

PARTICIPATORY ASSESSMENT OF LIVELIHOOD RESOURCES AND ADAPTATIONS TO CLIMATE CHANGE IN MADI VALLEY OF CHITWAN, NEPAL

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ABSTRACT

This paper has applied participatory tools to assess the livelihood resources and adaptations in Madi Valley, Nepal. It has utilized the social, economic, and environmental aspects of the identified adaptations through participatory scoring (1 to 5) for participatory cost-benefit (PCB) analysis. Additionally, it considered gender equality, technical feasibility, inclusiveness, future vulnerability for multi-criteria assessment (MCA). Series of focus group discussions (FGDs) were conducted to generate data based on communities' perceptions. Based on PCB ratio, afforestation was the most prominent adaptation strategy, whereas early warning siren and evacuation tower (EWSET) was found the most effective adaptation based on the MCA.

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Introduction

Many tools have been used to understand the local climatic risks, vulnerabilities and to increase resiliency. The Cost-Benefit Analysis (CBA) is one of such tools widely used to analyze the profitability of particular adaptations by comparing costs and benefits over a timeframe (Sain et al. 2017). It has been applied as an economic tool for evaluating projects for the last 200 years (Alves 2015). But there is a lack of detailed estimation and analysis of the costs and benefits of these adaptations in most cases since most people, especially rural, illiterate and poor people, do not record and track the actual costs, expenses, and benefits. Ortega et al. (2014) highlighted some of the limitations and challenges of conventional CBA particularly due to complexity, unpredictability, and long-term

issues due to time-consuming and expensive procedures. Thus, the interest in participatory cost-benefit analysis (PCBA) and multi-criteria assessment (MCA) has increased as the complementary approaches for economic valuation through the PCBA framework due to the limitations of monetary valuation of ecosystem services (Saarikoski et al. 2016). The PCBA and MCA utilize the participatory approaches with ranking exercise that includes the social and environmental aspects in addition to the economic condition. Ortega et al. (2014) emphasized ranking exercises to decide the most prominent environmental impacts and relevant adaptation in CBA. Furthermore, UNFCCC (2011) and IIED (2011) have emphasized the environmental & social costs and benefits in addition to the economic costs and benefits.

However, the process is mostly expert-driven, top-down, and also complex with the involvement of multiple actors, their interests, and values (Chaudhary et al. 2016). Acosta and Corral (2015) underlined the necessity of a participatory framework for inclusive, flexible, and effective decisions to address complex environmental issues.

The PCBA utilizes the participatory research appraisal (PRA) methods ensuring financial, social, and environmental costs and benefits of any interventions, by effective participation of diverse groups of stakeholders, thus, efficient and applicable to the community, city, state, and national level (Khan & Hawley n.d.¹; Alves 2015). Likewise, the MCA is applicable to deal with complex and multiple problems such as power relations, hidden interests, socio-cultural issues that are more pertinent in environmental and economic analyses (Acosta & Corral 2015). Thus, this study has concentrated on the participatory and rapid assessment of livelihood resources including the PCBA and the MCA. Multiple researchers such as Khan & Hawley (n.d.); Alves 2015; Licuanan et al. (2015) considered these participatory approaches as the alternate to analyzing the effectiveness of the adaptations in addressing the present and future impacts, especially in places with limited data/information about detail information on costs, expenses, and benefits.

Despite some studies on the economics of climate change at the global and regional levels, only a few studies (IIED 2011; Acosta & Corral 2015; Lunduka et al. 2016), have concentrated on the assessment of livelihood resources and costs and benefits focusing on social, cultural and plural values to evaluate the effectiveness and replicability at the local level. Very few numbers of such studies are conducted at the community levels, particularly in Nepal, mainly due to a lack of skilled human resources, financing, lack of reliable data and information, and also partially or wholly illiterate communities (White & Rorick 2010). We believe that the participatory and bottom-up analysis of costs and benefits of adaptation and analysis of multiple factors/criteria including gender equality, social inclusion, technical feasibility, and future prosperity enhance the effectiveness,

sustainability, and successful implementation of the interventions. Carolus and Pedersen (2018) also supported the effective and inclusive development and policy implementation through bottom-up CBA. In that relation, this study attempts to answer these research questions – What are the impacts on livelihood resources faced by the mainstream group and the ethnic groups in the study sites? What are the factors important for the success of the adaptations? Are social, and environmental aspects equally important to the economy for cost and benefit analysis? What are the additional factors to be considered for effective and successful adaptation?

