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New Markets for Pastoralism

A Project Report focusing on the
Changthang Plateau, Ladakh

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Centre for
Pastoralism

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**New Markets for Pastoralism: A Project Report focusing
on the Changthang Plateau, Ladakh**

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Contents

<i>The Economy of Goat Hair and Manure</i>	<i>2</i>
<i>Pastoral Mobility in Changthang Landscape</i>	<i>2</i>
<i>Goat Hair Insulation Initiative</i>	<i>3</i>
<i>Changing Pastoral Economies and Livelihood Diversification.....</i>	<i>5</i>
<i>Constraints, Uncertainty, and Experimental Enterprise Development</i>	<i>8</i>
<i>Manure Production Initiative</i>	<i>10</i>
<i>Manure Production in Changthang</i>	<i>11</i>
<i>Landscape Governance and the Monetisation of Manure</i>	<i>13</i>

The Economy of Goat Hair and Manure

Goat hair and livestock manure have long been important by-products of pastoral life in Ladakh, especially among the Changpa communities of the Changthang region. In the past, goat hair was commonly used to make ropes, tents, carpets, bags, and blankets that were well suited to Ladakh's cold and dry climate. At the same time, manure from goats, sheep, and yaks played an essential role as both a household fuel and a natural fertilizer for agriculture. Over the years, however, the use of goat hair has declined as synthetic materials such as nylon and polyester became more widely available, and much of the hair that was once collected is now left unused. Similarly, although livestock manure remains abundant, much of its potential economic value

has not been fully realised due to the absence of organized systems for processing and distribution. This report examines how these two pastoral by-products-goat hair and manure-can be better utilized in Ladakh's changing economy. Drawing on research and pilot initiatives by the Centre for Pastoralism (CfP) in collaboration with the Himalayan Institute of Alternatives, Ladakh (HIAL), it explores the potential of goat hair as a natural insulation material for eco-friendly construction and highlights the growing opportunities to market livestock manure for organic agriculture. Together, these initiatives demonstrate how materials that are currently underused can support rural livelihoods, local entrepreneurship, and more sustainable resource use in Ladakh.

Pastoral Mobility the Changthang Landscape

The pastoral economy of Changthang is inseparable from the landscape and migratory systems that sustain it. The Changpa pastoralists of eastern Ladakh practice seasonal mobility across extensive rangelands in one of the harshest inhabited environments in the Himalaya. Migration is not simply a cultural tradition or occupational characteristic, but the central mechanism through which grazing pressure, water access, herd survival, and rangeland regeneration are managed across the landscape.

Unlike many pastoral systems in the western Himalaya that depend on vertical migration between lowland and alpine pastures, Changpa migration occurs horizontally across large stretches of the Changthang plateau. Since the

plateau experiences broadly similar climatic conditions across much of the region, pastoralists move strategically between rangelands at different stages of vegetation growth rather than moving between distinct climatic zones. During summer months, herders migrate toward distant high-altitude pastures that become inaccessible during winter snowfall, while colder months involve gradual movement back toward areas closer to permanent village settlements. This cyclical movement prevents overgrazing in any single area and allows pasture systems time to regenerate.

Migration routes and pasture access are collectively governed through longstanding customary systems. Most pastures in Changthang are treated as community-managed resources,

with each village historically associated with distinct migration corridors and grazing territories. Seasonal movement patterns are determined collectively through local governance institutions such as the Goba system, which regulates access, timing, and movement between pasture areas. Pastoralists also maintain alternative migration routes that may be used during periods of drought, snowstorms, or sudden ecological stress. Migration therefore requires continuous planning around water access, grazing availability, climatic conditions, herd health, and seasonal risk.

Historically, mobility structured nearly all aspects of Changpa social life. Before the expansion of permanent settlements and road infrastructure, migration involved the movement of entire households across the landscape. Traditional yak-hair tents, household goods, food supplies, children, elders, and weak animals all travelled together during seasonal movement.

Yaks and horses formed the primary transport system, carrying both material goods and people

schools that travelled alongside pastoral families during migration periods. schools that travelled alongside pastoral families during migration periods.

