participation in creating green shelterbelts along the coastline. Projects proposed by Comoros include one targeting watershed rehabilitation (with multiple-use plantations, restoration of degraded forests, and agroforestry) to address shortages of water, firewood and timber, and reduce social vulnerability.

Most of the ecosystem activities proposed in the projects for social well-being and social adaptation to climate (total of 107 projects) focus on more than one type of ecosystem services. For example, Benin

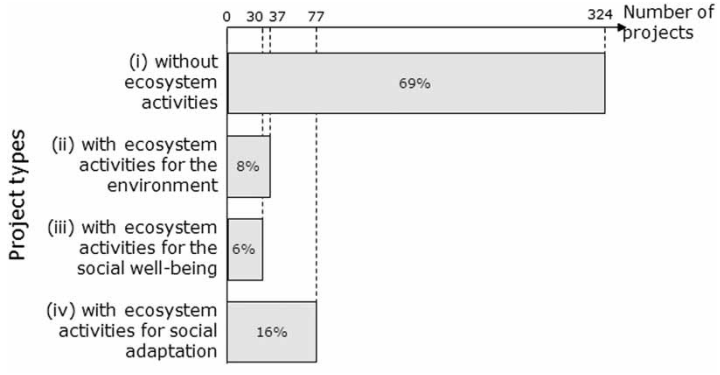

FIGURE 4 Number of projects included in the NAPAs per project category

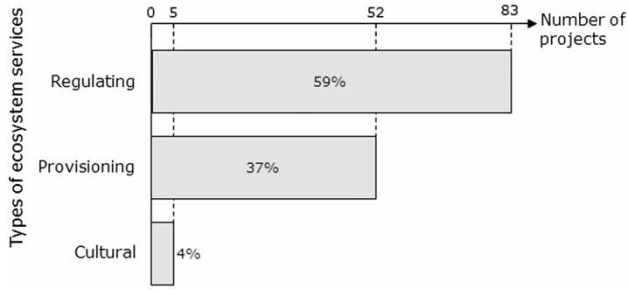

FIGURE 5 Types of ecosystem services considered in the projects with ecosystem activities for social well-being and social adaptation to climate

includes forest restoration and sustainable forest management activities to ensure fuel wood supply (provisioning services), rehabilitate soils, and control erosion (regulating services) in the NAPA second priority project. In Cambodia, a mangrove restoration project aims to protect coastal zones from natural hazards, rehabilitating soils for erosion control and water flow regulation, preventing salt-water intrusion (regulating services) and restocking fisheries (provisioning services).

Regulating and provisioning services are included in 83 projects and 52 projects, respectively (Figure 5). Regulating services are most frequently considered for soil rehabilitation, erosion control and water flow regulation (groundwater and runoff regulation), while provisioning services are mostly proposed for food (e.g. restocking of fisheries), fodder, fibre and fuel wood. Cultural services, considered in only five projects, are associated with tourism.

Most of the projects with ecosystem activities for social well-being or adaptation integrate ecosystem management activities in support of infrastructure or other measures (60% of a total of 107 projects). In a Cambodian project, for example, the rehabilitation of dams in Takeo and Kampong Speu provinces, which is an infrastructure measure, is supported by watershed reforestation (an ecosystem management activity proposed to further improve water supply and quality). Similarly, the development of water drilling infrastructure in the eighth priority project of Mali is combined with reforestation activities for water regulation. The NAPA of Haiti suggests reforestation together with technical solutions (dry walls, gabions and stone lines) in several projects targeting watershed restoration for reducing the negative impacts of extreme climate events.

Analysis of the sectoral benefits considered in the projects that encompass ecosystem activities for social well-being or adaptation highlights the potential of EbA strategies for achieving multiple benefits across sectors. Several sectors are usually described as beneficiaries of the activities in these projects – 176 potential sectoral benefits are mentioned in the 107 projects analysed (Figure 6). For example, in Djibouti, mangrove restoration is expected to contribute to food security (by restocking fisheries and controlling erosion for the enhancement of agriculture) and to the adaptation of coastal zones and the water sector (by protecting settlements against storms, controlling salt water intrusion and contributing to groundwater recharge). In Burkina Faso, a project to manage natural vegetation sustainably and promote non-timber forest products is expected to generate benefits for local livelihoods in terms of food (e.g. edible forest products), incomes (e.g. sales of non-timber forest products) and health (e.g. traditional medicines derived from forests).

