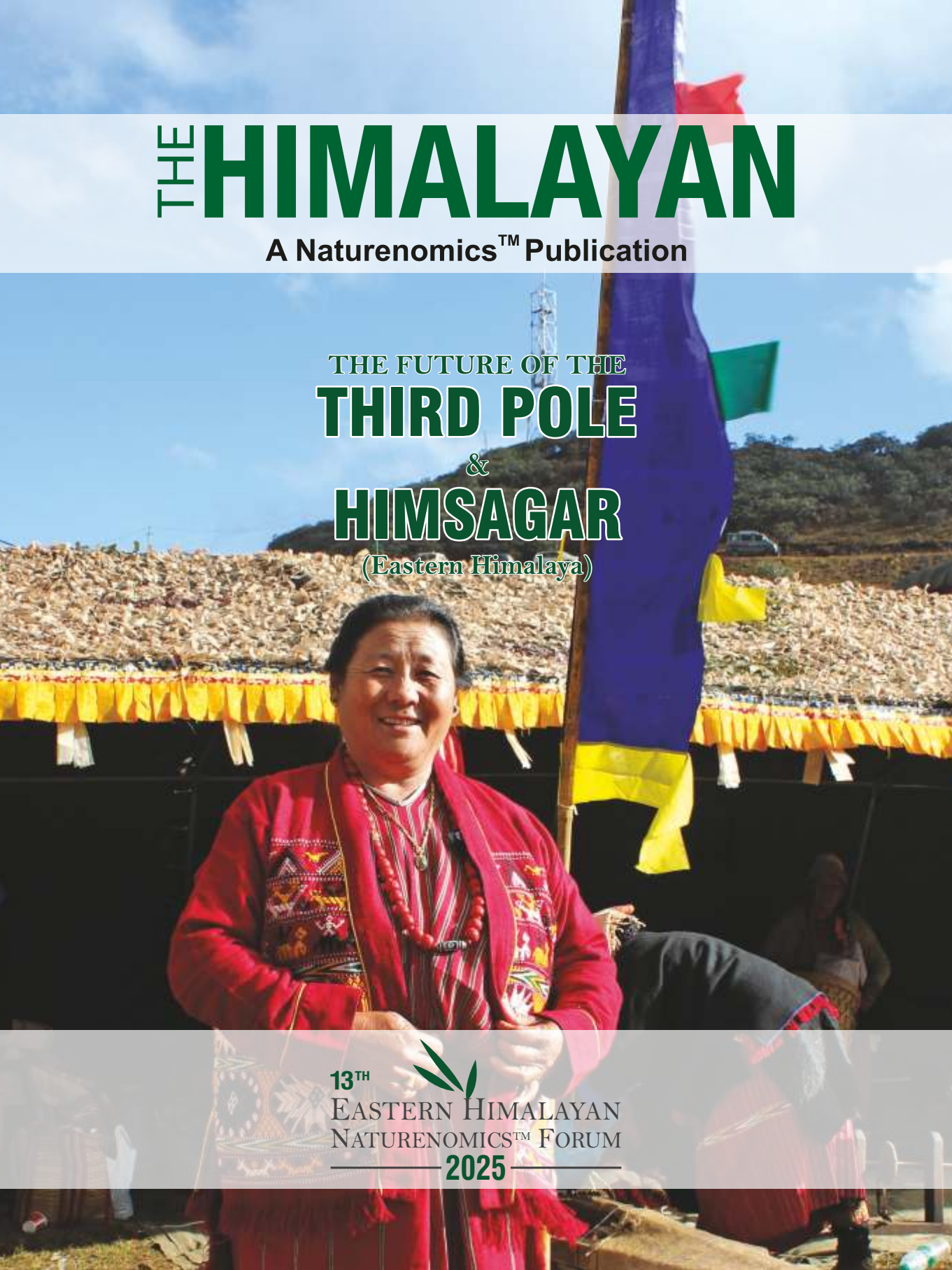
THE HIMALAYAN

A Naturenomics™ Publication



THE FUTURE OF THE THIRD POLE & HIMSAGAR (Eastern Himalaya)

13TH EASTERN HIMALAYAN NATURENOMICS™ FORUM 2025

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NATURENOMICS™ FORUM
10th & 11th December, 2025

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(Eastern Himalaya)

BALIPARA FOUNDATION
Assam • India

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Foreword

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The Eastern Himalaya and the larger Third Pole region occupy a unique place in Asia's ecological and cultural identity. Stretching from the Tibetan Plateau to the river plains of Northeast India, Bhutan, Nepal and Bangladesh, this vast landscape shapes the monsoons, regulates water systems, anchors biodiversity, and sustains millions of people, many of whom live in remote, fragile geographies. In the Northeast, the region's rhythms are inseparable from the forests, wetlands, rivers and mountains that surround daily life. From the shifting courses of the Brahmaputra and Dibang to the forested slopes of Arunachal Pradesh, these landscapes are not abstractions; they are the basis of food, cultural memory, livelihoods and security.

Yet today, this region stands at an inflection point. Glacier retreat, erratic rainfall, shifting river patterns, deforestation, rapid urbanisation, and land degradation are altering the landscape faster than communities can adapt. What we are witnessing is not only environmental change,

but a transformation in the very systems that support life in this region. As temperatures in the Third Pole rise faster than the global average, the Eastern Himalaya is already experiencing the first fractures in the stability it has long offered to Asia.

This is where the Naturenomics™ approach becomes essential. By recognising natural ecosystems - forests, wetlands, grasslands, rivers, as economic assets that sustain long-term wellbeing, Naturenomics™ reframes the value of ecological systems in terms of natural capital. In a region where communities have always depended on the land for their livelihoods, this perspective is neither new nor abstract. It echoes indigenous systems of stewardship in the Northeast, where forests are managed collectively, rivers are treated as living entities, and land is governed through customary laws that emphasise balance over extraction. The challenge now lies in scaling these principles in a rapidly changing economic and climatic context.

This edition of *The Himalayan* brings together diverse voices - scientists, youth leaders, academics, policymakers, practitioners, and community storytellers, to examine how the Third Pole can be reimagined in the face of unprecedented change. Rather than framing the region only through the lens of crisis, the magazine aims to present a broader picture: one that brings together scientific insights, community knowledge, and emerging innovations that are shaping the future. Each section speaks to a different dimension of this transformation, from climate frontlines to rewilding, infrastructure, and technology.

In the Northeast, these transformations are already visible. River-dependent communities in Assam are witnessing shifts in fish catch, changing soil textures, and unpredictable floods. Highland pastoralists in Bhutan and Arunachal Pradesh are adjusting their migration cycles as grazing pastures change. Farmers across the region are diversifying crops and reviving traditional varieties to cope with shorter growing seasons and unfamiliar weather patterns. At the same time, young people are emerging as a strong force, restoring forests, using drones for biodiversity monitoring, documenting climate impacts, and anchoring new forms of community-led conservation.

Across the region, the balance between tradition and innovation has never been more important. Traditional ecological knowledge, whether in the form of agroforestry, stilted homes, bamboo engineering, or community-managed forests offers tested models of resilience. When combined with modern tools like remote sensing, AI-driven ecological modelling, and participatory digital platforms, these traditional systems can do more than react to climate impacts, they can anticipate and prevent them.

Ultimately, the future of the Third Pole will depend on the interplay between people and ecosystems. Sustainable land futures cannot be achieved through policies alone; they require lived experience, shared stewardship, and a recognition that natural capital forms the foundation of economic and social stability. By amplifying stories, science, and solutions emerging from across the region, particularly from the Eastern Himalaya — *The Himalayan* hopes to contribute to a deeper understanding of what it means to shape a regenerative, resilient future for Asia's ecological heartland.

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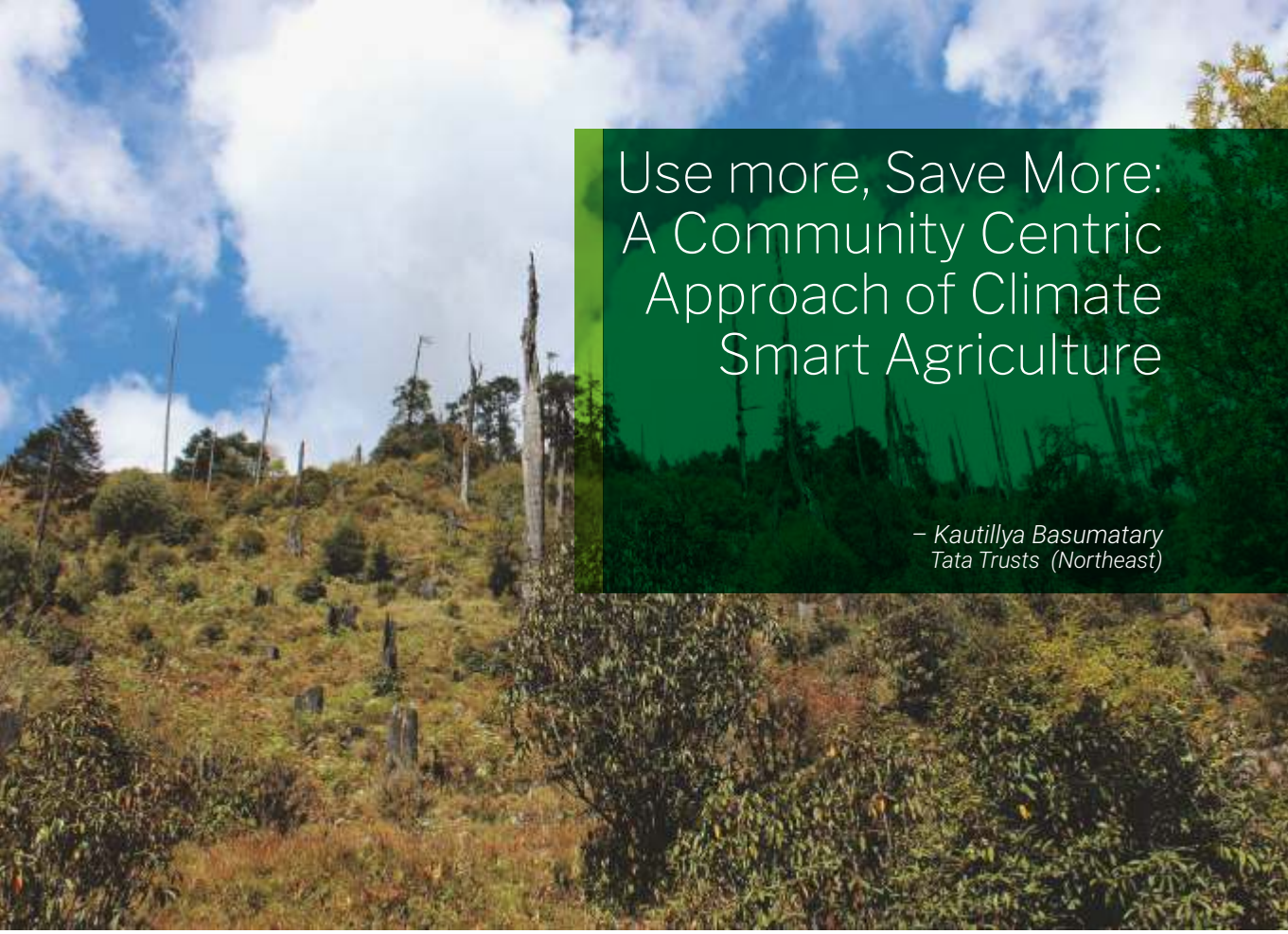

Use more, Save More: A Community Centric Approach of Climate Smart Agriculture

– Kautillya Basumatary
Tata Trusts (Northeast)

Boko, a block in Kamrup (Rural) district of Assam is home to some of the oldest tribal communities of the state. The block is majorly inhabited by people belonging to the Bodo and Rabha communities. The communities have been an agrarian economy since time immemorial. But with the advent of time, the people have also been slowly getting engaged in organized and unorganized sector. Still the households are mostly dependent on agricultural and livestock practices as the major source of livelihood.

Adherence to traditional methods of agrarian practices have been a bottleneck for the communities in improving their socio-economic conditions. The communities mostly practice a mono cropping system with one cycle of paddy per year. But with the change of the climatic conditions, these practices have also been getting effected lately. Changes in the climatic conditions like erratic rainfall, longer dry spells have been slowly negatively impacting the mono cropping of rice. This has gradually left the communities high and dry in terms of income

generation from their primary source of livelihood.

Lack of access to knowledge and awareness about better agriculture practices adds further to the hurdle. This has been slowly leading towards reduced agriculture production and productivity. In terms of livestock, piggery is the major practice. But the communities still practice unproductive or rather less remunerative methods of rearing. In the face of these limitations, the communities also have scope of improvement as they have ample resources in terms of the land available in their homesteads in addition to the agricultural land. Traditionally the tribal households of the block have been having large homesteads which were either lying underutilized or have been utilized in a very limited manner for areca nut plantations. The areca nut plantations although acted as a supplementary source of revenue generation, the income from this source is yearly and quite meagre.

Centre for Microfinance & Livelihood (CML), in the year 2017 decided to engage with the tribal communities in the area to intervene in agriculture and livestock with the aim of irreversibly uplifting the socio-economic conditions of the households. Being located in the foothills of Meghalaya the area is quite suitable for cultivation of high value crops like spices. Post intense engagement with the different communities and studying the local climatic conditions, the opportunity emerged in innovatively intensifying the existing orchards in the homesteads of the communities. The strategy was also to expose the communities to farming practices which would be more adaptive to the changing climatic patterns.

