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Sustaining ecosystem based adaptation: The lessons from policy and practices in Nepal

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ABSTRACT

The ecosystem based adaption (EbA) approach mobilizes ecosystem products and services to reduce people's vulnerability and improve adaptation to climate change. The approach is being tested and promoted globally including Nepal. However, there are limited studies on why EbA faces challenges of mainstreaming and wider upscaling in developing countries' policies and practices. Based on an empirical case study from the first EbA pilot project site in Nepal "Panchase Mountain Ecological Region", expert consultation, and in-depth policy analysis, this study examines the effectiveness of interventions implemented through EbA and explores "Why" questions related to mainstreaming and upscaling of EbA in Nepal. The results showed that EbA helps to reduce climate vulnerability and enhance socio-ecosystem resilience. However, it often lacks innovativeness in addressing the risk and vulnerability associated with the changing climate. Though EbA is spelled out in most of Nepal's climate change policies, it faces sustainability issues due to low priority, lack of a proper institutional mechanism, and inadequate budget provisions. The EbA related activities are implemented on a small scale, runs for a short period, and failed to demonstrate tangible impacts. The sustainability of the EbA practices in Nepal will be ensured, only if it is mainstreamed in the government's regular planning process, receives enough budget from the government, and has robust institutional mechanisms in place for implementing and monitoring EbA activities. The study's findings are expected to be useful for policymakers, practitioners, and development agencies to shape interventions to institutionalize the EbA approach in the developing countries.

1. Introduction

Climate change affects the ecosystem upon which the global population depends to meet their various needs creating additional stresses on land, exacerbating existing risks to livelihoods, biodiversity, ecosystem health, infrastructure, food systems, and posing a risk to the global economy (Mooney et al., 2009; Moreno-Mateos et al., 2020; World Economic Forum, 2019). Besides, the climate change consequences such as drought, flood, invasive species outbreaks, pest attacks, and heatwaves affected the natural ecosystem that provides valuable services to humankind (MEA, 2005; Mimura and Pulwarty, 2014). In this pretext, mitigation and adaptation were considered an effective tool to tackle climate change and go hand in hand (Maraseni et al., 2009).

The Paris Agreement, though, aims to reinforce global response to retain the global temperature rise below 2 °C above the pre-industrial level, climate change adaptation is a prerequisite as climate change's adverse impact is already observed due to the piling of greenhouse gases in the atmosphere (UNFCCC, 2015; World Economic Forum, 2019). The significant adverse impacts of climatic and climate-related extremes across regions demand an urgent need to implement feasible adaptation strategies and measures. Climate change adaptation is essential in the least developed countries like Nepal to trickle down climate financing and build the capacity of poor and vulnerable households impacted by climate change and mitigate the risk on the livelihood resources they depend on (Wester et al., 2019). Countries which are mostly affected by the climate change have started preparing National Adaptation Program of Action (NAPA), National Adaptation Plans (NAP), Local Adaptation Plans of Action (LAPA), and other climate change policies and strategies

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to reduce the risk of climate induced hazards (Reid et al., 2019; Seddon et al., 2020). Furthermore, climate change adaptation measures which are less expensive and more useful to improve resiliency is necessary (Seddon et al., 2020).

There are different approaches to climate change adaptation, e.g. Community based Adaptation (CbA) and Ecosystem based Adaptation (EbA). CbA aims to minimize poor people's climate change risks by engaging them in planning and implementation processes (Forsyth, 2013). EbA is defined 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 further refined in 2010, bringing management perspective and defined as "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; Moreno-Mateos et al., 2020).

EbA aims at improving the socio-ecological resilience and adaptive capacity of the people to climate change impacts through the sustained use of ecosystem services. It focuses on enhancing ecosystem resilience and reducing the people's vulnerability and has the potentiality to provide multiple benefits such as socio-economic co-benefits (Maes and Jacobs, 2017; World Bank, 2009) and climate change mitigation (Mori et al., 2013). EbA is gaining global recognition because it is considered as sustainable, low-cost (Emerton et al., 2009; Munroe et al., 2012), and "no-regret" option for climate change adaptation (Jones et al., 2012) and has been promoted in different countries by policy makers, development agencies and researchers (Maes and Jacobs, 2017; Mills et al., 2020; Munang et al., 2014a). Although the natural environment has been used as a buffer against climatic variability and other risks for ages, mobilization of ecosystem services to adapt against climate change impacts is a new concept and is gaining increased attention in a national and international forum (Donatti et al., 2020; Seddon et al., 2020).

Since the Paris Agreement has set the global target on adaptation and invited parties to "review the adequacy and effectiveness of adaptation" (Article 2, para 14c), monitoring and evaluation of mitigation and adaptation action are necessary for checking progress and devising new technologies (Morecroft et al., 2019; UNFCCC, 2015). Progress on mitigation can be measured through greenhouse gases (GHG) changes (Maraseni and Pandey, 2014), but measuring adaptation is more challenging. The measurement of effectiveness of EbA interventions is also complex because there is no accepted methodology (Donatti et al., 2020). Therefore, evidence on the success or effectiveness of EbA interventions is difficult to find; if available are of small scale in a limited number and often project-based (Mills et al., 2020; Milman and Jagannathan, 2017; Morecroft et al., 2019; Woroniecki et al., 2019). One reason for the lack of wider policy uptake is the dearth of knowledge on the successes of EbA practices (Brink et al., 2016; Doswald et al., 2014; Milman and Jagannathan, 2017). Furthermore, there is also no conceptual clarity on what EbA actually means (Milman and Jagannathan, 2017), and it is often difficult to distinguish with the existing sustainable management of ecosystem approaches. However, the recently launched monitoring and evaluation guidebook for EbA interventions entails the process needed for designing and implementing effective monitoring and evaluation for EbA (GIZ UNEP-WCMC and FEBA, 2020).