Over the last several decades, however, pastoral mobility in Changthang has undergone substantial transformation. Road construction, initially driven by military infrastructure development near the Tibetan border, altered many traditional migration corridors and facilitated the growing use of motor vehicles during seasonal movement. At the same time, tourism expansion around destinations such as Pangong Lake and Tso Moriri created new livelihood opportunities linked to transport, hospitality, guiding, and trade. These changes gradually increased forms of partial sedentarisation within the region, with many households combining pastoralism with more settled economic activities. The changing role of pastoral by-products such as goat hair and manure must therefore be understood within this broader context of infrastructural transformation, market integration, and livelihood diversification in Changthang.

Goat Hair Insulation Initiative

Historically, goat hair occupied an important place within Changpa material life. The coarse outer fibre separated during pashmina combing was traditionally woven into ropes, blankets, saddlebags, carpets, and tents specifically adapted to Ladakh's cold desert environment. These products were valued not as secondary crafts but as essential components of pastoral infrastructure suited to mobility, insulation, and durability in high-altitude conditions. However, the increasing availability of synthetic materials such as nylon and polyester gradually displaced many of these traditional uses often discarded during pashmina processing or left unused in animal pens.

The goat hair initiative therefore emerged not from the discovery of a new raw material, but from the re-evaluation of an existing pastoral by-product whose economic and material significance had declined under changing market conditions. In this sense, the intervention attempts to reconnect traditional pastoral materials with contemporary ecological and architectural demands. Rather than introducing an entirely external enterprise model, the initiative builds upon knowledge systems and resource practices already embedded within pastoral life while exploring their relevance within newer low-carbon construction and insulation markets.

Recent research by the Centre for Pastoralism (CfP), conducted in collaboration with the Himalayan Institute of Alternatives, Ladakh (HIAL), has sought to revive interest in goat hair by repositioning it as a natural, climate-appropriate material for contemporary use. Building on HIAL's long-standing innovations in passive solar architecture and low-energy construction, this initiative explores the potential of goat hair as a sustainable insulation material. The intervention seeks to reconnect a fading traditional resource with modern ecological design principles and the growing demand for green construction solutions in Ladakh's cold desert context. While initially HIAL had demonstrated interest in wanting to procure goat hair, this part of the project is currently on hold.

In parallel, CfP's economic and market survey identified yak, goat, and sheep manure - another abundant by-product of pastoralism - as a largely untapped resource with substantial economic potential. Based on estimates derived from the 2024 livestock census, the manure economy in Ladakh is valued at approximately ₹19 crore annually.



The initiative builds upon knowledge systems and resource practices already embedded within pastoral life while exploring their relevance within newer low-carbon construction and insulation.



Rather than introducing a new raw material, the goat hair initiative reimagined an existing pastoral by-product whose economic significance had diminished with changing market conditions.

Demand for organic manure is particularly strong in Ladakh's agricultural belt, where farmers are actively seeking alternatives to chemical fertilizers in alignment with the "Organic Ladakh 2025" vision articulated by the Ladakh Autonomous Hill Development Council (LAHDC), Leh. Despite this clear demand, no organized value chain currently exists to connect pastoral producers with agricultural users. In response, CfP is supporting two local entrepreneurs to pilot a business model that aggregates, processes, and markets livestock manure for organic agriculture. Together, these two interventions, reviving goat hair as a green building material and commercializing manure for organic farming, aim to reimagine pastoral by-products as drivers of rural entrepreneurship, livelihood diversification, and ecological sustainability. To support viability at the community level, CfP has conducted vermi-composting and goat hair insulation workshops with Changpa women, enabling them to add value to raw materials already available in abundance within the landscape and derive supplementary income from existing pastoral practices.

Changing Pastoral Economies and Livelihood Diversification

The emergence of goat hair and manure enterprises in Changthang cannot be understood independently of broader economic and infrastructural transformations occurring across the region. Over the last several decades, pastoral livelihoods in Ladakh have increasingly been shaped by road expansion, market integration, military infrastructure development, tourism growth, and new forms of education and wage employment. These processes have altered both the practice of pastoralism itself and the economic value associated with different pastoral products.

Historically, many pastoral by-products such as goat hair, yak dung, and animal manure were integrated directly into household economies through everyday use. Goat hair was woven into household items, yak dung and manure functioned as fuel sources, and mobility systems were sustained through locally adapted material infrastructures. As households increasingly gained access to industrial goods, fossil fuels, commercial transport systems, and manufactured materials, many of these by-products lost their direct household utility despite remaining abundant within the landscape. Consequently, materials that once circulated within pastoral economies became progressively categorised as waste or low-value residue.

