



Exploring Farmers' Perceptions of Climate Change Adaptation in Panchkhal Municipality-3, Kavrepalanchok District, Nepal

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Abstract

Nepalese smallholder farmers are becoming vulnerable to the impacts of climate change. This study aims to find the knowledge, perceptions and adaptation practices of the farmers in Panchkhal Municipality-3 of Kavrepalanchok, a renowned agricultural hub of Nepal. The study used qualitative approach and case study research design. Required information were collected through in-depth interview (n=12) and group discussion (n=3). The participants or representatives of farmers, agricultural officials and farmer community were selected purposively. Thematic analysis was performed on the data, and they were interpreted using Cultural Theory of Risk, which sees the way that institutions and social groups perceive and respond to climate risk as tied to their worldviews. The findings reveal that the farmers' knowledge of climate change is at moderate level, and this knowledge is mostly acquired from their personal experience of climate related issues like irregular rainfall, heat stress and reduced yields. Participants, in turn, have implemented strategies that they believe have made them less vulnerable to the risks of climate change and more resilient to climate impacts, such as diversifying crops, tunnel farming, percolating ponds and better irrigation practices. But awareness and implementation of the Local Adaptation Plan of Action is low among farmers and some adaptation activities have been limited by poor coordination with government agencies, inequitable budget allocation, weak monitoring and by political and economic instability. The study finds that enhancing institutional coordination, scaling up farmer-centered training and enhancing market and climate finance support is critical to maintaining adaptation progress. It suggests implementing integrated institutional assistance to build local climate change adaptation measures more resilient.

Keywords: Climate change adaptation; farmers' perceptions; vulnerability; local adaptation plan of action; Panchkhal municipality

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Introduction

Effects of climate change are well recognized and are far reaching, impacting on ecosystems, livelihoods and food systems (Below et al., 2015). Increased frequency of extreme weather events, along with changes in rainfall patterns and temperature, are pushing farmers around the world to rethink their farming methods. These changes are particularly affecting smallholder farmers in developing countries, relying heavily on rain fed farming and having limited access to financial and technical resources (Mertz et al., 2009). Their perception of climate risks and diversifying cropping, conserving water, or managing soil plays an important role in adaptation measures (Reddy et al., 2022). Reactions of farmers to climate change are not always consistent. They are a reflection of socio-economic, cultural and environmental factors that are interrelated (Arbuckle et al., 2015).

In other contexts, farmers are more likely to use formal extension services, government programs, or market signals to inform adaptive practices, including planting dates or plant varieties that are more resistant to climate change (Belay et al., 2022). Generally, farmers do not adopt short-term coping measures rather choose long-term ones, like agroforestry or irrigation systems (Limantol et al., 2016). However, awareness of climate risks has not yet fully translated into long-term adaptation practices as many farmers are still facing financial constraints, limited infrastructure, and conflicting/insufficient information (Guo et al., 2021). To inform the design of interventions grounded in farmers' own reality, rather than generic technical prescriptions, it is important to understand these dynamics.

Nepal is a country that shows these patterns around the world with a particular intensity. It has a low contribution to global GHG emissions but is one of the more climate vulnerable countries in the South Asian region due to its mountainous topography, high reliance on natural resources and low adaptive capacity. Temperature, rainfall and monsoon timing variations are highly sensitive for farming systems from the Terai to the Himalayas (Manandhar et al., 2011; Paudel et al., 2020). Pasa et al. (2026) also found that rising temperatures, erratic rainfall, and increased crop diseases have severely disrupted rural livelihoods around great Himalayan trail lower route region.

For the adaptation, most of the smallholder households still depend on traditional knowledge and coping strategies such as changing planting dates, using drought resistant crop varieties and adjusting irrigation methods (Sherpa, 2023). In mid-hill region, most of the farmers are aware of the climatic change, factors like financial constraints, lack of technical knowledge and weak infrastructure were still limiting farmers to implement adaptive measures (Joshi et al., 2017; Devkota et al., 2018; Dahal et al., 2022). Adaptation practices in Nepal also shows that farmer-led adaptation practices (e.g., crop diversification and agroforestry) are still more frequent than planned institutional adaptation practices; and that the sustainability of farmer-led

adaptation practices is not guaranteed as climate change pressures increase (Rijal et al., 2022). Improving communication, capacity building and policy support are essential to bridge the gap between what farmers experience and what empirical findings has proven to be effective as adaptation options.

