

Climate change adaptation governance in Nepal: a framework for sustainable generation of adaptation services

G. Karki^{1*}, B. Bhatta¹, N. R. Devkota² and R. M. Kunwar³

Received : 22, August, 2021 Revised : 25, November, 2021 Accepted : 23, December, 2021 Published : 31, December, 2021

Poverty and high dependency of rural and mountainous households on the natural resources of Nepal have made the country more vulnerable to climate change. On the other hand, there is inadequacy of adaptation services provided to the vulnerable households and ecosystems. Responding to climate change necessitates a more consolidated effort and effective implementation interventions from both the government and non-government actors. To help achieve this very essence, this study has aimed to— (i) review the existing climate change adaptation (CCA) practices, processes and patterns of sustainable resource mobilization and benefit sharing, and (ii) develop a framework that ensures sustainability of resources and equitable sharing of services and benefits accrued from CCA. Consultations with the communities, key state and non-state stakeholders both at federal and provincial levels, reviews of national policies, strategies, periodic plans and programs and field visits were carried out to synthesize the information, document the knowledge, and highlight the gaps pertaining to CCA. Qualitative Content Analysis (QCA) was executed for analyzing qualitative information. Recently, the Government of Nepal has developed a priority framework on sustainable resource management and delivery of adaptation services. In line with the eight themes identified by the National Climate Change Policy (NCCP, 2019), the proposed framework has paid central attention on medium and long-term adaptation planning adhered with Ecosystem-based Adaptation (EbA) and Community-based Adaptation (CbA). Building resilience, reducing vulnerability, increasing capacities, enabling environment, and integrating CCA in development planning have been the focus of the framework. It is found that the delivery of adaptation services to the climate vulnerable groups and poor communities is well reached out through CbA and EbA approaches. It is therefore, crucial in strengthening community- and locally-based mechanisms (such as forest-user groups, farmers groups, agricultural and fisheries cooperatives, and community networks) for sustainable management and delivery of services to facilitate effective adaptation.

Keywords: Adaptation service, benefit sharing, climate change, EbA, sustainable resources.

Nepal began systematic climate change adaptation (CCA) planning after the initiative of the United Nations Framework Convention on Climate Change (UNFCCC) in 2001 as the COP7 (decision 1/CP.

7) decided to formulate and implement National Adaptation Program of Action (NAPA) in the Least Developed Countries (LDCs), and established the Least Developed Countries (LDC) fund, Special Climate Change Fund (SCCF), and Adaptation

1 Agriculture and Forestry University, Bharatpur, Nepal. *E-mail: gyanendra.karki@icdpi.org

2 Gandaki University, Pokhara, Nepal

3 Food and Agriculture Organization of the United Nations, Kathmandu, Nepal

Fund (AF). The Millennium Development Goals (2001), 10th Periodic Development Plan (2002–2006), Sustainable Development Agenda (2003), and Poverty Reduction Strategy Paper (2003) are the entry-level protocols for addressing climate change issues in Nepal. Since 2002, the Government of Nepal recognized climate change as an emerging issue when the 10th Plan (2002–2007) aimed at working the influence of weather on national economy (Agrawal *et al.*, 2003). The plan accompanied by Medium-Term Expenditure Framework (MTEF) paper for the agriculture sector paid attention to curb climate-related risks. The First National Communication (NATCOM-1) Report to the UNFCCC (2004) provided an overview of the national circumstances that reflects Nepal's capacity to respond to climate issues. The National Capacity Need Self-Assessment (NCSA) (2008) accounted a report to jointly implement multilateral environmental agreements (MoEST, 2008), and came up with the challenges of climate change. These initiatives may advocate changes in practices and technologies, diversification of livelihood systems, and reconfiguring resource allocation and collective actions to access services, resources or markets as climate change actions (NCVST, 2009).

Adaptation to climate change has gained a prominent place on global, national, and local policy agendas only after 2010 (Swart *et al.*, 2014). Nepal prepared National Adaptation Program of Action (NAPA) in September 2010 with documentation of national climate change vulnerability and measures to identify the immediate and urgent CCA needs and priorities. The REDD Readiness Preparation Proposal (2010), National Framework on LAPA (2011), and Climate Change Policy (2011) were some other key strategic moves towards advancement of CCA (Regmi & Karki, 2010). While proceeding, the Nepal National Adaptation Plan (NAP) process started in 2015 complements the mission that enables achieving sustainable development goals (SDG 2030) and CCA together (Karki *et al.*, 2017). The Government of Nepal has endorsed the National Climate Change Policy (NCCP) (2019) that aims to contribute to the nation's socio-economic prosperity by building a climate-

resilient society. Sustainability of resources and equitability in sharing the benefits and services are envisioned in the NCCP.