The model that was developed was to intensify the arecanut orchards with Black pepper as the companion crop. Further to utilize the inter row spaces of the arecanut plantations short term remunerative crops like Pineapple and short duration crop like Assam Lemon were introduced. As on date, around 4600 Households spread across more than 20 villages have successfully adopted this innovative model. While the Black pepper starts to bear in an economically profitable manner from the 4th to 5th year onwards, pineapple can be harvested annually. Further Assam lemon starts to bear profitably from the 2nd to 3rd year onward. Over the period of years of interventions, other horticultural crops were also introduced utilizing the additional homestead land wherever available. These crops included season cucurbitaceous crops as well as high value papaya varieties like Red Lady. Picking up from the success of these crops, the communities now have also initiated cultivation of other spices like ginger and turmeric in rotation in their agricultural lands.

One of the key components for successful adoption of the package of practices by the communities have been the combined contribution of different crucial stakeholders. A deep diving mobilization drive followed by onboarding of suitable interested farmers laid the foundation for the interventions. Intensive hands on, on ground trainings enabled the farmers in exposing themselves to the improved package of practices. This was followed by sensitive support mechanism of Community Resource Persons (CRP) providing a round the clock follow up support locally. The Community Resource Persons are locally identified progressive farmers or community members with a keen sense of giving back to their community for development of their local areas.

While introduction of the crops and improved package of practices were being undertaken a conscious effort was put in to reduce chemical dependency through promotion of organic manures and pesticides. This resulted in lowering investment and application of chemicals. Another crucial area that also required addressing was the availability of water for agricultural practices. Although the area receives ample rains during the monsoon season, during winter, the area witnesses long dry periods. In order to cope up with this challenge, moisture management through use of organic mulching practices by locally available materials and development of water conservations structures like Jalkunds were introduced. The Jalkunds are 18 feet by 10 feet dug out pond with a depth of 4 meters. Lined with 200 GSM plastic, the structure has the capacity to hold 10,000 litres of water with a life cycle of 3-4 years. Accessibility to solar powered pumps enabled the farmers in continuing their agricultural practices in their orchards during the lean periods too.

The program also aimed at addressing the risks associated with the agricultural production practices like crop loss. This has become ever more relevant and important with the changing weather patterns resulting crop damage and reduced production. A pilot on satellite-based crop insurance for black pepper has been implemented across 135 acres of land covering more than 200 households. The pilot has received positive response from the communities and efforts are underway to increase the coverage of the crop insurance.

The program has resulted in the communities now practicing agriculture methods which are putting them in a vantage position of being more adaptive/resilient towards the climate change impacts. The blend of integrating their traditional practice of arecanut orchards with intercrop intensification also made it easier and beneficial for the communities to layer a new practice into the existing one. In the words of Nijara Boro, one of the farmers of the program, regarding the new method of intensification her views has been 'We always have been cultivating crops like pineapple and assam lemon, but it was in different plots of land. This most of the times was a limiting factor for us since we had to venture into new areas to undertake cultivation. Such land is also forest area so it comes with own challenges of animal destroying crops, difficulty in management because of distance etc. The method of Orchard Intensification has really come as blessing as now we can grow more crops in our own homesteads and in the same plot of land and earn more.'

Through this innovative model of land optimization and orchard intensification, the households on an average have been able to touch an additional annual income of Rs. 60,000 to Rs. 80,000. This has been an enabling factor for the households in further strengthening the socio-economic conditions.

The approach for this model of intervention is based on promoting climate smart agricultural practices among the tribal communities. Enhancing the agricultural diversity through multiple cropping has been steadily leading to increased agriculture resilience. The diversification of the agricultural practices is resulting in optimization of land utilization. The 'Use more, Save more' approach of increasing production and productivity by optimal use of same plot of land is also addressing a important factor of reducing the dependency of the communities on the forests thereby preventing land use expansion into the forest areas and deforestation.

From Many Small Steps to Lasting Resilience: Redundancy-Driven Infrastructure in the Eastern Himalayas

– Preetish Kakoty
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In today's globalized economy, seamless connectivity through physical and digital infrastructure is essential. Robust systems such as all-weather roads, reliable electricity grids, and efficient water networks enable communities to function, pursue sustainable growth, and deliver critical services like healthcare. Yet, these systems are interconnected in complex ways, which results in even small failures in one component triggering cascading effects in others. For instance, a power station outage may disrupt critical healthcare services, drinking water supply, and emergency communication services for a large region. Therefore, reliable and robust infrastructure design should be at the forefront of sustainable growth journey.

Designing infrastructure to remain functional, especially during extreme events such as floods or earthquakes, however, is not trivial. It presents three key challenges: geographical and administrative limitations, tension with ecological conservation, and disaster resilience. This article highlights all three, but focuses on the third challenge, disaster resilience, with a special

focus on the eastern Himalayan context. A conceptual framework is discussed, which can inform technological and policy interventions, emphasizing redundancy as a guiding philosophy.

Geographical challenges stem from difficult terrain, limited resources, and weak administrative capacity. As a result, many communities in the eastern Himalayas continue to lack equitable infrastructure access despite technological advances. In India's northeastern states, just under one-third of all roads are paved, far below the 70 percent national average. On national highways, only about 50 percent feature at least one lane in each direction, compared with 80 percent countrywide. And when it comes to internet access, six of the eight northeastern states rank among the bottom half nationwide. While these statistics do not establish causation, they illustrate persistent access gaps linked to geography and governance.

The second challenge involves balancing infrastructure development with environmental protection. In the eastern Himalayas, a region of unique ecology, culture, and geopolitics, infrastructure projects often clash with conservation goals. These tensions are exacerbated by top-down decision-making and the lack of cross-border policy coordination. Collaborative planning rooted in local knowledge and two-way communication is essential to achieve equitable and sustainable outcomes.

Another pressing challenge, and the focus of this article, is disaster resilience. The eastern Himalayan region not only hosts exceptional biodiversity but is also exposed to diverse natural hazards, including floods, storms, and landslides. With shifting climatic conditions changing the spatial and

temporal patterns of such events, the region faces unprecedented challenges from extreme weather events. Additionally, the eastern Himalaya region lies in one of the world's most seismically active zones, where the Indian and Eurasian tectonic plates collide. Ensuring infrastructure can withstand both geological and climatic threats demands flexibility, ingenuity, and innovation.

Disaster risk arises from the intersection of three processes: hazard, exposure, and vulnerability. Hazard is the occurrence of geological or climatic events that have the potential to cause harm to people and their surroundings. Exposure is understanding who and what is in harm's way. And, vulnerability, captures the degree to which individuals, communities, or systems are likely to suffer harm when exposed to the hazard. Vulnerability is multi-faceted, often shaped by social, cultural, institutional, and financial circumstances that shape the lives of the exposed communities and their assets. This article discusses a risk-based framework that underpins on understanding these three processes, and turn the gaze from the uncontrollable, i.e., the occurrence of hazard and their intensity, to the manageable, i.e., the exposure and vulnerability from these hazards.

While hazards are largely natural, exposure and vulnerability are products of human decisions and actions (or lack thereof). Rapid urbanization, resource inequity, infrastructure aging, and administrative fragmentation all contribute to changing risk. This makes risk reduction a continuous, strategic process that is ever evolving — one that must be informed by state-of-the-art

data, community wisdom, and long-term policy commitment.

Hazard monitoring and forecasting play a critical role in understanding and reducing risk. Advancements in data collection and analytical tools have strengthened our capacity for disaster preparedness, mitigation, and response. Sophisticated computer simulations—built on robust physical and statistical models—help identify where and how future hazards may occur. These models enable the detection of key risk drivers, guiding targeted interventions.

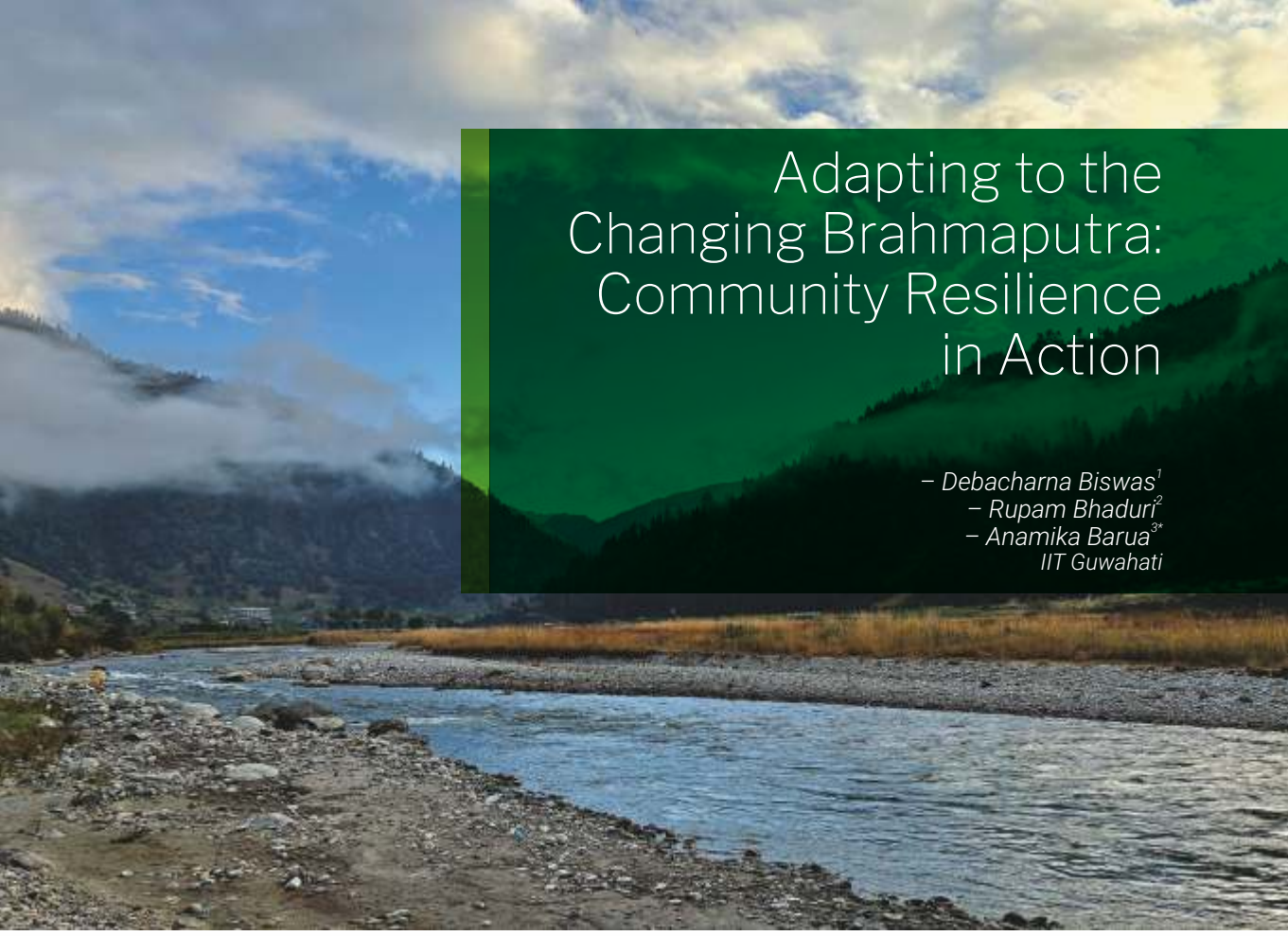
Such tools help map exposure to hazards and reveal vulnerabilities within infrastructure and communities. They can also inform decisions to restrict future development in hazard-prone areas, reducing the accumulation of risk over time. These insights support long-term strategies including land-use planning, siting of relief infrastructure, and the retrofitting of existing systems.

Importantly, risk models do not replace community knowledge, but they complement it. When integrated with local experience and traditional insight, these models create multiple layers of understanding risk. This multiplicity of knowledge pathways is a form of redundancy, which strengthens our ability to respond to and recover from disasters.

Redundancy can be physical: backup power systems, multiple bridges, or parallel transport routes, but also social and financial. Community awareness programs, emergency preparedness plans, and innovative financial instruments like parametric insurance create redundancy in response capacity.

While redundancy may seem inefficient in normal conditions, it is essential during crises. In some ways or the other, redundancy reduce vulnerabilities of our systems, and thereby our communities. And that has positive implications on future risk from disasters.

Ultimately, risk reduction and resilience planning is not about finding a single solution. It is about a series of small, informed actions that collectively reduce risk and move the needle in the right direction. In a world of uncertainty, strategic redundancy that is in-built within infrastructure, policy, and community practices, can help minimize harm and support recovery when disasters strike. Risk reduction and resilience planning, after all has no clear destination, but the pursuit of the journey itself.



