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Traditional Resource Management and Environmental Sustainability: A Study of the Pangwala Community in Pangi Valley, Western Himalaya, India

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ABSTRACT

The Pangwala community of Pangi Valley in the Western Himalaya inhabits a high-altitude environment characterized by climatic extremes, geographical isolation, and recurrent natural hazards. In such conditions, traditional systems of resource management have played a vital role in sustaining livelihoods and maintaining ecological balance. This study examines key indigenous institutions and practices, including the Praja (village council), Seva (collective labour), Khul irrigation channels, Gharat water mills, and the Ghot pastoral system. A qualitative ethnographic approach is employed, drawing on field observations, semi-structured interviews, and oral traditions, supported by secondary sources. The findings indicate that these practices function as interconnected systems of environmental management based on community participation, local ecological knowledge, and social regulation. Water distribution, grazing patterns, and infrastructure maintenance are collectively organized to ensure equitable access and prevent resource overexploitation. Cultural practices and ritual observances further reinforce social cohesion and facilitate collective action in resource management. Despite emerging challenges such as socio-economic change and declining participation in traditional systems, these practices continue to embody principles of environmental

sustainability. The study highlights the relevance of indigenous knowledge in shaping sustainable adaptation strategies in fragile Himalayan ecosystems.

Introduction

Pangi Valley, located in the high-altitude regions of Chamba district in Himachal Pradesh, is a land of dramatic landscapes, harsh winters, and seasonal isolation. Life in this remote valley is shaped by frequent avalanches, landslides, and flash floods, which profoundly affect agriculture, livestock rearing, and everyday survival. These extreme conditions have fostered a distinct socio-ecological organization among the Pangwal community, compelling them to develop adaptive strategies that harmonize environmental, social, and cultural dimensions.

For generations, the Pangwal community has relied on traditional institutions and local knowledge systems to sustain livelihoods and maintain social cohesion. Among these, the Khul irrigation network distributes glacial and spring water across terraced fields, ensuring agricultural productivity even under challenging climatic conditions. The Ghot pastoral system regulates communal grazing lands, while Gharat water mills harness the power of flowing water to process grains. Social practices such as Seva, or collective labor for maintaining infrastructure and managing shared resources, and the Praja system, a traditional village council for decision-making, ensure that these ecological arrangements operate efficiently and equitably. Together, these systems reflect a dynamic interplay between ecological management and social cooperation, enabling the community to withstand environmental hazards (Negi et al., 2025; Bharti et al., 2025).

Beyond these material and institutional adaptations, cultural and ritual practices play a vital role in reinforcing social bonds and collective identity. Festivals, fairs, and magico-religious ceremonies not only celebrate communal life but also function as mechanisms for transmitting knowledge, organizing labor for resource management, and mobilizing the community during critical seasonal activities, such as water channel repairs and pasture management (Sharma et al., 2020). The adoption of Indigenous Technical Knowledge (ITK) in agriculture and resource management is deeply influenced by socio-cultural factors, reflecting the community's active role in shaping its ecological and economic strategies (Patial, 2025). Recent initiatives, such as digitizing seasonal calendars and local knowledge through mobile applications, illustrate the potential for blending traditional wisdom with modern technology to enhance climate resilience and adaptive capacity (Menon et al., 2023).

Despite the richness of these practices, scholarly research on the Pangwal community's holistic socio-ecological resilience remains limited. Most studies focus on individual aspects like water management or Himalayan ecology, without fully examining the interconnected systems of indigenous knowledge, community governance, and cultural traditions that underpin climate adaptation in high-altitude environments.

This study seeks to bridge that gap by exploring how the Pangwal community's indigenous institutions, social practices, and cultural norms collectively sustain ecological resilience. Documenting these adaptive strategies not only sheds light on community-based climate adaptation but also highlights the importance of preserving traditional knowledge systems and provides potential models for sustainable development in other high-altitude regions of the Western Himalaya.

