
Climate Change Variability and its Impacts in Nepal

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Abstract

This paper aims to explore the climate variability in agriculture and discuss adaptation. Climate change has been an issue in relation to water, agriculture, and ultimately livelihood in the community. It impedes the ecosystem of nature and society. In Nepal, the temperature growth rate is increasing day by day and it reached 0.180C which contributes to climate change variability and it is contributing to the scarcity of water and hence, the impact on agricultural production. Similarly, only a small amount of available water (4.7%) in Nepal has been effectively utilized. The majority of households in Nepal depend upon agriculture and livestock. The imbalance in agriculture production is also directly related to nutrition and health. Many parts of the Karnali province have been faced with food deficiency and malnutrition. Due to the challenges, the proper utilization and sustainable use of water sources for securing food security in Nepal is imperative.

Keywords: Climate change, temperature, water management, agricultural production, nutrition

Introduction

Nepal is well-known as an Agricultural country where the majority of the population depends upon it. However, climate change variability has affected agriculture sectors and livelihoods. Climate change made water scarcity so water management is important for not only drinking water but also agriculture and food security. Climate change variability has led to increased variability in temperature and precipitation patterns. The rising temperatures and changing patterns of rainfall pose significant challenges to water resources and affect agricultural systems. Erratic rainfall and

prolonged droughts can result in water scarcity, reduced crop yields, and increased vulnerability to pests and diseases. Such changes directly impact the livelihoods of farmers and can have cascading effects on food security and nutrition.

Nepal is rich in water resources as about 6000 rivers have a drainage area of 191000 sq. km. Agriculture as a main livelihood means is mainly dependent on rain-fed and irrigation system that is being badly affected due to droughts, flooding, erratic rainfall, and other extreme weather events. These are the indicators of climate change. However, climate change variabilities in terms of rising temperature and rainfalls are directly affecting agricultural production(WECS, 2011). For agricultural development, the role of rain and temperature are crucial. The unmanaged water resources do not contribute to the irrigation system However, an imbalance in nature results in the consequences of agricultural production, and obviously human health. Only about 4.7% of available water in Nepal has been effectively utilized (Risal, 2022). Nepal's domestic product has been affected by Global warming /climate change increased flooding, and heat stress on crops/ livestock are expected to be a continual drag on growth (WB. 2022).

There are various threats of climate change in Nepal- rising atmospheric temperature, changes in the rainfall cycle, and the impact of glacial lake outbursts floods, and landslides. Millions of Nepalese are estimated to be at risk from the impacts of climate change including reductions in agricultural production, food insecurity, strained water resources, etc (Nepal Climate Change Policy, 2019). Considering political, geographic, and social factors, Nepal is vulnerable to climate change impacts, ranked 128th out of 181 countries in the 2020 ND-GAIN Index (University of Notre Dame (2020). The alteration in climate variability and its impacts on water sources are badly affecting farming systems and agriculture production as well as health in terms of nutrition and ultimately quality of livelihood. Therefore, the proper utilization of water resources to secure food security and adaptation in relation to climate variability are critical.

Objective and Method

The objective of the paper is to explore the effect of climate change variability in the agriculture sector, and further discuss coping it with adaptation in a sustainable manner. The literature on climate change, water, agriculture, and food behavior is reviewed. The secondary data from different sources such as the national report, annual report, books, journals, articles in the newspaper, and online news to depict the scene. To support it, one small case study at two VDCs namely Ramnakot and Badalkot of Kalikot district briefly discussed about water utilization for drinking water and irrigation for agriculture and kitchen gardens, with focus group discussions.

Climate Change Variabilities in terms of temperature and rainfall in Nepal

Climate change has emerged as a significant global challenge, affecting various sectors, including agriculture. Nepal, a country highly dependent on agriculture, is particularly vulnerable to the adverse impacts of climate variability and change. Nepal's ecology is mainly divided into three terrains- Himalaya Region, Hilly Region, and Terai Region. Nepal's climate varies considerably seasonally and according to altitude. The increment temperature consequence is different in Terai and Himalayan regions, in Terai hotness, and in Himalayan coldness. The climate varies in Nepal from subtropical in the southern plain area, to warm, and cool in the hills, to cold in the mountains.

Temperature

The rising temperature has contributed to climate change events. Climate change is exacerbating water scarcity and water-related hazards around 450 million lives in areas of high/extreme water vulnerability(UNICEF, 2023). Research shows how climate change has slowed the production of agriculture growth around the world. That rising heat is driving regional and seasonal temperature extremes, and intensifying heavy rainfall, -risking water shortage and reducing fertility capacity. The annual average temperature of Nepal has increased by 0.056 degrees Celsius; an increase

in the emission of greenhouse gasses in the atmosphere has led to an increase in global temperature.