Adapting to the Changing Brahmaputra: Community Resilience in Action

– *Debacharna Biswas*[1]
– *Rupam Bhaduri*[2]
– *Anamika Barua*[3*]
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Introduction

The Brahmaputra is not merely a river; it is a force that defines landscapes, livelihoods, and identities across Assam . For centuries, its fertile floodplains sustained communities, but today the river's rhythms have grown volatile, shaped by climate change, erratic rainfall, and upstream dam releases (Dekaraja & Mahanta, 2022). This edition of The Himalayan seeks to highlight how restoring nature is not only about ecological repair but also about driving economic revitalization and improving community well-being. In the face of mounting crises across the Eastern Himalaya, these local struggles must be situated within the broader context of the Third Pole, whose fragile river and glacier systems sustain billions and underscore the urgency of global collective action. It is in this frame that Dhemaji and Barpeta are presented not as isolated case studies, but as micro-stories from the climate edge. They show how communities, women, and youth are already adapting in creative ways: Barpeta reveals the gradual erosion of agrarian security and everyday strategies of diversification, while Dhemaji magnifies the stark realities of

climate-compelled migration. Together, their lived experiences, intertwined with local science, illuminate both the precarity and the resilience of life along the Brahmaputra.

Micro-story 1: Living with Uncertain Fields in Barpeta

In Barpeta, where the Beki and Manas rivers shape fertile plains, floods are as routine as the seasons: yet for farmers this rhythm has become fragile. *"Too much or too little water is not good for agriculture,"* one remarked, reflecting deep uncertainty. The devastating 2004 flood marked a turning point: embankments built afterward offered brief protection but shifted erosion downstream. Now, erratic monsoons and sudden dam releases from Bhutan add to the strain. Some farmers sow crops on sandbars, knowing each harvest may be the last, while others lease land collectively or shift to short-duration rice. When land disappears, migration becomes the safety net. Young men and women move to Guwahati, Jorhat, Kerala, or Tamil Nadu, working in construction, services, or domestic labor. Migration is adaptation, not rupture: remittances rebuild homes, pay school fees, and secure leases. Others diversify locally like electric rickshaw driving in Barpeta road now sustains many with limited education. Resilience also takes collective forms. Villages construct bamboo-raised granaries, pooling harvests so none go hungry in floods. A local school doubles as classroom and flood shelter, stocked with water and supplies by parents, teachers, and youth. Women lead savings groups that stabilize households in men's absence, while youth organize rescue teams. In Barpeta, resilience is fragile yet persistent, rooted in everyday ingenuity rather than sweeping transformations.

Micro-story 1: Living with Uncertain Fields in Barpeta

If Barpeta reflects erosion and gradual adjustment, Dhemaji magnifies crisis, where floods leave few choices beyond migration. At the Himalayan foothills, tributaries like the Jiadhal and Gainadi shift violently, unleashing over 25 major floods between 2015 and 2023 (Barua, Biswas, & Banerjee, 2025). Paddy farming, once secure, is now a gamble. *"We sow seeds with hope, but each flood washes away not only crops but also that hope,"* a farmer lamented. Migration has become central to survival. Nearly every household sends members to cities such as Bangalore, Hyderabad, or Kerala. *"Staying means hunger. Leaving at least gives a chance to eat,"* one villager explained. Remittances rebuild houses, buy tractors, and fund schooling. *"My husband's earnings in Bangalore are not much, but because of that, my children can study,"* said a mother. Yet resilience here is more than money. A mason returned from Kerala with new skills, teaching neighbours to build stilted houses. Women organized a seed bank, storing rice varieties in bamboo structures to replant after floods. These practices reveal resilience as innovation, not endurance. Migration, remittances, skill-sharing, and collective seed-saving intertwine, creating buffers against both immediate shocks and long-term uncertainty.

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Reflections on Key Research

Evidence from the Brahmaputra valley demonstrates that community resilience emerges through collective strategies to withstand and reorganize after recurrent disturbances. In Barpeta, resilience is expressed through livelihood diversification: families cultivating sandbars, leasing land collectively, or adopting new income options such as electric rickshaw driving when agriculture collapses. In Dhemaji, resilience is sustained by migration, where remittances enable households to repair flood-damaged houses, maintain education, and invest in small-scale enterprises. Research on gendered resilience further shows that women and youth are not only disproportionately exposed to risk but also act as resilience builders: women manage household food security, operate savings networks, and conserve seeds, while youth organize relief, convert schools into shelters, and maintain community networks during crises. These micro-stories align with wider scholarship that views resilience as a socially embedded process, co-produced by knowledge systems, institutions, and local ingenuity rather than imposed from outside.

Policy Insights and Conclusion

Community resilience in Assam illustrates how people draw on collective ingenuity to navigate chronic uncertainty. Migration, adaptive infrastructure, and inclusive social practices have long served as coping strategies, yet their potential is often undermined by gaps in policy and governance. Strengthening resilience therefore requires enabling secure migration through welfare portability and fair labour protections, so that mobility does not translate into vulnerability. It also calls for investments in resilient infrastructure—such as stilted housing, community grain banks, and context-specific embankments—that build safety into everyday life. Equally vital is the institutional recognition of women's and youth's roles in resilience-building, ensuring that their contributions are not treated as informal or peripheral but supported as part of formal governance structures.

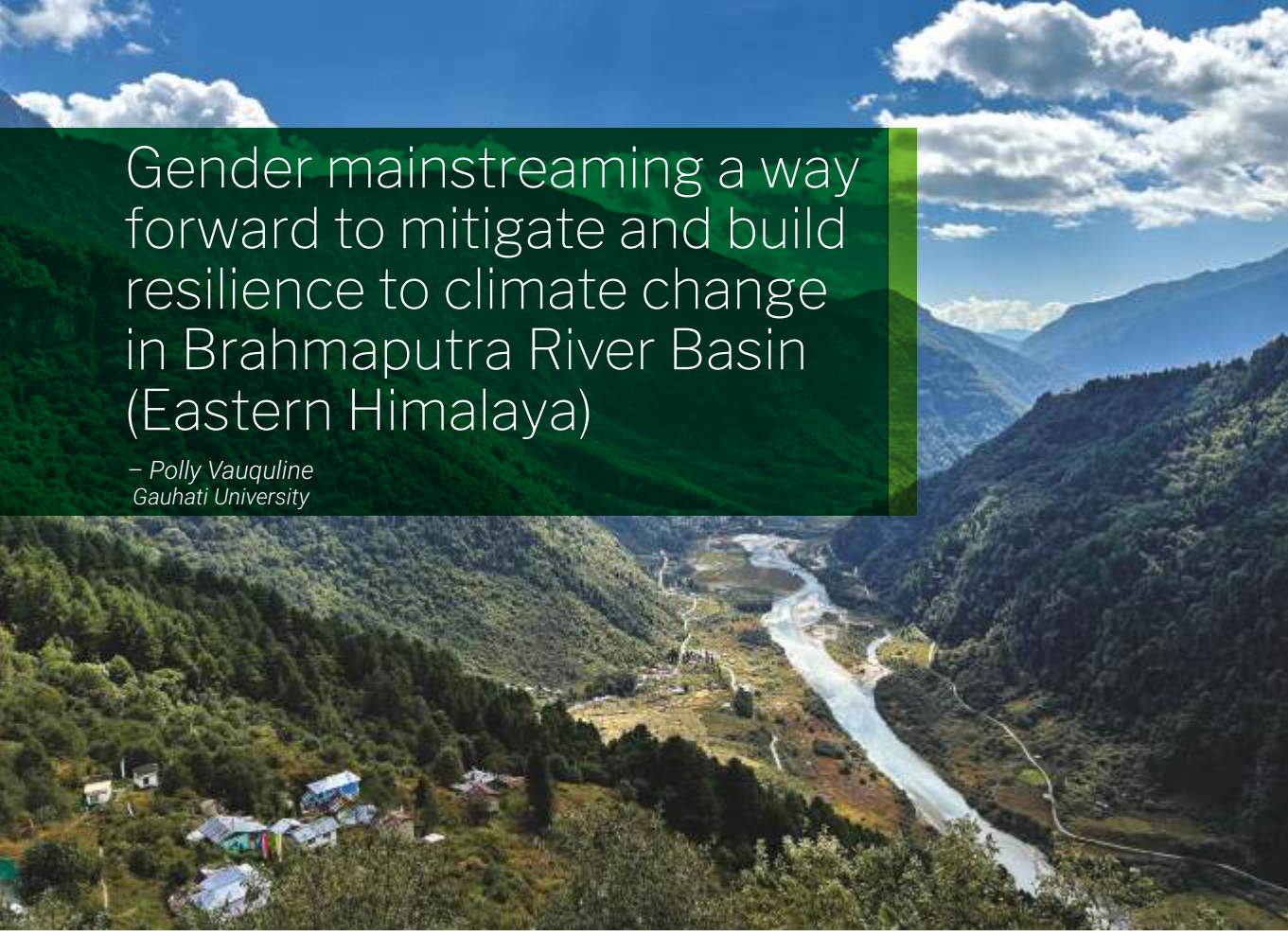
Policies that reinforce and scale up these locally rooted strategies can help transform fragmented efforts into systemic resilience across the Brahmaputra valley. In doing so, they not only safeguard livelihoods but also affirm the dignity and agency of communities who continue to adapt in the face of recurring floods and uncertainty.

References

Barua, A., Biswas, D., & Banerjee, D. (2025). A promise of development or a path to displacement? [Commentary]. Retrieved from Mongabay: https://india.mongabay.com/2025/03/a-promise-of-development-or-a-path-to-displacement-commentary/

Dekaraja, D., & Mahanta, R. (2022). Exploring the Socioeconomic Impact of Riverbank Erosion in the Brahmaputra Valley of Assam, India: A Case Study of Two Districts. Landscape Online, 97.

Sarmah, V. (2024). *The Influence of Riverbanks on Assamese Culture and Lifestyle.* Retrieved from Asian Confluence: Enaging the Third Space: https://www.asianconfluence.org/publication-details-full/the-influence-of-riverbanks-on-assamese-culture-and-lifestyle



Gender mainstreaming a way forward to mitigate and build resilience to climate change in Brahmaputra River Basin (Eastern Himalaya)

– Polly Vauquline
Gauhati University

Climate Changes in the Brahmaputra River Basin:

A pertinent study carried out by International Centre for Integrated Mountain Development (ICIMOD) on Brahmaputra River basin states that there is an increasing trend in the minimum temperature, rise of .5° C in average winter minimum temperature and in night temperature across the basin over the past fifty years, 1951-80 and 1980-2007. Extreme high temperature is increasing in the northern part of the basin. It is estimated that the summer temperature will increase to 1-3° by 2050 across the basin (Alfthan et al. 2018; Shrestha et al. 2015). Even though there is no significance change in the amount of the rainfall but extreme rainfall has decreased in the north and in the eastern part of the basin. At the same time intensity of the rainfall has increased in the eastern Brahmaputra River Basin (Shrestha et al, 2015). Such changes have caused disastrous floods in the past years. Again, there is an increase in the volume and the height of the rise of the flood water. And it is expected that the intensity of pre-

monsoon shower will increase. The duration of the flood will decrease but the height of the floodwaters will increase. Thereby, more areas are expected to be inundated under flood water in Brahmaputra plain (Shrestha et al, 2015).

Brahmaputra and its tributaries not only nurture the livelihood of the people of the North-east India but also supports millions of people of China, Bhutan and Bangladesh (Gupta et al, 2019; Shrestha et al, 2015). It's floodplain provides support to agriculture and fishery. Again, North-east India is the site of the 2 biodiversity hotspots, the Himalaya (Easter Himalaya) and Indo Burma of the 36 biodiversity hotspots of the world (Pradhan et al, 2021). Together with its nature bestowed endowment, there are more than 140 ethnic groups in the region (Haokip, 2012) with their rich customs, traditions, heritage and their traditional knowledge. The ecosystem of the region is strongly intertwined with the livelihood, food habit and ethnic and traditional lifestyle of the region. Changes in the factors of climate of the region will further accelerate the diverse impact on the sensitive ecosystem of north-east India. However, understanding climate change through gender perspectives is minimal in general and particular in the context of North-east India.

Gender and climate change:

Crises associated with climate change is not gender neutral because of the already existing gendered socio-cultural and economic positions of the women in the society (Mishra, & Mohapatra, 2017; UN Women, 2025). The degree to which women are affected by climate change impacts are partially a function of their social status, poverty, power and access to and control over resources (Mishra, & Mohapatra, 2017; Reggers, 2019). Higher the gender inequality more are the adversities, vulnerabilities and lesser the coping capabilities (Dankelman, (Ed.), 2010; Reggers, 2019). Gender intersects with climate risks and further amplifies the existing gender inequalities (UN Women, 2025).

There exist substantial gender gaps in terms of educational attainment, economic participation and opportunities, health and survival and political empowerment in India (Global Gender Gap Report, 2025) hence women are less able to cope and more exposed to the adverse effects of climate change. These instances can be attributed to their gender roles, gender constructivism and patriarchal system practised in a society (Vauquline, 2015).

Gender Roles:

Primarily in the rural area, people are highly dependent on the local natural resources for their livelihood. Because of their gendered roles women are generally responsible for securing water -drinking and for other uses, food for their family members, fuels and fodder for the cattle, pigs, hens, ducks and so on (Lippa, 2005; Shiva, & Mies, 2014). even during climate crisis and disasters. Above that their mobility are restricted and controlled because of their gendered position.

Socio-Cultural Norms:

There exist socio-cultural norms which are gendered in nature. As such women faces huge challenges in accessing all levels of policy and decision-making processes. Due to lack of information and skills necessary to

escape or avoid hazards their vulnerabilities intensifies during a crisis situation. Dress codes imposed on women can restrict their mobility in times of disaster. Due to gender constructivism women's responsibility as nurturer and care provider continues to prevail even during disasters so does their responsibility for older people, infants, small children who cannot swim or run, etc (Lippa, 2005; Shiva, & Mies, 2014; Vauquline, 2015).

