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Ecosystem-based approaches to climate change adaptation: progress and challenges

Joanne Chong

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Abstract Resilient ecosystems are vital to human well-being and are increasingly recognised as critical to supporting communities' efforts to adapt to climate change. The governing bodies of the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change are encouraging parties to adopt 'ecosystem-based adaptation' (EbA) approaches, which utilise biodiversity and ecosystem services to support climate change adaptation. These approaches are wide ranging and include mangrove restoration to buffer against storm surges; watershed management to protect against droughts and floods; rangeland management to prevent desertification; and sustainable management of fisheries and forests to ensure food security. This article examines the emergence of EbA in international legal frameworks for climate change and biodiversity and progress towards implementation. The EbA concept is potentially powerful in catalysing international and national commitments to act due to its key defining features of a focus on societal adaptation rather than ecocentricism, and a targeting of the immediate adaptation needs of the poorest and most vulnerable communities who are adversely affected by climate change. However, examination of national policy and practice in two least developed countries, Samoa and Cambodia, reveals that institutional and legal barriers at national level can pose significant challenges to operationalising EbA to achieve adaptation objectives.

Keywords Ecosystem services · Climate change adaptation · Ecosystem-based adaptation (EbA) · Convention on Biological Diversity (CBD) · United Nations Framework Convention on Climate Change (UNFCCC) · Cambodia · Samoa

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1 Introduction

Resilient ecosystems are vital to human well-being and are critical to supporting communities' efforts to adapt to climate change. Parties to the international legal regimes for biodiversity and climate change are increasingly recognising the importance of functioning ecosystems for the poorest and most vulnerable societies, whose people will be amongst those most severely affected by climate change (Dudley et al. 2010; Parry et al. 2007; UNFCCC 2011b).

The role of nature in societal adaptation is encapsulated by the concept of 'ecosystem-based adaptation' (EbA), described by the Secretariat of the Convention on Biological Diversity (CBD) as the 'use of biodiversity and ecosystem services to help people adapt to the adverse impacts of climate change' (CBD 2009). EbA spans many activities and adaptation outcomes, including mangrove restoration to buffer against storm surges; watershed management to protect against droughts and floods; rangeland ecosystem management to prevent desertification; and sustainable management of fisheries and forestry resources to alleviate threats on food security (Colls et al. 2009; Dudley et al. 2010). There are many interconnections between climate change and biodiversity, and the CBD positions EbA within the context of the resilience of biodiversity to the impacts of climate change, and also how changes in biodiversity affect climate change (CBD 2009).

Despite the historically disjointed relationship between the international legal frameworks for climate change and biodiversity (Morgera 2011), in more recent years, EbA approaches have shown potential to contribute towards achieving the respective objectives of both the United Nations Framework Convention on Climate Change (UNFCCC) and the CBD¹; indeed, both governing bodies have recently sought to encourage parties to implement EbA. This article traces the emergence of ecosystem-based adaptation in the CBD and UNFCCC regimes, and how they have facilitated implementation.² Progress and challenges of implementing EbA are illustrated through examination of the adaptation policies and practices of two least developed countries, Cambodia and Samoa.

2 Ecosystem-based adaptation at the nexus of climate change, biodiversity, and human well-being

Ecosystem-based adaptation is underpinned by the concept of 'ecosystem services,' which describes the links between the natural environment and human well-being. Popularised long before the severities of climate change impacts became apparent, in the 1970s, conservation biologists sought to build public interest in conservation and draw attention to the limits of growth by emphasising the importance of the natural world to humankind (Liu et al. 2010; Norgaard 2010). Over several decades, the status of ecosystem services has evolved from a tool of communication and persuasion to an influential framework for analysing and making decisions about global, regional and local environmental and

¹ There are limited references to biodiversity in the UNFCCC and no explicit reference to climate change in the CBD. However, more recently at CBD COP-10 the Joint Liaison Group nominated ecosystem-based approaches to climate change mitigation and adaptation as a joint activity. The CBD's 2nd Ad Hoc Technical Expert Group on Biodiversity and Climate Change has also explored the interconnectedness between climate change and biodiversity. Furthermore, the UNFCCC's Nairobi work programme, technical workshops on EbA have recently occurred.