In spite of this growing body of literature, farmer centric and qualitative documentation of farmers' own perception and adaptive practices is comparatively limited in the agricultural municipalities of the hills and peri urban areas in Nepal. The context of Panchkhal Municipality in Kavrepalanchok, an “agriculture city” in Nepal is more relevant. Farmers in Panchkhal municipality have facing financial barriers, insufficient technical training, and ineffective governance for local adaptation plan (Kathayat & Pasa, 2025). It is the location of government-supported agricultural modernization programs, but is at the same time vulnerable to disaster risk arising from climate change and also facing similar institutional constraints as reported elsewhere in Nepal (Practical Action Nepal, 2008). By knowing farmers' perception of climate change, practices adopted and their awareness and involvement in the Local Adaptation Plan of Action (LAPA), it can be known where the local adaptation efforts are successful and where they are still underperforming.

Objectives and Methodology

The objectives of the study were to explore farmers' perception regarding the knowledge of climate change along with adaptation strategies and climate change vulnerability reduction and appraised farmers awareness and implementation of LAPA. In so doing, the study used qualitative case study research design (Creswell, 2012). The study was purposively conducted in Panchkhal Municipality-3, an administrative center of the Municipality. The municipality has the slogan “Panchkhal Municipality Agriculture City”. The Municipality presently has a government supported potato super-zone project with an objective of making ten hectares of land under potato cultivation over a decade by 2029 as part of the Prime Minister Agriculture Modernization Project. Meanwhile, the region is increasingly vulnerable to climate related disaster, in line with Nepal's profile as one of the more disaster prone countries in the world. The municipality is home to government agencies, international non-governmental organizations and local non-governmental organizations, which contribute to the field of climate change adaptation by supporting farmers in terms of knowledge and skills training, as well as logistical assistance.

Required narrative information were generated through in-depth interview (n=12 including five females) and focus group discussion (n=3) techniques. Thematic analysis of data was used and the narrative results were presented in the form of six themes corresponding to the specific objectives of the study. Findings were analyzed using Cultural Theory of Risk which offers an insight into how the same climatic risks are

sometimes acknowledged by various farmer, local government and non-governmental actors, but are differently prioritized, communicated and acted upon.

Findings: Knowledge and skills of Farmers on Climate Change

General level of understanding of climate change among farmers in the Municipality was basic to moderate, most of them often talk of the “observable changes in rainfall and temperature”. *The change in the climate or weather is what we understand as “climate change* [P1] shared. For example: irregular rain, random change in temperature of the surrounding, etc. She went on to explain, *“The problems occurred in farming due to climate change are dry fields in the farming season, decreased production of crops due to high temperature etc.”*

[P2] explained that, *“Climate change is the change in the normal climate of a location for a longer period of time due to the change in temperature of earth's atmosphere, high or low rainfall, etc. of the earth's atmosphere.”* [P3] noted that this first-hand experience has enabled the farmers to have a better understanding of the issue as compared to what is expected. *“Farmers are on the front lines and directly affected by climate change so, based on my experience, I think they have a moderate to strong understanding of the issue.”*

The sentiments expressed by the Focus group participants were echoed, with a few stating that irregular rains and temperature changes were the core of climate change which they directly associated with dry fields and reduced crop yields. Most of the respondents said that they knew about climate change because of their own experience, but some said they were aware because of the information they had received through the ward office, farmer-group education sessions, or – less frequently – the news media, suggesting that how they perceived climate change was a synthesis of their personal experience and information they received from other sources, which is similar to what has been found in the wider literature on adaptation (Reddy et al., 2022).

Farmers' Skills and Practices in Climate Change Adaptation

Farmers in Panchkhal are actively taking measures to adapt to the impact of the climate change. Farmers have turned to tunnel farming to protect vegetables and vine crops from cold spells and unpredictable rainfall. By combining tunnels with trellised, drought- and cold-tolerant varieties, households report more reliable harvests despite an increasingly erratic climate. *“Farmers are practicing crop diversification, improve irrigation, tunnel farming, construction of percolation (recharge) ponds, tunnel farming, tree shadowing, growing dry, cold-resistant crops and “water stress-tolerant” crops have been adopted”* [P4] expressed. *“The farmers' group has also provided trainings and instructions on these adaptation methods, while the ward office has held a programme called comprehensive discussion related to agriculture' in which farmers*

learned these methods, in addition to the information in the news; these are the main channels through which farmers acquired their adaptive knowledge in the municipality” [P5] expressed.

