



Innovative interventions and inspiring stories from the Khangchendzonga Landscape

KHANGCHENDZONGA LANDSCAPE CONSERVATION AND DEVELOPMENT INITIATIVE (Phase-I)



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Message from the Director, GBPNIHE



The Khangchenzonga Landscape (KL), a Himalayan biodiversity hotspot, spreads across Bhutan, India, and Nepal. With its high natural and cultural significance, it has been identified as

one among 17 priority conservation landscapes in the Eastern Himalaya. And although there are several challenges to meeting the conservation and development needs of the landscape, there are also collective opportunities built around common transboundary interests. Realizing this, the Khangchenzonga Landscape Conservation and Development Initiative (KLCDI) was initiated in 2013 to address the common issues faced by the three countries using a landscape approach.

In India, the KLCDI programme is being implemented by the G.B. Pant National Institute of Himalayan Environment (NIHE) as a lead institute under the guidance of the Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India. This is being done in collaboration with multiple partners with an aim to ensure ecosystem management, sustainable livelihoods, and ecological resilience in the landscape. This programme is supported by the International Centre for Integrated Mountain Development (ICIMOD), Nepal.

During the first implementation phase of KLCDI (2017–2021), several activities were initiated by the Sikkim Regional Centre (SRC) of NIHE at the pilot level in three identified sites – Dzongu, Barsey-Singalila, and Bandapani. During this five-year duration, the SRC of NIHE initiated various successful interventions and initiatives in KL-India

[e.g. ecotourism, integrated livelihood models, knowledge networking for large cardamom and yak, women entrepreneurship, intervention in dairy farming, introduction of yacon (*Smallanthus sonchifolius*) as an alternative measure for human-wildlife conflict, promotion of indigenous practices, solid waste management, and development of long term monitoring sites]. I am glad that documentation on these successful interventions is being brought out in the form of these success stories. I believe these stories will act as records of the innovative interventions implemented under the programme and of the successes we have experienced in scaling up and scaling out our interventions – from the pilot level to the landscape level.

As Director of NIHE and the National Coordinator for KLCDI-India, I thank all the partner organizations, line departments, local committees, and self-help groups of the landscape who have contributed to the implementation of the programme's interventions. The authors of these success stories and the team from KLCDI-India deserve special thanks for leading this task and spending days and nights in remote pilot sites to accomplish activities and capture related stories. I would also like to thank Tashi Dorji for his utmost support and guidance towards making this publication possible.

I hope all the stakeholders of KLCDI will enjoy reading these success stories and that the interventions described here might motivate us all.

Kireet Kumar
Director, GBPNIHE

Foreword from the Director General, ICIMOD



The Khangchendzonga Landscape (KL) is very special for many reasons. It has very high biological and cultural diversity and there are many shared aspects of this diversity that unify parts of the three countries that

constitute this landscape. However, there are also many shared risks and challenges that threaten the ecosystems, people, and livelihoods in the landscape.

The Khangchendzonga Landscape Conservation and Development Initiative (KLCDI) is an excellent example of transboundary cooperation to address these shared concerns and threats. It brings together a diverse set of stakeholders – from government agencies to research institutions, NGOs, and community institutions – to address a range of issues from human–wildlife conflict to improved livelihoods, preservation of traditional knowledge and skills, and community-based tourism.

I am happy to see the suite of interventions that have been undertaken across the landscape to develop and demonstrate viable, scalable models that advance conservation and sustainable development. The success stories in this compilation are proof that this partnership across the landscape works and that we need more collaboration and sharing of knowledge and good practices, especially to address the emerging

challenges that threaten us all. We have so much in common that sharing and adapting these models across the landscape is far easier than adapting models that have been tried and tested in very different contexts.

The theme of this year's International Mountain Day is sustainable mountain tourism. Sustainable tourism in mountains can contribute to creating alternative livelihood opportunities and alleviating poverty, and support social inclusion as well as landscape and biodiversity conservation. Sustainable community-based conservation can also help conserve the natural and cultural heritage of the landscape, promote local crafts and niche products, and profile and celebrate the traditional knowledge and practices of indigenous communities. I see that interventions in community-based tourism and promotion of local handicrafts and large cardamom are among the KLCDI success stories that we are celebrating as part of International Mountain Day this year.

I would like to commend the G.B. Pant National Institute of Himalayan Environment (GBPNIHE), the lead institute for implementation of KLCDI in India, and its partners for achieving these successes in the KL-India part. Let us celebrate these successes – and share the experience and learning so that others in the landscape can benefit.

Pema Gyamtsho
Director General
ICIMOD





STORY ONE

Homestays lead Dzongu's community-based ecotourism growth

Authors: Santosh K. Chettri, Kailash S. Gaira, Rajesh Joshi, GB Pant National Institute of Himalayan Environment, Sikkim Regional Centre

Dzongu village in North Sikkim, India, lies within the transition zone of one of the highest protected ecosystems, the Khangchendzonga Biosphere Reserve. With its rich biodiversity and culture, Dzongu has largely contributed to the recent inscription of the Khangchendzonga National Park as a World Heritage Site.

Dzongu has been a designated reserve for the Lepchas, the indigenous people of the area, since the rule of the Chogyals in the 1960s. It was treated as a separate estate, administrated by a regional head (*kazi*) and comprised 12 villages (administrative divisions) each with a *mandal* as the head. The combination of ethnic culture, the rural setting, proximity to the wilderness, rich faunal and floral resources, and the picturesque beauty of the landscape make

Dzongu an attractive tourism destination in the Khangchendzonga Landscape (KL).

The local community here is highly dependent on agriculture and animal husbandry. However, limited livelihood options, human–wildlife conflict, scarcity of water for agriculture, shortage of seed supply, and outmigration of locals to the cities have led to gradual decrease in agriculture and livestock rearing. Despite the bountiful natural resources in Dzongu, the community has not been able to benefit economically from them.

Dzongu has homestays run by the community, which provides visitors with the experience of local hospitality and culture. The tourists and visitors can experience local cuisine such as *khuri*, *zero*, *tok-tok*, *dzomo* rice (*athey*); wines made from



bantarul (*Discorea* sp.) tubers, khanakpa (*Evodia fraxinifolia*) fruit, and nebaro (*Ficus auriculata*) fruit; and pickles made from various wild edibles such as lapsi (*Choerospondias axillaris*), and nakima (*Tupistra nutans*). The tourist attractions include the Lingdem-Songbing, Lingdem-Thulung-Kusong treks and points such as the Lingdem hot spring, Rikzing Tarling monastery, and Lingzya waterfall. Out of the 30 villages in Dzongu, a number of homestays are functioning well.

Promoting ecotourism services

The Khangchendzonga Landscape Conservation and Development Initiative (KLCDI)-India started working in Dzongu as a pilot site in 2017, working towards strengthening ecotourism services through homestay management.

To strengthen ecotourism services, KLCDI-India in association with Dzongu-based organizations – the Mutanchi Lom Aal Shezum (MLAS) and Songbing Tourism Development and Management Committee (STDMC) – introduced several activities to promote community-based ecotourism (Figure 1). The two Dzongu partners have been organizing the annual Songbing Nature and Culture Festival showcasing Lepcha ethnic cuisine, traditional attire, traditional practices, games, and artefacts. In 2017, KLCDI-India identified and developed the Lingdem-Songbing eco-trail from Lingdem village to the famous Songbing cave in Dzongu, which has attracted many tourists.

KLCDI-India has also been focusing on empowering marginalized groups from rural areas using a sustainable tourism approach. Ecotourism has played a pivotal role in linking socioeconomic development and conservation of biodiversity and resources through support from the local community. The G.B. Pant National Institute of Himalayan Environment (GBPNIHE) also carried out a series of capacity-building interventions (Table 1).

KLCDI-India mainly focused on the homestays in remote areas such as Laven and Lingdem, in hopes to streamline them. At present, six homestays, which are simple extensions of the Lepcha family homes, offer lodging facilities and cultural experiences (Table 2).

Impacts of the interventions

With the interventions and implementation, Dzongu has received widespread recognition as a tourist destination, especially for its unique culture, community, landscape, and biodiversity. The Dzongu community has benefitted economically from ecotourism and homestays have become a means of income; this has enhanced the village economy and social-cultural unity. Furthermore, the community has also been able to share its values, traditions, and culture with guests. There has also been proportional representation of women in livelihood interventions, such as making handicrafts, as well as in capacity-building interventions such as trainings and exposure programmes. The rural tourism and homestays have enabled women to become financially independent. KLCDI-India has also trained school dropouts who are now actively involved in ecotourism as tourist guides, bird watchers, and porters.

