

RESEARCH ARTICLE

QUALITATIVE ANALYSIS OF CLIMATE CHANGE ON RICE BASED FARMING SYSTEM IN WESTERN TERAI OF NEPAL

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ARTICLE DETAILS

Article History:

Received 10 September 2025
Revised 25 October 2025
Accepted 28 November 2025
Available online 15 December 2025

ABSTRACT

Climate change poses a critical threat to agricultural systems worldwide, with rice-based farming in Nepal being particularly vulnerable. This qualitative study assesses the effect of climate change on rice dominant farming system in Bardiya Nepal, focusing on shifting weather patterns, crop productivity, and farmers' adaptation strategies. Data were collected through Focus Group Discussions, Key Informant Interviews, transect walks, and agricultural calendar analysis. Findings reveal that delayed and erratic monsoons disrupt traditional planting schedules, forcing farmers to transplant over-aged seedlings, leading to reduced yields. Additionally, increased droughts, floods, and hailstorms further diminish crop output, compelling farmers to abandon long-duration local rice varieties in favor of drought-resistant and hybrid alternatives. The study identifies key challenges, including late seedbed preparation, moisture stress, and input shortages, which exacerbate food insecurity. Farmers have adopted adaptive measures such as use of electric irrigation pumps, modified crop rotations, and climate resilient rice varieties (Drought resistant Sukha series - Sukha dhan-1, -2, -3). However, limited access to resources and technology constrains their adaptive capacity. The research underscores the need for climate-smart agriculture, integrating local knowledge with scientific innovations to enhance resilience. Policymakers must prioritize institutional support, such as timely input supply, drought-tolerant seeds, and community-based adaptation programs, to mitigate climate risks. This study highlights the urgent necessity for sustainable strategies to safeguard Nepal's rice-based farming systems, ensuring food security and livelihoods amid escalating climatic uncertainties.

KEYWORDS

Climate change, drought, qualitative research, rice

1. INTRODUCTION

Nepal is considered as an agricultural country, as 57.3 % households depend on agriculture for livelihoods. The contribution of agriculture sector to the national GDP is approximately 24 % (NPC, 2024). Share of agriculture in GDP stands 24.10 percent in 2023/24 (NRB, 2024). Climate change is considered as one of profound problem of world (Feulner, 2015). Changing climatic patterns pose a serious threat to the food production system, increasing the likelihood of food insecurity and poverty (Saleem et al., 2025). The climate change impacts are unpredictable (Day and Hall, 2016). Agriculture depends strongly on weather and climatic condition, an important part of the economy of the county is sensitive to climate change (Alam, and Regmi, 2004). In recent years, shifts in precipitation patterns, rising temperatures, cold waves, extended dry spells, and prolonged droughts have been observed, all of which have a direct impact on agricultural production. Delays in the onset of the monsoon have caused late planting of rice and other rainy-season crops, leading to reduced yields. The decline in crop productivity due to unfavorable climatic conditions increases vulnerability, resulting in food insecurity, hunger, and shorter life expectancy (Ebi et al., 2007). Wassmann et.al have explained that rice is highly vulnerable to climate change, as recent maximum and minimum temperatures in many Asian regions are approaching or exceeding the optimal temperature thresholds for rice cultivation (Wassmann et al., 2009). In Bardiya district, farmers identified irrigation as the most practiced local adaptation measure. Other strategies adopted in the area included mulching, agroforestry, cooperative

vegetable farming, and the use of drought-tolerant rice varieties (Rana et al., 2022).

2. MATERIALS AND METHODS

This research was carried out in the western Terai region of Nepal, with Bardiya district purposively chosen as the study site. The study aimed to examine the impact of climate change on the rice-based farming system using qualitative data. Information was collected through one Focus Group

2.1 Focus group discussion

Information obtained from the interview was crosschecked during the focus group discussion; Additional information on various community-based adaptation strategies, difference observed in the present and past regarding the farming practices was collected through focus group discussions.

2.2 Key informant interview

Progressive farmers and local leaders were interviewed using a prepared checklist covering various aspects of climate change, and their perceptions were gathered accordingly.

2.3 Transect walk

The Transect Walk facilitated the observation of climate change impacts

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DOI:
10.26480/efcc.02.2025.69.72

on agricultural land and helped identify community adaptation strategies within the study area.

2.4 Agricultural calendar

A comparative cropping calendar in normal rainfall period before and late rainfall period at present were prepared from the discussion with farming communities.

2.5 Qualitative data analysis

The qualitative data collected during the field survey were systematically analyzed and presented in descriptive form.

3. RESULTS AND DISCUSSION

3.1 Description of the study area

Bardiya district, located in Lumbini Province of Nepal, is one of the country’s seventy-seven districts, with its administrative headquarters in Gulariya. The district spans an area of 2,025 km² and comprises 1,06,285 households with the majority of the district’s residents are engaged in farming.