At the same time, Changthang households increasingly began engaging in supplementary livelihoods connected to tourism, transport services, small trade, wage employment, and government work. While pastoralism remains central to Changpa identity and household economies, many families now combine

livestock herding with more sedentary forms of income generation. This gradual diversification has also altered labour availability within pastoral households, particularly for activities such as fibre processing, material collection, and seasonal migration.

The goat hair and manure initiatives emerged within this context of economic transition. Both interventions attempt to identify forms of value that remain embedded within pastoral systems but are no longer fully recognised or organised economically. In doing so, they seek not to replace pastoralism with alternative livelihoods, but to strengthen existing pastoral economies by reorganising underutilised by-products into potentially marketable resources. The interventions therefore represent efforts to adapt pastoral production systems to changing material economies while remaining grounded within the ecological realities of Changthang.

Objective of the Controlled Experiment

Before engaging potential buyers or scaling production, it was necessary to establish technical and economic feasibility. In particular, two key aspects required empirical validation:

- **Material Recovery Rate:** How much usable insulation-grade fibre can be obtained from raw, unprocessed goat hair?
- **Production Economics:** What is the realistic per-kilogram price for treated goat hair suitable for use as insulation in buildings?

Given that unprocessed goat hair collected from herders typically contains dirt and other impurities, understanding the post-processing yield was essential for accurate pricing and business plans. To address these questions, CfP conducted a controlled outcome experiment

simulating small scale production in Ladakh. The findings form the basis for price discussions and enterprise modelling.

Controlled Outcome Experiment - Process

The experiment began with 10 kg of raw goat hair, weighed using a digital weighing machine prior to any processing. The hair was procured directly from herders and had not undergone prior sorting or cleaning. The raw hair was then fed into a fibre shredding machine, a process that loosens and opens the fibres to increase volume-an essential characteristic of effective insulation materials. During shredding, a substantial amount of dust and fine debris was released.

After shredding, the material was weighed again. The initial 10 kg of raw goat hair was reduced to 6.6 kg, indicating a loss of 3.4 kg at this stage. The shredded hair was subsequently dipped into a borax solution, a standard treatment used to impart insect- and moth-repellent properties when the material is installed in buildings. Care was taken not to squeeze the hair beyond the natural dripping of the solution, as excessive squeezing can remove the chemical treatment from the fibers.



Shredded goat hair being dipped in borax solution to make it insect repellent.

Following chemical treatment, the hair was laid out in the open for natural sun-drying. Artificial heating was deliberately avoided, as exposure to high heat shortens fibre life and degrades performance. In Ladakh, where there are approximately 300 days of sunshine annually, natural sun drying is both practical and ecologically appropriate. Once fully dried, the treated hair weighed 6.6 kg, confirming a total loss of 34% from the original raw weight. Once dried, the insulation material is ready for use and can be installed by blowing or manual placement into wall cavities and ceilings. Owing to its natural thermal and hygroscopic properties, goat hair insulation performs comparably, and in certain conditions better, than many synthetic insulation materials, while remaining biodegradable and locally sourced. The final output of the experiment therefore yielded 6.6 kg of insulation-grade goat hair from an initial 10 kg of raw material. This recovery rate formed the basis for pricing discussions and market engagement.

Disclaimer: The goat hair used in this experiment was procured directly from herders without prior sorting or cleaning and contained significant amounts of dirt and manure. Introducing sorting before shredding is expected to reduce material loss and improve overall recovery rates.

Key Results:

- Initial raw input: 10 kg
- Final usable output: 6.6 kg
- Total material loss: 34%
- Recovery rate: 66%

This recovery rate forms the basis for cost calculations and pricing discussions.



With its natural thermal and hygroscopic properties, goat hair offers insulation comparable to - and in some conditions better than - many synthetic materials, while being biodegradable and locally sourced.

Market-Driven Business Plan for Goat Hair Insulation

- This business plan outlined a small-scale but viable opportunity to convert currently unused goat hair in the Changthang region into building insulation. The model offers supplemental income opportunities for herders and micro-entrepreneurs with relatively low capital investment. While limited in scale, the initiative aligns strongly with Ladakh's circular economy objectives and sustainability goals.
- The model draws on three primary sources of raw material: (1) goat skins from slaughtered animals, (2) by-product hair from pashmina cooperatives, and (3) hair collected from animal pens through regular brushing. Through basic cleaning, shredding, and chemical treatment, this material can be upgraded into insulation-grade fibre suitable for eco-construction.

