Ecosystem-based Adaptation (EbA) of African Mountain Ecosystems: Experiences from Mount Elgon, Uganda

Musonda Mumba, Sophie Kutegeka, Barbara Nakangu, Richard Munang, and Charles Sebukeera

Abstract In many developing regions of the world, economies and local communities depend largely on the services provided by ecosystems for their sustenance. Recent evidence has shown that the degradation and possible loss of these vital ecosystem services results in imbalance of both societies and ecosystems resulting in vulnerabilities. Hence resilient ecosystems have been seen as an important foundation to human well-being and also necessary for better adaptive capacity for the communities that depend on them. It's on this premise that the concept of Ecosystem-based adaptation (EbA) is particularly relevant. Evidence has shown that mountain ecosystems are particularly vulnerable to climate change and as such the ecosystem services that they provide for communities and species within and without the proximity of these areas are also threatened. This paper discusses the EbA approach that has been applied to mountain ecosystems of Nepal, Peru and Uganda. Vulnerability Impact Assessments (VIAs) were undertaken to understand community vulnerability, mapping the important ecosystems services provided and options offered for reducing this vulnerability for resilient ecosystems. The EbA implementation in all three countries also demonstrates a move from EbA conceptualization to realization on the ground and at the policy level. Finally this paper will also examine the policy implications of this approach nationally and ability for the work to be up-scaled to other mountain ecosystems and other ecosystems as well.

Keywords Ecosystems services • Climate change adaptation • Elgon • Uganda

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M. Mumba (✉) • R. Munang • C. Sebukeera
United Nations Environment Programme (UNEP), P.O. Box 30552-001001, Nairobi, Kenya
e-mail: Musonda.Mumba@unep.org

S. Kutegeka
International Union for Conservation of Nature (IUCN), P.O. Box 10950, Kampala, Uganda

B. Nakangu
University of Makerere, P.O. Box 11064, Kampala, Uganda

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1 Introduction

Climate change is no longer seen as an abstract issue and the impacts accompanied with it have manifested harshly in many parts of the world and more so in Africa. It's affecting millions of local communities across Africa with devastating effects that have left them in a cycle of poverty (IPCC 2007). Additionally natural ecosystems underpin the existence and sustenance of economies and local communities across the continent and the ecosystem services they provide are vital for human well-being.

This direct dependence on these life-sustaining services provided by ecosystems, is what makes communities and economies particularly vulnerable to the risks of climate change and the inability and lack of capacity by poor communities to adapt to the changes further complicates this vulnerability.

2 The Evolving Nature of Adaptation

The global discourse in recent years on climate change through the United Nations Framework Convention on Climate Change (UNFCCC) has further highlighted that the need for adaptation efforts (UNFCCC 2007) has never been so urgent (Munang et al. 2013). Furthermore parties to this convention have recognized that resilient ecosystems are certainly vital for human well-being and critical for helping communities adapt to climate change impacts. In June 2012 at the Rio+20 United Nations Conference on Sustainable Development, world leaders there explicitly recognised the role of ecosystems as the core element in addressing climate change and hence paving the way for better sustainable development, further noting that sustainable development has its roots in ecosystem maintenance (UNFCCC 2010, United Nations 2012).

There is evidence that ecosystems have substantively changed (Millennium Ecosystem Assessment 2005), affected by various drivers of change with climate change as the additional stressor. As such their capacity to deliver provisioning, buffering and regulatory services have greatly reduced. Its on this premise that the term resilience comes into play and is widely used to describe the ability of a social or ecological system to maintain basic structural and functional characteristics over time despite external pressures (Levine et al. 2012). However, ecosystems differ in the way they respond to change and also their reaction to disturbance – making some more resilient than others.

It's against this backdrop that this chapter addresses the issue of ecosystem resilience, which is a particularly relevant concept in the context of ecosystem-based adaption (EbA). Ecosystem-based adaptation has been described as the use of biodiversity and ecosystem services as part of an integral part of an overall adaptation strategy to help people adapt to the negative effects of climate change at local, national, regional and global levels. Its prudent to highlight that EbA spans many activities, which include forest restoration to storm surges; catchment management to protect communities against effects of droughts and floods; sustainable fisheries to alleviate the threat of food security and much more (e.g. Dudley et al. 2010).

Regardless of the disjointed relationship between the two Rio Conventions – the Convention on Biodiversity (CBD) and UNFCCC – both have in more recent years acknowledged and recognised the relevance and importance of EbA (CBD 2009; UNFCCC 2010). Encouragingly, the governing bodies of both conventions recently sought to encourage parties to implement EbA (Chong 2014).

3 African Mountain Ecosystems and Landscapes in the Face of Changing Climate

African mountain landscapes (Fig. 1) across the African continent are some of the most spectacular ecosystems. These ecosystems, though staggered across the continent in discrete locations, are particularly vital for the 1.1 billion people of Africa because of the ecosystem services they provide. While they are important and vital

