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

Research results from the Mountain EbA Project, Peru

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Summary

Ecosystem-based adaptation (EbA) is the use of biodiversity and ecosystem services as part of an overall strategy to help people to adapt to the adverse effects of climate change. Under the 'Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy' project, IIED, IUCN and the UN Environment World Conservation Monitoring Centre (UNEP-WCMC) are working at 13 sites in 12 countries to gather practical evidence and develop policy guidance for governments on how EbA can best be implemented. The project has developed a definition of effective EbA and a framework for assessing EbA effectiveness which has been applied at all 13 sites, and the results will be collated and compared to draw conclusions that are based on more than single case studies. This report presents the findings from a literature review and interviews with a wide variety of stakeholders conducted by IUCN at the project site in the Nor Yauyos Cochas Landscape Reserve in Peru, where EbA measures such as water channel and reservoir restoration, grassland management and vicuña management were implemented.

The report concludes that project activities contributed positively to adaptive capacity and resilience whilst laying the foundations for reducing vulnerability. While community members targeted by the project, notably mountain communities and livestock farmers, experienced more improvements than other groups, overall the benefits were widespread and led to no apparent trade-offs in terms of who benefitted. However, there were some trade-offs in terms of where and when the improvements occurred. A range of social co-benefits emerged from the project, and the incorporation of traditional and local knowledge was a crucial component of the process. Some improvements to ecosystem services provision are already apparent, with others expected over the longer term. Cost-benefit analyses comparing EbA practices with a business as usual scenario, both with and without climate change, suggest that investing in EbA was financially favourable, and the project was generally considered sustainable at the local, regional and national levels.

Acronyms

BMU	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
CBD	Convention on Biological Diversity
EbA	Ecosystem-based adaptation
Eco-DRR	Ecosystem-based disaster risk reduction
IIED	International Institute for Environment and Development
IKI	International Climate Initiative
IUCN	International Union for Conservation of Nature
MINAM	Ministerio del Ambiente (Ministry of Environment of Peru)
NGO	Non-government organisation
NYCLR	Nor Yauyos-Cochas Landscape Reserve
SDG	Sustainable Development Goal
SERNANP	Servicio Nacional de Áreas Naturales Protegidas por el Estado (The National Service of Natural Protected Areas)
TMI	The Mountain Institute
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-WCMC	United Nations Environment Programme World Conservation Monitoring Centre
UNFCCC	United Nations Framework Convention on Climate Change

Introduction

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

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

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

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

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

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

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

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

1. First, there is uncertainty around how best to finance EbA. International climate finance, through mechanisms such as the Green Climate Fund or the Adaptation Fund, is one possibility, but this will not provide enough to address adaptation challenges at the scale required to meet the needs of the world's most vulnerable. Payments for ecosystem services is another possibility, and may provide an alternative source of funding, or large-scale government social protection, employment generation, or environmental management programmes. However, in the context of providing finance for adaptation, both are in their infancy.
2. Second, many climate change impacts will be long-term, but this does not sit well with what are usually short-term political decision making processes often based on standard electoral cycles. Photogenic engineered adaptation solutions with immediate but inflexible benefits are thus often favoured over the long-term flexible solutions offered by EbA under which benefits may only be apparent in the future.
3. Third, the evidence base for the effectiveness of EbA, especially its economic viability (Black et al. 2016), is currently weak. Much evidence is anecdotal and comes from single case studies, and often the costs, challenges and negative outcomes of EbA activities are under-reported. Better EbA monitoring and evaluation systems are needed, along with more robust quantitative evidence, or at least consistently collated qualitative evidence, on the ecological, social and economic effectiveness of EbA projects relative to alternative approaches (Doswald et al. 2014; Travers et al. 2012; Reid 2011; Reid 2014a; UNEP 2012).
4. The final major challenge to EbA relates to issues around governance. EbA necessitates cooperation and communication across multiple sectors and varying administrative or geographical scales. This is challenging for most models of governance, where decision making is often strongly based on sectors and administrative boundaries, and opportunities for supporting participation and locally driven approaches are limited.

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

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

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

Project partner country	In-country partner institution	Project case studies
China	Centre for Chinese Agricultural Policy, Chinese Academy of Science	Participatory plant breeding and community-supported agriculture in Southwest China
Nepal	IUCN	Ecosystem-based adaptation in mountain ecosystems programme (Nepal)

Bangladesh	Bangladesh Centre for Advanced Studies	Economic incentives to conserve hilsa fish in Bangladesh – a supportive research project to the incentive-based hilsa fishery management programme of the Department of Fisheries
Kenya	Adaptation Consortium; Kenya Drought Management Authority	Adaptation Consortium – supporting counties in Kenya to mainstream climate change in development and access climate finance
South Africa	Conservation South Africa	Climate-resilient livestock production on communal lands: rehabilitation and improved management of dryland rangelands in the Succulent Karoo
Uganda	IUCN	Ecosystem-based adaptation in mountain ecosystems programme (Uganda)
Burkina Faso	IUCN	Helping local communities to prepare for and cope with climate change in Northern Burkina Faso
Senegal	IUCN	Ecosystems protecting infrastructure and communities (EPIC)
Peru	IUCN	Global mountain ecosystem-based adaptation programme (Peru)
	ANDES	Indigenous people biocultural climate change assessment, Potato Park
Chile	IUCN	Ecosystems protecting infrastructure and communities, South America geographical component (EPIC Chile)
Costa Rica	IUCN	Livelihoods and adaptation to climate change of the Bri Bri indigenous communities in the transboundary basin of Sixaola, Costa Rica/Panama
El Salvador	IUCN	Adaptation, vulnerability and ecosystems (AVE) project learning site in Ahuachapán, El Salvador

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

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

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

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

These questions encompass much important detail regarding how to assess and compare effectiveness in ecological, social and economic terms. They lead to a further set of nine more specific questions (Table 2) that reflect the growing consensus around the key characteristics of effective EbA (Box 1).

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

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

Table 2: Framework for assessing EbA effectiveness

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

The Mountain EbA Project, Peru

The 'Ecosystem-based adaptation (EbA) in mountain ecosystems' programme was a collaborative initiative of UNEP, IUCN and the United Nations Development Programme (UNDP). It was funded by Germany's Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), and implemented from 2011 to 2016 in partnership with the Governments of Nepal, Peru and Uganda. The programme had four main components:

1. Development of methodologies and tools for EbA decision making in mountain ecosystems.
2. Application of methodologies and tools at the national and ecosystem levels.
3. Implementation of EbA pilots at the ecosystem level.
4. Formulation of national policies and building an economic case for EbA at the national level.

This case study focuses on programme activities in Peru, which in this report are referred to as the Mountain EbA Project. In Peru, the project was commissioned by the Ministry of Environment of Peru (Ministerio del Ambiente, or MINAM) and was implemented in the Nor Yauyos Cochas Landscape Reserve (NYCLR) with the support of the National Service of Natural Protected Areas (Servicio Nacional de Áreas Naturales Protegidas por el Estado, or SERNANP). IUCN's role in the project focused on the design and implementation of EbA measures and capacity-building activities on the ground. These were implemented in partnership with The Mountain Institute (TMI), which led the methodological development and implementation process in the communities of Canchayllo and Miraflores in cooperation with the NYCLR. EbA measures were also implemented in the communities of Tanta and Tomas, also located within the NYCLR, under work led by UNDP.

The NYCLR is in the Andean highlands in the southern part of the regions of Lima and Junín. This area is characterised by montane grasslands and shrublands – more specifically, high-mountain Andean ecosystems including puna grasslands and wetlands. The Reserve has an area of 221,268 hectares, of which 62% is located in the Cañete River watershed and 38% in the Cochas-Pachacayo basin. The Reserve allows natural resource extraction and use, primarily by the local populations. Some 19 communities, totalling roughly 14,919 people, live within the Reserve and rely on livestock farming and subsistence agriculture for their livelihoods (Podvin et al. 2014).

The community of Canchayllo is located in the Jauja Province, Junín Region. It has around 900 inhabitants, and occupies an area of 7,650 hectares of an area ranging from 3,600 to 5,700 metres above sea level. The main livelihood is livestock farming – primarily sheep – although many families supplement their income with activities such as employment at the nearby hydroelectricity company. The community lies in the Cochas-Pachacayo watershed, which drains into the Mantaro River. The community of Miraflores is located in the Yauyos Province, Lima Region. It covers an area of 13,031 hectares of an area ranging from 3,000 metres to 5,400 metres above sea level, and is located in the Cañete River watershed. It has around 250 inhabitants whose main livelihood is cattle farming and small-scale cultivated agriculture. The community is characterised by high levels of migration and a low birth rate. Tanta is a community of roughly 600 people located at 4,300 metres above sea level in the NYCLR. Livestock farming is also important for this community. This research focuses mainly on activities in Canchayllo and Miraflores led by IUCN and TMI, but also includes some analysis of activities in Tanta.

EbA measures implemented under the project included (UNDP 2015):

- Restoring water channels and reservoirs to support micro-watersheds and wetlands to secure provision of water for the Reserve's communities and downstream users (in Canchayllo and Miraflores).
- Grassland management to enhance pastoral livelihoods and increase resilience to drought and frost (in Canchayllo, Miraflores and Tanta).
- Vicuña management to produce animal fibre for livelihoods and communal livestock management in natural grasslands (in Tanta).

Measures implemented in Canchayllo and Miraflores had three components: 1) institutional strengthening and community organisation; 2) capacity building to enhance local and traditional

knowledge; and 3) 'green-grey' infrastructure to rehabilitate water infrastructure, fences, native grassland and wetlands (Podvin et al. 2014; Zapata et al. 2016; Murti and Buyck 2014; Rizvi et al. 2014).

Genuine ecosystem-based adaptation initiatives must meet the following four criteria (Martin 2016; CBD 2009; CBD 2010): they must use biodiversity and ecosystem services; they must help people; they must support human adaptation to the adverse effects of climate change; and they must form part of an overall strategy. The Mountain EbA Project was designed as an EbA project and aimed to meet all of these criteria.

Methodology for assessing effectiveness

Reid et al. (2017) provide a methodology for assessing EbA effectiveness. This includes a framework (Table 2), which details a set of questions to be used as part of a process to draw conclusions about the effectiveness of an EbA project that is ongoing or has ended. Table 3 describes the Mountain EbA Project stakeholders interviewed individually or as part of focus group discussions using this methodology. The interviews primarily show the results of project activities in Canchallyo and Miraflores.

Table 3: Mountain EbA Project stakeholders interviewed in Peru

Interviewee level	Those interviewed
National	Three stakeholders from MINAM and SERNANP
Local authority	The head and staff of NYCLR, as well as local authorities from both communities.
Project implementers	Two staff members from TMI, two from UNDP and one IUCN staff member.
Community-level stakeholders	Local researchers from Canchayllo and Miraflores, and also members of both communities. Some 16 people from Canchayllo, and 16 from Miraflores attended focus group discussions held in February 2017. Although women were invited to the focus group discussion in Canchayllo, only men attended. In Miraflores, nine men and seven women attended. Efforts were made to invite a diversity of stakeholders, including the most vulnerable (the elderly and the poorest). People that participated in different phases of the project were invited, but not all attended.

Along with the interviews conducted, reports, webpages and publications on the Mountain EbA Project were also reviewed to assess the characteristics of project activities that contribute to effective implementation of the EbA approach. Results from EbA measures in Tanta have been included as well as Canchallyo and Miraflores, in part because key publications such as UNDP (2015) provide detail on these. The results of this assessment are described in the following section.

