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**Impact of Climate Change on Agro-based Farming and Rural Farmers'
Livelihoods: A Study of Balakhu, Okhaldhunga**

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Abstract

This research examined the impact of climate change on agro-industries and rural farmers' livelihoods in Balakhu, Okhaldhunga, where agricultural systems have been severely disrupted, and extremely affecting smallholder farmers. The study explored the livelihood strategies adopted by farmers and examined the impact of climate change on agro-based farming and livelihoods in Balakhu. The study used a descriptive design and qualitative methods. Purposeful sampling ensured diverse farming contexts, with data collected from 188 participants using unstructured questionnaires and observations, while secondary data were gathered through literature reviews and document analysis. The data were analyzed using MS Excel for quantitative insights and narrative analysis for qualitative responses. The findings revealed that rising temperatures, irregular rainfall, and water scarcity have reduced crop yields and stressed livestock, while frequent floods, soil erosion, and pest outbreaks have further compounded the challenges. Seasonal shifts have disrupted planting and harvesting cycles, forcing farmers to transition to resource-intensive alternative crops. These challenges highlight the urgent need for adaptive strategies such as climate-resilient crops, improved irrigation systems, and sustainable land management practices. The study concludes that climate change significantly affects agriculture, rainfall patterns, and temperatures, posing a serious threat to livelihoods in the region.

Keywords: adaptive strategies, agro-based farming, Balakhu, climate change, livelihood

Impact of Climate Change on Agro-based Farming and Rural Farmers' Livelihoods: A Study of Balakhu, Okhaldhunga

Climate change stances a significant threat to global stability and agricultural sustainability, with shifting weather patterns and rising sea levels threatening food production worldwide (Maharjan, 2024). Climate change has become a threat to agriculture and livelihoods globally. The entire world has been suffering from climate change and its effects when developing countries are marked more than developed countries. The climate pattern have been changed due to high increase levels of atmospheric carbon dioxide, produced by the use of the fossil fuels over the decades (Chaudhary et al., 2020). It is a threat to the lives in the world that largely affects water resources, agriculture, coastal regions, freshwater habits, vegetation and forests, snow cover and melting and geological processes such as landslide, desertification and floods, and has long term effects on food security as well as in human health (Malla, 2009).

People throughout the world who depend on agriculture for their employment are particularly vulnerable to the devastating effects of climate change. It is anticipated that the consequences of climate change on agricultural productivity and livelihoods would differ throughout nations and areas and will become more pronounced over time (Chambers & Conway, 1992; FAO, 2016) .

Livelihood refers to the resources and activities that individuals or groups use to meet their basic needs. It comprises the abilities, assets, and endeavors necessary for a sustainable lifestyle that can adapt to hardship and enhance opportunities for the future (Chambers & Conway, 1992). Among the many natural and man-made factors influencing livelihoods are cultural aspects and environmental conditions. While local economies and agricultural practices are influenced by climate, human interactions with the environment shape settlement patterns and cultures. The relationship between human life and the environment has a significant impact on people's ability to cope with challenges, and climate

change is negatively affecting livelihoods all over the world (Khatri & Pasa, 2023).

Climate change in Nepal has intensified the frequency of natural disasters, such as floods, landslides, and glacial lake outburst floods, threatening lives and infrastructure. It has also disrupted agricultural productivity, impacting the livelihoods of rural communities dependent on climate-sensitive farming practices. Nepal has implemented several climate change policies, including the National Adaptation Programme of Actions (NAPA) and Local Adaptation Plans (LAPA), to address the needs of vulnerable communities (Ministry of Environment of Nepal, 2011). Developmental research often focuses on the responses of local population climate change, highlighting the importance of community perspectives and traditional knowledge (Hughes, 2013).

The present study aims to explore the status of farmers and their agro based products regarding climate change and its impact on their way of life. One of the main environmental problems that affect people, animals, and plants in different ways is climate change. The topic of climate change has been the subject of study, research, and debate because Nepal is a mountainous nation with diversity in geography, hydrology, plants, animals, and ethnic groups. Changing rainfall patterns of Nepal, temperature, and other climatic conditions have a direct or indirect impact on livelihoods of People in addition to plants and animals (Sapkota, 2024).