FIGURE 1: Flowchart depicting KLCDI-India interventions with outcomes in Dzongu

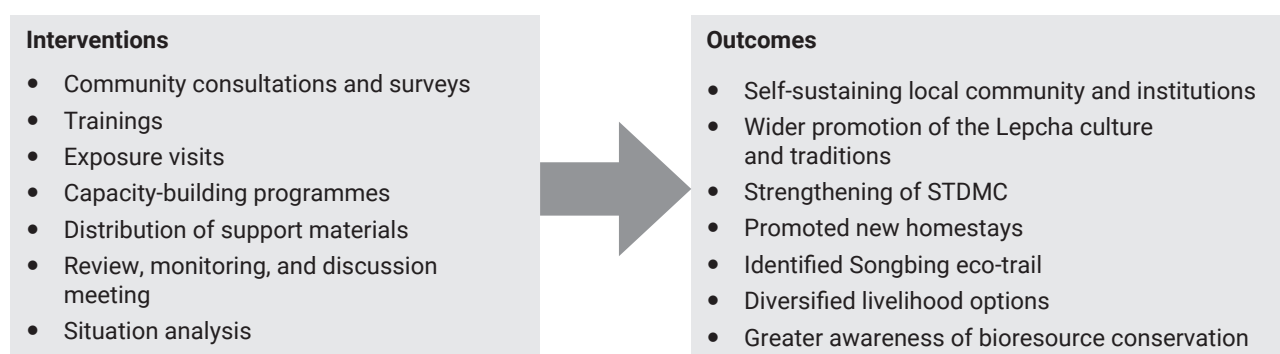


TABLE 1: Details of the capacity-building programme held in Dzongu

Livelihood interventions	Year	Participants from Dzongu pilot site		Level			Resource persons/ experts
		Men	Women	State	KL-India	Transboundary landscape	
Community consultation	2017-2018	35	15				NIHE, MLAS, STDMC
Discussion meeting	2017	22	15	✓			NIHE, MLAS, STDMC
Participatory rural appraisal	2018	25	20	✓			NIHE, MLAS, STDMC, STDMC
Preliminary planning and situation analysis	2018	15	16	✓			NIHE, MLAS, STDMC
Training on skill and capacity building for improved tourism services	20-24 September 2017	06 (24)	06 (16)		✓		International Centre for Integrated Mountain Development (ICIMOD); Khangchendzonga Conservation Committee (KCC); Ecotourism forum, Sikkim; Tourism Marketing, Sikkim
Training held on homestay steering and management programme	21-26 January 2019	06 (18)	07 (15)			✓	ICIMOD; KCC; Ecotourism forum, Sikkim; Tourism Marketing, Sikkim

Note: Numbers in parentheses represent the total number of participants.

TABLE 2: Homestays in Dzongu and their services

Homestay name	Location	Type	Services and facilities available
Songmit Lee	Laven	Traditional	Trekking, local village tour, traditional Lepcha food
Permit Lee	Lingdem	Traditional	Trekking, local village tour, traditional Lepcha food
Younfee Lee	Lingdem	Modern	Trekking, local village tour, traditional Lepcha food, hot spring bath
Ren Rong Anum	Lingdem	Traditional	Songbing trek, local village tour, traditional Lepcha food, hot spring bath
Brong Lee	Lingdem	Traditional	Traditional Lepcha food, hot spring bath
Kayusa	Lingdem	Traditional	Lepcha ethnic food, hot spring bath, history of Lepcha community, knowledge on medicinal plants, wine tasting, organic farming class



STORY TWO

An integrated model for livelihood enhancement in Gorkhey and Samanden forest villages

Authors: Kailash S. Gaira, Rajesh Joshi, Aseesh Pandey, GB Pant National Institute of Himalayan Environment, Sikkim Regional Centre

Forest ecosystems and farms provide communities with various livelihood options, which can be enhanced sustainably and profitably. KLCDI-India aims to conserve and manage the forest–farm matrix in the landscape for sustaining ecosystem goods and services, maintaining ecological integrity, enhancing livelihoods, and building socio-ecological resilience to climate and environmental change.

KLCDI-India chose Gorkhey and Samanden forest villages as pilot villages to implement activities for improving the livelihoods of disadvantaged forest-dependent communities through improved, eco-friendly, and remunerative livelihood options. Gorkhey and Samanden are located in fringe areas of Singalila National Park in Darjeeling District, West Bengal, sharing their border with

Sikkim to the north. These villages have limited transportation, healthcare, and telecommunication facilities. The community is highly dependent on tourism and natural resources for livelihood. To enhance livelihoods, minimize dependency on forest resources, and explore alternative livelihood options such as ecotourism, there was a need for Gorkhey and Samanden to have an integrated livelihood model based on low-cost organic farming, farming of off-season vegetables, and ecotourism.

Intervention

Prior to the intervention, KLCDI-India carried out a participatory planning process, in which feasible activities were identified through household surveys, focus group discussions, participatory

rural appraisals, vegetation survey, impact pathway analysis, and consultations. Target beneficiaries were also identified, which consisted of progressive farmers and households with farmland and dependent on agriculture for livelihoods.

The aim was to develop Gorkhey and Samanden as model villages for integrated livelihoods. To achieve that, KLCDI implemented the following set of activities:

Team building and synergy: The programme identified key stakeholders (local groups, experts, and line departments), and developed synergy with stakeholders through frequent meetings and co-ordination. This helped strengthen the synergy between stakeholders and partners such as the Directorate of Forest, Government of West Bengal; The Mountain Institute-India; Ashoka Trust for Research in Ecology and the Environment, Sikkim; Khangchendzonga Conservation Committee, Yuksam; and MEVEDIR, Gangtok; and projects like the Japan International Cooperation Agency (JICA) and National Mission on Himalayan Studies (NMHS), Ministry of Environment, Forests and Climate Change, Government of India. A local community group – the Gorkhey Ecotourism Committee – was formed to coordinate and monitor activities at the grassroots level.

Alternative livelihood options: KLCDI-India was the first to introduce yacon farming as an alternative livelihood option. In 2017, 700 seedlings were distributed for cultivation on marginal lands around the two villages. Currently, 44 farmers are practicing yacon cultivation in Gorkhey and Samanden.

Skill- and capacity-building programmes: KLCDI-India organized training and capacity building programmes on agro-horti practices, off-season vegetable farming, and organic farming including polyhouse construction and management, and field demonstrations on yacon cultivation and organic farming techniques such as vermicomposting, bio-composting, biofertilizer, and bio-pesticides preparation. To further strengthen the capacity of farmers and sustain these interventions, a bi-lingual (Nepali and English) training manual on low-cost organic farming techniques was developed, which demonstrates easy and cost-effective techniques for vermicompost, biopesticide, vermiwash, and biofertilizer.



KLCDI-India provided six vermicomposting beds and two vermi washstands. On average, each farmer now produces 600–900 kg of vermicompost per year for farming. However, during the first year of assessment, crop production in Gorkhey and Samanden declined because farmers stopped using chemical fertilizers. To address the fallout on household economy, a total of 13 low-cost polyhouses were provided to some farmers for production of high value vegetable crops.

Promoting ecotourism and waste management: The organic production in Gorkhey and Samanden was integrated with ecotourism services, like providing organic food and beverages to visitors, to ensure equitable benefit sharing and an integrated model where the various interventions complement each other. A zero-waste approach was also promoted using the 3Rs (reduce, reuse, and refuse) to address the issue of plastic waste and the village has been promoted as a clean and organic ecotourism destination.

Other support and interventions: KLCDI-India provided low-cost techniques for developing polyhouse, vermicompost/bio compost pits, and vermi washstand. Around 700 seedlings of yacon (*Smallanthus sonchifolius*) and 200 saplings of peach (*Prunus persica*) and seeds of carrot, cabbage, cauliflower, and spinach were also distributed.

In addition to these interventions, seasonal monitoring and survey, real-time monitoring, consultations, and review meetings were also conducted.

Impact of the work

Increase in the use of organic fertilizers: In 2017, a baseline assessment of farms in Gorkhey and Samanden revealed that majority of farmers on average used 40–50 kg of urea, 30–40 kg of super phosphate, 30–40 kg diammonium phosphate, 7,500–9,000 kg of farmyard manure, and 300–400 kg of decomposed forest litter per year in their fields. However, in 2018, the farmers reported using fewer chemical fertilizers compared to organic manure as a result of the training on organic farming. During the monitoring process, it was found that there has been a 90% increase in organic farming practices (only 8 out of 65 households were using chemical fertilizers.)

Successful yacon farming: Yacon farming has been successfully grown on fallow lands with negligible input cost. Each farmer obtained on an average of four kg yield per plant of yacon (total production 2,500 kg in a year). A total of 500 kg at INR. 30 per kg was sold in Kolkata in 2019. Yacon was also fed to animals as a nutritional supplement. Farmers report increased milk production up to 50% as a result.

Organic vegetable farming in polyhouse: A 24 sq. ft polyhouse in Gorkhey and Samanden produces on average 47 kg of vegetables such as beetroot, cabbage, carrot, broccoli, cauliflower, coriander, and spinach within two months using organic farming methods. However, farmers also cultivate vegetables inside the polyhouse on a rotational basis to ensure production throughout the year. The polyhouse approximately produces 282 kg of vegetables each year. The seasonal monitoring of implemented activities in the village in 2020 found that vegetables such as beetroot, cabbage, carrot, broccoli, cauliflower, coriander, and spinach were produced during the COVID-19 pandemic. To quantify the production income and profit, monthly data were collected for June and July 2020. Although the income and profit ratio varied with vegetables across the months, cabbage, carrot, broccoli, and cauliflower were among the most profitable crops. Based on the demand for these vegetables, they can be promoted at a larger scale. The production in polyhouse is better than farming on open agricultural land and farmers are now able to grow off-season vegetables, raise seedlings, and sell their produce to homestays in the villages.

There has also been an 80% increase in the involvement of youth in farming and a 30% decrease in the outmigration rate of youth from the two villages.

Promotion of ecotourism: As Gorkhey and Samanden is situated on the periphery of a biodiverse national park and has great potential for ecotourism, this intervention has focused on integrating farm-based livelihoods with ecotourism services to ensure equitable benefit sharing and integration of various aspects of the village economy. Community-based ecotourism services have been greatly improved in the villages. At present, six new homestays have been added for a total of 12 functioning homestays, with an emphasis on improved services such as solid waste management and cleanliness, local food and beverages, and improved hospitality. Other households also benefit by this intervention as they have the opportunity to supply necessary goods and services to the homestays and tourists.