Results

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

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

Interviewees were clear that adaptive capacity had been strengthened as a result of the project, resilience had improved, or at least the foundations for resilience had been laid, and vulnerability had been reduced or at least had not increased. They provided the following examples:

- ***Awareness on climate change has risen,*** thus increasing adaptive capacity. In Miraflores in particular, people are now more aware. Knowledge on the status of resources in Canchayllo and Miraflores has also increased. Podvin (2017a) also details how awareness of the importance of sustainable management of pasture, water and livestock has grown.
- ***Specific measures have been taken to address climate change***, and this has increased adaptive capacity. For example, EbA measures have increased water availability and improved pastures, most noticeably in Miraflores where a two-hectare area of wetland/grassland has been extended. 'Green-grey' infrastructure – such as dams, water canals or other hydrological infrastructure – has reduced vulnerability to droughts. UNDP (2015) also emphasises the adaptation gains from the availability of pasture for grazing and fodder all year round, including during the dry season, and the reduced risks from dry season fires due to moister grassland. Improved agricultural production and livestock productivity and quality also contribute to adaptive capacity (UNDP 2015).
- ***The community is now more organised***, especially in Miraflores. Communication with the authorities has also improved. Zapata et al. (2016) also describe how strengthening community organisation has improved grassland management and preservation, which has prepared people to cope with uncertain climate scenarios.
- ***Capacity to sustainably manage grasslands, water and livestock has improved***. The technical capacities of both Canchayllo and Miraflores communities are better, as is local governance in Miraflores. Both communities diagnosed water and grassland conditions and, based on this, developed community grassland and water management plans, which include better livelihood and landscape management strategies and address governance and capacity building. Grazing is now managed according to a strict plan, and better communal management of pastures and water has improved resilience. In Miraflores, people have abided by community agreements regarding pasture and water management. Podvin (2017a) reiterates that enhanced community capacities to conserve and improve pasture in turn strengthened community resilience.
- ***Participation has increased***. In Canchayllo, one particular group - ranchers - participated more than other community members, who participated less, but in Miraflores a larger group participated. There is now more willingness to replicate and scale-up.
- ***Reduced disaster risk from extreme climate change related events***, such as droughts and wildfires. Green-grey infrastructure in Canchayllo has already prevented wildfires from spreading in the project's area of influence.

Some interviewees did, however, caution that even with greater awareness, much still depended on local authorities, and also whether local people are committed enough to continue with the EbA measures.

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

The Global Mountain EbA Programme chose to focus on vulnerable mountain communities. Mountain people tend to be amongst the world's poorest and most marginalised populations, and the disadvantages of general rural poverty can be compounded by gender, ethnic and geographical discrimination (UNDP 2015).

Interviewees felt that livestock farmers or those whose livelihoods depend on livestock farming experienced particular changes in resilience, adaptive capacity or vulnerability as a result of the project. For example, new fencing near Miraflores has altered rotational grazing regimes, improving the management of native pastures and benefiting all the ranchers of Miraflores. Older people and also other community groups including women, men, children and youth also benefitted.

Trade-offs in terms of who *experienced changes in resilience, adaptive capacity or vulnerability,* where *changes occurred and* when

No trade-offs in terms of *who* experienced changes in resilience, adaptive capacity or vulnerability were apparent, although some experienced more changes than others, largely depending on their level of participation. Although beneficiaries were mainly involved with livestock farming (the main source of livelihoods in the area), broad invitations to participate in communal assemblies or workshops, and widespread information availability ensured that EbA measures included most community members. Interviewees commented that despite raised awareness on climate change, some people still lack awareness of the issues that would enhance their adaptive capacity.

There were trade-offs in terms of *where* changes in resilience, adaptive capacity or vulnerability occurred as a result of new grazing regimes. For example, new fencing in Miraflores controlled animal entry in one 80-hectare grazing area, and an expansion of protected wetlands, lakes and ancient dikes in Yanacancha also limited livestock entry. Gains in resilience were particularly apparent in these areas.

Changes in resilience, adaptive capacity or vulnerability as a result of the project sometimes took time to materialise and there were also trade-offs in terms of *when* these changes occurred. Grazing restrictions led to short-term reductions in adaptive capacity, and the benefits of such activities took longer to accrue. Some activities – such as improvements in technical capacities, awareness raising and tangible green-grey infrastructure – although initiated in the short term, provided longer-term resilience and vulnerability gains that were conditional on communities adhering to water and grassland management plans. Dourojeanni et al. (2016) describe how the project adopted a phased approach to planning, with an early Vulnerability Impact Assessment to identify initial EbA measures for implementation, thus securing community buy-in. Whilst some EbA measures demonstrated short-term benefits, however, additional benefits are expected in the medium to long term, beyond the project lifetime (Zapata et al. 2016).

Social co-benefits from the EbA project

A range of social co-benefits emerged from the project, many of which in turn indirectly contributed to improved adaptive capacity and the avoidance of maladaptation (UNDP 2015). As above, several of these took time to materialise as they depended on changes to governance structures and enhanced local and traditional knowledge (Podvin et al. 2014). Interviewees and published literature provided the following examples:

- ***Economic benefits*** from alternative livelihoods and improvements in agricultural or livestock production and productivity levels (Podvin et al. 2014). Early project 'no regret' activities focused on these in particular to secure local community support (UNDP 2015). Water and fodder provision has improved livelihoods.
- ***Community health improvements***. Sustainable grassland management has resulted in better pasture and hence healthier livestock products (milk and meat). Food security has been enhanced.
- ***Stronger local organisations and better management of communal land, water and livestock*** in Miraflores (but not Canchayllo or Tanta) due to sustainable grassland and water management

activities and plans. Capacity was built and technical assistance was provided for enhanced livestock and vicuña management. Capacity was also built for sustainable natural resource management related to water and pastures (Murti and Buyck 2014). Management plans were established, existing governance arrangements for water and rangeland management were strengthened and, in some cases, new management committees were formed (UNDP 2015). Agreements are respected and animal slaughter complies with regulations.

- ***Sustainable water provision***. Better water distribution in both communities due to green-grey infrastructure.
- ***Reduced conflict over resources***. For example, community members in Miraflores are now better organised when it comes to livestock farming activities. In Canchayllo, there are internal conflicts so this does not apply.
- ***Improved social cohesiveness*** in Miraflores (but not Canchayllo or Tanta). Community members are better organised, relations between them are more harmonious and they are working together better.
- ***Knowledge enhanced*** due to dialogue sharing local and technical knowledge throughout the project ('*diálogo de saberes*').

Distribution and trade-offs relating to social co-benefits

Some people accrued more social co-benefits from the project than others, but no trade-offs were observed. Those who participated more in the project gained more knowledge and capacity, and those who depended on livestock farming benefitted more as this was the focus of many EbA project measures. People in the area shared a similar socioeconomic status, however, and project activities were quite inclusive so inequitable accrual of social co-benefits was not a big problem. By definition, the 'no regret' EbA measures planned under the project were designed to yield net social benefits regardless of how future climate change scenarios play out (Podvin et al. 2014).

Regulating where animals can graze means some people may have to walk further for grazing, which could inconvenience them. This could potentially be a trade-off, but it has not been observed yet.

The role of participatory processes and local/indigenous knowledge

Cultural heritage in the area is rich. Ancestral technologies to manage the puna or high-altitude grassland ecosystems date back to pre-Hispanic times and were clearly intended to enhance soil retention and regulate water flow. There are various archaeological sites, and vast ancestral agricultural terraces and water courses (Podvin et al. 2014). Traditional and local knowledge was incorporated into project activities in various ways:

- Ancestral hydrological structures and dikes involving earth and stoneworks were maintained and improved, restoring a forgotten water management model to provide important climate change adaptation benefits (Zapata and Gómez 2015).
- The project relied on local and traditional knowledge of water, livestock and grassland management, and native pastures were planted on rangelands (UNDP 2015). Traditional animal watering sites were restored and traditional communal slaughtering rituals were valued, including, for example, 'paying the earth back' (ritual offerings to the earth/nature). Natural fences using prickly plants and hedges were restored.
- Community assembly spaces were respected and existing community organisations were valued. Project processes were conducted in keeping with community timeframes and regulations. Community decisions were respected.
- 'No regret' measures were chosen based on local perceptions of vulnerability as well as on available scientific information. Local knowledge was combined with technical/scientific knowledge.

Interviewees felt that the use of local knowledge was crucial throughout the project process. Project planners acknowledged the importance of using local and traditional knowledge in order to enhance EbA benefits, but they argue that traditional knowledge needs to be complemented by scientific knowledge, and that traditional measures may need to be altered to provide a climate change

adaptation function (UNDP 2015; Dourojeanni et al. 2016; IUCN 2017a). Zapata and Gómez (2015) reiterate that whilst ancestral and more contemporary technologies exist to help local people survive in the area, many of these technologies have fallen into disuse. Where they provide an opportunity for EbA, modification – based on local knowledge, practices and priorities, and in dialogue with scientific and technical knowledge – to ensure they suit the new socio-environmental context may be necessary (Zapata and Gómez 2015).

The project ensured participation occurred during various parts of the project cycle, from the early consultation, diagnosis and project design phase to the implementation of 'no regret' adaptation measures, and after this to the systematisation and dissemination phase.

The project adopted various types of participatory approaches, many of which can be classified as interactive.[1] Examples from interviewees and published literature include the following:

- Community management practices are already applied in the NYCLR, which aim to conserve natural resources in collaboration with government and communities (UNDP 2015).
- Initial rapid participatory assessments were conducted to increase understanding of links between climate change, ecosystems and livelihoods, and to increase understanding of EbA and its benefits (UNDP 2015). Community awareness was raised.
- An extensive integrated participatory rural appraisal was conducted by project staff together with a team of local researchers (eight each from the communities of Canchayllo and Miraflores), external specialists and NYCLR staff, to analyse vulnerabilities and design 'no regret' measures for the communities that integrated local and scientific knowledge using the '*diálogo de saberes*' approach. Under the appraisal, field trips and workshops with key stakeholders were conducted to identify vulnerabilities and to pre-select and prioritise 'no regret' measures. Consultations and interviews were held to assess prospective 'no regret' measures according to how they addressed local perceptions and community needs and priorities, and met a set of criteria for EbA measures (Zapata et al. 2016). Interviews and focus group discussions were used to validate the selected 'no regret' measures and identify sites (Rizvi et al. 2014). The design of comprehensive measures was also participatory, and local researchers maintained involvement throughout the implementation process.
- Three different types of Vulnerability Impact Assessments were carried out. These were more comprehensive than the process for designing 'no regret' measures. They enabled the design of well-grounded EbA measures at an appropriate scale to enhance the achievement of EbA benefits in the medium to long term. One of these approaches was participatory and involved local community members working as co-researchers, providing their perceptions on risks, needs and priorities (Dourojeanni et al. 2016).
- The process of developing management plans for pasture and water resources was participatory (Zapata et al. 2016). Certain activities in these management plans were included in the participatory budget.
- A qualitative cost-benefit analysis (using participatory approaches) was conducted in Canchayllo and Miraflores to complement the standard cost-benefit analysis (Alvarado 2015a; 2015b).