Literature Review

Many scholars have examined traditional ecological knowledge and community institutions in Himalayan villages. Negi et al. (2025) studied the role of indigenous knowledge in shaping climate-resilient villages and highlighted how high-altitude communities adapt to environmental hazards such as avalanches, landslides, and erratic snowfall. They emphasized the importance of local water management, sustainable agricultural practices, and communal governance for resilience.

Similarly, Bharti et al. (2025) explored the culinary and agro-pastoral practices of the Pangwal and Bhot communities in Pangi Valley. Their research showed how locally sourced foods and traditional farming methods reflect a deep ecological understanding and sustain livelihoods under harsh climatic conditions.

Other scholars have focused on the social and cultural dimensions of resilience. Sharma et al. (2020) studied magico-religious healing traditions, illustrating how rituals, festivals, and fairs strengthen social cohesion and facilitate communal cooperation for ecological and livelihood management. Patial (2025) analyzed the factors influencing adoption of Indigenous Technical Knowledge (ITK) in farming and resource management, highlighting the role of socio-cultural norms, family decision-making, and community participation.

In addition, recent studies have examined the integration of traditional practices with modern tools. Menon et al. (2023) demonstrated how digitization of seasonal calendars and indigenous agricultural knowledge can enhance local climate resilience by combining traditional wisdom with technological innovations.

Despite these valuable contributions, few studies have holistically examined the Pangwal community as a socio-ecological system. Most research focuses on isolated components such as irrigation systems, grazing practices, or cultural rituals. The interplay between ecological knowledge, community institutions, and cultural traditions that collectively sustain resilience in Pangi Valley remains underexplored.

This review underscores the need for comprehensive research that situates the Pangwal community within a broader framework of community-based adaptation, cultural continuity, and environmental management.

Research Gap

While many aspects of the Pangwal community's ecological and social practices—such as the Khul irrigation network, Ghot grazing system, and Seva labor—have been documented individually, there is limited understanding of how these indigenous institutions collectively function to maintain resilience, ensure resource governance, and adapt to environmental hazards. Furthermore, the interplay between ecological management, communal governance, and cultural practices, including festivals, rituals, and hydropower usage through Gharats, remains largely unexplored. This study aims to fill this gap by examining the integrated functioning of these indigenous systems, highlighting their role in climate adaptation, community cohesion, and sustainable resource management in the Pangi Valley.

Objectives

1.To describe the Pangwal community's key ecological institutions, including Khul irrigation, Ghot grazing, and Gharat water mills.

2. To examine collective labor (Seva) and village councils (Praja system) in maintaining infrastructure and managing resources.

3. To assess how these practices enable the community to adapt to environmental challenges in Pangi Valley.

Area of Study

The present study focuses on Phindpar village, located in the Pangi Valley of Chamba district, Himachal Pradesh (Figure 1). Pangi Valley is a remote, rugged, and cold desert-like region situated beyond the Pir

Panjal range, characterized by harsh winters, steep terrain, and limited accessibility. Its geographic isolation has shaped unique socio-ecological systems and adaptive practices among local communities.

At the block level, Pangi consists of 60 villages covering a total area of 31,080.22 hectares. Only 6.75% of this land is cultivable, and 46.03% of cultivable land is irrigated, reflecting the valley's challenging agricultural conditions and the reliance on traditional irrigation systems such as the Khul network (District Survey Report, 2024).

According to the Census of India 2011, Phindpar village has a population of 261 individuals in 56 households, with a male population of 122 and a female population of 139. The majority of residents belong to Scheduled Tribes, and literacy stands at approximately 55.2%, with female literacy considerably lower than male literacy. The village's high-altitude location, extreme weather, and limited connectivity underscore the importance of indigenous institutions, communal labor practices (Seva), and cultural norms in sustaining livelihoods, resource management, and social cohesion.

Phindpar thus provides an ideal setting for examining how the Pangwal community's traditional ecological knowledge and collective institutions contribute to resilience and adaptation in a high-risk Himalayan environment.