Significance of the study

Translating policies and protocols into actions requires enhancing the knowledge through scientific investigation, understanding the task, implementing the efficient and acceptable measures, generating the resources, fair sharing the benefits and building ownership through development programs. However, the mechanism for CCA resource management and benefit sharing in Nepal is hitherto unknown. The research on climate change and adaptation rendering implications to the national-level strategic way forwards for sustainable development and building resilience and adaptive capacity in Nepal are limited (Gentle *et al.*, 2018). The current climate change research agendas are consequence focused, not the cause, drivers and options based (Kunwar, 2020). It should also be equally relevant to address the "uncertainties" and "surprises" (Karki *et al.*, 2020) that arise from future climate change and its impacts, and pave the way forward that balances the adaptation services and benefits (Schneider & Kuntz-Duriseti, 2002). In this regard, this study, through the review, consultation and assessment of available adaptation services and needs, aims at developing a framework on 'how and where the adaptation services are generated, and what could be the best vehicle to distribute those adaptation services to the most vulnerable systems and households while giving due focus on sustainability of resources and equability of benefits and services.

Materials and methods

Study sites

The fieldwork for this study was conducted in Aabukhaireni (27° 54'– 27° 57' E latitudes and 84° 24'– 84° 32' N longitudes) of Tanahun district and Panchase (28° 15' – 28° 23' E latitudes and 83° 48' – 83° 51' N longitudes) of Kaski district, both situated in the mid-hills of central Nepal (Figure 1). As mid-hills are highly populated and curtailed by climate change, we

selected Aabukhaireni from Tanahun district and Panchase from Kaski district as our study sites. The fieldwork was carried out in December 2020, and was facilitated by two local assistants.

Methods

Climate-change-related programs, technical reports and other published documents were reviewed for the purpose of the study. The review was complemented by consultative process where the national, provincial, community and local stakeholders were interviewed. The data collection method was complemented by fieldworks. A 15-day-long fieldwork was carried out to obtain information regarding where and how the CCA resources, services and benefits had developed and shared. Field observation and discussion at Aabukhaireni helped collate information on climate change impact, vulnerabilities, and adaptation services at community-managed sites while that at Panchase helped record the account of the same from the temperate and protected forests. The field visit at Panchase also helped

observe and assess the impacts of the intervention of EbA. Twenty-six respondents from both sites representing community forest user group (CFUG) members, farmers, and village-elders were interviewed for acquiring the needed data and information. The major climate change adaptation services that tightly intrigued with climate stress, shocks, vulnerabilities & risks, and that helped promote lessening those constraints were sought while carrying out the fieldwork.

Data analysis

In course of data analysis, a qualitative method with quantitative steps was followed since the qualitative information were quantified and measured for Qualitative Content Analysis (QCA) (Mayring, 2014). With due focus on sustainable management, generation and delivery of CCA services and adherence with the eight major thematic areas identified by NCCP (2019), a framework on sustainable generation and delivery of adaptation services to the most vulnerable systems and communities

