Volume 10, Issue 11, November – 2025 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov1397

Disaster Vulnerability and Adaptation in Goat Farming: A Study of Thabang Rural Municipality, Rolpa, Nepal

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Publication Date: 2025/12/02

Abstract: This study examines disaster vulnerability and adaptation in goat farming within Thabang Rural Municipality, Rolpa, Nepal. Goat farming, a key livelihood source for local communities, faces recurrent disruptions due to environmental fragility, climatic variability, and inadequate infrastructure, including poorly designed sheds and limited veterinary services. A mixed-method approach was employed, combining quantitative analysis of disaster frequency and impacts with qualitative insights from semi-structured interviews of 24 key respondents representing 656 farmers across five wards. Results reveal that landslides and disease outbreaks cause the most severe losses, while climatic events such as snowfall and storms produce cumulative effects that weaken long-term productivity. Despite these challenges, emerging institutional interventions, including hazard mapping, resilient shed construction, vaccination programs, and adaptive feeding practices, reflect a shift toward proactive disaster management and community-based resilience. The study illuminates the importance of integrating technical support, local knowledge, and participatory planning to sustain goat farming and rural livelihoods under disaster-prone conditions.

Keywords: *Goat Farming, Disaster Vulnerabilities, Adaptation, Rural Livelihoods, Climate Hazards, Rolpa, Nepal.*

How to Cite: Ashim Dangi; Mohan Kumar Paudel; Amir Dangi (2025) Disaster Vulnerability and Adaptation in Goat Farming: A Study of Thabang Rural Municipality, Rolpa, Nepal. *International Journal of Innovative Science and Research Technology*, 10(11), 2141-2150. https://doi.org/10.38124/ijisrt/25nov1397

I. INTRODUCTION

Mountainous regions such as Nepal's mid hills and highlands are intensively vulnerable to hydrometeorological and geophysical hazards owing to steep slopes, fractured geology, and changing climate regimes (Paudyal, Khadka, & Khadka, 2013). In such settings, smallholder livestock farming, including goat rearing, plays a critical role in sustaining rural livelihoods by offering income, food security, and asset buffering during times of crisis (Neupane, Neupane, & Dhital, 2025). Yet the combination of natural hazards, climatic variability, and limited institutional support places goat farming systems at significant risk, often disrupting production cycles and reducing household resilience. For instance, a Nepal-wide study found that 42.9 % of households engaged in livestock reported moderate impacts of climate change, and 35.7 % reported severe impacts on productivity in small livestock systems (Gyawali & Kharel, 2021). Furthermore, disaster-related livestock losses have been repeatedly documented; following the 2015 earthquake in Nepal, over 40,000 small ruminants and goats were lost and nearly 1,000 hectares of grazing land rendered unusable, demonstrating the scale at which disasters can undermine local agricultural systems (Grayman, Karki, & Matthewman, 2022).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov1397

Within Nepal, scholars have highlighted both the prospects and constraints of goat farming in rural areas. A study of goat farming in Surkhet reported that although goats provide meaningful employment and income opportunities, the sector is constrained by feeding shortages, unskilled manpower, limited veterinary services, and inadequate financing (Devkota, 2025). At the same time, the adaptation capacity of pasture and livestock-dependent communities is shaped by access to credit, land resources, training opportunities, and broader agro-ecological settings, which collectively influence their ability to prepare for and respond to shocks (Dhakal, 2021). Adaptation studies in rural Nepal further underline that community-based strategies, such as crop diversification, fodder production, improved grazing management, and the strengthening of local resource institutions are critical to enhancing resilience in agriculture-livestock systems (Gautam, 2025).

Despite this body of research, the specific interface between multiple, recurring disasters (such as landslides, snowfall, windstorms, thunderstorms, and disease outbreaks) and goat farming systems in mountainous municipalities remains underexplored. In particular, knowledge is scarce on how small ruminant farmers in steep terrain negotiate and adapt to layered vulnerabilities comprising environmental, infrastructural, and institutional dimensions. Of the few studies that address livestock and disaster risk in Nepal, many focus on larger ruminants or the broader agricultural system rather than the unique experiences of goat farmers in hazard-prone rural municipalities. Recognising these gaps, this study investigates the dynamics of disaster vulnerability and adaptation in goat farming in Thabang Rural Municipality of Rolpa District (Lumbini Province), Nepal. In line with the purpose of the study, two main objectives were: first, to identify the types, causes, and impacts of disasters affecting goat farming in Thabang Rural Municipality, and second, to examine the existing plans, strategies, and local adaptation practices aimed at minimizing their effects. Together, these methodological approaches and objectives formed a solid foundation for understanding the dynamics of disaster vulnerability and resilience in the context of mountain-based goat farming in rural Nepal. It aims to contribute to a more nuanced understanding of how smallholder goat farmers navigate risks, implement adaptive strategies, and sustain livelihoods in one of the country's most geographically and socioeconomically fragile landscapes.