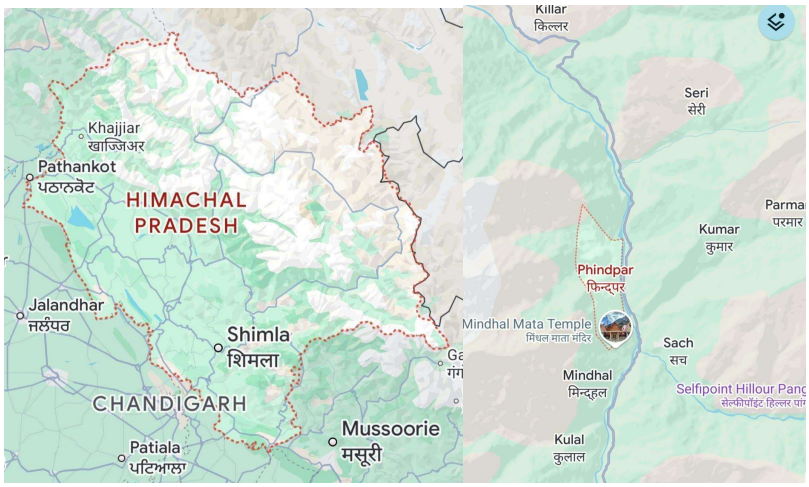

Figure 1: Map of Phindpar Village, Pangi Valley, Chamba, Himachal Pradesh

Source: Google Maps, 2026

Methodology

This study employs a qualitative, ethnographic approach to understand the adaptive strategies of the Pangwal community in Phindpar village, Pangi Valley. The methodology integrates field-based

observations, interviews, and archival research, aiming to capture both material and social dimensions of community resilience.

Field Observations: Direct observation of Khul irrigation channels, Ghot pastoral lands, and Gharat water mills was conducted to document traditional resource management practices and their seasonal maintenance. Particular attention was given to collective labor practices (Seva) and community decision-making (Praja system).

Oral Histories and Interviews: Semi-structured interviews were conducted with community elders, village leaders, and practitioners of traditional ecological knowledge. Interviews explored historical water and pasture management, seasonal calendars, ritual practices, and local strategies for responding to environmental hazards.

Archival and Secondary Sources: Historical records, district reports, and scholarly literature were reviewed to contextualize local practices within broader Himalayan ecological and socio-cultural systems. Sources included the District Survey Report, Chamba (2024), census data, and publications on Himalayan indigenous knowledge systems.

Data Analysis: Data were analyzed thematically, focusing on indigenous institutions, collective labor mechanisms, ecological adaptations, and cultural practices. The analysis emphasizes how these practices contribute to community resilience, social cohesion, and climate adaptation.

This methodology ensures a holistic understanding of the interplay between environmental constraints, community governance, and cultural norms, providing insights into sustainable adaptation strategies in high-altitude Himalayan regions.

Discussion

Khul – Traditional Irrigation Channels

The Khul serves as the primary source of irrigation in Pangi Valley, sustaining agriculture in high-altitude terraced fields. During field visits to Phindpar village, it was observed that the main Khul extends approximately 3 km from a glacier-fed stream, with smaller channels branching out to irrigate individual farms (Figure 2).

Maintenance of the Khul relies on collective labor, locally referred to as Begar, which the villagers organize every spring before sowing. The community emphasized that if this seasonal repair is neglected,

crops fail due to insufficient water supply. Begar activities include clearing debris, reinforcing the channel, and repairing damaged sections.

Figure 2: Khul irrigation channel in Phindpar village

Source: Field Observation, Phindpar, 2026

The Khul system faces several environmental challenges. Avalanches and heavy snowfall often block or damage the channels, while sudden rainfall can cause the water level in local streams (naalas) to rise sharply, sometimes destroying small village bridges (puli). In such instances, villagers promptly engage in collective repair work, restoring both the Khul and associated infrastructure to ensure water distribution.

Collaboration with the government irrigation department is sometimes necessary when water sources are disconnected or require technical support. Despite these challenges, the community's organized system of labor and shared responsibility ensures that every household receives adequate water for agriculture and domestic use. This system demonstrates how indigenous knowledge and communal cooperation sustain the village's resilience to high-altitude environmental hazards.