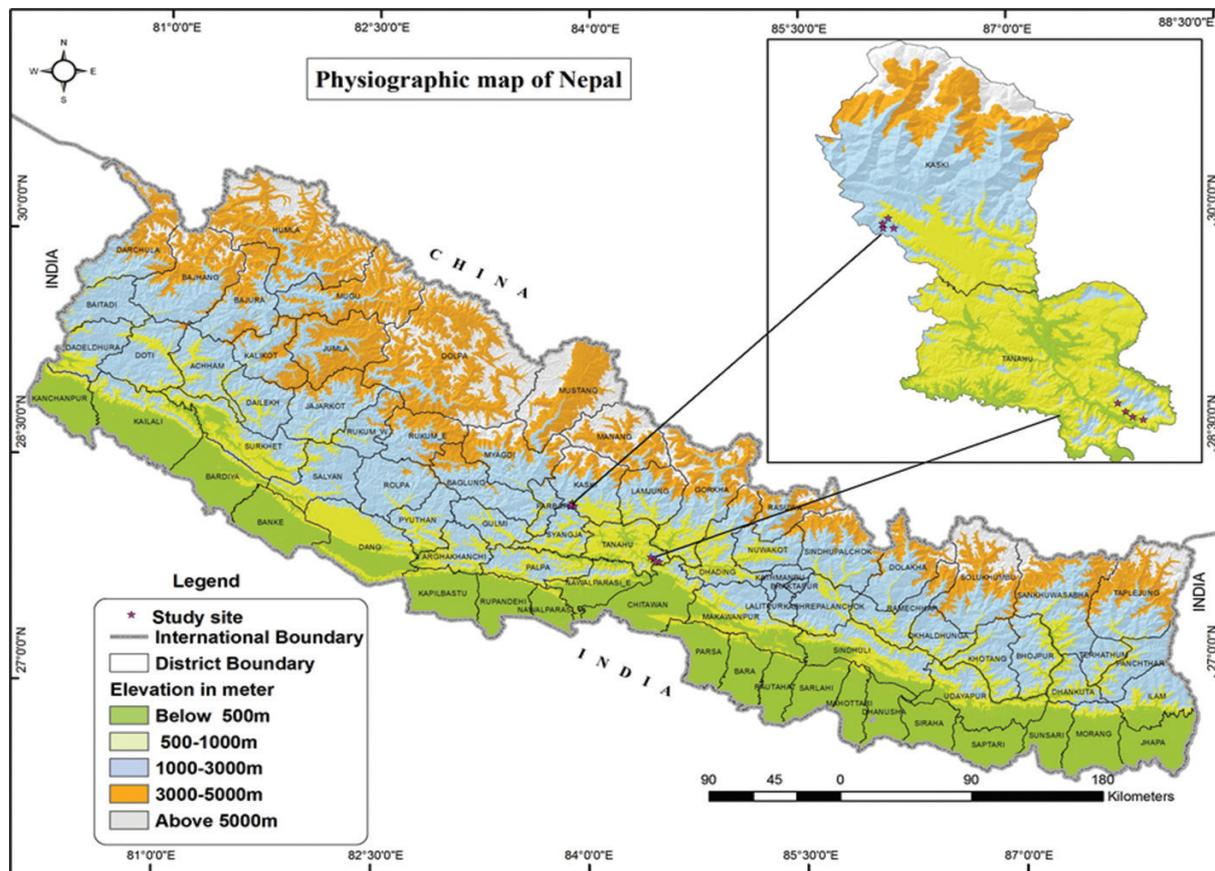


Figure 1: Map showing the location of the study-sites

was proposed. Additional focus was given on keeping on reducing vulnerability, strengthening institutions, enabling environment and integrating CCA in development planning for strengthening adaptive capacity and building more resilient system of CCA.

Results

Understanding climate change vulnerability and adaptation services

Climate change vulnerabilities and impacts on rural livelihood–base such as reduction in crop yields, destruction of homes and increase in food prices and food in security were common in the studied districts. The local residents also responded that the climate–induced erratic rainfall triggered landslides that caused in land degradation and crop loss in and around the study area. Here, the erratic rainfall was primary, landslide was secondary and land degradation and crop loss were tertiary impacts caused by climate change (Figure 2).

The climate change effects and their adaptation measures were observed to be different, locally developed in the study sites, as assumed; the warming effects were locally adapted and local counter measures were developed in Panchase area of Kaski district, which could be due to more community–centric and ecosystem–based adaptation–led works where forest–products–based local livelihood might have helped the

communities resilient to climate change. The local communities in the mountains have long been using their indigenous knowledge for CCA. The common adaptation practices adopted by the local people of Kaski and Tanahun districts included seasonal and/or permanent outmigration, redesigning their houses, diversifying livelihood portfolios, raising perennial vegetation around the settlements by planting bamboos in their homesteads for controlling soil erosion, forest–product collection and their storage, and ecotourism.

Climate adaptation services and priority activities

Panchase area demonstrated that the climate adaptation services rendered from the available ecosystem services were also due to the social coherence, which was also reflected in Lavorel *et al.* (2015), supported the local residents to be resilient to climate change and variability. Adaptation services complement the ecosystem services approach, and helps people develop choices for adaptation to climate change (Figure 3). It is, therefore, imperative to carry out to offer CCA options and services at local–levels. We observed that the climate services fostered the provision of more and better climate information/data (forecasts, modeling) that allowed farmers to fine–tune their planting, harvesting and marketing strategies based on climate forecasts (Goosen *et al.*, 2013; WMO, 2015; Webber, 2017).