² For reasons of scope, this article analyses the UNFCCC and the CBD. Other international biodiversity environmental regimes also promote and enable EbA; see, eg, the Ramsar Convention.

development challenges (Norgaard 2010), such as in international and national strategies for biodiversity conservation. Ecosystem services are increasingly codified and estimated as stocks and flows of economic value (Liu et al. 2010; Norgaard 2010; Pearce et al. 1989; Pearce and Atkinson 2006), the original impetus stemming partly from requirements in the United States' Superfund regulation and cost-benefit analysis requirements in the 1980s. The trend towards commoditisation is reflected in the expansion of payment for ecosystem services schemes such as those for maintaining biodiversity, catchment services or carbon sequestration (Greiber 2009; Gómez-Baggethun et al. 2010; Liu et al. 2010; Sommerville et al. 2010).

Although the ecosystem services basis of EbA reflects the interdependencies of people and nature, it fundamentally adopts a utilitarian, anthropocentric conceptualisation of the relationship between ecosystems and human well-being. There are, however, technical and ethical limitations to the monetary valuation often perceived as required to operationalise ecosystem services frameworks in decision-making processes (Adams and Redford 2010; Kosoy and Corbera 2010; Pearce and Atkinson 2006; Spash et al. 2005). The debates about the usefulness of the ecosystem services frameworks highlight the policy, research, law and practice challenges of balancing anthropocentric and ecocentric views regarding biodiversity conservation and ecosystem management (Henle et al. 2012).

Notwithstanding debates about its limitations, the very idea of ecosystems as providers of essential services for survival has captured the attention of communities and decision makers and has been successful in increasing the importance of nature conservation on policy agendas worldwide (Gómez-Baggethun et al. 2010; Skroch and Lopez-Hoffman 2010). The concept has been successful in drawing attention to the importance of ecosystems in addressing poverty and achieving the Millennium Development Goals. EbA, as an extension of the ecosystem services framework, similarly has the potential to inspire efforts to confront the impacts of climate change and acknowledge the importance of nature to supporting societal adaptation.

A key information base about ecosystem services is provided by the Millennium Ecosystem Assessment (MEA), which was initiated by various organisations involved in the CBD and the United Nations Convention to Combat Desertification to assess 'the consequences of ecosystem change for human well-being and the scientific basis for action' (Millennium Ecosystem Assessment 2005). The MEA defines ecosystem services as 'the benefits people obtain from ecosystems' including food and water provision, flood attenuation, pollination, soil formation, and cultural services. The MEA frameworks describe how ecosystem services underpin the components of human well-being including basic material for a good life, health, good social relations, security, and freedom of choice and action.

The vitality of ecosystems to life and humanity is a central but by no means only tenet of ecosystem-based adaptation. The link between ecosystems and people is by no means linear nor one directional, and approaches to implement EbA need to be situated in the context of the three types of linkages identified in the literature: The role of biodiversity and ecosystem services in societal adaptation; the impact of societal adaptation on biodiversity; and that biodiversity and ecosystems warrant adaptation strategies in their own right (Campbell et al. 2009).

There is significant evidence that climate change is hampering the ability of ecosystems to provide essential ecosystem services (CBD 2009). Due to the confluence of direct dependence on the life-sustaining services provided by ecosystems, high exposure to climate change risks, and a lack of capacity to respond, the poor are particularly vulnerable to the impacts of climate change. Many face key interrelated climate threats of flooding and

