

Impacts of climate change on the livelihood of people and their adaptation strategy: a case study from Chaukune rural municipality of Surkhet district, Nepal

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Abstract— Climate change refers to the variation in temperature and rainfall patterns that directly or indirectly affect human activity. A study on “Impacts of climate change on the livelihood of people and their adaptation strategy” was conducted in Chaukune Rural Municipality-4 of Surkhet district to analyze how temperature and precipitation trends changed over 30 years, and the impacts people faced and the adaptation measures they used. Information was obtained from household surveys, focus group discussions, key informant interviews, field observations, and reviews of the Department of Meteorology and Hydrology data and literature on climate change impacts and adaptation measures. The data were analyzed using Microsoft Excel and are presented in this report.

The study revealed that the average annual temperature increased by 0.0306°C, and rainfall patterns were unusual, with a decrease of 0.72 mm in annual rainfall and torrential rainfall during the monsoon season. This change in temperature and rainfall pattern has posed a significant threat to the livelihoods of people living in study areas, impacting agriculture, forestry, water resources, and the overall resilience of farmers. Torrential rainfall damaged irrigation systems, agricultural fields, forest areas, drinking water supply systems, and community land through landslides and floods. In addition, winter and early-summer droughts led to forest fires in the study areas. Furthermore, there was a decreasing trend in crop production and challenges in water management, highlighting the need for community-based adaptation initiatives. The common adaptation measures used by the respondent households are a change in cropping time, fertilizer use, plantation in farmlands and degraded forest areas, forest protection from fire, mulching in crop growing areas, water source protection, home gardening, changing crops, and construction of a check-dam to cope with climate change impacts.

Keywords— Adaptation Strategy, Climate Change, Climate Change Impacts, Rainfall, Temperature

I. INTRODUCTION

The change in climate over a given period, driven by natural processes or human activities, is called climate change. (IPCC, 2014). These changes, caused by both natural processes and human activity, are profoundly affecting the environment. Climate change can have disproportionately negative impacts on populations whose livelihoods depend heavily on natural resources, including agriculture, fishing, and forestry. Climatic variability in fragile ecosystems and nature-based livelihood systems of rural communities has further threatened local livelihoods. (Tiwari et al., 2015). Understanding and adapting to these repercussions is critical for fostering resilience and ensuring long-term growth.

Intergovernmental Panel on Climate Change's Sixth Assessment Report defines climate change as a change in the state of the climate that can be determined (for example, using statistical tests) by changes in the mean and/or variability of its attributes, and that lasts for a long time, generally decades or more. Climate change can be caused by natural internal processes or external forcings such as solar cycle modulation, volcanic eruptions, and long-term anthropogenic changes in atmospheric composition or land use (IPCC, 2003). There have



been fast changes in the atmosphere, ocean, cryosphere, and biosphere. Human-caused climate change is already impacting weather and climate extremes worldwide. This has resulted in broad, detrimental effects, including associated costs and damage to nature and people (high confidence). Vulnerable groups are disproportionately affected by climate change, despite their historically low contributions (IPCC, 2014). In addition, population growth and environmental degradation have intensified climate change and its impacts on people. Climate change is expected to have severe environmental, economic, and social impacts in the Hindu Kush Himalayan region, where rural farmers whose livelihoods depend on natural resources (ICIMOD, 2009). The region is also challenged by issues like poverty, environmental degradation, natural resource depletion, shrinking water resources, desertification, and climate change (Schid, 2008). Climate change and biodiversity loss are among the most important environmental challenges we face today. Both are complex and cross-cutting issues that affect nearly all human activity (European Union, 2013). The mean annual temperature is predicted to have climbed by 0.06 degrees Celsius between 1977 and 1994, and it is expected to rise by another 1.5 degrees Celsius by 2030 (IPCC, 2021).