The practice has started to promote empowerment for the farmers, however, there is still a gap between the farmers and their self-sufficiency. [P6] commented: *“Corrective measures can be taken but not everything on our own.”* Participants in the focus group reported that they had observed some impacts of climate changes including erratic rainfall, temperature change, and drought and flooding, which had contributed to their crops drying up prematurely, production loss and agricultural pest. Facing longer dry spells, farmer groups in Panchkhal have built percolation ponds to recharge groundwater and store rainwater for irrigation. The technique spread through farmer-group trainings and the ward office’s agriculture discussion program, showing how low-cost, locally organised infrastructure can ease water stress ahead of larger government investment.

Effects of Climate Change Adaptation on Farmers’ Vulnerability

Farmers' perceptions of their adaptation practices have led to a decrease in vulnerability and better agricultural outcomes. It was common to hear about the progress in terms of better crop diversity, productivity and irrigation. *“Now we are growing four varieties of crops and production has been enhanced, also better environment is created for the farmers to make easier for cultivation,”* [P7] shared. *“Climate change adaptation assignments have helped to increase agriculture production sector, business opportunities have been increased due to these changes which have positively contributed in agriculture production and lifestyle at the local level and making the farmers self-employed,”* [P8] expressed. *“Agricultural output has expanded and now all four types of crops can be grown and this has helped alleviate farmers' uncertainties and vulnerabilities in some way,”* [P9] highlighted.

Discussions in the focus groups further detailed practices used, including: percolation ponds; drought, cold, and water tolerant crop varieties; new technologies, training, and materials; and trellised or vine crops, which were seen as both local and experience-based adaptation, as well as involvement with the United Nations Framework Convention on Climate Change and its Conference of the Parties. By diversifying into four crop types and adopting tunnel farming and improved irrigation, farmers describe a shift from uncertainty to a more stable, self-employment-generating agricultural system illustrating how incremental, farmer-led adaptation can translate directly into reduced vulnerability.

Evaluation of Climate Change Adaptation Practices

Local stakeholders use mostly participative and observation-based approaches to assess the effectiveness of adaptation. [P10] added: *“Local government has been undertaking field-visits and other activities to assess the outcome of the adaptation work, including to see if seeds and fertilizer are free from pesticides and to test soil fertility.”* To know the success... we hold direct conversation and discussion meetings with the farmer groups and stakeholders; we make regular field trips to observe and collect information, [P7] added. However, the effectiveness of a number of the evaluation programs is compromised by lack of institutional support, political instability and inadequate funding. [P6] pointed out: *“There is poor coordination with government and political and economic instability “and lack of effective evaluation is a major obstacle”.*

The participants of the focus group gave a positive picture of the outcomes on the ground, explaining how the farmers of the region have become more self-reliant, social and economic with agricultural production and animal husbandry with Panchkhal being a center of agricultural development in the region. But they also noted an ongoing problem independent of the adaptation measures: *“Challenging access to outside markets due to inadequate transportation facilities and competitive pricing”* as mentioned by [P8]. Even where farmers and local officials agree that adaptation practices are working, [P6] account of poor government coordination and political and economic instability shows how weak institutional follow-through can undercut the evaluation and scaling-up of successful local initiatives.

Implementation and Challenges of LAPA

There is a general level of awareness for LAPA and its goals among public representatives, but many farmers seem not to be familiar with the term and how to implement it, reflecting a lack of communication and awareness at the community level. *“Cooperating with the local people, adaptation work-plan based on the local resources, tools, knowledge, skills and practice, is included”* [P2] said. He also unpacked a number of key issues as follows: *“Unfair allocation of budget, lack of coordination with the government and lack of monitoring and evaluation, and political and economic instability of the community are key issues encountered in implementing LAPA in our community.”*[P6] mentioned that there were other challenges such as lack of technical knowledge/expertise, budgetary constraints and inadequate political interest. To enhance the effectiveness, [P2] suggested: *“We can work better with local people through conferences and discussions, and combine local knowledge and traditional practices to boost the effectiveness of LAPA”.*

Focus group participants reinforced these findings, describing a need for well-planned, government-coordinated implementation of adaptation tasks to build farmers' confidence, and identifying an extended list of challenges: an inability to implement the

National Adaptation Programme well, poor coordination with government, unfair distribution of budget across wards and municipalities, weak monitoring and evaluation, insufficient transparency and accountability, and continued political and economic instability.