The livelihood resources are important to deal with the adverse impacts of climate change. Licuanan et al. (2015) also emphasized rapid and participatory assessment of the vulnerabilities and resources for effective planning, policy, and law enforcement and wise use of the resources including the investments in the structures and institutions. Without assessing the available resources and factors including the estimation and analysis of cost and benefits, several adaptations have been executed at the local level. Likewise, the communities and civil society organizations in Madi Valley have intervened in some adaptations such as the construction of dams, plantations, water ponds, early warning sirens, and evacuation towers (EWSET), etc. to address the negative consequences of climate change impacts. However, these adaptations are not analyzed in terms of their incurred or estimated costs, benefits, and other multiple effects in society. This paper aims to analyze the impacts of climate change on livelihood resources; the contribution of livelihood resources on climate change adaptation through applying Community-based Risk Screening – Adaptation and Livelihoods (CRiSTAL)² tool and the effectiveness of selected adaptations based on the community's priorities through the PCBA and MCA tools.

Methodology

Study Site and Choice of Research Methodologies

The study was carried out in Madi valley, situated in the southern part of the Chitwan

¹n.d. stands for no date

²CRiSTAL is a tool for assessing climate impacts on livelihood resources and influences of livelihoods resources

on adaption, developed by IUCN, Inter-cooperation, IISD, Stockholm Environment Institute (SEI)

district of Central Nepal, which is surrounded by the Chitwan National Park on three sides and bordered by Someshwor Hill in the South. Because of the National Park, it is somehow isolated from other parts of the district. Agriculture and forestry are the main sources of livelihood in the site, which is affected by both wildlife attacks and also climate risks and vulnerabilities. Floods, riverbank erosion, and drought were major climate risks and vulnerabilities in the site (Maharjan et al. 2017). This study applied the participatory tools mainly CRiSTAL, PCBA, and MCA tools in focus group discussions (FGDs) for analyzing the major impacts on livelihood resources, contributions of livelihood resources on adaptation, estimated or incurred costs, benefits, and other multiple values for making decisions on the effectiveness and replicability of adaptations in the valley. Most of these tools are embedded in the concept of resilience, sustainability, and development approach with practical application (Douxchamps et al. 2017). The communities were clarified about the objectives and methodologies of the study in the community workshops. The assessments of impacts on livelihood resources and adaptation strategies were carried out by applying the CRiSTAL tool based on the community's experiences, which is a planning and decision-making tool to understand and link the climate risks with the people's livelihood in a logical and user-friendly manner. Douxchamps et al. (2017) explained that the CRiSTAL tool as one of the tools developed by international organizations that uses a series of checklists and criteria aligning the concept of sustainable livelihood framework in assessing resources and impacts to understand the contexts of livelihood resources.

The PCBA and MCA tools were applied to analyze and evaluate the efficiency and sustainability of prioritized adaptation interventions. These assessments were done in the FGDs with a total of 112 local people. Altogether 7 FGDs were conducted with the participants ranging from 10-20 including the elderly, women, and youth with an average of 16 local people per FGD. Among them, 3 FGDs were carried out with the mainstream groups, 3 with the ethnic Tharu groups, and one with ethnic Tharu women group to gather the specific climatic issues faced by them. The participants for the FGDs were selected based on the interactions with the community leaders, elders,

and schoolteachers considering the people/communities directly affected by the climate-induced disasters in the site. The FGDs included representatives from ethnic minority groups, women, Dalits, and mainstream castes mainly to distinguish and analyze the importance of local resources with ethnicity. However, it is found that most of the mainstream groups live nearby the local markets, roads, and forest areas as compared to the ethnic Tharus and Dalits, who usually live close to the river and lowland areas.