Gharat (Ghat) Water Mills

In Pangi Valley, Gharat—locally known as Ghat—represents a traditional water-powered mill system, harnessing the energy of flowing Khul water for grain processing. During field visits to Phindpar village, it was observed that most households still rely on Gharats to grind cereals such as wheat and barley, demonstrating a direct link between water management and local food security (Figure 3).

Figure 3: Gharat (Ghat) water mill in Phindpar village

Source: Field Observation, Phindpar, 2026

These water mills are strategically positioned along the Khul channels to maximize flow and energy output. The community collectively maintains these mills through Begar, ensuring that the water wheels remain functional throughout the year. Seasonal challenges such as avalanches, blockages due to snow, or sudden rise in stream levels can disrupt operations, requiring immediate attention from villagers to repair both the mill structure and the channels feeding it.

Gharats also play a social role. They act as community hubs where villagers gather, exchange knowledge, and coordinate agricultural and irrigation activities. The continued reliance on Gharats highlights the community's ability to adapt traditional technology to local environmental conditions, reinforcing resilience and sustaining livelihoods in a high-altitude, resource-limited setting.

Praja (Pyaj) – Traditional Village Governance

The Praja, locally known as Pyaj, is the traditional governance system of villages in Pangi Valley, serving as the village council. It oversees all major activities, including agricultural planning, management of communal resources, rituals, festivals, and even death ceremonies. Through the Pyaj, the community ensures that social norms are maintained and responsibilities are shared fairly among villagers.

In Phindpar village, the Pyaj traditionally holds meetings in the Dehr, the local Kul Devta temple (Naag Mandir), following seasonal rituals and pujas. Conducting meetings in this sacred space emphasizes the integration of governance with spiritual and cultural life, giving communal decisions both social and moral authority(Figure 4).

Figure 4: Pyaj (village council) meeting at Dehr/Naag Kul Devta Temple, Phindpar village, performing puja

Source: Field Observation, Phindpar, 2026

The council is guided by respected elders and experienced villagers, who mediate disputes, coordinate collective work, and ensure that everyone participates in managing resources and community affairs. By combining practical governance with ritual observance, the Pyaj strengthens social cohesion, collective responsibility, and resilience, enabling the Pangwal community to face environmental challenges while preserving cultural continuity in the high-altitude landscape of Pangi Valley.

Ghot – Communal Grazing Shelters (Dhar Pastures)

The Ghot, locally known as Ghot, is a shelter used for livestock during grazing, typically located in the higher parts of the village, called Dhar. These shelters serve a multipurpose role: they provide shelter for

animals, accommodate the owners who stay with their livestock during grazing, and offer nighttime protection for crops and livestock from wild animals, locally called Rakh, such as bears (Figure 5).

Figure 5: Ghot – Communal grazing shelter in Dhar pasture, Phindpar village

Source: Field Observation, Phindpar, 2026

Field observations in Phindpar village revealed that Ghot were collectively managed by the community. Families rotated responsibilities for feeding, sheltering, and protecting livestock. Grazing schedules were carefully planned to prevent overgrazing, maintain pasture health, and ensure equitable access to pasture lands. The Pyaj (village council) coordinated these activities, resolving disputes and overseeing communal management of the Dhar and grazing areas.

Villagers also engaged in collective maintenance of Ghot, including repairs, clearing pathways, and securing water sources. These activities were often organized alongside seasonal festivals and community gatherings, reflecting the integration of ecological management, social organization, and cultural practices.

However, in recent times, these practices have declined. With increasing access to education, employment opportunities outside the village, and migration to urban areas, fewer community members participate in traditional livestock management. Consequently, the Ghot system is now used less

frequently, and its role in sustaining pastoral livelihoods and reinforcing communal cohesion has diminished.

Despite this decline, the Ghot remains an important symbol of traditional ecological knowledge and community resilience, reflecting the adaptive strategies that historically enabled the Pangwal community to thrive in the challenging high-altitude environment of Pangi Valley.