The cumulative effects of gender roles, gender inequalities and social constructivism along with poverty, social, economic and political barriers which operates through patriarchal system put women in a disadvantageous position in coping with the adverse impacts of the changing climate. These gendered aspects make women more vulnerable than men during climate change. These further poses typical and unique threats to their livelihood, health and safety. At present, 47.8 million more women and girls go hungry and encounter food insecurity than men and boys (UN Women, 2024). It is estimated that by 2050, climate change may further accelerate this crisis with a growth of 158 million more women and girls into poverty which is 16 million more than total number of men and boys (ibid).

Gender mainstreaming in climate change:

It can be argued that there is an urgent need of focused attention to gender in climate change discourse, policies, actions and strategies (Alston, 2014) because the impacts of climate change on gender still remains invisible (Nelson et al., 2002). Such gender invisibilities are even more opaque in Northeast India, an ecologically sensitive region of the country. Gender mainstreaming in climate change can provide social and environmental equalities (Gay-Antaki, 2020) both as short-term and long-term solutions to climate change adoption, mitigation and resilience. Thereby it can be emphasised that addressing climate change crises demands holistic and multisectoral approach to gender mainstreaming by incorporation gender perspective in every level and all aspects (Alston, 2014; Hannan, 2009 & Lam et al,. 2024) from research to policy framing and from planning to implementation. Gender mainstreaming will bridge the gaps of climate mainstreaming efforts (Lam et al,. 2024) for inclusive and gender equitable society and promote nature-based solutions.

Reference:

Agarwal, B. (2021, May). Gender Inequality. In Cooperation and Environmental Sustainability'(paper presented at a workshop on 'Inequality, Collective Action and Environmental Sustainability', Working Paper 02-10-058, Santa Fe Institute, New Mexico, 2002).

Alfthan, B., Gupta, N., Gjerdi, H. L., Schoolmeester, T., Andresen, M., Jurek, M., & Agrawal, N. K. (2018). Outlook on climate change adaptation in the Hindu Kush Himalaya. Mountain Adaptation Outlook Series. Vienna/Arendal/Kathmandu: UNEP, GRID-Arendal and ICIMOD. www.unep.org, www.grida.no, www.icimod.org.

Alston, M. (2014, November). Gender mainstreaming and climate change. In *Women's Studies International Forum* (Vol. 47, pp. 287-294). Pergamon.

Dankelman, I. (Ed.). (2010). *Gender and climate change: An introduction.* Routledge.

Gay-Antaki, M. (2020). Feminist geographies of climate change: Negotiating gender at climate talks. Geoforum, 115, 1-10.

Gupta, N., Mishra, A., Agrawal, N. K., Shrestha, A., Gupta, N., Mishra, A., ... & Shrestha, A. B. (2019). Potential impacts of climate change

on water resources and adaptation policies in the Brahmaputra River Basin (p. 3). by International Centre for Integrated Mountain Development GPO Box 3226, Kathmandu, Nepal.

Haokip, G. T. (2012). On ethnicity and development imperative: a case study of North-East India. Asian Ethnicity, 13(3), 217-228.

Hannan, C. (2009). Gender mainstreaming climate change. *Kvinder, køn & forskning,* (3-4).

Global Gender Gap Report. (2025). World Economic Forum. Cologny/Geneva.

Lam, S., Novović, G., Skinner, K., & Nguyen-Viet, H. (2024). Greener through gender: What climate mainstreaming can learn from gender mainstreaming. Wiley Interdisciplinary Reviews: Climate Change, 15(4), e887.

Lippa, R. A. (2005). *Gender, nature, and nurture.* Routledge.

Mishra, A. K., & Mohapatra, U. (2017). Is Climate Change Gender Neutral?. *International Journal of Humanities and Social Sciences (IJHSS),* 6(5), 149-154.

Nelson, V., Meadows, K., Cannon, T., Morton, J., & Martin, A. (2002). Uncertain predictions, invisible impacts, and the need to mainstream gender in climate change adaptations. Gender & Development, 10(2), 51-59.

Pradhan, N. S., Das, P. J., Gupta, N., & Shrestha, A. B. (2021). Sustainable management options for healthy rivers in South Asia: The case of Brahmaputra. Sustainability, 13(3), 1087.

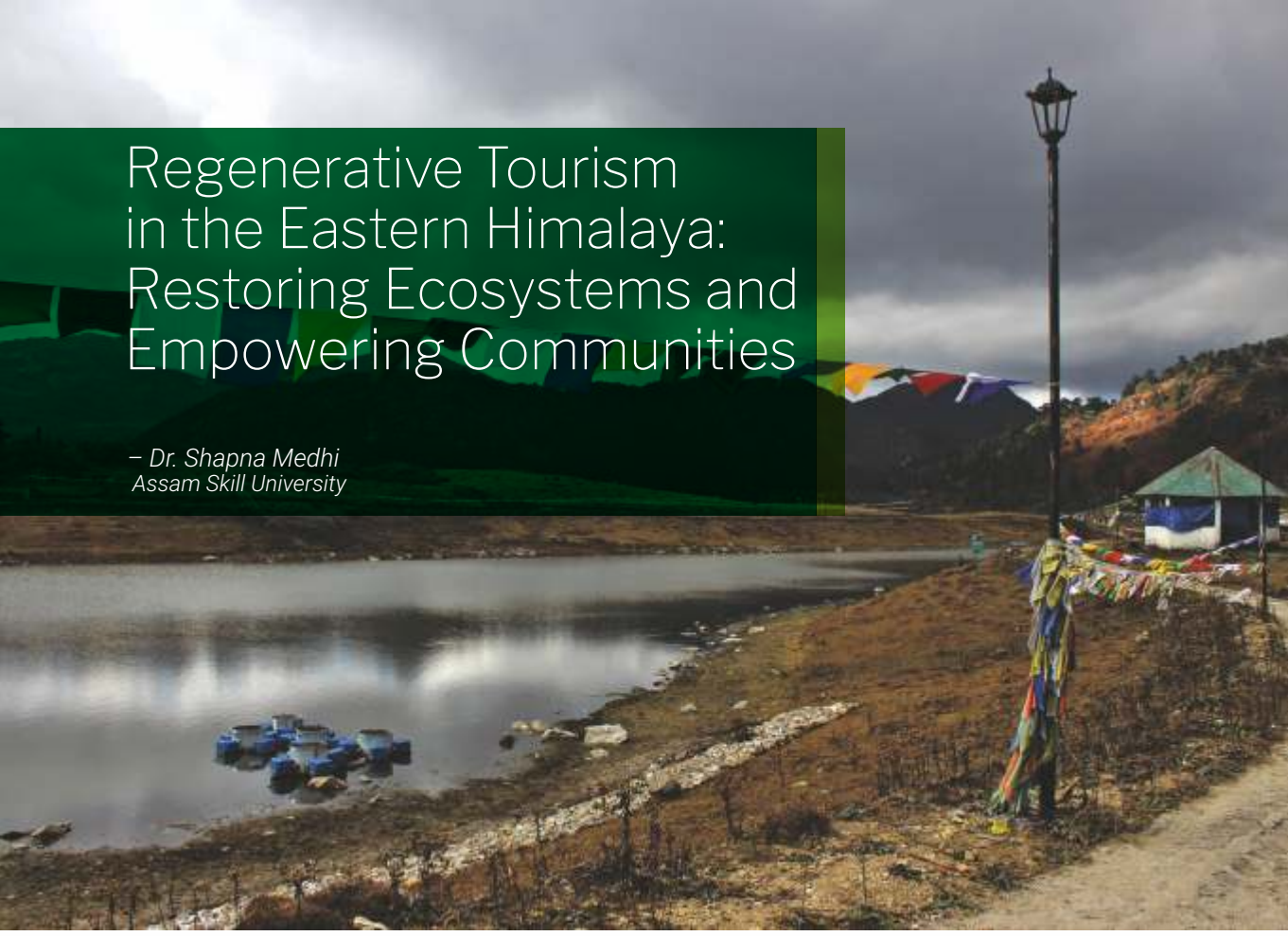
Reggers, A. (2019). Climate change is not gender neutral: gender inequality, rights and vulnerabilities in Bangladesh. In *Confronting climate change in Bangladesh: Policy strategies for adaptation and resilience* (pp. 103-118). Cham: Springer International Publishing.

Shiva, V., & Mies, M. (2014). *Ecofeminism.* Bloomsbury Publishing.

Shrestha, A. B., Agrawal, N. K., Alfthan, B., Bajracharya, S. R., Maréchal, J., & Oort, B. V. (2015). The Himalayan Climate and Water Atlas: impact of climate change on water resources in five of Asia's major river basins.

UN Women, 2025. How gender inequality and climate change are interconnected? https://www.unwomen.org/en/articles/explainer/how-gender-inequality-and-climate-change-are-interconnected

Vauquline, P. (2015). Socialisation process, power relations and domestic violence: Marginal voices of Assamese women. *Space and Culture, India,* 3(2), 54-71.



Regenerative Tourism in the Eastern Himalaya: Restoring Ecosystems and Empowering Communities

– Dr. Shapna Medhi
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Introduction

The Eastern Himalaya—spanning Sikkim, Arunachal Pradesh, North Bengal, and extending into parts of Bhutan—constitutes one of the world's most fragile mountain ecosystems as well as one of India's richest cultural landscapes. Over the last two decades, tourism has emerged as a major economic sector in this region, driven by demand for alpine scenery, biodiversity, monasteries, and Indigenous cultural expressions. However, the rapid expansion of tourism and unplanned infrastructural development have imposed significant pressures on local ecologies, water resources, and community life. These challenges indicate the need for a transformational tourism model capable of mitigating ecological degradation while enhancing community well-being.

Regenerative tourism— a paradigm that transcends sustainability by aiming to restore and revitalize ecosystems and empower local communities—offers such a framework (Bellato & Pollock, 2025; Kutlu, 2024). Building on conceptual foundations outlined in these works and supported by empirical insights from Indigenous communities in Northeast India (Mitra & Paul, 2025), this article examines how regenerative tourism can shape a resilient future for the Eastern Himalaya.

Understanding Regenerative Tourism

Regenerative tourism has gained global prominence for its emphasis on creating **net-positive impacts** rather than merely reducing harm. Instead of striving for ecological neutrality, it seeks to actively regenerate ecosystems, enhance cultural resilience, and strengthen local livelihoods.

Regenerative tourism possesses three defining characteristics. First, it is **place-based,** meaning that tourism practices are deeply connected to the ecological and cultural identity of a specific region. Second, it acknowledges that tourism can contribute to **ecological restoration** rather than functioning solely as a conservation or extraction-oriented activity (Bellato and Pollock, 2025). Third, regenerative tourism prioritizes **community agency**, ensuring that local people maintain leadership in decision-making and benefit-sharing.

On the other hand scholars also view tourism as part of a larger socio-ecological system, implying that regenerative practices must strengthen relationships between people, landscapes, and cultural traditions (Kutlu, 2024). This holistic perspective ensures that tourism development aligns with long-term ecosystem health.

However, some works also demonstrate that regenerative tourism is not purely conceptual. Researches from Northeast India shows that community-led tourism initiatives, indigenous ecological knowledge, and collaborative governance can produce measurable ecological, cultural, and socio-economic benefits (Mitra and Paul, 2025). These elements provide a practical foundation for implementing regenerative tourism in the Eastern Himalayan context.

The Eastern Himalaya as a Regenerative Landscape

- **Exceptional Ecological Sensitivity**

The Eastern Himalaya forms part of a global biodiversity hotspot, characterized by high-altitude forests, glacial rivers, endemic flora, and endangered species such as the red panda and snow leopard. Unregulated tourism has contributed to habitat fragmentation, waste accumulation, and water scarcity in several sites. Regenerative tourism practices—such as community-led reforestation, visitor-assisted habitat restoration, and zero-waste tourism models—can reverse ecological decline and support landscape-level regeneration.

- **Deep Indigenous Ecological Knowledge**

Indigenous communities residing in North-east India which have deep connections to nature as is evident in their customs and traditions possess intricate ecological knowledge built over centuries of sustainable living. Many research works also highlight the importance of indigenous practices—customary forest management, rotational

grazing, sacred landscapes—for regenerative tourism. These knowledge systems contribute to climate resilience and can guide ecologically sensitive tourism strategies.

- **Strong Cultural Identities and Living Heritage**

The Eastern Himalaya's socio-cultural fabric is shaped by ritual landscapes, agrarian traditions, and artisanal crafts. Regenerative tourism encourages revitalization of cultural heritage by ensuring that benefits flow directly to cultural knowledge holders rather than external commercial operators.

Restoring Ecosystems Through Regenerative Tourism

- **Rewilding and Reforestation Initiatives**

Regenerative tourism can support rewilding by involving visitors in ecological restoration activities such as tree planting, forest regeneration, and riverbank stabilization. Guided by local communities, these initiatives improve soil health, increase biodiversity, and reduce the impacts of deforestation.

- **Community-Managed Eco-Trails and Low-Impact Trekking**

Community-managed trekking routes limit environmental degradation through controlled visitor numbers, proper waste management, and minimized wildlife disturbance. Such models ensure that tourism revenue contributes directly to conservation efforts, so that regenerative tourism establishes self-sustaining socio-ecological systems.