Several cross-learning exposure visits have taken place and the techniques and approach replicated at local and regional levels across the landscape. The Ministry of Environment, Forests and Climate Change, Government of India, has also instructed to sustain and connect this integrated livelihood model with ecotourism. Subsequently, a follow-up project on “Promotion of sustainable community-based tourism in the Khangchendzonga landscape: linking livelihoods with nature conservation” has been sanctioned under the NMHS.



STORY THREE

A virtual platform for cardamom stakeholders in the Khangchendzonga Landscape

Authors: Jarina Lepcha, Aseesh Pandey, GB Pant National Institute of Himalayan Environment, Sikkim Regional Centre

Large cardamom (*Amomum subulatum* Roxb) is a perennial cash crop cultivated across the Indian Himalayan Region mainly in Sikkim, West Bengal, Arunachal Pradesh, and some parts of Uttarakhand, and in Nepal and Bhutan. The cultivation of this crop has now spread to northeast Indian states including Nagaland, Arunachal, Mizoram, Meghalaya, and Manipur.

Large cardamom is a climate-sensitive crop, and cardamom cultivation has been affected by climatic shocks and disturbances, disease, and declining agronomic yield. These changes may have severe impacts on the livelihood of communities who depend on large cardamom trade. Hence, there is a need to improve the resilience of these communities to both climatic and non-climatic threats and build their adaptive capacity by exploring and sharing good practices

related to pre- and post-harvest management and value-chain development at the landscape and regional levels.

Knowledge and information exchange

In June 2020, various stakeholders of KL-India came together virtually and decided to develop a common platform to access and share knowledge, experiences, and good practices on large cardamom farming, its processing, and marketing. A field survey conducted by KLCDI-India found that a large proportion of cardamom farmers are unable to access information and knowledge because they were unaware of government schemes and initiatives, including those on cardamom-related diseases and market



linkages to sell their products. To help the farmers and support cardamom production, KLCDI-India created a WhatsApp group called “Cardamom farmers KL-India” at the landscape level. The group is intended as a platform where farmers can communicate, share information, discuss issues regarding large cardamom farming, and connect with experts and resource persons. This digital platform also allows farmers to share updated and new information with each other. This initiative aims to develop coherent regional standards and messaging to promote large cardamom as a niche product from the region.

The WhatsApp group was created in June 2020 during the COVID-19 pandemic and now has over 100 members and stakeholders from the entire KL region including Sikkim, Kalimpong, and Darjeeling, West Bengal; representatives and members of research institutions, NGOs, large cardamom farming communities, individuals, and professionals. The main experts and resource persons in the platform are from NIHE’s SRC; Horticulture and Cash Crops Department, Government of Sikkim; Indian Cardamom Research Institute (ICRI) – Spices Board of India; and MEVEDIR, Sikkim.

Impact: A functional cardamom farmers’ network

The digital platform has been successful in directly involving farmers and enabling them to share and discuss large cardamom-related queries and problems. The experts and group administrators constantly provide information and updates on large cardamom cultivation, latest market prices, marketing links, related government schemes, and cardamom management information, including management of diseases and pests. Many rural farmers now have access to the current prices of large cardamom and can receive quick inputs and advice on solutions to their problems. This platform aims to add more stakeholders and resource persons from the KL-India region to cover a wider area with diverse beneficiaries. In the future, this group will work on a self-sustaining mode without the involvement of the KLCDI-India team.

The WhatsApp group was also helpful in gathering participants and spreading the word about large cardamom-based skill and capacity-building training programmes in different places of Sikkim, Kalimpong, and Darjeeling. The ICRI – Spices Board of India has also been utilizing this platform to reach cardamom farmers for the extension and outreach of ICRI schemes such as latest market prices, measures on disease and pest control, upcoming trainings on large cardamom cultivation, government schemes, and latest trends in production and marketing.



STORY FOUR

Shining a spotlight on traditional Lepcha bamboo crafts from Dzongu

Authors: Ugen P. Lepcha (Mutanchi Lom Aal Shezum, Dzongu);
Aseesh Pandey, Geetamani Chhetri, Kailash S. Gaira, GB Pant National Institute of Himalayan Environment, Sikkim Regional Centre

Dzongu is an officially demarcated reserve for the Lepchas, an indigenous ethnic minority of the Eastern Himalaya. The reserve falls within the transition zone of Khangchendzonga Biosphere Reserve bordering Khangchendzonga National Park, the first mixed (nature and culture) UNESCO World Heritage Site in India. The Lepchas of Dzongu are known for closely safeguarding their rich cultural heritage, and nature is central to their identity and way of life, providing resources for the community's subsistence and animist beliefs. The Lepchas also have a rich cultural heritage of arts and crafts.

Bamboo, in particular, forms an inextricable part of their lives and livelihoods. In Lepcha culture, bamboo is essential for all rites of passage from birth to death. The Lepchas use locally available bamboo to make various articles for daily use

– from cups, mugs, baskets, and hats to tea strainers, water-carrying containers, fish traps, and musical instruments. The diverse range of Lepcha bamboo crafts demonstrates the community's expertise, creativity, and traditional knowledge.

So far, this knowledge system has been preserved and transferred over generations. But with the erosion of the Lepcha language and culture, traditional knowledge and crafts are under serious threat. As a result, bamboo crafts and their use have drastically declined in recent times.

Indigenous knowledge and crafts, such as bamboo products, can provide alternative, egalitarian, and sustainable ways of managing resources and securing livelihoods. Therefore, preserving and promoting the Lepchas' age-old, eco-friendly, and sustainable traditional knowledge of bamboo



crafts assumes greater significance in today's world. Although the use of these crafts is mostly restricted to the community, their traditional knowledge and skills could be channelled towards creating viable livelihood opportunities through value addition, product diversification, and marketing promotion.

Market linkages and branding

Recognizing the potential of the Lepcha community's bamboo crafts, KLCDI-India and the MLAS (local partner from Dzongu) have undertaken interventions to profile and promote these products. Capacity-building programmes, trainings, and exposure events have emphasized the importance of value addition for mainstreaming traditional crafts and making them more marketable for greater economic returns.

KLCDI-India imparted training on the making of commercial bamboo products like lampshades, coffee/tea packaging boxes, LED bulb covers, trash bins, and pen stands using locally available bamboo *Dendrocalamus hamiltonii* (*choya baans* in Nepali and *po puli* or *puli mat* in Lepcha), *Phyllostachys manni* Gamble (*katabaans* in Nepali and *gey shi* in Lepcha), and cane *Calamus* spp (*bet* in Nepali and *ruh* in Lepcha). These bamboo products have a huge demand in the market, and trained artisans could capitalize on this demand.

KLCDI-India provided a platform to showcase and retail the various bamboo crafts prepared by Lepcha artisans at various events such as the Songbing Hot Spring Festival in 2017, 2018, and 2019 at Lingdem, Dzongu, and Sikkim; the ICIMOD General Body Meeting, Gangtok, Sikkim; and other events of NIHE's SRC at Pangthang, Gangtok, in 2019. Moreover, bamboo-made trash bins were also installed along the Lingdem-Songbing trekking corridor in Dzongu.

Following the interventions, six Lepcha artisans are now engaged in bamboo craft entrepreneurship, which employs 10 other members. They retail bamboo-based products at various events at local, state, regional, and national levels. As per NIHE's cost benefit analysis in 2021, each community member involved in bamboo entrepreneurship earns on average around INR 25,000–40,000 per annum.

The future

- So far, all the bamboo products are prepared manually in Dzongu. Mechanization is essential for large-scale production and marketing of these products.
- The inclusion of youth, especially from underprivileged sections of the community, through skill- and capacity-building programmes and exposure visits is vital.
- Branding and patenting of specific products and development of their value chain are essential.
- Detailed market surveys can help build a better understanding of the market demand of Lepcha bamboo crafts for selective large-scale production.
- Linkage of bamboo products with ecotourism and community-based tourism can diversify income.



STORY FIVE

Dzongu's women entrepreneurs turn to traditional nettle products

Authors: Ugen P. Lepcha (Mutanchi Lom Aal Shezum, Dzongu);
Geetamani Chhetri, Kailash S. Gaira, Aseesh Pandey, GB Pant National Institute of Himalayan Environment, Sikkim Regional Centre

The Lepchas have vast knowledge on the use of natural resources, including Himalayan nettle (*Girardinia diversifolia*), which they use for medicine, food, and fibre. The leaf and inflorescence of the nettle are used for food and medicine, the roots for medicine, and the fibre from the stem bark for making ropes and yarn for weaving traditional handlooms. The Lepchas use the fibre to make traditional dress materials (*kuzoovaadoah*, *thokroh*), shoulder bags (*tanggyip*), mufflers, stoles, and shawls (*yangloo*). However, they possess limited entrepreneurship skills and the market promotion of the products is limited. As a result, fewer people from the Lepcha community are pursuing these traditional practices today.

Strengthening entrepreneurship

KLCDI-India joined hands with Ongkit Lepcha from Lower Dzongu, a nettle fibre weaver and an active member of the women's self-help group Amu Sakchum, to train women in nettle fibre extraction, yarn making, and weaving. She is also the resource person for KLCDI-India for various skill development and capacity-building programmes.

KLCDI-India organized a two-phase skill development training programme on nettle fibre-based product making and value addition in 2018 and 2019 to strengthen women's entrepreneurship skills in the region and preserve biocultural and traditional practices. Ongkit Lepcha trained 15 members of women's self-help groups of different villages in Dzongu: Lingdem, Laven, Ruklu, and Kayem. During the first phase in December 2018,



the participants learned how to select and harvest nettle stems, extract the outer bark, and dry and store products. In the second phase in March 2019, participants learned how to make yarn from nettle bark, weave, and manufacture various marketable products such as shoulder bags, traditional Lepcha dress materials, mufflers, stoles, and shawls.