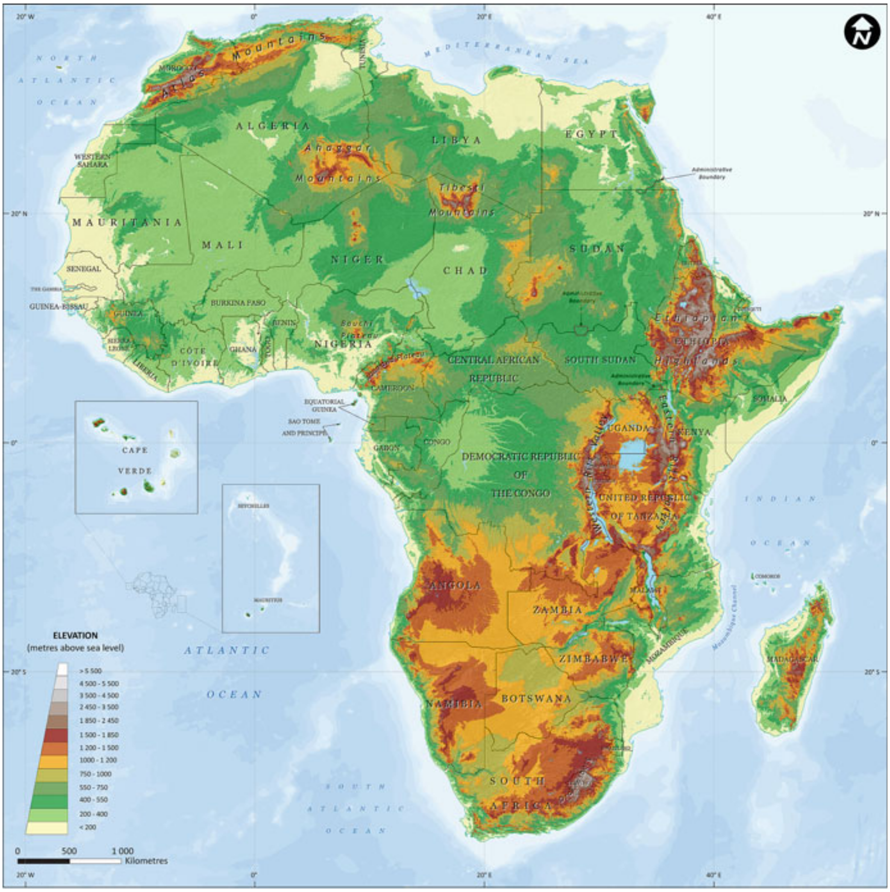

Fig. 1 Elevation map of Africa showing mountain areas (UNEP/DEWA)

for these services they provide, recent evidence has shown that they are also vulnerable and sensitive to environmental change (e.g. Knapen et al. 2006). Evidenced by the recognition of ecosystems in sustainable development at Rio+20 (UNDP 2013) mountain ecosystems also received substantive attention with renewed global political attention to these beautiful yet fragile ecosystems.

Furthermore in Africa, a step towards cooperative action and the creation of collaborative platforms for sustainable mountain development was taken at a regional meeting for African mountain regions held in November 2011 in Mbale, Uganda.

4 Understanding the Vulnerabilities of Mount Elgon

Uganda hosts two of Africa's mountain ecosystems – Rwenzori Mountain and Mount Elgon – and has been a champion (an ally in advocating for the issues around climate change in Mount Elgon) in the discourse on sustainable mountain development across Africa and on the global platform. It is on this premise that the German Government in liaison with the Government of Uganda recognised the vulnerability of the Mount Elgon ecosystem to climate change (e.g. Government of Uganda 2009a). The International Climate Risk Report (CIGI 2007) identified Uganda as one of the least prepared and most vulnerable countries in the world. Many parts of Uganda are already experiencing the impacts of climate change (Hepworth 2010) such as frequent droughts, famine, floods and landslides, and their knock on consequences on natural resources, agriculture, food security and livelihoods. Uganda being a signatory to the UNFCCC developed its National Adaptation Programme of Action (NAPA) in 2007. According to this report, drought was identified as the most prominent effect of climate change in Uganda. The NAPA suggested that the frequency of drought is on the increase with seven serious droughts experienced between 1991 and 2000 (Government of Uganda 2007). Floods were also experienced in many parts of the country. For example in 2007, the eastern region of Uganda experienced the worst floods in 35 years (Government of Uganda 2009b). In March 2010, several districts within the Mount Elgon area experienced unusual high rainfall, which resulted in landslides in Bududa District, for example. Hundreds of lives were lost, with the landslides burying three whole villages (e.g. Government of Uganda 2009b). In addition several households were displaced, schools and health facilities destroyed in the wake of this event. In close proximity in the next district, Kapchorwa, about 300 ha of wheat were destroyed. Nationally, coffee exports dropped by 60 % between October and November 1999, partly due to disrupted transport system. Facilities for treated water supply to climate change affected districts were destroyed following flooding of some pumping stations.

The Ugandan government identified the Mount Elgon ecosystem as a particularly vulnerable area because of its high incidences of floods and landslides (Knapen et al. 2006) and also climate change. These events have become more frequent and are emerging issues in this highly productive region with high population densities. Land shortages within the landscape have resulted in inappropriate land-use such as cultivation on steep slopes, lack of contour ploughing and terracing (NEMA 2008) that has also resulted in severe deforestation within the area (Petursson et al. 2013; Sassen et al. 2015). This ecosystem is also increasingly vulnerable to variable rainfall patterns (FAO 2010; Banana et al. 2014). Based on the frequent emergency operations that have become common for this area, it's evident from reports that adaptation is imperative and must be part of community response to climate change. In 2011 deadly landslides as a result of heavy rains as a result of changes in rainfall patterns left several hundreds of people dead. Further investigations showed that critical areas within the landscape that were responsible for providing important ecosystem services (e.g. provisioning services such as water supply) were severely degraded and hence vulnerable. As a result of this, communities in these areas had become very vulnerable.

