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Climate Variability and Transhumant Adaptation among Gujjar and Bakarwal Communities, India

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ABSTRACT

Climate change is an undeniable phenomenon observed by the Gujjar and Bakarwal communities in the region of Jammu and Kashmir in India. The changing climate has significantly impacted these communities, particularly their seasonal movement patterns with livestock. The region's economy is heavily reliant on livestock, which a series of climate-related challenges such as droughts and unseasonal snowfall have significantly impacted. Transhumance has historically functioned as a sustainable occupation worldwide due to herders' ability to utilise regions unsuitable for other agricultural activities. Transhumant communities effectively utilise those areas, which are commonly referred to as marginal landscapes. Due to environmental regulations and social dynamics, the transhumant population encounters considerable societal obstacles. The challenges manifest themselves through fluctuating weather patterns and governmental policies that enforce limitations on mobility and customary practices. This study examines climate change's effects on the economic and cultural practices of the Gujjar and Bakarwal tribes. Additionally, it identifies strategies for adapting to the changing climate to safeguard the longstanding transhumance economy of the Gujjars and Bakarwal, which is closely tied to animal husbandry.

Key words: *Climate Change, Gujjar and Bakarwal, Perceptions, Adaptations, Transhumance.*

Introduction

The Gujjar and Bakarwal tribes, residing in the Jammu and Kashmir region, are known for their nomadic lifestyle and primarily engage in livestock rearing. Geographically, these tribes can be located on either side of the Line of Control, which separates India and Pakistan (Map 1). These nomadic communities depend on natural resources for sustenance and economic support for their households (Ning *et*

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al., 2014; Cullen *et al.,* 2007). The nature-dependent lifestyle makes them dependent on forest pastures and other natural resources. Shepherds have unique values, traditions, and livelihood strategies to cope with the weather and climate vagaries (Bauer *et al.,* 2022; Euromontana, 2021; Feurer, Gritten, and Than 2018; Aantunde, 2011). The Gujjar and Bakarwal groups, characterised by their nomadic lifestyle, face significant challenges in sustaining their traditional transhumant practices that have been passed down for centuries. The Gujjar and Bakarwal population is facing significant difficulties sustaining their longstanding tradition of transhumance pastoralism due to the adverse impact of severe climatic events in the Jammu and Kashmir region. These catastrophes include the earthquake of 2005, flash floods and landslides in 2010, and extensive floods in 2014. The typical bi-annual migration of around six hundred thousand transhumant tribal individuals takes place in the region of Jammu and Kashmir (Sareen, 2022).

The nomadic tribes rely primarily on livestock rearing and consider pasturelands essential natural resources (Dong, 2016). Annually, on the first day of Baisakh or Vaisakha (the first month of the Indian lunisolar calendar), around April 13, nomadic communities embark on their customary migratory journey in pursuit of suitable grasslands for their livestock as the summer season commences. The respondents informed during field traverses that this transition becomes increasingly challenging for the livestock due to the gradual depletion of water sources, the rising temperatures, and the end of the grazing season in the lower altitude regions of the Himalayas. The actions of humans are subject to certain constraints imposed by nature, which manifest in various geographical factors such as relief, seasonal patterns, and diverse vegetative growth. Human beings engage with these various forms of diversity in order to maximise the efficient utilisation of resources. From this particular standpoint, the transhumance practice observed in the region of Jammu and Kashmir can be regarded as a human response to inhabiting marginal and underutilised environments. The objective of this practice is to utilise the evolving and spatially diverse natural resources available effectively. The economic significance of transhumance lies in its ability to maintain a delicate equilibrium among human populations, animal herds, and grazing lands within specific natural environments. Domestic animals play a significant role as primary sources of essential products, including milk, meat, wool, hides, and skins. In addition to their role in transportation, these devices also serve as sources of entertainment. The profound impact of affection for animals on various societies' cultural and religious aspects is evident, and this research has also substantiated this aspect discussed in several studies.

