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Perceptions of Climate Change Impacts in the Himalayan Region of Nepal: A Case Study of Nechasalyan Rural Municipality-2, Solukhumbu District

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Abstract

The ever-changing climate has posed numerous issues to all parts of the world. Still, the Hindukush-Himalaya areas, like Nepal, with their variation in topography and socio-economically backward people, are more susceptible to the impacts. This study explores perceptions of climate change impacts on people's livelihoods in Nechasalyan Rural Municipality-2, Solukhumbu District, Nepal. I used a qualitative approach and conducted purposive sampling involving in-depth interviews with five participants. The results indicate that due to climate change, farming practices have become inconsistent, and biodiversity has decreased, which has made animal husbandry more challenging than usual. Moreover, these alterations in their environment made fewer crops be produced, water and food became scarce, livestock became less productive, and families resorted to subsistence-based agriculture. Additionally, there has also been an impact on food security, an increase in the movement of people, and a change in customary practices. Thus, the study advances the understanding that there exists a critical need for targeted policy measures, effective infrastructure development, and appropriate distribution of resources to protect people living in high-altitude rural areas.

Keywords

Climate change, Livelihoods, Adaptation strategies, Nechasalyan Rural Municipality, Socio-economic vulnerabilities.

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1. Introduction

Climate change is well known to be one of the most pressing environmental issues in the world. It has had a profound effect on our ecosystems, economies, and human cultures, as well as long-term changes in global temperature, atmospheric conditions, and weather on the globe that have been several decades or more. Nevertheless, climate change as a natural phenomenon has oscillated over centuries, but the pace at which it has grown in the last few decades indicates that there is more to it, and several works claim that the current conditions cannot be explained through natural factors alone, but due to anthropogenic factors like industrial discharges, forest loss, and fossil fuel burning. The United Nations Framework Convention on Climate Change (2006 : 7) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". This is the point at which the majority of global warming has been intensified by human activities, thereby causing very high rates of temperature increases. Since the mid-twentieth century, the polar regions, particularly the Arctic, have warmed at abnormally high rates relative to the rest of the earth.

Climate change is now manifesting everywhere, and its impacts are less and less able to escape notice. Over the pre-industrialized period, global mean temperature has risen by roughly 1.2 °C. This warming has set off a chain reaction-sea levels are rising, ice caps are melting, rainfall patterns are shifting, and extreme weather events like heatwaves, floods, and droughts are becoming more common (IPCC, 2021; Granwal, 2022). In the Asia-Pacific region, the impacts are particularly severe. This field is struggling with a disturbing trend of climate-related disasters. Coastal urban areas such as

Mumbai, Dhaka, Jakarta, and Ho Chi Minh City, are highly vulnerable to inundation, posing a serious risk to the houses and earnings of millions of people (IMF, 2021).

The Himalayan area, including Nepal, is another region where climate change is acting strongly. This region is warming at a rate greater than the global mean, and across the region the harsher conditions are felt by ecosystems and those who live in these ecosystems, and those in particular mountains (Henley et al., 2020). But not everyone is affected in the same way. Rural and indigenous communities are most affected as they depend most on natural resources, do not have considerably good infrastructure and have difficulty adapting due to lack of resources (Regmi et al., 2013).

Nepal in particular is at risk owing to unusual spatial features and economic constraints. Although it contains only a small proportion of the global greenhouse gas emissions, temperatures in Nepal have increased by 1.6°C between 1976 and 2005-nearly three times the global estimates for that period (IPCC, 2021). Due to its wide range of geospatial settings, including the low-lying Terai plains and the high-altitude Himalayan ranges, Nepal is one of the most climate-vulnerable nations globally. Over 80% of its population is exposed to the hazards of floods, landslides, avalanches and glacier lake outburst floods, which pose an ongoing threat to life and property. These alterations are also affecting the agricultural-based economy of Nepal. Damage to crops, devastation of infrastructure causing significant health problems, are the results of irregular rainfall, glacier-induced flooding, and extended droughts.

