Policy Brief

Highland Ecosystem Management and Sustainable Yak Pastoralism in the Khangchendzonga Landscape, India









G. B. Pant National Institute of Himalayan Environment (NIHE)
Sikkim Regional Centre, Pangthang, Gangtok, Sikkim





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Authors: Kailash Singh Gaira[a], Rajesh Joshi[a], Karma Tenzing Bhutia[b], Nakul Chettri[c]

[a]G. B. Pant National Institute of Himalayan Environment, Sikkim Regional Centre, Pangthang, Gangtok, Sikkim
[b]Animal Husbandry and Veterinary Services Department, Government of Sikkim
[c]Ashoka Trust for Research in Ecology & the Environment (ATREE), Regional Office, Sikkim

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Agriculture, Animal Husbandry & Veterinary Services, Fisheries, and Horticulture Department
Government of Sikkim

SHRI PURAN KUMAR GURUNG
Hon'ble Minister



Message

Yak husbandry is an integral part of Sikkim's high-altitude pastoral heritage, sustaining the livelihoods, cultural traditions and socio-economic well-being of communities inhabiting the Himalayan highlands. Uniquely adapted to harsh mountain environments, yaks provide milk, meat, fibre, manure and transport, supporting local economies and preserving traditional knowledge and practices of highland resource management. Sustaining this valuable livestock resource is therefore essential for strengthening pastoral livelihoods and conserving Sikkim's rich cultural and ecological heritage.

However, yak husbandry faces growing challenges from climate change, rangeland degradation, winter fodder shortages, animal health issues, limited access to quality breeding resources and changing aspirations among younger generations. Addressing these challenges requires concerted efforts to strengthen veterinary and breeding services, improve pasture and fodder management, promote value addition and market access, and create sustainable livelihood opportunities for yak-herding communities.

This booklet is a timely initiative that highlights the ecological significance of the Khangchendzonga Landscape and the importance of sustainable yak husbandry in the Indian Himalayan Region. I am confident that it will serve as a valuable resource for policymakers, researchers, practitioners and development partners, while encouraging greater collaboration among herders, government departments, research institutions and local communities.

I hope the recommendations and insights presented in this publication will inspire practical action, foster innovation and strengthen community participation in sustainable yak husbandry. Through collective commitment and coordinated efforts, we can enhance the resilience of highland communities, conserve fragile mountain ecosystems and ensure that Sikkim's treasured pastoral heritage continues to thrive for generations to come.

SHRI PURAN KUMAR GURUNG
Hon'ble Minister



डॉ. आई. डी. भट्ट

Dr. I.D. Bhatt

निदेशक
गोविन्द बल्लभ पंत राष्ट्रीय हिमालय
पर्यावरण संस्थान

Director
Govind Ballabh Pant National
Institute of Himalayan Environment



Foreword

The yak is much more than a livestock species; it is a lifeline for Himalayan highland communities and a symbol of their resilience, cultural identity and traditional ecological knowledge. Uniquely adapted to harsh climatic conditions and fragile alpine environments, yak husbandry sustains pastoral livelihoods and offers opportunities for livelihood diversification, value addition and nature-based enterprises. Conserving this remarkable animal and its genetic resources is therefore vital for safeguarding the ecological integrity of highland landscapes and the socio-economic well-being of pastoral communities.

This publication brings together ecological, livelihood, cultural and governance perspectives relevant to the Indian part of the Khangchendzonga Landscape (KL), particularly Sikkim and the adjoining hill districts of West Bengal. Drawing on available literature and relevant knowledge, it highlights the interconnections among forests, pastures, farming systems, livestock, cultural landscapes and local governance. It emphasizes the need to manage these elements as interconnected components of a dynamic socio-ecological landscape.

The publication also identifies key challenges to sustainable yak husbandry and outlines practical management priorities for strengthening climate resilience, improving livestock health and productivity, promoting sustainable rangeland management, and enhancing livelihood opportunities for pastoral communities. The proposed actions provide a framework for informed decision-making and future interventions, recognizing the importance of community participation, traditional knowledge, scientific evidence and institutional collaboration.

I hope this publication will serve as a useful resource for policymakers, researchers, practitioners, development partners and local communities. By fostering collaboration and encouraging informed, community-led action, it can contribute to sustaining yak husbandry, strengthening highland livelihoods and conserving the unique biodiversity and cultural heritage of the Khangchendzonga Landscape for future generations.

Dr. I. D. Bhatt
Director
G.B. Pant National Institute of Himalayan Environment



Dr. Eklabya Sharma
FNA, FNASc

Strategic Advisor
Ashoka Trust for Research in Ecology and the Environment (ATREE)
Regional Office,Tadong,
Gangtok, Sikkim



Foreword

The yak is an iconic species of the Himalayan highlands, sustaining the livelihoods, cultural identity and traditional ecological knowledge of Indigenous and pastoral communities. Beyond its economic value, yak husbandry links biodiversity conservation, cultural heritage and the sustainable management of fragile mountain ecosystems. However, climate change, shifting snowfall patterns, rangeland degradation, fodder shortages, inadequate veterinary and breeding services, and declining economic incentives increasingly threaten this traditional livelihood.