Considering the importance of EbA, climate change-related policies and programs in Nepal have stressed its inclusion; however, there are no specific plans to guide EbA at the implementation level except some project-level manuals (GON/UNDP, 2016). For this, it is imperative to assess the effectiveness of EbA interventions at the ground level in order to better understand its social, economic, and ecological potentialities. Being a new approach, research and evidences supporting EbA are scant and are at a smaller scale. By examining EbA projects, this study examines EbA's effectiveness in Nepal based upon the selected criteria. It further identifies challenges and barriers for upscaling EbA in the country. This study is believed to guide policymakers, practitioners, and donors to shape interventions to institutionalize EbA approach for reducing the risk of climate adversities, and build resilience both at the social and ecological systems in Nepal.

1.1. Ecosystem based adaptation in Nepal

Nepal is rich in forest and agro-ecosystem with diverse natural resources, supporting millions of population for their living (MoFSC, 2014; Dhakal et al., 2012). However, most people's reliance on natural resources and agronomy, coupled with fragile geography makes it highly vulnerable to climate change impacts (Bhatta et al., 2015; Gentle and Narayan, 2012). Some visible climate change impacts, such as inconsistent weather patterns and extreme variability, glacial lake outburst flood, reduction in agriculture productivity, and loss of biodiversity were reported from different parts of the country (Poudyal et al., 2020; Sherpa et al., 2019; Wester et al., 2019). Increased food insecurity, water stress, climate change-induced disasters were considered the impact of climate change affecting the livelihood of vulnerable populations (Gentle and Narayan, 2012; Nagoda, 2015; Wester et al., 2019). Climate change is also considered a significant challenge to achieving sustainable development targets as envisioned through Sustainable Development Goals (SDGs) of United Nations (Nerini et al., 2019).

Considering the potential risk of climate change and vulnerability of the country's ecosystem, Nepal has adopted mitigation and adaptation measures by formulating different policies and programs and implementing them on the ground (Pandey et al., 2016). Adaptation measures are necessary to increase the people's resiliency and adaptive capacity to deal with climate change impacts. Among them, climate change adaptation (CCA) approaches like community based adaptation, disaster risk reduction (DRR), integrated climate change management, ecosystem based adaptation and landscape level conservation are being implemented in the country which has helped to reduce the vulnerability by increasing adaptive capacity of the local people (Adhikari et al., 2018; Gentle and Narayan, 2012). Among all, EbA is a relatively new approach that was initiated by the government with the collaboration of development agencies in 2011 (GON/UNDP, 2016). Also, EbA related provisions have been incorporated by different agencies in their climate change related programs such as Hariyo Ban Program and Resilient Mountain Solutions (RMS) Programme of International Center for Integrated Mountain Development (ICIMOD) in Nepal.

EbA is cost-effective, environment friendly, and easily adaptable at the local level to improve the socio-economic resiliency of the vulnerable people, making it suitable for Nepal (Adhikari et al., 2018; Reid, 2016; Reid and Adhikari, 2018). It also complements engineering structures, which are often capital and high skill demanding. It was first piloted as Ecosystem based Adaptation in Mountain Ecosystem Project in Panchase area of Gandaki province with the aid of different development agencies and leadership of Ministry of Forests and Environment (MOFE) from 2011 to 2016. The project intervened activities related to the restoration of the ecosystem, livelihood improvement, and stakeholders' capacity development (GON/UNDP, 2016). Subsequently, other projects were implemented on the same site to upscale the interventions. Similarly, EbA has been incorporated in other programs of some development agencies, including ICIMOD.

Several studies illustrated climate change, their impact in the different spectrum, and adaptation strategies (Byg and Herslund, 2014; Gentle and Narayan, 2012; Regmi and Star, 2014; Shrestha and Aryal, 2011); however, little is understood about the EbA interventions in Nepal. Although EbA has shown promising results, it is not extensively implemented in the country, and its reasons are unexplored. Few researches were carried out, but they were mostly project-focused (Klein et al., 2019; Reid, 2016). There is a scope for integration of CbA and EbA by incorporatning into community forest operational plan. This could be a major policy intervention to integrate adaptation into mitigation through community forest program. This provision could also be the one way out to make adaptation programs sustainable but is not investigated. Due to the lack of evidence, it may hurdle the implementation and

extension of EbA in Nepal. Therefore, this study will help fulfill the knowledge gap, supply evidence that will help the further investigation, and provide a basis for designing local, provincial, and federal level policy and strategic action.

2. Analytical framework

EbA is a nature-based solution for addressing climate change impacts. It focuses on the benefits communities derive from biodiversity and ecosystem services and how these benefits can be utilized to deal with the risk of climate change. Consequently, EbA is a people and community-centric concept which focuses on human resilience linked with the integrity of ecosystems. Yet ecosystem health alone does not guarantee social resilience, so EbA is best implemented as an integrated element of a broader adaptation strategy (FEBA, 2017). We argue that EbA has three major benefits i.e. socio-economic benefits, biodiversity and ecosystem conservation, and climate change adaptation (Fig. 1).

Several literature suggested that for EbA to be successful, it has to provide above three benefits outlined in the framework, including mainstreaming in policies and plan and wider uptake and scaling up. Our work examines how EbA benefits most vulnerable populations and also contributes ecosystem resilience. As stipulated in the analytical framework, our examinations are based upon three key assumptions derived from the literature. They are:

(i) *For EbA to be effective, it should demonstrate that it directly addresses the risk and vulnerability of ecosystem and people dependent on those ecosystems.*

Studies reported that climate change impacts could worsen the situation by making those people more vulnerable who depend on natural resources for their livelihood (Adger et al., 2007; IPCC, 2018; Mimura and Pulwarty, 2014). Climate change affects the socio-ecological system; therefore, appropriate climate change adaptation activities should address the socio-ecological interaction and how the interaction could contribute in resilience-building benefitting people and bio-physical environment (Hills, 2015). Different ecosystem services generate a wide array of benefits that play a pivotal role in socio-economic resilience building (MEA, 2005). The ecosystem restoration enables the increased supply of ecosystem goods and services to the vulnerable populations, enhancing their livelihood (Mills et al., 2020).