Climate change is taking its toll on the mountainous regions in Nepal. People living in these fragile environments are not only dealing with the strain on their surroundings but also facing growing threats to their way of life and economic stability. In addition, agriculture, the essence of the Nepalese rural economy, is severely affected. Alterations in weather patterns, excessive rainfall, and landslides cause damage to irrigation systems, lower yields, and create a threat of food insecurity in communities. In addition, with Nepal's wide range of ecosystems-from tropical lowlands to the icy peaks of the Himalayas-the country is exposed to a variety of extreme climate events, like scorching temperatures in the plains and rapidly melting glaciers in the high mountains. For instance, on the one hand, those alterations offer rural areas limited options, push them to move, for alternative income sources, or resort to new farming

practices for sustainment. On the other hand, these same communities often lack the resources needed to adopt effective adaptation measures (Regmi et al., 2013).

The impact of climate change is not equal for all. Nevertheless, the impact is greatest on the most disadvantaged members of society, exacerbating existing disparities. In Nepal, low-income farmers, ethnic, and poor households are obviously disadvantaged. They lack the ability, facilities, and the ability to adapt to these developments in the best way (Perelet, 2007; Saadat & Islam, 2010). Melting of the Himalayan glaciers that provide fresh water to the populations of millions is triggering more frequent glacier lake outbursts. In addition, such floods represent a significant risk to settlements and agriculture at lower levels (Henley et al., 2020). Side by side, as glaciers continue to shrink, they bring risks to water supplies, make crop failures more likely, and lead to greater competition for dwindling resources, deepening the social and economic divides that already exist.

An anthropological point of view provides an explanation for deep entanglement among environmental, social, and cultural processes, especially in relation to climate change. Although the environmental impact is self-evident, the susceptibility of vulnerable communities and their capacity to adapt often relates to socio-economic conditions, cultural attitudes, and power relation- ships. For example, in Nepal, people are turning to strategies like temporary migration and finding other ways to earn a living to cope with the pressures of climate change. However, these options are not available to everyone, because social inequalities make it much harder for poorer communities to adapt (Regmi et al., 2013). Additionally, climate change exacerbates these inequalities, disrupts cultural practices, and compels many people to forsake traditional ways of life, leading to severe social and economic repercussions.

Many studies show that climate change is not just an environmental issue but is closely related to socio-economic and political ones. Central and South Asian studies demonstrate that floods and droughts may lead to collapse of irrigation, food insecurity, and the eviction of traditional patterns of living, which is most acute for the most disadvantaged groups (Perelet, 2007; Saadat & Islam, 2010). Moreover, in Nepal, people have already attempted sharecropping, microcredit borrowing, and alternative energy usage to mitigate the impact of climate change. However, these solutions

sometimes deepen inequalities. On the one hand, wealthier families would be readily equipped to respond quickly through access to resources, education, and technologies. On the other hand, poorer households often have no choice but to take on risky strategies, like borrowing money at high interest rates, which can trap them in even greater hardships.

In this context, this study focuses on the Solukhumbu district, specifically Nechasalyan Rural Municipality-2, a region known for its high-altitude landscapes and rich biodiversity. It is also one of the areas where the effects of climate change are most visible. Because of the unique set of natural and cultural values, Solukhumbu is a prime candidate in which environmental change can be studied from the perspective of social structure and cultural behavior. Hence, the present study aims to investigate local residents' views on the climate change impact in Nechasalyan Rural Municipality-2, Solukhumbhu district of Nepal.

2. Literature Review

2·1 Anthropology of Climate Change

Research into climate change has increasingly become interdisciplinary and anthropology has made a major contribution in providing insight into the social and cultural dimensions of environmental problems. Anthropology has been gradually expanding its field of vision to study relationships with the environment, change adaptation, struggle for social justice, and policy shaping. As a result, the "demography of climate change" is an expanding field of research in which anthropological concepts and techniques have begun to be applied to contemporary problems such as climate change and sustainability as well as adapting to climate change (Baer & Reuter, 2015).

