

Ecosystem-based Adaptation Planning in the Panchase Mountain Ecological Region

Preliminary lessons learned from ecosystem-based adaptation planning at sub-watershed level in a mountainous area



Jaeyoon Park

Mozaharul Alam

Jaeyoon Park and Mozaharul Alam

Abstract: As part of numerous efforts on adapting to climate change in Nepal, an approach of Ecosystem-based Adaptation (EbA) is being demonstrated in the Panchase Mountain Ecological Region (PMER). Partners under the project entitled Ecosystem-based Adaptation in Mountain Ecosystems in Nepal have been implementing activities to reduce vulnerability of the PMER to climate change and enhance resilient capacity of communities and ecosystems in the region to cope with adverse impacts of climate change already being witnessed. This article places focus on the process of EbA planning and preliminary lessons learned through the project activities in particular at local and ecological level. Reflection and suggestion on EbA planning presented in the article is expected to help all stakeholders in the Himalayan region and beyond design and implement future climate change adaptation activities to be more effective and efficient while empowering local communities and ensuring social, economic and environmental sustainability.

Keywords: Ecosystem-based Adaptation, EbA, Adaptation planning, Panchase, Climate change in mountain, Nepal

Broad Context

Nepal is setting the scene of becoming a country featured by sustainable development although slowed by many factors – both internal and external. A number of indicators including Human Development Index, Gender Inequality Index, primary/secondary school enrollment and health show that the country is slowly but steadily improving its social condition (UNDP and World Bank: see weblink in reference). Nepal's economy, strongly backed by agriculture and remittances, is also growing although fluctuating much year by year (GoN 2014). Nepal has already met or will meet by the end of 2015 most of its Millennium Development Goals including halving extreme poverty (from 42 percent in 1990 to 23.8 percent in 2013) (GoN and UNDP 2013). The Government of Nepal put forward an ambitious goal of graduating from Least Development Country (LDC) status by 2022 (GoN 2013). Environment – another pillar of sustainable development – has gained attention but still depends much on foreign development assistance. More internalization and institutionalization is required now that the country is set to grow further fueled by potential political stabilization marked by the long delayed assembly election in 2013.

Despite Nepal's steady improvement, its socio-economic development is fragile to many factors. Its political instability – in spite of the election successfully run in 2013 – is a major internal constraint that oftentimes delays swift decision-making, as a result, disables to adapt to rapidly changing circumstances. High economic dependency on agriculture is to a great extent affected by seasonal weather and associated water availability. Natural disasters such as the earthquake in 2015 can hugely compromise its advancement due to insufficient readiness such as poor infrastructure and government's low-level of capacity to cope with them.

Climate change poses a great risk to people's lives and livelihood in Nepal. A number of climate vulnerability indices have shown that Nepal is one of the most climate-vulnerable countries worldwide

(Maplecroft 2011; Kreft, Eckstein et al 2015; TERI 2015). The economic loss induced by climate change is estimated to be about 2.2 percent of annual GDP by 2050 and soar up to near 10 percent by the end of the century (Ahmed and Suphachalasai 2014). The country's dependency on agriculture – consisting of nearly one third of its annual GDP and two third of the population employed in this sector (GoN 2013) – renders the country more fragile to climate change, particularly in rural mountainous areas. It is aggravated by insufficient basic infrastructure – electricity, water supply, roads, disaster protection, and so on –, limited planning capacity to cope with changes, and low level of awareness of climate change.

At global and regional levels, Nepal has advocated for international cooperation as well as assistance to tackle climate change which defies national borders. At its 20th Conference of the Parties (COP20) under the United Nations Framework Convention on Climate Change (UNFCCC), Vice Chairman of National Planning Commission – who headed delegations of Nepal as well as the Least Development Country Group and the South Asian Association for Regional Cooperation – called upon international community to reach a timely and ambitious post-2020 legal agreement at COP21 in 2015. He also urged Parties to develop a special work programme on mountains in a bid to reduce vulnerability and associated loss and damage. At regional level, Nepal, as a member of SAARC, facilitated Kathmandu Declaration in 2014 on enhanced cooperation on climate change and rapid response to natural disasters among other areas (SAARC 2014).

