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Political Ecology of Transhumance Pastoralism in the Central Himalaya-Conservation, Livelihoods and Institutional Transformation: Thematic Report

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Abstract: The Central Himalaya of Uttarakhand is home to two important pastoral communities, the transhumant Bhotiya people and the forest-dwelling nomadic Van Gujjars. For centuries, these communities have depended on seasonal migration with their livestock, moving between lower valleys in winter and high-altitude alpine pastures in summer. This traditional system, known as transhumance, helped them survive in the harsh mountain environment while also using natural resources in a balanced and sustainable way. However, significant changes emerged in their traditional life in the early 1980s after the implementation of the Wildlife Protection Act of 1972 and the creation of protected areas such as Nanda Devi National Park and Valley of Flowers National Park in 1982. These conservation measures restricted pastoral communities from entering many of their traditional summer grazing areas in Chamoli district. As a result, their traditional way of life began to change rapidly. Earlier, Himalayan pastoralism was considered an effective system for managing mountain resources because grazing patterns followed seasonal cycles and allowed pastures to regenerate naturally. But over time, strict conservation policies reduced grazing spaces and forced many pastoral families to adopt limited or "nuclear" forms of transhumance, where only a few family

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members continue migrating with livestock. Government agencies, especially the Forest Department, often view pastoralism as harmful to the environment. Yet, there is very little strong scientific evidence from the Himalayan region to prove that traditional grazing alone causes ecological damage. In fact, many local communities believe that controlled grazing has long helped maintain biodiversity and healthy grasslands. This issue is not only environmental but also social, cultural, and political. Alpine pastures are more than grazing lands, they are shared community resources deeply connected to the culture, traditions, spirituality, and livelihoods of mountain people. Restricting access to these lands has weakened traditional rights and increased uncertainty for pastoral communities. Most studies on Himalayan pastures have focused mainly on livestock and natural resources, while giving less attention to local institutions, traditional knowledge, and the everyday struggles of pastoral communities. There is also limited understanding of how conservation policies affect the livelihoods and rights of local people living around protected areas. This paper argues that conservation efforts in the Himalayas cannot succeed if local communities are excluded from decision-making. Sustainable management of fragile mountain ecosystems requires the active participation of pastoralists and local residents. A balanced approach is needed, one that protects biodiversity while also respecting traditional rights, cultural values, and the economic well-being of Himalayan pastoral communities.

Key words: Transhumance pastoralism, political ecology, alpine pastures, protected areas, traditional ecological knowledge, livelihood transformation, Central Himalaya.

Political ecology provides a critical framework for analyzing the complex intersections of society, development, and the environment (Engel-Di Mauro, 2004). Within the Indian Himalayan region, transhumance pastoral systems have historically evolved, embedding deep-rooted traditional knowledge and culture among local communities. However, these systems have transformed over time due to various factors, necessitating an analysis through the political ecology of scale to understand changes across different levels (Brown,1998). Since the 1970s, political ecology has studied how people, nature, and politics are connected. Earlier, it mainly focused on the lives and livelihoods of rural communities, but later it also started examining wider environmental issues and human-nature relationships. A key concern of this field is understanding who gets the right to use natural resources, whose voices are heard in environmental decisions, and why some groups become more powerful than others (Kamara *et al*., 2004; Kerven *et al*., 2012). Consequently, political ecology attempts to bridge the connections between environmental degradation, social marginalization, and conflicts over resource access and control (Saberwal 1996; 1999; Engel-Di Mauro, 2004). This lens provides critical insights into how conservation efforts influence socio-ecological systems (Saberwal 1996;1999).

Even though political ecology research has expanded into many areas, it still mainly studies how large social, political, and economic forces affect nature, local livelihoods, and food security (Peterson, 2000; Kamara *et al*., 2004; Kerven and Behnke, 2011; Kerven *et al*., 2012; Yeh *et al*., 2013). However, because political ecology combines ideas from many different subjects, it is often difficult to create one clear and consistent approach for understanding both environmental and social issues together (Mehta and Kellest, 1998; Maikhuri *et al*., 2001a; Rao *et al*., 2000). In the Central Himalayas of Uttarakhand, pastoralism is practiced by two major communities, the nomadic Bhotiyas and the forest-dwelling Van Gujjars, alongside common hill farmers, for whom livestock is a vital, complementary component of their agro-pastoral livelihood (Rawat and Uniyal, 1993; Hoon, 1996; Nautiyal *et al*., 2005; Maikhuri *et al*., 2017). The primary livestock, including sheep, goats, and buffaloes, graze in forests and alpine meadows in a cyclic, vertical migration pattern adapted to seasonal variations (Farooquee and Nautiyal, 1996; Rao *et al*., 2003b). The Bhotiya, a scheduled tribe, practice seasonal migration between high-altitude summer villages (2600-3700 m in the Mana, Niti, Darma, and Johar valleys) and lower-altitude winter settlements (Maikhuri *et al*., 2001a and 2017). Conversely,