Mount Elgon ecosystem occupies 772,300 ha, an ecosystem shared between Kenya and Uganda in almost equal parts (Moyini 2007). It is a mixed ecosystem composed of closed canopy tropical hardwood and bamboo forests and a variety of grassland and riverine ecosystems (Scott 1998). The area is composed of two main ethno groups the Sabiny who live on the northern slopes of the mountain and the Bagisu of Bantu origin who are located in the lower slopes of the Mountain districts. The Sabiny were pastoralists and the Bagisu agriculturalists. However, in the present time, they both share similar socio economic characteristics. Most are engaged in intensive cultivation and animal husbandry such that the land outside the national park has all been cultivated (Kazoora 2001). Kazoora (2001) notes that even the formerly protected areas like steep slopes have been farmed. The area of Mount Elgon that makes up the protected area (e.g. Nakakaawa et al. 2015) is approximately 221,401 ha. This protected area has also been highlighted as an important buffer for its dependent population that live adjacent to it. However, following the gazetting of the National Park, local communities lost all access rights in 1993 (e.g. Sassen et al. 2013, 2015).

It is also expected that the temperature rise will mean that the tree cover will move upwards to follow temperature zones. This implies that the prevalent socio economic and population pressures and movements stand to significantly increase and threaten all populations. A potential conflict between communities on the lower slopes is projected as climate and other anthropological factors continue to change the vegetation cover. Therefore without a clear solution to manage the threat, rather than buffer community, the vulnerability of the communities is expected to increase. This is a rather complex situation: the population is undermining the same ecosystem that is viewed as the best buffer and support to its adaptive capacity.

The other critical challenge for Mount Elgon, is that it is denoted by varied micro ecosystems. This has meant that while some communities enjoy favorable climate and exploit it fully especially such as those located on the higher altitude, on the other hand, communities in the lower reaches are exposed and suffer from the impacts of poor land use. Such is the case presented below of Sanzara Parish, which is located in a rain shadow and on the lower slopes of Mount Elgon. The challenge is such that it faces frequent long dry spells, it also faces significant floods and land slides from the upper catchment that is highly inhabited and highly exploited due to its favourable conditions. Hence for such a community, it has been projected that increased long dry spell and floods are expected from the intensifying rainfall on intensely farmed land. This is particularly likely to be enhanced in areas with very poor drainage (e.g. Government of Uganda 2009a, b).

Thus, as this paper will demonstrate, a holistic ecosystem approach is needed that tries to consider all factors that increase risk and all opportunities in the ecosystems mapped and used to determine the best EbA approach for a particular context.

In 2011, Germany (BMUB) supported Uganda to implement the ecosystem-based adaptation approach in the Mount Elgon area over a period of 4 years. The EbA Mount Elgon project is implemented jointly by United Nations Environment Programme (UNEP), United Nations Development Programme (UNDP) and The International Union for Conservation of Nature (IUCN). It was envisaged that this project would complement the efforts by the government of Uganda in implementing the different action plans in line with climate change adaptation and mitigation. However most of these action plans have been hampered by the lack of tools and methodologies that suit the local conditions of Uganda and more particularly Mount Elgon (Fig. 2).

5 Taking Action, the Bottom: Up Approach

While EbA is now widely accepted, evidence from the ground has shown that there is widespread uncertainty as regards the interpretation and measurement of ecosystem resilience (e.g. Levine et al. 2012). However, there is acceptance generally that as part of adaptation planning, some steps have to be followed at the community level in order to address the issue of ecosystem resilience. There is also general consensus that there is no "one-size fits all" approach nor is there an agreed single approach to ecosystem and hence climate resilience.

Detailed review to understand the challenges faced by the communities showed that ecosystem changes have occurred over time within this mountain ecosystem over a long period of time (e.g. IUCN 2014a). While most of these changes can be alluded to direct drivers such as changes in land-use, population growth, degradation of the forest ecosystems as a result of over-harvesting (e.g. Mutekanga et al. 2013), they have been further compounded by variability in climate within the area. Furthermore actions that include transition to other livelihoods, intensification of agricultural (e.g. cultivation on very steep slopes), are examples of factors that accentuate the impacts of climate change (IUCN 2014b).

The factors articulated above made part of the rationale for selecting Mount Elgon as the project site by the Uganda government. Disasters, particularly landslides that have been compounded by extreme rainfall events, further demonstrated the vulnerability of the communities in the area. As such there has been acknowledgement that adaptation to these changes is at best the only way forward and a

Fig. 2 View of Mount Elgon (© UNEP)

necessity (e.g. Levina and Tirpak 2006). The project partners – UNEP, UNDP and IUCN – agreed from the outset that adaptation approaches are certainly wide ranging infrastructure that reduce the risk of extreme events to actions and roles of local communities, individuals to name a few. As such there was consensus that in order to address the challenges faced by the communities within the Mount Elgon area, ecosystem-based approaches that took into consideration climate risk were favourable, hence ecosystem-based adaptation (EbA). This approach as a strategy took into account actions such as integrated management of land, water, natural resources, while promoting conservation and sustainable use in a fair and equitable manner (IUCN 2014a).

Therefore overall aim in implementing EbA in Mount Elgon has been to strengthen capacities of local communities, which are particularly vulnerable to climate change, by working to strengthen ecosystem resilience through the management of the ecosystem services and hence reducing vulnerability.

In order to address the challenges and hence work towards building community and ecosystem resilience, the project took a bottom-up approach and implemented EbA through a layered approach. This layered approach is shown in Fig. 3. This layered approach is iterative and lessons are drawn at every stage.

Firstly, in identifying the problem areas, three micro-catchment areas and four districts (Fig. 4) were identified and prioritised by the communities and their leaders through a participatory approach, for implementation of EbA options. Secondly, this project further worked to determine the vulnerabilities of the area. During this period of determining vulnerabilities through systematic methodology of Vulnerability Impact Assessment (VIA), the implementers employed the no-regret[1] approach as an important part of EbA implementation. And finally actions were identified in the form of EbA options, collaboratively with the affected communities and stakeholders.