Interviews suggested that the use of participatory processes supported the implementation of EbA and built adaptive capacity. Podvin (2017a) argues that a key project lesson is that it is advisable to incorporate participatory processes in all phases of implementation: consultation, diagnosis, design, planning, implementation, monitoring and evaluation, systematisation, documentation and

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

dissemination. This mirrors findings from a broader survey of 21 EbA case studies in Peru, which showed that participation in decision making contributed to good governance and was a key success factor for sustainability (MINAM 2017). Interviewees and published literature provided the following examples of the benefits of adopting participatory processes under the project:

- Participatory approaches adopted under the integrated participatory rural appraisal helped with information sharing and two-way influence between the NYCLR and local communities, improved understanding of local interests and perspectives in the context of management decisions, and improved understanding of local responsibilities (of the community, park management and local government) (Rizvi et al. 2015).
- Participatory processes were crucial to ensuring engagement, process legitimacy and sustainability of the resulting benefits (Zapata et al. 2016). Working with reserve staff as well as local communities was very important (Podvin et al. 2014).
- All three approaches adopted to conduct Vulnerability Impact Assessments rendered useful results and, surprisingly, recommended very similar adaptation measures. However, the participatory approach was the only one that did not require additional studies before implementation (Dourojeanni et al. 2016).
- Participatory approaches were key to delivering bottom-up activities that empowered communities, legitimised their knowledge and enhanced local community ownership. A sense of local ownership was extremely important for the success of activities as it facilitated buy-in for 'no regret' measures, thus helping to make the case for EbA at the local level and also securing support from government planners at the landscape level (Dourojeanni et al. 2016; UNDP 2015; Podvin et al. 2014; Rizvi et al. 2014).
- The qualitative cost-benefit analyses in Canchayllo and Miraflores were participatory, so helped engage the community and also helped conceptualise the different types of social, environmental and economic costs and benefits better than a standard cost-benefit analysis is able to do (Alvarado 2015a; 2015b).
- Developing management plans for pasture and water resources using participatory processes strengthened local capacities and increased understanding of how to manage natural resources in the context of a changing climate (Zapata et al. 2016; UNDP 2015).
- Participatory processes empowered and strengthened the capacities of NYCLR staff as well as the communities (Zapata et al. 2016).

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

Factors threatening local ecosystem resilience and service provision

Interviewees and published literature detail a number of factors that threaten local ecosystem resilience and service provision:

- ***Climate change.*** In mountain ecosystems, increasing temperatures melt glaciers and snowpacks, bringing flooding and then drought. Increasingly frequent landslides follow more intense rainfall, devastating remote agricultural villages. The project site is one of the most vulnerable regions to climate change in Peru, although there is a high level of uncertainty regarding what climate change impacts to expect. One study up until 2030 predicts that temperatures in the NYCLR will increase but that the amount of annual rainfall will not change. There will, however, be more variability in seasonal patterns and a reduction in surface water runoff. Another study suggests a decrease in precipitation by 2050, higher temperatures and more intense frosts. A third study predicts higher temperatures by 2100 and also a decrease in rainfall in the upper and middle parts of the basin, and an increase in frost in some regions (Zapata and Podvin 2017). Glacial melt is also expected, along with increased fire risks due to drier pastures and an increase in animal and plant diseases.

Droughts, frosts, changes in precipitation patterns and intense rainfall are already affecting the NYCLR. Changes in hydrological patterns are affecting grassland and water resources, which are vital for livestock-dependent communities. Extreme climatic events, such as hailstorms, have already been observed out of season, and the best conditions for potato cultivation are likely to be found at higher altitudes in the future (Zapata and Podvin 2017; UNDP 2015; Podvin et al. 2014; Podvin 2017a).

- ***Overgrazing***. Communal pasture areas in Canchayllo and Miraflores are degraded due to overgrazing, soil erosion and the presence of undesirable invasive plants such as thistles. The water-related functions of highland wetlands have been compromised, and reduced vegetation limits soil water retention and ecosystem carbon capture. Wild animals (vicuñas and deer) are displaced due to the competition for pasture, and animals and plants are left more vulnerable to disease (Podvin et al. 2014; UNDP 2015; MINAM 2017).
- Weak local community governance leading to worsened water management and distribution.
- ***Infrastructure and mining***. Political debates about the expansion of mining in Canchayllo are ongoing. Construction of new dams for hydropower could also cause ecosystem disturbances (UNDP 2015).
- ***Deforestation.*** This accelerates erosion and enhances landslide and flood risk (UNDP 2015). Burning, logging and other inappropriate practices cause loss of plant cover (MINAM 2017).

Whilst climate change has been identified as a key factor threatening local ecosystem resilience and service provision, it is also worth noting that a cost-benefit analysis modelling climate change impacts in Tanta found that grassland productivity actually increased under climate change (UNDP 2016).

Boundaries influencing ecosystem resilience

The project boundary was taken to be the land used by communities for living and grazing, and ecosystem boundaries were not a major project concern. The project site falls in two watersheds, however: the upper Cañete watershed in the region of Lima and the Cochas-Pachacayo watershed in the region of Junín. After the implementation of 'no regret' measures at the community scale, later project activities adopted an approach under which landscape connectivity and the provision of ecosystem services at the watershed and landscape scales were prioritised. This considered ecosystem management, restoration and conservation actions upstream, midstream and downstream and could therefore better address climate hazards such as floods, in addition to providing environmental benefits such as growth of natural vegetation or economic benefits such as improved livestock yields (UNDP 2015).

Thresholds influencing ecosystem service provision

One implementing partner interviewee explained how a threshold in levels of exploitation may exist, whereby at some point overgrazed grasslands will no longer be able to provide fodder and hydrological services.

EbA project impacts on ecosystem resilience and services provision

Project EbA measures aimed to strengthen the resilience of ecosystems to climate change and improve ecosystem service provision (Podvin 2017a; UNDP 2015). Interviewees and published literature provide a number of examples of contributions to service improvement:

- ***Improved water provision*** for the Reserve's communities and downstream users, including farms, due to restored water channels and reservoirs to support micro-watersheds and wetlands and reduced siltation. This in turn leads to more sustainable grassland management and better ecosystem resilience, including against drought (PNUD et al. 2016; Instituto de Montaña and UICN 2016a; 2016b; Zapata et al. 2016; UNDP 2015). Dike protection and allowing water to run into the drainage channels helps to purify the water in Canchayllo.
- ***Better hydrological regulation*** and storage due to conservation and management of upstream wetlands, especially during the rainy season, whether there is little or heavy rain (UNDP 2015). The

role of green-grey infrastructure was key to distributing and storing water for longer periods, and thus withstanding droughts and reducing fire risks (Podvin 2017a).

- ***Nutrients stored and soil structure maintained*** as a result of better grassland management. These supporting ecosystem services are fundamental to enhancing the ecosystem's resilience to climatic shocks and stresses. Glacial melt is expected to particularly affect the NYCLR, for example, but its impacts will be reduced as a result of grassland management and water regulation services. Slopes are more stable and soil erosion is reduced (UNDP 2015).
- ***Enhanced pasture condition*** with a visible increase in vegetation cover as a result of better communal pasture management, including replanting with native and introduced varieties. This leads to better water infiltration capacity and reduces the risk of soil erosion and the influx of soil nutrients into water bodies. This in turn increases soil fertility and productivity. Pastures are also now more resilient to drought and frost and experience fewer alien and invasive plant invasions (UNDP 2015). New fencing to control animal entry in some areas around Miraflores resulted in changes to the rotational system of communal livestock grazing covering a much larger area of roughly 3000 hectares. This is expected to affect the health of the ecosystem and the services it provides.
- ***Availability of pastures all year round*** for grazing and fodder, including during the dry season, as a result of better grassland management (UNDP 2015).
- ***Reduced occurrence of natural fires*** during the dry season due to rehabilitated wetlands and grassland ecosystems (UNDP 2015).
- ***More animal fibre*** as a result of better vicuña management, primarily in Tanta (UNDP 2015).
- ***Carbon storage enhanced*** in grasslands (UNDP 2015).
- ***Biodiversity conservation enhanced***. For example, sustainable grassland management reduces pressure on natural pastures, wetlands and alpine ecosystems, facilitating their recuperation and providing diverse habitats for wildlife. Wild vicuña populations are also supported by project interventions (UNDP 2015).
- ***Scenic beauty enhanced*** as a result of sustainable grassland management (UNDP 2015). Ecosystem conservation has improved the visual quality of the landscape.
- ***Cultural ecosystem services improved*** due to a stronger sense of community, education and enhanced traditional knowledge.

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

The Global Mountain EbA Programme found that the watershed or catchment area was a particularly good scale for planning and implementing EbA measures. Integrated management at the ecosystem scale in this way ensures the attainment of EbA benefits in a more comprehensive and sustainable manner, especially with regards to ecosystem provision and regulating services. In Peru, the NYCLR falls in two watersheds (UNDP 2015).

The landscape approach adopted under the NYCLR Master Plan also provided an overall guiding framework under which all project interventions were planned (UNDP 2015).

Interviewees also explained how ecosystem services were restored at the scale of the village and the land used by villagers. Some areas were the focus of particular green-grey measures and thus experienced greater improvements in ecosystem service provision than other areas. For example, in Canchayllo, the Chacara lake dam wall and the main 2855 metre channel linking Chacara to Jutupuquio to distribute water during the dry season was repaired, thus improving water provision to Jutupuquio. In Miraflores, the area of protected wetlands, lakes and ancient dikes in Yanacancha was expanded from three to five hectares, fencing was repaired and extended to prevent the entry of animals (mainly cattle and horses), two kilometres of water pipes linking Yanacancha to Curiuna were repaired and an additional 2.4 kilometres of pipe between Huaquis to Tuntinia were added. Some 80 hectares of grazing area in Curiuna, Pampalpa, Colulume and Tuntinia were closed off with fencing to control the entry of animals and protect the Aysha area (Instituto de Montaña and UICN 2016a; 2016b).

Synergies in terms of ecosystem services provision occurred between upstream and downstream areas in the same watershed. In Canchayllo, upstream wetland conservation and management is expected to enhance water provision downstream. The NYCLR is connected to downstream areas in the Lima and the Junín Regions, which use water for domestic, agricultural and hydroelectric purposes (UNDP 2015). It is estimated that more than 11 million Peruvians, including the inhabitants of Lima City downstream, depend on water that originates from the NYCLR (Dourojeanni et al. 2016). Healthier ecosystems in Tanta will also improve water provision and regulation to a vast rural and urban area downstream (UNDP 2015).

Trade-offs in terms of ecosystem services provision may also have occurred. Regulating where animals graze allows these areas to recover, but may mean neighbouring areas are grazed more and thus experience more degradation. Whilst this trade-off could in theory occur, it has not yet been observed.

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

Environmental benefits were already apparent towards the end of the project. For example, green-grey infrastructure project components delivered fast changes to water distribution and supply (Instituto de Montaña and UICN 2016a; 2016b; Zapata et al. 2016). Other improvements to ecosystem services, such as hydrological regulation, minimising the impacts of extreme events and grassland carbon storage, were expected over the longer term, beyond the project lifetime (Podvin et al. 2014). This reflects experiences from 21 EbA projects elsewhere in Peru, which MINAM (2017) notes do not necessarily show the impacts of measures during project lifetimes. Project planning was long-term, with vulnerability and impact assessments ensuring that EbA options considered the climate change adaptation context and thus led to longer-term benefits (UNDP 2015). Water and grassland management plans developed under the project extend to 2020.

Some NYCLR staff interviewees cautioned that whilst improvements to ecosystem services are already apparent, continuity and replication in the rest of the NYCLR is needed to ensure this continues. Trade-offs may occur in terms of grazing restrictions, whereby short-term localised drops in grassland productivity may occur before landscape-level improvements in grassland health deliver long-term productivity gains.

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

How cost-effective is the EbA project?

Cost-benefit analyses were conducted for Tanta, Canchayllo and Miraflores. These compared livestock and rangeland management practices designed for EbA with a business as usual scenario. Both of these scenarios modelled costs and benefits with and without climate change. These conventional cost-benefit analyses, along with more qualitative cost-benefit studies in Canchayllo and Miraflores, showed that the benefits of implementing robust EbA measures outweighed the costs. The qualitative studies also included results from a communal assessment of the environmental and social aspects of the EbA initiatives (Podvin 2017a). Interviewees agreed that the benefits of implementing robust EbA measures outweighed the costs, and a survey of 21 EbA case studies throughout Peru found that EbA options led to positive economic achievements (MINAM 2017).