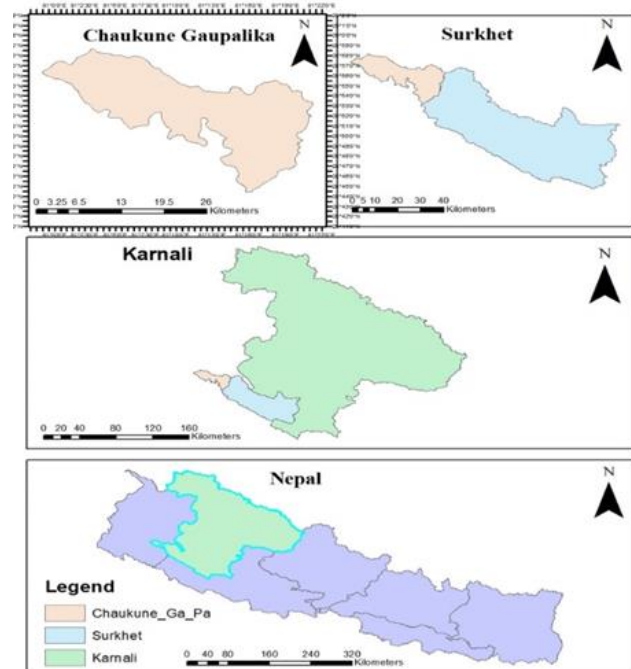
Human activities such as deforestation, fossil fuel combustion, livestock ranching, industrial waste, and forest fires are major drivers of human-induced climate change (Kaggwa et al., 2009). Global warming is one of the significant impacts of climate change. The Earth's warming is already having measurable consequences, and future impacts are expected to be wide-ranging and costly (IPCC, 2007a). Increasing levels of soot, sulphates, and other aerosol components in atmospheric brown clouds (ABCs) pose significant threats to water and food security in Asia. It is very likely that, overall, human activities since 1750 have contributed to global warming; evidence from all continents and most oceans shows that many natural systems are affected by regional climate change, particularly through increases in temperature (IPCC, 2007b). These changes will exert significant pressure on ecosystems, including water bodies, forests, and agricultural lands, further reducing agricultural productivity in the region. Apart from climate-related challenges, socioeconomic factors like poverty, migration, and population growth will also intensify the strain on agricultural systems and productivity. The implications of these challenges for a small Least Developed Country (LDC) such as Nepal, characterized by extreme geography and a high dependency on agriculture for livelihoods, remain inadequately understood (NCVST, 2009). The National Adaptation Programs of Action of the Ministry of the Environment, a body of the Nepal government (NAPA, 2010), identifies agricultural land across the entire southern plain region of the country as vulnerable to sedimentation from floods and inundation. Similarly, drought is affecting crop production and animal husbandry. The winter drought assessment confirmed that production of the major winter crops, wheat and barley, decreased nationally in 2009 by 14.5% and 17.3%, respectively, compared to previous years (FAO, 2008).

In Nepal, sustainable forest management has become a viable adaptation tactic. Numerous of these initiatives have significantly improved local adaptation to climate change. However, there are several criticisms that Nepal's adaptation strategies are frequently haphazard and unplanned, leading to mal-adaptation outcomes and ineffective adaptation due to a lack of economic frameworks, technology, resources, and integration of multi-level organizations in adaptation governance (Adhikari et al., 2018; Ranabhat et al., 2018). Adaptation measures also require a holistic and integrated approach to implementing community-managed resource-based activities to enhance local adaptive capacity (Younus, 2017). Activities related to building infrastructure, and institutional and communication networks, supported by government initiatives and international organizations, are important for fostering adaptive capacity (Younus, 2017; Bhandari, 2022). The effectiveness of these strategies needs to be evaluated against criteria relevant at different levels (Neil Adger et al., 2005).

People of Chaukune Rural Municipality are not externally supported to cope with climate change impacts. To identify, document, and disseminate climate change-related information and people's perceptions of climate change, its impacts, and the adaptation measures applied locally, we conducted a study in Chaukune Rural Municipality-4 of Surkhet district, Karnali Province, Nepal. This study explores and identifies the impact of climatic variability on livelihoods and agricultural practices in Surkhet district, Karnali Province, to assess adaptation success.

II. METHODOLOGY

FIGURE 1 LOCATION MAP OF THE STUDY AREA



1) Study Area

The study was conducted in Surkhet District, Nepal, an Inner

Terai district covering 2,489 km² with a population of 417,776 in 2021. The district lies at 28°31' N and 81°46' E and is influenced by the Bheri River and Karnali River systems. The specific study site was Chaukune Rural Municipality-4, which had a population of 26,950 in 2021. The area is highly dependent on agriculture and natural resources and is increasingly exposed to climate-related hazards, including floods, erosion, extreme rainfall, and seasonal water scarcity. Although local communities have adopted some autonomous adaptation practices, these remain insufficient to address the increasing intensity and frequency of climate impacts. Figure 1 illustrates the location of the study area.

2) Sampling design

During the household survey, households were selected using simple random sampling. The household number for the survey was calculated using the Cochran formula (1977). The Cochran formula allows us to calculate an ideal sample size given a desired level of precision, desired confidence level, and the estimated proportion of the attribute present in the population. Cochran's formula is particularly appropriate for large populations. A sample of any given size provides more information about a smaller population than a larger one, so there is a 'correction' through which the number given by Cochran's formula can be reduced if the whole population is relatively small.

$$n = \frac{N \times Z^2 \times P (1 - P)}{Nd^2 + Z^2 \times P (1 - P)}$$

Where,

- N= Population size
- P= Proportion of the sample on the population estimated (sample size as 5% of the population size)
- d= required level of precision (0.05%)
- Z= confidence Interval chosen (c= 1.96 for 95% confidence)

In Chaukune Rural Municipality-4, there were 513 households. Based on the Cochran formula 1977, 100 households need to be surveyed.