At national level, the Government of Nepal has established the Climate Change Management Division in the Ministry of Science, Technology and Environment (MoSTE) in 2010. The ministry prepared the National Adaptation Programme of Action (NAPA) to Climate Change in 2010 and developed Local Adaptation Plan of Action (LAPA) to support local level adaptation. Moreover, it has developed Climate Change Policy approved in 2011

with the main goals of improving people's livelihoods by mitigating and adapting to adverse impacts of climate change, adopting a low-carbon socio-economic development path, and supporting and collaborating in the spirits of country's commitments to national and international agreements related to climate change. One of the strong points in the policy is to allocate at least 80 percent of available funds for field-level climate change activities (GoN 2011).

Panchase Mountain Ecological Region

Straddling the three districts – Kaski, Syangja and Parbat in western Nepal, the Panchase Mountain Ecological Region (PMER) has been identified as vulnerable to climate change with its negative impacts on water resources, agriculture, biodiversity, and soil conservation among others. The climate change vulnerability mapping of Nepal confirmed vulnerability of the PMER to climate change (GoN 2010). In addition, a study undertaken by Ministry of Forest and Soil Conservation (MoFSC) found that wetland and aquatic ecosystems are fragile to changes triggered by climate change (Regmi; et al 2009), consequently affecting agricultural productivity, flora and fauna, availability of natural resources – including drinking water. These negative impacts will most likely put economically and socially marginalized people in the region in a direr situation with reduced livelihood outputs, insufficient basic ecosystem services and threatening natural disasters. Communities in the PMER are already experiencing water scarcity for drinking and agricultural use, erratic rain patterns, and infestation of insects and pests. Meanwhile, the PMER is considered as a region of national and international significance as Harpan Khola watershed feeding into Phewa Lake has been proposed as a Ramsar site.

Numerous efforts have been made to increase resilience of ecosystem and communities in the PMER by many institutions. Among others, the United Nations Environment Programme (UNEP), in partnership with the United Nations Development Programme (UNDP) and the International Union for Nature Conservation (IUCN) and financial support from the Government of Germany, has been supporting MoFSC to enhance ability of decision-makers at national and local levels to plan and implement an Ecosystem-based Adaptation (EbA) approach in the PMER under the project entitled the Ecosystem-based Adaptation in Mountain Ecosystems in Nepal (EbA-Nepal). It is part of the global programme initiated by UNEP and has been piloting in three countries: Peru, Uganda and Nepal.

Key criteria for the selection of the PMER as a project site were as follows (GoN 2012):

- 1 Ecosystem and associated services are vulnerable to climate change;
- 2 Local people's well-being is highly dependent on ecosystem services and goods;
- 3 Options of ecosystem-based adaptation are available and favored by local people;
- 4 Partners at different levels are ready to implement

- available options and institutional capacity is available to make the case at field level;
- 5 Potential scale-up and replication of the project is possible.

Impacts of Climate Change in PMER

Temperature and Precipitation

Climate change has been observed in many ways. Although insufficient data for more rigorous analyses in many cases, many studies including the one by the Department of Hydrology and Meteorology of Nepal indicate that there is no doubt about an increase in the mean temperature over the country since 1970s and even before (Dixit, A. et al 2015). NAPA found that an annual rate of 0.06 degree Celsius was observed with high variability across the country (MoE 2010). The seasonal variation and intensity in precipitation has increased as the overall precipitation has remained similar. As a result, an increased number of extreme weather events including floods, drought, landslides and glacier lake outburst floods have been reported since the 1930s (MoE 2010). Due to a limited number of climate monitoring stations in the PMER, the temperature trend in the PMER can only be extrapolated by other proxy indicators obtained at stations around the PMER such as one in Pokhara area. Historical data show a steady increase in temperature in both winter and summer in the PMER. Precipitation was analyzed based on data recorded in the three districts in the PMER and it does not show any discernable trends except some delay in both onset and withdrawal of summer monsoons by a few days (Dixit, A. et al 2015; Gautam and Regmi 2013).