All but three countries (the Democratic Republic of Congo, Liberia, and Sao Tome and Principe) propose at least one project that encompasses ecosystem activities for social well-being or social adaptation to climate (Table 2). In 10 countries, more than half of the projects proposed in the NAPAs

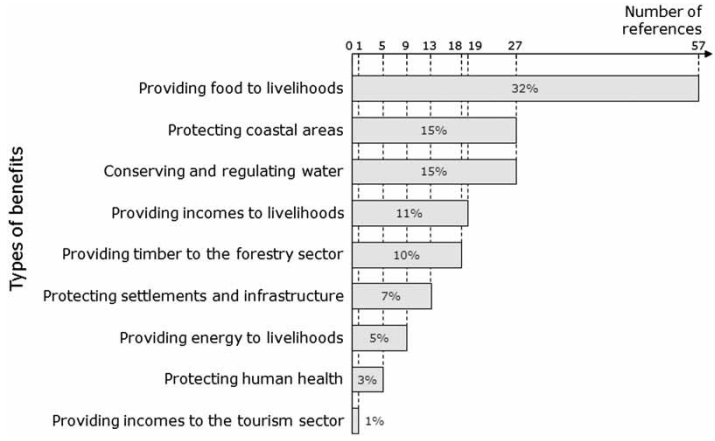

FIGURE 6 Number of sectors referenced as beneficiaries in the projects with ecosystem activities for social well-being and social adaptation to climate

portfolios include these activities; three of them (Cape Verde, Afghanistan and Mozambique) have only two to four projects in total, with one or two projects integrating ecosystem activities for social well-being or social adaptation. The NAPAs of the seven other countries (Benin, Djibouti, Haiti, Senegal, Solomon Islands, Sudan and Tanzania) have three to nine projects with ecosystem activities for social well-being or social adaptation.

The ranking given by the NAPAs country teams to projects including ecosystem activities for social well-being or social adaptation also varies greatly. Although the NAPAs of Bangladesh and Rwanda include only one project each with ecosystem activities for social adaptation, these are given the highest priority ranking. In the Central African Republic, the two projects with ecosystem activities for social well-being are in the second and third priority ranks. By contrast, the six top-ranked projects of Mali do not include any ecosystem management activities, and in the Maldives, the sole project with ecosystem activities for social adaptation is ranked ninth out of 11. Sixteen NAPAs (Bhutan, Burundi, Comoros, Ethiopia, Gambia, Guinea-Bissau, Lao PDR, Lesotho, Liberia, Madagascar, Maldives, Mali,

Table 2 Number of projects with ecosystem activities for social well-being and social adaptation to climate per NAPA of country

Number of NAPAs	Countries	Number of projects
5	Haiti, Djibouti, Guinea, Mali, Senegal	5 or more
12	Burundi, Benin, Burkina Faso, Cambodia, Comoros, Mauritania, Niger, Solomon Islands, Sudan, Tanzania, Uganda, Yemen	3–4
10	Bhutan, Cape Verde, Central African Republic, Chad, Gambia, Kiribati, Mozambique, Sierra Leone, Tuvalu, Vanuatu	2
14	Afghanistan, Bangladesh, Eritrea, Ethiopia, Guinea-Bissau, Lao PDR, Lesotho, Madagascar, Malawi, Maldives, Rwanda, Samoa, Togo, Zambia	1
3	Democratic Republic of Congo, Liberia, Sao Tome and Principe	0

Mauritania, Sao Tome and Principe, Sierra Leone and Yemen) do not include any projects with ecosystem activities for social well-being or social adaptation that are ranked among the top three projects (which are those most likely to be implemented first).

5. Discussion

Given the fact that the importance of ecosystems for the well-being of societies is stressed in the NAPAs guidelines (LEG, 2002), and that an ecosystem approach is encouraged therein, one would expect to find more related references as well as more projects considering ecosystem services; however, 15 NAPAs provide no mention at all in the background sections of the importance of ecosystem services, and most NAPAs projects do not include ecosystem management activities. Indeed, there are only 10 NAPAs in which 50% or more of the projects mention ecosystem services for social well-being or adaptation.