2·2 Foundations of Climate Change Anthropology

Anthropology's interest in climate-related problems originates from the work conducted by physical anthropologists, archaeological anthropologists, and archaeologists. In addition, these authors investigated how natural climate variability influenced the course of human evolution, the diffusion of human settlement, and the ultimate transformations of society. Researchers like Crumley and Fagan demonstrated how historical climate fluctuations not only affected the rise and fall of civilizations but also triggered migration patterns

over thousands of years (Crumley, 1994; Fagan, 2000). In addition, their work laid the groundwork for understanding how deeply environmental changes shape human societies, setting the stage for today's focus on human-caused climate change.

However, as the Industrial Revolution unfolded, anthropologists began shifting their focus to the ways human activities were altering the environment. The barbaric reliance on fossil fuels and the "growth at all cost" mentality resulted in significant disturbances such as global warming, sea level rise, and loss of biodiversity. Additionally, anthropologists such as Margaret Mead early on noted the strong relationship between social structure and environmental health. On the one hand, she advocated for interdisciplinary collaboration as early as the 1970s, emphasizing the importance of tackling climate problems together (Baer & Reuter, 2015). At the same time, this rising awareness provided the context for anthropologists to explore the intricate interplay between human communities and those environments with which they interact today in a rapidly changing environment.

2·3 Theoretical Perspectives Regarding Climate Change in Anthropology

Major theoretical perspectives regarding climate change in anthropology are cultural ecology, cultural interpretive approaches, and critical anthropology, as well as applied anthropology. Each of the following provides a different, through different ways of articulating the interaction between humans and the environment, an account of how, and why, this field came to generate such different results.

2·3·1 Cultural Ecology

Cultural ecology examines the way that people respond to their environment by drawing on their culture, their beliefs, and their livelihood. In addition, it emphasizes the intimate relationship between culture and the environment, demonstrating how groups adapt to changes in the environment. This is just one example, from the research of Mark Nuttall on Arctic Indigenous peoples. Specifically, he explored how such communities respond to a changing climate that threatens their traditional hunting and fishing activities. As research as part of the "Arctic Climate Impact Assessment", his investigations explain how culture and environment interrelate, informing adaptation of ways of life (Nuttall

et al., 2004). Likewise, Ben Orlove's work comparing past cultures, such as the Mayans and Norse, reveals both the advantages and disadvantages of coping with climate change. These are examples that still teach us today (Orlove, 2005).

2·3·2 Cultural Interpretive Approaches

Significantly, cultural interpretive perspectives emphasize how individuals build an understanding of climate change using their understandings and beliefs. On one hand, this approach examines behaviors of local people to changes in the environment perceived or reacted to. On the one hand, it raises questions about global policies that have failed for many reasons to understand these local modes of thought. Susan Crate's work is a good example. She contends that decision-makers assign too much weight to the notion of "adaptation" and ignore the nuanced ways in which communities react to climate change. Also, Crate's research shows how cultural ideas about climate risks shape how people adapt and reveal deeper problems with power and inequality (Crate, 2008).

2·3·3 Critical Anthropology

Critical anthropology is political and explores the interrelations between capitalism, environmental destruction, and injustice. Still, this approach doesn't just criticize; it also calls for change that is fair and just. Anthropologists claim that intensive use of resources and generation of waste, hallmarks of contemporary economics, are the primary drivers of climate problems (Baer & Singer, 2009). Meanwhile, critical anthropology points out that climate impacts are not evenly distributed. The least frequently contributing communities suffer the greatest hardships. In addition, this kind of approach emphasizes the importance of reforming these unjust systems so that people are equipped to handle climate issues in more effective ways and arrange a fairer society.

2·3·4 Applied Anthropology

Applied anthropology focuses, first and foremost, on the solutions to concrete problems, by involving communities, governments, and institutions. Moreover, it emphasizes cultural knowledge and local issues and has incorporated them into actions to mitigate climate change. For instance, applied anthropologists routinely function in such a role as being the broker between research and what local communities want/need to develop plans effectively

for all. Baer and Reuter note that such attempts can lead to solutions that are good for the environment and for local populations (2015).

