

EASTERN HIMALAYA

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Low carbon energy options in the Indian Himalaya: Unlocking Energy Potential through Integrated Energy Storage Systems



Dzongu: view from Mangan - Abriti Moktan

The Indian Himalayan region holds vast potential for low carbon energy generation. With an impressive 149 GW of hydropower potential, 79% of which lies within these mountains, the region can play a pivotal role in decarbonising power generation. However, the current development of hydropower projects without Electrical Energy Storage (EES) mechanisms has led to unforeseen environmental and social implications.

Sikkim, has a potential of 8000 MW of hydropower, yet it grapples with significant transmission and distribution losses and energy deficits during lean seasons. While the monsoons bring surplus energy due to ample water flow in rivers, the state's per capita energy consumption remains low at only 265 kWh peak compared to the national average of 1150 kWh peak. Despite fulfilling its energy demand, the rural areas of Sikkim still receive less than 20 hours of power supply per day.

Addressing these challenges requires the development of integrated EES systems. Currently, Sikkim has 20 operational hydroelectric projects with a combined capacity of 2321.2 MW and several others in the pipeline. However, concrete efforts have yet to be made to enhance energy security through EES implementation.



Interaction with the Sneha Kinetics' management officials at the powerhouse of the Dikchu Hydroelectric project. - Pema Lepcha

Pumped Storage Hydropower (PSH) emerges as a promising solution. PSH facilities consist of twin reservoirs, enabling surplus energy generated during peak hours to pump water from the lower to the upper reservoir. During off-peak hours, solar energy can then be utilized to pump water back, harnessing the potential for round-the-clock energy generation and storage. Implementing PSH and other integrated EES technologies in the Himalayan region would not only enhance energy security but also pave the way for more sustainable power generation. It would enable better management of energy surpluses during monsoons and bridge the gap during lean seasons, reduce reliance on thermal power sources from where Sikkim had an entitlement of 108 MW in 2022 and curb greenhouse gas emissions.

As we move ahead, unlocking the energy potential of the Himalayas through the development of Energy Storage Systems will prove

to be a significant step in the journey towards a low-carbon power sector. With the release of detailed guidelines on pumped storage hydropower policy by the [Ministry of Power](#) government of India, there is an opportunity for the Himalayan region to carve out a mountain specific PSH policy which would not only provide investment signal in this foundational technology for renewables but also ensure energy security for the region. Embracing innovation and renewable energy technologies such as PSH in harmony with environmental conservation may have the potential to lead us towards a low carbon future.

However, it is imperative to take into consideration the civil societies' movement in Sikkim which have highlighted the lack of inclusion of the local communities in the decision making processes, the differential access to developmental activities and the long term environmental repercussions of cascade hydro development in the state. Therefore, development of any form of EES system must be inclusive of the Gender Equity Disability and Social Inclusion (GEDSI) elements for an equitable and environmentally just transition to "Decarbonisation of Power."

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the water security issues in Sikkim with a special focus on the non-climatic factors determining the access to water in the region was laid out. This was followed by an intensive discussion on the water security issues in the region where the local stakeholders actively participated by voicing their lived experiences and concerns. The major output of the workshop was the concerns raised and recommendations from the local communities to ensure water security. Additionally the adaptive capacities of the local communities were also voiced which has been a driving force for their survival in a region with acute water shortage.

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City nature Challenge, 2023 (CNC23)



CNC23 Participants in Gangtok - Rohit George

Restoring Springsheds: A Pathway to Water Security - Dialogue with Sanga-Dorjee GPU



Participants at the meeting venue in Rinchenpong - Bren Kumar

This grassroots dialogue with the local communities was organized by Balipara Foundation in collaboration with ATREE, Khanchendzonga Conservation Committee, Yuksom and Sanga-Dorjee Gram Panchayat Unit (GPU), Rinchenpong, West Sikkim on 8th June 2023 in collaboration. The main objectives of the dialogue was to understand the community perspective on water sources and water insecurity issues, restoration and role of forests as spring sheds for water source sustainability, and to discuss innovative local practices adopted by communities to address water shortage. Firstly, context setting of

The City Nature Challenge is an international effort for people to document plants and wildlife in cities across the globe. It's a bioblitz-style competition where cities are in a friendly contest with each other to see i) who can make the most observations of nature, ii) who can find the most species, and iii) who can engage the most people. The activities included visiting forested/green areas within the city/town premises photographing plants and animals, and uploading in iNaturalist, a citizen science platform. 60 and 58 people, mostly students, participated from Gangtok and Darjeeling respectively, on 29 - 30 April. Overall in terms of observations contributed, Darjeeling ranked 13th and Gangtok 14th out of the 93 participating cities and towns from India. Details of the data contributed are in the table below.