The annual temperature increment is 0.092°C in the Himalayan region and in the same way 0.017°C in the Taria region. In the year 2022, it has been recorded that the annual increment of Himalaya temperature is 0.12°C . The rising temperatures upset precipitation patterns and the entire water cycle. Climate change is exacerbating water scarcity and water-related hazards like floods and droughts; around 450 million children live in areas of high or extremely high water vulnerability (UNICEF, 2023). Climate change and increasing water scarcity affect the food supply (about 70 percent on average) for agriculture (FAO, 2017). Regional Climate Model outputs also suggested that the average annual maximum temperature could decrease by 1.4°C , and the average annual minimum temperature may increase by 0.3°C from 2021 to 2050 (Risal, 2022).

Due to the effect of climate change variability, there may be heavy precipitation, and it can harm crops by eroding soil and depleting soil nutrients (Gowda, P., et al. 2018). Similarly, according to WB (2022), Global warming and climate change are already affecting Nepal's gross domestic product. It caused flooding, and heat stress on labor productivity and health, and livestock are expected to be a continual struggle on growth. Climate change variabilities will jeopardize the pace of Nepal's human development and poverty reduction. Women, indigenous people, and marginalized and vulnerable groups often suffer from the cumulative impacts of climate change and disasters.

Further, Nepal Climate Change Policy (2011) highlights that there are various threats of climate change in Nepal- rising atmospheric temperature, and changes in the rainfall cycle. As a result, millions of Nepalese are estimated to be at risk from the impacts of climate change such as reductions in agricultural production, food insecurity, water resources scarcity, etc.

According to NOAA (National Oceanic and Atmospheric Administration) (2021), the climate change report shows that the temperature-raised number has almost doubled per decade since 1981. The literature indicates climate change in Nepal with a 0.06 degree Centigrade average per year temperature rise. In western Nepal, the temperature rise is 2.00 C on average. It is relatively 3 times higher than the lower temperature within the country and significantly higher in the comparison of the global trend of temperature variation. The climate change-induced disasters which are drought, severe floods, landslides, etc have negative impacts on agricultural farms, particularly rice and maize, and food security in the hills and high hills of Nepal.

Rainfall:

According to Panthi (2015), the summer monsoon rainfall (June to September) accounts for approximately 80% of the total annual rainfall, which originates from the Bay of Bengal (Panthi et al. 2015). The summer monsoon has more been active in eastern and central Nepal, whereas winter rainfall is caused by western disturbances originating from the Mediterranean Sea (Shrestha and Sthapit 2015). Similarly, in the Kathmandu valley, rainfall during the summer monsoon has ranged in intensity between 0.13 and 0.37mmh⁻¹, over the last 42 years. It infers that this intensity of rainfall can pose problems leading to the development of flood conditions in the Kathmandu Valley (Panthi, 2015). There are three rainfall pockets in Nepal; high values of extreme percentile thresholds are found in the lowlands (Terai and Siwalik), while low values are found in the highland regions(Karki, 2017). Climate change is caused by to increase in the frequency of heavy precipitation, which can harm crops by eroding soil and depleting soil nutrients (Gowda, P., et al. 2018).

Water Sources:

Climate change variability necessitates effective water management strategies in the agriculture sector. Enhancing water storage and irrigation infrastructure, implementing water-efficient practices, and promoting rainwater harvesting can help mitigate the impact of water scarcity. Proper management of water resources, including river systems, lakes, and

groundwater, is crucial for sustaining agricultural production and ensuring the resilience of farming communities. The major sources of water in Nepal are Surface water (river, rainfall, pond) and Underground (well, tube well, under-ground piped water) water. These sources of water are used for irrigation, industrialization, hydropower, and household supply and sanitation. People use to take water from nearby water recourses such as well, spring water, ponds, and rivers. However, with the growing population water demand seems inadequate. Besides, there are two main sources of water resources in Nepal- perennial and rain. The rising level of temperature and changing patterns of rainfall would impact the source of water resources. The low layer of snow in mountainous regions has been noticed over one decade, which impacted the perennial water resources.

Climate Variability and Agriculture Production in Nepal

Changes in climate patterns directly influence agricultural production in Nepal. Shifts in temperature and rainfall affect crop growth cycles, phenology, and yields. Extreme weather events, such as floods and droughts, pose risks to crop productivity and disrupt farming practices. According to the Ministry of Agriculture and Livestock Development, agriculture is the mainstay of the national economy as it contributes 65 percent to the employment sector and 27 percent to the national GDP. The agriculture production in major staple food in the fiscal year of 2021/22 was decreased by 3.0 Metric tons compared to the production of food in the fiscal year of 2020/21. The lack of a proper irrigation system and the availability of fertilizers were some reasons behind it. Optimum agricultural production, safe water, and nutrition are the necessities of human life. The demand for food for a growing population is crucial. According to the Ministry of Agricultural Development (2072/73), nutrition-related agriculture included cereal crops, cash crops, pulses crops, live stocks, fishery, and horticulture. Annual food production of Nepal in 2022/23 (B.S 2078/79) was 10 million 772 thousand metric tons, in the meantime about 7530000 metric tons of seeds, and livestock were lost during preservation and in the time of post-harvest. According to the population, the processed food requirement was around 5 million 867

thousand metric tons. Nepal was self-sufficient in food grain production until 1990; due to various reasons, production fell short, and climate change variability may be one reason. The global pandemic COVID-19, has the human beings a new lesson in food security and development. In Nepal during the time of the pandemic, people used to store exact foods at home, which made food scarce. Nepal has committed to eliminating malnutrition, hunger, and food insecurity. However, “zero hunger” is incorporated in the sustainable development goal, to reduce food insecurity issues globally.