Sustaining yak pastoralism requires an integrated approach that combines scientific knowledge with traditional wisdom. Key priorities include conserving indigenous yak genetic resources, improving animal health and breeding services, restoring and sustainably managing highland pastures, and strengthening preparedness for climate-related risks. Value addition to yak milk and fibre, improved market access, responsible yak-based tourism, and greater participation of women and young people can create viable livelihood opportunities while preserving the cultural heritage and ecological integrity of Himalayan landscapes.

I commend this initiative for bringing together ecological, livelihood, cultural and institutional perspectives to advance sustainable yak husbandry in the Khangchendzonga Landscape and the wider Indian Himalayan Region. By highlighting the interdependence of highland ecosystems and pastoral communities, this publication provides a valuable foundation for informed policymaking, effective management interventions and collaborative action. Its emphasis on scientific evidence, traditional knowledge and community participation is particularly important for developing locally appropriate, climate-resilient solutions.

The future of yak pastoralism depends on strong partnerships among herders, local institutions, government agencies, research organisations and development partners. I hope this publication inspires collective action to strengthen pastoral livelihoods, promote responsible stewardship of highland ecosystems, and safeguard the Himalayan region's rich natural and cultural heritage for future generations.

Dr. Eklabya Sharma, FNA, FNASc
Strategic Advisor, ATREE



Preface

The highland ecosystems of the Indian Himalayan Region (IHR) are among the country's most ecologically significant and culturally distinctive landscapes, sustaining rich biodiversity, regulating freshwater flows, storing carbon, and supporting traditional livelihoods. Among these, yak pastoralism represents more than a livelihood system; it embodies the traditional ecological knowledge, cultural heritage, customary institutions, and resilience of highland communities.

The Khangchendzonga Landscape (KL), spanning Sikkim and the northern hills of West Bengal, encompasses diverse ecosystems, including alpine meadows, high-altitude wetlands, glaciers, and snowfields. These ecologically fragile landscapes and their dependent communities face growing challenges from climate change, rangeland degradation, changing snowfall patterns, winter fodder scarcity, livestock health concerns, limited market opportunities, and socioeconomic transitions. Addressing these interconnected challenges requires an integrated approach that places ecosystem conservation, sustainable yak pastoralism, and community well-being at the centre of highland development strategies.

This policy brief, titled "Highland Ecosystem Management and Sustainable Yak Pastoralism in the Khangchendzonga Landscape, India," presents evidence-informed recommendations for strengthening ecological resilience, pastoral livelihoods, and institutional cooperation. Under the Khangchendzonga Landscape Conservation and Development Initiative (KLCDI)–India, the G. B. Pant National Institute of Himalayan Environment (GBPNIHE), Sikkim Regional Centre, has undertaken field assessments, community consultations, exhibitions, and stakeholder engagements in collaboration with the International Centre for Integrated Mountain Development (ICIMOD), Animal Husbandry and Veterinary Services Department, Government of Sikkim, ICAR–National Research Centre on Yak, traditional Dzumsa institutions, and other stakeholders, including representatives from Nepal and Bhutan. These collaborative efforts have generated valuable insights into emerging challenges, community priorities, and opportunities for sustainable highland management. Building on these initiatives, the Ashoka Trust for Research in Ecology and the Environment (ATREE) supported to the formation of an Ad hoc Committee for the Yak Federation of India (YFI) and the preparation of a draft action plan, representing an important step towards strengthening pastoral representation, institutional coordination, and collective action for sustainable yak husbandry.

The policy brief outlines priority interventions for strengthening community institutions, integrating traditional ecological knowledge into decision-making, improving livestock health and breeding, ensuring winter fodder security, restoring degraded rangelands, and promoting value addition and market linkages. It also emphasizes women's and youth participation, climate and disaster resilience, human–wildlife conflict management, and long-term ecological and socioeconomic monitoring. Effective implementation will require coordinated action among government agencies, research institutions, conservation organizations, pastoral communities, and development partners.

We hope this policy brief will provide a useful framework for policymakers, researchers, practitioners, and community institutions to advance sustainable highland ecosystem management. Above all, it reinforces the principle that ecological conservation and pastoral livelihoods must be strengthened together through community-led, science-informed, and institutionally coordinated approaches. By integrating scientific knowledge, traditional wisdom, institutional partnerships, and livelihood innovations, we can enhance the resilience of yak pastoralism, safeguard the ecological integrity of the Khangchendzonga Landscape, and conserve its invaluable natural and cultural heritage for future generations.

(Authors)



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Executive Summary

Highland ecosystems of the Indian Himalayan Region (IHR) comprise interconnected subalpine forests, alpine meadows, grasslands, rangelands, high-altitude wetlands, glaciers, and snowfields. Generally occurring above 3,000 m above mean sea level (amsl), although ecological boundaries vary, these ecosystems support specialized biodiversity, regulate freshwater flows, store carbon, stabilize soils, and sustain traditional pastoral livelihoods, particularly yak husbandry and Pashmina goat rearing.

The Indian part of the Khangchendzonga Landscape (KL), spanning Sikkim and the northern West Bengal hills, extends from lowland environments to alpine and glacial ecosystems. Covering approximately 14,126.36 km², with elevations ranging from about 40 m to 8,586 m amsl, the landscape includes 17 protected areas, as reported in the source document. Its ecological diversity supports habitat connectivity, essential ecosystem services, and rich cultural heritage.