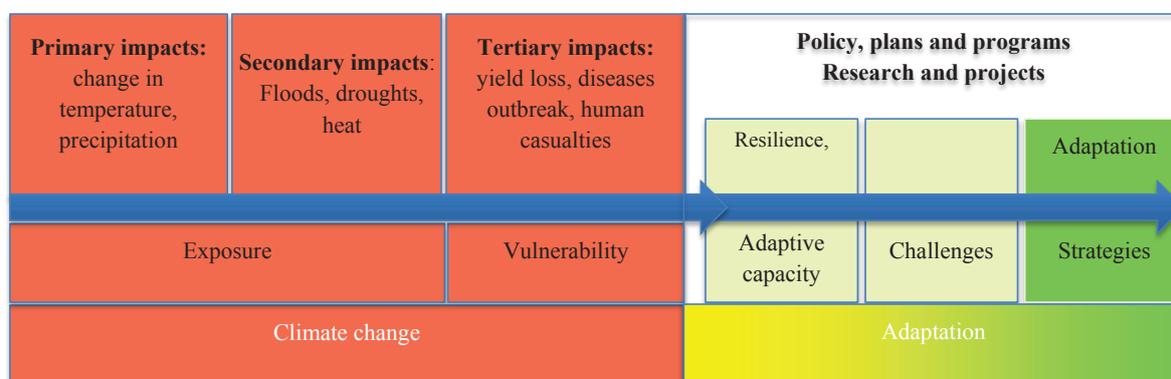


Figure 2: Climate change adaptation service approach (adapted from Goosen *et al.*, 2013)

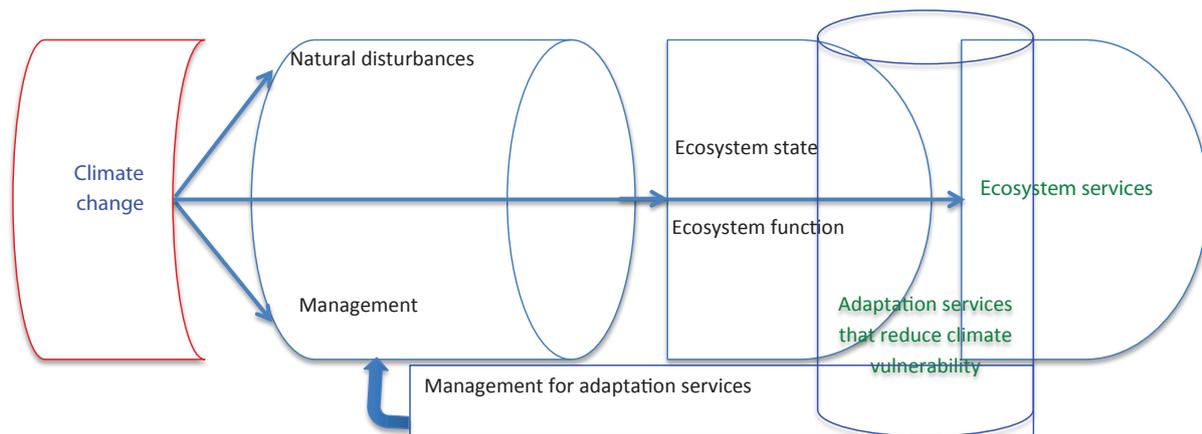


Figure3: Adaptation service framework (adapted from Lavorel *et al.*, 2015)

Our study found the following adaptation services from the reflection of community experiential learning, desk mining and field observation, which could be grouped under six thematic areas (Table 1); out of the 55 adaptation services catalogued, 14 were being practiced in Kaski and Tanahun districts.

Table 1: Thematic areas and potential sectors where additional CCA services can be generated

Thematic areas	Potential areas/ sectors	Potential CC adaptation services and generation traits
Forest, Biodiversity, and Watershed management	Community Forests (CFs), Leasehold Forests (LFs), Buffer Zone Community Forests (BZCFs), Collaborative Forests (CoFs), Private Forests (PvtFs), Protected Forests (PFs), NTFPs/MAPs	<ul style="list-style-type: none"> • Timber & non-timber-based enterprise/value addition activities in all types of forest management (e. g. saw-mills, furniture, essential oils, handmade paper, resin tapping); • Promotion of agroforestry model in Terai and mid-hills in PFs, LFs and other fallow lands; • Utilization of underutilized forest plant species such as Dhatelo (<i>Prinsepiautilis royle</i>), Chiuri (<i>Diploknema butyracea</i>), and Amriso (<i>Thysanolaena maxima</i>); • Cultivation of high-value MAPs such as Satuwa (<i>Paris polyphylla</i>), Valerian plants (<i>Valeriana officinalis</i>), Atis (<i>Aconitum heterophyllum</i>), Ban Lasun (<i>Allium wallichii</i>), Kurilo (<i>Asparagus officinalis</i>), etc. with value addition at local-level; • Forest-fire management; • Sustainable forest management; • Fruit tree planting.
	Watershed management	<ul style="list-style-type: none"> • Promotion of vegetation covers in Chure, Mahabharat and high-mountain areas; • Soil conservation practices (Hedge rows plantation, zero tillage cultivation, agroforestry practices); • Development of drought hardy forest species; • Creation of conservation pond especially in Chure foothills; • Degraded land rehabilitation.