the Van Gujjars are a semi-nomadic Muslim community lacking permanent settlement, who navigate between winter grazing in the foothills (near Dehradun) and summer migration to the tree line forests of the Greater Himalaya (Singh, 2003; Nusrat, 2011).

Pastoralism is essential for utilizing natural fodder resources and sustaining the livelihoods of marginal mountain communities, supplementing limited agricultural production hindered by rugged topography and harsh climates (Maikhuri *et al*., 2000). From a political ecology perspective, alpine landscapes in the Central Himalayas are recognized not only for ecological services and conservation value but also for supporting rich cultural, spiritual, and social practices (Maikhuri *et al*., 1998). While existing research has often focused on natural resources, carrying capacity, and livestock production, there is less understanding of how the establishment of protected areas (PAs) impacts local livelihoods.

Through this thematic report we propose to highlights how forest-related conservation policies, including forest acts, biodiversity acts, and tribal acts, affect the socio-cultural processes, traditional rights, and livelihoods of forest-dependent communities in the Central Himalayas especially in Uttarakhand. Our purpose is to assess the present status of transhumant pastoralism through a political ecology lens and understand human-environment interactions by investigating shifting patterns of access to and control over alpine pastures in Uttarakhand.

Uttarakhand, encompassing an area of 53,483 km², forms the core of the Indian Central Himalayas (Fig. 1.). Renowned for its vast forest tracts and exceptional bio-geo-diversity, the state maintains a significant ecological footprint: forests cover approximately 34,651 km² (64.8% of the total landmass), while high-altitude alpine pastures—vital for local ecosystems—occupy roughly 8,524 km² (14.5%). The Uttarakhand Trans-Himalaya forms a narrow belt along the northern flank of the state, immediately north of the main central thrust of Greater Himalaya. There are four major valleys representing the cold desert ecosystems of Nilang Valley located in the upper catchment of Jad Ganga (Jahnavi) in the Uttarkashi district, Inner ranges of Alaknanda and Niti and Girthi valleys in Chamoli, Upper Johar, Darma, and Byans valleys in Pithoragarh district. Nilang is connected with Kinnaur on the west and forms a contiguous habitat with the Tibetan plateau. It falls in the Gangotri National Park. Beyond its environmental wealth, Uttarakhand is a repository of cultural heritage and diverse wildlife. This study specifically examines two critical pastoral grazing zones. Located between 31°00′N to 31°15′N and 78°16′E to 78°37′E, this region serves as a traditional summer grazing ground for migratory shepherds and the nomadic Van Gujjar community. The other region is situated between 30°17′N to 31°00′N and 79°34′E to 80°00′E and represents high-altitude pastures, managed and grazed by the Bhotiyas and other indigenous pastoral groups. Both study sites are distinguished by their robust protected area networks, rich biodiversity, and the preservation of indigenous knowledge systems among their resident ethnic communities.

Materials and Methods

This study presents findings from an extensive participatory field survey and data collection effort focused on forest stakeholders and pastoral communities in Uttarakhand, specifically within the Garhwal region. Primary data were gathered through structured questionnaires and interviews with shepherds in the Niti Valley (including the Nanda Devi Biosphere Reserve buffer zone) and Van Gujjars residing within the Govind Wildlife Sanctuary and Rajaji National Park. To complement field observations, secondary data on protected areas were sourced from state forest offices and the State Forest Statistics of Uttarakhand. Furthermore, current forest acts and conservation policies were reviewed to analyze their impact on contemporary pastoralism. Finally, migratory routes were documented and mapped by actively participating in seasonal migrations alongside pastoralists through diverse forest tracts and alpine pastures.