II. LITERATURE REVIEW

In Nepal's mountainous and hilly regions, livestock systems are increasingly impacted by multiple hazards and climatic variability. For example, Agricultural perspectives of climate change induced disasters in Doti, Nepal found that farmers in Doti experienced both slow-onset disasters (drought, water scarcity) and rapid-onset events (landslides, floods) which adversely affected agricultural and livestock production; importantly, farmers shifted from larger ruminants to smaller animals such as sheep and goats to adapt to these pressures (Paudyal, Khadka, & Khadka, 2013). Similarly, Pastoralism in Crisis: Mounting Challenges in Herding System in High Altitude Region of Nepal documented how herding systems in high-altitude Nepal face livelihood stress from climate change, resource competition, and institutional weakness in the pastoral sector (Bhusal, Banjade, & Paudel, 2019). These studies underscore that mountainous livestock systems operate under layered geophysical, climatic and institutional vulnerabilities, making small-holder livestock production inherently risky. Further, Emergency Animal Health Management during Natural Calamities and Disasters in Nepal draws attention to the animal-health dimension of disaster risk, showing that natural calamities trigger acute veterinary and shelter challenges for livestock in Nepal (Sharma & Ghimire, 2023). Collectively, this body of literature demonstrates that livestock farmers in mountain Nepal, especially those rearing small ruminants are exposed to intersecting hazards of landslides, snow/frost, storms, disease outbreaks, and feed/forage scarcity.

Goats have long been recognized as a suitable livestock option for smallholder, resource-poor households in Nepal's hilly and mountain zones. For instance, the study A Socioeconomic View of Status and Prospects of Goat Farming in Rural Areas of Nepal found that goat farming contributes to employment, income, asset-buffering and is often managed by women and children in households affected by male out-migration (Neupane, Neupane, & Dhital, 2018). On the constraint side, Prospects and Problems of Goat Farming in Rural Nepal identified major barriers including fodder/grass shortage, unskilled manpower, weak insurance access, inadequate loans, and poor veterinary services (Devkota, 2025). Moreover, the analysis in Impact of Cooperative Membership on Adoption of Improved Goat Production Practices in Chitwan District of Nepal showed that membership in cooperatives significantly improved adoption of better goat production practices (Neupane et al., 2024). These findings suggest that while goat farming is feasible and relevant in Nepal's rural context, production constraints, limited institutional support, and lack of hazard-sensitive planning restrict its full potential for livelihood resilience.

Studies focusing on mountainous or marginal districts shed additional light on how ecological, management and infrastructural constraints impact goat systems in terrain-challenged settings. For example, the study Goat Feed Resources and Feeding Management in Mid-Hill of Nepal analysed 162 goat farms in Tanahun district and found that although goats are integrated with cropping systems, feed resources were seasonally constrained and grazing often extended into forests or communal land (Shah, Pandey, Bastola, Shah, & Shah, 2023). In remote districts, Study of Goat Production and Management Practices Adopted by Farmers in Bajura District, Nepal surveyed farmers in Bajura and highlighted that farm management practices play a crucial role in sustainability of goat enterprises in steep, less-accessible terrain (Thapa, Magar, & Hajee, 2025). Further, the article Observation of Rearing System of Small Ruminants in Jumla District documented transhumance systems in small ruminant

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov1397

rearing (goats and sheep) in Jumla district, indicating mobility, grazing area access and altitude as key management variables (Sah, Yadav, & Kanu, 2023). From a growth-performance perspective, Factors Influencing Different Stages of Growth in First-Generation Boer Crossbred Goats examined how non-genetic factors (location, herd size, parity) affect goat growth in Nepal, underscoring that location and system influences matter (Sap k ota et al., 2024). These studies collectively point towards the fact that in mountain/marginal zones, goats' productivity and management are significantly influenced by feed/forage availability, altitude, mobility and shedding/housing design.