3.2 Matrix ranking of major problems on crop production

Table 1: Matrix Ranking of rice Cultivation (FGD, 2012)

Problems	Late seed bed establishment	Transplantation of overmatured seedling	Fertilizers not being available when needed	Plant protection related (weeds, disease and pest)	Flood and hailstorm
Late seed bed establishment	X	Transplantation of overmatured seedling	Late seed bed establishment	Late seed bed establishment	Late seed bed establishment
Transplantation of overmatured seedling	Transplantation of overmatured seedling	X	Transplantation of overmatured seedling	Transplantation of overmatured seedling	Transplantation of overmatured seedling
Fertilizers not being available when needed	Late seed bed establishment	Transplantation of overmatured seedling	X	Fertilizers not being available when needed	Fertilizers not being available when needed
Plant protection related (weeds, disease and pest)	Late seed bed establishment	Transplantation of overmatured seedling	Fertilizers not being available when needed	X	Plant protection related (weeds, disease and pest)
Flood and hailstorm	Late seed bed establishment	Transplantation of overmatured seedling	Fertilizers not being available when needed	Plant protection related (weeds, disease and pest)	X
Score value	6	8	4	2	0
Ranking Value	II	I	III	IV	V

3.4 Hazard Trend Analysis in Kalika VDC

Conducting a climate hazard trend analysis helps in identifying historical patterns and projecting future changes in the frequency and intensity of hazards like floods, droughts, and storms, it provides a critical evidence base. This knowledge empowers communities, governments, and organizations to develop targeted adaptation strategies, invest in resilient infrastructure, allocate resources efficiently, and ultimately safeguard lives, livelihoods, and economic stability against the escalating impacts of climate change.

Table 2: Climatic hazard trend analysis in Kalika VDC Bardiya

Date (BS)	Disaster	Effects
2048	Drought	Difficult to cultivate rice, and crop failure by 40%.
2052	Flood	Damage of crop land, flood entered in to the village
2058	Drought	Decrease the yield of rice by 25%.
2062	Flood	rice crop destroyed by flood and swept away fish
2069	Drought	Most of the rice crop was failure and infestation of Army worm was increased.

3.5 Changes in rice performance before 10 years and present

Most respondents reported observing changes in rice performance, though some were unaware of any shift. When assessed on specific parameters like grain and biomass yield, a general decline was observed,

An analysis based on a Focus Group Discussion (FGD) in Kalika VDC, Bardiya, revealed that rice cultivation is predominantly constrained by climate-related hazards. Matrix ranking identified the transplantation of overmatured seedling due to unavailability of water during land preparation is the foremost problem resulting to substantial yield loss. Another issue was the late seed bed establishment, a problem somewhat addressed using electric motors for irrigation. Other contributing factors included untimely availability of fertilizers, weeds, pests, diseases, and flooding. The study concludes that the initial stage of the rice growing cycle is critically impacted by climatic instability, which significantly undermines productivity.

3.3 Major problems of rice cultivation

Transplantation of overmatured seedling due to delayed rainfall was one of the major challenges in faced by the farmers in study area. It reduced the rice yield significantly. Late seed bed establishment was another problem. In some cases, farmers sow the rice seed on time by using the electric motors, but they were unable to transplant appropriate aged seedlings. Most of the problems were associated with the rainfall. Unavailability of fertilizers on time, problems of weeds, disease and pest and problem of flood and hailstorm were secondary problems. A study showed that the major problems faced by the farmers of the study area due to climate change were prioritized as drought, flood hailstone, extreme hot and extreme cold (Pokhrel et al., 2021).

which farmers attributed to drought conditions and insufficient water for crop development. However, in specific cases where high-yielding varieties, increased chemical fertilizers, and irrigation via deep tube wells were employed, both grain and straw yields showed an increasing trend.

3.6 Crop rotation adopted by farmers

Farmers in the study area reported a shift from past cropping patterns. The primary monsoon season crops are rice in lowlands (Khet) and maize in uplands. In winter, lentil and pea are cultivated as relay crops, while wheat is grown in areas with access to irrigation via boreholes. Although on a small scale, many farmers also grow off-season vegetables. These practices reflect a broader change in crop rotation strategies.