This paper will provide only one case study from the whole area, clearly articulating the layered approach.

[1] The no-regret actions under the EbA Mount Elgon project were defined as those including autonomous measures by communities which do not worsen vulnerabilities to climate change or which increase adaptive capacities; and measures that will always have a positive impact on livelihoods and ecosystems regardless of how the climate changes.

Fig. 3 A layered approach to undertaking EbA in the Mount Elgon ecosystem

6 Implementation of EbA in the Sanzara Parish of Kapchorwa District Through the Four-Layered Approach

6.1 Identification of the Problem Area

Lessons from this project demonstrated that EbA though framed as a comprehensive approach and is usually rooted in both its view on ecosystems services and climate change adaptation (Chong 2014) the reality was such that activities were implemented independently. Within the overall context of the project the activities in the different locales were motivated *either* by changes in ecosystem services *or* climate change adaptation. Therefore for the purposes of this paper the focus will be on Sanzara Parish an area whose ecosystem services had been altered.

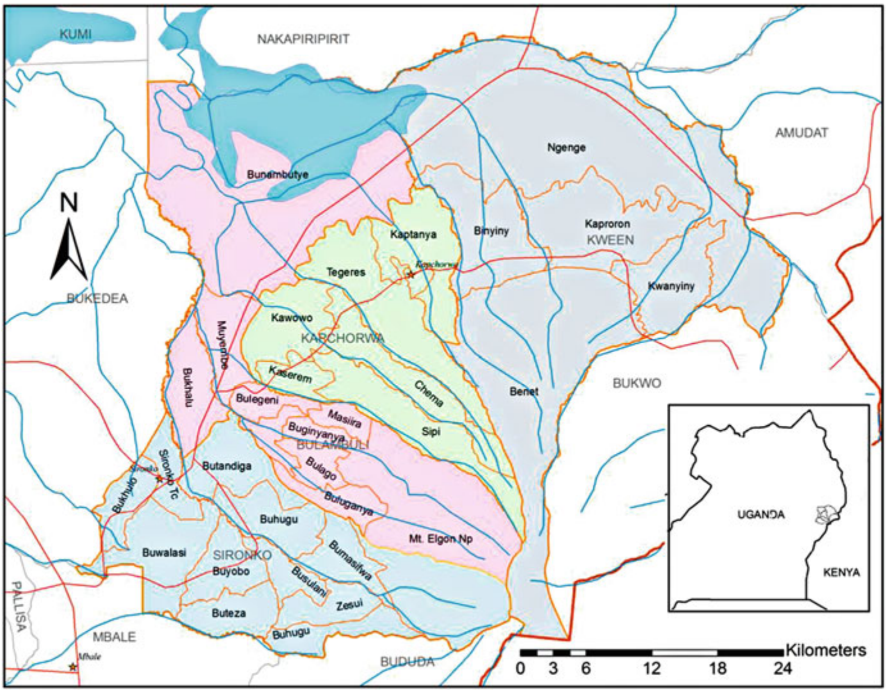

Fig. 4 Map of the project area in Mount Elgon – Uganda

Selection of Sanzara Parish as a problem area was based on earlier mapping[2] which highlighted the uniqueness of the parish due to its location in the rain shadow and the projected threats to the ecosystem and the livelihoods that would increase as a result. The communities in Sanzara parish[3] are purely subsistence farmers with systems ranging from food and cash crops (both perennial and annual) as well as animal rearing. Just as in the case of the entire district, the parish has two seasons, wet and dry which were observed to have changed in frequency hence hardly sustaining vegetation to healthy maturity. This as well as other poor agronomic practices has rendered the place almost bear of forest. This uniqueness made Sanzara a problem area which required deeper and concentrated understanding of the vulnerabilities, planning and demonstrating the probable EbA options to make a case.

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[2] IUCN, in partnership with UNDP and IISD undertook a study in 2012 on climate risk management for sustainable crop production in Uganda and the mapping identified Sanzara as one of the most vulnerable parishes.

[3] According to the Sub-county Development Plan (2011–2014/2015–2016), the population is projected at 11,270 people.

6.2 Determining Vulnerabilities

Understanding the vulnerabilities of communities and hence identifying adaptation measures to cope with the impacts of climate variability and change require localized investigations. In the case of Sanzara the project team helped the community through undertaking Vulnerability Impact Assessment (VIA) and as such a number of questions related to their vulnerabilities were posed about who and to what they were vulnerable to, how vulnerable they were, what the causes of their vulnerability were, how they were currently responding and what improvements would strengthen their responses to lessen this vulnerability. Hence VIA process was based on a rather iterative than linear step-wise methodology as shown in Fig. 5 (Munroe et al. 2015) that took integrated ecosystem considerations into account.

Hence to address the questions posed above, IUCN positioned communities at the center of their analysis and applied a range of participatory approaches such as the Climate Vulnerability and Capacity Analysis Took (CVCA),[4] and the Community-based Risk Screening – Adaptation and Livelihoods (CRiSTAL) and also Geographical Information Systems (GIS) mapping. CVCA provides a framework for analyzing vulnerability and capacity to adapt to climate change at the community level through prioritizing local knowledge on climate risk and adaptation strategies. CRISTAL on the other hand is a decision support tool which promotes integration of risk reduction and climate change adaptation into community-level projects. CRISTAL uses information from the vulnerability assessments. Building on the information generated by the CVCA and CRISTAL, IUCN then applied the GIS mapping to further visualise, interpret and understand the relationships, trends and patterns from a scientific point of view. This in effect facilitated the community to analyse their information (Fig. 5). These approaches were instrumental and critical in building community awareness, consensus and certainly capacity of both the local communities and also local government leaders and partners. They also contributed to the stakeholders having the ability to map the ecosystem goods and services within their areas, identify the risks at hand and also the EbA options that needed to be undertaken to address the issues (Fig. 6).