Existing literature highlights a growing interest in integrating traditional agricultural knowledge with modern organic practices. Scholars emphasize that such integrative systems can strengthen ecological resilience, promote environmentally responsible production, and support long-term soil regeneration. Research on the Rishi Krishi approach shows its potential to enhance soil fertility, ecological balance, and overall human and animal well-being, aligning closely with the holistic principles of the One Health perspective (Pun & Baral, 2025). Adaptation to climatic and disaster risk in livestock systems is an emergent but critical area in Nepal. The determinant study Determinants of Livestock Farmers' Adaptation Strategies to Climate Change in Gandaki Province, Nepal found that livestock farmers' adaptation strategies (such as improved breeds, fodder conservation, housing improvement) were influenced by access to extension services, credit, training and awareness of climate risk (KC et al., 2025).

In addition, the study Adoption of Goat Production Technology at the Farm Level: A Case of Krishnagandaki VDC, Shyangja District reported that adoption levels of goat production technologies (breeding, health, nutrition, pasture) were moderate (~42 %) in Syangja district, and technology adoption is relevant to adaptation capacity (Nepali et al., 2011). Moreover, hazard-specific livestock management is addressed in the article "Emergency Animal Health Management during Natural Calamities and Disasters in Nepal," which emphasises institutional preparedness, emergency veterinary responses and the need for resilient shelter/infrastructure for livestock in disasters (Sharma & Ghimire, 2023). Institutional mechanisms such as cooperatives, extension, local government plans and hazard mapping are increasingly seen as critical. Yet, according to Bhusal et al. (2019), pastoral systems in high-altitude Nepal are constrained by inadequate institutional coordination and conflict between pastoralists and forest/community governance systems. Thus, adaptation in livestock systems is multi-dimensional—requiring infrastructure (housing, feeding), mobile grazing management, veterinary services, institutional support and hazard-sensitive planning.

III. RESEARCH METHODS

The study followed a mixed-method, combining both qualitative and quantitative approaches to ensure a comprehensive understanding of the issue. Quantitative methods were applied to collect measurable data related to the frequency, causes, and impacts of disasters on goat farming, while qualitative methods were used to capture the experiences, perceptions, and coping strategies of local farmers. This integrated approach helped link the statistical evidence of disaster impacts with the lived realities and adaptive behaviors of the community. A total of 24 key respondents were selected from 24 farmers' groups across all five wards of Thabang Rural Municipality, representing a total membership of 656 farmers. The purposive sampling technique was employed to ensure that participants had adequate experience and knowledge of goat farming and disaster management in the local context. These respondents were identified as the most capable of providing in-depth insights into both the challenges and the adaptive practices associated with goat farming under disaster-prone conditions. Primary data were gathered through semi-structured interviews conducted in 2024, allowing respondents to express their personal experiences and local perspectives regarding the types, causes, and effects of disasters, as well as the preventive and adaptive measures they had adopted. In addition, field observations were carried out to visually assess the condition of goat sheds, grazing areas, and the visible impacts of landslides, storms, and other hazards on farm infrastructure. To complement the primary data, secondary information was collected from various journals, academic publications, government reports, and local records, which helped contextualize the field findings and validate the observations made during the study.

Data analysis involved both quantitative and qualitative techniques. Quantitative data were processed using descriptive statistics such as frequencies, percentages, and averages to illustrate patterns and trends in disaster occurrences and their effects on goat farming. Meanwhile, qualitative data were analyzed through thematic content analysis, which helped identify common themes, community experiences, and adaptive responses. The integration of these two methods ensured a balanced interpretation of the findings, providing both empirical evidence and contextual depth. Throughout the study, all ethical standards were carefully followed. Participants were informed about the objectives and significance of the research, and their informed consent was obtained before data collection.

Confidentiality and anonymity were strictly maintained, and respondents participated voluntarily without any coercion. The researcher ensured that the study adhered to the principles of respect, transparency, and honesty in dealing with all participants. To enhance the reliability and validity of the study, interview questions were pre-tested and adjusted for clarity and cultural appropriateness. Triangulation of data from multiple sources interviews, observations, and secondary documents, helped strengthen the credibility of the findings. By integrating

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov1397

quantitative evidence with qualitative insights, the research provided a realistic and comprehensive picture of how disasters affect goat farming in Thabang and how local farmers and institutions are responding to those challenges.