Empowering Communities Through Place-Based Tourism

- **Community Ownership and Governance**

Regenerative tourism requires governance frameworks that place communities at the center of tourism planning and management. Village tourism committees, cooperatives, and community benefit funds ensure equitable distribution of tourism income and reinforce local agency. **Revitalizing Cultural Heritage.**

By promoting community-designed interpretive programs, heritage walks, and workshops on traditional knowledge, regenerative tourism strengthens cultural pride and creates dignified livelihoods. This approach counters the commodification of culture commonly observed in mass tourism.

- **Skills and Economic Diversification**

Capacity-building programs in ecological monitoring, homestay management, hospitality, and digital marketing provide communities with diversified income opportunities. As Bellato and Pollock (2025) note, regenerative tourism enhances socio-economic resilience by broadening livelihood options while strengthening ties to local ecosystems.

Community-driven initiatives such as those facilitated by the **Balipara Foundation,** which build local capacity to regenerate forests, culture, and livelihoods, serve as exemplars of how regenerative principles can be operationalized in the region.

Conclusion

Regenerative tourism offers a transformative pathway for the Eastern Himalaya, a region marked by ecological vulnerability and

cultural richness. By centering ecological restoration, community empowerment, and Indigenous knowledge, regenerative tourism provides a framework for leaving landscapes and societies better than before. As research suggests (Bellato & Pollock, 2025; Kutlu, 2024; Mitra & Paul, 2025), tourism becomes regenerative when it is place-based, community-led, and grounded in long-term socio-ecological resilience. In the Eastern Himalaya, adopting this approach holds the potential not only to reshape tourism but also to secure a regenerative and inclusive future for people and the land they inhabit.

References:

Kutlu, D. (2024). A conceptual overview of regenerative tourism. In I. Yazıcıoğlu, Ö. Yayla, A. Işın, C. Aktuna, & E. Yalçın (Eds.), *Contemporary studies and theories in tourism* (pp. 69–82). Peter Lang Publications.

Bellato, L., & Pollock, A. (2025). Regenerative tourism: A state-of-the-art review. *Tourism Geographies,* 27(3–4), 558–567. https://doi.org/10.1080/14616688.2023.2294366

Mitra, A., & Paul, S. (2025). Empowering Indigenous communities through regenerative tourism: Cultural preservation and socio-economic resilience in Northeast India. In B. B. Sousa, L. Arantes, & S. Bhartiya (Eds.), *Regenerative tourism for social development* (pp. 281–310). IGI Global Publications. https://doi.org/10.4018/979-8-3373-0235-5.ch012

Shifting Waterways: Community Responses to Glacial Retreat and Watershed Changes in Bhutan's Highlands

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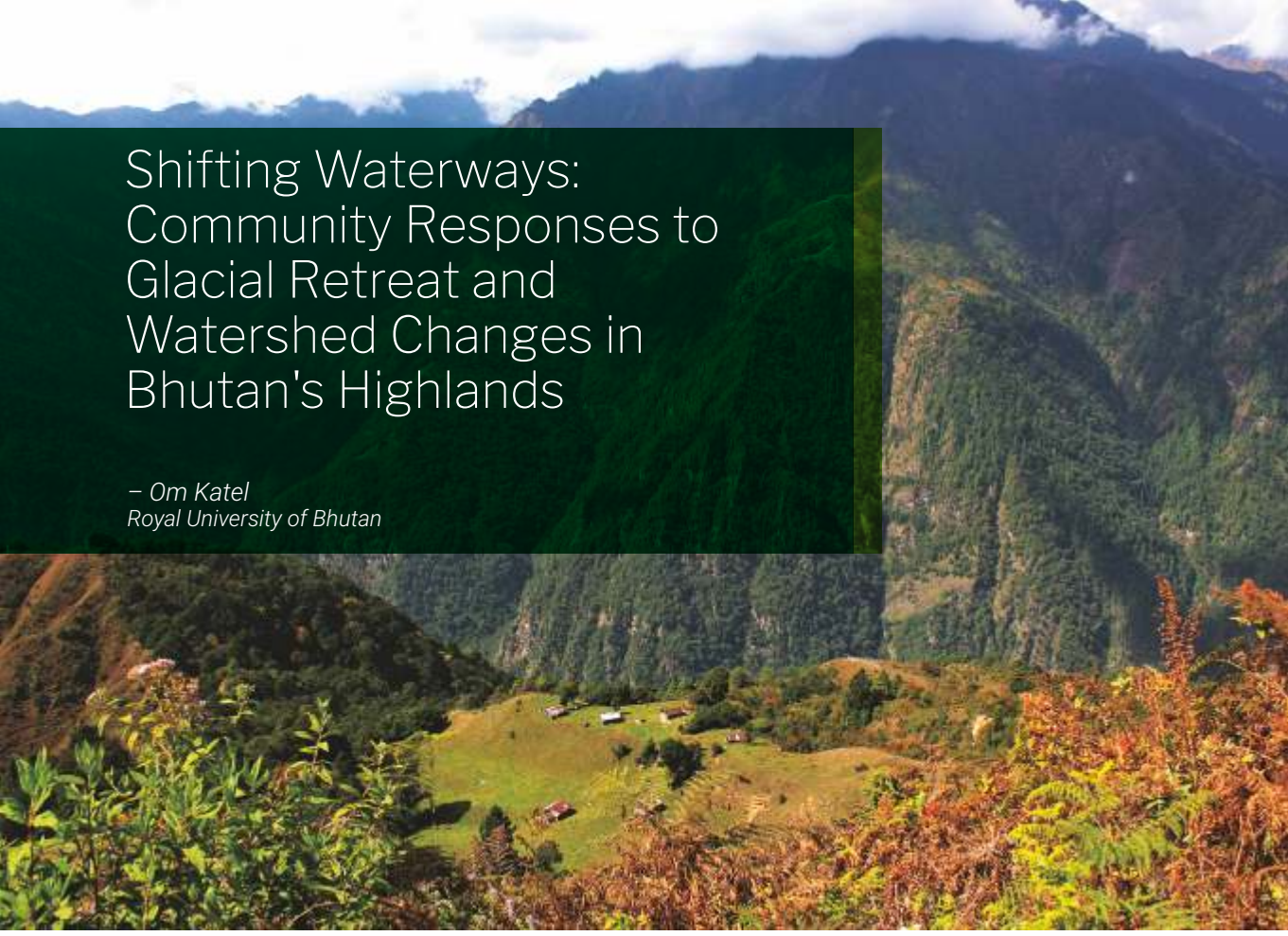


In the eastern Himalayas, Bhutan's breath-taking highlands cradle a delicate balance of life, where snow-capped peaks and gleaming glaciers feed rivers that sustain communities, agriculture, and unique tradition and culture. Himalayas, known as the "Third Pole", hold vast reserves of ice and snow, serving as a lifeline for millions across South Asia. It is but a sad reality that these beautiful glaciers are retreating, reshaping waterways in the region and challenging the resilience of people living in and within the vicinity. As the climate warms and rivers shift, highland communities are rising with courage and ingenuity to protect their way of life, weaving together tradition, innovation, and hope. This is particularly significant for Bhutan and the similar communities living in the Himalayas including those dependent on the Himalayan water resources.

Bhutan's glaciers, sprawling across roughly 1,034 square kilometers, are the lifeblood of major river systems that fuel livelihoods and hydropower. However, the signs of change are undeniable.

In 2021, researchers like Rinzin mapped Bhutan's glacial lakes, revealing a striking increase from 2,555 in 2016 to 2,574 by 2020, with an average annual expansion of 0.96 square kilometers. Glaciers are shrinking at a rate of 30 to 35 meters per year, swelling existing lakes or creating new ones. The Himalayas are warming two to three times faster than the plains, accelerating this transformation. This rapid warming, coupled with expanding glacial lakes, signals the profound impact of climate change on communities that rely on these waters for their livelihoods.

In Bhutan, glacial retreat is reshaping watersheds in ways both subtle and dramatic. In the short term, melting ice sends surges of water downstream, swelling rivers and increasing flood risks. However, in the long term, as glaciers dwindle, water scarcity looms, particularly during the dry winter months when river flows could drop by 10 to 25 percent. Summers, meanwhile, bring unpredictable rainfall, with intense downpours that erode soil, disrupt farming, and trigger flash floods, the incidents that have risen by about 30 percent in the past decade. With over half of Bhutan's population relying on agriculture, these changes threaten the heart of highland life, where families tend crops and livestock amid shifting seasons.

The consequences are far-reaching. Research suggests that by the century's end, half of Bhutan's glaciers may vanish, leaving downstream communities grappling with reduced water availability. Since all of Bhutan's river water drains into the Brahmaputra River through the state of Assam in India, and that these issues extend beyond Bhutan, affecting neighboring areas in India. Changing rainfall patterns are already impacting aquifer recharge, drying up spring water due to reduced groundwater and altering stream flows. For highland farmers, these shifts bring not only the slow creep of water scarcity but also the sudden fury of extreme weather. Yet, amidst these challenges, Bhutan's communities are responding with their best efforts to secure lives and livelihoods, a testament to their resilience, blending time-tested traditional knowledge with modern solutions to safeguard their future.

Across Bhutan's rugged highlands, communities are uniting with NGOs, government, and local agencies to build a shield against these significant hazards and risks. One such effort includes the installation of automated early warning systems that now protect over 21 highland communities, alerting them to the threat of glacial lake outburst floods. Villagers are contributing their knowledge by mapping hazards, identifying safe evacuation zones, and sharing their deep-rooted, generations-old understanding of the land to make their communities as safe as possible. Local traditional knowledge, such as community-based forest management to protect water sources and prevent wildfires, is being blended with modern scientific and technological interventions to ensure the mountains remain a sanctuary for both people and nature. Other initiatives include rainwater harvesting systems to store water for lean seasons and enhancing crop farming by shifting to drought-resistant crops, adapting fields to a changing climate to secure food and nutrition for the community.

These efforts reflect not just survival but also hope for endurance. Bhutan's developmental

philosophy, the Gross National Happiness framework, offers a unique lens, guiding sustainable adaptation that balances human well-being with ecological harmony. By tapping into local wisdom, communities are finding alternative solutions, at least for the short term, despite mounting challenges. For instance, traditional knowledge about soil and water management is being paired with modern techniques, creating resilient farming practices that withstand erratic rains and shrinking rivers. This blend of old and new empowers communities to face an uncertain future with confidence.

However, these efforts are not without difficulties. Despite their best attempts to address the challenges, extreme events are increasing year after year, alongside slow-onset changes, making adaptation increasingly difficult. Remote terrains, limited resources, and restricted access to technology complicate adaptation in Bhutan's highlands, and is similar to other Himalayan regions. Flash floods and shifting waterways do not respect borders, spilling across administrative boundaries, as ecosystems function within their own natural boundaries to heal and rebound. Therefore, efforts to address local impacts, such as climate change effects on glaciers and water resource hazards, must extend beyond administrative boundaries. For instance, managing river water resources must be approached at the basin level rather than within specific administrative boundaries. Transboundary collaboration with neighbouring basin countries is vital, fostering shared monitoring of glacial lakes and joint responses to climate risks. This is crucial for linking upstream and downstream communities, ensuring solutions ripple across the Himalayas. Bhutan's approach to building a network of resilience, linking local communities, traditional knowledge, and relevant agencies, could be scaled up to address climate risks and enhance regional sustainability.

The shifting waterways of Bhutan's highlands are a clarion call for action. Protecting lives, infrastructure, and livelihoods demands a blend of innovation and positive attitude to sustainable development. Policymakers must prioritize funding for expanded early warning systems and water management initiatives while fostering dialogues that bridge ecological and political boundaries. By weaving together technology, community wisdom, and regional cooperation, Bhutan can chart a path toward resilience that not only safeguards its own people but also inspires others across the Himalayas. In the face of retreating glaciers, Bhutan's highland communities are not just adapting; they are reimagining how to live in harmony with a changing world. Their story is one of courage, rooted in the belief that even as the ice melts, the spirit of togetherness and hope will endure, guiding them toward a sustainable future.

Cybersecurity Meets Sustainability: Protecting Digital and Natural Systems

– A.J. Vats

In the last one decade, India has seen a significant leap in its tech and digital prowess with the entire world talking about systems like Unified Payments Interface (UPI), Agristack, BharatNet and applications like Digilocker, UMANG that have brought convenience to millions of users. But as India accelerates its digital transformation through the adoption of Artificial Intelligence (AI) and widespread digital empowerment, the dialogue around sustainability is evolving in parallel. Moving beyond the scope of forests, water, and biodiversity, our digital ecosystems also require a reimagination of how they interact with natural ecosystems. Cybersecurity and environmental sustainability may appear to belong to different policy worlds but in reality they are deeply interlinked. For instance - A simple ChatGPT prompt uses approximately 0.00034 kilowatt-hours of energy, which is roughly equivalent to the energy used by a high-efficiency lightbulb for about two minutes! While this may feel insignificant, imagine millions of queries everyday and the amount of energy they require for computation. AI data

centers that make computing happen require huge amounts of energy and have significant emissions as well. At the current growth rate, AI data centers could generate 24 to 44 million metric tons of CO annually by 2030, equivalent to adding 5–10 million cars to U.S. roads. They also require vast amounts of water for cooling, broadening their footprint. This intersection of AI and sustainability is becoming a defining challenge and opportunity for the digital age. With growing climate risks and increased dependence on digital systems for governance, commerce and conservation, the security of one increasingly depends on the resilience of the other. For regions like the Northeast and Eastern Himalayas that are defined by ecological fragility, rich cultural heritage, and growing digital penetration, this convergence is particularly significant. Here, protecting natural systems and securing digital infrastructures are not parallel efforts but intertwined necessities.