Ultimately the community themselves, through the comprehensive VIA's and also rapid assessment methodologies, prioritised floods and droughts as major climate risks, which interfered and reduced their capability and capacity to use the land to meet their livelihood needs. The community further highlighted and identified the perennial River Sippi as a vital and main opportunity for them to adapt to climate change.

However further interrogation and analysis showed that this major source of water for Sanzara area actually originated from the slopes the Mount Elgon National Park in the upper reaches of the mountain. Furthermore, it was evident that the river traversed an intensely used landscape that undermines the water quality. These findings further demonstrated how the community's adaptive capacity would be threatened

[4] CVCA is a tool that is used as a guide to gather information using key questions at different levels: individual/Household, Local government/community and national levels.

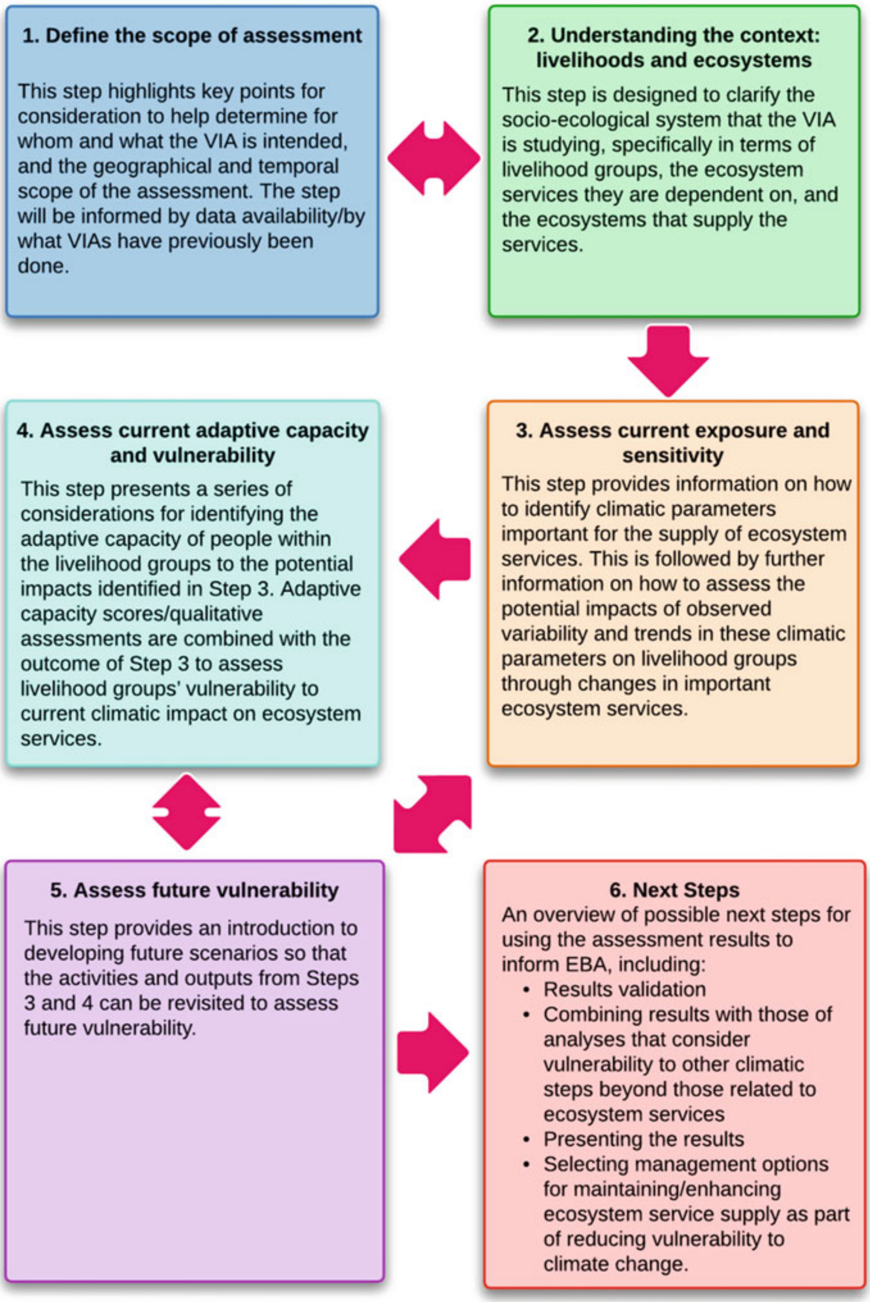

Fig. 5 Framework of VIA guidance steps (Munroe et al. 2015)

Fig. 6 Women as part of the community group using local drama to assess their vulnerability and propose EbA options during the planning sessions in Sanzara Parish (Photo: IUCN-Uganda)

due to the water sources high levels of degradation and contamination. In addition the rivers deep river banks were a risk to women and children who frequently used the river as a last resort water source especially when all streams had dried up. During such long dry spells, the communities were left with limited options but to cultivate the precarious riverbanks to support their livelihoods and productivity. In doing so, they compromised further the quality and availability of the water.

The detailed scientific VIA findings were also used to triangulate and support the participatory process further. These findings further confirmed the community prioritization and helped articulate both past and forecast climate variability within the broader Mount Elgon area and thereafter recommended strategic priorities for monitoring and management of adaptation options (IUCN 2014b).