Results and Discussion

*Pastoral grazing zones of Uttarakhand***:** In the Central Himalayas, pastoralists navigate three distinct ecological zones in response to seasonal changes: (1) the Subtropical Foothills (400-1,000 m), where lower-altitude forests

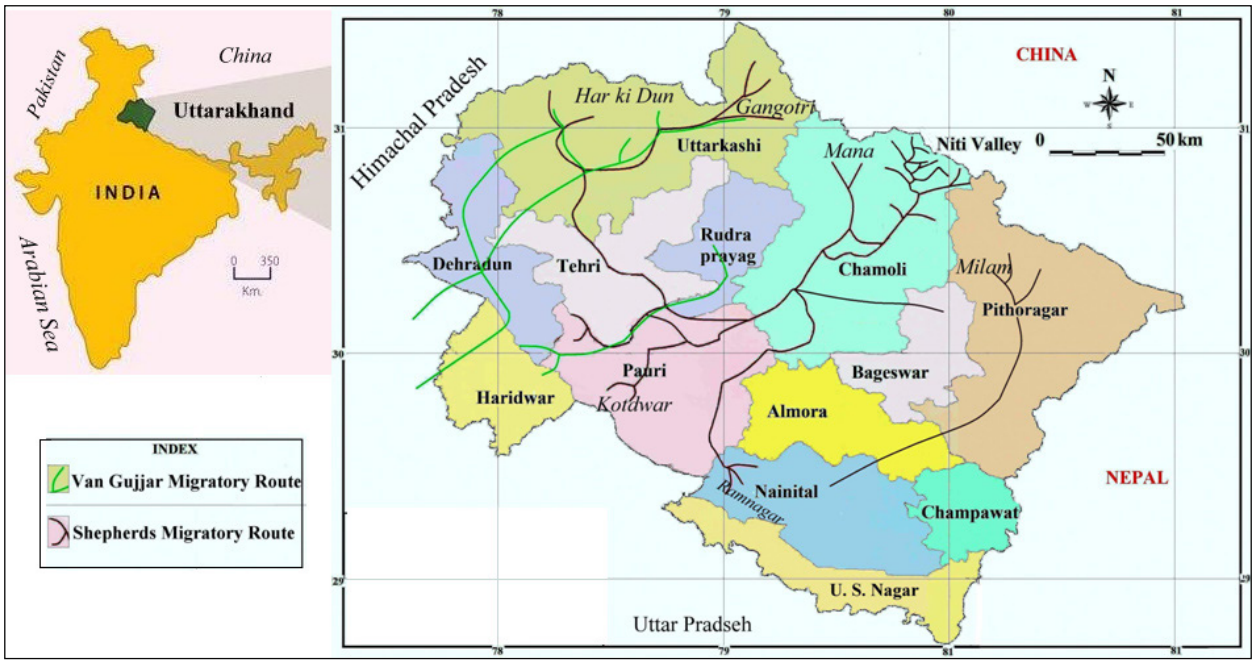

Fig. 1. Study area and pastoral migratory routes in the Indian Central Himalaya. Source: Jha, 2015), https://surveyofindia.gov.in/UserFiles/files/1_16-state%20boundary-1.pdf

serve as vital winter refuges from December to March; (2) the Temperate Transit Belts (1,000-3,500 m), which are used primarily during the spring ascent (April-May) and autumn descent (October-November). These zones facilitate seasonal migration, although the Van Gujjars generally remain within the forested tree line and rarely venture above 3,500 m; and (3) the Alpine Meadows (3,500-4,500 m), consisting of high-altitude grasslands that function as the principal summer grazing grounds. Each zone offers a distinct combination of topography, climate, and vegetation, shaping the rhythmic seasonal movements of Himalayan pastoral communities throughout the year.