To popularize nettle yarn-based fabrics and motivate women entrepreneurs, KLCDI-India and partners MLAS and Amu Sakchum, along with the ICIMOD, showcased nettle products at the state, regional, and landscape level. These products were displayed at various events and gained immense attention and appreciation.

Impact

Ongkit Lepcha is now recognized as an entrepreneur in the KL and earns a promising livelihood annually. Along with her group members, she has trained more than 80 local women. She has also been invited to several events as a resource person and traditional entrepreneur by various national and international organizations such as the Directorate of Handicrafts and Handlooms, Government of Sikkim, and the United Nations Development Programme. She has become an inspiration for other Lepcha women and has contributed to the promotion and preservation of their traditional knowledge and skills in nettle fibre-based product making.

Prospects for the future

In terms of the infrastructure, with the increase in the number of handloom weavers, the handloom centre in Dzongu will require expansion to accommodate more weavers. Since the nettle products are prepared manually in Dzongu, more mechanical support will be required to support large-scale production and to mainstream the product value chain. Furthermore, training programmes need to be extended to the younger generation, especially to the marginalized and underprivileged youth, to create more women entrepreneurs like Ongkit Lepcha. Entrepreneurship involving nettle fibre-based products can also be further promoted as a viable livelihood option, particularly for women, by linking it with ecotourism.



STORY SIX

Dairy entrepreneurship growing in Ribdi-Bhareng

Authors: Santosh K. Chettri, Kailash S. Gaira, Rajesh Joshi, GB Pant National Institute of Himalayan Environment, Sikkim Regional Centre

A unique transboundary location with eastern Nepal, the Ribdi-Bhareng Gram Panchayat Unit (GPU) is a composite of five village wards (Khopi-Ramitey, Upper Ribdi, Lower Ribdi, Upper Bhareng, and Lower Bhareng). The GPU falls within the Barsey-Singalila region, which extends across Sikkim and West Bengal and is inhabited by 325 households of diverse communities: Sherpa, Rai, Chettri, Tamang, and Gurung. Ribdi-Bhareng's strength lies in its history of agriculture and livestock rearing. The farmers of the region are also largely dependent on potato farming, along with maize, peas, cabbage, beans, carrot, and radish, among other crops. However, growing human-wildlife conflict and crop depredation have resulted in profound crop losses and stressors for livelihoods and food security.

In 2016, KLCDI-India identified Ribdi-Bhareng in the Barsey-Singalila site as a pilot village for sustainable development through resource management and livelihood initiatives.

During a consultation meeting between farmers of Ribdi-Bhareng GPU and KLCDI-India, improved dairy farming emerged as a viable alternative livelihood option, drawing from the rich livestock rearing history of the region. As part of the pilot, farmers would participate in different capacity- and knowledge-building activities to learn about different dairy techniques and entrepreneurship skills.

KLCDI-India and local communities recognized that sustainability is key for a functioning dairy economy. Unsustainable, large-scale dairy farming



and feed production can lead to the loss of ecologically important areas, such as rangelands, wetlands, and forests. It can also put pressure on natural resources, including freshwater and soil, not to mention the GHG emissions. A well-managed dairy farming system can restrict over-grazing; offer by-products such as manure for farms; provide regular cash income; and lead to the formation of dairy institutions and cooperatives for distributed profits, shared risks, and better market access and bargaining power. KLCDI-India's interventions were accordingly oriented for livelihood diversification and sustainability.

Interventions

KLCDI-India conducted interactions with communities and surveys to gather primary data on dairy and livestock. Simultaneously, KLCDI-India synergized its interventions with other partners such as The Mountain Institute; Diocesan Integrated Society for Holistic Action (DISHA), Kalimpong; and the Department of Animal Husbandry, Livestock, Fisheries and Veterinary Science, Government of Sikkim, to provide training and guidance to the community and the relevant government officials of Ribdi-Bhareng, which sensitized them about the importance of dairy farming, fodder management, and related techniques. For example, a training in November 2017 (in which 45 farmers, including 15 women, participated) focused on animal nutrition and healthcare for improving dairy production. The training covered wide-ranging topics: water requirements for livestock, mineral supplements, efficiency in milk production, preparation of feed mixture, and different cattle diseases and their

causes and treatment (including homemade ones). The training also involved an exposure tour to the dairy farm of Phurtenzee Sherpa (a national awardee in dairy farming) and to the house of cheese entrepreneur Dorjee Sherpa at Anden Sombarey.

During the same training, five beneficiaries received chaff-cutters and all 45 received medicines and nutrient supplements. Other trainings over the course of the pilot touched upon various issues such as disease, quantity and quality of milk required for effective business operation, closing the gap between the line departments and livestock owners, increasing awareness and capacity building, management of cowsheds, and preparation of nutrition-rich fodder species and feed. Such interventions helped broaden farmers' perspectives about dairy farming entrepreneurship opportunities in the landscape.

Growth of dairy entrepreneurship

According to surveys by NIHE and The Mountain Institute, villagers of the Ribdi-Bhareng GPU on average used to keep no more than two cows and subsequently used to produce only 2–5 litres of milk per household. Following the pilot project's livelihood-based interventions, the number of cows and milk production per household has gradually increased, and so have the number of milk-collecting units (MCU) in the village. Table 3 shows the year-wise progression of dairy farming in Ribdi-Bhareng GPU. As of 2020, farmers of Ribdi-Bhareng own 3–4 cows per household on average and have opened up three milk diaries so far (at Khopi Khadka, Upper Ribdi, and Upper Bhareng), producing 320–360 litres of milk daily. They sell milk to Sikkim Co-operative Milk Producers' Union Ltd., Karfector, Jorethang.

Milk prices have also increased from INR 32 in 2019 to INR 40 in 2020; in 2021, the Government of Sikkim announced an incentive of INR 8/liter to promote dairy entrepreneurship, which increased the average per liter value of milk to INR 48/liter. However, these prices can further increase to INR 48–55 based on the fat content in milk. On average, dairy farmers earn around INR 10,080 monthly per household. Shri Suman Rai, former Panchayat member of the Ribdi-Bhareng GPU and one of the beneficiaries of the KLCDI-India

interventions, shared that he learned much from the training/exposure event on improved dairy farming and has been dedicated to the profession.

The fodder requirements have also been managed using farmland species such as *Digitaria ciliaris*, *Zea mays*, *Arundo donax*, *Benincasa hispida*, *Cucurbita pepo*, and *Sechium edule*. Around 15% of the farmers purchase feed like Samrat feed, *kutti* (from Daramdin, Sikkim), and straw (from Siliguri) from Daramdin and Siliguri.

The promotion of dairy farming and on-farm fodder production has also reduced dependence on forests for fodder, easing the extractive

pressures on adjoining forests and helping conserve biodiversity. Furthermore, livestock health has also improved with sustainable dairy farming techniques and improved feed quality. Farmers have also been able to learn more about animal farming and actively engage in dairy entrepreneurship, helping slow down further outmigration of the youth for overseas employment. An emphasis on dairy farming in the pilot village has therefore revived traditional livestock rearing, increased livestock numbers, and improved dairy management practice and household economy in Ribdi-Bhareng.

TABLE 3: Year-wise progress in dairy farming in Ribdi-Bhareng (Barsey-Singalila site)

Parameters	Year-wise comparison				
	2017	2018	2019	2020	2021
Average number of cows/household	2	2-3	2-3	3-4	3-4
Average milk production/household/day (litres)	5.0	5.5	7.0	8.0	8.0
Number of MCUs	1	2	3	3	3
Average milk retailed/household/day (litre)	2	2.5	5.0	7.0	7.0
Income/household/month (INR)	INR 1,800 @INR 30/litre	INR 2,400 @INR 32/litre	INR 4,800 @INR 32/litre	INR 8,400 @INR 40/litre	INR 10,080 @INR 48/litre



STORY SEVEN

A yak economy network for highland management

Authors: Aseesh Pandey, Kailash S. Gaira, Rajesh Joshi (GB Pant National Institute of Himalayan Environment, Sikkim Regional Centre); Tashi Dorji (International Centre for Integrated Mountain Development); Karma T. Bhutia, Passang Bhutia (Department of Animal Husbandry, Livestock, Fisheries & Veterinary Services, Govt. of Sikkim)

The yak (*Poephagus grunniens*) is distributed across the Himalaya region of southern Central Asia, the Tibetan plateau, and Mongolia, and is exceptionally adapted to the hostile high-altitude environment. This herd animal is a cornerstone of life in the highlands and an important source of livelihood for transhumant pastoralists. It is the source of milk, meat, fibre, and hide, and helps transport goods in difficult mountain terrain.

In the KL, declining interest in yak farming and rearing has become apparent in recent years. Furthermore, the reduced availability of labour and forage in the rangelands, increasing yak mortality, limited access to the market for yak products, and underdeveloped value chains for yak product-based micro and small enterprises are major

issues that plague yak rearing and livelihoods of highland communities. Yak herders also have new livelihoods options, such as tourism and trade of the high-value caterpillar fungus yartsa gumba (*Ophiocordyceps sinensis*). Matters are compounded by policy roadblocks, such as the restriction of transborder movement of animals, which disrupts the centuries-old annual practice of yak herding across borders and genetic exchange.