The cost-benefit analysis for sustainable grassland management, vicuña management and animal husbandry in Tanta valued income improvements from the following ecosystem services: provision of alpaca and vicuña fibre, provision of sheep's wool, provision of beef and alpaca and sheep's meat, and provision of water for agricultural purposes. The main costs of the community farm (the business as usual scenario) were: food for domestic cattle, equipment and inputs (for example, fences, trucks, slaughter house, veterinary services), labour (for example, shepherding and infrastructure construction and maintenance), training (for example, on rotational grazing), an internship programme, and provision of technical assistance. The main costs the vicuña (EbA) project components were: food for vicuña, inputs for basic chaccu (gathering wild vicuñas for shearing), shearing equipment, labour for chaccu

and shearing, training, and an internship programme. The analysis considered four scenarios over a 20-year timeline (UNDP 2015; 2016):

1. A scenario without the project intervention (business as usual) and with climate change impacts. Interestingly, climate change actually has a positive impact on pasture growth in Tanta, which translates into an increase in cattle population and productivity and thus greater livestock-related income.
2. A scenario without the project (business as usual) and without climate change. Because livestock carrying capacity is reached earlier than under the scenario with climate change above, this translates to a lower income projection.
3. A scenario with project EbA measures to improve livestock management practices and the use of livestock products, and with climate change.
4. A scenario with the project (EbA) but without climate change.

Results show that implementing EbA measures in Tanta, even using a high 9% discount rate, is financially very favourable (see Table 4). These scenarios highlight that rational investors would choose to invest in the EbA project, which is both viable and profitable when compared to the business as usual scenario (Rossing et al. 2015). Whilst the net present values are higher for scenarios with climate change compared to those without, results show that EbA measures are better than business as usual in all circumstances (UNDP 2015; 2016).

Table 4: Profitability indices in Tanta for four different scenarios, 2014-2033

Profitability indices	**Scenario without the project (business as usual)**		**Scenario with the project (EbA)**	
	With climate change	**Without climate change**	**With climate change**	**Without climate change**
Net present value (US$)	205,324.40	181,047.35	652,150.32	602,452.55
Internal rate of return (%)	N/A	N/A	37	35
Benefit-to-cost ratio	2.24	2.15	1.62	1.55

Source: UNDP (2016).

A similar cost-benefit analysis was conducted in Canchayllo. Components quantified included water provision for pasture irrigation and livestock use, and improved provision of pasture (with resulting gains from the sale of greater yields of cattle meat and milk, and sheep's wool and meat). Costs with the project included project design, equipment and supplies for infrastructure, payment for two Reserve staff, labour for infrastructure, and the costs of training and technical assistance to build local capacity. Costs without the project included the opportunity costs of labour for grazing cattle, and payment for two Reserve staff. As above, four scenarios were assessed. The two scenarios with climate change assumed reductions in pasture condition[2] (as a result of drought, changing rainfall patterns and unsustainable grazing patterns), a consequent reduction in pasture carrying capacity, and lower resulting yields of meat, wool and milk:

1. Without the EbA project and without climate change.
2. Without the EbA project and with climate change.
3. With the EbA project and without climate change.
4. With the EbA project and with climate change

Results showed that the scenarios with the project are financially more beneficial than the scenarios without the project, and in the same way, the scenarios without climate change are financially more

[2] This is unlike Tanta, where models suggested climate change would increase productivity.

beneficial than the scenarios with climate change (see Table 5). A high discount rate of 9% was used, and a timeframe of 2013 to 2033 (Alvarado 2015a).

Table 5: Profitability indicators at a discount rate of 9% for four scenarios in Canchayllo

	Without the project and without climate change	**Without the project and with climate change**	**With the project and without climate change**	**With the project and with climate change**
Net present value	-637,451	-709,646	140,871	48,342
Benefit-to-cost ratio	0.57	0.52	1.07	1.03
Internal rate of return (%)	0	0	12	10

Source: Alvarado (2015a).

A qualitative cost-benefit analysis conducted in Canchayllo also suggests that EbA investments led to positive economic benefits. This analysis complemented the standard cost-benefit analysis above, and adopted a participatory rating system, from which an alternative benefit to cost ratio of 2.18 resulted (see Table 6) (Alvarado 2015a).

Table 6: Qualitative cost benefit analysis application in Canchayllo

Factor	**What benefits does the project bring, or will it bring? (rating: details)**	**What losses or investments does the project bring, or will it bring? (ratings: 0 = none; 1 = low; 2 = medium; 3 = high)**
Environmental		
Natural pastures	3: Pasture improvements; pasture conservation; field rotation; pasture irrigation in dry season	0
Water	3: Water availability in summer; emergence/recovery of springs; pasture preservation	0
Wildlife	2: Habitat improvement for wild animals; increase in ducks and deer	0
Ecosystem services	3: Conservation and better management of the ecosystem (pastures, water, climate); photosynthesis and absorption of carbon dioxide	0
Climate change		
Droughts, heavy rains, cold waves and heatwaves	2: Increased water availability in drought time; long-term afforestation using water; water flow control during heavy rains	0
Adaptive capacity	2: Sensitisation of the population to climate change; availability of water and pastures	0
Social		
Communal organisation	1: Agreements are respected for limiting animals; improving and adapting community statutes; forming committees in various areas; communal tasks for common benefit	1: Time for meetings/workshops

Coordination of local institutions	1: Agreeing criteria; teamwork between local authorities and community	2: Time to agree
Technical and local knowledge	3: Learning lessons about pasture and water management; sensitisation about what climate change is and how to face it; recovery of ancestral customs	3: Time
Participation of men and women	2: Participation and involvement of women and youth	2:
Economic		
Income generation	2: Improves the quality of life; temporary employment for community members; income improvements	3: Investment in channels; investment for the dam; skilled and unskilled labour (animal slaughter); food transport (fuel); other transport (personnel and materials); machinery; fences (poles, mesh)
Total	**24**	**11**
Benefit-to-cost ratio: 2.18		

A similar cost-benefit analysis was conducted in Miraflores. Components quantified included water provision for livestock and human consumption, and improved provision of pasture for livestock (and hence better-quality cattle and improvements in beef and cheese yields, because all milk is used to make cheese for sale). Costs assessed for the scenarios with and without the project mirror those described above for the Canchayllo study, and as above, four scenarios were identified. The two scenarios with climate change assumed reductions in pasture condition (similar to the Canchayllo study, but unlike Tanta), and a consequent reduction in cattle quality and cheese production:

1. Without the EbA project and without climate change.
2. Without the EbA project and with climate change.
3. With the EbA project and without climate change.
4. With the EbA project and with climate change.

As in Canchayllo, results showed that scenarios with the project are financially more beneficial than the scenarios without the project, and in the same way, the scenarios without climate change are financially more beneficial than the scenarios with climate change (see Table 7). A high discount rate of 9% was used, and a timeframe of 2013 to 2033 (Alvarado 2015b).

Table 7: Profitability indicators at a discount rate of 9% for four scenarios in Miraflores

	Without the project and without climate change	**Without the project and with climate change**	**With the project and without climate change**	**With the project and with climate change**
Net present value	-41,991	-115,236	958,821	700,405
Benefit-to-cost ratio	0.97	0.92	1.60	1.44
Internal rate of return (%)	0	0	28	25

Source: Alvarado (2015b).

The qualitative cost-benefit analysis conducted in Miraflores (see Table 8) resulted in a benefit-to-cost ratio of 2.25, again suggesting that the benefits of EbA investments outweigh the costs. This was higher than the benefit-to-cost ratio for Canchayllo because of the greater profitability of raising cattle compared to sheep, and the comparatively better organisation of the Miraflores community compared to Canchayllo (Alvarado 2015b).

Table 8: Qualitative cost benefit analysis application in Miraflores

Factor	**What benefits does the project bring, or will it bring? (rating: details)**	**What losses or investments does the project bring, or will it bring? (ratings: 0 = none; 1 = low; 2 = medium; 3 = high)**
Environmental		
Natural pastures	2: Food available for animal breeding; recovery of natural pastures	0
Water	3: Clean water for animals; animal watering holes; more water availability and for all of the time; good water management	0
Wildlife	2: More birds and deer; scenic beauty	1: Harm to alfalfa
Ecosystem services	2: Improvement in pastures, water and animals; healthier environment; decreased pollution	0
Climate change		
Droughts, heavy rains, cold waves and heatwaves	3: Water availability in summer time; water management	0
Adaptive capacity	2: Nature conservation; technology / fencing for water storage	0
Social		
Communal organisation	3: Community organisation to manage pastures; fulfilling communal tasks; reaching agreements	2: Time for meetings, assemblies and tasks
Coordination of local institutions	2: Paid municipal work; support from local government	2: Time
Technical and local knowledge	3: Training in pasture and water management; pollution reduction	2: Time
Participation of men and women	2: Participation of women in talks; participation of schoolchildren in talks, video and theatre	2: Time
Economic		
Income generation	3: Community income for renting communal pastures; better-fed animals increase income; generation of temporary employment; rental of llamas, horses and donkeys	3: Investment of labour in the purchase of materials (mesh poles); pipes; sand and cement; transport
Total	**27**	**12**
Benefit-to-cost ratio: 2.25		

Quantifying and estimating the monetary values of ecosystem services for the cost-benefit analyses was challenging. Many services are difficult to value in practice, with confidence in the valuation methodologies low. Assessing the multiple benefits of EbA in the context of climate change can also be challenging when it is unclear exactly what climate change impacts are expected. For example, assessing how grassland management was linked to water retention capacity and soil erosion was difficult (UNDP 2015).

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

Scenarios with EbA were compared to non-EbA business as usual scenarios (both with and without climate change) in Tanta, Canchallyo and Miraflores. As detailed in the above section, the scenarios with EbA were more cost-effective at all three sites.

Broader economic costs and benefits from the EbA project

Interviewees and published literature describe a number of broader economic costs and benefits that were not included in the conventional or participatory cost benefit analyses described above::

- Benefits from increased water infiltration, water regulation and soil erosion control were expected in Tanta as a result of new livestock and rangeland management practices. These were evaluated but were found to be difficult to measure so were not included in the final cost-benefit analysis. Analysis results therefore undervalued the project benefits (UNDP 2015).
- Sustainable management of grasslands in Tanta is expected to generate new or increased income for local communities from a boost in recreation and tourism activities (UNDP 2015)
- Losses from animal deaths are avoided in Miraflores due to higher availability of pastures (Podvin 2017b).
- Project activities generate temporary jobs.

Broader economic costs were few, but may have included:

- Some costs of IUCN and TMI staff management time (whilst project costs for the Canchayllo and Miraflores cost-benefit analyses included estimates for the provision of staff time for technical advice, not all the costs of IUCN and TMI staff management time were included in the analyses).
- The costs of community time invested in project activities.
- Possible costs associated with grazing restrictions.

One important lesson from the Global Mountain EbA Programme relates to the importance of supporting appropriate assessments of market opportunities for goods harvested or produced through EbA interventions. For example, the commercial sale of vicuña fibre provided a new income opportunity from the project in Peru, but was dependent on value chain development (UNDP 2015).

Financial and economic trade-offs at different geographical scales

Financial and economic trade-offs between management at different geographical scales were not assessed. However, grazing activities are now more organised, and there may have been short-term losses in productivity in some areas as a result of the implementation of specific times for gazing, rotational management techniques and the enforcement of protected areas where grazing is forbidden.