2·4 Interdisciplinary Collaboration and Policy Implications

Anthropology shows why it is so important for different fields to work together to tackle the environmental challenges we're facing. Naturalists, on the other hand, usually reflect on issues of weather, sea level, and glacial melt, but anthropologists think about how these changes affect people, their ways of life, their cultures, and their communities. On the other hand, this view is being increasingly recognized by organizations such as the Intergovernmental Panel on Climate Change (IPCC) and Future Earth. On the one hand, they have typically tended to depend on physical sciences to address climate problems. However, they are recently beginning to incorporate social scientists as they realize that addressing these problems goes beyond the environment, in that it requires understanding people (Baer & Reuter, 2015).

In the context of policy, anthropology (really) promotes a paradigm shift. Policy, rather than focusing on economic growth, should be designed to be equitable and sustainable. Furthermore, they must also make sure that the basic needs of the people, such as food, water, energy, etc. are available to all. Simultaneously, these policies should be able to safeguard local cultures and the ecology. Furthermore, Indigenous and local communities offer generations of knowledge about their surroundings, which can lead to better, more practical solutions. Side by side, this kind of knowledge complements scientific research by adding depth and context to global strategies.

Last, anthropology leads us back to the human element in climate change. But it's not just a matter of demonstrating the impact on individuals. It also explains why some communities are hit harder than others, how they find ways to adapt, and what we can do to create a future that is both fair and sustainable. Through the lens of cultural practices, the prevention of systemic effects, and the integration of various disciplines, anthropology offers practical solutions for climate change that benefit everyone.

3. Study Site and Methodology

The study was carried out in the Nechasalyan Rural Municipality-2, located in the Solukhumbu district of Nepal. This site was chosen, mainly, based on its substantial vulnerability to the consequences of

climate change. The region's geographical setting makes it prone to environmental hazards such as floods, landslides, and irregular rainfall patterns. The population in the area is people from different ethnic groups and their livelihoods depend on agriculture, pastoralism, tourism, and forestry as the main economic activities. Yet, given the growing prevalence of climate-related disasters, much of the necessary research has been overlooked on micro-level studies of the impacts of disasters on communities' livelihoods.

This study tried to explore the perceptions of the effects of climate change on these communities and how these communities cope with environmental issues. For this purpose, a descriptive research design was used with a purposive sampling approach to select 5 participants with knowledgeable as well as direct experience in matters of climate change. Similarly, the data collection utilized qualitative methods, with participants using semi-structured and informal interviews. Data were thematically analyzed following the structure of qualitative analysis.

4. Data Presentation and Interpretation

Rural communities are facing the brunt of climate change and its effects are prominently felt in high-altitude areas such as Nechasalyan in Solukhumbu, Nepal. This area has become a critical focus for research as it offers interesting insights into how climate change impacts the local environment and the people inhabiting it. Primary data collected in the field through interviews indicate the existence of a change that has and continues to affect the environment. Environmental changes which include irregular rainfall, increasing temperatures, and the introduction of new vegetation and insect species are beginning to become the norm, indicating a greater ecological shift.

Residents in Nechasalyan have more than one problem regarding agriculture and livestock that are their major economic activities, they have challenges that cut across all aspects of their lives. These changes result in food inadequacy, increasing water shortages, and alteration of farming systems. The conclusions advocate for policy frameworks that will provide adaptive responses in light of the challenges rural communities face due to the changing global setting. The case studies addressed below outline the different, often devastating, conditions experienced by the people of Nechasalyan and their reactions and coping mechanisms.

4·1 Impact on Agriculture

Global warming has changed temperature regimes, altered rainfall patterns, and caused weather extremes making agriculture in Nechasalyan feel the mark of climate change. The global temperature rise alters the environment in which crops of wheat, rice, maize, and others that require the saturation of warmth tend to grow. Heat stresses push these plants to grow under less than optimal conditions which reduces yield potential. It speeds up the attitude of maturity of crops and reduces the growing days which together constrain yield potential (Lobell et al., 2011; Rosenzweig et al., 2014).