Thematic areas	Potential areas/sectors	Potential CC adaptation services and generation traits
Agriculture and Food security	Agriculture	<ul style="list-style-type: none"> • Crop calendar; • High-value agriculture; • Off-season vegetables (e. g. cucumber in tunnel farming). • Climate-resilient seed varieties development, community seed banks; • Smart agriculture practices, climate-friendly agriculture practices (terrace farming, conservation tillage, SALT technology); • Cover crop, rotational, multiple cropping; • Agro-processing enterprises (jam, jelly); • Development of drought-hardy, low-moisture-requiring cereal and vegetables, integrated pest management; • Use fallow and unused land such as garlic cultivation after rice harvesting, watermelon in sandy land.
	Horticulture and livestock	<ul style="list-style-type: none"> • High-value horticulture (orange, mango, avocado, kiwi, dragon fruit); • Native/indigenous horticulture crops such as Sankhotra (<i>Citrus decumana</i>), Khurpani (<i>Prunus corbneta</i>), Lapsi (<i>Choerospondias axillaris</i>), Okhar (<i>Juglans regia</i>), etc. ; • Development of drought-hardy, water-resistant horticultural crop species; • Improved shade for livestock; • Plantation of forage and fodder trees; • Value addition in dairy products (e. g. make Paneer from milk, hard cheese); • Dry meat products, caning fish.
	Irrigation	<ul style="list-style-type: none"> • River-bed farming; • Increase irrigation facility and water use efficiency through promotion of shallow tube-well, water collection/recycling and rainwater harvesting; • Promotion of low-cost irrigation technology including drip/sprinkle irrigation, Thai-Jar and overhead water tank.
Water and Energy	Water (springs, streams, rivers and lakes)	<ul style="list-style-type: none"> • Conserve natural springs, streams, rivers, lakes and ponds; • Rainwater harvesting in water-scarce areas; • Watershed management, landscape management.
	Energy	<ul style="list-style-type: none"> • Replace the fossil fuel to green energy and hydro energy; • Utilize micro-hydro and biogas: integrating adaptation and mitigation; • Harness solar power; use improved cooking stoves; replace fuel wood to other types of energy; • Improve water mills.

Thematic areas	Potential areas/sectors	Potential CC adaptation services and generation traits	
Disaster risk reduction	Meteorological information, DHM	<ul style="list-style-type: none"> • Early warning system for extreme events; • Data for forecasting; • Flood defense: disaster risk reduction, ecological restoration; • Provide scope of IGA for poor and vulnerable communities; • Go beyond emergency planning: sustainable management of land, soil and vegetation; • Community-based seed bank/management; • Village-level emergency fund, crop and livestock insurance. 	
		Health	<ul style="list-style-type: none"> • Forecasting diseases outbreak; • Investments in health infrastructure and facilities; • Mapping watersheds and water-bodies.
		Tourism	<ul style="list-style-type: none"> • Early warning system for extremes in major touristic areas; • Ecotourism development at local-level; • Nature-based tourism development in potential areas beyond protected areas; • Heritage tourism development (both natural and cultural); • Village tourism development in rural areas.
Tourism and Infrastructure development	Infrastructure development	<ul style="list-style-type: none"> • Climate-resilient roads, houses and other infrastructure designs and built-ups; • Piloting of gravity-rope ways. 	

Delivery of adaptation services

The National Framework on Local Adaptation Plans for Action (LAPA) developed in 2011 and updated in 2019, presents an approach for “delivery of adaptation services to the most climate-vulnerable areas and people”. It has succeeded in mobilizing local institutions and community groups in adaptation planning and in recognizing their role in adaptation. With the advent of LAPA, there are several community-level initiatives in generation and delivery of climate adaptation services. Processes that are participatory and that acknowledge key government agencies and stakeholders such as local government or district-level institutions such as divisional forest office are more responsive to complement the local needs through more integrated approaches (Sharma, 2009). In this regard, the significance of community-based and community-led legally authorized organizations such as forest-user groups, farmer groups, cooperatives, and community networks was clearly emphasized for the generation of adaptation services and functional flow to the needful households.