Collective Labour – Seva (Begar)

Across Pangi Valley, the Pangwal community has traditionally relied on collective labour, locally called Begar or Seva, to maintain critical village infrastructure and manage shared resources. Participation in Begar is considered a social obligation, fostering cooperation, knowledge transmission, and communal responsibility.

Field observations in Phindpar village reveal that Begar is strictly organized and enforced. Non-participation is not taken lightly; the Pyaj (village council) decides penalties for anyone absent without a valid reason. This ensures that every household contributes to the welfare of the village, emphasizing that Begar is for the benefit of the entire community.

Begar is organized into specific types based on the task:

Khul Begar – Focused on the maintenance and repair of Khul irrigation channels, especially in spring, after snow and avalanches. Villagers clear debris, repair damaged channels, and ensure water reaches terraced fields.

Ghat Begar – Dedicated to maintaining Gharat water mills (Ghat) and Ghot livestock shelters, ensuring proper water flow, repairing structures, and sustaining grazing areas in the Dhar.

Both types are coordinated through the Pyaj, which schedules work, mediates any disputes, and ensures fair participation. These collective efforts not only maintain essential infrastructure but also reinforce social cohesion, mutual accountability, and a sense of ownership over communal resources.

While modern education and external employment have reduced participation in recent years, Begar remains a crucial adaptive mechanism, reflecting the Pangwal community's historical strategies for resilience in the high-altitude environment of Pangi Valley.

Results

The study of the Pangwal community in Phindpar village, Pangi Valley reveals a deeply interconnected system of indigenous knowledge, communal institutions, and ecological adaptation that sustains livelihoods in one of the most challenging high-altitude environments of the Western Himalaya. Field observations and interviews with local residents show that traditional practices are not isolated activities but form an integrated network that ensures agricultural productivity, livestock management, and social cohesion despite environmental hazards such as avalanches, landslides, and seasonal isolation.

The Khul irrigation system emerges as the backbone of agricultural resilience. In Phindpar, the main Khul extends for three kilometers from a glacier-fed stream, branching into smaller channels that irrigate terraced fields. Each spring, before sowing, villagers engage in Khul Begar, a collective labour effort to clear debris, repair snow-blocked channels, and restore water flow after floods or rising water levels. The work is highly organized and monitored by the Pyaj, the village council, ensuring that every household participates, as non-compliance carries social and sometimes material penalties. This practice illustrates the community's ability to maintain essential infrastructure through self-organized, cooperative action.

Similarly, Gharat water mills (Ghat) are maintained through collective labour, allowing the villagers to process grains locally and secure food supply without external dependency. The Ghot shelters in the higher Dhar pastures perform multiple roles: they house livestock, accommodate the owners who stay with animals during grazing, and provide protection for crops and animals at night from wild animals, locally referred to as Rakh. Families rotate responsibilities for feeding, grazing, and guarding the animals, while the Pyaj oversees equitable access and mediates disputes. This system reflects the integration of ecological management with social organization, demonstrating a nuanced understanding of high-altitude pastoral needs.

The Begar system, encompassing Khul, Ghat, and Ghot maintenance, represents a core aspect of community cooperation and obligation, reinforcing knowledge transmission and ensuring the sustainability of resources. All collective activities are coordinated by the Pyaj, which also functions as the village's traditional governing body, overseeing not only resource management but also ceremonial and ritual activities conducted in the Dehr or local temples, including festivals and religious observances. These cultural practices strengthen social bonds, transmit traditional ecological knowledge, and facilitate mobilization of labour when required.

Although modern education, migration, and employment opportunities have reduced participation in some of these traditional practices, the underlying principles of collective responsibility, adaptive governance, and ecological stewardship remain central to community life. Together, the Khul system, Gharat mills, Ghot shelters, Begar, Pyaj, and cultural practices form a holistic framework of resilience, enabling the Pangwal community to respond effectively to environmental challenges while maintaining social cohesion, cultural continuity, and sustainable livelihoods.

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