District	Observations	Users	Unique Taxa	Species Recorded
Darjeeling	1,641	58	483	280
Gangtok	1,614	60	604	292

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World Environment Day 2023, at Selimbong Tea Estate, Darjeeling



Participants at the plantation drive in Tiffin Dara - Tenzing Sherpa

ATREE, Darjeeling observed World Environment Day on 5th June 2023 at Tiffin Dara, Selimbong TG, Darjeeling. There were more than 90 participants comprising Self-Help Groups, Tea garden management and students from Pokhriabong, Darjeeling. The aim of the event was to create awareness, supporting plantation of indigenous tree species

As part of the theme of this year's World Environment Day 2023-"Beat Plastic Pollution", the program started with an awareness program with focus on waste management and segregation at source by chief guest Shri Abinash Rai, Manager, Selimbong Tea garden, Darjeeling followed by key note from Mr. Sanjay Rai, Teacher of Pokhreybung Boys Higher secondary school, who highlighted the importance of waste management. Clean up and tree plantation activities were actively taken up by all participants. 664 indigenous multipurpose saplings, like *Michelia cathcartii*, *Alnus nepalensis*, *Machilus edulis* were planted on this day.

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Combating Pangolin Trade across the Indo-Nepal Border

The Indo-Nepal transboundary meeting on "Combating Pangolin Trade across the Indo-Nepal border" supported by Ocean Park Conservation Foundation, Hongkong (OPCFHK) and Save Pangolins, US, was held on 24th-26th May 2023 at Tukre, Sagmaru Tea Garden, Darjeeling by ATREE as part of the project titled "Addressing the trade of Chinese Pangolin (*Manis pentadactyla*) transboundary landscapes: Darjeeling, Eastern Himalayas, India, bringing together relevant stakeholders from both the countries (Nepal: Ilam district and India: Darjeeling district) to share



Indoor Session on Transboundary Pangolin trade - Susadhna Gurung

information, coordinate, discuss and identify actions to curb the illegal cross-border trade of Pangolins which can be intercepted through strong coordination between the official and local residents of both the nations. The two-day meeting was attended by representatives from various government sectors such as District Forest Office, Ilam, Armed Police Force, Nepal, Customs Department, Nepal, Darjeeling Wildlife Division, Darjeeling Forest Division, Sashastra Seema Bal (SSB, India), Darjeeling Police and Tea Management, Darjeeling along with the participatory representatives from non-government organizations which included TRAFFIC India, WWF-Darjeeling, Greenhood, Nepal, Ilam Cooperation Council (ICC, Nepal), GVCLC Nepal and Mountain Organization, Nepal. On the first day, three presentations were put forward by Dr. Sunita Pradhan (ATREE), Ms. Astha Gautam (TRAFFIC India), and Mr. Kumar Paudel (Greenhood NGO, Nepal) to discuss the distribution, ecology, and trade scenarios related to Pangolins in India and Nepal which was followed by a workshop where group discussions were carried out to identify the local level challenges and opportunities/enablers for transboundary coordination to curb Pangolin trade. The possible steps/actions that can be taken at the local level to curb transboundary Pangolin trade were discussed on the second day. Based on the outcomes of the two-day meeting a report identifying key action points was devised by ATREE and shared with all the participants for further reference.



Participants at the Transboundary meeting - Susadhna Gurung

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International Workshop on Pumped storage hydropower (PSH) in the Himalayan region



Interaction with the Panchayat President at Phodong village - Pema Lepcha

The long-term objective of the PSH project, led by the Australian National University, is that Bhutan, Nepal, and Sikkim state have sufficient environmentally and socially sustainable PSH and other electrical energy storage (EES) to support 100% renewable electricity grids. The project is examining the potential for PSH to underpin renewable energy development of the national/state energy systems.

Under this project international workshops on PSH were held for a week each in Sikkim, Bhutan and Nepal from 23rd April 2023 to 13th May 2023. The main objectives of these workshops were to raise awareness about opportunities and need for electrical energy storage to facilitate uptake of solar as the cheapest electricity generation technology available; raise awareness about the opportunities offered by PSH for the Himalayan region, and discuss concerns relating to Gender Equity Disability and Social Inclusion (GEDSI), and environmental implications of solar and PSH rollout in the countries. These workshops focussed on capacity building and knowledge sharing with key government, civil society and electricity sector stakeholders.

In conjunction with the workshops we had potential PSH site visits in each country to get a first-hand experience of their challenges and needs. In Sikkim we visited the Dikchu hydroelectric plant and the reservoir area, and also visited the panchayats in Lingdok and Phodong villages. In Bhutan we visited the potential site in Geneykha and in Nepal we visited the Kulekhani reservoir. In all the three countries we had intensive discussions with the local communities and drew heavily from their lived experiences. In Sikkim the local stakeholders had a lot of concern towards the development of PSH considering the negative implications of the existing cascade hydel development. However in Bhutan and Nepal they were positive about PSH development in their areas.

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Promoting bird tourism in Rimbick, Darjeeling



Participants using Merlin Bird ID app to identify birds - Aditya Pradhan

Promoting bird tourism in key sites of the Darjeeling Himalaya can be crucial for conserving birds in human-dominated landscapes. Bird tourism generates interest and awareness among local communities, and provides economic incentives, creating livelihood opportunities and motivating locals to protect key habitats. Increased demand for birding sites leads to the implementation of conservation measures, including habitat restoration and sustainable land-use practices. Thus, creating a win-win situation, benefiting both communities and bird conservation in the face of changing landscapes.