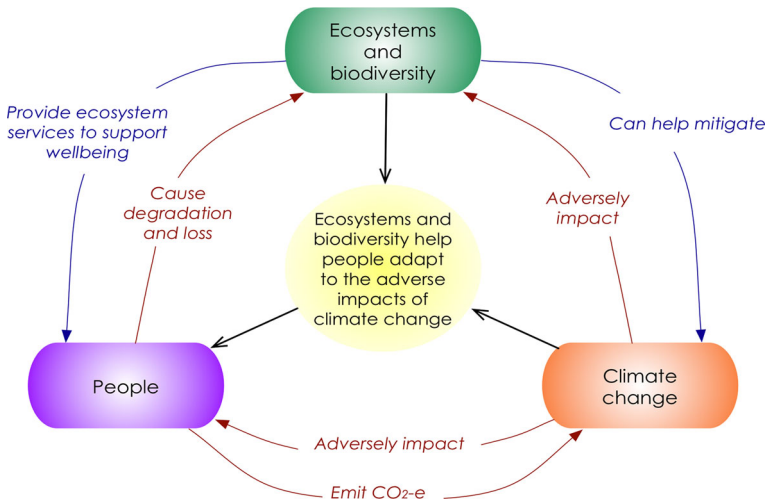


Fig. 1 Linkages between people, climate change, and ecosystems and biodiversity

drought, disease, and food shortages (McCarthy et al. 2001), and measures to enhance food security such as clearing for agricultural production often conflict with longer-term benefits of biodiversity conservation (Shearing 2010). However, there has been some optimism that these destructive cycles can be broken through reducing emissions from avoided deforestation and degradation in developing countries (REDD), and for mitigation, forest conservation and local livelihood objectives to be achieved simultaneously. EbA represents a further potential synergy between climate change adaptation, functioning ecosystems and human well-being (see Fig. 1).

There are many examples of EbA in practice. Mangroves and other vegetation have been restored and rehabilitated to protect coastal areas from storm and tidal surges in many locations including the tsunami-affected coastal areas of Indonesia, Sri Lanka, India, Thailand, and Malaysia (Colls et al. 2009). Integrated water resources and catchment management approaches are vital to water supply and quality regulation under changing climate conditions and have been implemented in diverse locations such as the Colombian Andes and Tanzania's Pangani River Basin (Colls et al. 2009). The protection of wetland ecosystems is also vital to supporting food security and livelihoods affected by climate change. For example, in the Sahel savannah region in north-eastern Nigeria, restoration of the valuable Hadejia–Nguru wetlands and natural flooding regime is ameliorating the maladaptive impacts of upstream dams that had been constructed to provide water for irrigation throughout drought (Andrade et al. 2011). Ecosystem management is also vital to buffer against hazards such as flooding, for example through the protection of natural forests in Argentina, and landslides, such as China's initiative to pay farmers to avoid clearing and farming on steep slopes (The World Bank 2010). Ecosystems are also critical in buffering communities from the impacts of disasters, and in turn well-designed adaptation strategies can improve the resilience of ecosystems themselves (Munang et al. 2013b). Community-based approaches to aquatic and marine resource management, including through marine protected areas, protect an important source of food and income threatened by climate change and other anthropocentric pressures (Colls et al. 2009). Other approaches to improve the management of ecosystems for food security in the face of

climate change include improved soil management and enhancing agrobiodiversity (Munang et al. 2013a).

Ecosystem-based adaptation is potentially more cost-effective than alternatives (Munroe et al. 2011) and is often implemented in tandem with 'hard' adaptation approaches including to significantly extend the lifetime of investment in costly barrier infrastructure (UNFCCC 2011b). Ecosystem-based adaptation approaches can be readily accessed by the rural poor and are consistent with and can be implemented via community-based adaptation, which is built upon a foundation of participation by local communities and the integration of indigenous, traditional and local knowledge (Reid et al. 2009a, b). However, there are limits to which ecosystem-based approaches can support adaptation, most evidently in situations where inundation forces dislocation.

3 International legal frameworks for climate change and biodiversity: enabling ecosystem-based adaptation?

3.1 The United Nations Framework Convention on Climate Change

The UNFCCC was the first binding international environmental instrument to explicitly incorporate the principle of common but differentiated responsibilities (Atapattu 2011) through placing special responsibility on developed country parties to take the lead in combating the causes as well as the adverse effects of climate change (UNFCCC 1992). Despite this, adaptation has long been marginalised relative to the Convention's ultimate objective of mitigation (Lin 2009; UNFCCC 1992),³ with parties only recently reaching consensus on its importance (UNFCCC 2008).⁴ As part of the growing recognition of the urgency and scale of adaptation needs, the Cancun Adaptation Framework, adopted as part of the Cancun Agreements in 2010, reflects parties' emerging understanding of the importance of ecosystem-based adaptation. It identifies a need to consider vulnerable groups, communities, and ecosystems, and also acknowledges the importance of traditional and indigenous knowledge in guiding adaptation activities. The framework invites all parties to undertake actions including 'building resilience of socioeconomic and ecological systems, including through economic diversification and sustainable management of natural resources' (UNFCCC 2011a). Through the Convention's Nairobi work programme on impacts, vulnerability and adaptation to climate change, knowledge-generation activities have also been undertaken by the UNFCCC secretariat. In its 2011 compilation of current information on EbA, the UNFCCC secretariat emphasised the critical role ecological resilience has in building societal resilience (UNFCCC 2011b).