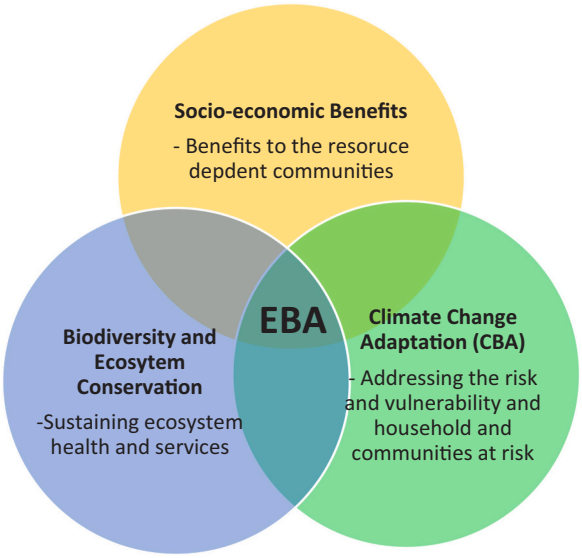

Fig. 1. EbA and its benefits adapted from Midgley et al. (2012).

(ii) *For EbA to be sustainable, it has to be mainstreamed in the national development policies and plans.*

Mainstreaming refers to integrating policy and good practices into the governments' planning, policies, and framework and their reflection into the fiscal planning process (Regmi and Star, 2014). Mainstreaming is essential as it ensures that adaptation is reflected in policies and plans; budget is available, avoiding duplication of initiatives (Cuevas et al., 2016). Climate change adaptation needs to be mainstreamed in policies and plans at national, regional, and local levels. Operational level mainstreaming is important to find suitable mechanisms where nature-based and livelihood-based adaptation options can be integrated and sustained.

(iii) *The learnings from pilot EbA has to be internalized, mostly shared, and disseminated for any system to uptake it.*

The upscaling of EbA to tackle climate change issues necessitate inclusion in the governments' policies, which require extensive socio-economic and ecological data (Mills et al., 2020). Therefore, long-term research and learnings from EbA projects need to be internalized into government policies for wider sharing and upscaling (Reid and Adhikari, 2018). It informs the policymakers and implementers and enhances climate financing mechanisms to ensure the planned activities are implemented (Bertram et al., 2018).

3. Methods

Climate change is a cross-cutting issue affecting multiple sectors and different disciplines; therefore, a mixed-method approach can bring synergy in all aspects (Cuevas et al., 2016). Furthermore, the qualitative and quantitative nature of data also demands mixed-method. The mixed-method generally uses a qualitative and quantitative approach for investigating a research. The quantitative method examines the status of an event which can be analyzed through qualitative method for justification, elaboration or triangulation (Hesse-Biber and Johnson, 2013). This study employed mixed methods through extensive literature reviews, experts' consultation, case study and policy analysis (Fig. 2).

At first, secondary information was gathered and reviewed mainly for selecting potential criteria for assessing the effectiveness of EbA. There are multiple guidelines and criteria devised to evaluate effectiveness globally (Andrade et al., 2011; Bertram et al., 2018; Doswald et al., 2014; FEBA, 2017). However, the selection of criteria can be complex because the effectiveness of climate change adaptation interventions varies across the location, time, and spatial scale and is dynamic (GIZ UNEP-WCMC and FEBA, 2020; Leiter and Pringle, 2018). Among those criterias, the one developed by FEBA (2017) was referred because it was well acknowledged and measurable (GIZ UNEP-WCMC and FEBA, 2020). FEBA (2017) has proposed 5 criteria and quality standards. Based on expert consultation, we clumped 5 criteria into 4, and 11 indicators were finalized for this study (Table 1).

The bibliographic search was done in SCOPUS and google scholar for peer-reviewed journal articles between 2010 and 2020. We used "ecosystem based adaptation", "EbA AND Nepal", "climate change adaptation AND Nepal" in titles, abstracts, and keywords as criteria in SCOPUS and google scholar. We reviewed papers to understand about EbA development worldwide, issues, with a particular focus in Nepal. Also, these literature were used to select the potential criteria for assessing the effectiveness of EbA.

Consultations with national-level experts were done at two stages, firstly for criteria selection to assess the effectiveness of EbA, and secondly, to capture their views on the effectiveness of EbA interventions and underlying challenges and barriers for upscaling EbA. For this study, people who are directly or indirectly engaged in either planning, implementation, monitoring and evaluation process, and research related to EbA were considered "experts". We prepared the roster of 100 such experts. We then shortlisted 40 experts who have at least three