The ban on livestock grazing in Khangchendzonga National Park and Singalila National Park in India has resulted in the sale of large numbers of livestock to Nepal; yak populations in Nepal nearly doubled from 4,093 in 2009 to 7,565 in 2012, placing considerable pressure on the country's rangeland management. Furthermore,



there are limitations in access to technology in the landscape compared with other yak-herding areas in China and Mongolia, which have experienced significant technological advancements in terms of renewable energy and value-added yak product development. Networking of yak economy-based stakeholders – for instance, yak herders, yak owners, yak product-based entrepreneurs, line departments, research institutions, and policymakers – can foster exchange of good practices in yak herding for sustainable and reinvigorated highland pastoralism.

Strengthening networks

Recognizing the importance of yak for highland communities and to address the decline in yak-herding practice and policy shortcomings, KLCDI-India organized a series of field explorations, community consultations, exhibitions, regional workshops, and brainstorming sessions. The deliberations pointed to a need to develop a mode of information sharing: a network for yak economy-based stakeholders. NIHE has formed a WhatsApp-based stakeholders' group, where members share activities, information, best practices, and government initiatives with each other.

NIHE partnered with ICIMOD for its interventions in the landscape, along with line departments, local governing bodies (Dzumsa), research institutions, and policy makers (Department of Animal Husbandry and Veterinary Services, Government of Sikkim; Indian Council of Agricultural Research-National Research Centre on Yak, Dirang, Arunachal Pradesh; Department of Animal Husbandry, Leh; Department of Livestock Services, Government of Nepal; and Department of Livestock, Government of Bhutan).

Early impacts

The network has helped stakeholders identify issues and opportunities in the KL highland areas and prioritize action plans (long, mid, and short-term basis) for highland management. Along with the Government of Sikkim's Department of Animal Husbandry, Livestock, Fisheries & Veterinary Services, the network conducted a characterization of yak herders (primary, secondary, and tertiary) and supported primary yak herders (who live a nomadic life with yak) under the KLCDI-India programme in November 2020. Following a needs

assessment conducted by NIHE during field explorations, movable multipurpose solar systems, tent equipment, and winter forage for yak were distributed to yak herders of North Sikkim.

Furthermore, the network is providing a platform to showcase yak products (such as yak cheese, butter, soap, lip balm, fabrics), share good practices, and organize yak festivals to highlight the yak-herding culture and to link it with the growing ecotourism market.

The network has also helped governments from the landscape agree on a momentous germplasm exchange across borders in the landscape. Bhutan gifted two yak breeding bulls to Nepal and one to Sikkim, India, in February 2020 in a bid to improve the genetic health and vigour of yak populations. In-breeding depression is prevalent among yak progenies across the highlands of KL-India and Nepal because of habitat fragmentation and due to restrictions in cross-border movement between Indian and the Tibetan Autonomous Region of China after the 1960s. Facilitated by ICIMOD, the yak germplasm exchange is the start of efforts to improve the yak gene pool in the landscape.

Goals for the yak economy network

- Develop a unique mountain economy through diversification of income sources by branding, product development, and promotion of yak products
- Enhance income diversification for women in highland communities and conceptualize community-based ecotourism focusing on yak and highland culture
- Foster regional cooperation for yak germplasm exchange within and between countries
- Improve management of highland pastures by planting viable fodder species to ensure year-round availability of fodder
- Address increasing population of free-range dogs in the highland areas, an emerging threat to young yak calves
- Bolster effective management of disease and vaccination
- Facilitate formation of region-specific clusters of yak herders (associations) and link them all to form a Hindu Kush Himalaya Yak Network



STORY EIGHT

Yacon: A potential crop for improving livelihood security of rural communities in the Khangchendzonga Landscape

Authors: Santosh K. Chettri, Bhim Pandey, Kailash S. Gaira, Rajesh Joshi, GB Pant National Institute of Himalayan Environment, Sikkim Regional Centre

Introduction

Yacon (*Smallanthus sonchifolius*, Poepp. & Endl., Asteraceae) is a perennial plant native to the Andean region of South America. In folk medicine, yacon's tuberous roots and infusions from dried leaves are used to treat diabetes and various digestive and renal disorders. Its tuberous roots, consumed fresh or cooked, are considered a functional food because of the large amounts of fructans (i.e., inulin and fructooligosaccharides). The above ground part of the yacon plant is used as fodder for livestock and its young leaves are used to prepare herbal drinks.

Considering the health benefits and multiple uses of yacon, its cultivation can play a pivotal role in improving rural livelihoods. Yacon requires minimum nutrients to grow, and unlike other crops, yacon plants are not depredated by wild animals due to the bitter taste of the tubers. These make yacon a potential crop for cultivation on agriculture lands, fallow lands, and forest fringe areas which are prone to crop depredation.

Piloting yacon farming

In 2017, under KLCDI-India, three unique pilot sites – Dzongu, Bandapani and Barsey-Singalila

– were identified for implementing activities on livelihood diversification. The pilot site in Barsey-Singalila is a transboundary area nestled between Barsey Rhododendron Sanctuary, Sikkim and Singalila National Park, West Bengal, and shares an international boundary with Nepal. Within the pilot site, Gorkhey and Samanden forest villages were selected for fallow land restoration activities under the KLCDI-India programme by NIHE, Sikkim in collaboration with local partner organizations, viz., the Gorkhey Ecotourism Committee, Gorkhey (Darjeeling) and The Mountain Institute-India, Gangtok, involving the Prakriti, Samiti, Singalila, Saraswati and Nabnita women self-help groups (SHGs). These forest villages were selected due to limited livelihood opportunities, crop depredation by wild animals, scarcity of fodder for livestock, people's dependency on non-timber forest produce, pest infestation of food crops, and soil erosion.

Under the fallow land management programme in Gorkhey and Samanden, yacon was identified as a potential crop to help address these issues. Since both are forest villages, they have limited landholdings and agricultural production. Furthermore, crops are often depredated by wild animals, resulting in fallowing of agricultural land. In 2017, 700 saplings of yacon were initially distributed to 44 households who were provided training on its cultivation, harvest, curing and marketing. As a result, farmers harvested approximately 4 kg/plant of yacon tubers with a total production of 2,500 kg/year (approx.), out of which 500 kg was sold in Kolkata, India at INR Rs.30/kg. In 2020, using the tubers from the old plants, 2,200 yacon plants were prepared and cultivated, which resulted in a greater production of 10,000 kg. This practice continues till date. Yacon also grows on lands other than crop fields thereby allowing for the productive use of fallow lands. The size of the fallows utilized by each household to grow yacon range between 500 and 750 sq. ft. covering a total area of 2.2-3.3 ha in the two target villages.

Impact of the intervention

The following questions were used to reflect on the impacts of the intervention.



- What is the rate of reduction in crop depredation in the area?
- Has it made any difference to achieving livelihood security?
- What percentage of fallow lands is utilized for growing yacon?
- Is there any decrease in people's dependence on non-timber forest produce? If so, by how much?
- Is there any reduction in crop pest infestation? If so, by how much?

Additionally, the cultivation of yacon for fallow land management was monitored and the changes in land use during the period were investigated.

Reduced crop depredation intensity

Crop depredation by wild pig and black bear is a major issue in the Barsey-Singalila region. The crop depredation intensity was determined by measuring the number of times the crops were damaged or attacked per year (frequency). After the initiation of yacon cultivation in the villages, crop depredation reduced. Yacon is not depredated by wildlife due its bitter taste when underground and the other food crops are also protected through the mixed cropping of yacon and food crops (and also by planting yacon around the agriculture fields).

Creation of livelihood opportunities

Under KLCDI-India, NIHE also aimed to diversify livelihood options for the local community and introduced yacon as a potential crop to uplift the household economy. In this regard, livelihood opportunities of the rural community have increased nearly twofold through yacon farming as compared to the livelihood opportunities in 2017. Yacon is marketed as a cash crop and food supplement that can also be used to prepare home-based medicines and syrup, which can help in managing blood sugar, improving gut health and metabolism, and in weight management. Farmers are also supplying yacon to manufacturing companies such as the Shoten Group, Sikkim, India, who have been promoting products such as yacon syrup. This indirectly benefits the farmers as it creates demand by popularizing the crop and highlighting its beneficial properties.

Fallow land restoration

Due to its nature of colonizing even poor soils, land use has been well managed through cultivating yacon and converting the fallow lands into productive croplands thereby reducing the high risk of wildlife crop depredation.

As Gorkhey-Samanden is an emerging tourist destination, the people in the region are now using yacon tubers in wine production. The wine is served to tourists, creating an added livelihood opportunity for the community. Farmers who feed damaged and unsellable yacon tubers to their livestock (especially cows) have reported that milk production has increased significantly. Furthermore, people who were consuming nutrition deficient diets are at present consuming an improved diet along with yacon tubers for health benefits.

Reduction of the dependency on NTFPs

The residents of Gorkhey and Samanden use forest resources and heavily depend on NTFPs (non-timber forest produce) for their livelihoods. However, due to yacon farming, their dependency on the forest and NTFPs has decreased as yacon serves several purposes – as material for herbal drinks, syrup, animal feed – and as an alternative livelihood option that brings in valuable cash income. In addition to all these benefits, yacon has made farmers less vulnerable to crop depredation by wildlife and is helping break the crop insect and pest cycle, thereby reducing crop losses due to insect pests and pathogens.