Transhumance is a kind of livelihood supporting over 20 million families worldwide (Blench, 2001). Transhumance is an eco-social system that entails the regular and cyclic seasonal movements of animal herds, humans, and their livestock between areas located at varying elevations and characterised by distinct physical and climatic conditions. The phenomenon in question has significantly contributed to developing the socio-economic and cultural aspects within the study area. The practice of transhumance is intricately linked to and influenced by climatic conditions. However, transhumance is an organisational strategy employed by nomadic communities to navigate topographical and climatic limitations. Its primary objectives are to safeguard their herds according to their tolerance to varying climatic conditions and maximise the utilisation of available grazing lands. This endeavour leads to oscillation across both temporal and spatial dimensions or cyclic mobility within a space and time continuum. In this research article, the term "space" encompasses various spatial zones or regions traversed by a transhumant within a transhumance ecosystem. Furthermore, transhumance is an ongoing phenomenon that unfolds over a temporal continuum within an ecologically defined habitat (IBID, 2001). The phenomenon under consideration is a direct reaction to the natural rhythm of the seasons, thus manifesting as an annual behavioural pattern with a temporal distribution that aligns with a cyclical calendar. The Gujjars and Bakarwal tribes migrate to higher pastures during the spring and summer.

Climate Change and Transhumance

The whole world has been facing climate change threats. However, the climate changesgradually, and it is impossible to forecast the changes exactly (Adger *et al.,* 2009). Climate change in recent decades poses a significant threat to the livelihoods of the transhumant population, which relies heavily on pasturelands for animal rearing, a centuries-old practice. Despite an ongoing decline in transhu-

mance, it remains the primary source of livelihood for over two million people in the study area. Herders worldwide, especially in drylands, face similar adaptation challenges, including declining traditional water sources and pasture degradation.

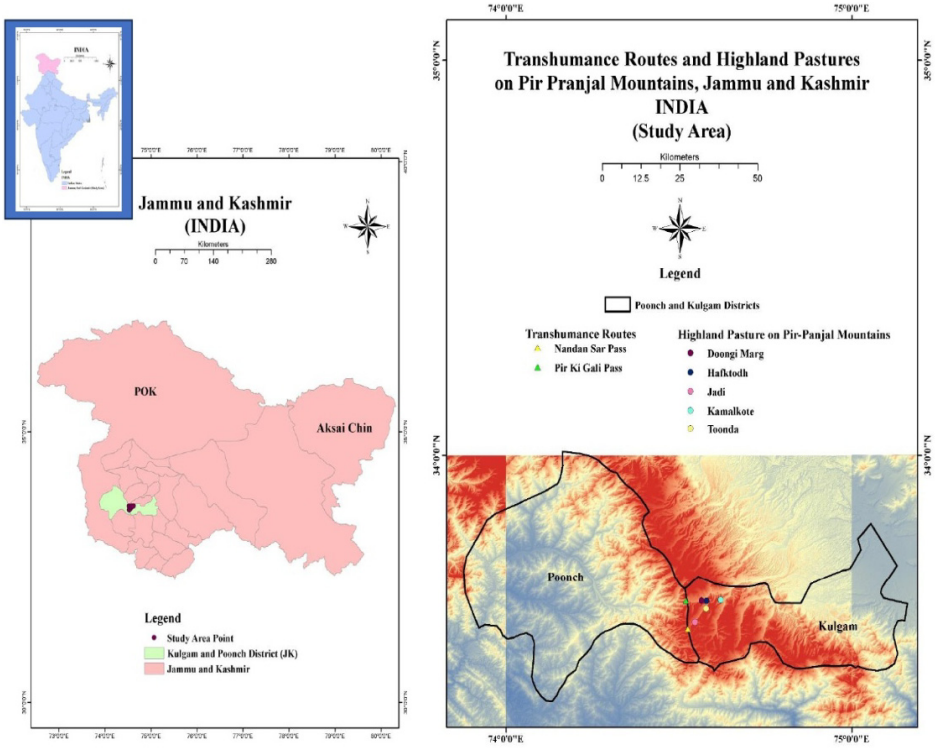
While potentially increasing vulnerability to climate change threats, the nomadic lifestyle may also confer a higher adaptive capacity in developing countries than settled lifestyles in developed nations. Although nomads are often more susceptible to climate change due to their marginalisation, poverty, and limited access to information and technology, they have historically adapted by modifying migration patterns and opting for drought-resistant livestock and pastures. This article considers the adaptive dynamics of the nomadic lifestyle as a key force driving resilience against climate change threats. The nomadic lifestyle may exacerbate vulnerability to climate change, yet the adaptability of nomadic populations in developing countries could surpass that of settled populations in advanced nations. Despite being a vulnerable societal segment due to marginalisation, poverty, and limited access to information and technology, nomads have historically demonstrated resilience by adjusting their occupational patterns to cope with drought conditions. Undoubtedly, most people who will feel the harmful effects of climate change will be poor and marginalised women, men, and children (Oxfam, 2008). Several studies have indicated that climate change is projected to substantially influence the survival and productivity of various populations. The studies have highlighted the potential consequences of climate change on lifestyle variations, livestock diseases, and the overall well-being of nomadic herders, emphasising the impact of alterations in environmental conditions on their livelihoods (Ayanlade and Ojebisi, 2020; Kimaro, *et al*., 2018; Oxfam, 2008).