Changing financial and economic benefits and costs over time

Several economic benefits from the project emerged from processes that took time to materialise (Murti and Buyck 2014). For example, results from the Tanta cost-benefit analysis show that for roughly the first two years after the implementation of EbA measures, short-term costs are higher in terms of net benefit flows. After this period, the financial benefits from the EbA measures outweigh those from the business as usual scenario, a situation that continues for the medium to long term (at least 20 years), beyond the project lifetime (UNDP 2015). Results of the qualitative cost-benefit analyses conducted in Canchayllo and Miraflores also showed that benefits from the EbA project were less apparent in the

short term, but that in the medium to long term the costs fell and the benefits increased (Alvarado 2015a; 2015b). One interviewee also commented that whilst there may have been short-term trade-offs resulting from grazing restrictions in certain areas, in the medium to long term healthier grasslands over the whole landscape will increase productivity and economic benefits. Early project observations were in line with these predictions, with UNDP (2015) noting that project EbA measures had started to demonstrate economic benefits and that these were expected to continue for the long term.

An important Global Mountain EbA Programme lesson relates to the fact that communities are more interested in the economic and social benefits of EbA and less so in the environmental benefits, so EbA projects must generate short-term economic and social benefits to secure community support (UNDP 2015). Whilst the 'no regret' EbA measures implemented under the project were designed to yield net economic benefits addressing current climatic conditions, and also regardless of how future climate change scenarios unfold (Podvin et al. 2014), it was also clear that these economic benefits could take time to materialise.

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

Local-level barriers to implementing EbA

Interviewees and published literature describe a number of policy, institutional and capacity barriers to implementing EbA at the local level:

- ***Weak institutions***. Communal rules/regulations are not followed and community organisation and leadership needs to be improved. Podvin and Arellano (2016) stress the need for institutional strengthening and capacity building amongst stakeholders directly involved with landscape management, and this includes integrating traditional and scientific knowledge into EbA processes, as well as improving interlinkages between different sectors. One important driver of overgrazing is the weakness of community organisations when it comes to managing water and grassland resources on community lands, which means carrying capacity is exceeded due to mismanagement and the lack of customary norms (Murti and Buyck 2014; UNDP 2015; MINAM 2017). Podvin et al. (2014) describe how in the past, good community organisation led to good ecological knowledge and sustainable communal land management, but that now, even though the land is communal, it has a type of inherited ownership so community rotational grazing no longer occurs, traditional knowledge is being lost and it is more difficult to reach agreements between community members. Poor community organisation, together with the loss of traditional knowledge, poor market access, declining agricultural prices and a lack of labour for agricultural work due to out-migration in the 1980s and 1990s, has led to a decline in agricultural production and a shift to intensive cattle farming, which has in turn led to overgrazing (MINAM 2017; Podvin et al. 2014).
- ***Knowledge unavailable***. Knowledge on the state of natural resources and on the impact of climate change on natural resources is insufficient. Better local understanding of EbA approaches (their benefits, costs, opportunities and limitations) would help with prioritising nature-based solutions in local policies such as municipal plans. Further community awareness-raising work is needed to support implementation.
- ***Insufficient financial resources***. Local governments have suffered budget cuts and community/participatory budgets need to prioritise EbA projects. Podvin and Arellano (2016) also stress the need for funding to help local municipalities develop projects promoting EbA as a viable alternative to conventional grey infrastructure options.
- ***Insufficient/unavailable technical skills and implementation capacity***. UNDP (2015) notes that whilst EbA is well mainstreamed into local management plans, implementing the EbA priorities and strategies identified remains critical. Podvin and Arellano (2016) reiterate that whilst EbA has been inserted into policies and strategies in Peru, it still needs to be operationalised at the local level. For example, park rangers need capacity building on technical issues (including climate change and EbA) and tools to communicate these issues (Podvin et al. 2014; Rizvi et al. 2014). Despite the

benefits, extensive adoption of participatory processes requires a great deal of time and effort, and requires an in-depth understanding of the local context (Podvin et al. 2014).

- ***Insufficient coordination between institutions***. For example, the municipal government should connect with other municipalities better, and inter-institutional relations between the community and municipal government should improve. Podvin et al. (2014) note that NYCLR management depends on several stakeholders – including SERNANP at the local level, local government, private and public initiatives, and local people – and that the overlapping and sometimes unclear responsibilities of these different stakeholders can make Reserve co-management challenging. Roughly 80 stakeholders have some degree of management relationship with the Reserve, including serving on the Reserve Management Committee, so governance is complex.
- ***Conflicting local interests***. Some community groups were interested in activities (such as agriculture or livestock) that depended on ecosystem services, while other groups were interested in different land uses (such as extractive activities) (Zapata et al. 2016). A key project lesson was the importance of analysing the level of local dependence on ecosystem services that would be maintained or improved by the EbA measure (Zapata et al. 2016). In Canchayllo, for instance, only 41% of the population depends on cattle grazing, while others wish to promote mining. The first group presided over the community at the start of the project and the second group presided during the final project implementation phase. Tension between these groups, and local authority resistance to supporting EbA measure implementation by the end of the project, limited the achievement of EbA measure objectives and sustainability (Zapata et al. 2016). Rizvi et al. (2014) also note that working with multiple actors whose visions of the territory and its management may not coincide was challenging, and that adopting participatory approaches helped include different stakeholder perspectives.
- ***Insufficient policy support.*** For example, local statutes and regulations should include commitments to continue with EbA projects and make better use of grazing land and water resources. UNDP (2016) notes that land-title deeds in the Reserve are lacking, and land ownership has not been recorded in the public registry. Secure rights to and responsibilities for land (ownership, sustainable use and management) maximise the chances of successful EbA (UNDP 2015).
- ***Insufficient government support***. For example, interviewees for the participatory cost-benefit study in Canchayllo were concerned that the EbA measures would fail due to a lack of interest from the authorities. Some felt the authorities were more interested in mining than in livestock (Alvarado 2015a).

Regional-level barriers to implementing EbA

Interviewees and published literature describe a number of policy, institutional and capacity barriers to implementing EbA at the regional level:

- ***Insufficient institutional collaboration***. Junín prioritises EbA in its regional plan, but coordination with sectoral plans under this, which affects what occurs on the ground, is not happening. The complexity of institutions means that even though some people have the will to implement EbA, they are prevented from doing so because of complex bureaucracy.
- ***Financial resources unavailable***. For example, the Junín Regional Climate Change Strategy does not provide a budget for delivering EbA (UNDP 2015), and funding is needed to help regional governments develop projects promoting EbA (Podvin and Arellano 2016).
- ***Inadequate implementation capacity***. Whilst EbA is well mainstreamed at the regional level, implementation remains a challenge (Podvin and Arellano 2016). For example, the Junín Regional Climate Change Strategy does not define roles and responsibilities for delivery (UNDP 2015). Ecological and economic zoning is also important.
- ***Lack of knowledge***. A better understanding of EbA approaches (their benefits, costs, opportunities and limitations) would help prioritise nature-based solutions in regional climate change plans.

National-level barriers to implementing EbA

Interviewees and published literature describe a number of policy, institutional and capacity barriers to implementing EbA at the national level:

- ***Insufficient cross-sectoral institutional or inter-ministerial collaboration***, which is needed to improve mainstreaming. The national government supports EbA solutions in the context of policies relating to climate change adaptation, and there are ongoing efforts to promote nature-based solutions (or natural infrastructure) in other sectors such as agriculture, forestry, water, health and fisheries, as well as land planning. Mainstreaming, financing and implementing these approaches across sectors, and at larger scales within the country, remain a challenge (UNDP 2015; Podvin and Arellano 2016).
- ***Lack of relevant data***. Gathering the data needed for quantifying and showing the multiple benefits of EbA is challenging, especially with regards to climate change adaptation and ecosystem functions as this takes times and often requires multifaceted scientific expertise. The lack of such data can mean EbA is undervalued in cost-benefit analyses and also means that monitoring its benefits is challenging. More quantitative evidence is needed to make the case for EbA, but most evidence to date is based on case studies. Podvin and Arellano (2016) identify the need for solid evidence to improve knowledge and understanding on the limitations, gaps, costs and benefits of EbA. Making the economic case for EbA requires better quantification of its multiple benefits (Podvin and Arellano 2016). Consolidating learning from EbA monitoring and evaluation efforts is also needed (Podvin and Arellano 2016), but the development of EbA indicators for monitoring and evaluation purposes is in its initial stages (UNDP 2015). Monitoring and evaluation are often undertaken for an EbA project but not an EbA measure. Community monitoring can help address this challenge (MINAM 2017). More qualitative and quantitative tools are needed to facilitate the design, implementation, monitoring and evaluation of the multiple benefits of EbA and ecosystem-based disaster risk reduction (Eco-DRR) in the context of meeting climate change, disaster risk reduction, biodiversity and sustainable development objectives (Podvin 2017a; MINAM 2017). A comprehensive overview of EbA projects is also needed.
- ***Shortage of finance***. EbA needs investment to support implementation (IUCN 2017b). EbA projects should be prioritised, particularly within public investment systems. Climate change policies need to be translated into budget allocations and expenditures, thereby making climate change part of the national budgeting process (UNDP 2015).
- ***Lack of capacity among national managers to mainstream EbA*** into policy, planning and strategic investment instruments at the national level (MINAM 2017). Podvin and Arellano (2016) reiterate that whilst EbA has been inserted in policies and strategies in Peru, it still needs to be operationalised at the national level, and actions need to be identified to ensure implementation progresses.
- ***Lack of long-term donor support.*** Donors need to support projects for longer periods to ensure a solid implementation phase and to support impact monitoring phases.

Local-level opportunities for implementing EbA

Interviewees and published literature describe a number of policy, institutional and capacity opportunities for implementing EbA at the local level:

- ***EbA 'champions'***, who started as local researchers, were involved in supporting project design during the early project stages and saw their role grow as the project progressed. This improved levels of community engagement and long-term project sustainability (Zapata et al. 2016; PNUD et al. 2016; Instituto de Montaña and UICN 2016a; 2016b). UNDP (2015) also note that working with local champions would help to extend the benefits of EbA measures beyond the Project lifetime.
- ***Government prioritises EbA***. One municipal government has accepted its responsibility for implementing EbA measures. There are strong local statutes, which are updated every two years depending on the local situation. Engaging municipalities is key, in part because they finance local plans. EbA is well mainstreamed into local management plans for water and grasslands in

Canchayllo and Miraflores, because the project helped develop these plans (UNDP 2015). Mainstreaming into other local priorities and policies is ongoing.