IV. RESULTS AND DISCUSSION

➢ *Results*

Goat farming in Thabang Rural Municipality, Rolpa is profoundly influenced by multiple and recurring disasters that have affected livestock production, farmer livelihoods, and the overall resilience of the rural economy. The analysis of historical records demonstrates that landslides, thunderstorms, disease outbreaks, snowfall, and windstorms are the most common hazards impacting goat-rearing households. Among these, landslides and disease outbreaks have caused the most severe losses, resulting in the death of hundreds of goats and sheep, destruction of sheds, and disruption of daily farming operations. Climatic hazards such as thunder and snowfall occur more frequently, producing moderate yet cumulative impacts that weaken the sustainability of goat farming over time. These findings indicate a pattern of increasing climatic variability and environmental fragility, exposing goat farmers to significant livelihood risks.

The study also found that the causes of disasters are closely linked to both natural factors and human activities. Poor site selection for shed construction, weak structural designs, and delayed response to hazards have amplified the effects of natural disasters. Likewise, the lack of early disease detection and insufficient veterinary services have intensified livestock mortality during disease outbreaks. Snowfall and cold stress, particularly in higher altitude areas, were found to adversely affect young goats and reduce reproductive efficiency. These results suggest that goat farming systems in Thabang are constrained by limited adaptive capacity and inadequate preparedness to cope with environmental and biological shocks.

Despite these challenges, the findings indicate growing institutional awareness and proactive planning for disaster risk reduction in the livestock sector. The supportive plans formulated by the Rural Municipality, such as the identification of landslide-prone areas, use of earthing technology in sheds, vaccination programs, feed storage for winter, and construction of wind-resistant shelters reflect a gradual transition from reactive to preventive approaches. These initiatives, involving both local authorities and farmers, aim to enhance the resilience, productivity, and sustainability of goat farming. The results thus highlight an emerging model of community-based disaster management, where localized interventions, technical innovations, and collaborative governance play a pivotal role in minimizing risks and sustaining rural livelihoods.

Table 1 Historical Records of Disasters in Goat Farming

S.N	Disaster	Year	Affected Wards	Description of Losses	Severity Level
1.	Landslide	2019	Ward No. 2	Death of 70 goats and sheep, along with some human casualties	High
2.	Landslide	2002	Ward No. 2	Death of 5 goats in shed	Low
3.	Thunder	2020	Ward No. 1	Death of 35 sheep in shed	Medium
4.	Poisoning	2021	Ward No. 2	Death of 2 he-goats	Low
5.	Strong Wind (Storm)	2019	Ward No. 3	Roofs of 1 house blown away	Low
6.	Thunder	2022	Ward No. 3	Death of 3 goats and 1 bull, damage to sheds	Low
7.	Disease Outbreak (PPR)	2004	Ward No. 4 & 5	Around 300 goats and sheep died due to Peste des Petits Ruminants (PPR)	High
8.	Landslide	2022	Ward No. 1	About 200 households' walking trail blocked due to landslide	Medium
9.	Snowfall	Each year (2002-2024)	All Wards (Wards 1-5)	Soil erosion and damage to pasturelands and crop fields	Medium

Source: *Field Survey, 2024*

The historical data presented in Table 1 provide a clear picture of how various disasters have affected goat farming activities in Thabang Rural Municipality of Rolpa District over the years. The records reflect a combination of natural, climatic, and biological hazards that have repeatedly disrupted rural livelihoods and livestock-based farming systems between 2002 and 2024. The data reveal that goat farming as an important livelihood source for local households but faces frequent challenges due to environmental fragility, disease outbreaks, and extreme weather events that directly and indirectly affect livestock productivity and community resilience.

The earliest recorded disaster dates back to 2002, when a landslide in Ward No. 2 caused the death of five goats in a shed. Though categorized as low severity, this event highlights the long-standing exposure of hilly terrain communities to slope instability and rainfall-induced soil movement. A few years later, in 2004, a major disease outbreak (Peste des Petits

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov1397

Ruminants - PPR) in Wards No. 4 and 5 caused the death of around 300 goats and sheep, representing one of the most severe biological disasters in the recorded history of Thabang. The event was rated as high severity, underscoring the devastating economic and livelihood impacts of livestock epidemics in rural mountain regions where veterinary services are limited and disease control measures are weak.