Yak husbandry is a traditional livelihood across the highlands of Ladakh, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, and the higher reaches of West Bengal. Yaks provide milk, meat, fibre, hides, manure, and transport services while sustaining Indigenous knowledge, customary institutions, and community identity. However, this livelihood faces mounting pressures from climate change, shifting snowfall patterns, rangeland degradation, winter fodder shortages, inadequate veterinary and breeding services, weak market linkages, limited infrastructure, human–wildlife conflict, and declining interest among younger generations.

Under the Khangchendzonga Landscape Conservation and Development Initiative (KLCDI)–India, the G. B. Pant National Institute of Himalayan Environment (GBPNIHE), Sikkim Regional Centre, spearheaded field explorations, community consultations, exhibitions, and stakeholder workshops in collaboration with the International Centre for Integrated Mountain Development (ICIMOD), the Government of Sikkim's Animal Husbandry and Veterinary Services Department, ICAR–National Research Centre on Yak, local Dzumsa institutions, and other stakeholders, including representatives from Nepal and Bhutan. These engagements identified priorities for sustainable yak husbandry, livelihood security, and highland ecosystem conservation.

Priority Actions

Strengthen community institutions: Enhance herder participation, representation, and integration of traditional ecological knowledge into policy and planning.

Improve livestock productivity and welfare: Expand veterinary care, breeding services, nutrition, winter fodder security, and appropriate technologies.

Conserve rangelands: Promote sustainable grazing, pasture restoration, carrying-capacity assessment, and biodiversity monitoring.

Promote livelihood diversification: Develop value-added yak milk and fibre products, strengthen market access, and support women- and youth-led enterprises, handicrafts, and responsible nature-based tourism.

Build climate resilience: Improve preparedness for extreme weather, livestock diseases, fodder shortages, and human–wildlife conflict.

Establish long-term monitoring: Track rangeland health, climate impacts, livestock performance, and community well-being through long-term environmental and socioecological monitoring.

A community-led approach integrating scientific evidence, traditional knowledge, institutional coordination, and livelihood innovation is essential to sustain yak husbandry, strengthen pastoral communities, and safeguard the ecological integrity and cultural heritage of the Khangchendzonga Landscape.



Conserving highland ecosystems and sustaining pastoral livelihoods should be pursued together through community-led, science-informed and cross-sectoral management.

1
Highland Ecosystems of the Indian Himalayan Region (IHR): Ecological Significance and Livelihoods



Highland ecosystems of the Himalaya comprise interconnected ecological systems, including subalpine forests, alpine meadows, grasslands, rangelands, high-altitude wetlands, glaciers, and snowfields. Generally occurring above 3,000 m above sea level (asl), these ecosystems are shaped by steep elevational gradients, cold climatic conditions, seasonal snow cover, and distinctive ecological processes. Their ecological boundaries vary across the Himalayan landscape. They harbour specialized biodiversity and provide essential ecosystem services, including freshwater regulation, carbon storage, soil stabilization, and habitat connectivity. They also sustain traditional pastoral livelihoods, particularly yak husbandry and Pashmina goat rearing.

Within the Indian Himalayan Region (IHR), highland ecosystems occur in Jammu and Kashmir, Ladakh, Himachal Pradesh, Uttarakhand, Sikkim, the Darjeeling hills of West Bengal, Arunachal Pradesh, and Nagaland. Their ecological characteristics vary with elevation, topography, climate, and land-use practices. These landscapes support important wildlife, including the Himalayan musk deer (*Moschus chrysogaster*), snow leopard (*Panthera uncia*), and bharal or Himalayan blue sheep (*Pseudois nayaur*), which contribute to ecological balance. Domestic yaks (*Bos grunniens*) and Pashmina goats support local economies, cultural traditions, and community-based resource management. Alpine bumblebees (*Bombus* spp.) facilitate pollination, while specialized plants, including cushion plants (*Androsace* spp.), rhododendrons (*Rhododendron anthopogon* and *R. campanulatum*), alpine primroses (*Primula* spp.), and Sikkim sundari (*Rheum nobile*), contribute to the region's distinctive biodiversity.

However, climate change, altered snowfall and precipitation, unsustainable grazing, infrastructure development, and other anthropogenic pressures threaten these fragile ecosystems. Their slow vegetation regeneration and limited ecological recovery make sustainable management essential. Conserving Himalayan highlands therefore requires integrated landscape-level planning that combines biodiversity protection, sustainable rangeland management, climate adaptation, and livelihood security while recognizing the traditional knowledge, cultural heritage, and active participation of mountain communities.