3) Data collection methods

a. Primary data collection

Participatory Rural Appraisal (PRA) tools and techniques used for field information collection included questionnaire surveys, key informant interviews, focus group discussions, and direct observation.

• Household Survey

First, a questionnaire for the survey was prepared, tested in a few households, and finalized. Then, 100 households out of 513 were selected from the three economic groups (rich, middle, and poor) using simple random sampling. A questionnaire survey was conducted in selected households across different economic groups to assess their socio-economic conditions and general awareness of climate change and its impacts. Questions about how they are affected by climate change-related events, which area of their livelihoods is most affected, and the

remedial measures taken by each household were also recorded during the household-level questionnaire survey.

• Focus Group Discussion

The focus group discussion was organized with selected group members, including wealthy, middle, and poor members of different ethnic groups; women's groups; disadvantaged groups; forest user groups; and groups affected by climate change-related events, such as floods, landslides, drought, and fire. A checklist was prepared and used during this discussion to assess climate change, its impacts, and adaptation measures used by local people. In total, 8 focus group discussions were organized.

• Key Informant Interview

Key informant interviews were conducted with senior citizens, village leaders, teachers, elected local ward members, and technical personnel working in Chaukune Rural Municipality and Panchapuri Municipality, as well as with DFO staff, using a checklist. It was conducted to assess existing climate change-related events and their impacts on local livelihood assets, as well as the adaptation measures used in the study areas. This discussion was also carried out with various NGOs and INGOs working in collaboration with Chaukune Rural Municipality and Panchapuri Municipality.

• Direct Observation

Direct observation of areas affected by climate change events and adaptation measures used by farmers in farmlands, forests, and community lands was conducted during field visits with farmers, ward members, and other concerned line agencies to observe and gather information on social and physical features for getting insight view of the consequences of climate change disasters and locals measures adopted by people to cope with floods, drought, and other climate change-related events. Observations were made while going through various fields by DFO field staff.

• Secondary Data Collection

Secondary information was collected from various sources such as the Ministry of Forest and Environment, Department of Forest and Soil Conservation (DoFSC), Red Implementation Centre, Ministry of Industry, Tourism, Forest and Environment Karnali Province, Department of Soil Conservation and Watershed Management (DSCWM), Department of Hydrology and Meteorology, Integrated Centre for Integrated Mountain Development (ICIMOD), Karnali Province Forest Directorate and DFO office. The rainfall and temperature data from 1993 to 2023 were collected from the Department of Hydrology and Meteorology (DHM). All the required secondary data were extracted in accordance with the study objective. The annual progress reports, management plans, research, and publications related to climate change and its impacts were also reviewed.

4) Data Analysis and Presentation

The primary information collected from the household survey, key informant interview, focus group discussion, direct observation, and data collected from secondary sources regarding climate change, its effects, and the adaptation process and practices were compared and analyzed using statistical packages like SPSS (Statistical Packages for Social Science) 27.0.1 and MS Excel, and presented in this report with tables

and figures.

b. Climatic Data Analysis

Temperature and precipitation data obtained from the Department of Hydrology and Meteorology were corrected for missing data. The temporal trends in temperature and precipitation were analyzed using linear regression. For temperature, analysis was conducted on both an annual and a seasonal basis (summer: May-August; winter: November-February). Similarly, precipitation was analyzed on an annual and seasonal basis (monsoon: June-September), as reported by MOE (2015). The linear trend between time series and climatic data is given in the equation below. The least-squares curve-fitting technique was used to fit a linear trend to the data. The linear trend between the time series data (Y) and time (t) is given in the equation below:

$y = a + bt$, where y = rainfall or temperature, t = time (year), and “a” and “b” are the constants estimated by the principle of least squares.

III. RESULTS AND DISCUSSIONS

1) Demographic Information of the Respondent

Of the respondents, 69% were male, and 39% were female. Also, the majority of the respondents were Dalit (46%), followed by Magar (26%), Chhetri (21%), and Brahmin (7%). Regarding educational level, 47% have primary education, 24% have secondary education, 17% have higher secondary education, and 12% are illiterate.