Projection

A number of climate projections at national level were developed based on Global Circulation Model with various timeframes. Most of them commonly predict that temperature would increase and precipitation would become more erratic. The mean temperature rise in Nepal is estimated in the range of two to six degree Celsius by the end of the century. The overall amount of rainfall is projected to increase throughout the country but with less confidence (NCVST 2009; McSweeney, New and Lizcano 2010). More precipitation in pre-monsoon and monsoon seasons and less in winters are also predicted (Bartlett, Bharati et al 2010). In the PMER, similar trends in temperature and precipitation are projected but with a more increased mean temperature and pronounced seasonal variation in precipitation (NCVST 2009).

Climate Change Impacts in Sectors

Analyzing impacts of climate change in specific sectors is a very complex process. Such studies in the PMER are limited and not readily available. As part of the EbA-Nepal project, Institute for Social and Environmental Transition of Nepal (ISET-N) carried out survey at Village Development Committee (VDC) level in the PMER. It offers a good basis for deriving meaningful assessment of sectoral impacts

of climate change when no quantifiable data are available. The most pronounced impact perceived by local communities is on agricultural production. Almost all 17 VDCs within the PMER witnessed a decrease in agricultural productivity. They also reported increased incidences of pests and diseases, which is likely to contribute partly to the decrease in agricultural productivity. Respondents said water availability had been reduced with fluctuation of time distribution of flow. Some other major changes include shift in wildlife and plant habitats which contributes to loss of biotic interaction in habitats and consequently leading to deprivation of ecosystem goods services (Dixit, A. et al 2015).

When asked about perception on current vulnerability of various sectors or ecosystem services, local people highlighted, similarly to the above, the vulnerability of drinking water and agricultural productivity to climate change (Dixit, A. et al 2015). As perception on current vulnerability could be possibly formed by witness or experiences of past changes, this once again would confirm that agricultural productivity and shrinking drinking water have been the most prominent impacts of climate change in the PMER.

Vulnerability of PMER

Assessing vulnerability is the first step to devising EbA measures. Many definitions and attempts to quantify vulnerability exist, however no agreement on the set of indicators to do so has reached yet. IPCC's Fourth Assessment Report in 2007 used the term of vulnerability as 'a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity'. Starting from this, the EbA-Nepal project established a set of indicators for vulnerability to climate change through the work carried out by ISET-N. A total of 32 indicators – 8 on exposure, 8 on sensitivity, and 16 on adaptive capacity – were selected through reviewing global literature and in consultation with local stakeholders. All indicators were weighed equally to have numerical value between -1 to 1. To improve visualization, values were sectionalized into five groups – very low, low, moderate, high and very high, respectively (Dixit, A. et al 2015).



Figure 1: Vulnerability categories at sub-watershed level
(Excerpt from Dixit, Karki and Shukla 2015)

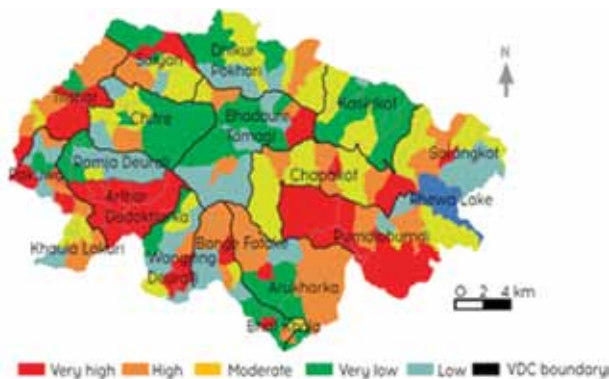


Figure 2: Vulnerability categories at ward level
(Excerpt from Dixit, Karki and Shukla 2015)

Maps of vulnerability to climate change at different levels, depicted in Figure 1 and 2 below, provide a useful basis for planning EbA measures and prioritizing locations for immediate interventions. Vulnerability at sub-watershed level – which resulted from a sum of vulnerability of wards falling within the given sub-watershed – will then be used for EbA planning (see the following sections). Andheri Khola sub-watershed was assessed as most vulnerable in the PMER. Most people in this sub-watershed are dependent on rain for their agriculture without irrigation facilities and are highly exposed to natural disasters (Dixit 2015).