The implementation of adaptation in developing countries relies on developed nations meeting their commitments to provide additional finance and support for technology and capacity building. In the Copenhagen Accord in 2009, developed countries recognised the need for greater financial resources and pledged \$100 billion of additional funding per year by 2020 to assist developing countries to undertake both mitigation and adaptation (UNFCCC 2010a). However, even if these non-binding pledges are fulfilled, they are unlikely to meet the estimated \$28–\$230 billion annual cost of adaptation in developing countries

³ Parties negotiating the Kyoto Protocol were concerned that attention on adaptation would detract from the pressing need for mitigation.

⁴ It was not until 2007 at UNFCCC COP-13 that adaptation was clearly highlighted as a priority.

(Klein 2010; Smith et al. 2011).⁵ The adaptation fund mechanism, established under UNFCCC decision 10/CP.7, is expected to be a relatively steady source of funding, drawing from 2 % of clean development mechanism (CDM) proposals, and is likely to be supplemented by additional private funding (Grasso 2011). However, although the Adaptation Fund does not rely on voluntary contributions it is not projected to contribute significantly to overall funding of adaptation (Grasso 2010).

Developing country parties have stressed in climate change negotiations that developed country pledges to support adaptation are additional to overseas development assistance (ODA), reflecting a principle of compensation for harms caused by global greenhouse gas pollution, rather than acts of charity (Grasso 2011). Whether the adaptation financing deficit is a problem for 'climate change adaptation' or 'development' has been hotly debated (Smith et al. 2011). However, in practice it is difficult to separate the two (McGray et al. 2007), and the need for coordination of adaptation efforts between Convention funds, the multilateral development agencies and bilateral donors are well documented (Klein 2010; Smith et al. 2011). In recent years, organisations have begun to monitor and evaluate adaptation policies, projects, and programmes (Munroe et al. 2011), although the practice is far from universal, methodologies are fledgling in development (UNFCCC 2010b). Successful demonstration of outcomes will be crucial for accessing funding for adaptation, including for EbA.

A notable exception to the lack of EbA-targeted adaptation funding mechanisms under the UNFCCC is the current debate about mobilising financial resources for the REDD+ mechanism (Downard 2010), which aims to harness the mitigation potential of forests while attaining conservation co-benefits such as EbA. This article does not endeavour to add to the growing body of scholarship on REDD+, except to note that in many situations, institutions do not adequately protect the rights of indigenous and local communities, nor do they ensure agency in decision-making (Lyster 2011), which suggests substantial limits on the ability of the mitigation mechanism of REDD+ to enable effective ecosystem-based adaptation.

A key initiative for enabling adaptation by least developed countries (LDCs) is National Adaptation Programmes Adaptation (NAPA). NAPAs are funded through the least developed countries fund (LDCF) and aim to identify priority activities that address the urgent and immediate adaptation needs of LDCs. In a review of the 41 NAPAs conducted by 2009, 56 % of projects reviewed (283 out of 51) included natural resource components (Reid et al. 2009a, b). Of the 44 NAPAs prepared by August 2010, over half acknowledge the importance of ecosystem services and approximately 22 % of proposed projects expressly link proposed ecosystem activities to social well-being or adaptation outcomes (Pramova et al. 2012).

The adaptation focus of NAPAs is encouraging some LDCs to apply integrated natural resource management approaches, such as through combining forestry and catchment management (Stucki and Smith 2010). However, integration with cross-sectoral planning is limited due to the 'narrowing down' processes used by NAPA teams to prioritise sectoral activities (DANIDA/GEF 2009) cited in Pramova et al. (2012). The lack of a programmatic, cross-sectoral approach poses barriers to the implementation of EbA, which by definition requires involving the multiple sectors who manage and benefit from ecosystem services. Moreover, the failure of many NAPAs to address the systemic causes of climate

⁵ UNFCCC mechanisms account for about 10 % of total international transfers for adaptation, the remainder provided through official development assistance.

change vulnerability such as land access and tenure will limit the successful implementation of EbA.