2) People’s perception of climate change

a. Knowledge about climate change

More than half of the surveyed respondents (65%) were unfamiliar with the term “climate change”. Respondents were asked about their knowledge of climate change. Among the respondents, only 35% reported knowing about and hearing of climate change. They were also asked how they got information about climate change, and the majority (68.6%) reported receiving messages from District Forest Office staff and their community forestry programs, whereas 22.9% from Radio and TV news, and the remaining 8.5% from schools.

b. Perception of respondents on temperature variability

The majority (72%) of respondents reported that summer temperatures have increased in recent years, whereas 15% reported the same as before, and the remaining 13% had no idea whether summer temperatures had increased or decreased.

c. Perception of respondents on winter temperature variability

23% of respondents experienced a cooler winter, whereas 39% reported a warmer one. On the other hand, 21% of the total respondents reported the same winter temperature as before, and the remaining 17% had no idea whether the winter temperature had increased or decreased (Figure 2).

d. Change rainfall pattern

The majority (58%) of the total respondents observed changes in average rainfall in contrast to 10 years ago; whereas 16% of them did not notice any changes, and the remaining 26% of the total respondents had no idea about any changes in

rainfall in the study areas (Figure 3)

FIGURE 2 PERCEPTION OF RESPONDENTS ON WINTER TEMPERATURE

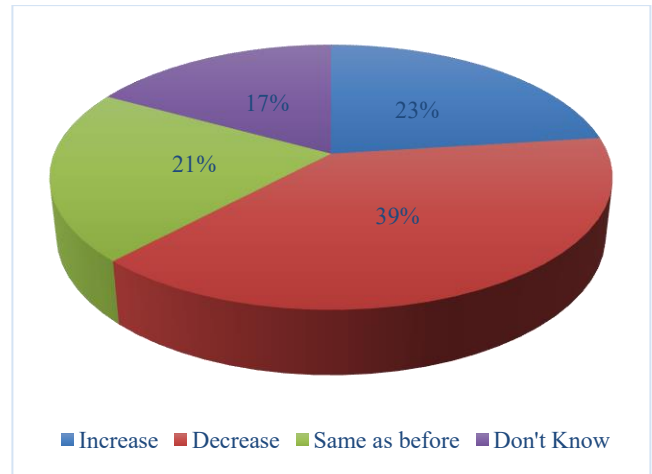
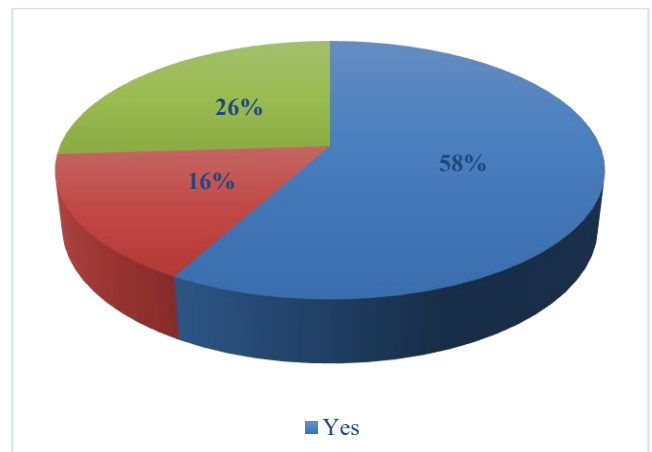


FIGURE 3 RAINFALL VARIABILITY IN THE STUDY AREA



3) Climatic parameter analysis

a. Temperature trend of study areas

- The mean annual temperature, derived from the annual maximum and minimum values for 1993–2023, shows a consistent warming trend across the study areas despite interannual variability. Mean annual maximum, minimum, and average temperatures exhibit an apparent long-term increase, reaching 22.73 °C in 2023. Linear regression indicates a positive warming rate of 0.0306 °C yr⁻¹, reflecting sustained long-term warming (Figure 4).

Mean summer maximum, minimum, and average temperatures across the study areas during 1993–2023 were 32.76 °C, 22.72 °C, and 27.42 °C, respectively, with apparent interannual variability. All summer temperature indices exhibit increasing trends, with summer maximum and minimum temperatures rising at rates of 0.0083 °C yr⁻¹ and 0.0058 °C yr⁻¹. The mean summer temperature shows the strongest warming signal, increasing at 0.014 °C yr⁻¹, indicating persistent summer warming over the study period (Figure 5).