EbA Approach

Among a number of different definitions of EbA approach, UNEP defines it as follows:

'The use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people and communities adapt to the negative effects of climate change at local, national, regional and global levels.'

Other definitions or terms in common use by the Convention of Biological Diversity (CBD), UNFCCC and IUCN are very close to the above definition, stressing the importance of taking account of biodiversity and ecosystem in designing policies, strategies and plans to cope with climate change. The PMER, rich in biodiversity and ecosystem services on which local communities' livelihood highly depends, is an excellent location to demonstrate multiple benefits of EbA approach. The approach is applied to the PMER but capacity for EbA planning should be developed at all levels. This is because a plan is effective only when relative plans at different levels ranging from grass-root to central government are aligned, well-connected, and closely communicated and managed. The EbA-Nepal project has been designed to involve not only central line ministries but also planners at district and village levels. It was set to support all key stakeholders to fully understand EbA approach and to be capacitated to take it further with ownership of local communities.

Planning for Adaptation

The EbA approach places ecosystem in the center of planning process. Planning for EbA

should therefore be carried out within boundaries of ecosystem characteristics. Since ecosystem rarely follows human-made borders, stakeholders for planning should be identified based on ecological boundaries. The PMER can be divided into 13 sub-watershed areas, each of which cuts across one or more VDCs (Orlang sub-watershed and others: one VDC and Rati sub-watershed: five VDCs). In order to make the planning more inclusive and meaningful, its process should include not only VDCs comprising of each sub-watershed but also other stakeholders such as district line agencies – particularly Forest Office, Soil Conservation Office, Agriculture Development Office, and Livestock Services Office –, Community Groups such as Community Forest User Groups, Farmers Groups, Women Groups and Youth Groups. An inclusive planning process will foster ownership and ensure that implementation at a later stage will be carried out more effectively with a high level of acceptance by local communities. The following table -1 shows a proposed list of key stakeholders for an EbA planning at a sub-watershed level in the PMER. It can be used as a basis for composing key stakeholders when designing similar activities in other areas.

Number of participants	Stakeholders for EbA Planning
4	District line agencies (under respective ministries) representatives
	1 Forest Office
	1 Soil Conservation Office
	1 Agriculture Development Office
	1 Livestock Services Office
8-12	1 Representative from VDC
	6-10 Representatives from vulnerable wards
	1 Representative from Protected Forest Management Programme (in the PMER)
5-8	1 Representative from Community Forest User Groups
	2-3 Local NGOs
	2-4 Community groups – such as teachers, women, youth, farmers etc.

Table 1: Proposed stakeholder composition for EbA planning at a sub-watershed level

The exact number of stakeholders is to be determined based on needs and availability. As for representatives from vulnerable wards, they can be selected in consultation with VDC Secretariats to invite people from the most vulnerable wards within VDCs at a given sub-watershed. Assessment results such as the vulnerability map at ward level above can also play an instrumental role in prioritizing vulnerable wards. It is advised to keep in mind that the total number of participants should not exceed 25 to make EbA planning effective.

Capacity Building

It is imperative that institutions and individuals are able to understand concept and benefits of EbA approach and recognize ways to integrate EbA into regular development planning processes. Only with

their sufficient capacity, can integration of EbA occur and be maintained. As the concept of EbA is relatively new (although some practices are being exercised indigenously without notion of EbA), it is recommended that capacity be developed at all levels – from national to local level. National level policy-makers need to understand socio-economic benefits accrued by adopting EbA approach and produce guidance for policy direction both at central and local levels. At district level, planners are to review steps for their development planning and identify possible entry points of EbA integration. It should be done in line with central level policies and in coordination with VDCs. VDCs, the lowest administrative level in Nepal, are expected to plan and implement EbA options and recommendations from EbA planning meetings such as EbA planning meetings at sub-watershed in the PMER. Raising awareness of EbA at wards level is equally important for people on the ground to understand benefits and meaning of EbA.

Case Study of EbA Planning in the PMER

This section is largely based on excerpting and summarizing the work carried out by Dixit, Karki and Shukla 2015, as part of the EbA-Nepal project in an attempt to show readers an example of EbA planning at sub-watershed level.