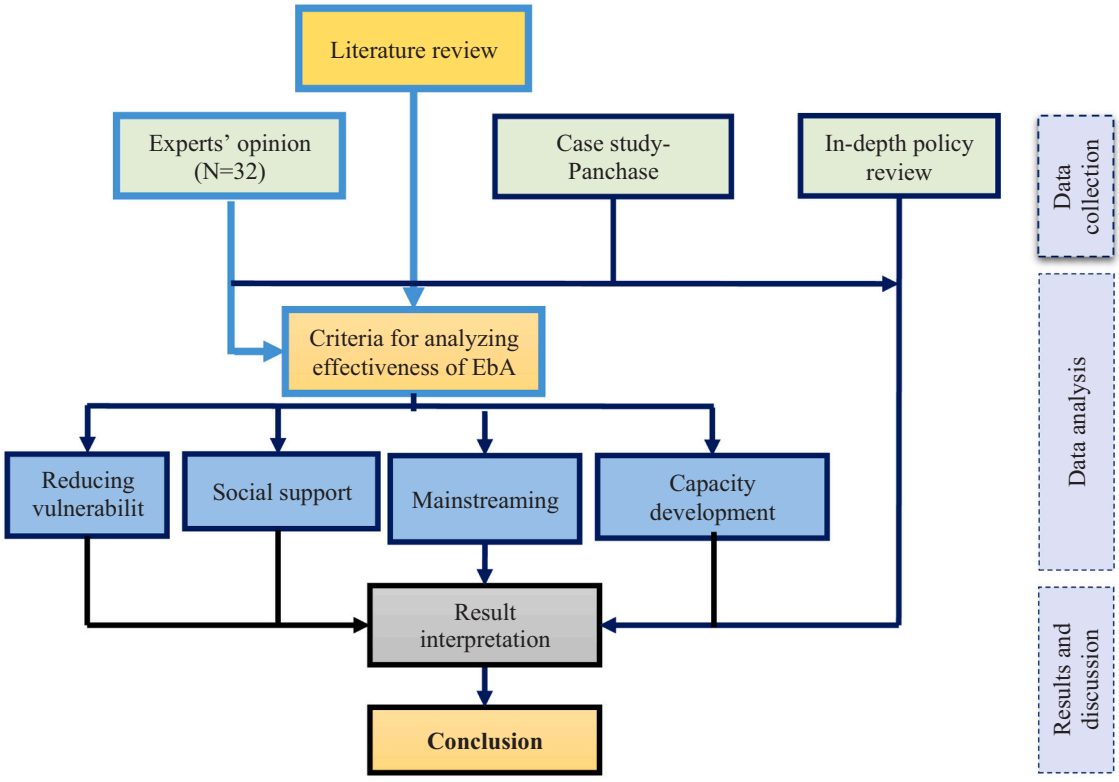

Fig. 2. Study approach.

Table 1
Criteria selected for assessing the effectiveness of EbA interventions.

Criteria	Indicators
1. Reduce risk and vulnerability of ecosystem and people dependent on those ecosystem	- Usage of local knowledge - Vulnerability assessment - Restoration of ecosystem - Pursuing unique characteristics and attribution
2. Social support to deal with climate change adaptation	- Tangible and intangible benefits to people - Sustainable flow of ecosystem services and benefit to people - Economic effectiveness
3. Mainstreamed in the national development policies and plans	- Provision of EbA in policies and plans - Institutional mechanism
4. Capacity development	- Capacity building of local people and stakeholders - Research, documentation, and sharing

years of experience working in EbA projects at the policy, practice, or research arena. We sent a survey questionnaire to these experts through an online survey tool, 32 experts responded to our request. Among 32 experts, 17 were from a non-governmental organization, 13 government officials, and 2 from academia. The experts have different qualifications (forestry, agriculture, environment, etc.), knowledge, and experience of working in Nepal's climate change sector. These experts were consulted to finalize criteria and indicators and data input for assessing the effectiveness of EbA and underlying issues and challenges for its upscaling through an online structured questionnaire.

Similarly, we reviewed the policy documents such as Climate Change Policy 2019, Local Adaptation Plans of Action 2019, National Adaptation Program of Action (NAPA) 2010, Environment Protection Act 2019, Nepal National REDD+ Strategy 2017, and Forest Policy 2019 to check if these documents have EbA related provisions or not. In addition, we also reviewed Nature Conservation National Strategic Framework for Sustainable Development (2015–2030), National Biodiversity Strategy and Action Plan (2014–2020), Environment Friendly Local Governance Framework (2013), and other sectoral policies.

The data obtained were collected, cleaned, and processed for analysis. During this phase, we used descriptive and prescriptive methods to draw the study's analysis, triangulated by various data sources, and presented to back the assumptions and substantiate the objectives. It helped us to understand, interpret, and derive conclusions based on the requirements. The quantitative data obtained from the experts' survey were analyzed using descriptive statistics. All the qualitative information gathered from Key Informant Interview (KII), Focus Group Discussion (FGD), and field observation from case study site were recorded, translated, and analyzed. These qualitative data were also used to support and triangulate quantitative data obtained from the experts' survey. In addition to the information obtained from the primary sources, data from the detailed review of policy documents were analyzed to identify policy provisions and mainstreaming of EbA.

3.1. *Case study site: Panchase*

Panchase has a mountain ecosystem fostering the growth of valuable flora and fauna, rich biodiversity connecting lower region, and high Himalaya of Annapurna range (Fig. 3). The site was selected as a case study as it is considered as one of the climate vulnerable region (MoE, 2010), and have long experience of EbA project implementation in different periods through different agencies. With the piloting of first EbA project of Nepal, this site is preferred for subsequent EbA interventions through the implementation of projects like "EbA in mountain ecosystem" jointly implemented by MoFSC/DoF, MoSTE, UNDP, UNEP and IUCN which was executed from 2011 to 2016 (GON/UNDP, 2016) and "Scaling up mountain Ecosystem based Adaptation", implemented by MoFE, TMI and IUCN from 2017 to 2020. The project claimed to increase local people and stakeholders' adaptive capacity through livelihood diversification, skill development, education,