2
Features of Highland Ecosystems

- **Alpine Meadows and Rangelands:** Provide seasonal forage for yaks and other livestock, sustaining pastoral livelihoods while supporting alpine plants, medicinal herbs, pollinators, and wildlife. Their ecological health depends on sustainable grazing and vegetation recovery.
- **Subalpine Scrub and Forests:** Form transition zones between forests and alpine landscapes, providing shelter, browse, fuelwood, and other resources. They support carbon storage, soil stabilization, and habitat connectivity but are vulnerable to excessive browsing, trampling, and fuelwood extraction.
- **Glaciers, Snowfields, Springs, Streams, and High-Altitude Wetlands:** Regulate water availability, sustain biodiversity and pastoral activities, and support downstream communities. Climate change, glacial retreat, altered precipitation, and land-use pressures threaten their hydrological functions and ecological integrity.
- **Sacred Mountains, Lakes, and Cultural Landscapes:** Reflect the spiritual values, cultural identity, and traditional ecological knowledge of Himalayan communities. Customary practices and community institutions support natural resource stewardship, offering opportunities to strengthen participatory conservation and sustainable highland management.



3
Need for Highland Ecosystem Management

Highland ecosystems are vital to the ecological security, water resources, biodiversity, and socio-economic well-being of the Indian Himalayan Region (IHR). They regulate freshwater flows, store carbon, stabilize soils, maintain habitat connectivity, and support specialized biodiversity. Alpine meadows and rangelands sustain traditional pastoral livelihoods, particularly yak husbandry, contributing to household income, food security, and cultural heritage.

Despite their importance, these ecosystems face increasing pressures from climate change, altered snowfall and rainfall patterns, unsustainable grazing, infrastructure development, and resource extraction. Harsh climatic conditions, steep terrain, short growing seasons, and slow vegetation regeneration further limit their recovery from disturbance.

Sustainable highland management requires an integrated landscape approach combining biodiversity conservation, sustainable rangeland management, water-resource protection, climate adaptation, and livelihood security. Assessing livestock carrying capacity, promoting seasonal and rotational grazing where appropriate, restoring degraded pastures, and protecting water sources can strengthen ecosystem resilience. Recognizing customary rights, traditional knowledge, and community participation in planning and decision-making is equally important. Integrating conservation priorities with the needs of yak-herding communities can safeguard biodiversity and ecosystem services while sustaining pastoral livelihoods, cultural heritage, and resilient Himalayan landscapes.



Management Principle: Healthy rangelands and viable herder livelihoods are complementary goals. Conservation measures are more durable when developed with communities and grounded in ecological evidence.

4
Yak Pastoralism in the Khangchendzonga Landscape (KL)-India

Mount Khangchendzonga (8,586 m), it encompasses deep valleys, temperate and subalpine forests, alpine meadows, glaciers, snowfields, rivers, and high-altitude wetlands (HAWs). In India, yak pastoralism is primarily practised in the high-elevation areas of North Sikkim, particularly the Lachen–Thangu region and adjoining alpine belts, as well as Kupup and Gnathang Valley in East Sikkim, West Sikkim, and other locally important pastoral areas. The extent and use of seasonal grazing grounds depend on accessibility, customary practices, land-use regulations, weather conditions, and conservation requirements.

Yak- A Living Highland Heritage

Yaks are uniquely adapted to cold, high-altitude environments and have sustained mountain communities across the Hindu Kush Himalaya for generations. In the KL, yak husbandry extends beyond livestock production; it represents a traditional livelihood system shaped by seasonal movement, inherited knowledge, community relationships, local markets, and access to highland pastures. Yaks provide milk, meat, fibre, and other valuable products while contributing to household incomes, food security, cultural identity, and the continuity of pastoral traditions.

In India, yak-rearing regions include Arunachal Pradesh, Sikkim, Uttarakhand, Himachal Pradesh, and the former state of Jammu and Kashmir, now reorganized into the Union Territories of Jammu and Kashmir and Ladakh. According to the 20th Livestock Census (2019), India's yak population was approximately 58,000, representing a 24.67% decline from the 2012 census. However, Arunachal Pradesh and Sikkim recorded increases in yak populations (Table 1), highlighting the regional variation in yak husbandry trends.

Table 1: Status of Yak Population in the Indian Himalayan Region (IHR).

State	Yak population 2012 (%)	Yak population 2019 (%)	Difference between (2012-2019)
Jammu & Kashmir	54,493 (71.08)	26,221 (45.43)	28,272
Arunachal Pradesh	14,061(18.34)	24,075((41.71)	-10,014
Sikkim	4,036 (5.26)	5,219 (9.04)	-1,183
Himachal Pradesh	2,921 (3.81)	1,940 (3.36)	981
West Bengal	1,089 (1.42)	213 (0.37)	876
Uttarakhand	62 (0.08)	54 (0.09)	8
Total	76,662	57,722	18,940

In Sikkim, tribal households in Lachen, Lachung, and Gnathang practise semi-pastoral yak husbandry across elevations of approximately 3,000–5,000 m above sea level. This livelihood system depends heavily on temperature, snowfall patterns, and the seasonal availability of suitable pastures. Snowfall influences yak movement, endurance, and access to forage. However, climate-related changes have altered traditional pastoral practices. Pandey et al. (2019) reported a shift in the snowfall period from November–December to January–March, alongside an estimated temperature increase of 0.03–0.04 °C per year.

These changes have affected the seasonal migration of yak herders. Rising temperatures in March have advanced the commencement of upward migration by approximately 15–30 days, while extending the overall migration period by about 45 days. Downward migration, previously reaching elevations of around 2,000 m, is now restricted to mid-elevation areas of approximately 2,750–3,000 m. Meanwhile, upward migration has extended to elevations about 500 m higher than previously recorded, reflecting changing climatic conditions and the reduced availability of suitable forage at traditional grazing sites.