The EbA-Nepal project helps local communities in the PMER to understand complex linkages of ecosystems and their goods and services on which communities depend, become aware of ecosystems' vulnerability to climate change, and identify EbA options to reduce the vulnerability of and further impacts on their livelihoods. Planning meetings for EbA are being carried out until the end of the project cycle – December 2015. According to the vulnerability assessment of the PMER to climate change, Andheri Khola sub-watershed is the most vulnerable to climate change. An EbA planning meeting was organized in Bhat Khola VDC for Andheri Khola sub-watershed in 2014. Fifteen participants from the three VDCs within the sub-watershed (Bhat Khola, Bange Fatake and Aarukharka) including VDC representatives, community groups, representatives of community-based organizations, and teachers among others were in attendance for an initial dialogue. VDC representatives attended in a back-to-back meeting to identify EbA options for building resilience and potential implementing agents. Additionally, participants from Syangja district and PMER regional levels took part.

During the EbA planning meeting, the following were carried out:

- a) Share the results of the vulnerability assessment and the preliminary adaptation options identified at ward, VDC and sub-watershed levels;
- b) Develop a climate scenario for 2030;
- c) Identify most critical ecological and social systems;
- d) Envision changes in the socio-economic context; and
- e) Identify options for EbA and agents to implement.

Issues	Future scenario		Resilience Strategies
	Rainfall	Temperature	
Soil conservation, land degradation, and water availability	<ul style="list-style-type: none"> - Extreme rainfall and hailstorms damaging crops - Extreme rainfall events accelerating soil erosion and occurrence of landslides, further aggravating land degradation 	<ul style="list-style-type: none"> - Higher temperature increases evaporation rates, drying of small water sources in the dry season - Increase in instances crop pests and diseases 	<ul style="list-style-type: none"> - Revitalizing the use of fallow and degraded land by planting vegetation with a comparative advantage, such as citrus fruit trees or coffee plants - Use of agricultural technologies such as drip and sprinkler irrigation to improve water-use efficiency - Promotion of bio-engineering for river training and bank protection - Rehabilitation of degraded land and soil fertility restoration through conservation of existing ponds
Unemployment of youth and low skills	<ul style="list-style-type: none"> - Economic return from farming will decrease due to erratic rainfall and disasters 	<ul style="list-style-type: none"> - Temperature rise will reduce labor output due to increased incidences of diseases and sickness 	<ul style="list-style-type: none"> - Skill-based training to develop entrepreneurship and employment - Enhanced connections with micro-finance institutions to increase access to credit for income generating activities to pursue technological innovation, new knowledge managerial capacity and add to product value chain - Enhanced skills to transform current agricultural systems and practices from a subsistence to a remunerative approach
Low level of awareness	<ul style="list-style-type: none"> - Increased occurrence of extreme rainfall events will further limit people's mobility and access to knowledge and skill development 	<ul style="list-style-type: none"> - Temperature rise will make local living more uncomfortable and people will migrate to cities but with lower advantage of indigenous knowledge and skill 	<ul style="list-style-type: none"> - Initiation and continuity of awareness programs targeted at changing social stereotypes (such as superstition and other social evils) - Emphasis on gender inclusion in designing and implementing awareness and skill development programs - Increase disseminating information on future impacts
Biodiversity and ecosystem	<ul style="list-style-type: none"> - Extreme rainfall events and more incidences of landslides and mass wasting may accelerate the degradation of ecosystems and biodiversity loss 	<ul style="list-style-type: none"> - Higher temperature could create favourable conditions for forest fire and habitat destruction 	<ul style="list-style-type: none"> - Inventory and ethno-botanical studies of medicinal herbs and plants as first step towards their conservation - Developing and implementing strategies to control forest fires

Table 2: EbA options in Andheri Khola sub-watershed (excerpt from Dixit, Karki and Shukla 2015)



Figure 3: Located EbA options in Andheri Khola sub-watershed (excerpt from Dixit, Karki and Shukla 2015)

Participants for Andheri sub-watershed identified land, forest and water as the three key ecosystems that are vulnerable to climate change. It was argued that

increased incidences of unregulated and haphazard construction that do not consider sensibility of local ecosystems exacerbate landslides, flooding and soil conservation. Also, unregulated extraction of forest products – grass, timber, and firewood – would make forest ecosystem vulnerable. For key social systems, they were concerned most about economic status, social harmony and education/awareness. They reasoned that skewed landholding and lack of local level employment opportunities render their economic system vulnerable to future climate change.