Climate change has influenced both the survival and production aspects substantially. The fieldwork also highlighted the potential consequences, such as alterations in lifestyle and the emergence of livestock diseases. Additionally, the livelihoods of nomadic herders are expected to be profoundly affected by the modifications in environmental conditions (Zhang *et al.,* 2019). The literature (Sareen, 2022; Bauer *et al.,* 2022; Ning *et al*., 2014; Adger, Lorenzoni, and O'Brien, 2009) highlights the implications of climate change on transhumant communities worldwide. These implications encompass significant concerns, including production, pasture quality and quantity, environmental diseases, climate change perceptions, adaptation strategies, vulnerability, resilience, mitigation, and unseasonal weather conditions. The investigation of the impacts of climate change in the highlands and plains region has emerged as a prominent area of scholarly inquiry in recent years due to its significant global implications.

According to Runting *et al.* (2017), climate change's impacts on ecosystem services are anticipated to be uneven, particularly about the sustenance of local livelihoods in impoverished nations. In certain high-latitude interior regions of Asia, monitoring crucial environmental variables poses a significant challenge in studying climate change's effects. This research article compares the effects of climatic change on the transhumant Gujjar and Bakarwal tribes of Jammu and Kashmir in India. This community primarily relies on nature and has been practising transhumance between low-altitude areas and the highlands of the Himalayas for centuries, which are the focus of this analysis. This study examines the impact of shifting environmental conditions on the socio-economic circumstances of transhumant populations. This study aims to examine the perceptions and understanding of indigenous herders regarding the interaction between the ecosystem and their livelihoods in the Himalayan state of Jammu and Kashmir, with a specific focus on the effect of changing environmental conditions. In this study, we examined the sentiments expressed by transhumants regarding the impact of recent climate change on various aspects of their daily lives.