Importance of transhumance pastoralism: Transhumance, a specialized form of pastoralism, involves the seasonal, regular movement of livestock between fixed grazing points, typically between low-altitude winter pastures and high-altitude summer pastures (Manzano-Baena and Casas 2010; Mitra *et al*., 2013). As a sustainable strategy for managing low and seasonal fodder availability, this practice enables the survival of livestock in harsh, high-altitude climates, particularly in the Himalayas (Bhasin, 1998; Nautiyal *et al*., 2003). Transhumance is essential for ecological stability, facilitating the conversion of green vegetation into animal products (Desta and Coppock, 2004) while aiding in soil fertilization and the management of alpine pastures (Mitra *et al*., 2013). Transhumance represents a vital adaptation to marginal environments and variable (Gentle and Thwaites, 2016). The mobility allows pastures to regenerate, preventing long-term overgrazing and aiding in the conservation of biodiversity (Manzano-Baena and Casas 2010; Mitra *et al*., 2013). It is a foundational livelihood for high-altitude communities (Bhasin, 1998). It provides food security, raw materials (wool, meat, milk), and enables the maintenance of a larger stocking rate, converting high-altitude vegetation into valuable food resources (Desta and Coppock, 2004). The system relies on customary rules and informal institutions (Dong *et al*., 2007). Even without legal permits, social mechanisms like hiring pastoral labourers or establishing seasonal contracts for herd management allow community members to utilize alpine resources (Desta and Coppock, 2004). The migratory pattern provides a crucial buffer against local fodder shortages, allowing herds to move to areas with higher productivity during the summer (Mitra *et al*., 2013). Despite its importance, the traditional, community-managed, and communal-property nature of this practice is breaking down in some regions due to a lack of social integration, bureaucratic

hurdles, and declining profitability (Desta and Coppock, 2004; Mitra *et al*., 2013).

Major Challenges to Himalayan Pastoralism: Transhumance pastoralism in the Himalayas is facing an existential crisis due to a convergence of ecological, political, and socio-economic pressures. While traditional pastoralism (e.g., Bhotiya, Van Gujjar, Gaddi, Bakarwal) has historically sustained itself through rotational grazing, recent decades have witnessed a dramatic decline in these systems. Despite this decline in livestock numbers, grazing pressure has paradoxically increased in fragmented, accessible alpine pastures, causing ecological strain. The most immediate threat to pastoralists, specifically groups like the Van Gujjars and Bhotiyas, is the expansion of Protected Area (PA) networks. While intended to preserve biodiversity, these policies often weakened traditional grazing rights. The exclusion of pastoralists from ancestral lands, such as the Nanda Devi Biosphere Reserve and Rajaji National Park, has led to "conservation-induced displacement," forcing many into sedentary lives for which they are economically unprepared. The pastoralist mobility is increasingly restricted by rigid national borders and internal state boundaries. The closure of the Indo-Tibetan border in 1962 permanently severed centuries-old trade and grazing routes, forcing the Bhotiya community to pivot from a robust trans-border economy to precarious local wage labor or settled agriculture. Besides, modern land-use policies often categorize alpine meadows (Bugyals) as wastelands or forest land, failing to recognize the customary "user rights" of nomadic herders.

The conflict between conservation policies and Himalayan transhumance pastoralism:The growing global focus on protecting biodiversity, especially in the high Himalayan region, has led to the creation of many protected areas in India. Although these protected areas are important for conserving nature and wildlife, they have also created serious problems for traditional nomadic pastoral communities who depend on these landscapes for grazing their animals. Over time, several laws introduced during both the British colonial period and after independence gradually restricted the grazing rights of these communities, turning many pastoralists into "victims of conservation. communities affected by conservation policies. The roots of this problem go back to the Indian Forest Act of 1927, which brought forests and grazing lands under government control. Areas traditionally used by local pastoral communities for grazing were declared state forests, reducing community access and rights. Later, the Wildlife (Protection) Act of 1972 further strengthened these restrictions by creating protected areas such as national parks and wildlife sanctuaries that focused mainly on wildlife conservation, often ignoring the needs and livelihoods of local people (Bosak, 2008; Luxom *et al*., 2022).

In Uttarakhand, nearly 65% of the land area is under forests. Several important national parks such as Nanda Devi National Park, Valley of Flowers National Park, Rajaji National Park, and Govind Pashu Vihar National Park now cover a large part of these forests. As a result, traditional grazing in many high-altitude summer pastures has been banned (Nautiyal *et al*., 2003). Over 20,000 livestock from the Mana Valley lost access to grazing, while Bhotiya communities in the Niti Valley saw a 66% decline in sheep population between 1970 and 1995 due to habitat exclusion (Maikhuri *et al*., 2001 a,b). Similarly, the nomadic Van Gujjar communities were displaced from forests and faced major livelihood challenges despite later legal protections under the Forest Rights Act, 2006 (Haq *et al*., 2021).