Through collective work, the participants deliberated on and ranked the most appropriate EbA options that would reduce identified vulnerability. They additionally located the options to be implemented in the sub-watershed. The Table 2 below describes EbA options identified vis-à-vis critical socio-ecologic issues in the sub-watershed. The Figure 3 below depicts tentative locations of some of the resilience options in Andheri sub-watershed.

Preliminary Lessons Learned and Reflection

The EbA-Nepal project offers a set of preliminary lessons and provides a basis for further reflection for an effective and efficient EbA planning at local and ecological levels. More comprehensive lessons and recommendations will be made available once

the project comes to the end in December 2015. The following can be served as useful consideration when designing activities related to EbA planning or similar activities at various levels. Different circumstances and setting, of course, need to be taken into account in each and every case. These reflection points may, however, provide some basic insight and baseline consideration for designing and implementing a successful adaptation project.

- **Ecological boundary:** EbA planning should be conducted placing basic ecological characteristics and boundaries in the center, not administrative ones. Ecosystems are inter-connected in a very complicated manner but this has yet to be fully understood. For example, changes in upstream of a waterbody would significantly affect downstream. Planning at both upstream and downstream should therefore not be separate. So, it is advised that an appropriate target should be selected based on ecological boundaries or specific characteristics ecosystems to achieve holistic adaptation plans.
- **Capacity at all levels:** In a bid to elicit meaningful results of EbA approach, concept and benefits of EbA must be understood at all levels ranging from lowest administrative unit to central government. An ecological area falls within or cuts across, partially or entirely, various administrative levels and layers. Hence, level of understanding of EbA at different levels will tremendously affect the effectiveness and functioning of EbA measures. It is recommended that key materials and messages be translated into local language to ensure capacity is properly built, in particular, at local level. However, the messages should be kept simple and concise for effective communication. It is also important that awareness of local communities about vulnerability to climate change and EbA benefits be raised.
- **Inclusiveness:** All key stakeholders should take part in EbA planning processes. Key stakeholders may include, in Nepal's cases, officials in charge of development planning in VDCs, district line agencies under various key ministries, representatives from related programmes or projects (Protected Forest Management Programme in the PMER case), representatives from different community-based organizations and groups, people from wards – particularly from wards that are the most vulnerable to climate change. These can be identified by VDC Secretariat based on vulnerable impact assessment at ward level, if available. It will ensure that EbA options are identified in a transparent and participatory manner and make sure that communities have ownership of the plans and activities. A tentative list of key stakeholders in the PMER for EbA

planning was proposed in Table 1 above. In addition this will contribute to the sustainability of EbA approach by enhancing local people's knowledge and capacity to plan in future.

- **Partnership and coordination:** A number of small and big projects and activities are being implemented in many parts of Nepal. To create synergy out of various initiatives and to avoid fragmented efforts and resources, it is advised to foster maximum collaboration among different actors. Combining similar activities through partnership can reduce duplication and ineffective spending of limited resources. Stakeholders from central ministries to local communities may experience development-aid fatigue if activities continue to be conducted in a fragmented way. Coordination is equally important to ensure effectiveness and efficiency especially when it comes to partnership and collaboration.
- **Sustainability:** Projects and activities should pave the way toward long-term impacts through community empowerment and ownership. Mid- and long-term monitoring and evaluation framework should be established during the project or activity cycles. Likewise, enhanced capacity of national and local stakeholders is imperative for them to take benefits of the projects beyond projects' cycle and meaningfully incorporate it into their daily lives. In the meantime, development agencies, external partners and local organizations should make sure that any upcoming activities will be built on the projects and activities that were conducted in the past or are currently being implemented. This will both optimize their resources and maximize benefits to local communities. It is, therefore, recommended that sustainability strategy be developed before the end of cycle of any given projects or activities.