The key informants and focus group participants repeatedly highlighted two key barriers to the implementation of LAPA – unfair distribution of the budget across wards and weak financial monitoring – indicating that Panchkhal's adaptation gains are less likely to be limited by lack of local knowledge than by uneven budget distribution and a lack of financial monitoring. Public representatives' knowledge of LAPA and the limited knowledge of the ordinary farmer about LAPA is a reflection of weak communication channels that hinder participatory implementation at the ward level.

Future Support for Adaptation

The participants have various supportive expectations for enhancing the climate change adaptation in Panchkhal, with a focus on institutional support, training, and participatory planning. *“To carry out more public awareness programs, technical trainings and to provide technology is what is needed, and the support of the local people and the attention of the local government is required”*, added [P8].

[P11] highlighted the importance of *“technology and skill-based training and orientation programs for collaboration in order to practice adaptation at local level”* and [P12] reiterated the view that *“better adaptation to climate change should start at the local level, through skill development and productivity, through collaboration.”* At policy level, [P2] suggested to develop an adaptation work plan with clearly identified problems and options to ensure effective implementation of climate change adaptation plans. The recommendations were confirmed by the focus group members, who noted the need for increased public awareness programs, enhanced knowledge and technical training and local administration support for marketing local products, as well as improved policy formulation and effective execution.

Overall, the practical action regarding climate change adaptation, and the degree of vulnerability has decreased as a result of adaptation practices, which has also enhanced productivity. Meanwhile, there are significant policy awareness gaps and a lack of technical resources and institutional support. Coordination, inadequate funding and unfairly allocated resources, and planning that does not include everyone remain a hindrance to progress. Enhancing local implementation of LAPA, increasing training, enhancing access to markets, and building collaborative governance models become the main focus areas for the advancement of climate resilience in the community. Farmers' calls to strengthen farmer groups, cooperatives, and community-based adaptation committees echo the FGD finding that Panchkhal households have become more self-reliant through collective agricultural and livestock production suggesting that future

adaptation support is likely to be most effective when it works through, rather than around, existing farmer organizations.

Discussions of Findings

Farming experiences of the farmers residing in Panchkhal Municipality-3 supplement empirical evidence about the impacts of climate change. In line with Below et al. (2015) and Mertz et al. (2009), farmers in this study did not refer to climate change in technical or scientific terms, but in terms of changes that they could observe and experience in the rainfall and temperature patterns and its impacts on crop production. There is a need to be sensitive to this framing of experience as this influences farmers' decision-making on whether to take up any potential adaptive measures or not (Reddy et. al., 2022), as farmers' perception of the climate risk rather than the actual climate risk influences their decision. In Panchkhal, the lived experience to perception to action was quite evident farmers who spoke about dry fields and reduced yields were the same ones who had implemented tunnel farming practices, percolation ponds and diversification of crops.

Adaptation measures tunnel farming, percolation ponds, crop diversification and improved irrigation practices are similar to those documented in other parts of Nepal's hills and mountains where farmer adaptation is largely incremental, through trial and error, including changing planting dates and introducing drought-tolerant varieties (Manandhar et al., 2011; Paudel et al., 2020; Sherpa, 2023). They further underscore the observation of the systematic review conducted by Rijal et al. (2022) that autonomous, farmer-led adaptation is more prevalent, and more apparent on the ground, than planned institutional adaptation in Nepal. This suggests that the farmers of Panchkhal have constructed their resilience through farmer group trainings and ward level discussion programs, which are largely bottom-up rather than top-down processes of extension in Nepal.

This gap between perception of adaptation working and perception of the evaluation and institutionalization of adaptation can be explored through the lens of Cultural Theory of Risk. CTR argues that the actors involved do not merely argue about what is and isn't true; they also approach these questions from the point of view of different institutional cultures, with their own ideas of what constitutes a risk, what knowledge they consider credible, and how success will be defined. Farmer groups in Panchkhal act in ways consistent with an egalitarian group culture, developing solutions that are shared and cooperative such as percolation ponds, cropping on a trellis, informal knowledge sharing through farmer groups – and defining success by face-to-face direct observation and trust in reference to “direct conversation and discussion meetings with the farmer groups and stakeholders.” Local government and donor-financed programs, on the other hand, tend to be more of a type of hierarchical bureaucracy with budget, monitoring, and formal planning documents. Poor coordination with Government and ineffective evaluation and unfair budget distribution and weak monitoring are not just resource

issues, but also a mismatch in the recognition and prioritization of risks between an egalitarian, trust culture of farmers and a hierarchical, procedure culture of government.