Methodological Considerations

To robustly examine the impact of climate change on the Gujjar and Bakarwal tribes, a data-driven approach was essential, mainly because existing literature on this topic is scant. Given the absence of significant prior work on these communities, this study is premised on primary data collected by the researchers in 2022. The study adopts a comprehensive multi-method approach to data collection, centred on the tribes' annual transhumance routes, highland pasturelands, and lower-altitude winter settlements. The communities predominantly inhabit the Pir Panjal Mountains and adjoining plains of Jammu in various regions, necessitating a diverse and thorough investigation (Map: 1). Five highland pasturelands (Table 1 and 2), namely Hafktodh,



Map 1. Details of Study Area

Jadhi, Doongi Marg, Kamalkota, and Toonda, have been surveyed in the Pir Panjal range (Map 1). The field trips conducted by the researchers in 2022 are shown in Table 3. Two hundred fifty households were selected through simple random sampling to investigate various facets of climate change adaptation and socio-economic conditions. Additionally, two major transhumance routes used by the Gujjar and Bakarwal tribes were studied. The data collection is composed of (1) Household schedules targeting highland pastures, (2) Kafila (caravans) schedules for the transhumance routes, and (3) In-depth interviews with community leaders. This methodology provides a holistic perspective on the tribes' adaptive strategies against the existential threats of climate change.

Table 1. Households Surveyed in the Highland Pastures of Pir Panjal Mountains of Jammu and Kashmir

S. No.	Name of the Highland Pasture	Number of Households Surveyed
1	Hafktodh	50
2	Jadhi	50
3	Kamalkote	50
4	Doongi Marg	50
5	Toonda	50
	Total Households Surveyed	250

Table 2. Transhumance Routes Surveyed on the Pir Panjal Mountains (Himalayas) of Jammu and Kashmir

S. No.	Name of the Transhumance Route	Number of Caravans Surveyed
1	Pir Pass	30
2	Nandan Sar Pass	20
	Total Caravans Surveyed	50

Results and Discussion

Expansion of Transhumance Duration

The cyclical rhythm of transhumance among the Gujjar and Bakarwal tribes is deeply entwined with ecological factors-pasture availability and climatic conditions. The tribes segment the year into four seasons-summer, autumn, winter, and spring-each aligned with specific altitudinal movements and livestock-grazing strategies. Summer at higher altitudes offers the most abundant grazing opportunities, whereas winter months necessitate strategies

like supplemental salt intake for livestock. This seasonal migration is a logistical manoeuvre and a form of ecological wisdom honed over centuries.

However, testimonies from elderly community members suggest a disturbing temporal shift in the last 15-20 years, indicative of climate change's acceleration. Winter periods have contracted, and temperatures rise prematurely in mid-March, posing threats to the health of newborn lambs. Moreover, this climatic inconsistency causes water resources and pastures to deplete earlier than usual, compelling the community to commence their transhumance before their traditional starting date, which aligns with the Baishakhi Festival on April 13.

Indeed, transhumance serves both as an adaptive mechanism and a barometer of ecological imbalance. It is adaptive in that it allows the community to navigate seasonal scarcity and abundance, but it also serves as an early-warning system, with shifts in its timing and duration reflecting broader environmental changes. This nuanced understanding challenges us to see transhumance as a coping strategy and a lived philosophy embedded within a larger ecological framework, now under threat from climate change. Previous studies (Gebeyehu *et al.,* 2021; Wanjiru 2018; Ning *et al.* 2014; Berhe and Butera, 2012; Aantunde, 2011; Oxfam 2008) substantiate that transhumanists migrate with their livestock in search of pastures and water at different times of the year and highlight the results similar to our research findings, but the present study's results are an extension to the earlier researches and present a nuanced understanding of the phenomena.

Change in the Timings of Migration

The practice of transhumance is a profoundly community-based and strategic endeavour among the Gujjar and Bakarwal tribes. Each February, sheep and goat breeders from a village convene to discuss the upcoming transhumance route and alpine pasture grazing, setting a movement date to optimise lower-altitude pasture usage before reaching the alpine regions.However, the increasing volatility of weather patterns, marked by a shortening winter, necessitates an earlier start, endangering the livestock, especially newborns, due to harsher conditions at higher altitudes. All the respondents shared a two to three-week change in starting routes. Mukhtar Chechi, a shepherd from the Bajran Kafila, voiced a common sentiment: "*We are all singing the same song... We are trying to tell the rest of the world, look, we are seeing these things, and you are not doing anything about it. If the animals die, we die; if the pastures dry, we will be no more. If the river dies, we are gone*." This stark testimony underscores the existential threat climate change poses to the Gujjar and Bakarwal tribes, whose vulnerability, as Chechi noted, places them at the epicentre of climate change impacts.In this context, the tribes' transhumance practice is more than a logistical manoeuvre—it is a survival strategy intricately connected to the ecosystem. Therefore, any changes in this practice signal not only a disruption in the tribes' way of life but also a broader ecological crisis that demands urgent global attention.