Conclusion

Adapting to climate change is already occurring as a means to survive at community level regardless degree of readiness of central and local authorities. Even a successful outcome of COP21 in Paris in 2015 may not lessen burdens of local communities to adapt to on-going climate change impacts being witnessed in their everyday lives, at least in short- and mid-terms. The way in which these inevitable adaptation efforts can be more socially-equitable, environmentally-sustainable, scientifically-sound, and cost-effective is to provide all stakeholders with freedom to choose whatever would be the best in their circumstances and empower them to plan their future lives to be more resilient. This process, however, should be undertaken with maximum information and knowledge made available. EbA is one of the adaptation and resilience options. Through the EbA-Nepal project, partners have been trying to demonstrate benefits of EbA

approach so that local communities can adapt to climate change more effectively and efficiently. It has enhanced and is still improving capacity of stakeholders at national and local levels to make them able to identify feasible options and develop their resilient plans in a participatory, transparent and community-led manner based on vulnerability assessed at VDC, ward and sub-watershed levels.

Projects and activities in future that are related to climate change or further socio-economic development should build on activities that were conducted in the past or are being implemented – such as the EbA-Nepal project – in an attempt to have all efforts and resources deployed in the country and local areas maximally optimized. At the same time, all projects and activities should produce sustainability strategy before the end of their cycles to ensure lessons learned are utilized and benefits are maintained. UNEP is scaling up EbA in Nepal through other EbA projects supported through Least Developed Country Fund (LDCF) and Special Climate Change Fund (SCCF), both under the Global Environment Facility (GEF). These are a) catalyzing ecosystem restoration for resilient natural capital and rural livelihoods in degraded forests and rangelands of Nepal, b) ecosystem-based adaptation for climate-resilient development in the Kathmandu Valley, Nepal, and c) enhancing capacity, knowledge and technology support to build climate resilience of vulnerable developing countries. Nepal is also one of the UN-REDD programme countries jointly implemented by the Food and Agriculture Organization (FAO), UNDP and UNEP. Its current support focuses on economic valuation of avoided deforestation.

The Himalayan region in general should take advantage of the lessons learned from the EbA-Nepal project and others. Ecosystem-based adaptation will provide the Himalayan region with great opportunities for reducing vulnerability to climate change and enhancing resilience of communities and ecosystems in the region while keeping its unique ecological characteristics and beauty intact for the current and future generations.

--

Jaeyoon Park is currently working at the United Nations Environment Programme (UNEP) Regional Office for Asia Pacific in Bangkok, Thailand as a Programme Officer. He obtained his Master's Degree on environmental engineering from the Ecole Nationale Supérieure des Mines de Paris (Mines Paris Tech) in France. He has seven years of professional experiences with a focus on climate change adaptation and water management.

In Nepal, he promotes Ecosystem-based Adaptation (EbA) to climate change in Panchase area through developing methodologies and tools and enhancing capacity of integrating EbA into planning in collaboration with partners in the country. He also plays an instrumental role in running the Myanmar Climate Change Alliance which has been

designed to help Myanmar primarily develop its National Climate Change Strategy and Action Plans. At regional level, he assists in mobilizing knowledge and building capacity for climate resilience and sustainable water management through various activities such as the Asia Pacific Adaptation Network. His expertise extends further to the African region with similar activities. Prior to joining UNEP, he worked as a research engineer at Veolia Environnement conducting research and producing industrial solutions with regard to wastewater treatment and sludge management.

Corresponding address: jaeyoon.park@unep.org

Mozaharul Alam has obtained his M. Sc. degree in Geography in 1989 from Jahangirnagar University in Bangladesh. He joined Bangladesh Centre for Advanced Studies (BCAS) in 1992 as researcher. He served the Ministry of Environment and Forests, Government of Bangladesh as National Project Coordinator to formulate National Adaptation Programme of Action (NAPA). He joined the United Nations Environment Programme (UNEP) in 2009 as Regional Climate Change Coordinator for the Asia Pacific region. He is responsible for supporting development and implementation of climate change related projects in the Asia Pacific region. His areas of specialization are in adaptation and mitigation to climate change, integrating climate change into development planning and international negotiations. He has attended climate change negotiations more than a decade and coordinated adaptation group of G77 and China during 2007 to 2009. He has experiences working with multidisciplinary team of experts as coordinator and team leader for several climate change adaptation and mitigation projects. He has worked as Lead Author for Working Group II for IPCC Fifth Assessment Report. He has also received an international fellowship award by International Institute for Environment and Development (IIED) under Climate Change Programme for three years in 2006.