3.2 The Convention on Biological Diversity

The concept of ecosystem-based adaptation is closely aligned with the objectives and principles of the CBD that address the conservation and sustainable use of biodiversity. Although peoples' dependence on ecosystem services is not explicitly addressed in the provisions of the CBD text, the preamble encapsulates parties' appreciation of the value of biological diversity and its essential role in 'maintaining life-sustaining systems of the biosphere' and agreement that the 'conservation of biological diversity is a common concern of humankind' (CBD 1992). To operationalise the provisions of the CBD, parties developed and endorsed the 'ecosystem approach' as the primary framework of action to promote 'integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way' (CBD 2000). Principle five of the ecosystem approach places priority on the maintenance of ecosystem services, now considered integral to achieving biodiversity conservation (Warren 2010).

The recent ascension of EbA on international biodiversity agendas results from many years of work by the CBD and other organisations, including non-governmental organisations, on the linkages between biodiversity and climate change. In their seventh meeting in 2004, parties identified the ecosystem approach as a tool to enable both mitigation and adaptation to climate change (Morgera 2011). The secretariat has encouraged parties to take management measures to improve the resilience of ecosystems to climate change as a means to reduce human vulnerability (Erens et al. 2009).⁶ In 2009, the CBD's 2nd Ad Hoc Technical Expert Group on biodiversity and climate change outlined the potential of ecosystem-based adaptation (CBD 2009). At COP-10 at Nagoya in 2010, the IUCN's presentation on lessons learned from ecosystem-based adaptation practices helped galvanise parties' support for EbA (Andrade et al. 2011), which they endorsed in decision X/33 on climate change and biodiversity. At Nagoya, parties were called upon to recognise that 'ecosystems can be managed to... help people adapt to the adverse effects of climate change' and to 'implement, where appropriate, ecosystem-based approaches for adaptation... as part of an overall adaptation strategy' (CBD 2010a).

The potential for nations to implement EbA must be examined within the context of the significant challenges facing implementation of the CBD. The Third Global Biodiversity Outlook revealed the stark failure of the CBD to halt the rate of biodiversity loss specified in its 2010 target (Secretariat of the CBD 2010). Globally, habitat loss and fragmentation continue; the risk of extinction has increased for many species; and invasive and alien species are spreading (CBD 2009). Despite an ostensibly 'hard law' regime, the CBD contains no binding provisions for implementation and has at its disposal only the 'soft law' approaches of information and facilitation, which have so far proved inadequate to achieve conservation and sustainable use of biodiversity (Adam 2010).⁷ Developing nations in particular are limited in their capacity to develop and implement National Biodiversity Strategy and Action Plans (NBSAPs), a key planning instrument of the CBD (Shearing 2010). Although the direct contributors to biodiversity loss such as habitat

⁶ These measures include reducing fragmentation of habitat to enable species to migrate with changing climates.

⁷ However, the CBD has had greater success in achieving progress towards access and benefit-sharing goals.

degradation and invasive species are relatively well understood, these are in effect symptoms of underlying, interrelated drivers such as population growth, inequality, and poverty (Adam 2010) and the barriers posed by ineffective legal, political and institutional frameworks (Shearing 2010) and insufficient financial resources (CBD 2009; Morgera 2011). The failure of the CBD to address the underlying drivers of biodiversity loss (Long 2011) has implications for the effectiveness of EbA. In many developing nations, inadequate institutional structures fundamentally limit the effectiveness and sustainability of initiatives aimed at protecting ecosystem services, and the extent to which biodiversity conservation and ecosystem management concerns are integrated into development policies and plans (Shearing 2010).

Despite these limitations, the work of the CBD on managing and promoting the expansion of protected areas (CBD 2010b)⁸ is a potential enabler of ecosystem-based adaptation. Protected areas can buffer against climate hazards such as flooding, landslips, avalanches, tidal waves, storm surges, cyclones, and hurricanes (Dudley et al. 2010) and can also guard against desertification and other climate hazards threatening food security and the achievement of Millennium Development Goals. The CBD's Programme of Work on Protected Areas emphasises the need for expanded governance types, and in particular participation by indigenous and local communities (Lausche 2011).

The focus on effective governance and involvement of indigenous and local communities in the management of natural resources addresses two of the key, interrelated ingredients required for effective EbA. Whilst many challenges remain, protected area governance has evolved to recognise the interlinkages between natural resources, peoples and cultures and include a range of approaches from government-managed protected areas, to co-management, to local communities holding full authority (Burhenne-Guilmin 2008). However, despite several decades of ascending popularity, many community-based natural resource management (CBNRM) and protected area strategies have failed to be genuinely participatory or to empower local communities. There are relatively few success stories and many examples of where the ideal of CBNRM has not translated into practice, with resultant loss of local-level autonomy over resource management (Dressler 2010). This represents another potential barrier to effective EbA.