This cultural mismatch is one of the reasons why public representatives are reasonably familiar with LAPA, but ordinary farmers do not know it. Formal plans are generally passed down from senior management via formal planning documents in hierarchical institutional cultures, while group discussion and trusted peer networks are used in egalitarian farmer cultures. In the areas where the two channels do not overlap, farmers are actively working to adapt (and feeling that they are doing so well), but outside of the policy framework that should accompany and formalize their adaptation. It chimes in with the overall conclusion in the Nepal literature that limited financial resources, technical knowledge and infrastructure are the constraints to uptake of adaptation options (Devkota et al., 2018; Dahal et al., 2022), but also the constraint of how farmers and institutions define and communicate risk and success, with a cultural dimension.

Market-individualist variant of CTR as do the farmers' suggestions for the role of the private sector. The same conditions are implicitly recognized in the call for better prices, secure purchase contracts and better access to market for climate resilient produce, a different approach from the trust-based cooperation of the farmer group and the procedural planning of the government. Recommendations to strengthen cooperatives and collective bargaining can be interpreted as a strategy for farmers to reclaim some of this market risk through the use of more familiar and egalitarian forms of organization, similar to the global findings that collective and cooperative structures often act as a buffer between smallholder farmers and markets adaptation finance (Belay et al., 2022; Limantol et al., 2016).

The overall discussion indicates that there is no knowledge deficiency in Panchkhal's adaption challenge. Farmers' knowledge and response to climate change has been observed to be in line with the results of similar experiences from other areas of Nepal and other countries (Arbuckle et al., 2015; Joshi et al., 2017) and is locally appropriate. The more lasting barrier is institutional and cultural connecting an egalitarian culture of farmers based on experience with a hierarchical culture of government based on procedure; connecting a market-individualist private sector with an egalitarian culture of farmers; allowing the two sides to each value the other's understanding of risk. This cultural disadvantage has to be overcome and not just more technical knowledge passed on to farmers; it could be the most powerful tool for advancing the implementation of LAPA and climate resilience in Panchkhal in the future.

Conclusion and Policy Implications

This study concludes that farmers and local authorities in Panchkhal Municipality-3 have a moderate level of knowledge and practical action regarding climate change adaptation. It helped to decrease agricultural vulnerability and enhanced productivity.

Enhancing implementation of local adaptation of plan, increasing training, enhancing access to markets become the main focus areas for the advancement of local adaptation plan. Farmers are becoming more self-reliant through forming farmers groups, commercialization of agro and livestock productions. However, farmers are facing institutional barriers with a hierarchical culture of government based on procedure; connecting a market-individualist private sector with an egalitarian culture of farmers; allowing the two sides to each value the other's understanding of risk. This cultural disadvantage has to be overcome and not just more technical knowledge passed on to farmers; it could be the most powerful tool for advancing the implementation of LAPA and climate resilience in Panchkhal.

Therefore, the municipality must implement integrated institutional assistance to build local climate change adaptation measures more resilient. Federal government need to implement a National Climate-smart Agriculture Policy. Focusing on crop diversity, conservation of soil and water use efficiency in agriculture. Improve localized weather forecasts and early-warning systems. Establish specific climate change adaptation funds for smallholders. Municipal government need to increase investments in cheap irrigation systems, such as drip. Promote the use of local seed banks for hardier native species. Create community-based adaptation committees for joint decision making. Private market sector need to provide farmers with low-cost, sustainable farm machines. They can create high-value markets, provide contract farming with flexible loans and insurance, reducing post-harvest losses and promoting tax credits for investing in climate adaptation. I/NGOs need to support farmers in recovering losses due to the climate change through the provision of microfinance and insurance. They also need to encourage gender-inclusive adaptation in order to ensure that women and marginalized groups are equally provided access to resources and training. Local cooperatives need to organize farmer's field schools on pest management, soil health and crop rotation. They also need to improve collective bargaining to achieve improved prices and market access as well as encourage organic farming practices.

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