The ranking exercises from 1 to 5 (the least to the highest score) based on communities' judgment, experiences, analyses, and perceptions were carried out during participatory approaches. FAO (2018) also emphasized the participatory approaches with ranking and scoring approaches for relative weights to the vulnerability, impacts through a series of FGDs and workshops with the relevant stakeholders. Whenever there was a conflict on the scores among the participants in the FGDs, the participants themselves discussed and made a consensus on the score, sometimes compared with the other score and cases. For the PCBA, the farmers, first, identified the most prominent and efficient adaptations in the locality based on the ranking exercise. The scoring was done for the individual interventions (for both costs and benefits) by the community representatives in terms of economic, social, and environmental aspects. The community, themselves, decide the scoring for each intervention. Same adaptation interventions were used for the MCA, but farmers were asked to define the social, environmental, and other criteria that are important in the locality such as gender equality, social inclusions, technicalities, future prospects, and long-term sustainability, etc. In each of these identified criteria, the community again ranked the interventions with the similar scoring method by themselves.

Results

Livelihood Resources Assessment

The livelihoods resources were brainstormed in FGDs separately with the dominated mainstream group and the ethnic Tharu group. Both groups prioritized agriculture, forest, and biodiversity including wild animals, rivers, and streams as the top natural resources. The mainstream group has different priorities on other resources than the ethnic Tharus based on the socio-economic and cultural conditions despite living in the same valley. Additionally, the

priorities are also dependent on the challenges they have faced and the geographical locations. In terms of physical infrastructures, the mainstream group emphasized communal buildings, schools, and colleges, roads, and bridges. The communal buildings are mainly for regular gatherings to make community decisions and are used as shelters to evacuate during floods. Likewise, the schools and colleges generate qualified human resources which enhance the adaptive capacities to address the impacts and are also used as shelters during heavy floods. The roads and bridges improve the accessibility to migrate in difficult situations, especially during heavy rain and floods. But ethnic Tharu gave more importance to schools and colleges, army barracks since they support them in reconstruction and re-building after climate-induced disasters.

The mainstream group revealed commercial agriculture, fisheries, and poultry farms, and farmers' cooperatives are vital for them since they possessed comparatively larger pieces of land for performing it with enhanced market access as the main sources of the economy that are growing rapidly in the sites. The farmers' cooperatives support them in financial matters. The ethnic group prioritized farmers' savings/credits & community funds, farmers' cooperatives, and banks based on easy accessibility. Surprisingly, they gave more importance to religious groups even more than farmers' groups and disaster management groups under the social resources, whereas the ethnic group emphasized the inter-relationship and social cohesion among them as the main priority followed by indigenous societies and then the farmers' groups. For human capabilities, they emphasized agricultural technicians, teachers, and health workers as they are dependent on agriculture for their livelihoods. But the ethnic group prioritized agricultural laborers, teachers, and veterinarians/technicians. The results show these two groups have different priorities/emphasis on the resources except natural resources.

Climate Change Impacts on Livelihood Resources

The study found flood, drought, and wildlife attacks as the most severe climatic and non-climatic vulnerabilities based on the community perceptions and experiences on the most livelihood resources. However, the impacts are more prominent among the ethnic Tharu due to

limited resources and adaptive capacities, and high sensitivity/exposure. Since the site is at the premise of Chitwan National Park, the wildlife has severely affected the farmers' livelihoods in addition to the climatic vulnerabilities, especially during the crop harvesting seasons. The impacts of the top three vulnerabilities on the identified livelihood resources were analyzed through a ranking exercise. The agriculture sector was found the most affected from all three vulnerabilities in terms of natural resources. Agriculture is rainfed despite having several rivers and streams. Both excess rainfalls during the monsoon leading to flooding and riverbank erosion and scarcity of water affect agriculture. During monsoon, it is observed that ethnic Tharu living close to the river have to stay awake for a whole night and search for areas to evacuate for safety. Likewise, agricultural labor forces were the most affected human capabilities since more than 90% of them are farmers. In terms of social resources, farmers' groups and indigenous societies were the most affected with the higher-ranking scores. Both financial resources and physical infrastructures had the least impact in the area. Most of the respondents believed that agriculture and farmers, especially the ethnic, poor, marginalized, and women are highly affected by climatic or non-climatic vulnerabilities due to high dependence on agriculture and being close to the rivers, National Park, and forests.