Digital Risks to Environmental Sustainability

Over the years, India's attempt to popularize the Digital India initiatives has also encompassed environmental and climate governance making decision making becoming highly data-driven. Digital platforms are increasingly driving environment and climate-related monitoring, evaluation and decision-making ranging from drone-powered forest monitoring and biodiversity mapping to river basin modeling and disaster early-warning systems. As technologies grow and accessibility increases, these dependencies will only shoot up in the near and long term future. This means that any kind of threat to the digital systems can directly have detrimental consequences for natural systems. For example, most of the biodiversity and forest related information are stored and maintained by the Forest Survey of India (FSI) in databases. In case of negative externalities affecting these databases, the effects would ripple across conservation decisions, resource allocation, and even community safety. In recent years, cyberattacks on power grids have been reported from across the globe including the 2021 attacks in India revealing vulnerabilities in critical infrastructure software. If such risks threaten large hydropower plants in the NE Indian region, they might end up affecting the ecosystems and communities making this risk convergence no longer theoretical but a practical challenge that needs immediate attention and action.

Climate Risks to Digital Systems

For the two systems, the reverse is also true which means any environmental challenge also threatens digital resilience. Research suggests that the Eastern Himalayas might be warming twice the global average. This has caused an increase in the frequency of landslides, flash floods and extreme rainfall. The 2023 Sikkim flash floods, triggered by a glacial lake outburst (GLOF), damaged hydropower infrastructure, disrupted telecom networks and halted digital and logistics services in the region. This had a domino effect as the region's connectivity got disrupted, server hubs were damaged and power supply needed for digital operations was compromised. When climate extremes destabilise digital systems, everything from emergency response to supply chains becomes vulnerable putting all interlinked systems at high risk.

NER: A Digital-Environmental Frontier

The North-East Indian Region has shown great potential in how digital and natural systems can intersect in unique ways to improve socio-ecological outcomes. For instance - indigenous communities in the region that have long been the stewards and protectors of the ecologically sensitive landscapes have built harmony between traditional knowledge and digital tools leveraging mobile-based biodiversity documentation or satellite-supported community forest monitoring to enhance these efforts. In parts of Assam and Nagaland, start-ups are introducing IoT based soil sensors, automated irrigation systems, and GIS driven crop planning for smallholder farmers. These technologies support climate-resilient livelihoods, reduce water stress and improve yields. Further, the expansion of digital payments, e-governance platforms, telemedicine, and online education in remote Himalayan districts has helped bring down socio-economic vulnerabilities.

But these systems also come with their own set of vulnerabilities. Mobile apps, cloud storage, and sensor networks used for conservation generate sensitive data on rare species, community land and resource mapping. If accessed unlawfully, such information could be exploited for illegal logging, wildlife trafficking or land dispossession. Similarly, insecure IoT devices can be hacked, leading to manipulation of data, disruption of irrigation cycles or even theft of farmers' personal information warranting cyber hygiene critical for climate resilience. Since these systems are also heavily dependent on fragile physical infrastructure like power grids, telecom towers and fibre-optic cables in hazard-prone terrain, it makes them susceptible to any unwanted incident that can cause long-term damage consequently taking down the digital backbone that supports entire local economies.

Toward Integrated Resilience: Bridging the Two Worlds

In an era where globalisation has become synonymous with rapidly evolving tech and digital infrastructure and its accessibility, sustainability and cybersecurity 5solutions must converge as well. First, it is imperative that we secure digital infrastructure for climate resilience and conservation systems by treating environmental datasets and early-warning systems as critical infrastructure. This would require strong encryption for environmental databases, cybersecurity protocols for IoT sensors in forests and farms, secure data storage for indigenous and community-contributed information and regular vulnerability assessments for disaster dashboards amongst other important measures. For instance, Assam's flood-forecasting systems that are already dependent on advanced modelling could be protected through routine cyber-audits and backup servers located outside flood-prone zones.

Secondly, we must focus on building local cyber-environmental capacities. This would require building capacities of people to build cybersecurity and sustainability efforts. For instance - the NER already has strong community-led natural resource governance systems and adding basic digital literacy and cyber-hygiene training will help strengthen this foundation. In Nagaland and Mizoram, community councils with the help of domain

experts are training the youth to collect and secure biodiversity data, recognise phishing, malware or data-misuse risks etc.

Third, as part of our foresight approach, we must be investing in more green and resilient digital infrastructure that is both environmentally sustainable and climate-resilient. For the Eastern Himalayas, this could mean regular risk assessments and early warning systems for at high-risk infrastructure, solar-powered micro data centres for remote districts, disaster-resilient telecom towers with stronger foundations, low-energy IoT sensors for environmental monitoring, E-waste collection hubs for hill towns like Gangtok, Aizawl, or Itanagar etc.

Conclusion: Distinct Systems, Collective Future

As India pushes forward with its digital revolution while also dealing with an unpredictably changing climate, the line between cybersecurity and sustainability are starting to fade away. Nowhere is this more visible than in the NER where fragile ecologies and expanding digital systems coexist in delicate balance. It's almost unfeasible and impractical to protect one without protecting the other. In today's day and age, environmental resilience is tightly tied to digital foundations requiring both of them to be stable and secure. India's path to sustainability and regional prosperity means treating cyber systems and natural ecosystems the same way. This calls for the same level of dedication in innovation and urgency.

From Fragility to Resilience: Macroeconomics for a Living Planet

– *Ashok Kumar Gupta*
Balipara Foundation

Introduction

The world today faces many challenges climate change, loss of biodiversity, rising inequality, and unstable economies. These problems show how fragile our planet and economies have become. To create a stable and healthy future, we must shift from weak systems that easily break to strong systems that can recover and grow. The journey from fragility to resilience requires reimagining macroeconomics itself not as a machine for maximizing output, but as a living framework that aligns human prosperity with the planet's ecological limits.

So, this is how fragility to resilience. Transformation is not only about protecting nature it's also about rethinking macroeconomics, the big picture of how countries manage money, production, trade, and growth.

Macroeconomics for a Living Planet

Macroeconomics for a Living Planet means shaping the whole economy like national and global so that it supports life on living planet not just money growth. It connects economic goals like jobs, income, sustainability with climate balance, biodiversity, clean air and water.

As we are in development sector or society activist so focus on like encouraging sustainable farming and green jobs, protecting forests and rivers as part of national wealth, investing in renewable or green energy instead of fossil fuels and including environmental costs in budgets and business decisions. So, we can be more focused on making the economy work with nature, not against it.

Redefining Wealth in a Living Planet Economy

For generations, Gross Domestic Product (GDP) has been the heartbeat of economic performance. Yet, GDP measures the flow of money, not the health of nature. When a forest is cut for timber, GDP rises; when it stands and cleans our air, GDP stays silent. This paradox lies at the heart of fragility. As Sir Partha Dasgupta mentioned on his book "On Natural Capital" that GDP measures only current production, not resource loss; a country can grow GDP while destroying forests or water, but that's not sustainable wealth and we must measure "Inclusive Wealth" - which includes natural, human, and produced capital.

A Living Planet Economy demands a broader definition of wealth like one that includes natural capital (forests, wetlands, soil, air, water, minerals), human capital (health, education, skills, aptitude character), and social capital (trust, institutions). As Sir Partha Dasgupta argued in The Economics of Biodiversity, an economy that ignores nature's value is effectively "running down its asset base while counting it as income". Resilience begins when we recognize that nature is not a backdrop to the economy it is its foundation.

Economic models for ecological resilience

Traditional macroeconomic models considered as the environment as an external factor-something outside the market, to be managed by policy after growth occurs. Any disturbance in the ecosystem has an immediate impact on the economy, leading to lower production, higher costs, and a decline in GDP. So, I think that following are the economic models for ecological resilience-

1. Green GDP and Natural Capital Accounting Model:

   Integrating ecological value into national accounts changes incentives. Nations like Bhutan and New Zealand already use well-being budgets that include biodiversity, mental health, and carbon balance. By embedding environmental health into fiscal systems, governments can link prosperity directly to planetary stability.

   I think if we do nature is treated as an economic asset - forests, rivers, soil, and biodiversity have measurable value like the economy grows on a sustainable base, because natural resources are not overused. It will be resulting that balanced growth that maintains both ecological and economic wealth.

2. Blended and Impact Finance Model:

   Financial innovations like green bonds, blue bonds, and blended finance help de-risk private investments in conservation. When public funds attract private capital for reforestation or clean energy, macroeconomics becomes a tool for ecological regeneration.

   Recently attended Eco-Business conference in Singapore, so what I observe that expert speakers were trying to focus on green finance must be inclusive, transparent, and data driven and blended, and transition financing will accelerate regional decarbonization.

3. Resilience-Based Fiscal Policy Model:

   Instead of stimulus packages focused solely on infrastructure, green recovery programs channel funds into renewable energy, sustainable agriculture, and ecosystem restoration. Such spending generates jobs today and ecological security tomorrow.

4. Green Value-Chain and Eco-Tourism Model:

   Develop products and services that depend on healthy ecosystems, not on destroying them. It will work like that add value locally through processing, branding, and sustainable harvesting and support small enterprises based on natural resources like herbal products, handicrafts, organic farming, eco-tourism. It will be resulting that income generation and conservation, resilient local economies in fragile regions like the Eastern Himalayas where our mainly working areas.

5. Community-Based Resource Management Model:

   I think local communities manage forests, water, or pastures themselves. So it will work that local institutions create rules for resource use and restoration, benefits like timber, non-timber forest products, water are shared fairly, and collective action reduces overuse and builds long-term resilience. Also, I want to add like bamboo product which is very popular in communities of northeast states, and they use to is for various purposes like house, kitchen utensils, foods, etc. So, resulting will be strengthened ecosystems and self-sustaining rural economies.

6. Payment for Ecosystem or Sustainability Services (PES) Model:

   Money plays a vital role in human survival, as it fulfils basic needs for living. When people are financially secure, they are more likely to care about the environment and support ecological conservation. One effective approach is the Payment for Ecosystem Services model where individuals or communities who protect the environment are financially rewarded for the ecological benefits they provide. These payments may come from government programs or industries that depend on natural resources, such as hydropower, tourism, or agriculture.

   For example, farmers and forest communities can be compensated for maintaining forests, ensuring clean water, and preserving carbon sinks. This system incentivizes conservation while providing a stable income, creating a strong link between ecological protection and sustainable livelihoods.

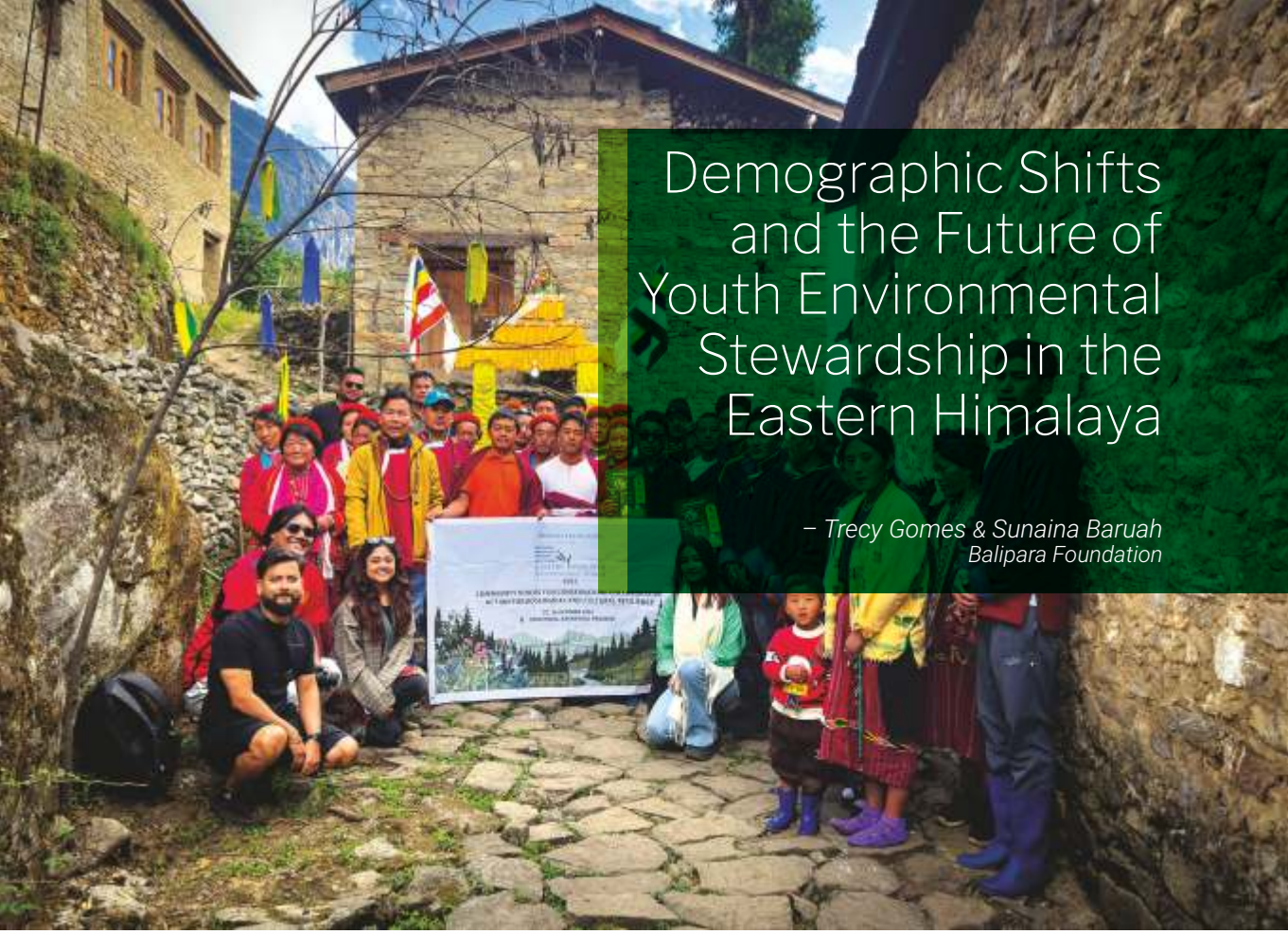
I believe there are many economic models that can be designed and implemented to strengthen ecological resilience, such as nature-based solutions, carbon pricing, and biodiversity valuation models. A resilient ecology creates a resilient economy, as sustainable economic growth depends on preserving the natural systems that support production, livelihoods, and overall well-being.