4 Country examples: challenges and potential

4.1 Cambodia

As a least developed country (LDC) with many of its 14 million people directly dependent on biodiversity and ecosystems, Cambodia is highly vulnerable to the adverse impacts of climate change. Cambodia's coastal areas face sea level rise and storm surges, and across the country, the incidence of malaria is projected to increase (Kingdom of Cambodia 2006). Also under threat are the distinctive and highly valuable ecosystems of the Mekong River and the United Nations Educational, Scientific and Cultural Organization (UNESCO) Tonle Sap Biosphere Reserve, whose flow reversals and flood pulses underpin food

⁸ Aichi Biodiversity Target 11: "By 2020, at least 17 % of terrestrial and inland water, and 10 % of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes".

security and livelihoods by supporting extensive wetland and floodplain ecosystems, sustaining fisheries, and transporting fertile soils vital for agricultural productivity (Mekong River Commission 2010; Andrade et al. 2011).⁹ Although many peoples' livelihoods are integrated with the natural annual patterns of the Tonle Sap, they have low capacity to adapt to unexpected changes (Yusuf and Francisco 2009), particularly to drought (Nuorteva et al. 2010).

Three of 20 high-priority projects in Cambodia's NAPA identify ecosystem-based approaches to adaptation: rehabilitation of the upper Mekong waterways to restore flood mitigation capacity; vegetation planting to protect against damage from floods and windstorms; and community mangrove restoration to stabilise shorelines, prevent seawater intrusion, and provide biodiversity products for coastal communities (Kingdom of Cambodia 2006). Although these projects refer to biodiversity conservation co-benefits, their primary rationale is to restore ecosystems as buffers against climate change hazards. Two projects which combine a number of priorities established under the NAPA have since been implemented under the auspices of government agencies and donors convened by the Cambodian Climate Change Alliance. The first project commenced in 2010 and aims to promote climate-resilient water management and agricultural practices (D'Agostino and Sovacool 2011). However, its focus on intensifying rice production, using flood and drought-tolerant seed varieties; and building rainwater harvesting infrastructure does not indicate a direct consideration of role of enhanced ecosystem services. The second project announced in March 2012 aims to build the resilience of the coastal communities in Koh Kong and Preah Sihanouk (Cambodia Ministry of Environment 2012) and has greater potential to incorporate ecosystem-based elements of mangrove restoration and biodiversity conservation identified in the NAPA as priority projects.

Although various EbA-oriented projects are identified in Cambodia's NAPA, the gaps and lack of integration in the broader climate change legal and policy environment are not conducive to progressing effective EbA. Policies and strategies and climate change and disaster management are in place but are fragmented, and the focus of the latter is primarily on post-disaster emergency relief, with little integration with global or national climate change policies. Critically, climate change policy and strategy development have been undertaken at the national level without engagement of vulnerable people and communities (Reid et al. 2012). Nevertheless, the civil society National Climate Change Network has had some emergent success in providing inputs to key government climate change policy and strategy documents (Reid et al. 2012).

The success of the ecosystem-based approaches will also depend on whether projects will also address the complex and challenging amalgam of barriers to effective biodiversity conservation and ecosystem management in Cambodia. The destructive legacy of the Khmer rouge regime has impeded Cambodia's development and implementation of legislative and governance structures. There are many institutional, political and socio-economic factors which hinder biodiversity conservation, including weak governance of natural resources, poor enforcement of laws, corrupt practices, and the exclusion of local people from participation in ecosystem management (D'Agostino and Sovacool 2011; Nagle 2009). These factors in turn pose obstacles to efforts to build resilience of communities through EbA. Despite many barriers, governments, non-government organisations and communities have attempted to increase the importance of biodiversity and ecosystems including through the NBSAP, which although not addressing climate change does link

⁹ Over the last three decades, various anthropogenic pressures have resulted in the loss of more than 95 % of the lake's flooded forest cover, which are the breeding and feeding grounds for fish and other species.

biodiversity conservation to the goal of poverty reduction (Shearing 2010). Nevertheless, enforcement of legislation addressing water management, forestry, fisheries, wildlife, and protected area management is lacking and illegal resource extraction is rife (Cambodia Water Partnership 2010). For example, despite numerous laws regulating fisheries, illegal fishing in the spawning areas of the upper Mekong prevails (Nagle 2009), which poses immense obstacles to the implementation of adaptation approaches involving fisheries management. Enforcement is weak, and in many situations, the military, police and government fisheries officers have been implicated in coercing local villagers to take extensive stocks (ICEM 2003). Moreover, aquatic ecosystems are also at risk of pollution due to ineffective environmental impact assessment legislation (Nagle 2009).