STORY NINE

Setting up long-term monitoring sites with automatic weather stations

Authors: Aseesh Pandey, Puja Sharma, Jarina Lepcha (GB Pant National Institute of Himalayan Environment, Sikkim Regional Centre); Ujjal Ghosh (Department of Forest, Govt. of West Bengal)

The Himalayan region is a barometer of climate change; because it sits at the top of the world, it experiences heightened impacts before most other regions of the world. Ongoing climatic upheavals will have very real and catastrophic impacts on the region's rich biodiversity. An important part of a global biodiversity hotspot, the KL is a forested landscape that is vulnerable to natural and anthropogenic stressors, which may alter forest structure, composition, and function. The KL includes 19 protected areas and supports more than 5,198 plant species, 173 species of wild mammals, 613 bird species, and 600 butterfly species. Its diverse habitats are home to various threatened, endangered, and keystone flora and fauna such as satuwa (*Paris polyphylla*), Himalayan yew (*Taxus wallichiana*), bikh/bikhuma (*Aconitum* sp.), snow leopard (*Panthera uncia*), red panda

(*Ailurus fulgens*), takin (*Budorcas taxicolor*), tiger (*Panthera tigris*), yak (*Poephagus gruniens*), and Asian elephant (*Elephas maximus*).

Given the importance of understanding the complex interplay of climate change and biodiversity through systematic datasets, there is a need for more long-term research and monitoring across the landscape. Such data can inform holistic and viable conservation approaches.

Monitoring efforts in the landscape

KLCDI-India conducted a feasibility assessment of KL-India from 2015 to 2017 to assess various criteria and indicators for selecting sites and monitoring long-term impacts on the landscape's biodiversity and economy. KLCDI-India organized



various consultation meetings with experts from various institutions from Gangtok (such as Ashoka Trust for Research in Ecology and the Environment, Sikkim University, and The Mountain Institute). Based on the field surveys, the programme established a long-term environment and socioeconomic monitoring (LTESM) site in 2018 in Dzongu, North Sikkim. The 1 ha site was demarcated for monitoring initially for a five-year period, with certain zones permanently marked to monitor various vegetation parameters (tree regeneration, forest structure, composition, biomass accumulation) along with soil parameters (nitrogen, potassium, phosphorus, soil organic carbon, moisture content, bulk density). In 2019, the site was equipped with an automatic weather station (AWS) to monitor real-time climatic variables.

During field explorations, the KLCDI-India team observed the dominance of bamboo species (*Yushania maling*), which was hampering forest regeneration in parts of the landscape, especially inside protected areas (Singalila National Park and Neora Valley National Park). Therefore, to monitor the long-term impact of bamboo dominance over the native vegetation, KLCDI-India set up three experimental plots (1 ha each) in Neora Valley National Park in 2019 in coordination with the Government of West Bengal's Department of Forest and ICIMOD. The KLCDI-India team is systematically monitoring the sites and collecting seasonal data on vegetation and soil parameters. This site was equipped with an AWS in 2021.

Impacts

- This is the first long-term monitoring site established in KL-India in which vegetation parameters, soil parameters, and climatic variables are under observation on a long-term basis.
- Vegetation inventories and monitoring of tree growth rate and regeneration in the long-term will provide a road map for forest resource utilization pattern and management.
- The KLCDI-India team has conducted experiments in three trial plots to study regeneration and survival rates of tree species, after removing *maling* bamboo from each of the 1 ha plots and (i) leaving the site undisturbed to check natural regeneration; ii) planting seedlings of tree species from a nearby forest to observe their survival rate; and iii) planting nursery-raised seedlings to check their survival rate. Results from these experiments will inform policy planning on *maling* bamboo management in natural forests, especially in protected areas.
- Real-time climate data logging in two different forest types of the landscape is in progress. This will provide an understanding of representative vegetation's response to climatic anomalies and change over the years.



STORY TEN

Solid waste management and the role of Resource Recovery Centres

Authors: Aseesh Pandey, Kailash S. Gaira (GB Pant National Institute of Himalayan Environment, Sikkim Regional Centre); Tshering U. Bhutia (Khangchendzonga Conservation Committee, Yuksam); Bhushan Chettri (Gorkhey Ecotourism Committee)

The fragile ecosystems of the Himalayan region are facing severe impacts of climate change in the form of shifting of habitats, loss of biodiversity, and environmental degradation. These are affecting the lives and livelihoods of many communities. Besides, the increasing amount of solid waste is an emerging concern given the region's rich biodiversity and ecosystem services. In a larger context, as the population of the world grows, solid waste management is expected to pose a significant environmental challenge, especially for the eco-sensitive Himalayan region. To counter this, interventions by way of skill and capacity building through training programmes and awareness campaigns, and development of relevant infrastructure may yield significant results. This will also improve the overall civic sense of the people living in the region.

Towards this end, KLCDI-India, supported by ICIMOD, has taken up solid waste management as one of its major activities (see Table 4). KLCDI-India has identified three pilot sites for implementing welfare activities during its first five-year phase; these sites are: the Lepcha conservation reserve in Dzongu, North Sikkim; Barse-Singalila, a transboundary site of India and Nepal nestled in the Barsey Rhododendron Sanctuary, Sikkim, and the Singalila National Park of Darjeeling, West Bengal; and Bandapani, a transboundary area of India and Bhutan. As part of the programme, a Resource Recovery Centre (RRC) has been established at the Barsey-Singalila pilot site, which is the first of its kind in the KL.

TABLE 4: KLCDI-India's activities concerning solid waste management

Year	Programme/initiative	No. of participants
2016	Solid waste-free campaign in Ribdi-Bhareng GPU, Barsey-Singalila pilot site	97 (men:59; women:38)
2017	Orientation/training programmes on solid waste management across the three KLCDI-India pilot sites	121 (men:59; women:62)
2017	Awareness campaign and training on solid waste management in Gorkhey-Samanden, Barsey-Singalila pilot site	59 (men:30; women:29)
2018	Awareness campaign on solid waste management by aligning with the Swachh Bharat Mission in Gorkhey-Samanden, Barsey-Singalila pilot site	24 (men:12; women:12)
2019	Follow-up on solid waste management activities in association with the Swachh Bharat Mission in Gorkhey-Samanden, Barsey-Singalila pilot site	30 (men:24; women: 6)
2020	Skill and capacity building of rural women on solid waste reuse and recycling; establishment of an RRC in Gorkhey-Samanden, Barsey-Singalila pilot site	46 (men:10; women:36)
2021	Monitoring of solid waste management activities and of RRC functions in Gorkhey-Samanden, and distribution of support materials	30 (men:11; women:19)

Major initiatives

NIHE's Sikkim Regional Centre has organized a series of activities under the KLCDI-India programme to manage solid waste in the Himalayan landscape; these included: a series of awareness campaigns in different parts of KL-India in association with the Swachh Bharat Mission, the national cleanliness drive; a skill development programme (on World Environment Day) in alliance with the gender budgeting programme of the Indian Ministry of Environment, Forest and Climate Change on the reuse of plastic waste; installation of dustbins to promote cleanliness and effectively manage solid waste in the tourist areas of Dzongu and Gorkhey-Samanden forest villages – the dustbins in Dzongu were prepared by trained villagers under the KLCDI-India programme using the locally available bamboo species *Dendrocalamus hamiltonii* (however, iron-grill bins were installed in the Gorkhey-Samanden forest village, which is the entry point of the Gorkhey-Falut trekking corridor); and since 2016, various training programmes on women empowerment and on waste identification, segregation, and management have been organized. In all, around 400 people have been trained under the KLCDI-India's solid waste management campaign.

Resource Recovery Centres

An RRC is a designated area with the facility to collect, sort, and transfer waste. It is a locally governed system (at the community and local government levels) that creates social enterprise through repairing, reusing, and recycling waste into a resource. The RRC reduces the volume of waste going into landfills at the local level by either recycling or through resource recovery. Thus, an RRC has been set up at the Barsey-Singalila pilot site through the participatory approach. The centre covers an area of 375 square feet and has separate chambers for waste segregation, storage, and collection. Training on RRC management and functioning was given to members of several self-help groups – Prakriti and Samiti from Gorkhey and Singalila, respectively, and Saraswati and Nabnita self-help groups from Samanden villages. The training was conducted by experts from the KCC, Yuksam, and NIHE. Through hands-on sessions, the participants were trained in waste segregation (separating the reusable from the disposable), categorization (recyclable, reusable, repairable) and in the maintenance (involving the arrangement of waste and managing the segregation and storage chambers) of the centre. The following are seven salient points regarding RRCs and why more of them should be established:

- The RRC is an integrated waste management centre that can be established by local communities and local governments after following the due legislative process.
- It enables the processing of waste whereby higher recovery and recycling rates are ensured before disposing the waste in an environmentally sound manner.
- It creates livelihoods as community members and other stakeholders are involved in its running; it also guarantees environmental benefits.
- It is cost-effective and works with what is locally available, and the design is adapted to the priorities of the community concerned.
- By ensuring more efficient recovery and recycling of waste, the centre generates resources (which translates into income) and also saves cost on landfilling.
- It can be used as a demonstration site where students and faculty can learn about sustainable environmental practices.
- It forges unity among communities and inspires them to participate in the running of sustainable waste management systems.

Impacts and way forward

According to a World Bank report, the total waste generated globally in 2016 was 2.01 billion tonnes. This figure is expected to grow to 3.40 billion tonnes by 2050, more than double the estimated population growth over the same period. Under KLCDI-India, small initiatives have been taken to not only sensitize communities



towards effective solid waste management but also to build their capacity in terms of recovering resources from the waste material. Based on the follow-up programmes by NIHE to monitor the impact of these interventions, it was observed that the process of waste segregation and management has improved in the KL-India pilot sites, and among them, the villages of Gorkhey-Samanden have shown the most promising results. According to Bhushan Chettri, President of the Gorkhey Ecotourism Committee, the technical and structural support received through the KLCDI-India programme has raised awareness among the villagers about effective management of solid waste and they have also been avoiding plastic products to some extent. And, since the forest villages of these pilot sites are some of the cleanest and well-managed ones, they stand a great chance to be nominated as the cleanest villages of the KL. As a way forward, given that there is an increasing demand for RRCs in other parts of KL-India, more such centres need to be installed. This will go a long way in laying the ground for productive management of solid waste in the KL.