ATREE in collaboration with Rimbick Nature Guide Association, through the Rufford Small Grants project "*Conserving and monitoring woodpeckers and other birds in the differently-managed forests of Darjeeling, Eastern Himalaya, India*", organized a two-day Birding Guide Training in Darjeeling. The training was carried out in Smriti Bhawan, Rimbick Bazaar on 29th and 30th April, 2023. Aiming to promote bird tourism, 19 local guides were trained in bird identification and guiding skills. They were also introduced to regional flora and fauna through technical and field sessions. Notably, the participants identified 48 bird species, including the Greater Yellownape *Chrysophlegma flavinucha* and Bay Woodpecker *Blythipicus pyrrhotis*. This initiative is expected to empower the local community, foster conservation efforts, and encourage sustainable bird tourism in the differently-managed forests of Darjeeling.

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Meeting for developing a field manual for oak restoration in Sikkim



Stakeholder meeting in Gangtok - Bren Kumar

An expert group meeting was conducted on 28th May, 2023, at Forest Secretariat, Deorali, Gangtok, for preparing a field manual for oak restoration in Sikkim. 11 participants representing Forest and Environment Department, Government of Sikkim, West Bengal Forest Department, and representatives of other institutions such as Khangchendzonga Conservation Committee, Botanical Survey of India, Department of Science and Technology, Sikkim GB Pant National Institute for Himalayas Environment, Sikkim Regional Centre participated in the meeting. The meeting highlighted the need for ensuring that the manual was simple enough to be used by field level staff and community members.



Field visit to a nursery

Following the meeting a field visit was organised on 16th June 2023 at Deorali Forest Nursery, Ravangla, Namchi Wildlife Division, with the objective to witness and learn about the various nursery practices adopted by the Forest Nursery for the propagation of oak seedlings. 12 participants representing Forest and Environment Department, Government of Sikkim, representative of local organization (Khangchendzonga Conservation Committee) and Sikkim University, participated in the visit. The observation on the propagation methods adopted by the nursery helped in knowledge building with regard to appropriate nursery practices. The visit largely helped to incorporate important details in the handbook from a field level perspective.

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Bat Call Reference and Library Development



SM4BAT FS placed on a tree to record echolocation call of free-flying bats - Deoashis Thapa

Like birds, bats can also be identified through sound. The echolocation calls produced by bats to navigate, and forage are ultrasonic sounds below our hearing range.

Echolocation calls can be recorded using ultrasonic recorders called bat detectors. There are different detectors and software by different companies to record and analyse echolocation. We use Wildlife Acoustics' Song Meter range of devices to record and Kaleidoscope software to analyse the call data.

For these recordings to be useful, we need to be able to identify these calls to a species level. To this end, through the National Mission on Himalayan Studies and Bat Conservation International Student Scholarship, we recorded release calls of bats captured during mist net and of free-flying to build a call reference library for the Darjeeling-Sikkim Himalaya landscape. The identified calls will then be uploaded to ChiroVox, a database for Asian bat calls, and licensed under CC BY-NC-ND to be freely accessible for non-commercial use. This will enable researchers and citizen scientists alike to use non-invasive techniques to study bat ecology in the region.

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New Publications:

1. Scott, C. A., Khaling, S., Shrestha, P. P., Riera, F. S., Choden, K., & Singh, K. (2023). Renewable Electricity Production in Mountain Regions: Toward a People-Centered Energy Transition Agenda. *Mountain Research and Development*, 43(1), A1-A8.
2. Bida, Y. B., & Pradhan, A. (2023). A daytime observation of a Spotted Linsang *Prionodon particolor* in Namdapha Tiger Reserve, Arunachal Pradesh, India. *Small Carnivore Conservation*, 61.
3. Opinion: Why Sikkim is crisscrossed with pipes that run dry Abriti Moktan and Sarala Khaling

New Grants:

1. Orchard development and allied livelihood support activities in Darjeeling district supported by National Bank for Agriculture and Rural Development (NABARD), Kolkata Regional Office
2. Addressing the information gap on the Critically Endangered Chinese Pangolin, *Manis pentadactyla* in West Bengal, India supported by West Bengal Biodiversity Board, Kolkata



Enchanting Beauty of the Eastern Himalaya: A Green Dragontail butterfly (*Lamproptera meges*) mud-puddling. They have a fluttery flight pattern, often flying low near the ground or water sources. This individual was photographed on the highway to Walong in Anjaw, Arunachal Pradesh - Rohit George

ATREE's mission is to promote socially just environmental conservation and sustainable development by generating rigorous interdisciplinary knowledge that engages actively with academia, policy makers, practitioners, activists, students and wider public audiences. ATREE's Northeast / Eastern Himalayas Programme has a direct presence in the Darjeeling and Sikkim Himalaya with a range of local partners in the other states of North East India.

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