Table 3: Before and after comparison of crop rotation practices

	Before (before 2012)	Present (2012)
Low land	Rice-Wheat Rice-wheat Rice-Lentil+ chickpea Rice-Potato+ Mustard Rice-Mustard+ Wheat Rice-fallow Rice-wheat Rice-lentil Rice-fallow-fallow	Rice-wheat/mustard Rice-potato/lentil/chickpea Rice-chickpea/pea/mustard Rice-lentil/cauliflower/onion Rice-lentil Rice-winter maize-bitter gourd Rice-fallow (Share cropping) Rice-linseed/lentil Rice-fallow

Table 3 (Cont): Before and after comparison of crop rotation practices

	Before (before 2012)	Present (2012)
Up land	Maize-mustard Maize+ cowpea Maize Maize Pigeon pea	Maize Maize+ cowpea-cauliflower Maize-potato Maize-tomato/chili/cauliflower Pigeon pea

3.7 Cropping Calendar

Onsets of timely rainfall are major factor for improving agricultural

Table 4: Cropping calendar of study area (2012)

Months/Crops	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1. Rice												
(Normal)					N(4th wk)	T(4thwk)					H(1stwk)	
(Late rainfall)						N(3-4 th) wk June	T(4 th wk-1 st wk) of Aug				H(3 rd wk)	
2. Maize												
(Normal)					SS(4 th wk)			H(4 th wk)				
(Late rainfall)					SS(3 rd wk)			H(4 th wk)				
3. Wheat												
(Normal)												
(Late rainfall)					H(3 rd wk)							
					H(1 st wk)							
4. Lentil/Chickpea												
(Normal)												
(Late rainfall)												
5. Mustard												
(Normal)												
(Late rainfall)												

(*N=Nursery, SS= Seed Sowing, T= Transplanting and H= Harvesting)

3.8 Changes in rice varieties in study area

In the study area, local landraces of various crops, particularly long-duration rice varieties, have been lost. Farmers reported that the delayed onset of the monsoon prevented the timely transplantation of these varieties, while inadequate soil moisture later in the season led to poor yields. Due to this poor productivity, farmers have largely replaced local indigenous varieties, including those of maize, with improved and hybrid alternatives to secure higher yields.

Table 5: Different varieties of rice used in study area (2012)

Before		Present	
Bhadiya	Janaki	Radha-4	Survi
Gopal	Diruwa	Hybrid: Prithivi	Sukha rice-3
Madanchand	JiraMansuli	Suka rice-1	Sukha rice-2
Bikash	Talcon		
Suwapankhi	Suhawat		
Deharadhun	Motadhan		
Sabitri			

Farmers adopted new rice varieties for diverse reasons, primarily influenced by the varieties' specific traits. While many shifted to hybrid types for their superior yield, they acknowledged the trade-off of increased water and fertilizer requirements. Farmers' choice of rice varieties is strategic and depends on land tenure and specific varietal traits. On sharecropping lands, where landlords provide inputs, farmers cultivate hybrid varieties. On their own land, they opt for varieties like Radha-4 due to its lower water requirement and moderate drought tolerance. Furthermore, new drought-tolerant varieties from the "Sukha Dhan" series (Sukha Dhan-1, -2, -3) have been introduced for the first time in the area by CARITAS NEPAL under the SAF-BIN project. These varieties, valued for their resistance to pests like stem borer and leaf folder, have received a positive response from farmers.

4. CONCLUSION

This qualitative study highlights the significant impacts of climate change on rice-based farming systems in Bardiya district. Farmers reported delayed and erratic monsoon rains, leading to late nursery establishment,

production. Changes in rainfall pattern adversely affect the normal cropping calendar of the farmer. There was almost one and more than one month shift in the cropping calendar of the farmer due to late rainfall. The detailed cropping calendar for major crops in the study area was shown in Table 4. A study found that climate change has a negative impact on both the yield and quality of rice crops (Wasaya et al., 2022).

The change in the cropping calendar is due to the delaying in the onset of the monsoon. The followings are the major problems observed in rice.

- Late seed bed establishment for nursery
- Delayed transplanting
- Transplantation of overmatured seedling
- Moisture stress at growth and development stage

transplantation of overmatured seedlings, and moisture stress during

critical growth stages all of which reduce rice yields. Additionally, frequent droughts, floods, and hailstorms have exacerbated crop losses, forcing farmers to shift from traditional long-duration rice varieties to drought-resistant and hybrid alternatives. The study also reveals changes in cropping calendars and rotations, with farmers increasingly relying on irrigation and resilient crop varieties to adapt to unpredictable weather. These findings underscore the urgent need for climate-smart agricultural practices to sustain rice production and food security in the region.

This research highlights that climate change is a social and economic problem, not just an environmental one, and it places a heavier burden on smallholder farmers than on others. While some have adopted adaptive strategies such as use of electric pumps for irrigation, cultivating stress-tolerant rice varieties many still face constraints like input shortages and limited access to technology. Community-based adaptation efforts, supported by government and NGOs, are crucial in building resilience. However, long-term solutions require integrated policies that combine local knowledge with scientific innovations, ensuring sustainable farming systems amid worsening climatic uncertainties. Addressing these challenges is vital for safeguarding Nepal's agricultural livelihoods and food security in a changing climate.

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