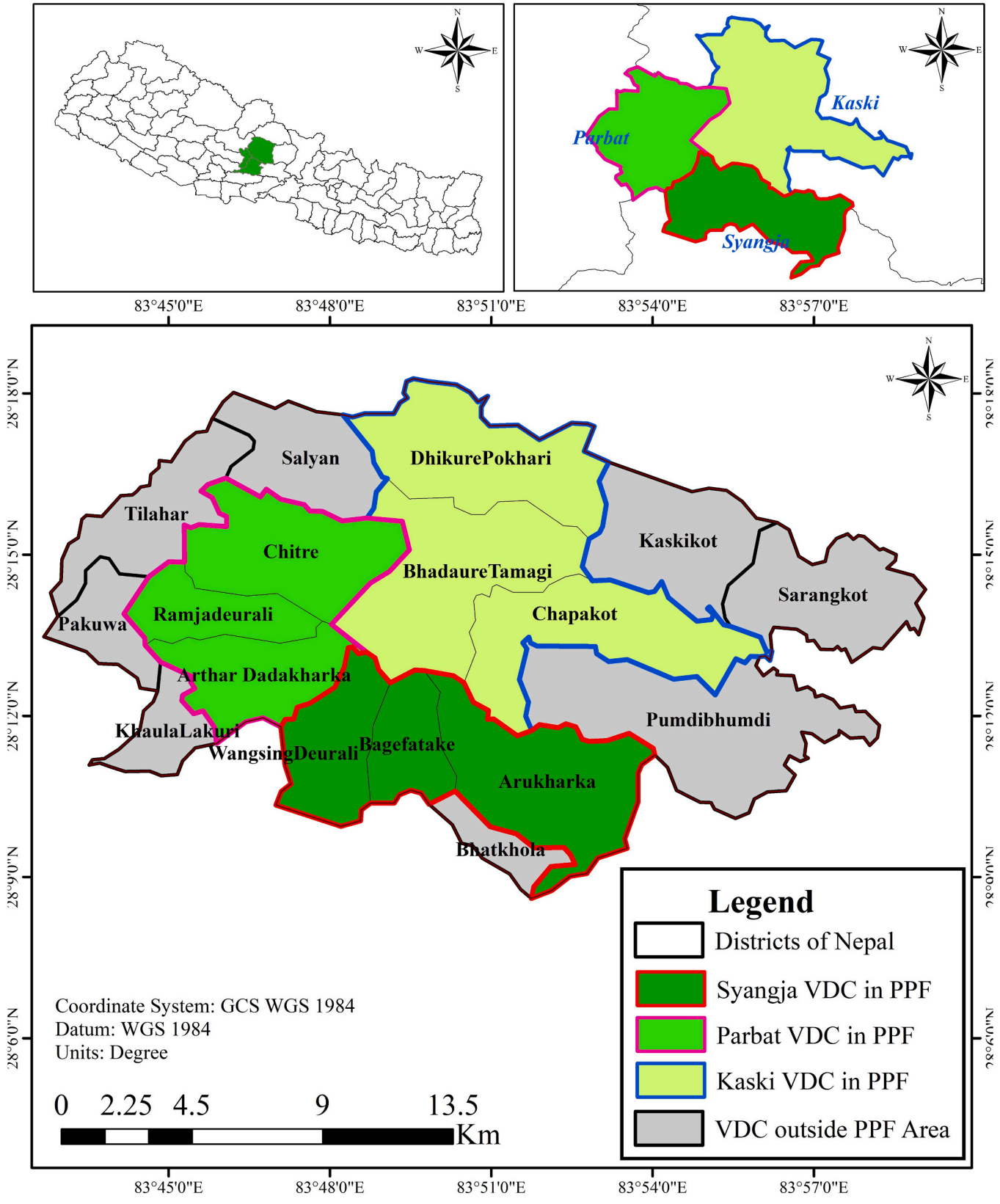

Fig. 3. Location map of Panchase Mountain Ecological Region.

and awareness-raising activities. The project report documented different initiatives for restoring ecosystem services such as vulnerability assessment, damage control measures, plantation, and implementation of different adaptation interventions (GON/UNDP, 2016; Reid and Adhikari, 2018). The data for case study were collected from Bhadaure Tamagi village in Panchase that lies in ward no 23 of Pokhara metropolitan city, Bhadaure Tamagi was selected because EbA related interventions were concentrated in this village. Interviews with key

informants like forest officials, executive members of Community Forest User Group (CFUG), local leaders, and people from indigenous and marginalized groups were done. In total, 10 key informants were interviewed for in-depth discussion. Similarly, 2 focus group discussions were conducted with communities engaged in EbA activities. Besides, direct field visit was also done for field verification of the EbA related interventions.

4. Results

4.1. Effectiveness of EbA

4.1.1. EbA and vulnerability

In Panchase, vulnerability assessment was done prior to the implementation of EbA activities that helped to identify and prioritize the adaptation activities and location for intervention. The FGDs revealed that the participatory method was adopted during vulnerability assessment and planning of adaptation activities, focusing on locally available resources and indigenous knowledge. For example, local species were prioritized for plantation and local resources such as bamboo while constructing checkdams. The priority activities were selected, putting ecosystem at the center. Activities were targeted towards protection, conservation, restoration, and management of degraded ecosystems and regulation of ecosystem services to improve ecosystem conditions to provide valuable services to people to better adapt to climate change. As per the experts' opinion for overall EbA interventions in Nepal, about 94% of respondents suggested that EbA interventions helped restore multiple ecosystem services, mainly provisioning (direct services such as food, forest products, etc.) regulating, cultural, and supporting services.

Amidst other adaptation approaches like CbA, EbA stand out because it emphasized utilizing ecosystem services as a unique strategy to climate change adaptation. However, local communities in Panchase believed that interventions implemented under EbA lack innovativeness. They claimed that some activities implemented resemble business as usual (similar activities were implemented before the introduction of EbA) or identical with other climate change adaptation activities like CbA. For example, checkdam is mostly constructed to reduce soil erosion, flooding, and runoff in the country's hilly areas. Checkdam was constructed before implementing EbA in Panchase area with support from government offices (such as division forest office, district soil conservation office) and local government offices (such as ward office) in the past. Similar type of checkdam is constructed through EbA without any innovativeness or technical modification. It was difficult to find how checkdams remarkably reduced the additional risk from climate change or the changes made in the structure's design that helped build systems resilience. Similarly, plantation of broom grass and bamboo was carried by EbA continuing existing interventions.

According to experts' opinion, 43% of respondents perceived that EbA activities are similar to other activities implemented by the communities, government, or non-government support. About 57% of respondents perceived that EbA activities are innovative because, in their opinion, they are targeted to improve the ecosystem resiliency; however, they agree that there are no any significant differences at the activities level.

4.1.2. EbA and social support

Though EbA is in its infant stage in terms of its contribution to reducing risk and vulnerability as revealed in the case above, the social perspective found positive in the case study site. EbA, in the case study site, provided both direct and indirect benefits supporting the vulnerable population's livelihood to tackle the climate change impacts. Local communities from Panchase benefited in different ways from EbA support. Respondents from KIIs and FGDs revealed that they could diversify their livelihood through the engagement in the cultivation of Non-Timber Forest Products (NTFPs), forest-based enterprise, ecotourism, and vegetable farming. They are trained to cultivate and manage commercially viable NTFPs like Timur (*Zanthoxylum armatum*) and Chiraito (*Swertia chirayita*) through seedling support, technical guidance, and market linkage. Apart from creating additional income for the communities, these activities helped to reduce the dependency on forest resources, motivate people in conservation activities, and reduce vulnerability. EbA helped to build communities' adaptive capacity against climate change impacts through conservation and sustainable ecosystem services management. Local communities in Panchase suggested that different water management activities such as drinking water source conservation, maintenance of conservation pond, and irrigation canal increases water availability reducing water-related stress.