References

- Ahmed, M. and Suphachalasai, S., 2014, Assessing the costs of climate change and adaptation in South Asia, Mandaluyong City, Philippines: Asian Development Bank (ADB).
- Bartlett, R., Bharati, L., Pant, D., Hosterman, H. and McCornick, P., 2010, *Climate change impacts and adaptation in Nepal*, IWMI Working Paper 139, 35, Colombo, Sri Lanka: International Water Management Institute (IWMI).
- Dixit, A., 2015, *Ecosystem based climate adaptation planning at sub-watershed level of Panchase mountain ecological region, Nepal*, Kathmandu, Nepal: Institute for Social and Environmental Transition-Nepal (ISET-N).
- Dixit, A., Karki, M. and Shukla, A., 2015, *Vulnerability and impacts assessment for adaptation planning in Panchase Mountain Ecological Region, Nepal*,

- Kathmandu, Nepal: Institute for Social and Environmental Transition-Nepal (ISET-N).
- Gautam, D.K. and Regmi, S.K., 2013, Recent trends in the onset and withdrawal of summer monsoon over Nepal, *ECOPERSIA*. 1 (4): 353-367.
- GoN (Government of Nepal), 2010, *Climate change vulnerability mapping for Nepal*, Ministry of Environment.
- GoN (Government of Nepal), 2011, *Climate change policy 2011*, Ministry of Environment.
- GoN (Government of Nepal), 2012, *Project document for ecosystem-based adaptation in mountain ecosystems in Nepal*, Ministry of Forests and Soil Conservation.
- GoN (Government of Nepal), 2013, *Approach paper to the 13th plan (FY 2013/14-2015/16)*, National Planning Commission.
- GoN (Government of Nepal), 2013, *Statistical information on Nepalese agriculture 2012/2013*, Agribusiness Promotion and Statistics Division: Ministry of Agricultural Development.
- GoN (Government of Nepal), 2014, *National account of Nepal 2014 press release*, Central Bureau of Statistics.
- GoN (Government of Nepal) and UNDP, 2013, *Nepal millennium development goal progress report 2013*.
- Kreft, S., Eckstein, D., Junghans, L., Kerestan, C. and Hagen, U., 2015, *Global climate risk index 2015*, Germanwatch e.V.
- Maplecroft, 2011, *Climate change risk atlas 2011*, Bath, UK: Maplecroft.
- McSweeney, C., New, M. and Lizcano, G., 2010, *UNDP climate change country profiles: Nepal*.
- MoE (Ministry of Environment of Nepal), 2010, *National adaptation programme of action to climate change*.
- NCVST (Nepal Climate Vulnerability Study Team), 2009, *Vulnerability through the eyes of vulnerable: Climate change induced uncertainties and Nepal's development predicaments*, Kathmandu and Boulder, Colorado: Institute for Social and Environmental Transition-Nepal (ISET-N) and ISET for Nepal Climate Vulnerability Study Team.
- Regmi, B.R., Thapa, L., Suwal, R., Khadka, S., Sharma, G.B., Tamang, B.B., 2009, *Agro- biodiversity management: An opportunity for mainstreaming community-based adaptation to climate change*.
- SAARC (South Asian Association for Regional Cooperation), 2014, *Kathmandu declaration, the 18th Summit of SAARC*.
- TERI (The Energy and Resources Institute), 2015, *Global sustainable development report 2015: Climate Change and Sustainable Development: Assessing Progress of Regions and Countries*.
- UNDP, Gender Inequality Index trends, 2000-2013, link: <http://hdr.undp.org/en/content/gender-inequality-index>
- UNDP, Human Development Index trends, 1980-2013, link: <http://hdr.undp.org/en/content/table-2-human-development-index-trends-1980-2013>
- World Bank, General analysis with data from the World Bank, link: <http://data.worldbank.org/country/nepal>