Nutritional Aspects:

It is a vital role of nutritional status to reduce under and over-nutritional problems. Both children and adults need to have good nutritional status. Children are a vulnerable group in society. In the case of children, the frontal nutritional efficiency consequences are: stunted wasted, underweight, and overweight. In the practices of Nepal, the nutrition policy and strategy 2004 enlightens on the nutrition revolution. Compared to the data of NDHS 1996 to 2022, the number of stunted and wasted is improving. According to NDHS (2020), the status of under-five-year-old children has improved, 25% of the children were stunted, 8% were wasted and 19% were underweight respectively, and only 1% were overweight. Climate change impacts on agriculture have broader implications for nutrition and food security. Reduced crop yields, changes in crop composition, and fluctuations in food availability can affect dietary diversity and nutritional status. Vulnerable populations, including women and children, are particularly at risk regarding nutritious food. It is essential to promote diversified diets, improve access to nutritious foods, and enhance resilience in the face of climate change to ensure food security and optimal nutrition for all.

Case study

There was a scarcity of drinking water in Ramnakot of Kalikot district of Karnali Province. However, people have managed the small water source (*mul*) by collecting it in the reservoir. The intake of the drinking water area is about 2 km far from the settlement. GI and PVC pipes are being used for

supplying water No water leakage or seepage or clogging in the distribution of water was noticed. There is a Water Users Committee for maintaining the drinking water. The wastewater is properly managed and it is being used for the kitchen garden and irrigation. The water conveyance system of the irrigation was made by the RCC canal. People maintain the schedule of irrigation in the fields and cooperate with each other as well. Due to the irrigation facility, barren land is being cultivated and better production could be seen. People in the region have developed some adaptations to cope with climate change and manage water resources to increase agriculture production. Although, resources of water are limited around the village. In discussions with people, food security is the major problem in this area. Kalikot is also known as a food-deficient district of Nepal. So food security is a major concern for people, and the proper use of water is vital.

Discussion and Conclusion

Agriculture production is directly linked to climate and weather. The climate change variability in relation to temperature, precipitation, and rain could be associated with the growing season and different crops to be grown in some regions. According to Joshi and Thapa (2010), there were marginal impacts of climate change on agriculture, both based on season and climatic zone. Further, the study found a significant impact of climate variables on net farm income per hectare. Climate change, water management, agricultural production, and nutrition are linked to human holistic growth and development. Healthy livelihood needs a good climate, sufficient water both for drinking and utility purposes, sufficient and healthy agricultural production, and good.

U.S. agriculture already has many practices in place to adapt to a changing climate, including crop rotation and integrated pest management. Nepal has been already implemented some programs to recalibrate its economy by adopting a Green, Resilient, and Inclusive Development (GRID) approach for 2021. Its main objective was to guide long-term green growth and build resilience to climate. The role of the local level to implement such program is a crucial. The climate-related vulnerability has been associated with

particularly those living in poverty and in remote areas operating subsistence agriculture. Some adaptation approaches have been practiced globally such as air conditioning, water storage, and new crop varieties, Irrigation may help in agriculture production. They need support in terms of awareness, technology, and money to the poor. There is a positive relationship between climate change and sustainable development in terms of agriculture with nutritious food. The rising temperature as a sign of climate is alarming the ecosystem and results in water scarcity and low production of agriculture that directly affect livelihood.

Climate change variability poses significant challenges to the agriculture sector in Nepal, impacting water management, agricultural production, and nutrition. Adaptation and mitigation strategies are crucial for building resilience and sustaining agricultural livelihoods. Investments in water management infrastructure, adoption of climate-smart agricultural practices, and promotion of diversified diets are key steps toward addressing the adverse impacts of climate change. Moreover, collaboration between various stakeholders, including policymakers, researchers, farmers, and communities, is essential to develop and implement effective strategies that safeguard Nepal's agriculture sector in the face of climate change. There is a necessity “adaptation” to cope with climate change to ensure water management for both for drinking water and irrigation purposes. The case study also hints that there is an alarming situation to protect water resources for not only drinking water but also irrigation purposes. The consciousness toward climate change and its effects as well as adaptation are crucial.

To cope with challenges, farmers should adopt climate-smart agricultural practices like pre-information on climate change issues, crop diversification, and agroforestry. For sustainability, innovative strategy and policy by the governance system are crucial for agriculture and food security. Innovative thinking and usage of tools and technology can only replace the subsistence form of agricultural practice. The educational intervention in terms of awareness and usage of a technology-oriented mindset could help farmers to get information on climate change issues and

threats. The detecting system of diseases in crops is very necessary. Similarly, the pre-information on temperature and rainfall and utilization of fertilizer and market information would enhance farmers in coping with agriculture production.

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