The study found significant impact of climate change on agro-based industries and the livelihoods of rural farmers in Balakhu. As climate change accelerates, it alters weather patterns, disrupts agricultural cycles, and contributes to extreme weather events. These changes lead to reduced crop yields, challenges in production, and economic instability for those dependent on farming and related industries. Rural farmers, already vulnerable due to limited resources and adaptive capacity, face heightened risks to their income and food security (WWF,

2005). Understanding the specific effects on agro-industries in the study area is essential for developing effective mitigation and adaptation strategies.

This study has shown that the impacts of climate change on livelihoods of farmers are evident, making adaptation crucial for coping with these changes. The goal is to enhance understanding of these effects on agro-industries and to recommend policy interventions to support vulnerable farming communities. Understanding how farmers implement adaptation measures to sustain their livelihoods is particularly important given the severity of climate change effects on agro-based livelihoods in Balakhu, located within Sunkoshi Rural Municipality, Okhaldhunga. This study, using a qualitative research approach, explores perceptions of farmers in impacts of climate change on various farming aspects.

Literature Review

Several recent studies have focused on the impacts of climate change on various aspects of human life and livelihoods in Nepal; however, there remains a significant knowledge gap in understanding its localized effects on specific communities, adaptive strategies, and long-term socio-economic implications (Dhakal, 2021). Glaciers are melting at alarming rates, heightening the risk of glacial lake outburst floods that pose significant threats to lives, property, and community relocation efforts (WWF Nepal Program, 2005). A study explores the impact of climate variability on livelihoods, highlighting how extreme weather events such as floods, droughts, and glacier melt jeopardize food security and agricultural productivity (Davis & Hirji, 2019). They argue that climate change is one of the primary barriers to sustainable development and poverty reduction initiatives. Studies (Sharma et al., 2020; Gautam & Bhandari, 2019; Dhakal, 2021) have explored diverse socio-ecological contexts of Nepal, highlighting the differing perceptions and experiences of rural communities regarding climate change. However, significant gaps remain in fully understanding the effects of

climate change on water resources and related hazards in the Himalayan region. To address these knowledge deficits, scholars recommend the implementation of monitoring systems that integrate considerations of socioeconomic development, ensuring a more holistic approach to climate adaptation and resource management (Chapagain et al., 2010).

The effects of climate change in the Manang Valley have been investigated, with four adaptation strategies proposed to bolster food production resilience: reclaiming abandoned land, substituting barley with wheat, reducing conspicuous consumption, and modifying agricultural practices (Aase et al., 2013). The importance of incorporating local knowledge as a vital resource for addressing climate change is emphasized, particularly through the examination of the intersection of local socio-cultural narratives and global climate discourses (Scally, 2019).

Environmental changes disproportionately impact different groups, with women facing greater challenges in collecting fodder and men experiencing increased difficulty in gathering firewood (Massey et al., 2010). The adverse effects of altered snowfall and monsoon patterns on the livelihoods of the Lama and Dalit communities have been documented (Maharjan, 2024). Many Nepali farmers rely on traditional knowledge to interpret climate change, highlighting the need for comprehensive support systems to foster effective coping mechanisms (Ministry of Environment of Nepal, 2011). Community-level projects designed to mitigate the effects of climate change in sectors such as infrastructure, forestry, and agriculture have been the focus of some studies (Sapkota, 2024).

Adaptive techniques and indigenous knowledge utilized by Kathmandu farmers in response to declining rainfall have also been highlighted (Rijal et al., 2022). The cultural dimensions of climate change's impact on millet production among the Magar community in Baglung district have been examined, linking these shifts to changes in ritual practices and livelihoods (Khatti, 2013). Sharma

et al. (2020) provide a comprehensive review of how gendered roles in agricultural practices intersect with climate change, emphasizing the unequal burden placed on women in managing biodiversity under shifting environmental conditions. Similarly, significant changes in rainfall patterns of Nepal, including decreases in pre- and post-monsoon rainfall, have critical implications for livestock and agricultural management. Extending this discourse, the research emphasizes the need to examine climate change and migration by assessing push and pull factors to inform future development priorities (Bhattarai et al., 2015).