- ***Appropriate incentives are in place to motivate action***. It was essential for the project to provide early socioeconomic benefits that could enhance livelihoods, to make the case for the project itself and eventually for EbA more broadly (UNDP 2015). Participatory approaches for designing early project activities helped foster a sense of ownership as well as prioritising immediate economic benefits. Green-grey infrastructure construction caught people's attention and motivated them to engage in the project (Murti and Buyck 2014).
- ***Working with and strengthening existing local organisations supports implementation***. The project worked with community assemblies in Tanta, Canchayllo and Miraflores. In Tanta, there are also community committees such as the livestock/cattle committee (UNDP 2015). Miraflores has low levels of social conflict, relatively strong social organisation and good relationships with the NYCLR (Rizvi et al. 2014). It has good governance with strong local statutes, providing opportunities for EbA to be prioritised (Podvin 2017b). Existing natural resource committees were strengthened and new ones created, for example for managing pastures in Miraflores and for managing pastures, water and climate in Canchayllo. Strengthening existing local natural resource management governance structures helped implement EbA measures and secure resulting benefits, incorporate EbA into existing local structures and plans, and ensure sustainability beyond the project lifetime. Management plans for communal pasture and water resources were developed for the communities of both Canchayllo and Miraflores, and the project has strengthened overall community-level management capacities. The communities have now also dedicated part of their own, community-level participatory budgets for implementing jointly planned project activities. Local institutions are getting stronger, resulting in better community governance and stewardship (UNDP 2015).
- ***Existing local knowledge and technologies*** (both ancient and recent) for adaptation to climate variability through ecosystem management. These were key elements for implementing EbA measures in Miraflores and Canchayllo, although it was sometimes necessary to adapt these technologies to the current context (for example, using green-grey infrastructure in Canchayllo and Miraflores) (Zapata and Gómez 2015).
- ***Existing NYCLR management plans and governance structures facilitate EbA implementation and local mainstreaming.*** It was expected that pasture in the Reserve would already be more resilient than elsewhere, and able to resist heavy rainfall and drought better. The NYCLR Master Plan prepared by SERNANP also already provided good information on local ecosystems and ecosystem services, and included an integrated approach to water management (UNDP 2015).
- ***Communal land ownership*** facilitates EbA implementation more easily than in areas characterised by small, privately owned land parcels, where initiating landscape-level changes can be challenging (UNDP 2015). Management of communal land is not without challenges, however, and in the Peruvian Andes, land ownership and usufruct are complex. Communal land ownership can facilitate EbA implementation at the landscape-level, but not in all cases. For example, it has been difficult to secure the continuous commitment of authorities and the population in Canchayllo (and Tanta) where EbA measures were implemented on communal farmland grazed by communally-owned cattle (Zapata et al. 2016). EbA implementation under the project was more successful in areas with communal land ownership but private (family-owned) cattle, as in Miraflores.

Regional-level opportunities for implementing EbA

Interviewees and published literature describe a number of policy, institutional and capacity opportunities for implementing EbA at the regional level:

- ***Working with regional governments*** has provided an opportunity to integrate EbA into regional climate change strategies. Support to regional governments in this respect needs to continue (Podvin and Arellano 2016).
- ***Government is prioritising EbA***. EbA is now well mainstreamed at the regional level in Peru (UNDP 2015), and the Junín and Lima Regions have EbA as a priority in their strategies. Regional government has also supported and prioritised the project.

- ***EbA 'champions'*** have an interest in EbA and the will to promote it.

National-level opportunities for implementing EbA

Interviewees and published literature describe a number of policy, institutional and capacity opportunities for implementing EbA at the national level:

- ***Working with MINAM, SERNANP and the Ministry of Economy and Finance (MEF)*** provides an opportunity to integrate EbA into existing governance structures, planning and policy instruments, particularly public investment systems (Podvin and Arellano 2016).
- ***Government is prioritising EbA, and EbA 'champions' are promoting it***. Government officials are now interested in EbA and have the will to promote it. Ministry technical staff are capable, and finances have been allocated accordingly. Government interest in integrating EbA approaches into climate change adaptation planning is growing. Ways to promote EbA are being explored and developed, for example through public investment, payment for ecosystem services mechanisms, sectoral targets under the Intended Nationally Determined Contribution, and attempts to mainstream EbA into sectors. Public sectors are increasingly incorporating EbA into their planning and policy processes. The project itself was also prioritised and given support.
- ***There is strong national policy in place***. Peru has a solid set of national-level policies that provide a framework for implementing EbA (see Box 2), and more opportunities for doing this than many other countries. UNDP (2015) notes that EbA is mainstreamed well into national policies.

Box 2: National policies and strategies supporting EbA in Peru

- The **National Climate Change Strategy** (2014) comprehensively integrates EbA into adaptation approaches. It goes beyond proposing EbA as an adaptation measure to adopting an ecosystem-based lens, where appropriate, to all adaptation planning. Based on the **Organic Law of Regional Governments** (2002), it also contains a legal obligation requiring each regional government to have a Regional Climate Change Strategy. This enhances decentralisation on climate change and provides an opportunity for more detailed and localised adaptation planning.
- The **Nationally Determined Contribution** (2015) includes EbA-relevant elements in its water and forestry components. It refers to the Mountain EbA Project in the context of key projects from which results and practical experiences must inform adaptation planning in Peru.
- The **Bicentenary Plan 2011-2021** is Peru's main document guiding national development. It has an objective relating to the conservation and sustainable use of natural resources and biodiversity using an integrated and ecosystem-based approach to environmental management that enables a good quality of life for people, and healthy, viable and functional ecosystems in the long term. Climate change adaptation is one of five priorities addressed under this objective.
- Climate change is included in various environmental policies, such as the **National Policy on the Environment** (2009), the **National Action Plan on the Environment 2011-2021** (2011), the **Strategy for the Conservation of Biodiversity 2021** (2014), the **National Agreement** (2002), and the **General Environmental Law** (2009). Although these do not specifically link ecosystems and adaptation, they prioritise ecosystem management, identify climate change as a threat to ecosystems, and emphasise the importance of adaptation.
- The **National Biodiversity Strategy and Action Plan** (2014-2018) strongly emphasises both people and nature, and addresses climate change in components addressing government/policy planning and regulatory frameworks and mainstreaming.
- The **National Policy and Strategy on Water Resources** (2012) identifies an action around ecosystems and adaptation.
- The **Risk Management and Adaptation Plan for the Agricultural Sector** (2012-2021) identifies risk in the agricultural sector and details specific objectives related to food emergencies, drought/irrigation, and soil and forest management. The plan also seeks to build resilience and develop adaptation measures in the sector.

- **The Policy Guidelines for Public Investment in Biodiversity and Ecosystem Services 2015-2021** provide a path for investing public finance in projects such as watershed management and species conservation as opposed to grey infrastructure (as in the past). One of the guidelines is "to implement ecosystem-based adaptation actions ensuring the sustainable provision of ecosystem goods and services to reduce current and future vulnerability of the population to climate change". There has already been much investment in riverbank protection and forestry by municipal governments as a result of the guidelines.
- The **Climate Change Framework Law (2018)** aims to establish the principles, approaches and general provisions to coordinate, articulate, design, execute, report, monitor, evaluate and disseminate public policies for the integral, participatory and transparent management of adaptation and mitigation to climate change, in order to reduce the vulnerability of the country to climate change, take advantage of the opportunities of low carbon growth and fulfil the international commitments assumed by the state before the UNFCCC, with an intergenerational approach. The law highlights EbA as an approach for integrated climate change management.

Source: UNDP (2015); Podvin and Arellano (2016).

- ***Peru has various national-level institutions to support in-country action on climate change***. The Department of Climate Change and Desertification was designated as the MINAM focal point for developing the Climate Change Action Plan for Adaptation and Mitigation. MINAM chairs the National Commission on Climate Change, which in 2013 was tasked with tracking public and private sector involvement in climate change, and there is a Multi-sectoral Working Group for the implementation of the Intended Nationally Determined Contribution. There are also technical groups on climate change – municipal environmental commissions (created in provincial and district municipalities) that coordinate municipal environmental policy and also promote dialogue between the public and private sector and civil society (Podvin and Arellano 2016).

Is the EbA project sustainable?

The project was generally considered sustainable at the local, regional and national levels. In Canchayllo, however, whilst those with an interest in the livestock/farming sector are on board with the project activities, there are other sectors which may promote other land uses. Interviewees and published literature described a number of factors facilitating long-term project sustainability:

- ***Existing NYCLR structures and plans were used***. The fact that the project was in an existing protected natural area supports sustainability (Podvin 2017a; Rizvi et al. 2014). Partnering with SERNANP, the national protected areas agency, was key. The NYCLR Master Plan acted as a guiding framework for prioritising and embedding activities in, while SERNANP and NYCLR staff provided an essential institutional framework, along with technical expertise for sustainable delivery of EbA. Climate change, EbA and Project Vulnerability Impact Assessments have been integrated into the new NYCLR Master Plan (UNDP 2015).
- ***Showing the multiple benefits of EbA to government planners and policymakers*** helped make the case for EbA and increased interest in implementation. This in turn led to incorporation of EbA into relevant governance structures, plans and policies, as well as allocating budgets in relevant sectors, from the local to the national level. For example, having seen early benefits on the ground from implementing grassland management measures, the Municipality of Tanta dedicated some of its existing communal budget to hiring two communal rangers and buying a motorcycle to help monitor vicuñas. The mayor´s office has also co-financed vicuña management activities (UNDP 2015), and participatory municipality budgets have financed some elements of the Canchayllo and Miraflores water and grassland management plans (Podvin 2017a).
- ***Local organisations have been strengthened or created, and agreed management plans developed.*** For example, natural resources management committees have been either strengthened or created, and the project has implemented a community water and grassland management plan for both Canchayllo and Miraflores (UNDP 2015). The Miraflores community has considerable interest in continuing with its water and grassland management plan. Podvin (2017b)

comments on how organisational development is fundamental to sustainability, as well as appropriate knowledge, skills and alignment between social, environmental, cultural and political contexts.

- ***Political will*** was particularly important at the regional and national levels. Regional governments in Junín and Lima promote EbA and have prioritised it in regional plans, and there is also ministerial-level support for EbA and for building on lessons from the project.
- ***Local ownership promoted*** due to interactive participation.
- ***Livelihood improvements*** incorporated into EbA measure design and implementation.

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

The project initiated various activities at the local, regional, national and international levels to replicate, scale up or mainstream EbA into planning and implementation in Peru and more widely. Activities at the local level include the following:

- EbA has been mainstreamed in local-level water and grassland management plans (UNDP 2015).
- There has been a change in attitude to EbA amongst policymakers and planners at the local level, especially in Miraflores. In both Canchayllo and Miraflores, however, communities prioritised activities under the new community water and grassland management plans in their participatory municipal budget for 2016.
- More animal watering sites have been constructed in Miraflores, and there is a proposal to expand the fenced-off pasture areas and continue the zoning work, taking advantage of programmes under the Ministry of Agriculture, for example.
- Project activities in Tanta are being replicated in the nearby community of Tomas under a subsequent project being implemented there (UNDP 2015).
- With support from the project, climate change adaptation and EbA has been incorporated as a cross-cutting issue into the NYCLR's main areas of activity and its Master Plan (Podvin et al. 2014; UNDP 2015). Project Vulnerability Impact Assessment results have also been incorporated into the NYCLR's revised Master Plan (2015-2020).

Mainstreaming activities at the regional level include the following:

- EbA has been mainstreamed at the regional level in Junín. For example, the project worked with the Regional Government of Junín to formulate the Regional Climate Change Strategy (2014). The Project Vulnerability Impact Assessment results informed this Strategy, which includes EbA in its vision, strategy and named projects (UNDP 2015).
- The project has also provided direct technical support to the development of the Regional Climate Change Strategy for the Lima Region (UNDP 2015).
- SERNANP is now collaborating more closely with the regional governments of Junín and Lima to manage the middle and lower stretches of the watersheds in which the NYCLR sits, given the critical ecosystem services to large downstream rural and urban populations provided by upstream areas. This provides an opportunity for including EbA in planning for a broader area, beyond the NYCLR (UNDP 2015).
- SERNANP is using the NYCLR Vulnerability Impact Assessment to inform how vulnerability impact assessments could be conducted in protected areas elsewhere. The assessment process, along with project monitoring and evaluation indicators, was designed to fit with existing SERNANP plans and guidelines in order to facilitate replication in other protected areas in Peru (UNDP 2015).
- The Project Vulnerability Impact Assessment has also been useful for SERNANP in the context of watershed-level planning with the Regional Water Authority (UNDP 2015).