The 77 projects with ecosystem activities for social adaptation explicitly address the objective of reducing societal vulnerabilities through ecosystem services ('ecosystems for adaptation'). None, however, defines parallel measures for adapting ecosystems ('adaptation for ecosystems'). This can be explained by the fact that, before considering adaptation for ecosystems to climate change, projects have to address other threats to ecosystems in the short term. If the ecosystem is threatened by land-use change and is to be converted in the coming years, it is irrelevant to plan for its adaptation to climate change. Among the 37 projects with ecosystem measures for the environment, some encompass strategies that can potentially aid the adaptation of ecosystems. However, none of them considers social vulnerabilities and well-being and the role of ecosystems in social adaptation. Owing to their focus on nature only, they resemble typical conservation projects.

The absence of references in some NAPAs that link ecosystem services to human well-being or adaptation indicates missed opportunities when considering certain aspects of vulnerability, particularly for those social groups or economic sectors that are dependent on ecological resources for their livelihoods (Adger, 2000). The inclusion of ecosystem services can both facilitate the identification of stakeholders by linking ecosystem managers or owners to the stakeholders representing the demand side (Locatelli et al., 2011) and provide a better understanding of the potential winners and losers of specific changes in socio-ecological systems due to climate change or other pressures (Metzger et al., 2008).

The sectoral emphasis of the NAPAs process may have led teams away from a holistic identification of the causes of vulnerability, including ecosystem degradation. The Least Developed Countries Fund framework has been judged to leave no room for a programmatic approach to adaptation. Instead, NAPAs teams have been urged to use 'narrowing down' processes for the prioritization of sectoral activities (DANIDA/GEF, 2009), thus missing the opportunity to integrate cross-sectoral planning. The difficulties in proceeding with multi-sectoral planning are important barriers to EbA, because it requires involving both the sectors that manage ecosystems and those that benefit from ecosystem services. Moreover, civil society stakeholders have expressed concerns that the systemic and structural causes of climate change vulnerability (e.g. land access and tenure, and lack of institutional adaptive capacity), which can be detrimental for the consideration of EbA, have been inadequately addressed in the NAPAs process (DANIDA/GEF, 2009).

When degraded ecosystems or insecure access to services are connected to social vulnerability in NAPAs, statements are often very general, not supported by evidence and not directly related to the proposed projects. In most of the NAPAs examples, the links between ecosystems and services, and those between services and human well-being or adaptation, are not substantiated and need to be explored. These links are still open research issues, and not only in the context of the NAPAs (Turner

and Daily, 2008; Fisher et al., 2009). The lack of knowledge regarding the links between ecosystem structures or functions and services can lead to misconceptions about service delivery from different ecosystem types. For example, it is not always guaranteed that reforestation will solve water problems, as water scarcity might in fact increase when watersheds are reforested in dry areas (Locatelli and Vignola, 2009). A clear delineation between ecological functions, their direct and indirect contributions to human welfare in the form of services, and the benefits they generate, is crucial to improve decision processes (Boyd and Banzhaf, 2007; Wallace, 2007). A clear understanding of the spatial distribution of where the ecological function occurs is required, where the provision of the service can be assessed and, ultimately, where the benefits are appreciated (Fisher, Chaudhury et al., 2010; Fisher, Kulindwa et al., 2010; Balmford et al., 2011; de Groot et al., 2010).

The lack of knowledge about the role of ecosystem services in adaptation is an important barrier to the development of EbA. EbA is not a panacea, but it has the potential to improve the sustainability of both conservation and development strategies. More research is needed to evaluate when, where and the type of problems for which EbA is an effective and efficient approach. It is also essential to build bridges between 'scientific' knowledge and traditional local knowledge, as indigenous and local people have been adapting to change for centuries and have used their ecosystems for this purpose. Decisions concerning EbA need to be supported by risk assessments, scenario planning and adaptive management approaches that recognize the occurrence of potential trade-offs under uncertainty (Rodríguez et al., 2006). Comprehensive and efficient monitoring methods need to be developed and applied to provide information about social–ecological systems and allow for the adjustment of management actions under changing conditions (Fisher, Kulindwa et al., 2010).

Much can be learned during the process of implementation of NAPA projects. During initial implementation phases, critical knowledge gaps on ecosystem structures, functioning and services can be identified and communicated through national channels and the UNFCCC platform to encourage research projects that scientists could undertake in association with local organizations. Some NAPAs projects could become long-term research sites for studying questions related to social vulnerability and ecosystem services.