Change in the Pasture Usage

The practice of transhumance among the Gujjar and Bakarwal tribes is not a mere seasonal migration but

Table 3. The Field Trips (2022)

S. No.	Months	Places Visited
1.	April & May (Start of Summer season)	The researchers travelled with the caravans from the Kalakote tehsil of Rajouri District to Highland Summer Pastures located on the Pir Panjal mountains via the Pir Pass transhumance route. The other caravans are being visited from Teryath and Nowshera of the Rajouri district towards the Highland Pastures via the Nandan Sar transhumance route. Their daily activities during the migration are recorded on both the transhumance routes.
2.	June-July (Summer Season)	The researchers surveyed five highland pastures in the Pir Panjal Mountains: Hafktodh, Jadhi, Doongi Marg, Kamalkota and Toonda.
3.	November-December	Visited community leaders for an in-depth interview regarding the burning issue of changing environmental conditions of the Himalayas and its impact on the Gujjar and Bakarwal tribals

Source: Field Work, 2022

a calibrated strategy of resource allocation and ecological synchronisation. Typically, these pastoralists employ a dual-pasture strategy, exploiting higher-altitude meadows in the summer and retreating to sub-temperate mid-altitude zones in the winter. These transitions are far from linear, as tribals utilise the routes between the altitudes as transitional pastures. However, this intricate system is increasingly disrupted by climate volatility, compelling earlier migrations to protect both humans and livestock from rising temperatures. The adaptations to these interruptions—already in effect for two decades—are practical solutions to emergent ecological dilemmas andindictments of a crisis global climate system.

Amid these challenges, broader shifts in agricultural demand further exacerbate the precariousness of this pastoral lifestyle. Growing populations and rising incomes have surged the demand for animal-derived food products, resulting in increased domestic livestock populations—particularly in low-income nations where pastures serve as primary animal feed. Such demands risk overtaxing a fragile ecosystem with finite carrying capacity, threatening environmental degradation and pastoral productivity. Therefore, transhumance is a philosophical lens through which we can scrutinise broader human-environmental dynamics. It is a model that manages scarcity, negotiates ecological limits, and stands at the frontline of climate change impacts. Thus, any perturbation in this practice holds implications not just for the Gujjar and Bakarwal tribes but also for the collective ecological and ethical considerations of our interconnected global society.

Reviving the Deteriorated Highland Pastures

The burgeoning livestock numbers exert mounting pressure on pastures, leading to the proliferation of wild seeds and overexploitation of grazing grounds—a phenomenon identified by the transhumants as a primary cause of pasture degradation. Notably, several community leaders underscored the urgent necessity to restore these deteriorated meadows as a prerequisite for sustainable livelihood security. This situation invites us to reconsider the intricate interplay between mobility, variability, and sustainability. The respondents suggested implementing a monitoring strategy to assess the condition of overgrazed areas near villages and undergrazed pastures in remote locations. Such efforts have facilitated the creation of pasture management agreements among Pasture Committees, local governments, and pasture users in the study regions, ultimately regulating pasture usage and rotation. Thus, the ongoing challenges faced by the pastoral communities necessitate a multifaceted approach that encompasses not only the restoration of degraded lands but also the implementation of sustainable pasture management practices. This holistic approach would ensure the livelihood security of the transhumant population and contribute to the region's broader ecological resilience.