6.3 Investigating Options: No Regrets Actions and Taking Action (EbA Options)

Water provisioning as an ecosystem service was identified, and River Sippi as d the ecosystem providing it. Within the overall project area it was clear that the best approach was to protect River Sippi and as such address the challenges it was facing. It was therefore realistic and crucial to start with the most hard-pressed and vulnerable community – Sanzara Parish. Furthermore, the project needed a short-term intervention that would in effect mobilise and incentivise the community to appreciate the value of the River Sippi and hence no-regrets actions were identified. The project partners agreed on the working definition of no-regrets actions as those that included "*autonomous measures by communities which do not worsen vulnerabilities to climate change or which increase adaptive capacities*; *and measures that will always have a positive impact on livelihoods and ecosystem services regardless of the climate changes*." The no-regret approach was therefore seen as an important part of the long-term EbA actions for the area.

Thus this provided a strategic opportunity and also entry point for the project to commence its work and hence sustain the ecosystem service to manage the entire ecosystem for the community in its proximity. The added value was that upstream communities would also benefit even though the floods did not affect them. In essence the Sanzara community had been facilitated to be at the forefront of requesting the upstream communities to reduce the degradation of the riverine area.

Henceforth, a partnership was forged between the downstream (Sanzara Parish) and the upstream community – Kapchorwa District Water Office and their communities. Through the discussions that ensued and with the support from this project, the communities supported the tapping of water from River Sippi through a gravity flow scheme – a form of gray infrastructure (e.g. Palmer et al. 2015) (Fig. 7). The historical experiences evidenced by the disasters and hence vulnerabilities as a

Fig. 7 Gravity water scheme at Sanzara Parish after completion (Photo by IUCN – Uganda)

result of the variability within the area, convinced communities on the agreed plan of action. To emphasise the EbA approach, an Environmental Impact Assessment (EIA) was carried out and this confirmed the feasibility of the intervention lest the project further undermined the security of the people, and the ecological integrity. The findings of the EIA confirmed that the abstraction of the water would not compromise the regular supply of water and mitigation measures were recommended. The bigger picture of the scheme within the context of EbA was that the scheme would enhance the water provisioning service, through access to water for food production through irrigation. The scheme would also enhance the supply of clean water for domestic use and thereby increasing the resilience (e.g. Epple and Dunning 2013) and adaptive capacities of over 1000 households in Sanzara Parish area. It was also envisaged that this initial step would catalyse the Sanzara community to take lead in influencing the upper catchment communities to sustain the initiative through catchment restoration and ensure the continuous flow of this water (Fig. 8).

Through thorough analysis, consultations and discussions with the communities, the project settled for a "semi-gray" infrastructure option in the form of the gravity flow scheme as an entry point for engaging with both upstream and downstream water users (UNEP 2014). The strategy therefore was to use this type of infrastructure to restore the integrity of river from its source while ensuring water supply downstream.

The Gravity water scheme (UNEP 2014) demonstrated additionality through its ability to use an existing river to address water stress and mobilise both upstream and downstream communities in integrated water catchment management. The scheme provided a platform for planning and demonstration the value of catchment

Fig. 8 Irrigated field (downstream) using running water in trench after the completion of Gravity Scheme (upstream) (Photo by IUCN – Uganda)

management in enhancing social and ecosystem resilience. Through this platform, communities developed a 10 year catchment plan with a vision (Fig. 9) for resilient people and ecosystems within Sanzara area. Key interventions which have been implemented as part of this plan include river bank rehabilitation, soil and water conservation structures and tree planting to restore the entire degraded landscape on which River Sippi depends. In the face of climate change, the integrated watershed management practices are expected to control soil erosion, reduce water pollution risk and increase crop productivity. Agro-forestry systems will be integrated in the farming systems for reduced pollution loading and reduced pressure through provision of domestic energy. Establishment of a buffer zone along the river was expected to support natural regeneration hence stabilising the soils and making them more resilient to floods, in addition to providing water for production during the dry season, and clean water for domestic use.

These actions, therefore set the premise for EbA in Sanzara and in effect the project applied most of the principles of EbA as indicated in IUCN (2014b).

What is evident through literature and experience is that EbA is a relatively new concept and approach whose premise is to systematically harness the services of ecosystems to cushion local communities from extreme events therefore facilitating

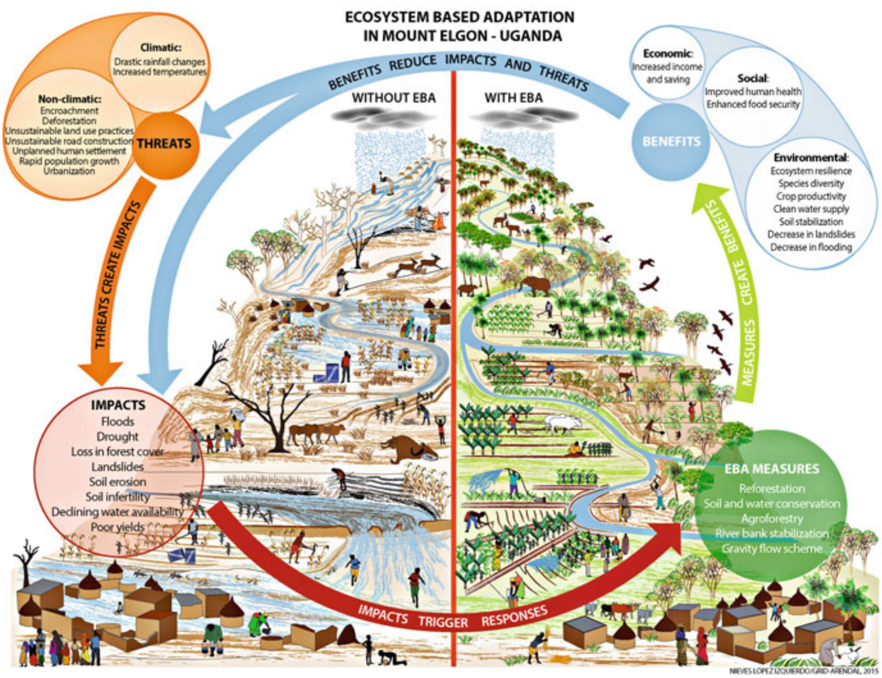

Fig. 9 Sanzara Vision as developed by local communities – Impression by local artist (Source: Nieves Lopes Izquierdo/GRID-Arendal, based on technical guidance from T. Rossing, P. Dourojeanni, C. Petersen, N.I. Nyman & P. Nteza)