There have been extensive efforts by organisations such as the International Union for the Conservation of Nature (IUCN) to support the expansion and management of Cambodia's protected area system (ICEM 2003). The Cambodian government's emphasis on decentralisation of decision-making to local levels has been identified as an opportunity to enhance participation by local communities, and develop a system of local rights to the many resources and services in protected areas on which their livelihoods depend (ICEM 2003). However, the weak rule of law and dissonance between formal laws and customary norms (Ironsides 2010) results in ongoing encroachment of conservation areas and destruction of natural resources such as through illegal logging (Loehr 2012). Widespread 'land grabbing' and the granting of forestry, economic and other concessions that effectively shift land rights to private companies and are emblematic of the extreme power imbalances affecting Cambodian society, and undoubtedly constrain efforts to implement ecosystem-based approaches to adaptation.

4.2 Samoa

Like many small island developing states in the South Pacific, Samoa is extremely vulnerable to climate change. 70 % of Samoa's population and infrastructure are located in the low-lying coastal areas of the four main inhabited islands. Samoa is affected by sea level rise and increases in the frequency and severity of storm surges, tropical cyclones, drought, floods, pest, and disease outbreaks (Ministry of Natural Resources, Environment and Meteorology 2005). Climate-induced disasters affect food production, water availability, watershed health and biodiversity resources such as forestry. The tourism sector, which is of major importance to the Samoan economy, is also threatened by erosion of beaches, saline intrusion, and degradation of coastal ecosystems (Ministry of Natural Resources, Environment and Meteorology 2005).

Responding to climate change has long been a high priority for the Samoan government, and Samoa was one of the first LDCs to prepare and submit a NAPA. Like other small island state NAPAs, Samoa's illustrates the importance of ecosystem-based approaches to adaptation. EbA is well integrated within five of the nine priority projects identified in the NAPA, which makes explicit the value of ecosystem services to building the adaptive capacity of communities. The first-ranked priority project, securing community water resources, encompasses integrated watershed management and the restoration and protection of coastal springs. The second-ranked priority focuses on reforestation, rehabilitation, and sustainable management of forests. Another priority project recognises that alternative, diversified farming systems that protect soil and water resources will enhance the ability of farming communities to survive prolonged periods of drought. Other EbA projects include the establishment community-based marine protected areas and the development of sustainable tourism strategies (Ministry of Natural Resources,

Environment and Meteorology 2005). The zoning and strategic management project centred on Apia addresses flooding caused by building on flood prone and poorly drained lands, mangrove destruction and septic tank effluent pollution of groundwater and coastal ecosystems (Ministry of Natural Resources, Environment and Meteorology 2005). Three of these ecosystem-based adaptation projects have since been implemented under the LDCF (UNFCCC 2012), and a further project to enhance coastal community resilience has been funded under the Adaptation Fund (Adaptation Fund 2012).

A key strength of Samoa's adaptation process is the government's attempt to integrate and align adaptation with the cross-sectoral 'Strategy for the Development of Samoa' programme, which aims to improve governance and strengthen institutions for delivery of government services (Ministry of Natural Resources, Environment and Meteorology 2005). In addition to encompassing economic stability, growth, employment, education, and health, the programme also outlines its vision for sustainable management of the environment (Ministry of Finance 2008). This focus on mainstreaming adaptation across sectoral policy and planning responses is evident in the NAPA, and will be critical for successful implementation of ecosystem-based approaches. The Pacific Regional Environment Programme, headquartered in Apia, has been assisting in direct implementation as well as technical advice (SPREP 2006). The NAPA, however, also identifies a number of barriers to implementing priority projects. Unsurprisingly for a nation whose economy is fundamentally dependent on international aid, common across all projects is the lack of substantial financial and human resources required. Other barriers include poor quality information about baseline conditions and the need for improved institutional and legal frameworks at the local level (Ministry of Natural Resources, Environment and Meteorology 2005).