These shifts in migration patterns indicate growing pressures on yak husbandry and highland ecosystems. Changes in grazing duration, elevation, and pasture availability may increase pressure on alpine rangelands, disrupt traditional management practices, and affect yak health and productivity. They also highlight the need for systematic monitoring of climate trends, pasture conditions, and yak movement. Adaptive grazing strategies, improved pasture management, and the integration of herders' traditional ecological knowledge into conservation planning are essential to sustaining yak-based livelihoods while maintaining the ecological integrity of Sikkim's fragile highland landscapes.

A Community-centred Approach: Herders should be treated as knowledge holders and co-managers—not only as beneficiaries or sources of pressure on ecosystems.



5
Diversifying Highland Livelihoods through Yak- based Value Addition and Tourism

Yak husbandry offers significant opportunities to diversify highland livelihoods through value addition, product innovation, and nature-based tourism. Transforming raw yak resources into higher-value products can increase household incomes, generate local employment, and strengthen the economic viability of traditional yak-rearing systems.

Yak milk-based products: Yak milk whey beverages blended with kiwi fruit pulp have been developed as potential health drinks for small-scale enterprises and local markets. The indicative selling price is ₹20 per 200 ml pack. Fibre-fortified functional paneer made from yak milk has also been developed to enhance its functional and nutritional attributes, with an indicative price of ₹350 per kg. Further product refinement, nutritional assessment, shelf-life evaluation, and consumer acceptability testing would help establish their commercial feasibility.

Yak fibre-based products: Coarse yak hair can be converted into value-added handicrafts, including hand-knotted carpets, wall hangings, and foot mats featuring traditional and contemporary designs. These products have an indicative price of ₹350 per square foot and offer opportunities for community-based artisan enterprises. Blending coarse yak fibre with jute and cotton can further expand its applications in yarns, fabrics, and textile products. Technologies developed by ICAR–National Research Centre on Yak, Dirang, Arunachal Pradesh, demonstrate the potential to manufacture products such as overcoats, jackets, half-jackets, and table linen. Claims of up to 1,000-fold improvement in the cost–benefit ratio through jute–yak wool blended fabrics require validation against production costs, yields, and market prices before commercial adoption.



Integrated farm resources and cultural heritage: Yak dung can support nutrient recycling through organic manure and, where appropriate, serve as fuel. Preserving traditional herding knowledge, seasonal grazing calendars, animal-care practices, local terminology, and customary institutions is equally important for sustaining the cultural heritage and ecological knowledge of highland communities.

Yak tourism and livelihood diversification: Community-led yak tourism can complement pastoral incomes through guided highland trails, responsible yak encounters, traditional food experiences, handicrafts, and demonstrations of pastoral practices. Such initiatives should involve herders and local institutions and prioritize animal welfare, ecological carrying capacity, biodiversity conservation, and respect for culturally significant landscapes.

6
Key Challenges for Sustainable Yak Pastoralism

Yak husbandry is a traditional livelihood across the Indian Himalayan highlands, including Ladakh, Uttarakhand, Himachal Pradesh, Arunachal Pradesh, the Darjeeling hills of West Bengal, and Sikkim. Deeply rooted in indigenous knowledge, religious beliefs, and community life, it supports pastoral livelihoods and preserves the cultural heritage of highland communities. However, climate change, changing socio-economic conditions, and limited livelihood opportunities have reduced interest in traditional yak rearing.

- **Limited representation and policy support:** Yak herders lack effective platforms to communicate their concerns and influence decision-making. Targeted investments and institutional support for pastoral livelihoods remain limited.
- **Inadequate technology and innovation:** Traditional tools, labour-intensive practices, and limited access to improved technologies constrain productivity, processing, and value-chain development.
- **Poor connectivity and infrastructure:** Inadequate roads and communication networks isolate herders dispersed across remote, rugged mountain terrain.
- **Substandard living conditions:** Inadequate shelter, unreliable energy supplies, and limited access to essential services complicate the lives of herders who migrate seasonally with their livestock.
- **Weak market linkages:** Limited value addition, branding, processing, and access to market centres reduce the returns from yak products.
- **Limited social services:** Inadequate access to education, healthcare, veterinary services, and other essential facilities affects community well-being and the continuity of pastoral livelihoods.



- **Rangeland degradation and fodder scarcity:** Shrinking grazing areas, deteriorating pastures, and inadequate winter fodder threaten livestock nutrition and productivity.
- **Climate change and disaster risks:** Rising temperatures, shifting snowfall patterns, extreme weather events, and increasing disaster risks disrupt seasonal migration and grazing practices.
- **Human–wildlife conflict:** Livestock losses to wild predators and problems associated with free-ranging and feral dogs create additional risks for herders.
- **Poor breeding resources:** Limited access to quality breeding animals and systematic breeding support constrains genetic improvement, reproductive performance, and yak productivity.

Addressing these interconnected challenges requires coordinated policy support, climate-resilient rangeland management, improved veterinary and breeding services, appropriate technology, stronger market linkages, and community-led planning that recognizes herders' traditional knowledge and priorities.