Constraints, Uncertainty and Experimental Enterprise Development

While the goat hair insulation initiative demonstrates promising technical and economic potential, the intervention remains exploratory and subject to significant uncertainty. At present, the enterprise model depends heavily on the development of stable institutional demand, consistent supply systems, and viable transport networks across a geographically dispersed pastoral landscape. The initiative should therefore be understood not as a fully established market system, but as an ongoing experiment in pastoral value addition under conditions of infrastructural and ecological constraint.

One major limitation is the current dependence on a small number of institutional buyers. Although the Himalayan Institute of Alternatives, Ladakh (HIAL) initially expressed strong interest in procuring goat hair insulation for low-energy construction projects, procurement discussions remain subject to changing institutional priorities and project timelines. This creates uncertainty regarding long-term demand stability and raises broader questions about market diversification and scalability. At present, the absence of multiple confirmed buyers limits the extent to which large-scale collection systems can be reliably organised.

Supply consistency also remains uneven. The availability of goat hair fluctuates seasonally according to migration cycles, pashmina combing periods, livestock mortality, and household labour availability. The quality and cleanliness of raw goat hair additionally varies considerably depending on collection methods, storage conditions, and whether material is sourced from animal pens, slaughtered skins, or pashmina-processing by-products. Experimental processing further revealed that substantial quantities of raw material are lost

during shredding and cleaning due to the presence of dust, manure, and debris. These factors complicate standardisation and pricing.

Transportation and processing infrastructure remain additional constraints. Collection sites are distributed across remote areas of Changthang with limited storage facilities and uneven road connectivity. The movement of low-value bulk materials such as manure and untreated fibre over long distances generates substantial transport costs relative to product value. In practice, many collection and transport activities currently depend on informal arrangements, shared transport systems, and opportunistic coordination with traders already travelling toward Leh. These constraints highlight the extent to which pastoral enterprise development in Changthang remains shaped by logistical, ecological, and institutional realities that cannot be resolved through production interventions alone. The initiative therefore illustrates both the possibilities and limitations involved in attempting to reorganise underutilised pastoral materials into viable market systems.

Supply and Demand Overview

Estimated Annual Raw Supply

Source	Estimated Quantity of Raw Materials
Slaughtered goats (26,880 animals)	9,408 kg/year
Pashmina by-product	30,000 kg/year
Pen-collected hair	67,200 kg/year
Total Estimated Supply	106,600 kg/year

Confirmed Demand

- HIAL insulation requirement: 60,000 kg over two years (30,000 kg/year). However, while initially HIAL had shown interest in procuring goat hair for insulation, currently this project is on hold.
- Coverage rate: 1 kg of goat hair insulates approximately 1 sq ft (8-inch thickness)
- Purchase price: ₹50/kg for treated insulation-grade hair

Enterprise Model

Entrepreneurs source raw goat hair from the three identified streams, clean and treat it using boric acid, and deliver finished insulation material to HIAL or future buyers.

Unit Economics (Per Kilogram)

Component	₹ per kg
Raw hair procurement	₹12/kg
Processing costs: transport, cleaning, treatment	₹23/kg
Total Cost	₹35/kg
Sale price	₹50/kg
Net Margin	₹15/kg

Margins may increase to ₹25/kg if higher market prices are secured.

Earnings Potential

- Annual processing volume: 20,000-40,000 kg
- Annual entrepreneur profit: ₹3-10 lakh
- Collective herder income: ~₹5 lakh/year
- Total sector value: ~₹25 lakh/year

Infrastructure Requirements

- Drying racks and cleaning space
- Boric acid treatment setup

- Storage sacks and transport access Potential shared use of pashmina cooperative or HIAL facilities

Key Risks

- Dependence on a single institutional buyer (HIAL)
- Seasonal supply fluctuations due to migration
- Variable cleanliness and fibre quality
- Lack of institutional acceptance of goat hair as a viable insulation material

Mitigation Strategies

- Partnering with pashmina cooperatives for supply stability
- Cash incentives to encourage systematic hair collection
- Exploring additional buyers (private eco-builders, NGOs)
- Piloting quality control and moisture management protocols

Sustainability and Next Steps

The goat hair insulation initiative reinforces Ladakh's broader goals of self-reliance, low-carbon development, and waste valorization. With minimal infrastructure and energy requirements, the model complements manure-based enterprises and could share logistics and processing facilities. With scale, the initiative may expand into additional felted or fibre-based products.