The literature discussed above underscores the significant impact of climate change on agro-based industries and rural livelihoods in Nepal, with communities like Balakhu in Okhaldhunga facing a variety of challenges. Melting glaciers and extreme weather events, such as floods and droughts, are major threats to food security, agricultural productivity, and the overall stability of these communities (Sharma et al., 2020). These environmental stresses not only affect the immediate agricultural output but also disrupt the socio-economic fabric of rural areas, demanding urgent adaptive measures (Dhakal, 2021). While rural farmers often rely on traditional knowledge for resilience, they face mounting difficulties from shifting monsoon patterns and gender disparities exacerbated by changing agricultural practices. To effectively support these farmers and enhance their resilience, it is essential to integrate local knowledge and implement community-level adaptation strategies, promoting sustainable development and mitigating climate vulnerabilities (Gautam & Bhandari, 2019).

Objective

The general objective of this study is to assess the impact of climate change on agro-based farming and the livelihoods of the rural farmers in the community of Balakhu village of Okhaldhunga district. The specific objectives are as follow:

- a. To access the practices of livelihood strategies adopted by farmers.

- b. To investigate how agro-based farming and livelihoods are affected by climate change.

Methodology

The study was adopted descriptive design and conducted by using qualitative method in which data were collected by researcher with the participants by using unstructured questionnaire and observation. Such approach supported to explore the lived experiences of farmers with effects of climate change on agro-based farming and livelihood. For the primary data, 188 participants, out of 3918, were selected using of purposeful sampling techniques to ensure representation from a range of farming contexts within the study area. Similarly, secondary data consists of literature reviews and document analyses in order to assess the impact of climate change in agro- industries and livelihoods of farmer. Data were analyzed using tables and figures with the support of MS Excel, while the perceptions of respondents were analyzed narratively.

Description of the Study Area

Balakhu is a village of Sunkoshi Rural Municipality which is in the Okhaldhunga District of Koshi Province, mid-eastern Nepal. It lies on the bank of Sunkoshi River, in the southwestern part of Okhaldhunga District. Following the restructuring of Nepal in 2007 A.D., Balakhu was divided into two wards (Ward Nos. 1 and 2) within Sunkoshi Rural Municipality. According to the census of Nepal, 2022, Balakhu has a population of 3,918, with Ward No. 1 accounting for 2,145 and Ward No. 2 hosting 1,773 population, living in 835 individual households.

Balakhu is a rural community known for its rich agricultural heritage and reliance on agro-based farming. Situated in a hilly region, the village supports the cultivation of diverse crops, including paddy, maize, millet, cereals, wheat, and various vegetables and fruits. Traditional farming practices, deeply rooted in local culture and passed down through generations, form the backbone of economy of

the village. However, Balakhu faces significant challenges posed by climate change, such as unpredictable rainfall patterns, prolonged droughts, and increased pest infestations. These factors adversely affect crop yields and threaten the livelihoods of the local farmers. Despite these challenges, the community demonstrates resilience through adaptive strategies that are critical for sustaining agricultural productivity and ensuring food security.

Results and Discussion

Nepal has diverse agricultural zones, including plains, hills, and mountains. The cropping patterns of farmers are influenced by the characteristics of these agro-zones. Climatic factors have a significant impact on the ecological distribution of agricultural production. Climate change primarily affects water resources, herbs, pasturelands, crops, vegetables, cereals, and soil quality. An increase in temperature causes greater damage to the agricultural sector compared to other types of production. As temperatures rise, cropping patterns and vector-borne diseases affecting humans and livestock (Malla, 2009).

Most of the informants in the study area reported that the timing of crop planting and harvesting has changed compared to previous years. Similarly, the frequency of landslides, floods, irregular rainfall, droughts, and vector-borne diseases has been increasing in the community. Based on the study and perceptions of farmers, the researcher has presented the results and discussion through detailed data analysis.