More recent years show a clustering of disasters, especially between 2019 and 2022, indicating an increasing frequency of environmental and climatic disturbances. In 2019, two significant events were reported. First, a landslide in Ward No. 2 resulted in the death of 70 goats and sheep and even some human casualties, classified as high severity. This disaster underscores the coexistence of human and animal vulnerability in landslide-prone slopes of Rolpa's rugged landscape. The same year, a strong windstorm in Ward No. 3 damaged property, blowing away the roof of one household, though its impact was recorded as low severity. Such incidents, while less intense, represent the ongoing exposure of rural settlements to localized weather-related hazards.

The 2020 thunderstorm in Ward No. 1 caused the death of 35 sheep in a shed, categorized as medium severity, reflecting the increasing risk of lightning strikes and thunderstorms to confined livestock. Similarly, in 2022, another thunderstorm event in Ward No. 3 led to the death of three goats and one bull, along with damage to sheds. Although considered low severity, such recurring thunder-related incidents indicate an upward trend in climatic variability, possibly linked to regional weather shifts. Additionally, in 2021, a poisoning incident in Ward No. 2 caused the death of two he-goats, pointing to potential contamination of feed, fodder, or water sources; an anthropogenic risk that further compounds the natural hazards faced by livestock farmers.

In 2022, another landslide in Ward No. 1 blocked the walking trail used by about 200 households, causing disruption in daily movement and access to grazing areas. While no direct livestock mortality was reported, the event was classified as medium severity due to its indirect but substantial impact on goat-farming operations and local mobility. Beyond single-year disasters, annual snowfall events (2002–2024) have continuously affected all wards of Thabang Rural Municipality, leading to soil erosion, damage to pastures, and degradation of crop fields. This recurring, slow-onset hazard, rated as medium severity, has cumulative effects on land productivity and fodder availability; both essential for sustainable goat rearing.

When analyzed collectively, the disaster records highlight that landslides and disease outbreaks have caused the most severe losses to goat farming in Thabang Rural Municipality, while climatic events such as thunderstorms, strong winds, and snowfall occur more frequently with moderate impacts. The combination of high-severity and recurrent moderate-severity disasters indicates that the area is facing multi-dimensional vulnerability, influenced by steep terrain, fragile ecosystems, limited veterinary infrastructure, and increasing climate variability. These factors jointly erode the resilience of goat-farming households, making recovery and adaptation more difficult over time.

Table 2 Causes and Impacts of Disasters

S.N.	Type of Disaster	Causes	Impacts
1.	Landslide	Geographical condition, poor site selection for shed construction, delay in removing landslide debris.	Loss of shed, death of goats, interruption in goat farming activities.
2.	Thunder	Natural disaster	Death of goats, sheep and damage to sheds.
3.	Disease Outbreak	Delay in disease identification and lack of timely treatment.	Death of goats.
4.	Snowfall	High altitude area and climatic variations.	Adverse effects on goat sheds and young goats (bucklings and doelings).
5.	Storm/Windstorm	Weak and unprotected shed construction.	Destruction of goat sheds.

Source: Field Survey, 2024

The data presented in Table 2 highlight the underlying causes and resulting impacts of major disasters that have affected goat farming in Thabang Rural Municipality of Rolpa District. The findings reveal that both natural and human-induced factors contribute to the occurrence of disasters in the area, leading to significant losses in livestock, infrastructure, and farming continuity. These disasters, landslides, thunder, disease outbreaks, snowfall, and windstorms reflect the vulnerability of mountainous agricultural systems where topography, climatic variation, and inadequate preparedness collectively exacerbate the risk to goat farmers.

The landslide disasters, as identified in the study, are primarily attributed to the geographical conditions of Thabang's steep terrain, coupled with poor site selection for goat shed construction and delays in debris removal after landslides. These factors indicate that environmental fragility is being intensified by human negligence and lack of technical

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov1397

awareness in settlement and infrastructure planning. The impacts of landslides include the destruction of goat sheds, loss of livestock, and disruption of regular goat-farming activities, which not only cause direct economic losses but also affect farmers' morale and livelihood stability. The combination of natural slope instability and human error emphasizes the need for better site management, engineering interventions, and awareness programs on safe shed construction practices in landslide-prone zones.