7
The Initiative: Formation of National Yak Federation of India

To understand these concerns, the G. B. Pant National Institute of Himalayan Environment (NIHE), Sikkim Regional Centre, led field explorations, community consultations, exhibitions, and regional workshops under the Khangchendzonga Landscape Conservation and Development Initiative (KLCDI)–India. The initiative was undertaken in collaboration with the International Centre for Integrated Mountain Development (ICIMOD) and the Animal Husbandry and Veterinary Services Department, Government of Sikkim. It engaged stakeholders from the animal husbandry departments of Sikkim and Ladakh, ICAR–National Research Centre on Yak, Arunachal Pradesh, and local Dzumsa institutions, with additional inputs from the Department of Livestock Services, Government of Nepal, and the Department of Livestock, Government of Bhutan. These consultations identified key constraints and highlighted priorities for collaborative action to sustain yak husbandry and strengthen highland livelihoods.







Desired outcome: A viable yak-based livelihood system that rewards good stewardship, strengthens local institutions and gives younger generations a reason to sustain highland knowledge.

The KLCDI-India programme provided a vital platform for bringing together yak herders, local communities, researchers, government departments and other stakeholders to promote sustainable yak husbandry and strengthen highland livelihoods across the Indian Himalayan Region. Through community engagement, transboundary yak germplasm exchange, knowledge sharing, stakeholder consultations and institutional networking, the programme fostered collaboration, collective learning and a shared vision for yak conservation and pastoral development. A significant milestone in this progression was the National Stakeholder Workshop for the Formation of the Indian Himalayan Yak Network, organized jointly by the G. B. Pant National Institute of Himalayan Environment (NIHE), Animal Husbandry and Veterinary Services Department, Government of Sikkim, and International Centre for Integrated Mountain Development (ICIMOD) in Gangtok (28–29 November 2024). The workshop brought together yak herders, representatives of state line departments and other stakeholders from across the IHR, providing a platform to recognize and strengthen state-level yak herders' associations and federations while advancing the vision of a coordinated national network. Building on this foundation, the Ashoka Trust for Research in Ecology and the Environment (ATREE) supported to the institutional development process by facilitating the formation of an Ad hoc Committee of the Yak Federation of India (YFI) and the drafting of an action plan during the Consultation Workshop on Strengthening Yak Pastoralism and Rangeland Network in India, held in Gangtok, Sikkim (1–2 September 2025).These initiatives progressively evolved from grassroots networking into a coordinated national movement, culminating in the announcement of the "National Yak Federation of India" on 9 November 2025. The Federation represents a significant collective outcome of this process, providing a national platform to strengthen stakeholder coordination, conserve indigenous yak genetic resources, promote climate-resilient yak husbandry, and advance sustainable livelihoods and the well-being of highland pastoral communities.



8
Action Plan: Highland Ecosystem Management for Sustainable Yak Pastoralism

Strategic action areas	Key actions and interventions	Time frame	Mapping of organizations/ Institutions
1. Integrated livelihood development	Partner with socially responsible private-sector enterprises to develop, brand and market yak products for niche markets; introduce labour-saving equipment to improve hygiene, product quality and diversification; promote yak-based ecotourism through festivals, homestays, herding trails and highland biodiversity experiences; strengthen extension services and artificial insemination for breed improvement; improve winter feed and nutrition management, including complete feed block technology; maintain pasture-specific databases of yak diseases and health issues.	Short to medium term	Department of Animal Husbandry & Veterinary Services (AH&VS), Sikkim; ICAR-NRCY; NIHE; Indian Yak Federation
2. Highland ecosystem management	Provide environment-friendly, cold-resistant herder tents with renewable energy; develop yak shelters with feed and fodder storage facilities; strengthen rangeland co-management by integrating traditional knowledge with scientific practices; promote community stewardship of high-value non-timber forest resources; facilitate stakeholder dialogue on grazing access and management with protected-area authorities, community forest user groups and local governments.	Medium to long term	AH&VS; ICAR-NRCY;NIHE, ATREE; Other relevant Institutions
3. Human–wildlife conflict management	Facilitate multi-stakeholder collaboration among livestock departments, border security forces, local governments and communities to manage feral dog populations in high-altitude rangelands; pilot community-based livestock insurance to compensate for losses caused by attacks from wild carnivores, including feral dogs.	Short to medium term	AH&VS; ICAR-NRCY; Indian Yak Federation; ATREE; Other relevant Institutions
4. Long-term environmental and socioecological monitoring	Establish long-term environmental and socioecological monitoring (LTESM) sites to assess grassland condition, rangeland carrying capacity and broader environmental and socioecological changes.	Long term	NIHE; ATREE; AH&VS; Other relevant Institutions
5. Strengthening yak herders' networks	Identify yak-rearing clusters and mobilize herders into groups, cooperatives and associations to improve collective action and bargaining power; consolidate local, district and state networks into a national community-based apex institution for yak conservation and welfare; connect the national network with neighboring countries to promote regional cooperation, knowledge exchange, policy dialogue, education and research.	Medium to long term	AH&VS, NIHE; ATREE; Indian Yak Federation; ICIMOD; Other relevant Institutions

9
Key Performance Indicators (KPIs) for the Action Plan on Sustainable Yak Pastoralism and Highland Ecosystem Management

The following KPIs translate the five strategic action areas into measurable indicators for monitoring implementation, assessing outcomes, and guiding adaptive management. The proposed targets are indicative and should be finalized in consultation with the concerned departments, yak herders, research institutions, and community organizations.