Diet Supplementation

The examination of human-environment interactions can be enriched by studying the adaptive practices of the Gujjar and Bakarwal tribes, particularly about how they supplement the diets of their livestock. Faced with diminishing pasture availability in lower altitudes during winter, these communities have embraced feed supplementation strategies endorsed by various government animal welfare agencies. They provide their livestock with crushed maise and wheat as viable substitutes for grazing grasses. In a broader context, the turn toward feed supplementation is emblematic of a larger, more complex narrative. It represents the tribes' adaptive response to fluctuating environmental conditions but also forces us to confront ethical and existential questions about adaptation and sustainability. Supplemental feed—including oilseeds, cakes, bran, and vegetable waste—has become more than a dietary alternative; it symbolises the tribe's resilience and ingenuity in changing climate conditions.

However, one must ask: to what extent are these adaptive measures sustainable in the long term? Does this transformation signify a loss in the traditional pastoral lifestyle that can never be regained? These supplementary practices can be seen as a coping mechanism and a potential pathway toward dependency on external inputs. This duality frames the community's adaptive strategies within a more extensive dialogue on sustainability, inviting us to rethink how measures of "adaptation" and "success" are defined in the age of climate change. Thus, while feed supplementation enhances immediate livestock growth and productivity, it also calls into question the economic aspects and viability of such practices in an era of environmental flux. This tension between adaptation and sustainability under-

scores the intricate balance that pastoral communities must navigate to ensure their survival and that of the ecosystems they inhabit.

Perceptions of climate variability among Gujjar and Bakarwal Communities

In line with the narrative of the Bakarwals, one encounters an existential lament articulated through the word *musibet*, denoting affliction or tribulation. The elderly shepherd's recounting serves as a poignant elegy for a past that was more in harmony with the land, a harmony now ruptured by manifold forces, including climatic changes, territorial encroachments, and societal pressures to assimilate into a different lifestyle. The narrative evokes a sense of irrevocable loss but also points to the resilience and deep emotional attachment to a way of life, a philosophy that finds its spiritual centre in the highland pastures of the Himalayas. Here, the Bakarwals find a fleeting respite from their *musibets* (afflictions). This raises critical and ethical questions about the social costs of environmental degradation and the politics of space. It also raises questions about freedom, identity, and the ethical considerations incumbent upon society to understand and perhaps alleviate these afflictions.

In the age of Anthropocene, where the human impact on climate is unmistakable, it is revealing that among the Gujjar and Bakarwal tribes inhabiting the five highland pastures of the Pir Panjal Mountains, more than 42% remain unaware of the concept of "climate change". Meanwhile, 58% have, through various channels, become cognizant of the altering environmental conditions. This dissonance in awareness is a microcosm of the enormous disconnect between lived experiences of climate impact and the scientific discourse surrounding it. Regarding the perception of temperature variability, the data suggest a community at the frontline of climate change grappling with the tangible impacts of in-

Table 4. Perceptions about the temperature variability among the Gujjar and Bakarwal tribes

S.No.	Temperature Differences	No Change (%)	Increased (%)	Decreased (%)
1	Summer Temperature	22.5	72.3	5.2
2	Winter Temperature	42.2	48.4	9.4
3	Snowfall melting	11.5	8.2	80.3
4	Drought periods	38.6	48.3	13.1

Data Sources: Field Work, 2022

Table 5. Perceptions about the rainfall variability among the Gujjar and Bakarwal tribes

S.No.	Rainfall differences	No Change (%)	Increased (%)	Decreased (%)
1	Average rainfall	32.5	22.3	54.8
2	Average monsoon rainfall	12.3	18.2	69.5
3	Unpredictability of rainfall	8.7	58.2	33.1
4	Unseasonal snowfall, hailstorms	10.4	53.7	35.9
5	Thunderstorms events	5.2	78.4	16.4