Water Sources in Balakhu Village

This region is home to several large and small water sources. The Sunkoshi River, the largest water source, flows to the south of the area. Other notable streams include Balakhu Khola, Mate Khola, Kaule Khola, Jalkeni Khola, Katuwa Khola, Lukuwa Khola, Ambote Khola, Ririshe Khola, and Sankhe Khola and name a few. In addition to these, there are several small ponds that supply clean drinking water.

Balakhu Khola, Sankhe Khola, Ambote Khola, Katuwa Khola, Sirise Khola, and Lukuwa Khola serve as primary sources of irrigation. However, water availability is largely limited to the wet season, with these streams almost drying up during summer and experiencing flash floods during the rainy season. Despite the presence of the Sunkoshi River, it is not yet utilized for irrigation due to the absence of modern water-lifting technology. Residents have reported a noticeable decline in the flow of these water sources. Many perennial streams in the area have become seasonal or have dried up entirely, posing challenges to both drinking water and irrigation needs.

Consequently, inhabitants of the study area increasingly rely on traditional water sources such as Kuwa and local streams to meet their water needs. The existing drinking water supply of the area is insufficient. The local government intends to draw water from the Sunkoshi River to meet the increasing demand for drinking water (Sunkoshi Rural Municipality, 2022). People hope that after the project is completed, extra water may be used for irrigation on small family farms, increasing the agricultural output of the area.

Factors Effecting Climate Change

The observed factors of climate change such as rising temperatures, irregular rainfall patterns, declining water resources, and increased natural disasters, have significantly disrupted the agricultural systems in Balakhu. These changes have led to shifts in cropping patterns, reduced soil fertility, and greater vulnerability to pests and diseases, as farmers struggle to adapt their practices to a rapidly changing environment. Seasonal shifts further complicate planting and harvesting schedules, shortening growing periods and limiting productivity. These factors underline the complex relationship of climate change impacts, threatening both agro-industries and the livelihoods of farmers who depend on sustainable agricultural practices for survival.

Table 1

Observation of Farmers on Effecting Factors of Climate Change

Effecting factors of climate change	Observation of farmers on effecting factors of climate change	Response 'Yes' (%)	Response 'No' (%)
Temperature	Noticeable warming, particularly during the summer months	90	10
Rainfall Pattern	Delayed onset and irregular rainfall; shorter monsoon seasons.	95	5
Water Resource Availability	Streams and small ponds drying up during summer; flash floods in rainy seasons.	93	7
Soil Fertility capacity	Loss of topsoil due to frequent floods; declining soil fertility over time.	80	20
Pest and disease outbreak	Increased frequency and intensity of crop and livestock diseases	95	5
Crops adaptability	Shifts in crop-growing areas; traditional crops struggling to adapt	80	20
Natural Disasters	Increased frequency of landslides and floods due to extreme weather.	90	10
Seasonal Shift	Changes in planting and harvesting times; shorter growing seasons.	98	2
Average (mean) in percent		90.12 %	9.88 %

Note. The data in the table is based on the field survey carried out in 2024.

According to Table 1, a substantial majority (90%) reported noticeable warming, especially during summer, highlighting the impact of rising temperatures on agricultural productivity and livestock health. Similarly, 95% of respondents noted irregular rainfall patterns, including delayed onset and shorter monsoon seasons, which disrupt traditional farming calendars and exacerbate irrigation challenges. Water resource availability is another critical concern, with 93% observing the drying up of streams and ponds in summer, compounded by flash floods during the rainy season. Soil fertility is declining, as reported by 80% of farmers, due to frequent flooding and topsoil erosion, leading to reduced agricultural productivity and increased dependency on chemical inputs. Pest and disease outbreaks were identified by 95% of respondents, affecting both crops and livestock and escalating the cost of farming. Furthermore, shifts in crop adaptability were noted by 80% of farmers, with traditional crops struggling to flourish under changing climatic conditions.