Despite the absence of legislation explicitly addressing climate change, ecosystem-based adaptation efforts are likely to be well supported by Samoan laws relating to land and natural resource tenure, fisheries, forestry, water resource management, national parks, environmental assessment, and strategic planning (Boer and Clarke 2012). In particular, the incorporation of customary law and practice into natural resource management laws and policy has resulted in a strong system of governance that recognises traditional knowledge, and the rights of indigenous communities to participate in decision-making (Techera 2006). In the years following Samoa's independence, it had become clear that the top-down approach to regulating biodiversity conservation was not working and that conventional protected area management approaches that sought to limit indigenous people's access had failed to protect Samoa's biodiversity and ecosystems (Techera 2006). The subsequent legal recognition of tribal hierarchical structures under the Village Fono Act (1990), which was passed to 'validate and empower the exercise of power and authority by Village Fono (council of chiefs and leaders) in accordance with custom and usage of their villages,' (Village Fono Act 1990) is a significant enabler of community participation in natural resource management. For example, fisheries regulations passed in 1996 permit communities to develop their own by-laws and to develop and oversee community-based marine protected areas and fisheries management plans (Boer and Clarke 2012). The customary law in Samoa provides a strong foundation for effective protection and restoration of ecosystem services, including support for communities to build their resilience to climate change.

5 Conclusion

Biodiversity and ecosystems play an elemental role in sustaining life and are thus fundamental to building human resilience to the adverse effects of climate change. Attention

on this role is of paramount importance for those in our global community who are most vulnerable to the effects of climate change, and whose ecosystem-dependent livelihoods are already being threatened by a combination of climate change and other pressures.

Through the mechanisms of the CBD and UNFCCC, parties have been encouraged to implement and integrate ecosystem-based approaches into their adaptation and development strategies. A key defining feature of the emerging narrative around EbA is that its ultimate aim is societal adaptation, rather than ecocentricism. Ecosystem-based approaches have potential to provide communities with potentially more sustainable outcomes than other adaptation approaches, whilst also targeting the immediacy of adaptation needs of the poorest and most vulnerable communities who are already adversely affected by climate change. This could be interpreted as an invocation of not only the inter-generational principle but also the intra-generational equity component of the principle of sustainable development, recognition of which has been of major concern to developing country parties in international biodiversity and climate change negotiations. The anthropocentric, intra-generational focus of EbA provides a clear line of sight through the complex and potentially conflicting linkages between well-being, biodiversity and climate and is thus potentially powerful in catalysing international and national commitment to act.

There is cause for cautious optimism that ecosystem-based approaches to adaptation will help nations and communities achieve the interconnected objectives of conserving biodiversity, using ecosystems sustainably, adapting to the adverse impacts of climate change, and climate change mitigation. Undoubtedly, however, there are significant limitations to international environmental law's ability to enable EbA. Drastic losses and degradation of biodiversity, habitats, and ecosystems exacerbate the pressures on the many communities already vulnerable to the harsh vagaries of our changing climate. While parties to the UNFCCC agree that Annex-1 countries are obliged to support adaptation in developing countries, transfers to date have primarily relied on voluntary actions and have not been sufficient to provide poor nations with the necessary resources to build resilience. Moreover, challenges to monitoring and evaluating adaptation need to be overcome in order to better support communities and make the political cases for funding adaptation.

However, greater transfers of finance and technology in the form of knowledge and capacity building, while necessary to support implementation of convention initiatives, do not by themselves drive achievement of adaptation and biodiversity goals. Notwithstanding international agreement that biodiversity is a common concern of humankind, the sovereign rights and primary responsibilities regarding conservation and sustainable use of biodiversity remain with nation states. The success of EbA therefore depends on enabling national political, socioeconomic and institutional conditions. In Cambodia, local communities lack agency in the management of ecosystems on which they depend, a function of spiralling and intertwined drivers of poverty, illegal resource extraction, poor law enforcement, corruption, lack of political will, and the historical dismantling of a society and its customs. In contrast, the recognition of customary law in Samoa empowers local communities to utilise their knowledge and experience to participate in the management of natural resources and the design and implementation of adaptation strategies. These case studies clearly illustrate the fundamental need for national operationalisation of the principles of public participation and good governance, in order for ecosystem-based adaptation to support progress towards the goals of international biodiversity and climate change law.

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