FIGURE 4 YEARLY AVERAGE TEMPERATURE OF THE STUDY AREA

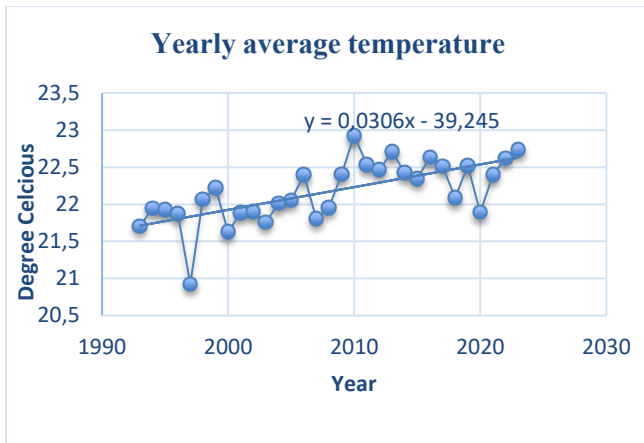
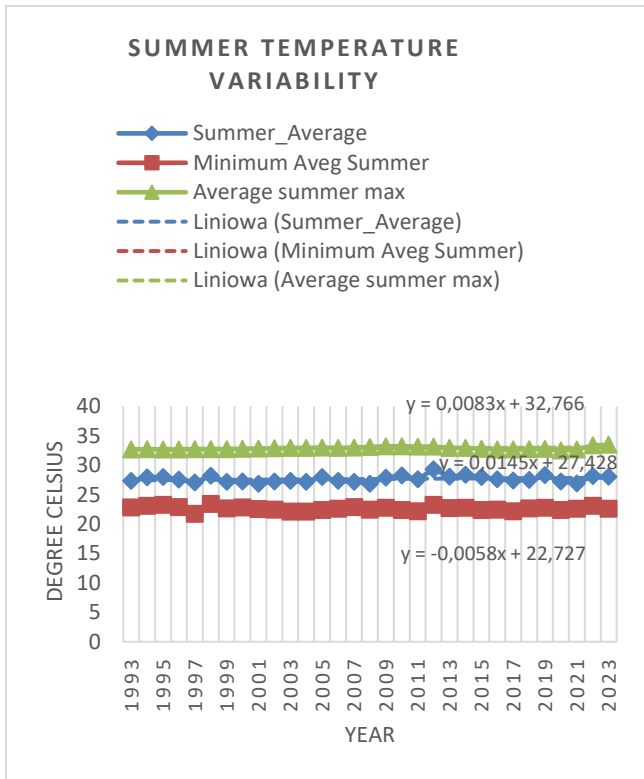


FIGURE 5 SUMMER TEMPERATURE OF THE STUDY AREA OVER 31 YEARS



Mean winter maximum, minimum, and average temperatures across the study areas during 1993–2023 show a clear warning signal, with the mean winter maximum temperature averaging 22.03 °C. Trend analysis indicates a pronounced increase in winter temperatures, with winter maximum, minimum, and mean temperatures rising at rates of 0.0615 °C yr⁻¹, 0.0019 °C yr⁻¹, and 0.0317 °C yr⁻¹, respectively. Despite interannual variability, winter temperatures exhibit a more rapid warming trend than those of other seasons, indicating accelerated winter warming in the study areas (Figure 6).

b. Precipitation trend of study areas

Mean annual precipitation at the Surkhet Airport meteorological station during 1993–2023 exhibits substantial interannual variability. Despite this variability, trend analysis indicates a weak but positive long-term increase in total annual rainfall over the study period. Linear regression shows an increase in mean annual precipitation of approximately 0.03

mm yr⁻¹, suggesting a marginal upward trend in annual rainfall over the past three decades (Figure 7).

FIGURE 6 WINTER TEMPERATURE OF STUDY AREAS OVER 30 YEARS

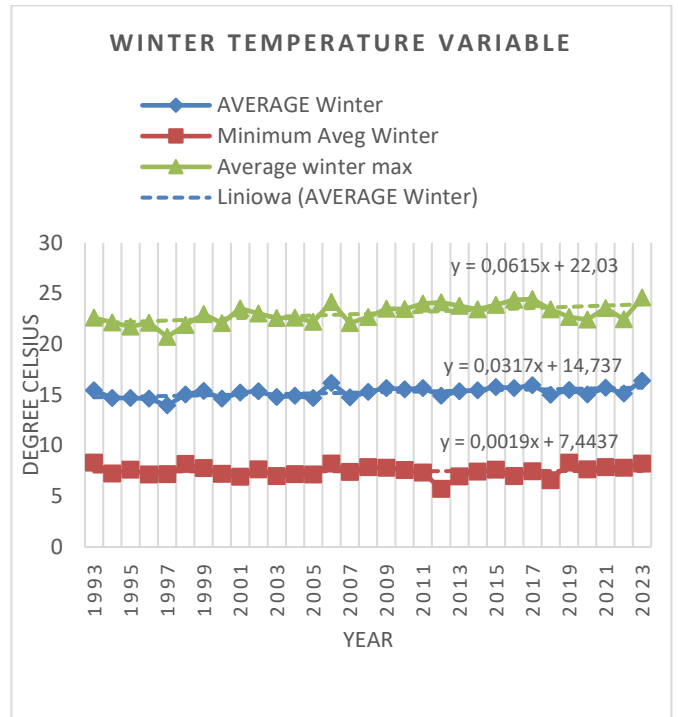
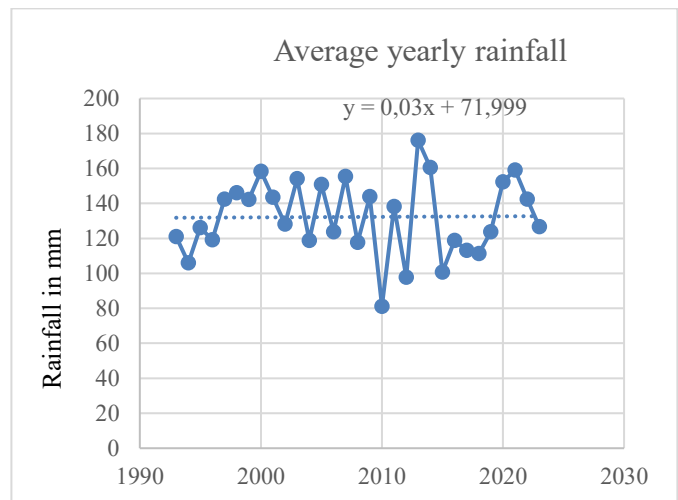