At the national level, interviewees noted that there is now more funding for EbA, both from donors and also from public investments. Mainstreaming activities facilitated by the project at the national level include the following:

- MINAM organised two workshops in 2017 to facilitate the integration of EbA into public investments, development planning and the Intended Nationally Determined Contribution process. These workshops facilitated the sharing of experiences and strengthening of synergies between the different actors and sectors working on EbA (IUCN 2017b).
- The project worked to integrate EbA into public investments by collaborating with the Ministry of Economy and Finance and the Ministry of the Environment and Natural Resources to include EbA in the Policy Guidelines for Public Investment in Biodiversity and Ecosystem Services 2015-2021. These Guidelines were approved in 2015 and promise far-reaching impact by mainstreaming EbA into government investments (UNDP 2015).
- The project informed the development of Peru's Intended Nationally Determined Contribution (UNDP 2015). This document promotes the project as a model for the design of future EbA measures (Podvin 2017a).
- Project lessons have been incorporated into MINAM's national environmental training programme.
- The project 'Scaling Up Mountain Ecosystem-based Adaptation: building evidence, replicating success, and informing policy' is taking place in Peru from 2017 to 2020. This is supported by IKI and implemented by TMI and IUCN. It builds on work done under the Mountain EbA Project. Project measures include ensuring that past and new EbA projects yield long-term evidence and lessons; extracting that knowledge and evidence; building local capacity to replicate successful approaches; and informing local, national, and international adaptation plans and policies. Applied training will be used to convey lessons, replicate EbA practices, and link to national adaptation planning.

No significant upscaling of EbA lessons has yet taken place at the level of Latin America or the Andean region. However, mainstreaming activities at the international level include the following:

- Project experience has fed into the UNFCCC policy process through the Nairobi Work Programme process and the Subsidiary Body for Scientific and Technical Advice. This has enhanced buy-in for EbA from a range of stakeholders, including other governments (UNDP 2015).
- New tools have been developed to support EbA replication, and existing tools have been adapted. These include integrated participatory rural appraisal, action learning, qualitative cost-benefit analysis and the Project Vulnerability Impact Assessment.[3] UNDP (2015) notes that given the time and financial resources invested in developing vulnerability impact assessments for EbA, their true value can be maximised if they are also developed as longer-term planning tools that feed into local-level climate change planning processes for ecosystems and landscapes in other locations.

Conclusions

Global Mountain EbA Programme activities in Peru were implemented in the Nor Yauyos-Cochas Landscape Reserve (NYCLR) in the southern part of the regions of Lima and Junín. EbA measures implemented under the project included water channel and reservoir restoration, grassland management and vicuña management.

Effectiveness for human societies

Project activities contributed positively to adaptive capacity and resilience whilst laying the foundations for reducing vulnerability. This occurred through raising awareness on climate change; specific measures to improve water availability and improve pastures; improvements to community organisation; higher capacity to sustainably manage grasslands, water and livestock; greater levels of participation; and reduced disaster risks from extreme climate change related events.

[3] These tools have been collated and can be accessed here: http://www.cambioclimatico-regatta.org/index.php/es/documentos-herramientas/category/adaptacion-basada-en-ecosistemas

Community members targeted by the project (notably mountain communities and livestock farmers) experienced more improvements in adaptive capacity than other groups, but improvements were widespread and led to no apparent trade-offs in terms of reductions in adaptive capacity and resilience amongst other groups.

New controls to the movement and watering of livestock meant there were trade-offs in terms of *where* improvements in adaptive capacity and resilience were apparent. There were also trade-offs in terms of *when* improvements in adaptive capacity and resilience occurred, because changes in resilience, adaptive capacity or vulnerability as a result of the project sometimes took time to materialise, and short-term localised reductions in resilience occurred when grazing restrictions were first introduced. Overall longer-term resilience gains are expected, however, and a phased approach to project implementation sought to address these trade-offs.

A range of social co-benefits emerged from the project, many of which in turn indirectly built adaptive capacity. These included: economic benefits from alternative livelihoods and improvements in agricultural or livestock production; community health improvements; stronger local organisations and better management of communal land, water and livestock; sustainable water provision; reduced conflict over resources; improved social cohesiveness; and enhanced knowledge. Some people accrued more social co-benefits from the project than others, but no trade-offs were observed.

Cultural heritage in the area is rich and indigenous technologies for managing high-altitude grassland ecosystems date back to pre-Hispanic times. Traditional and local knowledge was incorporated into project activities in various ways, and this – along with the incorporation of scientific knowledge – was a crucial component of the project process.

The project ensured participation occurred during different parts of the project cycle and adopted various types of participatory approaches, many of which can be classified as interactive. Adopting these approaches supported EbA implementation and built adaptive capacity.

Effectiveness for the ecosystem

A number of factors threaten local ecosystem resilience and service provision: climate change; overgrazing, weak local community governance worsening water management and distribution; infrastructure and mining; and deforestation. It is also worth noting that one model predicts that grassland productivity actually increases under climate change in one project site.

Later project activities prioritised landscape connectivity and the provision of ecosystem services at the watershed and landscape scale to better address climate hazards and provide broader environmental benefits. Thresholds influencing ecosystem service provision were not a key project concern.

Project EbA measures strengthened the resilience of ecosystems to climate change and improved ecosystem service provision in a number of ways: improved water provision; better hydrological regulation and storage; nutrients stored and soil structure maintained; enhanced pasture condition and year-round pasture availability; reduced occurrence of natural fires; more animal fibre; enhanced grassland carbon storage; enhanced biodiversity conservation; enhanced scenic beauty; and improved cultural ecosystem services.

The watershed or catchment area was a particularly good scale for planning and implementing EbA measures, and the landscape approach also provided an overall guiding framework for project interventions. Ecosystem services were also restored at the scale of the village and particular green-grey measures.

Synergies in terms of ecosystem services provision occurred between upstream and downstream areas in the same watershed. Trade-offs in terms of ecosystem services provision could also have occurred if grazing restrictions in some areas meant other areas experienced more degradation, but these were not observed.

Some improvements to ecosystem services provision are already apparent, but others are expected over the longer term. Trade-offs may occur whereby short-term localised drops in grassland productivity may occur as a result of grazing restrictions elsewhere before landscape-level improvements deliver overall long-term productivity gains.

Financial effectiveness

Cost-benefit analyses were conducted for Tanta, Canchayllo and Miraflores. These compared livestock and rangeland management practices designed for EbA with a business as usual scenario. Both of these scenarios modelled costs and benefits with and without climate change. These conventional cost-benefit analyses, along with more qualitative cost-benefit studies in Canchayllo and Miraflores, showed that EbA land management options provided more financial benefits than non-EbA options. Even using a high 9% discount rate, investing in EbA was financially favourable.

However, quantifying and estimating the monetary values of ecosystem services for the cost-benefit analyses was challenging. Many services are difficult to value in practice, and confidence in the valuation methodologies is low.

A number of broader economic benefits that were not included in the conventional or qualitative cost-benefit analyses were also accrued: economic benefits from increased water infiltration, water regulation and soil erosion control; new or increased income for local communities from sustainable management of grasslands; avoided losses from animal deaths; and temporary jobs from project activities.

Broader economic costs that were not included in the conventional or qualitative cos- benefit analyses were few, but may have included: the costs of some staff time for project technical advice; the costs of community time invested in project activities; and possible costs associated with grazing restrictions.

Grazing activities are now more organised, and whilst economic benefits emerged over the longer term, there may have been short-term losses in productivity in some areas as a result of grazing controls. Several project economic benefits emerged from processes that took time to materialise, so EbA projects must consider generating economic and social benefits in the short term to secure community support.

Policy and institutional issues

A number of policy, institutional and capacity barriers hindered EbA implementation at the local level: weak institutions; conflicting local interests; lack of knowledge; insufficient financial resources; insufficient/unavailable technical skills and implementation capacity; the need to improve coordination between institutions and secure stronger policy support; and the need for stronger local government support.

A number of policy, institutional and capacity barriers hindered EbA implementation at the regional level: insufficient institutional collaboration; unavailability of financial resources; inadequate implementation capacity; and lack of knowledge.

A number of policy, institutional and capacity barriers hindered EbA implementation at the national level: the need for further cross-sectoral institutional or inter-ministerial collaboration to improve mainstreaming; the lack of relevant data; shortage of finance; capacity-building needs; and the need for donors to support projects for longer periods.

A number of policy, institutional and capacity factors provided opportunities for implementing EbA at the local level: EbA ‘champions’; government prioritisation of EbA; the presence of appropriate incentives to motivate action; working with and strengthening existing local organisations to support implementation; existing local knowledge and technologies; existing protected area management plans and governance structures which facilitated EbA implementation and local mainstreaming; and communal land ownership.

A number of policy, institutional and capacity factors provided opportunities at the regional level for implementing EbA: working with regional governments; government prioritisation; and EbA ‘champions’.

A number of policy, institutional and capacity factors provided opportunities at the national level for implementing EbA: working with MINAM and SERNANP, which provided an opportunity to integrate EbA into existing governance structures, planning and policy instruments; government prioritisation of the issue and EbA ‘champions’; and strong national policies supporting EbA.

The project was generally considered sustainable at the local, regional and national levels, although sectors promoting alternative land uses to livestock/farming are present in Canchayllo. A number of

factors facilitated long-term project sustainability: working with existing protected area structures and plans; showing the multiple benefits of EbA to government planners and policymakers; strengthening or creating local organisations and agreeing on management plans; political will; local ownership; and the prioritisation of livelihood improvements.

The project initiated various activities at the local, regional, national and international levels to replicate, scale up or mainstream EbA into planning and implementation in Peru and more widely. These included: activities to mainstream EbA into local-level management plans specific protected area management plans, broader protected area/watershed planning, regional climate change strategies, and national policies, investment guidelines and training programmes; facilitating a change in attitude to EbA amongst policymakers and planners; and supporting cross-sectoral collaboration.

References

Adnan, S., A. Barren, S.M. Nurul Alam and A. Brustinow (1992) *People's participation: NGOs and the flood action plan*. Research and Advisory Services: Dhaka, Bangladesh

Alvarado, L. (2015a) *Consultoría: Elaboración de análisis costo-beneficio y valoración participativa de las medidas robustas de adaptación al cambio climático. Informe Final. ACB Convencional y ACB Participativo en la comunidad de Canchayllo*. IUCN and The Mountain Institute.

Alvarado, L. (2015b) *Consultoría: Elaboración de análisis costo-beneficio y valoración participativa de las medidas robustas de adaptación al cambio climático. Informe Final. ACB Convencional y ACB Participativo en la comunidad de Miraflores*. IUCN and The Mountain Institute.

Anderson, S. (2014) *Getting ahead of the curve: when climate adaptation has to get radical*. IIED briefing paper. November 2014.

Andrade, A., R. Córdoba, R. Dave, P. Girot, B. Herrera-F, R. Munroe, J. Oglethorpe, P. Paaby, E. Pramova, E. Watson and W. Vergara (2011) *Draft Principles and Guidelines for Integrating Ecosystem-based Approaches to Adaptation in Project and Policy Design: a discussion document*. IUCN-CEM, CATIE. Turrialba, Costa Rica.

ARCAB (2012) *Action Research for Community Adaptation in Bangladesh: Monitoring and Evaluation Framework Paper*. Final report.

Ayers, J., S. Anderson, S. Pradha and T. Rossing (2012) *Participatory Monitoring, Evaluation, Reflection and Learning for Community-based Adaptation: A Manual for Local Practitioners*. CARE International.

Bertram, M., E. Barrow, K. Blackwood, A. R. Rizvi, H. Reid and S. von Scheliha-Dawid (2017) *Making Ecosystem-based Adaptation Effective: A Framework for Defining Qualification Criteria and Quality Standard*. FEBA (Friends of Ecosystem-based Adaptation) technical paper developed for UNFCCC-SBSTA 46. GIZ, Bonn, Germany, IIED, London, UK, and IUCN, Gland, Switzerland.