Immediate next steps include confirming multi-year demand commitments from HIAL, identifying one to two motivated entrepreneurs for pilot implementation, finalizing cleaning and treatment protocols, mapping seasonal supply patterns during migration, and seeking government or donor support for basic infrastructure.

Insights

The goat hair insulation model supports one to two micro-entrepreneurs with annual profits ranging from ₹3–10 lakh, depending on scale. Risk remains relatively low due to minimal upfront investment and confirmed institutional demand, though scalability is constrained by reliance on a single buyer. Herders gain modest but meaningful supplemental income from

waste material collection, and the enterprise is well-suited for women's groups or self-help collectives. Importantly, the initiative revives a near-abandoned pastoral practice by adapting it to contemporary ecological and economic contexts, with potential for further evolution as markets and infrastructure develop.

Manure Production Initiative

Manure is a natural by-product of livestock digestion, composed of both urine and feces. It serves two essential purposes: first, for domestic use as a fuel source, and second, in agriculture to improve soil fertility. The production of manure is directly linked to livestock rearing, and as animal farming continues, so does the accumulation of manure. In recent years, there has been growing awareness and a shift toward organic agricultural practices worldwide.

This movement is steering farming practices away from chemical fertilizers and pesticides and focusing instead on organic manure. The use of organic manure has improved soil health, increasing soil organic matter from medium to high levels on cultivated lands. This shift is contributing to more sustainable farming systems, aligning with global trends toward environmentally friendly agriculture.



Increasing awareness of sustainable farming has led to a greater emphasis on organic manure as an alternative to chemical fertilizers and pesticides.

Ladakh is an important agriculture region despite its harsh climatic conditions, where short growing seasons and limited precipitation challenge local farmers. Agriculture is the most prominent occupation of the people of Ladakh and also the main source of income, with barley, wheat, mustard oil, buck wheat, peas, and potatoes being

the principal crop. In addition, Ladakh farmers also cultivate a variety of fruit and nut trees. They have used only organic manure, maintaining the purity of their produce by avoiding fertilizers and pesticides. The use of organic manure has proven to be not just a preference but a necessity, contributing to the unique taste and the quality of Ladakh produce.

Manure Production in Changthang

The Changthang region, located in the eastern part of Ladakh is primarily inhabited by nomadic pastoralists. The extreme cold and arid climate limit conventional agricultural activities, but the region is home to large herds of livestock, including yaks, goats, and sheep. According to a 2022-23 survey conducted by the regional administration. The livestock population includes 2,53,740 goats, 1,84,148 sheep and 23,733 yak. Pashmina goats are in the highest number in the Changthang region. The manure produced by these animals play a critical role in local agriculture practices due to its high nutrient content. Goat and sheep manure

in particular contains a high concentration of nitrogen, making it a valuable organic fertilizer. Yak dung on the other hand, is rich in carbon and contains essential nutrients like phosphorus, potassium, iron and zinc, making it an effective soil amendment. Despite the availability of this nutrient-rich manure, there has been a long-standing issue of underutilization in the Changthang region.

Many factors contribute to this problem, including a lack of market information and access, absence of a minimum support price for organic products, and limited knowledge of improved composting techniques. As a result, much of the manure remains unused or is not distributed effectively to agricultural regions across Ladakh. Additionally, the non availability of recommended practices for manure processing has further hindered its efficient use.

In recent times, modern manure management techniques, such as composting and vermicomposting, have been introduced to the region. These methods not only enhance the nutrient content of manure but also increase its marketability, offering pastoralists a new source of income. raining programs have been initiated to teach improved composting techniques, enabling the community to add value to their manure and contribute to sustainable agricultural practices.



Lack of market information and access, absence of minimum support price for organic products, and limited knowledge of improved composting techniques are responsible for the underutilization of nutrient rich manure in the Changthang region.