FIGURE 7 AVERAGE YEARLY RAINFALL OF THE STUDY AREA



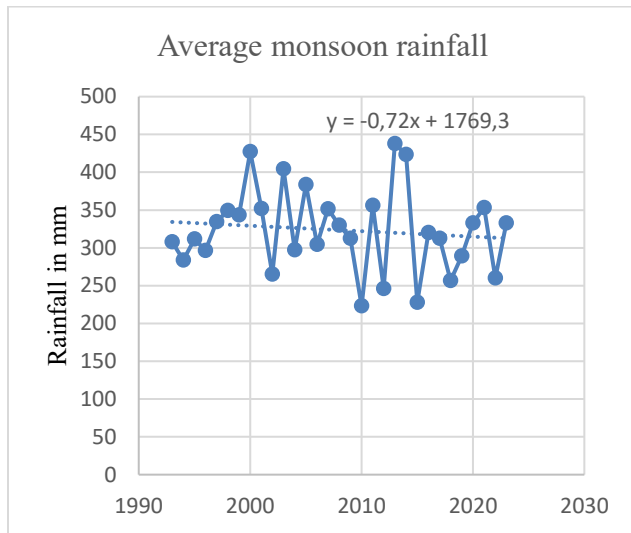
Monsoon (May–August) precipitation at the Surkhet meteorological station during 1993–2023 exhibits pronounced interannual variability. Trend analysis indicates a declining trend in monsoon rainfall over the study period. Linear regression shows a decrease in monsoon precipitation of approximately 0.72 mm yr⁻¹, suggesting a gradual long-term reduction in monsoon rainfall in the study areas (Figure 8).

4) Impacts of climate change

All respondents reported witnessing numerous changes in their local environment and described their experiences with climatic conditions. However, they were unsure whether this was due to climate change or to any other factor affecting their village's climate. They are facing a variety of challenges as a result of this change, including low or unprecedented rainfall,

drought, drying of wetlands and other water sources, very hot summers, and changes in crops and cropping patterns. The effects of these changes are described in the following section.

FIGURE 8 AVERAGE MONSOON RAINFALL OF THE STUDY AREA



a. Impact on agriculture

The majority (78%) of the total respondents are dependent on agriculture for their livelihood. The main crops are rice, maize, and wheat. In the study areas, 56% of households depend solely on rain-fed irrigation systems. Due to climate change, rainfall patterns in the study areas have also changed, significantly impacting paddy production. Drought in winter has affected wheat and oilseed crop production. In addition, dryness in early summer has affected maize production. The torrential rainfall in the monsoon season affected irrigation systems, agricultural lands, forests, and community lands by landslides and floods.

However, 67% of respondents reported an increase in vegetable and cash crop production, such as ginger and turmeric, in recent years compared with 10 years ago. This was attributed to changes in crops and cropping patterns to generate income, the use of chemical fertilizers and pesticides to control insects, pests, and diseases, and improvements in irrigation systems to grow vegetables and other crops.

b. Impact on forests

Climate change has affected forests and community lands. The productivity, distribution, and condition of forests were also affected by changes in temperature and rainfall patterns. Forest fires are becoming more common due to rising temperatures and drought in March and April. There was a loss of soil, its nutrients, and biodiversity due to natural hazards such as landslides and forest fires.

In addition, the majority (65%) of respondents reported that invasive species such as *Lantana camara*, *Eichhornia crassipes*, and other local weeds are increasing in the study areas. The invasion of invasive species has reduced fodder and forage production on forest and community lands, with direct impacts on livestock production. There has been a decline in wildlife populations due to increasing forest fires and a shortage of green feed. No action has been taken to control forest weeds and invasive species.

c. Impact on water resources

It has been revealed that the people of Chaukune Rural Municipality-4 in Surkhet district are facing water resource problems. Drinking water resources are altered and drying out due to drought, pollution, and climate change. The majority (67%) of respondents reported that, due to increased temperatures and soil dryness, high surface runoff of rainwater occurred, resulting in low infiltration into the soil. Water sources dry up during dry seasons, making it more challenging to meet the daily drinking water needs of the people in the study areas.