The infrequent consideration of ecosystem services in NAPAs can be explained by a lack of capacity or guidance for applying ecosystem-based approaches to adaptation. The NAPAs guidelines themselves provide some basis for using the ecosystem approach as defined by the CBD. This approach comprises a strategy and a decision-making framework for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way through the consideration of diverse social and economic factors. It is the primary framework for action under the CBD and is recognized as the basis for building synergies between the three Rio conventions to achieve their (mutually supportive) objectives (CBD, 2010). The NAPAs guidelines strongly advocate both maximizing opportunities for synergies between adaptation activities and multilateral environmental agreements and exploring the links with other plans, such as the National Biodiversity Strategies and Action Plans (LEG, 2002). Synergies with multilateral environmental agreements have been used as one criterion for ranking project activities in the NAPAs processes of most countries (with varying weight). However, very few NAPAs in fact demonstrate planning activities based on a synergistic approach.

The ecosystem approach incorporates adaptive management to address the complex and dynamic nature of ecosystems, in conditions of imperfect knowledge related to their functioning (Howard and Taylor, 2010), something that is essential for the implementation of EbA strategies. All of the 12 interlinked principles of the approach are important for EbA, for example, the inclusion of all relevant sectors and stakeholders in the planning process, consideration of indigenous knowledge, management of ecosystems within a social and economic context and related trade-offs, the balance between conservation and the appropriate use of biodiversity, and provision of incentives for sustainable use (CBD,

2000). Another NAPAs analysis (Stucki and Smith, 2011) has shown that only two of the 436 NAPAs projects analysed followed a truly integrated approach similar to the principles of the ecosystem approach. (These were Comoros, 'Reconstitution of basin slopes', and Eritrea, 'Groundwater recharge for irrigation wells'.) Stucki and Smith concluded that the basic principles of broad, landscape-level or ecosystem-scale approaches were not present in most NAPAs projects, including ecosystem management.

The ecosystem approach of the CBD is highly relevant for the planning and implementation of EbA projects. Other approaches, such as those of the MEA and the Economics of Ecosystems and Biodiversity (TEEB), are important for recognizing the value of ecosystem services and integrating them into sectoral and cross-sectoral decision making. The MEA framework makes explicit the links between ecosystems and human well-being. This influential framework for analysing social–ecological systems has resulted in policies and practices for enhancing ecosystem services and human well-being (Carpenter et al., 2009). Through the concept of ecosystem services, decision making can be based on tangible assets associated with socio-economic sectors (Bateman et al., 2011).

The low uptake of ecosystem services in the NAPAs project profiles could also be attributed to the lack of both awareness and regional and national data regarding the social, ecological and economic values of ecosystem services in a context of climate change. The valuation of ecosystem services has been a complicated task in the scientific community (Nunes and van den Bergh, 2001; Nijkamp et al., 2008), although in recent years there has been a large increase in such studies (Bateman et al., 2011). There is, however, no standardized definition and system of measurement for ecosystem services. This has resulted in a lack of consensus, and a panoply of meanings and classifications (Boyd and Banzhaf, 2007; de Groot et al., 2010). Furthermore, many LDCs lack the capacity to undertake such valuations and integrate them into national planning processes. This may have led NAPAs teams to opt for 'tried-and-tested' measures that are easily costed and for which data are readily available.

Although economic values are not the only influencing factors in decision making, they do have a major role to play in it as indicators of the most effective ways to invest funds (Emerton, 2008). Clearly, economic valuations of ecosystem services can lead to a more accurate accounting of the costs and benefits of different policy options. However, this has rarely been applied in LDC settings due to the very particular methodological challenges. Novel approaches that involve group-based participatory and deliberative choice methods, such as those tested in the Solomon Islands, can result in a more sophisticated view of ecological–cultural linkages, collective stakeholder learning, and overall awareness of the consequences of human actions for the environment (Kenter et al., 2011).

The MEA did not focus extensively on the economics of ecosystem change, so the TEEB study introduced a framework to develop this. According to TEEB, maintaining nature's capacity to cushion the impacts of climate change on people is often less costly than having to replace lost ecosystem functions through the use of heavy infrastructure or technology. In many cases an ecosystem investment can be justified solely on the basis of one valuable service in comparison to an engineered solution. However, such an investment becomes even more attractive when the whole range of services and benefits provided by this particular ecosystem is taken into consideration (TEEB, 2009).