From experts' consultation, 87% of experts believed that income generating activities helped to reduce the local communities' vulnerability, including the poor and marginalized. Also, skill development activities enhanced the adaptive capacity of the vulnerable population. However, only 13% of respondents think that activities implemented under EbA did not reduce vulnerability.

While enquiring about the cost-effectiveness of EbA interventions with experts, 71% of experts perceived that EbA is more cost-effective whereas 23% of experts considered the cost and benefit are roughly similar, followed by 6% saying EbA less cost-effective. These finding were in line with the response from the respondents of study site. Respondents from Panchase perceived that activities such as NTFP cultivation (Broom grass – *Thysanolaena maxima*, Timur – *Zanthoxylum alatum*) and water based adaptation interventions (conservation pond, drinking water, water source maintenance) are economically viable with regards to the contribution to the livelihoods and building ecosystem resiliency.

4.1.3. Mainstreaming EbA

The paper examined the provisions for mainstreaming EbA in policies, programs, and plans. The findings suggested that Nepal has devised a number of policies and established institutional mechanisms for mainstreaming climate change into the development process. These policies contributed to making development plans and local actions more climate-resilient. The review of major policies related to CC and the environment revealed that EbA is incorporated in most policy documents (Table 2). But specific guideline for planning and implementing EbA is lacking. Some documents addressed the need for integrating EbA with CbA or DRR plans, for example, LAPA 2019 highlighted that EbA can be integrated with CbA. But, there is no information available about how to integrate these approaches. Climate Change Council was established in 2009 as an institutional framework to formulate and implement CC related policies in Nepal, but mainstreaming of climate change at the local level is still a question. Although sectoral policies do mention practices like EbA, it is not discussed in detail leaving some practical challenges for implementation.

Furthermore, a number of co-ordination mechanisms were formed in different periods for consultation and collaboration among the stakeholders. Department of Environment is mandated to plan, implement, monitor, and evaluate policies and programs related to environment and CCA. Despite the number of policy and regulatory framework, climate change receives significantly lesser budget from the government and government mostly seek donor or external funds for implementing CC related program. In such a case, EbA too, receives less priority.

Due to this, EbA struggles and fails to get incorporated in local, provincial, and central level planning and budgeting process. In some areas where EbA projects were implemented, EbA was integrated in fiscal year's planning process (local government' planning process), for example, in Panchase. In most cases, we don't find evidence of mainstreaming at the governments' planning process at the local level. Since majority of the EbA based interventions were implemented at the project model, the sustainability of the project-based initiatives is questionable. Experts' claimed that the government started to prioritize climate change related program, and provided the budget code, specific plans,

Table 2
Policy arrangements related to Ecosystem based Adaptation.

SN	Policies	Focus	Limitations with respect to EbA
1	Climate change policy 2019 (MoFE, 2019a)	Overarching policy on climate change with 8 thematic and 4 cross-cutting areas. The goal of this policy is to develop a resilient climate society and socio-economic prosperity. Specifically, it aims at increasing adaptive capacity of vulnerable population; develop resilient ecosystem; promotion of green economy; equitable benefit distribution of climate funds received from mitigation and adaptation at national and international level; effective research, technology development and information system; mainstreaming climate change in sectoral policies of all levels and gender and ensure gender and social inclusion in mitigation and adaptation programs.	The document addressed EbA for reducing the vulnerability of local people using ecosystem services, but it failed to address how EbA like mechanism mainstream in planning. It emphasized federal, province, and local level budget for CCA, but remained silent on how EbA finance can be ensured. It highlighted the necessity of institutional mechanism for CCA at all levels, but there is no specific perspective on ecosystem resilience.
2	NAPA 2010 (MoE, 2010)	This is the first policy document highlighting climate change adaptation and priority programs in six thematic areas. Six thematic areas were: "agriculture and food security, forest and biodiversity, water resources and energy, climate-induced disasters, public health, and urban settlement and infrastructure".	It mentioned ecosystem services as a medium under the ┼Forest and Biodiversity┌ thematic area for dealing with CC, but it didn't explicitly mention how EbA can be instrumental for addressing socio-economic and ecological systems.
3	LAPA 2019 (MoFE, 2019b)	It is an operational framework for guiding NAPA's implementation to integrate local and national level climate change adaptation planning and implementations to make a more resilient society.	Mainstream CCA at the local level development and resource management sector to develop a climate-resilient society. Mobilization of ecosystem services for climate change adaptation. But it lacks clear mechanism for EbA and funding from the local level.
4	REDD+ strategy 2018 (MoFE, 2018)	It guides policies and programs to deal with deforestation and forest degradation drivers to increase the forest's carbon sink capacity in Nepal.	Promotion of EbA, landscape conservation, as a strategy to improve forest management. However, the implementation of EbA is not explicitly mentioned.
5	Sectoral policies such as Forest sector strategy (2016), Forest Act (2019)	It sets targets and identifies signature programs on mitigation and adaptation.	EBA is regarded as one of the approaches in addressing climate change issues in the sector

and separate institutions for implementation and monitoring; EbA can benefit from this. Therefore experts suggested improving the enabling policy and institutional mechanism for the mainstreaming of EbA.

4.1.4. Capacity development of stakeholders

EbA is a relatively new approach for Nepal, demanding conceptual clarity on the approach for local communities, government, and non-government organizations engaged in EbA implementation. Therefore awareness-raising activities targeted to stakeholders mainly to develop knowledge on CCA and EbA and skill-based training for building capacity of vulnerable households, including women and poor were implemented in Panchase. These awareness-raising trainings on issues like climate change, biodiversity conservation, and forest management, enabled stakeholders to gain conceptual knowledge and develop a common understanding that respondents believed helped during the execution of adaptation interventions at the ground. On the other hand, skill development training to communities like forest management, NTFPs harvesting, and marketing and home stay development created an avenue for developing entrepreneurship and skilled employment opportunities. However, respondents from FGDs argued that the capacity development program was not enough. Rather than event-wise training and workshop, they suggested on-site coaching so that mass of people can be benefitted.