d. Impact on human health

The majority (77%) of respondents reported that insect, pest, and disease incidents on crops have increased due to climate change. Therefore, farmers in the study areas use insecticides and pesticides to control insects, pests, and diseases, which have direct impacts on human health. Moreover, it is reported that evidence of non-communicable diseases such as asthma, high blood pressure, heart diseases, airway-infectious disease, and breathlessness is also an increasing trend in study areas due to drought, dryness, forest fire, and consumption of insecticide and pesticide-used food, fruits, and vegetables (Bhandari, 2024). Similarly, other impacts of climate change on human health included hunger and malnutrition in children of low-income families, water crises, threats to livelihood from floods and landslides, health risks due to an increase in heat stress during summer, and the increasing spread of insects, pests, and diseases have been reported by the respondents of the study areas.

e. Impact on financial capital

It is revealed that farmers of the study areas were facing problems in generating income from agriculture due to increases in summer temperature and changes in rainfall patterns such as drought in March, April, and May and torrent rainfall in July and August causing landslides and flood damage of crops, and also increasing temperatures and changing precipitation patterns resulted in more frequent and severe flooding, landslides, and water scarcity, all of which disrupt infrastructure, transportation and overall economic activities of study areas.

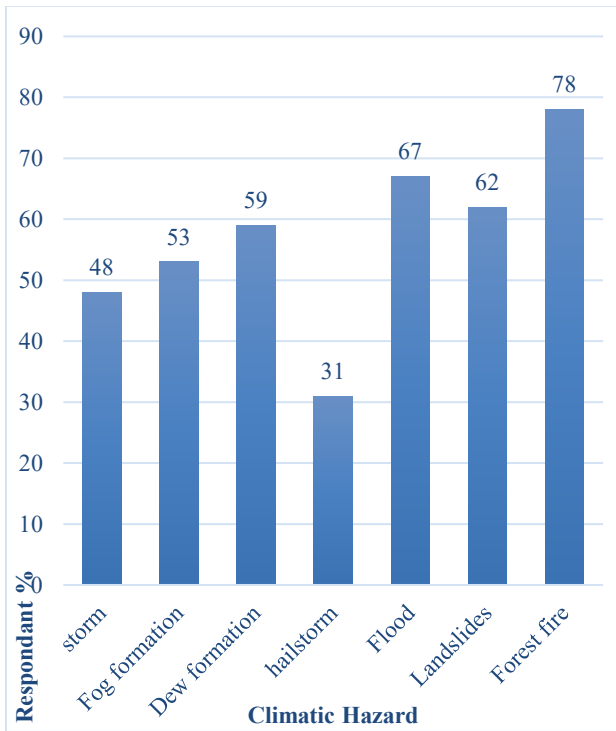
f. Invasive species

Warmer temperatures and altered precipitation patterns have created favorable conditions for invasive species to spread and establish themselves in new areas, often outcompeting native flora and fauna. These species could thrive in disturbed environments caused by climate-induced events such as floods, landslides, altered river flows, and forest fires, which were occurring in the study areas due to climate change. Species such as *Ageratina adenophora*, *Lantana camara*, *Parthenium hysterophorus*, and *Ageratum houstonianum* have increased in study areas, posing a threat to forests and biodiversity.

g. Climatic hazard

The majority of respondents (72%) reported an increase in climatic hazards in the study area, with forest fires, landslides, and floods identified as the dominant hazards causing losses to agricultural land, adverse impacts on human health, and other related damages (Figure 9).

FIGURE 9 CLIMATIC HAZARDS OF THE STUDY AREA

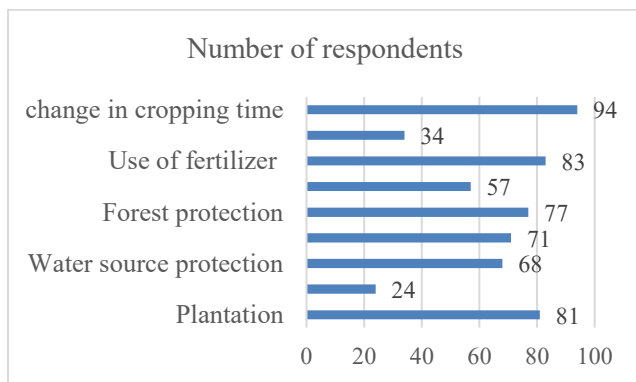


5) Climate change adaptation strategy

a. Adaptation strategy used by local people

The majority of respondents (74%) reported adopting various strategies to cope with climate change impacts, including changes in cropping time and fertilizer use, plantation in farmlands and degraded forest areas, protection of forests from fire, mulching in crop-growing areas, water source protection, home gardening, crop diversification, and the construction of check dams (Figure 10).