Other approaches have sought to take the MEA and TEEB further and might be used to design EbA measures. For example, Bateman et al. (2011) consider ecological assets to be the stocks of potential services that the ecosystem, conditioned by structure and processes, might provide. The same ecosystem good can generate very different benefit values depending on the context (e.g. location) and timing of delivery. The work of Bateman and colleagues has provided much of the economic methodology for the UK National Ecosystem Assessment (UK NEA), a direct successor to the MEA, and takes into account the conceptual and scientific advances that have arisen since 2005.

More national and international political support is needed to integrate these approaches into planning processes, overcome the challenges of cross-sectoral and multi-stakeholder coordination, and

reap the full benefits of EbA. Stand-alone localized or single-sector adaptation responses will not be sufficient to achieve long-term sustainable adaptation. Strong institutions with relevant capacity, empowerment and ownership of the NAPAs process are necessary to support the good practices already taking place and integrate them into strategic national planning. In this context, local institutions should be considered as key actors in adaptation planning, building on their potential to efficiently detect vulnerability and define possible adaptation responses and outcomes.

Financial support will be critical for capacity-building, extension services, implementation and monitoring of projects. It will also be necessary to compensate for trade-offs between short-term gains of intensive and exploitative land uses, on the one hand, and the long-term benefits of ecosystem approaches in cases where they will take longer to manifest, on the other, such as those observed in the transition from intensive agriculture to tree-based systems (Verchot et al., 2007). In the wake of the Green Climate Fund design and the revision of the NAPAs process, it is timely to consider the above issues in formulating criteria for the funding of national adaptation strategies. Criteria could include inter-departmental and cross-sectoral cooperation, synergies with multilateral environmental agreements, co-benefits and involvement of local institutions.

6. Conclusion

With a twofold content analysis of the 44 NAPAs documents, the role of ecosystem services in the background sections and the proposed adaptation projects was examined. The importance of ecosystem services for human well-being, whether it concerns communities directly or the broader economic sectors, is mentioned at least once in more than half of the NAPAs. However, 15 NAPAs do not include any references at all related to ecosystem services. Ecosystem services are mostly mentioned for their role both in providing basic materials for a 'good life' (e.g. sufficient nutritious food or livelihoods) and enhancing security under disaster conditions. The ecosystem services most often considered are those provided by forest, woodland, coastal and marine ecosystems.

Although the majority of the proposed projects in the NAPAs do not encompass any ecosystem management activities for either increased resilience or provision of ecosystem services, there are positive signs. Almost all NAPAs present at least one project with ecosystem activities for social well-being or adaptation and, in some countries, these projects are high on the priority list. Technical adaptation measures are frequently supported by ecosystem services and some projects focus exclusively on EbA. Several projects consider ecosystem services for multiple benefits (e.g. adaptation, poverty alleviation, biodiversity conservation, and water and food security) and multiple beneficiary sectors.

An opportunity to address the knowledge and institutional gaps for EbA exists during the revision and implementation of the NAPAs. Knowledge should be built on the links between ecological functions, ecosystem services and the benefits they generate across spatial and temporal scales and contexts. Regional and national data regarding the values of ecosystem services under climate change should be acquired, building on approaches such as the MEA, TEEB and UK NEA. Effective monitoring methods and adaptive management will be needed to enable a learning-by-doing process. The principles of the ecosystem approach can form a good basis for planning and implementation. Sufficient political, financial and technical support is also needed to address important structural constraints related to institutional capacity, cross-sectoral collaboration and ecosystem governance.

It is clear that more needs to be done in mainstreaming the role of ecosystem services in adaptation and building corresponding awareness and capacity, if sustainable and effective cross-sectoral adaptation is to be achieved. Many NAPAs projects have the potential to jointly address the vulnerability of ecosystems and people, and to implement strategies in which resilient ecosystems contribute to a decrease in social vulnerability to climate change.

Notes

1. Quoted from the UNFCCC's NAPAs web page: http://unfccc.int/national_reports/napa/items/2719.php.
2. This was arbitrarily chosen as a threshold to identify the 25% of the 44 NAPAs with the highest number of references.

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