Data Sources: Field Work, 2022

Table 6. Climate change adaptation among the Gujjar and Bakarwal tribes of Jammu and Kashmir who recognised the changing climatic conditions (in %)

Study Area	Number of the Households	Recognised changing climatic scenario	Adaptation among those who recognised	
			Adapted	Not Adapted
Hafktodh	50	82.5	80.2	19.8
Jadhi	50	78.4	75.5	24.5
Toonda	50	84.8	84.6	15.4
Kamalkote	50	80.2	82.8	17.2
Doongi Marg	50	79.5	86.7	13.3

Data Sources: Field Work, 2022

creasing temperatures. A significant majority, 72.3%, observe an uptick in summer temperatures, 48.4% note accelerated snowmelt, and another 48.3% identify an increase in drought days. Each percentage points to the lived experience, adding weight to the lamentations captured in the tribe's oral histories.

The relation between empirical data and the deeplyfelt "story of afflictions" offers a multidimensional perspective on climate change's social and ecological ramifications. It prompts us to rethink the metrics we evaluate environmental impacts, folding in the experiential and spiritual dimensions that are too often overlooked in purely empirical analyses. Thus, the community's plight is not just a tale of environmental degradation but a lament, a philosophical inquiry, and a call to action all rolled into one.

Perception of Temperature and Rainfall Variability

Respondents noted a diminishing pattern in precipitation during the winter and the monsoon season in the elevated pastoral lands, amounting to 54.8% and 69.5%, respectively (Table 5). Likewise, the respondents shared that the fluctuations in temperature by 3-4 degrees Celsius. Transhumant populations have encountered heightened irregularities in precipitation, with 58.2% observing increased unpredictability, 53.7% perceiving an uptick in instances of typical snowfall and hailstorm, and 78.4% opining that thunderstorm occurrences have surged over the past two decades. A poignant instance of this phenomenon occurred on March 25, 2023, when lightning claimed the lives of over 300 goats in the Khattu Khal forests of Uttarkashi (Bahuguna, 2023). The National Crime Record Bureau (NCRB) data substantiates the perilous nature of this climatic anomaly, disclosing that between 1967 and 2019, lightning strikes accounted for 33% of fatalities in the Himalayan region. The respondents informed that since the last three decades, there has been a discernible augmentation in the frequency and intensity of cloud bursts and lightning strikes across the region, resulting in a concurrent escalation in mortality, particularly among the nomads during the monsoon period.

Adaptation Strategies

Table 6 elucidates the adaptation strategies employed by the Gujjar and Bakarwal communities in response to evolving environmental conditions. A significant proportion of respondents acknowledged the alterations in climate, with 82.5% in Hafktodh, 84.8% in Toonda, 80.2% in Kamalkote, 78.4% in Jadhi, and 79.5% in Doongi Marg asserting that climate change is impacting their livelihoods in various ways. Furthermore, a majority indicated that they had adopted specific strategies to mitigate the effects of climatic changes. Table 7 illustrates that 62.5% of respondents in Hafktodh, 52.8% in Toonda, and 56.0% in Doongi Marg have altered the highland pastures designated for animal grazing due to grass scarcity.

Concerning the elongation of the transhumance period, it was observed that 72.4% in Hafktodh, 80.1% in Jadhi, 66.5% in Toonda, 77.2% in Kamalkote, and 64.8% in Doongi Marg implemented this approach to shield their livestock from the adverse effects of climate change. Conversely, 78.4% in Hafktodh, 74.7% in Jadhi, 84.8% in Toonda, 59.5% in Kamalkote, and 67.2% in Doongi Marg indicated that they modified their migration schedules in response to climatic variations. Interestingly, among those who adopted this strategy, there is a steadfast commitment to the age-old practice of transhumance, with no signs of sedentarisation detected within the communities, as indicated in *Table 7*. This steadfastness reveals a nuanced interplay between tradition and adaptability, crucial for the