From the experts' survey, it was revealed that the clarity on EbA is not adequate, which affects the selection of activities during planning and technology used to implement EbA interventions at the ground level. EbA should take future climate scenario in mind while designing the adaptation activities however we did not find any evidences. This may be due to the inadequate understanding on EbA.

4.2. Barriers for upscaling EbA in Nepal

While discussing the barriers associated with the upscaling of EbA in Nepal, various issues were identified as outlined in Fig. 4. The findings from experts' opinions showed that EbA being a relatively new concept, there is a lack of conceptual clarity and knowledge among communities and stakeholders. There are also limited technical human resources both at the government and non-government sectors mainly to design, guide, and support the implementation of EbA interventions. This is more problematic at the government level because even if the project builds the human resources' technical capacity, the frequent transfer of the government officials takes away institutional memory. For example, if one officer receives the EbA related training when posted in the project district, they got transferred (in most cases) before implementing their new knowledge in the ground. Furthermore, we found that the EbA interventions were well executed during the project's active implementation phase, but they did not function properly during post-project period.

The experts informed that either the project's exit strategy had not been well formulated or there has not been an effective follow-up and monitoring from the government's level. Another barrier is the lack of financial resources for extending EbA in other parts of the country. Experts revealed that EbA is mostly donor-driven and receive lower priority from the government. Also, EbA requires broader scale/ landscape level interventions demanding co-ordination and collaboration from different sectors. The majority of the experts perceived that there is also a problem with the inter-sector or inter-ministerial collaboration and lacking legal documents for collaboration.

To remove institutional, technical and other barriers, experts suggested different enabling conditions that will enhance upscaling and sustainability of EbA in Nepal (Table 3). Among them, cross-sector coordination and collaboration, strong institutional setting, mainstreaming, benefits to the communities etc. were regarded as necessary conditions for the sustainability of EbA.

5. Discussion

5.1. Socio-ecological resilience

Due to climate change, global poorest countries face severe social

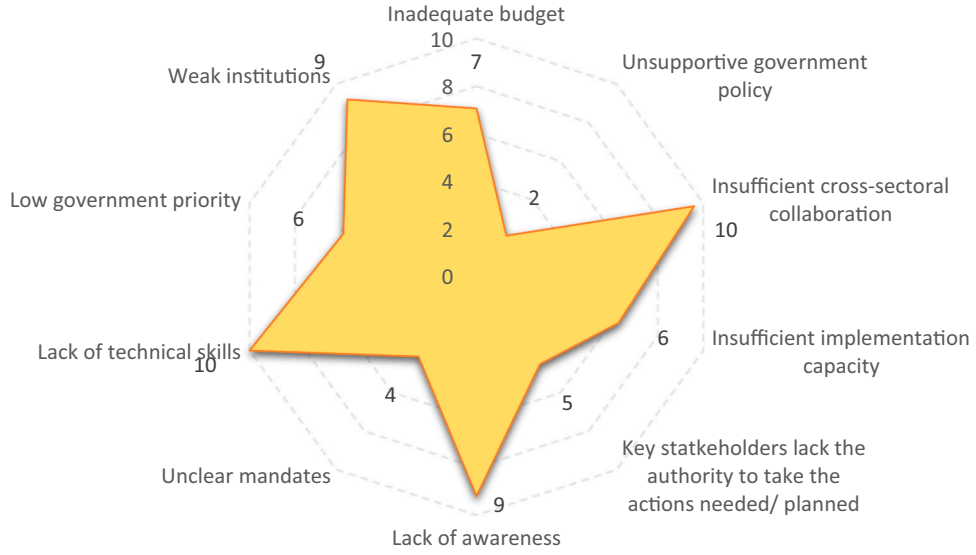

Fig. 4. Barriers for EbA upscaling in Nepal.

Table 3
Enabling conditions for EbA upscaling.

Enabling conditions for EbA	Description
Cross-sectoral coordination & collaboration	Engagement of multiple ministries, local government and multi-stakeholder participation during planning & implementation process.
Strengthening institution	Clear division of responsibility, institutional collaboration
Mainstreaming in planning/ budgeting and implementation	Priority by GoN, need to be mainstreamed at all sectors and all planning process, availability of funding, policy guideline
Socio-economic benefits	Direct benefits to the community for the ownership and long term sustainability of EbA initiatives
Linkage with ongoing community-based approaches	Linking EbA with community forest, CbA, watershed management plan
Capacity building, learning & sharing	Awareness, technical know-how program to GoN staff and other stakeholders

and economic impacts, urging immediate, cost-effective adaptation measures (IPCC, 2018). EbA mobilizes natural resources as a strategy to improve the vulnerable populations' resiliency, has huge potential as majority of population in Nepal depend on natural resources (Reid and Adhikari, 2018; Seddon et al., 2020). Several studies suggested social co-benefits of EbA (Mills et al., 2020; Reid et al., 2019; Woroniecki et al., 2019), and our study found similar findings. EbA provided benefits to improve the communities' adaptive capacity, diversify livelihood options, and maintain ecosystem services as co-benefits. It has helped to generate income and reduce vulnerability. Similar results were found by Munang et al. (2014b) in Togo where EbA generated multiple social benefits.

The EbA interventions are considered effective and cheaper than other adaptation approaches, including engineering structures (Narayan et al., 2017; Reid et al., 2019). Our study also found that some interventions were cost-effective; however, we recommend detailed economic analysis to fully claim cost-effectiveness (Doswald et al., 2014; Reid et al., 2019). Doswald et al. (2014) also gathered evidences of EbA's potentiality to provide socio-economic and ecological co-benefits. Some scholars, however, warned the risk of dependency of rural poor population on EbA interventions (Doswald et al., 2014; Jones et al., 2012). Our study found that local communities, including vulnerable people, were involved during the planning and designing of adaption activities, but Ojha et al. (2016) cautioned that disadvantaged communities are often left out during decision making even though they are engaged in the planning process.