Biesbroek, G. R., C. J. A. M. Termeer, J. E. M. Klostermann and P. Kabat (2013) 'On the nature of barriers to climate change adaptation.' *Reg. Environ. Change* 13: 1119-1129.

Black, D., J. K. Turpie and N. Rao (2016) 'Evaluating the cost-effectiveness of ecosystem-based adaptation: Kamiesberg Wetlands case study.' *SAJEMS Asset research NS* 19(5): 702-713.

CBD (2009) *Convention on Biological Diversity 2009: Connecting Biodiversity and Climate Change Mitigation and Adaptation. Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change*. CBD Technical Series No. 41. Secretariat of the Convention on Biological Diversity, Montreal, Canada.

CBD (2010) Convention on Biological Diversity 2010: Decision adopted by the Conference of the Parties to the Convention on Biological Diversity at its 10th Meeting. X/33. Biodiversity and climate change. UNEP/CBD/COP/DEC/X/33.

Chong, J. (2014) 'Ecosystem-based approaches to climate change adaptation: progress and challenges.' *International Environmental Agreements: Politics, Law and Economics* 14(4): 391-405.

Dazé, A., K. Ambrose and C. Ehrhart (2009) *Climate Vulnerability and Capacity Analysis: Handbook*. CARE International.

Doswald, N., R. Munroe, D. Roe, A. Giuliani, I. Castelli, J. Stephens, I. Möller, T. Spencer, B. Vira, H. Reid et al. (2014) 'Effectiveness of ecosystem-based approaches for adaptation: review of the evidence-base.' *Climate and Development* 6(2): 185-201.

Dourojeanni, P., E. Fernandez-Baca, S. Giada, J. Leslie, K. Podvin and F. Zapata (2016) 'Vulnerability assessments for Ecosystem based Adaptation: Lessons from the Nor Yauyos Cochas Landscape Reserve in Peru.' In N. Salzmann, C. Huggel, S. U. Nussbaumer and G. Ziervogel (eds) (2016) *Climate Change Adaptation Strategies: An upstream – downstream perspective.* Springer, Switzerland.

Faulkner, L., J. Ayers and S. Huq (2015) 'Meaningful measurement for community-based adaptation.' In *Monitoring and evaluation of climate change adaptation: A review of the landscape New Directions for Evaluation* (eds. D. Bours, C. McGinn and P. Pringle), pp. 89–104.

GEF (2012) *Operational Guidelines on Ecosystem-Based Approaches to Adaptation*. LDCF/SCCF Council meeting, 15 Nov 2012, Washington DC.

Girot, P., C. Ehrhart, J. Oglethorpe, H. Reid, T. Rossing, G. Gambarelli, H. Jeans, E. Barrow, S. Martin, N. Ikkala and J. Phillips (2012) *Integrating community and ecosystem-based approaches in climate change adaptation responses*. ELAN, unpublished.

Instituto de Montaña and UICN (2016a) *Informe final de implementación de la medida robusta de Adaptación basada en Ecosistemas en la comunidad de Canchayllo (Reserva Paisajística Nor Yauyos Cochas)*. IM and UICN, Lima.

Instituto de Montaña and UICN (2016b) *Informe final de implementación de la medida robusta de Adaptación basada en Ecosistemas en la comunidad de Miraflores (Reserva Paisajística Nor Yauyos Cochas)*. IM and UICN, Lima.

IUCN (2017a) *Cambio Climático y las Áreas Naturales Protegidas en Perú: compartiendo avances y perspectivas*. Blog post 15 Dec 2017. See https://www.iucn.org/node/29542

IUCN (2017b) *La Adaptación basada en Ecosistemas se transversaliza en la planificación del desarrollo en Perú*. Blog post 9 Nov 2017. See https://www.iucn.org/es/news/south-america/201711/la-adaptaci%C3%B3n-basada-en-ecosistemas-se-transversaliza-en-la-planificaci%C3%B3n-del-desarrollo-en-per%C3%BA

Jeans, H., J. Oglethorpe, J. Phillips and H. Reid (2014) 'The role of ecosystems in climate change adaptation: Lessons for scaling up.' In E. L. F. Schipper, J. Ayers, H. Reid, S. Huq and A. Rahman (2014) *Community Based Adaptation to Climate Change: Scaling it up*. Routledge, London. Pp. 253-265.

Jones, H. P., D. G. Hole and E. S. Zavaleta (2012) 'Harnessing nature to help people adapt to climate change.' *Nature Climate Change* 2(7): 504-509.

Martin, S. (2016) '*EbA revisited, part 1: disentangling misconceptions about nature and adaptation*.' WWF, Washington DC. http://www.climateprep.org/stories/2016/6/14/eba-revisited-part-1-disentangling-misconceptions-about-nature-and-adaptation

MINAM (2017) *Systematization of Ecosystems Based Adaptation measures with potential to scale in the public investment system in Peru*. PowerPoint presentation by the Directorate of Climate Change, Desertification and Water Resources, 02/03/17.

Murti, R. and C. Buyck (eds) (2014) *Safe Havens: Protected Areas for Disaster Risk Reduction and Climate Change Adaptation*. IUCN, Gland.

Ojea, E. (2015) Challenges for mainstreaming Ecosystem-based Adaptation into the international climate agenda. *Current Opinion in Environmental Sustainability* 14: 41-48.

PNUD, PNUMA, UICN and IM (2016) *El futuro ancestral: la adaptación basada en ecosistemas*. PNUD, Lima.

Podvin, K. (2017a) Analizando la efectividad de medidas de adaptación basada en ecosistemas en Perú y Chile: experiencias y lecciones aprendidas. Paper presented at the *International Congress on*

Climate Change and its Impacts, Huaraz, Peru, Nov. 29th to Dec. 1st, 2017. https://www.iucn.org/node/29542

Podvin, K. (2017b) Ecosystem-Based Adaptation Approach Project: Strengthening Evidence and Generating Information for Policy. PowerPoint prepared for *Webinar: Module 18: Generating EbA Evidence*, March 2nd 2017.

Podvin, K. and S. Arellano (2016) *Peru Climate Change Adaptation Policy Analysis. As part of the Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy project (led by IIED)*. Unpublished report. IUCN, Quito.

Podvin, K., D. Cordero and A. Gómez (2014) 'Climate Change Adaptation in the Peruvian Andes: implementing no-regret measures in the Nor Yauyos-Cochas Landscape Reserve.' Pp 94-103 in: Murti, R. and C. Buyck (eds) (2014) *Safe Havens: Protected Areas for Disaster Risk Reduction and Climate Change Adaptation*. IUCN, Gland.

Reid, H. (2011) *Improving the evidence for ecosystem-based adaptation*. IIED Opinion: lessons from adaptation in practice series. IIED, London, November 2011.

Reid, H. (2014a) 'A natural focus for community-based adaptation.' In J. Ensor, R. Berger and S. Huq (2014) *Community-based Adaptation to Climate Change: Emerging Lessons*. Practical Action Publishing, Rugby. pp 35-54.

Reid, H. (2014b) *Ecosystem- and community-based adaptation: learning from natural resource management*. IIED Briefing. IIED, London.

Reid, H., T. Cannon, R. Berger, M. Alam and A. Milligan (2009) Community-based adaptation to climate change. *Participatory Learning and Action* 60. IIED, London.

Reid, H., N. Seddon, E. Barrow, C. Hicks, X. Hou-Jones, V. Kapos, A. R. Rizvi, D. Roe and S. Wicander (2017) *Ecosystem-based adaptation: question-based guidance for assessing effectiveness*. IIED, London.

Renaud, F. G., K. Sudmeier-Rieux, M. Estrella (2013) *The role of Ecosystems in disaster risk reduction*. UN University Press, Tokyo/New York/Paris.

Rizvi, A. R., E. Barrow, F. Zapata, D. Cordero, K. Podvin, S. Kutegeka, R. Gafabusa, R. Khanal and A. Adhikari (2014) *Ecosystem based Adaptation: Building on No Regret Adaptation Measures.* Technical Paper prepared for the 20th session of the Conference of the Parties to the UNFCCC and the 10th session of the Conference of the Parties to the Kyoto Protocol, Lima, Peru, 1-12 December 2014. IUCN, Gland.

Rizvi, A. R., E. Barrow, F. Zapata, A. Gomez, K. Podvin, S. Kutegeka, R. Gafabusa and A. Adhikari (2015) *Learning from Participatory Vulnerability Assessments – key to identifying EbA Options*. 21st session of the Conference of the Parties to the UNFCCC and the 11th session of the Conference of the Parties to the Kyoto Protocol, Paris, France, 30 November to 11 December, 2015. IUCN, Gland.

Rossing, T., N. I. Nyman and B. Abidoye (2015) *Making the economic case for Ecosystem-based Adaptation. Global Ecosystem-Based Adaptation in Mountains Programme*. Learning Brief 3. UNDP, New York

Seddon, N., X. Hou-Jones, T. Pye, H. Reid, D. Roe, D. Mountain and A. R. Rizvi (2016a) *Ecosystem-based adaptation: a win-win formula for sustainability in a warming world?* IIED Briefing paper, July 2016, IIED, London.

Seddon, N., H. Reid, E. Barrow, C. Hicks, X. Hou-Jones, V. Kapos, A. R. Rizvi and D. Roe (2016b) *Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy: Research overview and overarching questions*. IIED, London.

Travers, A., C. Elrick, R. Kay and O. Vestergaard (2012) *Ecosystem-based adaptation guidance: moving from principles to practice*. UNEP.

UNDP (2015) *Making the Case for Ecosystem-Based Adaptation: The Global Mountain EbA Programme in Nepal, Peru and Uganda*. United Nations Development Programme, New York.

UNDP (2016) *How to Use Ecosystems. Cost-Benefit Analysis of the EbA Mountain Project in NYCLR - Nor Yauyos Cochas Landscape Reserve*. UNDP, Magdalena del Mar.

UNEP (2012) *Making the case for ecosystem-based adaptation: building resilience to climate change*. UNEP, Nairobi.

Vignola, R., B. Locatelli, C. Martinez and P. Imbach (2009) 'Ecosystem-based adaptation to climate change: What role for policy-makers, society and scientists?' *Mitigation and Adaptation Strategies for Global Change* 14(8): 691-696.

Vignola, R., T. L. McDaniels and R. W. Scholz (2013) 'Governance structures for ecosystem-based adaptation: Using policy-network analysis to identify key organizations for bridging information across scales and policy areas.' *Environmental Science and Policy* 3: 71-84.

Zapata, F. and A. Gómez (2015) *Adaptación basada en Ecosistemas de Montaña: Experiencia y lecciones aprendidas en la restauración de tecnologías ancestrales y contemporáneas para el manejo de los pastos y del agua en la puna*. The Mountain Institute, Washington DC.

Zapata., F. and K. Podvin (2017) *Medidas robustas de Adaptación basada en Ecosistemas en Canchayllo y Miraflores en la Reserva Paisajística Nor Yauyos Cochas (Perú). En el marco del Programa de Adaptación basada en Ecosistemas de Montaña*. Formulario de postulación - Concurso: "Mostrando evidencia alrededor de la Adaptación basada en Ecosistemas: Casos en América Latina y el Caribe." TMI / IUCN, Lima.

Zapata, F., M. Torres, A. Gómez and K. Podvin (2016) *Informe de sistematización de la experiencia: Implementación de las medidas robustas de Adaptación basada en Ecosistemas en las comunidades campesinas de Canchayllo y Miraflores (Reserva Paisajística Nor Yauyos Cochas)*. The Mountain Institute and IUCN, Lima.

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

Project Report

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