Livelihood Resources Supporting Climate Change Adaptation

These livelihood resources also support climate adaptation dealing with the impacts. The farmers were asked to list and rank the coping/adaptations found in the locality. Based on the ranking, the farmers identified plantation, the raising the plinth of the house, and check dam as top three coping/adaptations though there were additional adaptations such as early warning siren and evacuation tower (EWSET), water conservation ponds. These adaptations were commonly found in the valley with different levels of success, whereas others were specific to some parts of the valley. While analyzing the influences of the livelihood resources on these adaptations, it was found that agriculture has comparatively more influences and supports in raising the plinth, plantation, and check dams since these adaptations are usually done in the agricultural lands to protect or escape from the climate impacts. However, farmers revealed that

the raising plinth level, plantation, and check dams were not fully effective and successful. Most of the traditional houses were constructed with the use of wood and wooden poles. Since It's mostly sandy loam soil, the wooden poles used for raising the plinth level was not successful as it created holes in the field when the flood occurred for a week or more.

Likewise, the plantation and check dams were not found 100% successful because of the lack of proper planning, realized by themselves, hence proper planning with quick-growing plants such as bamboo needs to be promoted based on their experiences. The roads and bridges enhanced the accessibility, thus, contributing to the adaptation in terms of physical infrastructures. Likewise, the buffer zone was found as one of the main sources of economy for adaptation purposes, which was not reported in the assessment of livelihood resources. The construction skills and agricultural technicians contributed comparatively more to adaptations concerning human capabilities since these skills are highly applicable in agriculture and constructing new houses and repairing houses damaged by the flood. The youth clubs were found as the fundamental social resources for the adaptations as they can contribute their efforts, skills, new technologies, and human labor. The social cohesion such as labor exchange during agricultural operations and during a difficult time such as flood and climate-induced disasters were found very strong within the ethnic Tharu as compared to the mainstream group.

Participatory Cost-benefit Analysis (PCBA) and Multi-criteria Assessment (MCA)

The adaptations such as check dam, plantation, the EWSET, and water conservation pond were prioritized for the analysis of costs and benefits based on the community's rankings among other adaptations at the community level based on the participatory scoring exercise. Since raised plinth level is the adaptation done at the individual level, it was not included in this analysis. Instead, EWSET and water conservation pond were prioritized as the important adaptation since these adaptations helped them at a community level to deal with the impacts, thus, worth analyzing the costs and benefits through a participatory approach. Rather than estimating the exact economic, social, and environmental costs and benefits, the scoring of the costs and benefits from 1 to 5 (from the least to the highest)

was carried out in the FGDs as farmers usually do not record all the expenses and benefits of any adaptations. It is difficult to estimate the social and environmental costs and benefits in monetary terms, but important to be considered in the analysis. Thus, the PCBA with scoring exercise was carried out as an alternative approach to estimate the cost and benefits including the discount rate in the analysis. Concerning the time factor, it is more effective to estimate PCBA before and after the execution of any adaptations.

With this analysis, the plantation was found as the best adaptation in terms of benefit and cost ratio of 1.625 that indicating that the spent of every 1 USD gives the benefit of 1.625 USD for plantation. The analysis also included the social and environmental costs and benefits in addition to economic costs and benefits. White and Rorick (2010) have revealed that the B: C ratio would be significantly higher if it is possible to fully quantify the social and environmental resources. Alves (2015) also conducted the PCBA utilizing the environmental, social, and economic values through the scoring method, but they have included the short-term and long-term scoring in environmental, social, and economic valuation.