However, many scientists now argue that traditional pastoralism is not necessarily harmful to the environment. In fact, moderate and rotational grazing can help maintain healthy alpine meadows and biodiversity (Baronti *et al*., 2022). The restriction of traditional migratory grazing practices has forced many pastoralists to adopt sedentary grazing in smaller areas, increasing pressure on the remaining open pastures. This has not only weakened the economy and culture of pastoral communities but has also created new ecological pressures on unprotected grazing lands.

*The Forest Rights Act (2006) and Himalayan Pastoralists: New Hope Amid Ongoing Struggles***:** For generations, nomadic pastoral communities like the Van Gujjars and Bhotiyas in the Himalayas have depended on forests and high-altitude pastures (bugyals) for their livelihood. They move seasonally with their livestock between summer and winter grazing areas

following traditional migration routes. However, despite living in these forests for centuries, they were often treated as illegal encroachers and were denied legal rights over the land and resources they used. To address this historical injustice, the Government of India introduced the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (FRA), which came into force on 31 December 2007. The Act recognizes the rights of forest-dwelling communities over forest lands, including Reserved Forests, Protected Forests, National Parks, and Wildlife Sanctuaries. The Act also balances conservation with community rights. It allows the government to create "Critical Wildlife Habitats" inside National Parks and Sanctuaries when necessary for wildlife protection. However, people can only be relocated if it is scientifically proven that their presence is causing irreversible damage to wildlife and forests. Even in such cases, the government must provide proper rehabilitation and ensure secure livelihoods for affected communities. Overall, the Forest Rights Act is an important step toward protecting the traditional rights, culture, and livelihoods of pastoral and forest-dependent communities while also supporting conservation efforts.

Neglect of transhumant pastoralist communities from a policy perspective: Although transhumance pastoralism has traditionally helped manage and sustain the fragile high-altitude ecosystems of the Himalaya, it is often ignored or blamed by government authorities for environmental degradation (Rao *et al*., 2003a; Pande, 2004). As a result, many conservation policies focus on restricting or excluding pastoral communities rather than working together with them. However, traditional grazing practices can also provide important ecological benefits, such as maintaining biodiversity, controlling excessive shrub growth, and supporting healthy alpine pastures. At present, one major challenge in policymaking is the lack of long-term scientific studies in the Central Himalaya that clearly examine how livestock grazing affects vegetation and ecosystems.

Research from different Himalayan regions also shows that grazing does not always have negative impacts. In some cases, moderate grazing can even help maintain plant diversity, depending on local environmental conditions (Gadgil *et al*., 1993; Roder *et al*., 2002; Aryal *et al*., 2013, 2014). Therefore, instead of treating pastoralism only as a problem, there is a strong need for detailed scientific studies in Uttarakhand to better understand the relationship between livestock, grazing patterns, and vegetation changes. Such evidence-based research can help develop balanced policies that support both environmental conservation and the livelihoods of pastoral communities.

The waning tradition: transformation and decline of transhumance: The practice of transhumance is currently undergoing a significant global decline, marked by contraction and structural transformation. In Uttarakhand, for instance, the population of Tibetan sheep managed through traditional migratory systems has dropped sharply. This shift is driven by younger generations seeking alternative livelihoods and the geopolitical disruption of trade routes with Tibet, which once anchored the regional economy.

The indigenous knowledge and customary lifestyles of communities like the Bhotiya are increasingly threatened by integration into market economies and mainstream social structures. Research indicates a diminishing reliance on livestock as a primary economic base, leading to fewer households utilizing alpine meadows for grazing. Consequently, this migration away from high-altitude pastures has intensified grazing pressure on low-altitude forestlands and increased the necessity of stall feeding. This imbalance under-grazing in the altitude alpine region and over-grazing in the lower elevation poses serious long-term ecological risks to the region's biodiversity.