Nepal’s National Climate Change Policy (NCCP, 2011 and its Update, 2019) have proposed eight key climate vulnerable areas where adaptation services are to be focused and delivered through the coordinating leadership of the corresponding thematic lead ministries. These areas broadly include– i) climate adaptation and disaster risk reduction; ii) low carbon development and climate resilience; iii) access to financial resources and utilization; iv) capacity building, peoples’ participation and empowerment; v) study and research; vi) technology development, transfer and utilization; and vii) climate-friendly natural resource management. Yet, creating an enabling environment, building capacities of all three levels (local, provincial, and federal) of governance and active linkage amongst research, policy and practice also needs to be considered as priority while advancing adaptation. Thus, service generation and delivery could sustain once direct and effective vertical and lateral communications are in place amongst central, provincial, and local governments and non-government stakeholders (Figure 4).

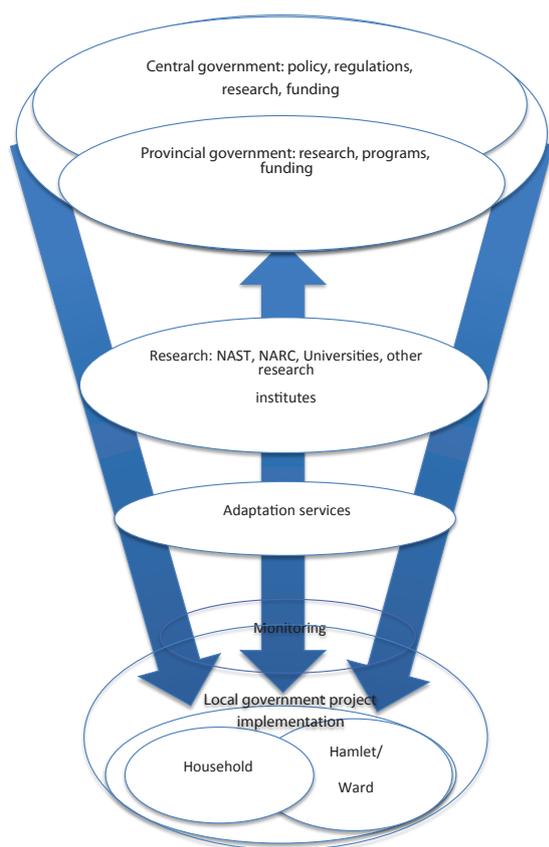


Figure 4: Climate change adaptation service delivery framework

Discussion

The study helped understand that climate-related hazards exacerbate other stressors, they often chain with negative outcomes for livelihoods, especially of the pro-poor people living in inaccessible areas. Thus, the poor and rural residents of hills and mountains, who are heavily dependent on forests and other natural resources for their livelihoods are more hard-hit (Mainali & Pricope, 2019) and challenged by the climatic disorders. Despite the local adaptation practices and application of indigenous traditional techniques, many households were already forced to abandon their dwellings, and migrated to the nearby cities/towns for the protection of their lives and earn livelihoods. Out-migration of the folk population leaving their properties un-attended could be noticed in many places of Panchase of Kaski district and in other districts, such as Manang, Mustang, Ramechhap and Nuwakot (Khatri, 2013). Land abandonment due to un-attendance is prevalent in Tanahun (Baral

et al., 2021).

Policy and CCA service generation

In spite of the promulgation of over a dozen of climate change protocols, their implementation is fairly effective, which could be attributed by the fact that they were not efficiently materialized, monitored and measured by virtue of limited capacity of the service providing and regulating bodies. In addition, the policy makers and decision makers are not well aware of the urgent call of embedded vulnerability of poor households for climate change adaptation interventions. Local and community-based adaptation interventions are, therefore, needed that can address climate vulnerabilities and help rural communities adapt in better ways sooner than later. In here enabling policy environments, capacities and partnerships are prerequisite for successful adaptation at all level.

NAPA (2010) and Climate Change Policy (2011 and 2019) both place significant emphasis on local adaptation plans, including implementing mandatory provisions to use at least 80% of their available budget for local adaptation activities (GoN, 2011). Moreover, the National Planning Commission (NPC) had developed a framework, for climate-resilient planning, that included a useful format for the appraisal of core plans, providing support, and developing institutional systems (NPC, 2011). Apart from the institutional approaches in service generation, there were some community-led initiatives in generating adaptation services despite the incentives are local and minimal. The locally-embedded initiatives like agroforestry system helps support agricultural production, checks air quality and soil health, maintains biodiversity, connects habitats and wildlife, sequesters carbon, and promotes regeneration of plants; the latter four being adaptation services underpin bundles of regulating services fostering the former two.