Conclusion

When any nations or region adopt these models, they begin to see nature not as a cost, but as capital an asset that underpins all economic activity. Fiscal systems start rewarding conservation, investors see restoration as opportunity, communities become partners in resilience rather than victims of collapse.

Ultimately, the goal of macroeconomics for a living planet is not merely to sustain growth, but to sustain life. It envisions economies that function like ecosystems-diverse, adaptive, and regenerative. Such an economy safeguards both human well-being and planetary balance, ensuring that the wealth we create today does not steal from the generations of tomorrow.

In essence, macroeconomics for a living planet is not a new chapter in economics it is a return to balance. A recognition that resilience is the real wealth of nations, and that our shared prosperity depends on restoring the living systems that sustain us all.



Demographic Shifts and the Future of Youth Environmental Stewardship in the Eastern Himalaya

– Trecy Gomes & Sunaina Baruah
Balipara Foundation

Across the Eastern Himalayas, the landscape is changing not only in its forests and rivers, but also in its people. Villages that once echoed with the chatter and laughter of children now feel quieter. Many homes are occupied only by elders, waiting for the annual visit of children who now study or work far away. Families are stretched across districts and cities, tied together by memory and obligation, yet living very different lives. Young adults walk new paths in search of better education, economic security, and the promise of opportunity beyond their ancestral lands. These shifts tell an important story: the custodians of tomorrow's ecosystems are growing up in a world far different from the one their elders inherited. The forests, rivers, and sacred groves that earlier shaped every part of life no longer hold the same daily proximity for many young people.

Yet within this transition lies extraordinary possibility. As demographic dynamics reshape the region, the question is no longer simply who will protect our ecosystems, but how youth will

redefine stewardship itself for a rapidly changing Himalaya.

For generations, stewardship in the Eastern Himalayas evolved naturally. Children learned the names of trees and birds not from textbooks but from elders pointing them out on the way to fields. Forests were classrooms, rivers were teachers, festivals were reminders of the bond between people and land. Nature was not seen as an external resource. It was woven into identity, livelihood, and spirituality, passed down through stories, rituals, and lived experience.

But this relationship is shifting. Out-migration, modern education, and new aspirations are reshaping youth identity and weakening traditional ties to land. Young people today grow up with smartphones as often as they do with bamboo groves. Many leave their villages for urban cities, reducing the number of hands involved in caring for forests or managing community resources. Even those who stay find that traditional knowledge, once shared around hearths, is fading as families spend less time working together on the land.

But this is only one side of the story.

The other side reveals a rising generation of young people who are globally connected, technologically empowered, and increasingly conscious of climate and ecological issues. They may be fewer in rural landscapes, but they return carrying broader perspectives, exposure to global environmental movements, and a readiness to innovate. Whether through community youth collectives, climate advocacy, forest monitoring using simple apps, or entrepreneurship in nature-based solutions, youth are forging new identities that blend tradition with modernity. They are redefining what environmental engagement can look like, grounding action in cultural memory while thinking in terms of systems, networks, and impact.

Their role matters more today than ever before. The Eastern Himalayas are experiencing rapid ecological stresses in the form of shrinking forests, changing rainfall, riverbank erosion, disappearing species. These crises demand a generation that can navigate both the digital and the natural world, a generation that understands how local realities connect to global climate shifts. And today's youth stand at exactly that intersection.

Unlike their grandparents, who grew into stewardship through tradition, young people now must choose it deliberately. These young leaders emerging from the Eastern Himalaya increasingly serve as bridges, translating scientific knowledge for communities, amplifying indigenous insights for policymakers, and shaping conservation approaches that respond to shifting social realities. Their digital fluency, coupled with traditional ecological sensibilities, positions them uniquely to communicate complex environmental issues in relatable ways.

It is this generational consciousness, rooted in identity yet open to reinvention, that carries immense promise for the future of the region's ecological well-being.

But their journey is not easy. Economic pressures often push them toward fields unrelated to conservation. Nature-based livelihoods remain uncertain, seasonal, or underfunded, making it hard for young people to imagine long-term careers in restoration or community resource management.

Migration weakens traditional knowledge systems, diluting ecological literacy that once came naturally. And in many community or policy spaces, young voices still struggle to be heard or taken seriously.

These challenges do not reflect apathy, they highlight systemic gaps. Young people care deeply, but the structures around them don't always allow their passion to take root.

Even so, the seeds of change are everywhere. Youth-led eco-conscious groups are reviving degraded commons. Students are documenting local species and creating digital archives of folklore. Community volunteers are restoring riverside forests and nurturing traditional crops lost to monoculture. Some are building nature-based enterprises such as rural eco-tourism, traditional craft revival, bamboo innovation, that bridge livelihood and conservation. Others are choosing to stay back in their villages and reimagine their relationship with land in new, meaningful ways.

What we see is a generation learning to weave together two worlds: the wisdom of their elders and the ideas of a rapidly changing planet. They are proving that stewardship is not a fixed tradition but a living practice—one that can adapt, grow, and resonate across identities and geographies.

The Eastern Himalaya stands at a delicate crossroads. But its young people carry within them a quiet strength: the ability to hold on to what is fading while shaping what is yet to come. If supported with opportunities, mentorship, and inclusive platforms, they can turn demographic shifts into a powerful force for ecological renewal.

And in their hands lies the hope of a thriving, resilient, nature-positive future - one that is rooted in memory, shaped by innovation, and carried forward by the courage of youth.

Restoring Balance: Science, Ethics, and Community in Wildlife Habitat Recovery in the Eastern Himalayas

– Dr. Subham C. Mondal
Balipara Foundation

Abstract

In the rapidly transforming landscapes of the Eastern Himalayas, wildlife habitats are being lost or fragmented at an extraordinary pace. With modern day challenges, the conservation efforts are also increasingly shifting from protection alone to active restoration, yet the success of such interventions anchors not only on ecological knowledge but also on ethical engagement with human communities residing in the fringe areas. This article explores how science and indigenous communities converge in the creation and restoration of wildlife habitats in the Eastern Himalayas, a global biodiversity hotspot where Elephants, Rhinos, Hornbills, and human settlements coexist within fragile and shifting ecological boundaries. Through a lens of science and field-based human experience, the narrative highlights on why wildlife friendly, community-inclusive, and ecologically intelligent restoration is the future of conservation in human-dominated landscapes.

1. Introduction: Rewilding a Fractured Landscape

"When Forests Fade, Who Decides What Comes Back?"

The Eastern Himalayas are a landscape of extremes, vast tracts of dense, ancient forests broken suddenly by tea gardens, settlements, roads, and fields. For centuries, this mosaic sustained both wildlife and people in a complex dance of dependence and negotiation. But as modern pressures push habitats to the brink, the question is no longer just about protecting what's left, it's about rebuilding what's been lost. Restoring wildlife habitats is more than an act of ecological repair. It is also a question of ethics: Whose vision of "restoration" are we realizing? Who defines what a forest should look like? And how do we ensure that both wildlife and human communities can coexist in a landscape that's being reshaped by climate change, development, and shifting ecological baselines? In the heart of this challenge lies the Eastern Himalayas, a region where seven states of India share similar, yet diverse landscapes and ecosystems supporting a plethora of biodiversity including but not limited to several critically endangered, endangered, vulnerable, and near threatened species. However, in recent times, this ecologically rich landscape is under severe pressure due to anthropogenic activities, the push for development, and increasing populations. According to Forest survey of India Report 2023, the northeast India has lost 3132.27 Km^2 of forest cover from 2013 to 2023, and 327.30 Km^2 was lost only in a period of 2 years (2021-23) [1]. Therefore, it becomes crucial to restore the degraded forests and rejuvenate the habitats of the Eastern Himalayas to minimize the net forest and tree cover loss in the long run.

2. More Than Shelter: Understanding What Makes a Habitat 'Wildlife-Friendly'

"From Roots to Canopy: The Architecture of Biodiversity"

Eastern Himalayas is a complex landscape supporting more than 200 ethnic groups having distinct languages, dialects and socio-cultural identities. The Region covers 7.97% of the country's geographical area and 3.78% of its population [2]. This is also the home for 163 globally threatened species including Asia's three largest herbivores—the Asian elephant (Elephas maximus), the greater one-horned rhinoceros (Rhinoceros unicornis), and the wild water buffalo (Bubalus bubalis)—and its largest carnivore, the tiger (Panthera tigris), as well as several large birds such as vultures, adjutant storks, and hornbills [3]. Restoring a degraded forest hence, doesn't necessarily mean creation of a rich habitat, but also to ensure that the restored habitat is wildlife friendly. The geography of the habitats is such that the nature and communities cannot be kept isolated. Encroachments into the forest, damaging the wildlife corridors, crop raids, and human-wildlife conflicts have made the relationship of wildlife and humans more complicated. Therefore, to create a habitat, that is also wildlife friendly, the participation of the communities is the most important and also the most challenging aspect. For the people who have lost lives and property due to the conflicts, crop raids, and encounters, accepting to create forests for the wildlife is a dilemmatic decision. Furthermore, without the participation of the communities in execution of the restoration project is next to

impossible. To make the restored habitat wildlife friendly along with safeguarding the community, it is also crucial to implement unconventional non-invasive methods of wildlife blockades, such as integrated biofencing[4, 5]. In this method, the fencing is done with densely planted lemon and king chilli saplings as fence and integrated with bee boxes near the fence. However, it is important to note that without changing the response of the community towards the wildlife encounters, the blockade methods shall be of minimal impact. Therefore, orientation of the communities towards information management, circulation, emergency and trauma response, and wildlife encounters become vital.

3. The Eastern Himalayas: A Living Puzzle of Forests, Fields, and Fauna

"Where Rivers Carve Paths and Elephants Walk Them"

As a home to several species and a hotspot of global biodiversity, the Eastern Himalayas is a repository for animal and plant resources. The distribution pattern of these floral and faunal species is governed by climatic conditions, as the entire Eastern Himalaya experiences subtropical to temperate, cold, alpine, and frigid cold weather. Heavy to extremely heavy rains coupled with high temperatures contributed to the establishment of forests at lower elevations. Heavy summer rains occur even in hilly areas, while winter temperatures are low enough to prevent severe evapotranspiration, limiting the likelihood of any soil moisture stress. Despite being harmed by slash and burn cultivation, the forests in the hilly areas have persevered and are regenerating again. From tropical evergreen at lower elevations in the upper Brahmaputra River to pine forests in the Himalayas and birch-rhododendron scrub at even higher elevations, these forests exhibit a vast range of morphological and floral traits –[6]. With an average rainfall of 2000mm, the Eastern Himalayan region receives around 10% of the country's total precipitation. This facilitates the region with a number of rivers, with over 125 prominent ones in Assam alone. Of which, the Brahmaputra is the largest, which is also one of the major rivers in the planet Earth. At 5,300 meters above sea level, the river begins immediately south of the Konggyu Tso lake, which is roughly 63 kilometers southeast of the Manasarowar lake in Tibet. It travels

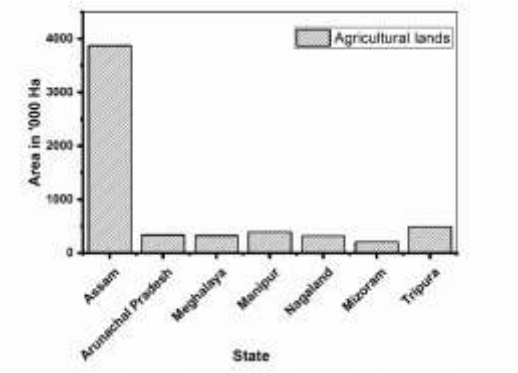


Fig. State wise distribution of Agricultural lands in Northeast India

2,906 kilometers through the Himalayan plains, hills, and mountains before arriving in Bay of Bengal in Bangladesh [7]. After entering India with the name of Siang in Arunachal Pradesh, it enters into Assam taking two important tributaries the Dibang and the Luhit and becomes a braided river system. This results in the formation of river islands, also known as 'chapori'. As a braided river system, the chaporis also provide routes for seasonal wildlife migration [8], especially the Asiatic Elephants (Elephas maximus) and One Horned Rhinos (Rhinoceros unicornis).