Thunder and lightning disasters are described as purely natural hazards, yet they exert a substantial impact on goat farming. The table indicates that thunder events have resulted in the death of goats and sheep, along with damage to sheds. This pattern reflects the vulnerability of open or semi-open livestock structures and the lack of protective mechanisms such as lightning arresters or grounding systems. Thunder-related livestock deaths not only reduce herd size but also disrupt breeding programs and income generation. Such incidents underline the need for climate-resilient infrastructure and farmer training on preventive safety measures against extreme weather events.

The disease outbreak disasters are associated with delayed identification of illnesses and the absence of timely veterinary intervention. This cause points to systemic issues such as limited access to veterinary services, lack of disease surveillance, and inadequate farmer knowledge regarding early symptoms of livestock diseases. The resulting impact; death of goats demonstrates how preventable biological hazards can turn into major livelihood shocks when local institutions and farmers lack capacity for early action. The persistence of such outbreaks highlights the urgent requirement for regular vaccination programs, veterinary outreach, and farmer awareness campaigns to strengthen animal health management and reduce disaster-related mortality.

Similarly, snowfall-related disasters are linked to high-altitude climatic conditions and temperature fluctuations characteristic of Thabang's mountain environment. Snowfall poses particular threats to young goats (bucklings and doelings) and poorly insulated sheds, leading to hypothermia, stress, and higher mortality rates among juvenile livestock. The impacts include adverse effects on goat shelters and animal health, especially during prolonged cold spells. These findings imply that climate change and altitudinal exposure have become significant determinants of disaster vulnerability in goat farming, necessitating interventions such as thermal shed improvements, fodder storage systems, and adaptive livestock management practices during the winter season.

Storm or windstorm events are primarily caused by weak and unprotected shed construction, revealing a structural vulnerability rather than a purely climatic one. The impact; destruction of goat sheds suggests that farmers often rely on temporary or low-cost materials that cannot withstand strong winds. This highlights the lack of technical guidance, resource constraints, and building code compliance in rural livestock management systems. The destruction of sheds exposes goats to harsh weather, increasing disease risk and stress, while also requiring farmers to invest additional resources in reconstruction. Addressing this issue requires capacity building on resilient shed design, use of locally available but durable materials, and incorporation of disaster risk reduction principles in livestock infrastructure development.

Table 3 Goat Rearing Supportive Plans

Hazard	Activities	Location	Duration	Responsible Agency	Estimated Budget (NPR)
Landslide	Identify landslide-prone areas, construct safe sheds, build access roads, and create an environment suitable for commercial goat farming.	Ward No. 1 & 2	2 years	Farmers, Rural Municipality, and related organizations	2,80,000
Thunder	Use earthing technology during shed construction.	Ward No. 1	1 year	Livestock Service Section, Rural Municipality, and related organizations	1,40,000
Disease	Identify diseases, apply local knowledge, conduct vaccination, and provide training for farmers.	Ward No. 1–5	2 years	Rural Municipality and related organizations	2,28,000
Snowfall	Manage grazing in safe locations and store feed for winter season.	Ward No. 1–5	1 year	Rural Municipality and related organizations	2,80,000
Windstorm	Construct sheds resistant to windstorm damage.	Ward No. 1–5	1 year	Rural Municipality and related organizations	

Source: Field Survey, 2024

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov1397

The data presented in Table 3 outline a series of supportive plans and mitigation activities designed to strengthen goat farming resilience against various disasters in Thabang Rural Municipality of Rolpa District, Nepal. These plans reflect a localized approach to disaster risk reduction (DRR) and sustainable livestock management, focusing on both preventive and adaptive measures. The proposed activities cover major hazards such as landslides, thunder, disease outbreaks, snowfall, and windstorms, and involve collaborative efforts between farmers, the Rural Municipality, and related local organizations. The integration of short- and medium-term actions indicates an emerging institutional commitment toward minimizing losses and improving the productivity of goat farming in a geographically vulnerable area.

For landslide management, the proposed activities include identifying landslide-prone areas, constructing safe goat sheds, developing access roads, and promoting a suitable environment for commercial goat farming in Wards No. 1 and 2. These measures address both the immediate safety and long-term development aspects of goat farming. By focusing on proper site identification and infrastructure development, the plan aims to reduce the exposure of livestock shelters to slope instability while simultaneously enhancing market access and mobility. The two-year duration and an estimated budget of Rs. 2,80,000 suggest a moderate-scale intervention emphasizing risk-sensitive planning and structural resilience. This reflects a strategic effort to transform traditional, subsistence-level goat farming into a more secure and commercially viable enterprise despite the environmental challenges of the region.