As the review manifested that the delivery of adaptation services to the climate vulnerable groups of hills and mountains is immediate and could be well reached out through community-based adaptation (CbA) and ecosystem-based

adaptation (EbA), it is advised to ensure that the poor and vulnerable households and communities are prioritized, and the issue of inclusion and equity and integration of adaptation plans at CFUG or village-level is considered (MSFP, 2016; Karki *et al.*, 2021).

Collaboration between political leadership and resource users such as local governments and CFUGs seemed to be imperative for delivery of CCA services as purported by Regmi & Karki (2010); FAO (2011); Dhakal & Jamil (2015). Besides, considerable investment is also a matter of concern for the purpose of generating and delivering adaptation services, and also transparent and inclusive decision processes and competent human resources and political leadership having good understanding of climate foresight are needed to best deliver the adaptation services (Pettengel, 2010). A suite of services comprised of administrative, financial and institutional services is an imperative for the generation and supply of adaptation services to the climate-vulnerable households.

Conclusion

Translating policies, protocols and plans into practices requires enhanced knowledge through research, understanding the gaps, implementing the efficient and acceptable measures, managing available resources in coherence for optimum products in perpetuity, fair sharing of the benefits and building the ownership. Locally-governed institutions, for resource governance, are the best powerhouse for generating adaptation services through mobilization of natural and social capitals. For the delivery of climate change adaptation services, institutional mechanisms comprised of multi-stakeholders and having interconnectedness are required to deliver adequate supply of adaptation services. As climate change adaptation planning and implementation is a multi-stakeholder country-driven process, the best possible and available option for the mobilization of natural and bio-physical capital need to be explored and strengthened. This study concludes that there are multiple opportunities of generating adaptation services where the opportunities of

mobilizing natural and social capital are available. In the present context, local communities are well acquainted with the knowledge of community-based and ecosystem-based adaptation, which need to be capitalized with the embracing of circular economy and nature-based solutions to the adverse impacts of climate change. Local governments are constitutionally mandated to act on local development together with climate change adaptation and disaster risk management; therefore, their capacity of coordination and leveraging resources could play a crucial role. There is a need of capacity building of all level of governments for leveraging adaptation resources and develop multi-stakeholder partnership for synergy in actions.

Acknowledgements

We would like to thank Dr. Maheshwar Dhakal, Ms. Srijana Shrestha, Mr. Binaya Parajuli, and Late Man K. Dhamala for their constructive feedback on its earlier drafts. Mr. Ram P. Acharya, Mr. Abdul S. Ansari, Mr. Rajan Mahat, and Dr. Bhagawat Rimal are acknowledged for their support on data collection, curation and analysis.

References

- Agrawal, S., Raksakulthai, V. A., Alast, V., Smith, M., Reynolds, J. and Larsen, P. (2003). Environment directorate development co-operation. <https://www.oecd.org/environment/about/> (Accessed on June 27, 2020).
- Baral, K., Sharma, H. P., Kunwar, R., Morley, C., Aryal, A., Rimal, B., and Ji, W. (2021). Human Wildlife Conflict and Impacts on Livelihood: A Study in Community Forestry System in Mid-Hills of Nepal. *Sustainability* 13: 13170. DOI:10.3390/su132313170 (Accessed on December 03, 2021).
- Dhakal, T. N. and Jamil, I. (2015). Community Governance for Climate Change Adaptation in Nepal. In: Ha, H. (ed.). *Land and Disaster Management Strategies in Asia*. Springer, New Delhi. DOI:10.