Table 7. Adaptation strategies among the Gujjar and Bakarwal tribes of Jammu and Kashmir who recognised the changing climatic conditions (in %)

Adaptation Strategies	Hafktodh	Jadhi	Toonda	Kamalkote	Doongi Marg
Change of Highland Pastures	62.5	43.2	52.8	38.3	56.0
Duration of migration Expanded	72.4	80.1	66.5	77.2	64.8
Change in the timing of migration	78.4	74.7	84.8	59.5	67.2
Change in pasture utilisation practice	82.6	75.5	66.6	83.2	69.5
Feed Supplementation	83.5	88.6	81.3	92.4	80.3
Searching for Alternate sources of income	92.6	88.5	86.2	78.5	80.4
Sedentarisation	23.5	32.8	14.5	28.5	17.8

Data Sources: Field Work, 2022

survival and continuity of these communities amidst the challenges posed by climate change.

The Gujjar and Bakarwal tribal communities, native to the Himalayan region of Jammu and Kashmir, have exhibited adaptive resilience by modifying their pasture utilisation strategies in response to climatic fluctuations. In the surveyed villages, an overwhelming majority, exceeding 80%, of the tribal population have adopted feed supplementation as a critical strategy to navigate the challenges posed by the shifting weather patterns. The field data further elaborates that during transhumance, especially in the highland pastures, most families explored alternative sources of income during the migration season. This diversification of income sources reflects a strategic response to the multifaceted challenges induced by climate change, encompassing environmental and economic dimensions.

The changing climate has imposed significant daily hardships on these communities, compelling many to abandon the traditional practice of transhumance and settle on the lower slopes of the Himalayas. This trend indicates a broader transformation within the community, as the climatic pressures necessitate a reevaluation of longstanding traditions and practices. It underscores the gravity of climate change's impact on these communities' socio-cultural fabric, prompting shifts in livelihood strategies and settlement patterns.Such adaptation strategies, while necessary for survival, also raise critical questions about the sustainability of traditional practices and the preservation of cultural heritage amidst the inexorable forces of climate change. It necessitates a comprehensive approach that addresses the immediate challenges of climate change and considers the long-term implications for these communities' cultural and socio-economic well-being.

Conclusion

Transhumance, the practice of seasonal livestock migration, is not only a primary source of income but also ingrained in the cultural identity of the Gujjar and Bakarwal tribes. These tribes have observed rising temperatures in both summer and winter, accelerated snowmelt in the Himalayas, and increased drought frequency. This study asserts that the perceptions of transhumant populations provide vital insights into data-scarce regions, subsequently informing the development of adaptive and interventionist strategies to sustain Himalayan transhumance. The Gujjar and Bakarwal tribes have recognised the shifting climatic landscape and are adapting in various ways. Among the adaptive measures observed were a 2-3 month extension of the transhumance period and alterations in pasture utilisation strategies. Due to grass shortages, most have resorted to feed supplementation during winter grazing on the lower Himalayan slopes. Despite these adaptations, a commitment to preserving the ancient practice of transhumance persists among those who have implemented these changes. Moreover, this study reveals that the local inhabitants of the surveyed pastures possess a keen awareness of the changing climatic conditions and have adopted strategies to counteract the adverse effects of weather fluctuations. Notably, these strategies align with recommendations proposed by climate researchers, underscoring the importance of incorporating such strategies into policy frameworks to safeguard transhumance from sedentarisation.

In conclusion, the adaptations observed among the Gujjar and Bakarwal tribes, characterised by strategic modifications in transhumance and grazing practices, reflect a broader narrative of resilience and adaptability. However, these adaptations also underscore the urgent need for comprehensive policy interventions that address the immediate challenges of climate change and consider the long-term implications for these communities' cultural and socio-economic well-being. Ultimately, this study underscores the critical importance of an informed, culturally sensitive, and proactive approach to sustaining the ancient practice of transhumance in the face of mounting climatic challenges.

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