Additionally, changes in weather patterns coupled with rainfall which is also becoming more turbulent create a situation where water resources for crops get limited and places the chances of droughts or flooding higher. These changes are destructive, especially to rain-fed agriculture, which is still very common in many underdeveloped countries. In South Asia, for instance, varying monsoon qualities have caused planting seasons to go out of range thus severely affecting the country's productivity (IPCC, 2021). Nechasalyan's 48-year-old man, Ram Bahadur (Pseudonym) narrates his own experience of these calamities on a personal level:

> The rains were everything, ever since I can recall. They were when we needed them, absorbing water into the ground and fertilizing our crops. But it is no longer as simple. The rains don't arrive on time anymore. Suppose they do, either too much or too little. It pours some days so hard it fills the fields and scours away all my labour. And when I stare now at my fields - sodden, scratched, vacant - I cannot help but feel a pit in my stomach. That maize and potatoes I once strutted about and raised my family, they don't even sprout. Each season is a game of a guess and most of the time I'm on the losing end. Everything my dad and grandfather had taught me is now a waste of time. So much weather has happened that I'm trying all the time to know what to do and it's not working. And, the worst part is to think of what this is doing to my family. I want to feed them but it's tougher every year. I thought I was part of this place, but now I am fighting it-and losing. And some days I wonder if I can even keep it up.

Ram Bahadur's testimony reveals how climate change has completely upended traditional agricultural practices in

Nechasalyan. What used to be dependable monsoon rains are now unpredictable, often arriving too late and in overwhelming bursts that flood fields instead of providing the steady moisture crops need. This has resulted in water scarcity, decreased yields, and drastically altered cropping patterns, making it increasingly difficult for farmers to grow enough food to meet their needs. The transition from stable weather patterns to such erratic conditions highlights the urgent need for adaptive agricultural strategies that can better cope with the unpredictable climate.

4·2 Impact of Unseasonal Rainfall and Livelihood

The problem of unseasonal rainfall adds to the woes of the local farmers. Such rainfall has been reported to interfere with subsistence farming, whereby the crops are vandalized, low yields are realized, and food security is aggravated (Ray et al., 2015). More often than not, unseasonal rain waters the crops at the most inopportune times which include flowering and harvest, leading to crop destruction and soil being washed away. Additionally, rainfall at unexpected times like harvest time can lead to immature sprouts of the crops or rot thus lowering the marketable quality of the crops and causing losses to the farmers (FAO, 2019). A 76-year-old woman of Nechasalyan, Hiradevi (Pseudonym), says these dynamics help her understand how her fellow community members have come through this:

> When I came here after my marriage, the seasons felt dependable. The rains came on time, and the fields gave us what we needed. We knew when to plant and when to harvest, and life seemed to have a rhythm we could trust. But over the years, everything has changed. The rains don't come when they're supposed to anymore. Sometimes they come late or fall so heavily that the fields flood, and other times they don't come at all, leaving the soil dry and hard. It's disheartening to see the fields like this. They used to be full of maize and potatoes, but now the crops grow less and less. No matter how much I try, it feels like things aren't improving. Each season feels harder than the last, and it's tiring trying to adapt to something I can't control. I still hold on to hope, though. This land has taken care of us for so long, and I believe it can again. I just wish the weather would return to what it once was, so we could go back to the life we knew and trusted.

Hiradevi's account highlights the immense difficulty of adjusting to a rapidly changing climate. Once-predictable weather patterns

have become unpredictable, making it impossible for farmers to plan planting and harvesting schedules. This erratic weather has led to a dramatic decrease in agricultural productivity, forcing families to shift from farming for income to subsistence farming. In many cases, this transformation has led to the migration of younger generations in search of better opportunities elsewhere.