The thunder-related plan emphasizes the application of earthing technology during shed construction, specifically in Ward No. 1, for a duration of one year with an estimated budget of Rs. 1,40,000. This initiative represents a technological and preventive intervention, addressing one of the most frequent natural hazards; lightning strikes that cause direct livestock mortality and property damage. The involvement of the Livestock Service Section of the Rural Municipality and other related organizations demonstrates institutional recognition of thunder as a significant hazard in local goat farming. Implementing earthing or lightning protection systems will not only reduce animal deaths but also set a precedent for climate-smart and safety-oriented livestock infrastructure in mountainous regions.

In addressing disease outbreaks, the plan proposes comprehensive activities including identifying common livestock diseases, applying indigenous or local knowledge, conducting regular vaccination programs, and providing training for farmers across all five wards (Ward No. 1–5). This program, planned for two years with a total budget of Rs. 2,28,000, seeks to build community-based animal health resilience through early diagnosis and prevention. The integration of local knowledge with modern veterinary practices illustrates an inclusive approach that values traditional wisdom while enhancing scientific intervention. The plan also prioritizes farmer capacity building, critical for improving response time, ensuring animal welfare, and minimizing the recurrence of epidemic losses such as Peste des Petits Ruminants (PPR). This comprehensive strategy highlights the importance of knowledge transfer and institutional partnership for sustainable livestock health management in rural settings.

To mitigate the effects of snowfall, the supportive plan recommends managing grazing in safer locations and ensuring adequate feed storage for the winter season, targeting all wards of the municipality. The initiative is to be implemented within one year, with an estimated budget of Rs. 2,80,000, under the coordination of the Rural Municipality and related organizations. These actions directly address the climatic and topographical challenges of high-altitude goat farming, where extreme cold and limited pasture availability during winter significantly affect livestock health and productivity. Feed storage systems and the relocation of grazing activities are adaptive measures that enhance livestock survival and ensure continuous production cycles during adverse weather. This reflects a strong alignment with climate adaptation and food security goals within the broader context of rural livestock development.

Lastly, to address windstorm-related risks, the plan proposes the construction of wind-resistant goat sheds across Wards No. 1–5, under the responsibility of the Rural Municipality and associated organizations. Although no specific budget is mentioned, the activity's inclusion demonstrates recognition of the structural vulnerabilities observed in prior years. The focus on improving shed design and material strength is a practical approach to minimize physical damage and financial losses caused by strong winds. By reinforcing goat shelters, this initiative will protect livestock from weather-induced stress and mortality while also reducing recurrent repair costs for farmers. The plan promotes structural resilience and sustainability through improved building standards suited to the local climatic context.

- *Discussion*

The findings derived from the analysis of Tables 1, 2, and 3 collectively illustrate a holistic understanding of the patterns, causes, consequences, and adaptive responses related to disasters affecting goat farming in Thabang Rural Municipality, Rolpa District, Nepal. The study reveals that goat farming, one of the principal livelihood sources in this mountainous municipality, remains highly susceptible to a range of natural and human-induced hazards. The historical records, field observations, and local perceptions highlight how the interplay between geography, climate, and socio-institutional capacity shapes the vulnerability and resilience of the livestock sector in the area.

The historical documentation of disasters (Table 1) reflects that goat farming in Thabang has been periodically disrupted by various calamities such as landslides, thunderstorms, disease outbreaks, snowfall, and windstorms.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov1397

These recurring events have had profound implications on livestock mortality, shed destruction, and the overall productivity of goat-rearing households. The evidence suggests that the topographical fragility of the region, coupled with unplanned settlement and shed construction, has significantly contributed to the frequent losses of livestock and property. Such disasters not only undermine the immediate income of farmers but also diminish their long-term adaptive capacity by eroding physical and economic assets. Moreover, the absence of systematic record-keeping and limited institutional intervention in earlier years indicate a reactive approach to disaster management rather than a proactive or preventive one.

The assessment of causes and impacts (Table 2) further reinforces that the vulnerability of goat farming stems from both natural and anthropogenic factors. Landslides are primarily linked with the area's fragile geological formation and the poor selection of sites for shed construction, often without adequate drainage or slope stability considerations. The delayed removal of landslide debris exacerbates the damage, leading to prolonged interruptions in goat farming operations. Similarly, thunderstorms, being a naturally occurring hazard, have caused severe losses through the death of goats and sheep and the destruction of sheds, reflecting the absence of protective infrastructure such as lightning arrestors or earthing systems.