STORY ELEVEN

Participatory conservation of *Paris polyphylla* (Satuwa), a high value medicinal plant of the Khangchendzonga Landscape

Authors: Aseesh Pandey, Kailash S. Gaira and Rajesh Joshi

Paris polyphylla (Family: Melanthiaceae) is a slow-growing perennial rhizomatous herb of global significance. It flowers in April-May and fruiting occurs from July to September (Polunin and Stainton 1984). The fruits are set as berries, usually between August and October. The underground buds sprout from the rhizome in the early spring.

Due to its varied uses, *Satuwa* is often referred to as the “cure for all ailments”. With multiple medicinal attributes, it is used as an analgesic, antibacterial, antiphlogistic, antispasmodic, antitussive, depurative, and for the treatment of poisonous bites, burns, wounds, ulcers, skin diseases, diarrhoea, dysentery, fever, gastric problems, sleeplessness, and typhoid.

China is the main market for *Satuwa*, where the volume of trade is estimated at 800-1,050 tonnes annually. Its price increased 400-fold from 2.7 Chinese Yuan CNY/kg in 1980 to 1100 Chinese Yuan/kg in 2017. The *Satuwa* from eastern Indian states is often exported to China via Myanmar, and some 47,753 kg of *Satuwa* rhizomes from Nepal were exported to Tibet/China (76%) and India (24%), respectively in 2017. Similarly, *Satuwa* from Bhutan also finds its way to markets in China.

In recent times, the threat to natural populations of *Satuwa* has increased due to illegal collection, unscientific harvesting, unregulated livestock grazing, poor forest resource and trade management, impacts of climate change, developmental activities such as construction

or widening of roads, natural hazards, and forest fires. Furthermore, seed predation by birds, fruit predation by deer and other wild animals, poor seed viability, and herbivory of the whole plant (including its rhizomes) by deer, bear, and lagomorphs further threaten the species. During the flowering season, only 40% of plants develop flowers and evidence indicates that the species exhibits poor adaptability and is susceptible to climate change. Due to these reasons, *Satuwa* was recently assessed and listed as Vulnerable under criteria A4cd by the International Union for Conservation of Nature (IUCN) in the Red List of Threatened Species 2020.

The G.B. Pant National Institute of Himalayan Environment (GBPNIHE) has adopted a participatory approach to the conservation of *Satuwa*, starting with ten farmers at Dzongu. It includes training on various aspects and steps – harvesting and storage of seeds, nursery bed preparation and soil composition, sowing, mulching and shading methods, watering, acclimatization, and harvesting. Seedlings, sourced from Sewalung Nursery of Mr. M.B. Limboo, Yuksam, West Sikkim were distributed to restore wild populations in Dzongu in collaboration with Songbing Tourism Development and Management



Committee (STDMC), Mutanchi Lom Aal Shezum (MLAS), Dzongu, North Sikkim. Seedlings were also distributed to selected farmers at Pangthang, East Sikkim.

Future interventions include:

- Strengthening community involvement in the conservation of *Satuwa* by forming growers' groups or cooperatives
- Encouraging traditional medicine practitioners to establish medicinal plant nurseries by providing incentives and involving them in conservation of high-value medicinal plants
- Developing species-specific agro techniques

REGIONAL STORIES



STORY TWELVE

Promoting homestays and transboundary tourism circuits in the Khangchendzonga Landscape

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Tourism is a priority sector for national and local governments across Bhutan, India and Nepal in the Khangchendzonga Landscape (KL). The landscape's rich natural and cultural heritage, its mountains, forests, agrobiodiversity, cultural traditions, local food and the ways of life of diverse ethnic groups provide unique attractions for tourists. Such unique offerings not only bring tourists closer to nature, culture and community, but also provide income and employment opportunities for host communities and promote community-based enterprise.

The transboundary Khangchendzonga Landscape and Conservation Development Initiative (KLCDI) was established with the mission of promoting conservation and sustainable development through regional collaboration in the three

countries. Given this mandate, KLCDI is rightly positioned to facilitate and provide a platform to promote sustainable regional tourism cooperation through interventions at the transboundary level, especially community-based tourism and transboundary tourism circuits.

Community homestay development

Homestays are important community-based tourism products. They are a rapidly emerging form of tourism accommodation services, providing economic benefits to host families and communities through the use of family homes as traditional lodgings. In the Khangchendzonga Landscape, homestays are mostly operated and managed by women. In fact, women of all ages, from grandmothers to granddaughters, collectively

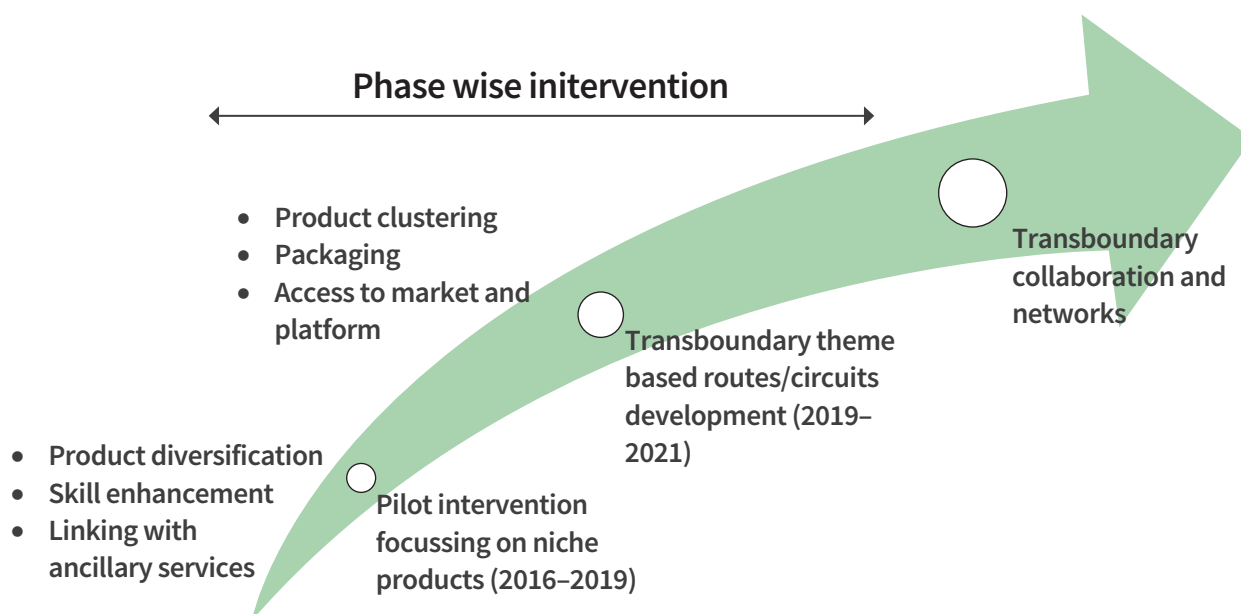
contribute towards operating the services, thus leading to greater and inclusive economic participation of women in the tourism enterprise. There is a growing demand for such tourism. In Bhutan, it is estimated that 68% of the population travels for experience of rural life, Dzongkhags, and festivals (TCB, 2018). In India, the annual growth for homestay-based tourism in the travel market range from 11-11.5% (Puri, 2018).

To develop and promote community homestays, KLCDI focused on promoting homestay based community tourism as one of the prioritized activities from 2016. Over the last five years, a total of 107 homestays – 70 in Bhutan, 18 in India, and 19 in Nepal – have benefitted through collaborative partnerships among government, private sector, and community. Using regional cooperation and networks as a strategic entry point, the scope for community-based homestays and tourism was explored and the development process underwent several phases (Figure 1).

inclusive growth and equitable benefit sharing. This was done through preparation of destination management plans and their integration into government plans of action, practice-based peer to peer learning opportunities through exposure visits, training and skill enhancement activities, and linking with income generation and enterprise development across different supply chains (handicrafts, food, guiding and interpretation).

With a successful pilot intervention phase, the scope and scale of homestay development has now expanded across the KL. From 2022 on, the focus will be on clustering and packaging of community-based tourism products such as homestay circuit development and enabling access to tourism markets and platforms through public-private-community participation. Bumthang-Wangdue Phodrang-Haa-Chhukha, Bhutan; Lachen/Lachung-Dzongu-Rumtek-Yuksom (Sikkim) and Samanden-Gorkhey-Phalut-Sandakphu-Darjeeling-Kalimpong (West Bengal), India; and Maipokhari-

FIGURE 1: Process towards community homestays development in the KL



Piloting, developing and diversifying tourism products

The pilot intervention in 2016-2019 focused on diversifying tourism products, enhancing capacity, and linking homestay operators with ancillary services – to create jobs, improve incomes, support enterprise development, and promote

Dobato-Jaubari-Meghma (Ilam) and Phalelung (Panchthar), Nepal have great potential to be developed as transboundary community homestay circuits through regional cooperation. The potential of such community-based tourism products also extends beyond the landscape. For instance, there are strong cross border community and heritage based tourism linkages between KL India and Bangladesh, in particular the Paharpur Buddhist

Circuit. Furthermore, the rhododendron circuits of Yuksom-Dzongri and Hiley-Barsey in the KL can be promoted for nature enthusiasts.

Stakeholders across Bhutan, India and Nepal have forged partnerships and work is already underway to develop and package homestay circuits, promote and market homestays through online platforms, build capacity to strengthen institutional and operational aspects of homestay management, and establish a homestay network.