Unlike human vulnerability, which is relatively easier to measure, the impact on ecosystem services such as biodiversity through short period interventions is difficult (Seddon et al., 2020). Adaptation to climate change takes a long time to show impact; therefore, long term assessment is required to assess its effectiveness on ecosystem resilience (Doswald et al., 2014). Vulnerability assessment, tree and multi-purpose species plantation, soil and water conservation and promotion of forest-based activities were performed to restore ecological conditions in the study sites. Although these activities were recently implemented, our study found that it showed positive output to improve ecosystem services such as provisioning services (Mills et al., 2020). But, detail temporal analysis on different components of ecosystem is deemed necessary.

5.2. *Challenges for upscaling EbA*

First, conceptual clarity on EbA is lacking, it is loosely associated with bioengineering and other activities related with green activities such as plantation (Doswald et al., 2014). Our study also had similar findings regarding inadequate conceptual clarity. There are also similarities between the activities implemented by other adaptation approaches, such as CbA or community forestry. Other studies also reported no uniqueness at the activities level due to lack of conceptual clarity (Brink et al., 2016; Milman and Jagannathan, 2017; Munang et al., 2014a). It demands a clear need for national-level guidelines for piloting and upscaling EbA, bringing coherence in understanding and moving forward from the business as usual activities in EbA's name. EbA should be distinct from the "business as usual" scenario because it utilizes biodiversity and other ecosystem services to reduce people's vulnerability against climate change (Bertram et al., 2018). Activities implemented under EbA in Nepal also focus on ecosystem services; however, most activities are similar to normal development or other adaptation activities (Reid, 2016). EbA, in many cases, resembles CbA though they have conceptual differences. CbA focuses on community and their ability to adapt to climate change, which not necessarily focuses on ecological complexity, whereas EbA utilizes ecosystem services to support people for adaptation (Bürgi et al., 2017; Girot et al., 2012).

Furthermore, EbA received less priority, followed by weak institutional mechanisms, limited financial resources, and dependency on the donor, creating difficulties for upscaling EbA in Nepal (Reid, 2016). In most cases, EbA is implemented at a project-based model for a shorter

period, which raised concerns over its sustainability (Milman and Jagannathan, 2017). Although projects showed impressive results during the project period, most of the positive results vanished during the post-project period (Schipper, 2007).

5.3. Sustainability of EbA

The study findings showed that the EbA cannot be sustainable if there is a lack of government ownership and if not mainstreamed in policies and plans. Therefore, post-project monitoring and follow up from the concerned government's level is necessary for the sustainability of EbA interventions at the ground. Also, it requires integration with the governments' regular planning process. For example, CbA is mainstreamed in the regular government planning process and received the budget; EbA can take the opportunity by integrating with CbA (Regmi and Star, 2014). Also, Community Forest User Group (CFUG), grass-root institution mandated to manage local forest resources, prepare and implement adaptation plans; they can integrate EbA into their plans which ensure mobilizing CFUG's funding for EbA activities. For this, local people should be capacitated and assisted in integrating EbA in their existing plans (GON/UNDP, 2016). Therefore, EbA can be integrated with these institutions based upon suitability. Nepal has undergone governance reform with the presence of local government now. Thus, there is a pressing need to develop an institutional mechanism that can own, plan, coordinate, and monitor EbA and other climate change adaptation interventions at the local level. Local government can take leadership by incorporating EbA in their plan with separate budget. EbA covers a larger scale (landscape) that requires multi-sectoral co-ordination, which is lacking. It hindered EbA implementation and upscaling (Mills et al., 2020).

Through policy analysis, it is evident that EbA is considered as an essential tool to deal with climate change adaptation at the landscape approach. However, we found that learning from EbA in Nepal lacks wider sharing and dissemination. It is a reason why the government and other agencies are not aware of the successes of EbA. Literature also suggests that the contribution of EbA on policies or vice versa is limited (Doswald et al., 2014; Milman and Jagannathan, 2017). Furthermore, to highlight the contribution of ecosystem services for people's adaptation against climate change impacts and devise solutions, we need evidence and data (Morecroft et al., 2019). Analyzing EbA at a broader scale and observing study site, this study fulfills the gap by providing evidence and can be used to monitor and evaluate the impact of EbA in the future.

6. Conclusion

The study investigates the effectiveness of EbA and significantly examines the barriers to EbA upscaling, and provides policy feedbacks to institutionalize EbA approach in Nepal. EbA implementation results have shown the potentials of improving the people's livelihood and enhancing ecosystem services. However, despite these achievements, the EbA faced challenges of upscaling and difficulty for the more comprehensive extension. At present, EbA is mostly focused on a small scale and implemented with a fixed time frame with external assistance, which hinders the availability of technical and financial support required to make EbA successful and sustainable. Due to the lack of priority and ownership, EbA is not internalized and mainstreamed in Nepal's government's regular development policies and plans. EbA's success rests on the stakeholders, including the government's interest and acceptability to allocate resources and prioritize their forest and biodiversity management strategies and action plans. Awareness-raising, sensitization, and capacity building are necessary to make a common understanding among stakeholders about EbA.

Disclaimer

The views and interpretations in this publication are those of the author's and they are not necessarily attributable to their organizations.

Author statement

Sushma Bhattarai and Bimal Raj Regmi conceptualize and design the study. Sushma Bhattarai and Basant Pant collected and analyzed the data. Sushma Bhattarai wrote manuscript and Bimal Raj Regmi, Basant Pant, Dharam Upreti, and Tek Maraseni reviewed and provided inputs.

CRediT authorship contribution statement

Sushma Bhattarai, Bimal Raj Regmi: Conceptualize and design the study. **Sushma Bhattarai, Basant Pant**: Collected and analyzed the data. **Sushma Bhattarai, Bimal Raj Regmi, Basant Pant, Dharam Upreti, Tek Maraseni**: Wrote, reviewed and finalized the manuscript.

Declaration of Competing Interest

The authors declare no conflict of interest.

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