4·3 Health and Public Wellbeing

Notwithstanding, climate change impacts agricultural systems beyond the fields themselves and consequently brings important implications for public health. The rise in extreme meteorological events, rising temperatures, and changing disease epidemiology are placing heavy demands on public health. Heatwaves and temperature increases are linked to an increase in heat-related diseases (dehydration or heatstroke) particularly in high-risk groups such as children or the elderly (Haines et al., 2006). Changes in rainfall regimes and flooding create ideal conditions for waterborne diseases (e.g., cholera and dysentery) in regions with limited sanitation infrastructure (McMichael et al., 2006).

In addition, the changing climate is also affecting the distribution of certain diseases, such as malaria and dengue, due to the increased range of their vectors, including mosquitoes, to new territories (Patz et al., 2005). Socioeconomic status, however, usually increases these effects because there are not sufficient resources for most minorities to respond to these health challenges. Sherjung (Pseudonym), 39 years old, a teacher of Nechasalyan, speaks about the effects that he has noticed due to the preexisting climate changes on the health of people:

> I learned firsthand about the consequences of climate change through working on different climate change projects in my village. It's dismal to realize my friends coming to urban areas, thus leaving their village, due to the challenges ascribed to climate change, in search of better opportunities. Losses in agriculture and livestock breeding have extended the certain environments of folk living in regions where it is increasingly difficult to sustain a viable livelihood against climate change that has now become a part of our life routine, not the only thing that has changed in our food or clothes. Floods and landslides, as natural disasters, have achieved this by diminishing agricultural land and killing more residents of the community. I have identified during my role as a teacher, an aversive increase in

> health conditions in children, such as eye infections, conjunctivitis, and common illnesses (diarrhea, common cold), suspecting that there is a link with climate change.

Sherjung's testimony highlights all the complex effects of climate change on rural populations. Not only does it affect livelihoods, but it also introduces a host of health challenges, from waterborne diseases to respiratory infections. The rise of such natural disasters as inundation and landslides further compound these health risks by depleting the amount of arable land and causing injuries. The increasing number of medical problems in children, in particular, points to the need for broad adaptation measures to safeguard public health in the context of climate change.

4·4 Impact on Biodiversity and Livelihoods

Along with sea level rise, climate change represents a major threat to biodiversity because in the perpetual process of changing climate parameters ecosystems are continuously destroyed and species are redistributed, increasing the risk of species extinction. This has wider implications for the local communities that provide food, pharmaceuticals, and income in return for biodiversity. Amrit Sherpa (Pseudonym) a 39-year-old farmer, described the decline of local biodiversity:

> I've worked in the farming sector for the last decade and the environment has changed immensely. I have seen the climate change that affected our ecology and biodiversity. Just exploring the remnants of all the Indigenous plants and species now in the phase of extinction and our forests, lakes, and meadows that become degraded due to erosion over time, we felt that finding similar outlooks would be a major challenge. However, the most apparent is bare fields instead of our grasslands due to rainfall reduction as well as water deficits. Species like Kafal, Pipal, and Dhayera, which used to be the most common ones, have now become very rare. Hence, although these foodstuffs may still be marketed, these in the meantime are of major importance to me. Ways of selecting storage space and introducing transport facilities are great challenges facing me about moving my produce to the market, but often I confront middlemen that undervalue my performance and damage my profit margins.

Amrit's log also shows the heavy consequences of climate change on the biodiversity of Nechasalyan. Damage to ecosystems and the

extinction of native species, for instance, are some of the most obvious consequences of climate change. In response, Amrit has been adjusting by growing new cash crops such as kiwi and cardamom, which have now become the region's cash crops of choice. Nevertheless, he is limited from promoting his crops owing to the inability to develop appropriate infrastructure. If storage and transportation infrastructure is not provided, he is at a disadvantage in bringing his harvest to market and often has to seek the services of middlemen who pay him low prices while reducing his margins.

Amrit's story demonstrates both the resilience and adaptability of farmers in Nechasalyan in the face of climate change. Nevertheless, it also draws attention to the systemic limitations (E.g., lack of infrastructure) that prevent their success. The loss of biodiversity, compounded by insufficient infrastructure, poses a serious threat to the economic stability of rural communities.