Factors contributing to the decline of transhumance systems: The transhumance system, a traditional socio-ecological model, is currently facing significant decline and vulnerability (Mearns, 2004). In the Himalayan region, particularly among the Bhotiya and Van Gujjar communities of Uttarakhand, several converging socio-economic, political, and environmental factors are threatening the continuity of this lifestyle. Globalization has accelerated the flow of ideas, technology, and capital, although its impact on remote highland areas remains unpredictable (Choudhary and Garkoti, 2024). One major consequence has been the migration of youth to urban centres in search of diverse employment opportunities,

resulting in a chronic shortage of manpower for livestock rearing, a trend that has intensified across the high-altitude regions of Uttarakhand (Pathak, 2016). Historically, the transhumance system was closely linked with trans-Himalayan trade with Tibet (Joshi and Brown, 1986). The export of livestock products and the import of Tibetan salt formed important economic foundations of the pastoral economy. However, the closure of international borders not only disrupted this trade but also restricted access to traditional summer grazing lands and limited genetic exchange among livestock populations, thereby increasing the risk of inbreeding. These geopolitical disruptions have fundamentally destabilized the pastoral economy of the region (Brower,1992).

At the same time, the growth of pilgrimage and eco-tourism, including trekking and mountaineering, has created alternative livelihood opportunities for local communities. Many households located near major tourist and pilgrimage routes have shifted from traditional animal husbandry to tourism-related service sectors (Saxena *et al*., 2020). Although economically rewarding, these new occupations often lack the ecological and cultural depth associated with traditional pastoral systems. Increased enrolment of children in schools and educational institutions located in urban centres has further distanced younger generations from their pastoral heritage. Another important factor contributing to the decline of transhumance is the increasing dependence on high-value non-timber forest products (NTFPs). The collection of medicinally and commercially valuable species such as *Ophiocordyceps sinensis* (caterpillar fungus or Kira Jari) and *Morchella* (locally known as guchi) has significantly transformed the regional economy. These "low-volume, high-value" resources provide substantial income, improving living standards and access to education, and consequently many traditional herders now prioritize fungus collection over the physically demanding practice of transhumance.

Climate change has emerged as an additional "threat multiplier," intensifying existing socio-political and economic pressures on pastoral communities (Aryal *et al*., 2013). Transhumant herders are highly vulnerable to changing rainfall patterns, erratic agricultural seasons, and rapid snowmelt in alpine rangelands, all of which directly influence the availability of water and forage resources. Such environmental uncertainties impose severe stress on already marginalized communities that possess limited adaptive capacity (Maikhuri *et al*., 2001a). Thus, the decline of transhumance in Uttarakhand cannot be attributed to any single factor; rather, it reflects a complex interplay of modernization, economic transformation, geopolitical change, and environmental stress. The erosion of this traditional system poses serious risks, including the loss of valuable cultural heritage and the degradation of fragile mountain ecosystems that have long been sustained through traditional pastoral practices (Nautiyal and Kaechele, 2007).

Political ecology emphasizes the critical nexus of human-environment relations, highlighting how power dynamics influence access to, knowledge about, and control over natural resources, which are central to the sustainable development of local communities in an era of global liberalization and economic modernization (Peterson, 2000; Kamara *et al*., 2004; Kerven and Behuke, 2011; Kerven *et al*., 2012). Consequently, this field is frequently associated with interdisciplinary studies investigating environmental change and livelihood loss driven by nature conservation policies in developing countries (Saberwal, 1999). In the Himalayas, high-altitude pastures are important not only for the environment but also for conserving biodiversity, supporting ecosystem services, and preserving the rich cultural and spiritual traditions of local communities. However, most earlier studies on Himalayan pastoralism mainly focused on natural resources, grazing lands, and livestock production. In recent years, researchers have started recognizing that these pasturelands and forest ecosystems can be managed more effectively when local pastoral communities are actively involved in decision-making and governance (Bagchi *et al*., 2004).

The Central Himalayan rangelands have unique natural landscapes along with distinct social, cultural, economic, and political systems. However, many top-down development programs, restrictive environmental policies, and new conservation approaches have deeply affected pastoral communities. It is now clear that efforts to manage alpine ecosystems cannot succeed in improving livelihoods or protecting

the environment unless they respect the traditional knowledge, rights, and participation of pastoralists. Today, the future of Himalayan pastoralism is under serious threat. The rapid expansion of protected areas, increasing tourism, changes from mobile grazing to settled land use, growing population pressure, and lack of proper administrative support are making traditional pastoral livelihoods increasingly difficult to sustain (Colchester, 2004).