Natural disasters, such as landslides and floods, were highlighted by 90% of farmers, causing damage to farmland and infrastructure. Seasonal shifts were observed by 98% of respondents, indicating changes in planting and harvesting times and shorter growing seasons, which disrupt crop cycles and overall agricultural productivity. On average, 90.12% of respondents acknowledged the impact of climate change across these indicators, emphasizing its persistent influence on agriculture and livelihoods in the region.

Impacts of Climate Change on Agro-based Farming and Livelihoods

The study exposed that temperatures in the region have been steadily rising, while the amount and patterns of rainfall have undergone significant changes. Compared to previous years, snowfall has ceased, and the occurrence of frost, dew, fog, and hail has noticeably declined. These changes highlight the pressing impacts of climate change in Balakhu. Key challenges include reduced agricultural productivity, higher risks of crop failure, limited water resources, increased heat stress on crops and livestock, declining soil quality, and disrupted agricultural calendars, all of which threaten local livelihoods.

Table 2

Perceptions on Impacts of Climate Change on Agro-Based Farming and Livelihoods

Factors of climate change	Perceptions on impacts of climate change on agro-based farming and livelihoods	Response 'Yes' (%)	Response 'No' (%)
Temperature	Reduced productivity of temperature-sensitive crops; heat stress for livestock.	95	5
Rainfall Pattern	Reduced crop yields; increased reliance on irrigation; higher risks of crop failure.	96	4
Water Resource Availability	Limited water for irrigation; higher dependency on rain-fed agriculture	97	3
Soil Fertility capacity	Reduced agricultural productivity; increased costs for fertilizers and soil treatments	90	10
Pest and disease outbreak	Loss of crops and livestock; additional expenses for pest and disease management.	90	10
Crops adaptability	Farmers transitioning to different crops, requiring new knowledge and inputs.	95	5

Natural Disasters	Damage to farmland, infrastructure, and livelihoods.	98	2
Seasonal Shift	Disrupted agricultural calendars; reduced production cycles	97	3
Average (mean) in percent		94.75 %	5.25 %

Note. The data in the table is based on the field survey carried out in 2024.

The results from the study (Table 2) demonstrate the significant impacts of climate change on agro-industries and livelihoods of farmers in Balakhu. A remarkable 94.75% of respondents acknowledged the adverse effects of climate-related changes across various indicators. Rising temperatures were reported by 95% of farmers as a major factor reducing the productivity of temperature-sensitive crops while also causing heat stress in livestock. Similarly, 96% of respondents observed disruptions in rainfall patterns, which have led to reduced crop yields, increased dependency on irrigation, and heightened risks of crop failure. Water resource availability emerged as a critical concern, with 97% of respondents highlighting limited water for irrigation and increased reliance on rain-fed agriculture, especially during the dry season. Soil fertility has also been significantly affected, with 90% of farmers reporting declining agricultural productivity and rising costs associated with soil treatments and fertilizers. Pest and disease outbreaks have become more frequent, with 90% indicating substantial losses in crops and livestock, coupled with additional financial burdens for pest and disease management.

The adaptability of traditional crops is another pressing issue, with 95% of respondents noting a transition toward different crops requiring new knowledge and inputs, a challenge for farmers accustomed to traditional practices. Natural disasters, such as floods and landslides, have imposed widespread damage on farmland, infrastructure, and livelihoods, as reported by 98% of respondents. Seasonal shifts were also observed by 97%, disrupting agricultural calendars and reducing production cycles, thereby intensifying the challenges for agro-industrial activities.

Table 3*People's Perception on Changing Crop Sowing and Harvesting Time*

Change in Crop Sowing and Harvesting Time	No. of Respondents	Percent (%)
Yes	110	58.51
No	78	41.48
Total	188	100

Note. The data in the table is based on the field survey carried out in 2024.