Since PCBA has not included the aspects of gender, social inclusion, future vulnerabilities, and other socio-cultures in the analysis, MCA was carried out with the involvement of the community representatives in the FGDs. These criteria were defined and clarified based on their involvement based on benefits, gender, understandability, and applicability to them. The criteria were discussed and finalized with them based on the local situation. They scored each of the identified adaptations from 1 to 5 (from the least to the highest scores) based on their experiences and knowledge. As a result, the EWSET (25.66 scores) was found the most appropriate adaptation for them followed by the plantation (23.62 scores), dam construction (21.18 scores), and water conservation pond (19.83 scores). From the PCBA, the plantation was identified as the most appropriate adaptation whereas the MCA revealed EWSET as the most effective adaptation considering the multiple social aspects. They scored high in the EWSET due to gender equality and technical feasibility as they first prioritize women, children, and the elderly to evacuate in the EWSET when flood and other climate-induced disasters occurred. In terms of technical know-how and feasibility, they believe EWSET is technically sound and feasible

for the communities to warn and protect from the impacts and climate-induced disasters in the future as well and it could be managed by themselves with limited resources once it is installed and trained to operate it. But it needs additional resources in the case of plantation though it could be managed by the local communities.

Discussion

Although we assumed the same importance on the livelihood resources among the communities in the study site, we found diverse opinions and experiences on the importance of livelihood resources between mainstream groups and ethnic Tharu groups influenced by the socio-cultural and economical aspects, though both communities live within the same geographic areas. The study also revealed the impacts and adaptation priorities differ based on the localities, socio-economic and cultural differences, and accessibility to the resources. NTNC/ACAP (2012) also affirmed the different importance of communities on different livelihood resources based on the impacts faced by them. Agriculture, forest, rivers, and streams are the main prioritized sector since both groups rely on these resources for their livelihood and food security.

It's important to assess the resources to help them in addressing the climate impacts. The availability or scarcity of these resources determines the exposure, sensitivity, and adaptive capacity of the communities. However, the local resources are analyzed in terms of accessibility, not in the context of availability. Since the study site is in the premises of National Park, the resources inside the national parks are there, but not accessible for the local people. The analysis has focused more on accessible resources aside from the park resources. For instance, the mainstream group with more productive land for commercial farming has the least exposure and sensitivity than the ethnic group. It is observed that the mainstream group live and/or possess agricultural fields in the upland areas with low risk of flooding and riverbank erosion, whereas the ethnic Tharu group live and/or have agricultural lands in the lowland areas close to rivers with high exposure and sensitivity.

The agriculture was found the most severely affected sector. Most of the ethnic Tharu people's main source of livelihood is subsistence agriculture whereas, the mainstream group has commercial agriculture and other income sources

as well. In that relation, the mainstream group has better adaptive capacity than the ethnic group. UNFCCC (2011) has predicted similar impacts in developing countries impacting food, water, health, and livelihood due to limited resources to adapt socially, technologically, and financially. OECD (2009) also anticipated exacerbation of such impacts on food, infrastructures, and natural resources, affecting the livelihood of the poor and marginalized people. Nhemachena et al. (2010) highlighted that rural livelihoods are highly relying on climate-sensitive livelihood resources including agriculture, forest, and biodiversity. Also, NTNC/ACAP (2012) highlighted the impacts on agriculture, livestock, hydrologic balances, physical infrastructures in the high mountains of Nepal. Similarly, Maharjan and Sigdel (2010) reported the impacts on livelihood resources such as agriculture, livestock, forestry, physical infrastructures, and water resources in western Tarai, Nepal. More interestingly, Rupantaran Nepal (2011) has defined the indicators in each livelihood resource – economic, social, human, physical, and natural to analyze the climate impacts.

It was also found that these resources are supportive to the communities in dealing with the impacts. Especially, agriculture, roads/bridges, buffer zones, youth have contributed in dealing with the impacts in the valley, based on the community's perceptions and scoring. For instance, roads have enhanced the communities' access to the market and other facilities. Likewise, the buffer zone has enhanced accessibility and approachability to the micro credits and finance for all the identified adaptations. For raising the plinth level, community's saving and credits is the most accessible financial resources, whereas for plantation and check dam, they have to rely on the buffer zones since the requirement of the resources is comparatively high.