Disease outbreaks have emerged as another critical threat, often resulting from delays in disease identification, lack of early veterinary intervention, and insufficient awareness among farmers. Snowfall and extreme cold conditions, characteristic of the high-altitude landscape of Thabang, have shown adverse effects particularly on young goats (bucklings and doelings) and weakly built sheds. In addition, strong winds and storms frequently cause the collapse of temporary sheds, further intensifying the economic burden on smallholder farmers. These multiple stressors highlight a complex risk environment where ecological vulnerability intersects with infrastructural weakness and limited adaptive preparedness.

The findings from the supportive plans (Table 3) illustrate an encouraging shift from vulnerability recognition toward risk reduction and adaptive resilience-building. The Rural Municipality, in collaboration with local farmers and related organizations, has proposed a series of context-specific interventions aimed at minimizing future disaster losses and promoting sustainable livestock management. The proposed activities, ranging from identifying hazard-prone zones and constructing resilient sheds to disease control, vaccination, and feed management represent an integrated framework of preventive, mitigative, and adaptive strategies. The allocation of specific budgets, durations, and responsible agencies indicates growing institutional awareness and commitment toward local-level disaster risk governance.

For instance, the landslide management plan emphasizes structural safety and site suitability, which directly addresses the root causes of physical vulnerability in goat farming systems.

Similarly, the thunder protection initiative through earthing technology reflects the application of simple yet effective scientific techniques to reduce animal mortality. The disease management program, focusing on training, vaccination, and local knowledge utilization demonstrates a participatory approach that values farmers' experiential knowledge while enhancing technical capacity. Meanwhile, the snowfall management plan, emphasizing feed storage and safe grazing practices, showcases a climate adaptation strategy essential for sustaining livestock health during harsh winter months. The inclusion of wind-resistant shed construction as a priority activity also underlines the necessity of engineering resilience in livestock housing structures. These efforts, although localized and limited in scope, embody the principles of community-based disaster risk reduction (CBDRR) and sustainable livestock management.

Integrating the insights from all three tables, it becomes evident that disaster risk in goat farming within Thabang Rural Municipality is multifaceted, rooted in environmental fragility, climatic variability, and socioeconomic limitations. Yet, the evolving institutional response and farmer-level awareness signify a gradual transition toward adaptive governance and livelihood resilience. The presence of structured plans, participatory involvement, and budgeted interventions indicates that the local government has started to internalize disaster preparedness as an essential component of agricultural development. This shift represents a crucial step in mainstreaming disaster resilience into rural economic planning.

Furthermore, the findings suggest that sustained capacity building, early warning systems, and technical support mechanisms are essential to transform these plans into tangible outcomes. Strengthening coordination among local agencies, veterinary services, and farmers' cooperatives could further enhance the implementation efficiency of these initiatives. The study thus underscores that effective disaster management in goat farming requires not only infrastructural improvements but also institutional strengthening, knowledge dissemination, and continuous community participation.

V. CONCLUSION

The study concludes that goat farming in Thabang Rural Municipality, Rolpa is highly exposed to multiple hazards, including landslides, thunderstorms, disease outbreaks, snowfall, and windstorms, which collectively undermine the stability of rural livelihoods. The findings reveal that the area's fragile geography, climatic variability, weak infrastructure, and limited veterinary services are key factors contributing to recurring losses in livestock and productivity. However, the emerging local initiatives, such as hazard mapping, resilient shed construction, vaccination programs, and climate-adaptive feeding practices reflect a growing shift toward risk-sensitive

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov1397

and sustainable goat farming practices. Strengthening these community-based and institutional efforts through continuous technical support, awareness, and resource mobilization will be vital for building long-term resilience, food security, and livelihood sustainability in the mountain communities of Rolpa.

- *Conflict of Interests*

The authors of this study have no conflicts of interest to disclose.

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ACKNOWLEDGEMENTS

We gratefully acknowledge the financial support provided by the Development Concern Society (DECOS), Dang, Nepal, for the field survey. We also extend our sincere appreciation to all the respondents of Thabang Rural Municipalty, Rolpa for their valuable time, support, and response.

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