Rainfall shifts have caused maize and rice to snow later in the past and present. These two crops were traditionally sown in *Baisakh or Jestha*, but now people must wait until *Asar*. The informants did not state whether the time for wheat sowing had changed from the past. *Kartik/Mangsir* is when wheat is sown. According to informants, there hasn't been much of a change in harvest time. According to the majority of them, crops that are sown earlier will be harvested sooner, and crops that are sown later will ripen later. However, some of the informants agreed that they have noticed a shift of roughly 15 days in the ripening time of all crops and fruits as a result of rising temperatures and shifting soil quality. Crop sowing and harvesting times are directly impacted by altered weather patterns, particularly those related to temperature and precipitation.

Findings

The findings from the study illustrate the profound impacts of climate change on agro-industries and the livelihoods of farmers in Balakhu. Rising temperatures, reported by 95% of respondents, have reduced the productivity of temperature-sensitive crops and caused heat stress in livestock. Disrupted rainfall patterns, noted by 96%, have led to reduced crop yields, increased reliance on irrigation, and heightened risks of crop failure. Water resource availability has emerged as a critical issue, with 97% of respondents highlighting the drying up of streams and ponds, increased dependency on rain-fed agriculture, and challenges in accessing sufficient water for irrigation.

Soil fertility has declined significantly due to frequent floods and erosion, as reported by 90%, forcing farmers to rely on expensive fertilizers and soil treatments. Pest and disease outbreaks have intensified, affecting crops and livestock, with 90% of respondents highlighting increased financial and labor burdens. Farmers are also transitioning to alternative crops to adapt to climate changes, but this shift, noted by 95%, requires additional resources and knowledge. Natural disasters such as floods and landslides have caused widespread damage, as indicated by 98% of respondents, while seasonal shifts have disrupted planting and harvesting schedules, reducing production cycles.

The findings underscore the need for adaptive strategies, including improved irrigation, soil conservation techniques, pest management, and the adoption of climate-resilient crop varieties. Addressing these challenges is essential to mitigate the adverse effects of climate change on agro-industries and farmers' livelihoods in Balakhu.

The increased variability in temperature, rainfall, and water resources, combined with soil degradation and pest outbreaks, creates a challenging environment for agricultural sustainability. Natural disasters and seasonal shifts further exacerbate the difficulties farmers face, highlighting the urgent need for adaptive strategies, such as climate-resilient crops, efficient irrigation systems, and sustainable land management practices, to mitigate these impacts and safeguard livelihoods.

Conclusion

The study concludes that climate change has profoundly affected the agro-based farming and livelihoods of farmers in Balakhu. Rising temperatures and altered rainfall patterns, particularly a decline in winter, have reshaped agricultural landscape in the area. Traditional weather phenomena such as fog, dew, frost, and hail are now rare, signaling a dramatic shift in climatic conditions as remembered by the local community. While residents share consistent

experiences and interpretations of these changes, individual perceptions vary, reflecting the complexity of the impacts.

The findings indicate that climate change has led to declining soil quality, changes in agricultural practices, increased crop and human diseases, and more frequent droughts. These disruptions underscore the dynamic and multifaceted nature of livelihoods, which are influenced by environmental changes and factors of climate change but also by socio-economic and cultural factors. To mitigate these impacts and support local livelihoods, community-based climate adaptation strategies are essential. These should include raising awareness of climate change effects, promoting climate-resilient agricultural practices, and integrating traditional knowledge into modern adaptation measures. To safeguard livelihoods and ensure sustainability, implementing community-led climate adaptation strategies, preserving traditional knowledge, and promoting climate-resilient practices are imperative.