adaptation to the severe effects of climate change (Wamsler et al. 2014; Munang et al. 2013). As indicated earlier the provisioning service identified by the community was one through which the natural ecosystem sustained and fulfilled the human life. It is on this premise that after the initial step of enabling the Sanzara community to access water, the subsequent process involved mobilising both the downstream and upstream communities in catchment restoration (Fig. 8). Evidence from many parts of the world has shown that the ecosystems concept is considered as an effective avenue to advance sustainable local government planning (Ahern et al. 2014; Wamsler et al. 2014). As such in order for this project to advance the sustainable planning, the role of the local government of the area was emphasised. Thereafter the project also established an incentive scheme for the upstream communities, as it was evident that the degradation emanated from their socio-economic activities. On their part this was not intentional as this was the only option and resort they had (Fig. 10).

Many factors were taken into consideration during the implementation of this project component. Notably an Environmental Impact Assessment (EIA) conducted and approved by the National Environment Management Authority (NEMA) demonstrated the leadership, commitment and support of government to address the communities' challenges.

Fig. 10 Map developed by the community identifying the priority restoration areas within Mount Elgon

The involvement of various stakeholders to understand the EbA, in participatory planning and implementation, ensured that leadership and the community's awareness, committed, to take lead. The technical local government leaders saw this as delivering on their mandate. While the political leaders show this as being responsive to their constituency. It was an opportunity to engage their people and mobilise them towards a critical goal. The awareness and tools provided to the local leaders enabled them lobby the extension of the project through government support to the villages not reached. Generally a process was established that strengthened social adaptive capacity of the leaders to respond through their institution, ecosystem adaptive capacity and the communities. The project facilitated regular community planning and reflection meetings on progress of planned target. This enabled communities to engage and take charge of the EbA actions, including demanding for actions from their leaders. In fact, community members based on the awareness and the engagement platforms that had been created through the project, regularly summoned leaders. Some village chiefs were changed, the district chairman always moved with technical officers to respond to people's interest and demands. As a result the district had to budget for the extension of the project to the neighbouring villages that had not been reached. Further, they took lead in convening council meetings to discuss actions in the upstream that would affect the lower stream action learning groups and agree on working modalities and management structures for better and coordinated implementation of activities on the ground.

It should be noted that the community contributed 30 % of the cost of the gravity flow scheme through their own labour. The participatory communal work of constructing trenches to lay the initial pipes within community land was particularly relevant taking into account the land tenure dynamic. Participatory construction of the community gravity flow was officially launched on 11 April 2012 by the project in partnership with Kapchorwa District Local Government. Construction of the trenches was eventually completed in September 2012 with a total of 6 km (kilometer) trenches constructed and pipes laid.

Capacity building was seen as a necessary component of the approach. As already mentioned the aim was to place communities at the center of the project, to assess situations and determine best way forward in using the ecosystem to respond to the effect of climate change. However, the project ensured that a scientific analysis were undertaken to triangulate and inform options for the community. Climate change scenarios for the ecosystem were mapped and these were used to raise awareness and facilitate discussion with the communities on the possibilities based on the changing climate.

Communities were trained and introduced to an incentive mechanism as a strategy for promoting better ecosystem management. This was tagged to better management of River Sippi to ensure sustainable flow of quality water in the right quantities, through better land management practices which the communities decided on indicators. The indicators helped determine the best contributors and the mode of payment to motivate and encourage better performance.

7 Conclusion

It's clearly evident that climate change is increasingly threatening local livelihoods in the Mount Elgon area and the very ecosystems they are dependent on. Ecosystem-based adaptation (EbA) provides an opportunity as a robust and flexible strategy that can at the same time cope with the uncertainties that climate change poses. The experience from Sanzara also showed that involvement of all the different stakeholders coupled with local and scientific knowledge decreased the likelihood of maladaptation and also promoted ownership and sustainability (e.g. IUCN 2014a). In addition as demonstrated at the site level in the Mount Elgon area, EbA has the potential for synergies with other adaptation options as its part of an overall adaptation strategy. What is equally evident from this work is that EbA still remains underutilized by policy makers and associated stakeholders.

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References

Articles

Ahern, J., Cilliers, S., Niemela, J. (2014). The concept of ecosystem services in adaptive urban planning and design: A framework for supporting innovation. *Landscape and Urban Planning, 125*, 254–256.

Banana, A. Y., Byakagaba, P., Russell, A. J. M., Waiswa, D., & Bomuhangi, A. (2014). *A review of Uganda's national policies relevant to climate change adaptation and mitigation: Insights from Mount Elgon. Working paper 157*. Bogor: CIFOR.

CBD. (2009). Connecting biodiversity and climate change mitigation and adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change.

Chong, J. (2014). Ecosystem-based approaches to climate change adaptation: Progress and challenges. *International Environmental Agreements Political Law Economy, 15*, 17–41.

CIGI. (2007). International risk report: The Center for International Governance (CIGI).