According to Saarikoski et al. (2016), the PCBA and MCA have been widely used tools for prioritizing and deciding adaptations to analyze and assess the climate change impacts, and adaptations. Furthermore, Carolus and Pedersen (2018) emphasized on bottom-up CBA approach to analyze and address the local issues more strategically and effectively with the active participation of the local stakeholders. This process enhances the transparency, trustworthiness, and ownership among the local communities in addition to its effective and

successful implementation. OECD (2009) emphasized the participatory methodologies and involvement of the public in the processes in analyzing the monetary and non-market costs and benefits in environmental protection, sustainability, and climate change. The social and environmental aspects are equally important in addition to the economy for effective costs and benefits analysis. The whole process enables the local communities to understand and perceive the local issues and problems and subsequently plan and execute the local strategies in more effective and sustainable ways (Carolus and Pedersen 2018).

OECD (2009) further highlighted PCBA, MCA, and expert judgment for analyzing the cost and benefits for social accountability. Among them, MCA is a popular prioritization method with an adaptation decision matrix. Maharjan et al. (2010) found MCA very effective to ensure the inclusion of poor and vulnerable people in the decision-making process. They also carried out the PCBA and MCA among the drip irrigation, water conservation pond, and resource center in Dhading district, in which drip irrigation is the most appropriate adaptation from PCBA whereas water conservation pond is the best option after including the perspective of vulnerability, gender, social inclusion, and poor/marginalized people. The most important aspect of PCBA and MCA is the effective participation of the communities in defining criteria and making decisions (OECD 2009).

Conclusion and Recommendation

Climate impacts are exacerbating every year with increased impacts to the poor communities as they are highly dependent on climate-sensitive livelihood resources. The poor, ethnic, and marginalized people, living in the riverbanks and nearby forests and depending on agriculture are highly vulnerable to the impacts. Agriculture, community buildings, commercial farming, fisheries and poultries, religious groups, and agricultural technicians are the most important natural, physical, economic, social, and human resources to mainstream groups, whereas ethnic groups emphasized agriculture, schools and colleges, farmers' saving/credits & community funds, farmers' social cohesions, and agricultural labor forces as the important livelihood resources. Agriculture is the common priority among both groups. The impacts and adaptation priorities of the mainstream groups and ethnic Tharu groups

are different despite living in the same valley based on the socio-economic conditions and access to the resources.

These resources have been contributing to the adaptations as well. In that regards agriculture, roads and bridges, buffer zone, agricultural technicians, and youth clubs are contributing the most to the adaptations. Many coping and adaptations are practiced by the communities with or without the support of external agencies including government and civil society organizations. Not all of these interventions are equally successful. Some of these interventions prioritized by the communities are plantation, water conservation ponds, EWSET, check dams among others. In addition, the climate impacts on livelihood resources, the contributions of these resources in dealing with the impacts are also analyzed. It is realized that agriculture is the most sensitive and vulnerable to climatic and non-climatic stresses as it is the main source of livelihood for them. Based on the PCBA, plantation was identified as the most appropriate adaptation, whereas MCA determined the EWSET as the effective adaptation based on gender sensitivity, social inclusion, new technology, and future prosperity.

The estimation and analysis of costs and benefits of those adaptations considering the economic, social, and environmental aspects would enhance the effectiveness and sustainability. Furthermore, in the countries like Nepal, it is very important to consider the gender equality, social inclusion and accessibility, and technical feasibility of the interventions in addition to economic costs and benefits. The effective and active participation of farmers and their associations are crucial in the whole adaptation process. Analysis of costs and benefits is usually a top-down process, but it would be more effective to follow bottom-up and participatory process considering multiple factors and local issues. These analyses have to be further analyzed, crosschecked, and triangulated with the climatic data and information. Based on this analysis, we would like to recommend the estimation costs and benefits before and after the adaptations with the active participation of the communities considering the multiple factors and criteria based on local contexts. This analysis would be effective and appropriate for the implementation of the Local Adaptation Plan of Action (LAPA), and Nepal Climate Change Support Programme (NCCSP) of the government

and other local-level adaptation strategies and mechanisms.

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