- 1007/978–81–322–1976–7_16(Accessed on June 27, 2020).
- FAO (2011). FAO–Adapt, framework program on climate change adaptation. Food and Agriculture Organization of the United Nations. Rome, Italy.
- Gentle, P., Thwaites, R., Race, D. and Alexander, K. (2014). Differential impacts of climate change on communities in the middle hills region of Nepal. *Natural Hazards* 74: 815–836.
- GoN (2011). Climate Change Policy, 2011. Unofficial translation, Approved by the Government of Nepal on 17 January 2011. <https://ldclimate.files.wordpress.com/2012/05/climate-change-policy-eng-p.pdf>(Accessed on January 05, 2021).
- Goosen, H., Groot–Reichwein, M. A. M., Masselink, L., Koekoek, A., Swart, R., Beembinder, J., Witte, J. M. P., Stuyt, L., Blom–Zandstra, G. and Immerzeel, W. (2014). Climate Adaptation Services for the Netherlands: an operational approach to support spatial adaptation planning. *Regional Environmental Change* 14 (3): 1035–1048. <https://DOI.10.1007/s10113-013-0513-8>(Accessed on July 07, 2020).
- Karki, G., Bhatta, B., Devkota, N. R., Acharya, R. P., and Kunwar, R. M. (2021). Climate Change Adaptation Interventions and Indicators in Nepal: Implications for Sustainable Adaptation. *Sustainability* 13: 13195. DOI:10.3390/su132313195(Accessed on December 04, 2021).
- Karki, G., Paudel, B. and Uprety B. (2017). Integrating forests and biodiversity in Nepal's National Adaptation Plan: A review and synthesis of knowledge stock on opportunities and way forward. *Banko Janakari* 27 (2): 21–31.
- Karki, S., Burton, P. and Mackey, B. (2020). Climate change adaptation by subsistence and smallholder farmers: Insights from three agro–ecological regions of Nepal. *Cogent Social Sciences* 6: 1720555. DOI:10.1080/23311886.2020.1720555(Accessed on June 07, 2020).
- Khatri, N. R. (2013). Climate–change Refugees in Nepal: the need for climate–smart capacity building. In: Leal Filho W. (ed.). *Climate Change and Disaster Risk Management*. Springer, Berlin, Heidelberg. DOI:10.1007/978–3–642–31110–9_22(Accessed on June 28, 2020).
- Kunwar, R. (2020). Review and synthesize Nepal's past and current adaptation measures and assess their effectiveness for planning and advancing NAP process, Nepal. Component 1 (Final Report). NAP, PMU, Babarmahal, Kathmandu.
- Lavorel, S., Colloff, M. J., McIntyre, S., Doherty, M. D., Murphy, H. T., Metcalfe, D. J., Dunlop, M., Williams, R. J., Wise, R. M. and Williams K. J. (2015). Ecological mechanism underpinning climate adaptation services. *Global Change Biology* 21: 12–31.
- Mainali, J. and Pricope, N. (2019). Mapping the need for adaptation: assessing drought vulnerability using the livelihood vulnerability index approach in a mid–hill region of Nepal. *Climate and Development* 11 (7): 607–622. DOI:10.1080/17565529.2018.1521329(Accessed on January 12, 2021).
- Mayring, P. (2014). *Qualitative content analysis. Theoretical foundation. Basic procedure and software solution*. Klagenfurt, Beltz, Verlag.
- MoEST (2008). *National Capacity Need Self–Assessment Report*. Ministry of Environment, Science and Technology, Singhdurbar, Kathmandu Nepal. 2008.
- MSFP (2016). *Enhancing resilience of vulnerable communities to climate change: MSFP experiences and lessons learnt*. Multi–

- stakeholder Forestry Program, Kathmandu, Nepal. https://www.dfae.admin.ch/dam/countries/countries-content/nepal/en/Enhancing_Resilience_of_Vulnerable_Communities_to_Climate_Change-EN.pdf(Accessed on June 23, 2020).
- NCVST (2009). Vulnerability Through the Eyes of Vulnerable: Climate Change Induced Uncertainties and Nepal's Development Predicaments, Institute for Social and Environmental Transition–Nepal (ISET–Nepal), Kathmandu and Institute for Social and Environmental Transition (ISET) Boulder, Colorado for Nepal Climate Vulnerability Study Team (NCVST), Kathmandu.
- NPC (2011). Climate–resilient planning: A tool for long–term climate adaptation (Working document). Government of Nepal, National Planning Commission. https://www.npc.gov.np/images/category/climate_resilient_planning.pdf(Accessed on January 05, 2021).
- Pettengel, C. (2010). Climate Change Adaptation: enabling people living in poverty to adapt. Oxfam International, UK.
- Regmi, B. R. and Karki, G. (2010). Local Adaptation Plans in Nepal. *TIEMPO*, 76: 21–25. <https://www.tiempocyberclimate.org> (Accessed on June 07, 2020).
- Schneider, S. H. and Kuntz–Duriseti, K. (2002). Uncertainty and Climate Change Policy, In: *Climate Change Policy: A Survey*, Schneider, S. H., Rosencranz, A., and Niles, J. O. (eds.). Island Press, Washington D. C.
- Sharma, A. (2009). Planning to deliver: making the Rio Conventions more effective on the ground: *Climate Change, Biodiversity, and Desertification*, GTZ.
- Webber, S. (2017). Circulating climate services: Commercializing science for climate change adaptation in Pacific Islands. *Geoforum* 85: 82–91.
- WMO (2015). Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services (World Meteorological Organization, Publication No. 1153). Geneva, 308 pp.