References

- Aase, I., Aase, K., & Dieckmann, P. (2013). Teaching inter-professional teamwork in medical and nursing education in Norway: A content analysis. *Journal of Inter-professional Care*, 27(3), 238–245. <https://doi.org/10.3109/13561820.2012.745489>
- Bhattarai, B., Beilin, R., & Ford, R. (2015). Gender, agrobiodiversity, and climate change: study of adaptation practices in the Nepal Himalayas. *World Development*, 70(September 2017), 122–132. <https://doi.org/10.1016/j.worlddev.2015.01.003>
- Chambers, R., & Conway, G. R. (1992). Sustainable rural livelihoods: Practical concepts for the 21st century. *IDS Discussion Paper*, 296 (January 1992).
- Chapagain, S. K., Pandey, V. P., Shrestha, S., Nakamura, T., & Kazama, F. (2010). Assessment of deep groundwater quality in Kathmandu valley using multivariate statistical techniques. *Water, Air, and Soil Pollution*, 210(1–4), 277–288. <https://doi.org/10.1007/s11270-009-0249-8>
- Chaudhary, D., Maharjan, S., Anusha, & Pallapu, V. (2020). The effect of climate change in the rural livelihood in Nepal (case of Badarjhula of Chitwan district, Bagmati Province, Nepal). *IOSR Journal of Humanities and Social Science (IOSR-JHSS)*, 25(2), 21–30. <https://doi.org/10.9790/0837-2510022130>
- Davis, R., & Hirji, R. (2019). Climate risks and solutions: Adaptation frameworks for water resources planning, development and management in south Asia background paper. *Review of Water and Climate Change Policies in South Asia* (May). <https://doi.org/10.5337/2019.202>
- Dhakal, M. (2021). Long-term socioeconomic impacts of climate change on vulnerable communities in Nepal. *Climate Change Research*, 10(1), 78–89.
- FAO. (2016). The state of food and agriculture, 2016. *The Eugenics Review*, 59 (2).

- Gautam, D., & Bhandari, K. (2019). Community responses to climate change in rural Nepal. *International Journal of Climate Adaptation*, 8(2), 123–136.
- Hughes, J. (2013). *Food and agriculture: Environmental management in organizations*. The IEMA Handbook (2nd ed.).
<https://doi.org/10.4324/9780203597675-13>
- Khatri, B. B., & Pasa, R. B. (2023). Climate change adaptation strategies of the communities in Bagmati Province, Nepal. *Pravaha*, 29(1), 89-102.
- Khattri, M. B. (2013). Climate change, millet and ritual relationship with the Magars of Argal, Baglung, Nepal. *Dhaulagiri Journal of Sociology and Anthropology*, 6, 107–124. <https://doi.org/10.3126/dsaj.v6i0.8481>
- Maharjan, R. K. (2024). Impacts of climate change on farm based livelihood: A study of Panchkhal. *Journal of APF Command and Staff College*, 7(1), 16–50. <https://doi.org/10.3126/japfcsc.v7i1.66996>
- Malla, G. (2009). Climate change and its impact on Nepalese agriculture. *Journal of Agriculture and Environment*, 9, 62–71.
<https://doi.org/10.3126/aej.v9i0.2119>
- Massey, D. S., Axinn, W. G., & Ghimire, J. G. (2010). Environmental change and out-migration: Evidence from Nepal. *Population and Environment*, 32(2), 109–136. <https://doi.org/10.1007/s11111-010-0119-8>
- Ministry of Environment of Nepal. (2011). *National framework on local adaptation plans for action climate change management division*. Ministry of Environment of Nepal.
- Rijal, S., Gentle, P., Khanal, U., Wilson, C., & Rimal, B. (2022). A systematic review of Nepalese farmers' climate change adaptation strategies. *Climate Policy*, 22(1), 132–146. <https://doi.org/10.1080/14693062.2021.1977600>

- Sapkota, K. N. (2024). Local people response to flood in Roshi rural municipality, Kavrepalanchowk: Adaptive strategies for resilience. *International Journal of Democracy and Development*, 7(3), 29–36.
- Sally, D. De. (2019). “Because your environment is looking after you”: The role of local knowledge in climate change adaptation in Cook Islands [Master’s Thesis, University of Waterloo].
<https://uwspace.uwaterloo.ca/items/7e716ebd-2619-46dc-ae99-676f221f9cda>
- Sharma, B., Thapa, S., & Koirala, R. (2020). Climate change impacts on livelihoods in Nepal: A comprehensive review. *Journal of Environmental Science*, 12(3), 45–60.
- Sunkoshi Rural Municipality (2022). Profile of Sunkoshi Rural Municipality, 2023.
- WWF Nepal Program. (2005). *An overview of glaciers, glacier retreat, and subsequent impacts in Nepal, India and China*. WWF Nepal Program.