4·5 Livestock and Climate Change

The livestock industry is experiencing the adverse effects of climate change in the form of rising average temperatures, climate variability, and recurring climatic hazards, all of which negatively affect animal health and production. High temperatures lead to heat stress, which negatively impacts milk yield, reproduction, and weight gain in livestock, in turn, precipitation changes impact the livestock grazing and forage lands. The impact of natural hazards such as floods and landslides also contribute to increased challenges by cutting back the quality of pastures and the amount of water available, which in the long run, puts the insects of farmers who depend on livestock for economic survival and other needs at risk (FAO, 2018; IPCC, 2021). Among, Pasang Sherpa (Pseudonym), a 37 years old farmer of Nechasalyan says:

> Floods, landslides, and variable rainfall make it challenging to manage our livestock. Rainy seasons were a foregone conclusion and the overgrazed pastures had never been more than adequate to feed our animals. Today's rains are different, they may all come at once or after a prolonged period of drought. The floods have swept away the grass and landslips have left some places uninhabited, which means we have a lesser number of grazing places. Unsatisfactory levels of forage and water availability have now compromised the health of our livestock and our milk production is greatly down. Lack of enough quality and quantity

of fodders has also made our livestock difficult to fatten or to become pregnant. This has resulted in a reduced number of animals and consequently, reduced production of what we have historically used to expect, i.e., the production outcome.

Pasang's experience highlights the disruptions caused by climate change, which has led to degraded pasture, limited water resources, and a decrease in livestock productivity. Farmers are switching to less-demanding animals but this is far from a simple solution with its own set of problems. Adaptation requires novel abilities, novel food categories and a novel trophic level. Nevertheless, these modifications are both necessary for environmentally sustainable livestock production under climate change.

5. Major Findings

- Because of climate change, the people experience unpredictable monsoon patterns; grossly reduced crop yield from shortened growing seasons generally disrupted traditional agriculture on which communities depended for generations.
- Unseasonal rainfall during the period of critical growth and harvest resulted in large-scale damage to crops, soil erosion, and a reduction in agricultural productivity, which has forced many families to give up income farming and focus on subsistence agriculture for survival.
- Rising temperatures, increased extreme weather events, and altered rainfall patterns increase health risks, such as waterborne diseases, heat-related illnesses, and respiratory infections, most of which especially affect the vulnerable groups of children and the elderly.
- Ecosystem degradation and loss of biodiversity because of climate change have reduced the number of indigenous plant species; farmers had to adapt by cultivating new cash crops, such as kiwi and cardamom, but their efforts are crippled by limited storage, transportation infrastructure, and market access.
- Erratic rainfall, prolonged droughts, and extreme weather events have degraded pastures and reduced grazing land, leading to declines in livestock productivity and forcing farmers to explore alternative livestock management strategies despite associated challenges.

6. Conclusion

This research shows the mitigation of the challenges faced by rural communities, the ecosystems and livelihoods in high-altitude areas like Nechasalyan Rural Municipality-Ward No 2 in Solukhumbu, Nepal due to climate change. The erratic occurrence of rainfall, heat waves, and severe storms have caused damage to the age-old methods of farming, reduced the stock of animal's husbandry, and resulted in the degeneration of the wildlife. Such issues have contributed to low levels of agricultural production, insufficiency of water resources for irrigation and impaired efficiency in animal husbandry, resulting in a transition from commercial farming to survival farming. The disruptions have also worsened food security, increased human mobility and changed dependency on ecological means, highlighting the relationship between environmental change and people's vulnerability and social economic conditions.

Regardless of the effort's made, such as improving crop rotation and altering the management of livestock for the purpose of improving adaptation, some of the entrenched barriers still remain. An explanation for the inherent geographical areas populations that are vulnerable may include such strategies as targeting policies to ensure vulnerable communities have access to climate-proof infrastructure, appropriate farming practices and relevant resources for effective adaptation. This shows how important it is for leaders and people involved to act quickly to deal with the growing dangers of climate change. We need to work on building a future that is good for everyone, especially those who are often left out. The results make it clear that working together is essential to help these areas deal with the problems caused by a changing climate.

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