1. Integrated livelihood development

Key performance indicator	Target	Timeline	Means of verification
Yak product value chains developed through private-sector partnerships	Develop and commercialize at least 3 yak-based products or product lines	3 years	Partnership agreements, product catalogues, sales records
Hygienic processing and value-addition units established or upgraded	Establish or upgrade 2 units	2 years	Procurement records, facility inspection reports
Yak herders trained in processing, quality assurance and marketing	Train at least 50 herders, with participant records disaggregated by gender	2 years	Training registers, assessment reports
Community-based yak ecotourism products operationalized	Establish 2 pilot initiatives, each with a documented operating plan and community participation	3 years	Operating plans, visitor registers, tourism revenue records
Yak breeding and artificial insemination services strengthened	Deliver breeding and veterinary outreach services in at least 2 priority herding clusters annually	2 years	Service registers, breeding records
Improved winter nutrition practices demonstrated	Establish 2 feed and fodder management demonstrations, including complete feed blocks where feasible	2 years	Demonstration records, feed-use data
Pasture-specific yak health database established	Document disease occurrence, herd size and veterinary interventions in 100% of identified priority grazing areas	2 years; annual updates	Georeferenced database, veterinary reports
Income from yak-based livelihoods improved	Achieve at least a 15% increase in average annual yak-derived household income among participating households against baseline	5 years	Baseline and follow-up household surveys, sales records

2. Highland ecosystem management

Key performance indicator	Target	Timeline	Means of verification
Renewable-energy-equipped, cold-resistant herder tents deployed	Install 10 tents across selected high-altitude herding locations	3 years	Installation records, field inspections
Yak shelters with feed and fodder storage established or upgraded	Establish or upgrade 2 shelters	3 years	Completion reports, site inspections
Participatory rangeland co-management plans prepared and implemented	Prepare and implement 2 plans covering priority grazing areas	3 years	Approved plans, community resolutions, implementation reports
Grazing areas assessed for ecological condition and carrying capacity	Complete baseline assessments for 100% of selected priority grazing areas	3 years	Field assessment reports, geospatial maps
Sustainable grazing and rangeland restoration demonstrated	Implement 2 pilot interventions with measurable baseline and follow-up vegetation assessments	4 years	Vegetation surveys, grazing records, restoration reports
Community stewardship agreements for high-value non-timber forest products established	Establish 2 community stewardship agreements	3 years	Signed agreements, community management records
Grazing-access and protected-area coordination strengthened	Conduct at least 2 documented stakeholder consultations annually and record action taken on each agreed decision	Annual	Meeting minutes, action-taken reports

3. Human–wildlife conflict management

Key performance indicator	Target	Timeline	Means of verification
Multi-stakeholder coordination mechanism for livestock protection established	Establish 1 mechanism with designated representatives from relevant departments, security agencies, local governments and herder communities	1 year	Constitution order, membership list, meeting minutes
Feral dog populations and livestock predation risks assessed	Complete baseline assessments in 100% of selected priority grazing areas	2 years	Survey reports, georeferenced records
Coordinated feral dog management interventions implemented	Implement 2 pilot interventions in consultation with competent authorities and communities	3 years	Intervention records, veterinary and field reports
Community-based livestock insurance piloted	Operationalize 1 pilot insurance scheme with defined eligibility, premium, claims and settlement procedures	3 years	Scheme documents, enrolment and claims registers

Eligible herder households covered by the pilot insurance scheme	Enrol at least 50% of eligible households in the selected pilot area	3 years	Verified beneficiary register, policy records
Livestock losses and compensation claims documented	Record 100% of reported livestock-loss incidents in the pilot area, including cause, location and claim status	Annual	Incident database, veterinary verification, claims records
Livestock losses due to predation reduced	Reduce verified predation-related livestock losses by at least 20% from baseline in pilot areas	5 years	Comparable annual incident records and baseline assessment

4. Long-term environmental and socioecological monitoring

Key performance indicator	Target	Timeline	Means of verification
Long-term environmental and socioecological monitoring sites established	Establish 2 permanent monitoring sites representing contrasting high-altitude rangeland conditions	3 years	Site coordinates, installation records, monitoring protocols
Ecological and socioeconomic baselines completed	Complete baseline assessments at 100% of established sites, covering vegetation, soil, grazing pressure, yak populations and herder livelihoods	3 years	Baseline reports, survey datasets
Standardized monitoring protocol adopted	Develop and implement 1 protocol covering ecological, climatic, livestock and socioeconomic indicators	2 years	Approved protocol, institutional records
Annual monitoring completed	Complete at least 1 standardized monitoring cycle per site per year	Annually after establishment	Field sheets, laboratory results, datasets
Rangeland carrying capacity and seasonal fodder availability quantified	Generate annual estimates for 100% of monitored sites	Annually after baseline	Biomass measurements, carrying-capacity assessment reports
Long-term monitoring reports produced	Publish 1 consolidated monitoring report annually	Annually after monitoring begins	Technical reports, institutional publications
Monitoring evidence incorporated into management decisions	Review monitoring findings annually and document at least 2 management decisions or corrective actions over 5 years	5 years	Review minutes, revised management plans, action-taken reports