Dudley, N., Stolton, S., Belokurov, A., Krueger, L., Lopoukhine, N., MacKinnon, K., et al. (2010). *Natural solutions: Protected areas helping peoplecope with climate change*. Gland: IUCN-WCPA, TNC, UNDP, WCS, The World Bank and WWF.

Epple, C., & Dunning, E. (2013). *Ecosystem resilience to climate change: What is it and how can it be addressed in the context of climate change adaptation? Technical report for the Mountain EbA Project*. Cambridge: UNEP World Conservation Monitoring Center, UNEP.

FAO. (2010). *Global forest resources assessment. FAO Forestry paper 163*. Rome: FAO of the United Nations.

Government of Uganda. (2007). National Adaptation Programmes of Action *Kampala.*
Government of Uganda. (2009a). National development plan 2010/11–2014/15.
Government of Uganda. (2009b). The state of Uganda population report, 2009: Addressing the effects of climate change on migration patterns and women (Funded by UNFPA Uganda).
Hepworth, N. D. (2010). *Climate change vulnerability and adaptation preparedness in Uganda*. Nairobi: Heinrich Böll Foundation.
IUCN. (2014a). Technical paper – Ecosystem based adaptation: Building on no regret adaptation measures. UNFCCC COP20, Lima.
Kazoora, C. (2001). *Uganda Country Report*. Compiled for IUCN and WWF.
Knapen, A., Kitutu, M. G., Poesen, J., Bruegelsmans, W., Deckers, J., & Muwanga, A. (2006). Landslides in a densely populated county at the slopes of Mount Elgon (Uganda): Characteristics and causal factors. *Geomorphology, 73*, 149–165.
Levina, E., & Tirpak, D. (2006). *Adaptation to climate change: Key terms*. Paris: OECD.
Levine, et al. (2012). *The Relevance of 'resilience'?*. ODI, 2012.
Moyini, Y. (2007). *Pro-poor and pro-conservation policies and operational procedures in the Mount Elgon Ecosystem*. Nairobi: IUCN, Eastern Africa Regional Office.
Munang, R., Thiaw, I., Alverson, K., Mumba, M., Liu, J., & Rivington, R. (2013). Climate change and ecosystem-based adaptation: A new pragmatic approach to buffering climate change impacts. *Current Opinion in Environmental Sustainability, 5*, 1–5.
Munroe, R., Hicks, C., Doswald, N., Bubb, P., Epple, C., Woroniecki, S., et al. (2015). *Guidance on integrating ecosystem considerations into climate change vulnerability and impact assessments to inform ecosystem - based adaptation*. Cambridge: UNEP-WCMC.
Mutekanga, F. P., Kessler, A., Leber, K., & Visser, S. (2013). The use of stakeholder analysis in integrated watershed management: Experiences from the Ngenge watershed, Uganda. *Mountain Research and Development, 33*(2), 122–131.
Nakakaawa, C., Moll, R., Vedeld, P., Sjaastad, E., & Cavanagh, J. (2015). Collaborative resource management and rural livelihoods around protected areas: A case study of Mount Elgon National Park, Uganda, Forest Policy and Economics (2015). http://dx.doi.org/10.1016/j.forpol.2015.04.002
NEMA. (2008). *State of environment report for Uganda*. National Environment Management Authority Publications.
Palmer, M. A., Liu, J., Matthews, J., Mumba, M., & D'Odorico, P. (2015). *Science, 349*(6248), 584–585.
Petursson, J. G., Vedeld, P., & Sassen, M. (2013). An institutional analysis of deforestation processes in protected areas: The case of the transboundary Mount Elgon, Uganda and Kenya. *Forest Policy and Economics, 26*, 22–33.
Sassen, M., Sheil, D., & Giller, K. (2015). Fuelwood collection and its impacts on a protected tropical mountain forest in Uganda. *Forest Ecology and Management, 354*, 56–67.
Sassen, M., Sheil, D., Giller, K. E., & ter Braak, C. J. (2013). Complex contexts and dynamic drivers: Understanding four decades of forest loss and recovery in an East African protected area. *Biological Conservation, 159*, 257–268.
Scott, P. (1998). *From conflict to collaboration: People and forests at Mount Elgon, Uganda*. Gland: The World Conservation Union (IUCN).
UNEP. (2014). Fast tracking ecosystem-based adaptation: Building resilience to climate change in Africa. UNEP Technical report.
UNFCCC. (2007). The Nairobi work programme on impacts, vulnerability and adaptation to climate change. UNFCCC Secretariat, Accessed from: https://unfccc.int/files/adaptation/sbsta_agenda_item_adaptation/application/pdf/nwp_brochure.pdf
United Nations Development Programme (UNDP), & Bureau for Crisis Prevention and Recovery (BCPR). (2013). *Climate risk management for sustainable crop production in Uganda: Rakai and Kapchorwa districts*. New York: UNDP BCPR.

Wamsler, C., Lenderitz, C., & Brink, E. (2014). Local levers for change: Mainstreaming ecosystem-based adaptation into municipal planning to foster sustainability transitions. *Global Environmental Change, 29*, 189–201.

Books

IPCC. (2007). In M. L. Parry, O. F. Canziani, J. Palutikof, P. J. van der Linden, & C. E. Hanson (Eds.), *Climate change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press. 976 pp.

Millennium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Synthesis*. Washington, DC: Island Press.

Internet Resources

IUCN. (2014b). *Ecosystem based adaptation – An approach responding to climate hazards*. Fact sheet. https://cmsdata.iucn.org/downloads/eba_english.pdf

UNFCCC. (2010). Dec 1/CP.16, para 14 (d), http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf

United Nations. (2012). The future we want. Shared at Rio+20. http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N11/476/10/PDF/N1147610.pdf?OpenElement