Traditional Himalayan grazing lands are now becoming politicized landscapes, where decisions about their use are mostly made through policies created far away from mountain communities. Forest authorities have long believed that pastoralism and livestock grazing damage the environment, even though there is little strong scientific evidence for this in the Himalayan region. In reality, grasslands and grazing animals depend on each other for maintaining ecological balance. These grazing lands are not just sources of fodder; they are shared community resources that hold deep cultural, economic, and spiritual importance for local people. Since pastoralism remains a crucial livelihood in the fragile Himalayan ecosystem, the idea of political ecology helps us better understand the close connection between environment, local communities, and government policies (Saberwal, 1996, 1999; Brown, 1998).

Despite having large forest areas and traditional pastoral communities, many state governments still do not have appropriate grazing management policies. For generations, village communities and pastoralists have protected and managed grazing lands on their own. For example, the high-altitude Bhotiya communities do not allow grazing in some pastures during the early growing season so that plants can naturally regenerate. In the Lang Payar grassland near Niti village, grazing is completely banned because it is an important habitat for the endangered musk deer, and local people strictly follow this rule.

Instead of imposing outside control, governments should support local communities in protecting and managing common grazing lands sustainably. Scientific methods, such as maintaining a proper balance between livestock numbers and available pasture, can help prevent overgrazing and keep these ecosystems healthy. On the other hand, forcing pastoral communities to settle permanently can seriously damage their traditional way of life. For communities like the Van Gujjars, whose livelihoods depend on seasonal movement with livestock, settling in one place may lead to the loss of their culture, traditions, and economic security.

Conclusions

Traditional pastoralism in the Himalaya continues to play a vital role in sustaining food security, livelihoods, and the ecological stability of mountain ecosystems. Pastoral communities possess rich traditional knowledge related to grazing management, livestock care, seasonal mobility, and the sustainable use of forests and alpine pastures, developed through generations of close interaction with nature. In the Uttarakhand Himalaya, agriculture, livestock rearing, and forests function as an interconnected socio-ecological system in which crops, animals, and forest resources mutually support one another. This traditional system is highly efficient in recycling nutrients, maintaining productivity, and conserving fragile mountain landscapes. Therefore, the conservation of forests and alpine ecosystems cannot succeed in isolation from the communities that directly depend upon and manage these resources. The active participation of pastoralists and local communities in the planning and management of forests and rangelands is essential for long-term ecological sustainability. However, the trans-Himalayan pastoral regions are undergoing rapid socio-economic and environmental changes. Traditional nomadic and transhumant practices are increasingly being replaced by more settled forms of grazing due to changing lifestyles, economic pressures, educational aspirations, and the migration of younger generations to urban centres. As a result, valuable indigenous knowledge related to rangeland management, livestock breeding, and adaptation to harsh mountain environments is gradually disappearing. The decline of pastoralism not only threatens local livelihoods but also risks the erosion of cultural traditions and ecological knowledge systems that have historically contributed to the sustainable management of Himalayan ecosystems.

In this context, there is an urgent need to recognize the ecological and economic value

of Himalayan rangelands and the ecosystem services they provide, including fodder production, biodiversity conservation, carbon sequestration, water regulation, and livelihood security. Such recognition can support the development of more inclusive and scientifically informed policies, including mechanisms such as Payment for Ecosystem Services (PES), through which local communities may be compensated for their role in conserving natural resources. Sustainable pastoralism should therefore be promoted as both a livelihood strategy and an ecological management approach capable of reducing the vulnerability of mountain communities to climate and environmental change.

Future policies related to transhumance and pastoralism must balance environmental conservation with the socio-economic well-being of pastoral communities. There is also a need to critically examine how legislative frameworks such as the Forest Act, the Biological Diversity Act (2002), and the Forest Rights Act (2006) influence pastoral practices and access to natural resources in the Himalaya. In addition, practical interventions such as community-managed fodder banks and grazing reserves can strengthen climate resilience, provide fodder security during periods of scarcity, and help conserve medicinal and aromatic plant diversity. These initiatives can serve as important demonstration models for integrating biodiversity conservation with sustainable livelihood development in high-altitude pastoral regions. Overall, strengthening pastoral systems through participatory governance, policy support, and ecological restoration will be essential for safeguarding both the fragile Himalayan environment and the cultural heritage of mountain communities.

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Competing Interests

The authors declare no competing interests.

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