Average Manure Production

Animal	Average Weight (in kg)	Daily Production (in kg)	Monthly Production (in kg)	Yearly Production (in kg)
Goat	35-45	1.4-1.8	42-54	511-657
Sheep	40-50	1.65-2.15	49.5-64.5	603-784
Yak	-	1.68-2.22	50.4-66.6	613-810

Economic Potential

Changthang, with a livestock population of 268,800 goats and sheep, produces approximately 8,064,000 kg of manure per month. Since the animals spend nearly 12 hours grazing in the landscape, about 50% of the manure (4,032,000 kg) is deposited directly onto pastures. The remaining 50% (4,032,000 kg) is collected in animal pens.

Of the manure collected in pens:

- 25% (1,008,000 kg) is used as rikpa (dried manure drops)
- 25% (1,008,000 kg) is processed into rikpa (rammed and solidified manure used as firewood)
- The remaining 50% (2,016,000 kg per month) is available for agricultural use as organic manure

Annual Availability

On an annual basis:

- $2,016,000 \text{ kg} \times 12 \text{ months} = 24,192,000 \text{ kg}$
This equals 24,192 tons of manure per year available for agricultural application.

Economic Value

If sold at the current informal market rate of Rs 3 per kilogram, the total annual economic value would be:

- $24,192,000 \text{ kg} \times \text{Rs } 3 = \text{Rs } 72,576,000$
- Equivalent to **Rs 7.26 crore** per year

Landscape Governance and the Monetisation of Manure

The increasing commercial interest in livestock manure has also generated new discussions around ownership, regulation, and control over pastoral resources within Changthang. Historically, manure functioned primarily as a locally used resource associated with household fuel systems and small scale agricultural practices. However, as manure began acquiring greater commercial value through emerging organic agriculture markets, communities increasingly started negotiating how access, extraction, and sale should be governed collectively.

One notable example emerged in Kargyam village, where community consultations around manure commercialisation led village leadership to formally discuss pricing systems, extraction rules, and penalties related to manure collection and sale. Public notices issued following village meetings established locally recognised rates for manure transport and introduced penalties for unauthorised extraction by outsiders. The declarations also framed manure reserves within the valley as collectively governed resources associated with the wider community rather than as entirely individual property.

These developments are significant because they demonstrate that pastoral by-products are not merely market commodities but are embedded within systems of customary governance, territorial control, and collective resource management. The process of monetisation therefore does not simply create economic opportunity; it also reshapes how communities define ownership, regulate access, and negotiate control over resources that were previously treated as abundant or informally shared.

The manure initiative consequently reveals that livelihood diversification within pastoral systems

is closely tied to evolving forms of commons governance. As previously underutilised resources acquire market value, communities may increasingly seek to regulate extraction, protect local control, and negotiate terms of participation in emerging markets. These dynamics suggest that future pastoral enterprise development will likely depend as much on governance arrangements and institutional legitimacy as on technical feasibility or market demand alone.

Key Challenges

One of the major challenges that the initiative has encountered is the costs incurred in the transportation of packaged manure sacks to distribution centres in Leh, that are quite far away from the sites where collection and packaging of manure in Changthang takes place. Due to a lack of concrete roads for heavy transportation, pastoralists have to rely on informal support and tie up with Wother kinds of traders moving towards Leh to cut costs.

Conclusion

Taken together, the goat hair and manure initiatives suggest that pastoral economies in Changthang already contain substantial forms of latent value that often remain unrecognised within conventional market systems. The challenge is not necessarily the absence of economically useful materials, but rather the lack of infrastructure, market organisation, processing systems, and institutional support capable of connecting these resources to wider demand. This became especially visible in the case of manure, where Changthang produces large quantities of nutrient-rich organic material while agricultural regions elsewhere in Ladakh simultaneously depend on imported compost



As the market value of previously underutilised resources increases, communities may increasingly regulate their extraction, strengthen local governance and negotiate equitable participation in emerging markets.

and fertiliser inputs. Similarly, goat hair that was once deeply integrated into pastoral material life is now often discarded despite growing interest in biodegradable insulation and low-carbon construction materials. In both cases, the core issue is less of production scarcity than of spatial disconnection between resource-rich pastoral landscapes and emerging ecological markets. At the same time, the interventions also demonstrate the uncertainties involved in reorganising pastoral by-products into contemporary enterprise systems.

Questions of transport, seasonality, labour, institutional demand, commons governance, and market stability remain unresolved and continue to shape the viability of such initiatives. The projects should therefore be understood not as fixed enterprise models ready for rapid replication, but as ongoing efforts to explore how pastoral systems might adapt to changing material economies while remaining ecologically grounded within the realities of Changthang pastoral life.





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