FIGURE 10 ADAPTATION MEASURES USED IN THE STUDY AREA



b. Barriers to Adaptation Strategies

The study also assessed the barriers to the use of climate change adaptation measures in the study areas. The majority (82%) of the total respondents reported that limited information regarding climate change and its adaptation options, shortage of skilled workforce, low access of people to government services, financial problems, loan facility not available, more demand for hardware activities, less activeness of elected members, lack of market, limited irrigation facilities to grow cash crops, good quality seedlings of desirable species not availability and lack of cooperation between farmers to cope with climate change

impacts.

The main barriers to adopting climate change adaptation strategies were a lack of knowledge about climate change and adaptation measures, followed by a lack of funds, insufficient irrigation facilities, and insufficient access to government services and inputs. The result is thus supported by the similar study conducted by Bryan et al. (2011), Deressa et al. (2009), IFPRI (2008), and Kandlinker and Rishey (2000), which identified the lack of knowledge about climate change and its adaptation strategies; lack of money/credit, insufficient irrigation facility, and insufficient access to inputs as the most important barriers to adopting climate change adaptation strategies in rural communities.

6) Discussions

The study conducted in Chaukune Rural Municipality-4 of Surkhet district highlights changes in temperature and rainfall patterns that are impacting local livelihoods. Over the past 30 years, the region has experienced notable changes in temperature and precipitation patterns, with severe consequences for agriculture, forestry, water resources, and overall community resilience. The findings indicate a marked decrease in crop production and increased challenges in water management, which are critical to the livelihoods of the local population. The study reveals that 72% of respondents have observed an increase in climatic hazards, including forest fires, landslides, and floods, leading to the loss of agricultural land and adversely affecting human health. Furthermore, invasive species such as *Ageratina adenophora* and *Lantana camara* have proliferated due to warmer temperatures and altered precipitation, posing a threat to local biodiversity and people's livelihoods. This result aligns with Ansari's (2018) finding that climate change is real and poses a significant threat to the livelihoods of communities worldwide, particularly in developing regions where reliance on agriculture and natural resources is high.

Adaptation strategies adopted by 74% of the total respondents include changing crop timing, using fertilizers, planting in degraded areas, protecting forests from fires, mulching, protecting water sources, home gardening, and constructing check dams. These measures reflect the community's resilience and proactive approach to coping with climate change impacts. Smith et al. (1999) also reported that adaptation is necessary to address adverse climatic stresses and hazards and to take advantage of opportunities, such as current, relevant, and locally adaptable innovations.

However, significant barriers persist, with 82% of respondents citing limited information, financial constraints, insufficient irrigation facilities, and lack of government support as significant obstacles to effective adaptation. The study underscores the necessity for enhanced awareness, diversified livelihood options, improved water management, and increased collaboration among stakeholders to foster sustainable adaptation practices. Integrating traditional knowledge with modern approaches can further strengthen community resilience and ensure a sustainable future. Policymakers and local officials are encouraged to use these insights to develop better strategies and support mechanisms to mitigate the

adverse effects of climate change on vulnerable communities in Surkhet district.

By addressing these challenges and promoting sustainable practices, the local community can build a more resilient and adaptive system capable of withstanding the ongoing and future impacts of climate change.

IV. CONCLUSION

From the findings of the study, it is found that people have observed some changes due to climate change in their environment, even though some of them are not familiar with the term 'Climate Change'. The survey showed an overall increase in temperature and precipitation, resulting in visible impacts on the community, including landslides, floods, forest fires, drought, drying of water sources, and increased insect, pest, and disease activity. The study also emphasized the importance of understanding local perceptions and adaptation strategies, such as change in cropping time, use of more chemical fertilizers, plantation in farmlands and degraded forest areas, forest protection from fire, mulching in crop growing areas, water source protection, home gardening, changing crops and cropping time and construction of check-dam in response to the climate change impacts.

The study found that climate change has severely affected study households. The study area was exposed to climatic hazards, including prolonged droughts, flood-damaging irrigation schemes, and insect, pest, and disease outbreaks in farmland. Most respondents reported that prolonged droughts, coupled with invasive species, have severely affected forage production on forest and community lands, affecting the livestock industry. Local people in study areas have shown resilience and adaptability by adopting various adaptation strategies, such as changing agricultural practices, improving water management, protecting forests, and planting for livelihood diversification. However, it was concluded that more comprehensive and sustainable adaptation measures are needed to address the long-term challenges of climate change.

To improve the resilience of local communities in study areas, the study suggests implementing community-based adaptation initiatives, capacity-building programs, and integrating traditional knowledge with modern scientific approaches. Cooperation between government agencies such as DFO, local communities, scientific institutions, local bodies, various NGOs, and I-NGOs is essential to develop effective climate change adaptation strategies tailored to the specific needs of the people.

The findings can be used to analyze the local people's understanding of climate change, its impacts, and adaptation practices. Key institutions can play an important role in adaptation if people's voices are heard. Further, it can be implicated in a similar type of research related to climate change.

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