Community homestay circuits

In Bhutan, activities have already begun with resources being leveraged from Bumthang, Wangdue Phodrang, Haa and Chhukha Dzongkhags, Tourism Council of Bhutan (TCB) and Association of Bhutanese Tour Operators (ABTO). In India, collaboration with the Govind Ballabh Pant National Institute of Himalayan Environment (GBPNIHE), Mutanchi Lom Aal Shezum (MLAS), Association for Conservation and Tourism (ACT) and Help Tourism Pvt Ltd is being strengthened. Likewise, in Nepal, co-designing and co-development of products and packages for transboundary community homestay circuit is being initiated in collaboration with the [Community Homestay Network](#) (CHN), [Red Panda Network](#), Maipokhari-Deurali Community Homestay Committee, Mabu-Dobato Community Homestay



Committee, Phalelung-Panchthar Ecotourism Committee, and the Sandakphu and Mai Jogmai Rural Municipalities.

Homestays have become a promising avenue to support rural economic diversification by offering tourists diverse products and services, including local food, organic and dairy produce, and the experience of rural farms and hospitality. The growing interest of youth in tourism and the support of local government, private sector, community and ICIMOD and its partners have been instrumental in community homestay tourism development in the landscape. With the pandemic ushering in new opportunities and prospects for and demand from domestic and regional tourism markets, rural destinations and community-based tourism products such as homestays are gaining a foothold in the mainstream tourism market.



STORY THIRTEEN

Yak genetic improvement through transboundary cooperation

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Background

The yak is an iconic species of the Hindu Kush Himalaya (HKH) region, exceptionally adapted to the harsh climatic conditions of the high mountains. The transboundary movement of yak and yak herders is critical for genetic exchange among yak populations from different areas. Unfortunately, closed borders and restrictions on grazing and movement have isolated yak populations for nearly seven decades. In the southern Himalaya – across parts of Nepal, Bhutan, India, and Pakistan – yak populations have suffered from inbreeding depression and reduced productivity. This leads to low quality of offspring, reproductive problems, and reduction in growth rate and body size, making yak populations less

adaptive to the changing environment and more prone to fatality, especially at a young age.

ICIMOD, through its Khangchendzonga Landscape and Conservation Development Initiative (KLCDI), has taken up yak as one of its thematic areas for intervention. Partners from Nepal, India, and Bhutan have unanimously endorsed the need for exchange of yak germplasm to harness the benefits of transboundary cooperation.

Starting from 2018, KLCDI organized several regional yak events including transboundary yak festivals, capacity building of herder groups/cooperatives, and exposure visits. These events provided opportunities to strengthen the regional network and enable cooperation and linkages

at different levels (herder to herder, government to government). In a collaborative move that bolstered yak conservation in the landscape, the Government of Bhutan handed over two best-quality breeding bulls to Nepal and one to Sikkim in 2020.

Building on the past

The yak genetic exchange programme of 2020 was made possible with lessons from 2005, when a bilateral yak exchange took place between Sikkim (India) and Bhutan. The Government of Bhutan gifted 30 good-quality yak to Sikkim. Their offspring were found to possess better genetic characteristics regarding body size, inter-calving period, and milk yield. Building on this past fruitful experience of genetic transfer and recognizing the need for greater transboundary cooperation to improve the yak gene pool in the region, KLCDI started a series of local and national consultation meetings and dialogues between stakeholders in all three countries and moved forward the process for necessary approvals for the exchange.

The process and status

The Department of Livestock, Bhutan, took the initiative to select five quality bulls aged 3 to 4 years from Haa and Paro districts of Bhutan. For the exchange, certain technical parameters had to be fulfilled as per the live animal import regulations of the Government of Nepal and the State Government of Sikkim, including disease-free status at the source, habitat, and the condition of the animals themselves. The National Centre for Animal Health, Department of Livestock, Bhutan, assessed the health status of the whole herd and collected blood and fecal samples. The samples were investigated in the laboratory to ascertain their disease-free status. The results were further cross-checked by the Bhutan Agriculture and Food Regulatory Authority (BAFRA) to ensure that quarantine requirements are fulfilled.

The Royal Government of Bhutan formally handed over two yak breeding bulls to Nepal and one to Sikkim at Tsento block of Paro district. The Government of Nepal and the Government of Sikkim observed a 14-day quarantine period to monitor the health of the breeding bulls before mixing them with local herds. The bulls in Nepal



are now being raised in yak herds at Charrate at an altitude of 3,560 masl in Panchthar district. They are under the care of the Panchthar, Ilam, Taplejung Yak Network and Phalelung Rural Municipality. In Sikkim, the bulls are being raised at the Zema Yak Breeding Station, Lachen, North Sikkim at an altitude of 3,100 masl. By mid-2021, the young bulls became potential breeding sire and have successfully bred with several cows that are due for calving in the spring of 2022.

The yak germplasm exchange programme was a historical event on transboundary cooperation among Bhutan, India, and Nepal. Representatives from the three countries agreed that the programme will benefit the transboundary cooperation among the three countries in livestock genetic exchange and other genetic resources in the future. This germplasm exchange among member countries is in line with KLCDI's broader vision of establishing a HKH Yak Network.

The yak were handed over by Dasho Tenzin Thinley, Governor, Paro district. Banshi Sharma, former Director General of the Department of Livestock Services, Government of Nepal, led the delegation from Nepal. Diki Lepcha, Department of Animal Husbandry, Livestock, Fisheries and Veterinary Services, Government of Sikkim, led the delegation from India, and Nakul Chettri, Programme Coordinator, KLCDI, ICIMOD, led the team during the germplasm exchange programme.

Key messages

- The Khangchendzonga Landscape Conservation and Development Strategy and Regional Cooperation Framework (ICIMOD, 2017) endorsed by the three member countries (Bhutan, India, and Nepal) was crucial for policy support in implementing the yak exchange programme as live animal transport across

borders invokes sections of the Biodiversity Act and Material Transfer Agreements of/between the respective countries.

- Preparatory groundwork was initiated a year ahead in terms of organizing exchange visits and facilitating transboundary yak festivals – all of which helped in building rapport and trust and served as an advocacy tool to influence policy makers on the role, significance, and critical status of yak husbandry in the region.
- The yak exchange programme was profitable for all stakeholders involved. Local communities are satisfied with access to high-quality breeding bulls that will improve milk, meat, and wool productivity of their herds, government line agencies and partners were able to address the urgent needs of yak herding communities, and ICIMOD was able to fulfill its mandate of facilitating transboundary cooperation among member countries.

Acknowledgement

We would like to thank the Royal Government of Bhutan for providing quality yak bulls to Nepal and Sikkim. We wish to thank all individuals from government and partner institutions who were directly and indirectly engaged in facilitating the exchange programme.

About G.B. Pant National Institute of Himalayan Environment

The G.B. Pant National Institute of Himalayan Environment (NIHE), formerly known as G.B. Pant Institute of Himalayan Environment (GBPNIHE), was established in 1988. The mandate includes to undertake in-depth research and development activities on front running environmental problems, and to develop and demonstrate technology packages for sustainable development of the region. Over the years, the Institute has emerged as focal agency to advance scientific knowledge; evolve integrated management strategies and demonstrate their efficacy for the conservation of natural resources; and ensure environmentally sound development in the entire Indian Himalayan Region (IHR). The NITI Aayog, Ministry of Environment & Forests, Government of India, and many research and development international organizations have recognized the Institute as a nodal agency to implement research and development programmes across the IHR.

Objectives: Undertake in-depth research and development studies on environmental problems of the IHR. Identify and strengthen the local knowledge of the environment, and contribute towards strengthening research of regional relevance in the scientific institutions, universities/ NGOs/ voluntary agencies working in the Himalayan region, through interactive networking; evolve and demonstrate suitable technology packages and delivery systems for sustainable development of the region, in harmony with local perceptions.

The institute has a decentralized set up, with its headquarters in Kosi-Katarmal, Almora, and at five other regional centres - Garhwal Regional Centre (Srinagar); Himachal Regional Centre (Mohal-Kullu); Sikkim Regional Centre (Pangthang-Gangtok); NE Regional Centre (Itanagar); Ladakh Regional Centre (Leh-Ladakh); and the Mountain Division (at MoEF&CC, New Delhi).

About Sikkim Regional Centre

The Sikkim Regional Centre (SRC), formerly known as Sikkim Unit of the institute was established in Gangtok, Sikkim in 1989. In 2004, SRC campus was made functional at Pangthang (2000 m, asl), at a distance of about 15 Km from Gangtok covering an area of 17 acre land. Facing the mighty Mt. Khangchendzonga, SRC is well equipped with basic support facilities for research and development activities. This includes, laboratories, a gamut of nurseries, herbal garden, arboretum, rural technology centre, residential quarters, etc. The arboretum (10 acres area) houses over 100 native tree species, along with numerous shrubs and herbs, bamboo groves, Rhododendron's conservatory, medicinal plants and multi-purpose tree habitat zones, with over 100 inhabiting and visiting birds and small mammals. The broad focus of SRC is on: Biodiversity conservation and management, biotechnology applications, capacity building, climate change studies, ecosystem services, knowledge base development, and sustainable environmental development. SRC has been taking up activities with research and development on the environment and development in Sikkim and hilly region of West Bengal (Darjeeling and Kalimpong districts including foothill parts of Alipurduar and Jalpaiguri districts). The center has succeeded in bringing out several knowledge products as peer reviewed papers in reputed scientific journals, popular articles, books/booklets, and technical reports. The center is now attempting to build a strong-network of partners for delivering research and development products that serve policy and planning process in Sikkim.

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