5. Strengthening yak herders' networks

Key performance indicator	Target	Timeline	Means of verification
Yak-rearing clusters mapped and documented	Map 100% of identified yak-rearing clusters in the target landscape	1 year	GIS maps, verified cluster database
Community-based herder groups established or strengthened	Establish or strengthen at least 3 functional groups	2 years	Membership registers, meeting records, group action plans
District- and state-level coordination networks established	Operationalize 1 coordination network at each relevant administrative level	3 years	Constitutive records, membership lists, meeting minutes
National community-based apex institution for yak conservation and welfare established or strengthened	Develop and adopt 1 institutional framework with representation from relevant yak-herding regions	5 years	Constitution, membership records, governance documents
Regional cooperation and knowledge exchange promoted	Organize at least 1 regional knowledge-exchange or policy dialogue event annually	Annually after network formation	Event reports, participant lists, proceedings
Herder capacity-building programmes delivered	Conduct at least 2 programmes annually, covering animal health, livelihoods and rangeland management	Annually	Training reports, attendance and assessment records
Women and young people represented in herder organizations	Record gender- and age-disaggregated membership and increase their representation by at least 10 percentage points against baseline in participating groups	5 years	Membership registers, baseline and follow-up records
Herder recommendations communicated to policymakers	Submit at least 2 documented community recommendations annually to relevant authorities	Annually after network formation	Submitted memoranda, official correspondence, action-taken reports



10
Way Forward

Climate change is increasing uncertainty in highland pastoral systems. Rising temperatures, shifting snowfall and rainfall patterns, extreme weather events, and changes in vegetation can affect forage availability, water resources, animal health, and access to seasonal grazing routes. Addressing these challenges requires an integrated, community-led approach that combines traditional ecological knowledge and herders' observations with scientific monitoring, adaptive management, and regular assessment. The following priority actions should be initiated to strengthen the resilience of yak husbandry, secure pastoral livelihoods, and conserve highland ecosystems.

- **Document:** Establish community-supported databases of yak-herding households, herd composition, seasonal migration routes, grazing patterns, animal health, breeding practices, product sales, and livelihood needs, while safeguarding sensitive personal and customary information.
- **Monitor:** Integrate herders' observations, repeat field surveys, photographic monitoring, vegetation plots, and geospatial data to track changes in rangeland condition, high-altitude wetlands, snowfall, water availability, and seasonal migration routes. Use the findings to guide timely management interventions.
- **Prepare:** Develop locally appropriate contingency and disaster preparedness plans for extreme weather, heavy snowfall, fodder shortages, disease outbreaks, livestock losses, and transport disruptions. Identify emergency fodder sources, veterinary support, safe shelters, and communication arrangements.
- **Invest:** Prioritize community-identified needs, including veterinary outreach, quality breeding services, reliable water and energy supplies, appropriate shelters, communication facilities, fodder storage, product processing, and small-scale infrastructure. Strengthen skills, entrepreneurship, and market access, particularly for women and young people.
- **Coordinate:** Establish regular coordination among yak herders, Dzumsa and other village institutions, the Department of Animal Husbandry and Veterinary Services, forest and conservation authorities, local government bodies, research institutions, and relevant development agencies. Ensure that herders participate meaningfully in planning, implementation, and benefit-sharing.
- **Conserve and restore:** Promote sustainable seasonal and rotational grazing, where ecologically appropriate, alongside pasture restoration, protection of water sources, and assessment of rangeland carrying capacity. Integrate livestock health, predator-conflict mitigation, and responsible management of free-ranging dogs into local action plans.
- **Diversify:** Support value addition to yak milk and fibre, traditional handicrafts, community-based tourism, and other locally appropriate enterprises to improve incomes and reduce dependence on a single livelihood source.
- **Learn and adapt:** Review ecological, livestock, and livelihood indicators annually, document successful practices, and adjust grazing strategies, conservation measures, and enterprise support based on evidence and community feedback.
- **Implementation priority:** Initiate participatory baseline documentation, climate-risk assessment, and stakeholder coordination immediately, followed by targeted pilot interventions and periodic evaluation. This phased approach can strengthen climate resilience, sustain yak-based livelihoods, preserve cultural heritage, and maintain the ecological integrity of the Khangchendzonga Landscape.

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G. B. Pant National Institute of Himalayan Environment (NIHE)
Sikkim Regional Centre, Pangthang, Gangtok, Sikkim

Ashoka Trust for Research in Ecology and the Environment (ATREE)
Regional Office,Tadong, Gangtok, Sikkim

Animal Husbandry and Veterinary Services Department
Government of Sikkim, Tadong, Gangtok, Sikkim

For Further information, contact

Director
G.B. Pant National Institute of Himalayan Environment (NIHE)
Kosi-Katarmal, Almora, Uttarakhand - 263643 Email:psdir@gbpihed.nic.in

Regional Central Head
G.B. Pant National Institute of Himalayan Environment (NIHE)
Sikkim Regional Centre, Pangthang, Gangtok - 737101, Sikkim, India
Email:dr.rajeshjoshi@gmail.com

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