The chaporis predominantly have naturally fertile soils due to the new alluvial soil deposits carried by the river from eroding the soils of higher altitudes. The fertile new alluvial soil provides for good agriculture and thus inducing human settlements in and around these areas. Around 5.9 million hectares of agriculture is done in the Northeastern states of India supporting the livelihood of the communities [9]. This has nurtured a complex relationship between the communities, wildlife, rivers and forests.

4. Science-Driven Restoration: Planting with Purpose, Monitoring with Precision

"Beyond Green Cover: Designing Habitats for Life to Return"

Scientifically, Assisted Natural Regeneration (ANR) is the primary method of ecological restoration of habitats through which the Balipara Foundation is holding its operations at the Eastern Himalayan landscape. In its approach, Assisted Natural Regeneration (ANR) are being combined with community wisdom, local stewardship, and ethical conservation planning. By combining active interventions with passive restoration measures, the assisted natural regeneration approach has become a viable and affordable substitute for conventional restoration techniques––––[1012]. In order to remove barriers and hazards to forest regeneration on marginal areas, ANR uses indigenous knowledge of the local communities. Examples of this include removing invasive shrubs to promote the establishment of native tree species and erecting bio-fences to keep wildlife away from saplings[13, 14].

The intervention begins with the biodiversity assessment of the nearby intact forests to understand the vegetation structure, avifaunal, mammalian, entomological, reptilian and amphibian population structure. This is followed by mobilization of the community where orientation is done towards the importance of conservation and habitat restoration. In the meantime, mapping of the plantation area is done using ground-based GPS devices. After the GPS polygons are acquired, appropriate GIS tools are employed to study the landscape, including but not limited to Land Use Land Cover, Erosion-Accretion, Flood, and Stream Order. The maps thus acquired is used for vulnerability assessment of the site. Once the community is oriented, a socio-economic baseline is surveyed. Simultaneously, an ecological baseline is also established by studying the designated area in terms of vegetation structure, avifaunal, mammalian, entomological, reptilian and amphibian population structure, soil quality, and water quality. The studied parameters are used to compare and understand the impact of the implemented project in the long run. Based on the biodiversity assessment and the baseline study done, and also the literature study from the past research, an appropriate plant list is prepared and the list is shared with the nursery to germinate saplings accordingly. Post germination, after the saplings reach an appropriate height and health, they are planted as per the plan prepared for the location. The plantation process is taken forward with the help of the community members under the direction of the assigned supervisors. Continuous monitoring and appropriate actions are taken to ensure maximum survival of the saplings. Since habitat restoration is a long process and takes time for the trees to grow and positively alter the carrying capacity of the

degraded forests, appropriate indicators are set to monitor the impact of the restoration processes.

5. Conclusion: Toward Ethical, Ecologically-Intelligent Landscapes

"Why Restoration Must Be as Much About Justice as About Trees"

Assisted Natural Regeneration provides a cost-effective solution to restore degraded landscapes with the help of communities. However, restoring a habitat is not just about escalating the natural regeneration process, but also about creating a safe haven for the wildlife during migratory seasons (or otherwise) as well as the communities residing in the fringe areas. With facilitating for a sanctuary for the wildlife having better carrying capacity, and orienting the community for emergency response, conflict mitigation, data management and provision of alternate livelihood options, a wildlife friendly habitat can be created. True restoration must also restore dignity and opportunity for the people who depend on these forests. In the Eastern Himalayas, linking restoration with community well-being and alternate livelihoods, such as nursery development, honey collection, community-based eco-tourism, and NTFP (non-timber forest product) harvesting has proven critical. These activities reduce dependency on extractive practices and create economic incentives for stewardship rather than exploitation. They turn conservation from an imposed model into a collaborative enterprise. The ethics of habitat restoration demand that we ask not just what we restore, but how and for whom. It means respecting traditional ecological knowledge, ensuring free, prior, and informed consent (FPIC), and safeguarding the rights of marginalized communities. Ethical restoration is about co-creation, not coercion. It embraces equity, justice, and ecological intelligence as inseparable goals.

In a time of accelerating ecological crisis, the Eastern Himalayas offer a powerful lesson, "regenerating forests and rebuilding futures are part of the same story, one in which science, community, and ethics must walk together".

References:

1. ISFR. (2023). *India State of Forest Report Volume I.* Uttarakhand, India: Forest Survey of India, Ministry of Environment, Forest and Climate Change. Government of India.
2. Government of India, M. (n.d.). Ministry of Home Affairs | Government of India. Retrieved May 1, 2025, from https://www.mha.gov.in/en/commoncontent/north-east-division
3. CEPF. (2007). *Eastern Himalayas Region*. Retrieved from www.cepf.net
4. Perera, A. A. L. ., Abhayapala, K. M. R. ., Dharmarathne, N., Nugara, R. N., & Kumarasinghe, U. (2023). Bio-fencing as Promising Solution for Human-Elephant Conflict (HEC): Responses of Elephants and Underlying Leaf Chemistry of Polyalthia longifolia. https://doi.org/10.21203/RS.3.RS-2926225/V1
5. Sharma, A., Jat, S. K., Upadhyay, K., & Choudhary, A. (n.d.). Bio-Fencing: An Eco-Friendly Approach to Boundary Management. *Agriman 2024,* 1, 3–6.
6. Dikshit, K. R., & Dikshit, J. K. (2014). Natural Vegetation: Forests and Grasslands of North-East India. *Advances in Asian Human-Environmental Research,* (9789400770546), 213–255. https://doi.org/10.1007/978-94-007-7055-3_9

7. Bora, A. K. (2004). Fluvial Geomorphology, 88–112. https://doi.org/10.1007/978-94-017-0540-0_6

8. Choudhury, A. (1999). Status and conservation of the Asian Elephant Elephas maximus in north-eastern India. *Mammal Review,* 29(3), 141–174. https://doi.org/10.1046/J.1365-2907.1999.00045.X

9. MAFW. (2024). Press Release:Press Information Bureau. Retrieved May 2, 2025, from https://pib.gov.in/PressReleasePage.aspx?PRID=2039218

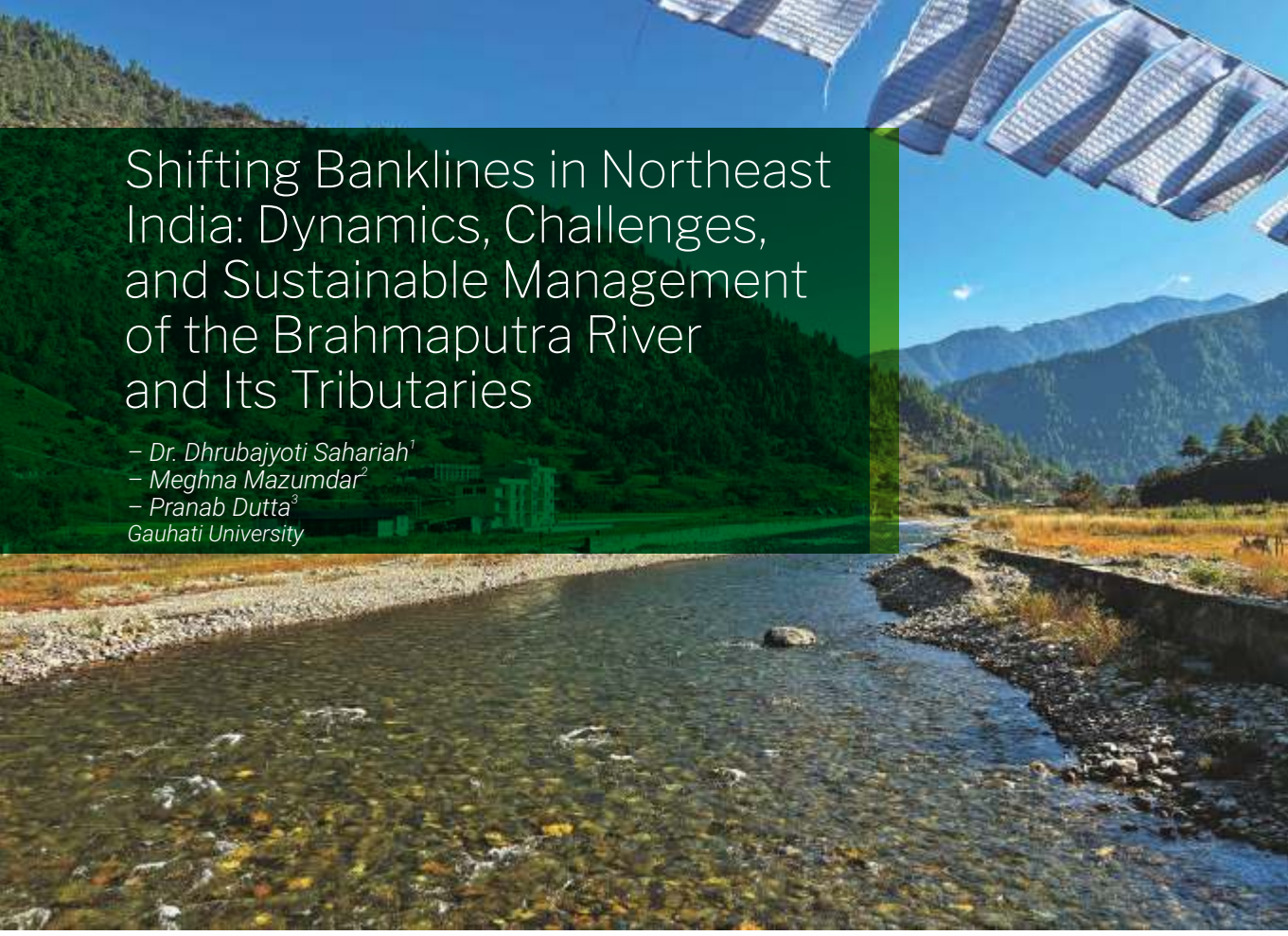
10. Holl, K. D., & Brancalion, P. H. S. (2020). Tree planting is not a simple solution. *Science, 368*(6491), 580–581.

11. Lewis, S. L., Wheeler, C. E., Mitchard, E. T. A., & Koch, A. (2019). Restoring natural forests is the best way to remove atmospheric carbon. *Nature,* 568(7750), 25–28.

12. Poorter, L., Bongers, F., Aide, T. M., Almeyda Zambrano, A. M., Balvanera, P., Becknell, J. M., … Chazdon, R. L. (2016). Biomass resilience of Neotropical secondary forests. *Nature,* 530(7589), 211–214.

13. Alves, J., Oliveira, M., Chazdon, R., Calmon, M., Pinto, A., Darvin, E., & Pereira, B. (2022). The role of assisted natural regeneration in accelerating forest and landscape restoration: practical experiences from the field.

14. Shono, K., Chazdon, R., Bodin, B., Wilson, S. J., & Durst, P. (2020). Assisted natural regeneration: harnessing nature for restoration. *Unasylva,* 252(71), 71–81.



Shifting Banklines in Northeast India: Dynamics, Challenges, and Sustainable Management of the Brahmaputra River and Its Tributaries

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Northeast India, with its distinct river dynamics, geological sensitivity, and profound socioeconomic reliance on riverine resources, presents considerable issues from shifting banklines, particularly in the Brahmaputra River system and its tributaries such as Barak, Tista, Dhansiri, and Subansiri. These rivers have extremely dynamicaspects in respect of channel migrations induced by erosion, sediment deposition, seasonal floods, and river meandering, which modify floodplains and surrounding areas on a yearly basis. In Assam, the Brahmaputra River exhibits severe bankline alterations, with migration rates as high as 25 meters per year on the right bank and 15 meters on the left in some regions. This quick shift results in the loss of considerable agricultural land and the displacement of human settlements, causing complicated socioeconomic issues that impede development attempts. The unstable rivers occasionally devastated several infrastructures, including roads, bridges, embankments, and communication networks. These damagesare exacerbated by the region's delicate

geological formations, significant silt loads, and flow changes. Although anti-erosion measures have been put in place, their effectiveness is still uneven and varies (Nath & Medhi, 2021; NDMA Report, 2023).

Looking particularly at Assam, the bankline shift of the Brahmaputra in the Morigaon district degraded approximately 181.81 square kilometers between 1996 and 2021, affecting at least 94 villages. Owing in large part to non-cohesive silt banks, fluctuating river discharge, and sediment load, the south bankline showed significant fluctuations that resulted in agricultural land loss and relocation, negatively impacting local infrastructure and habitation (Nath & Medhi, 2021). Geological control points in floodplain reaches have an impact on the river's pronounced right bank shifting near Goalpara and Guwahati, where it flows along the northern edge of the Shillong Plateau. This causes the river to expand northwestward and increases the risk of erosion to agricultural land and settlements (Sinha et al., 2012). Shifting banklines worsen the socioeconomic and ecological vulnerabilities outside of Assam's main river systems, as demonstrated by the Burhi Dihing River, a southern tributary that exhibits dynamic erosion and deposition patterns changing river morphology (NDMA Report, 2023; Sarma et al., 2007).

Shifting banklines have a significant impact on land cover and land use, as demonstrated in the Barak River basin, where channel alterations alter forest cover and agricultural patterns, increasing flood risk. Local economies based on fishing and agriculture are constantly adapting to these changes, while urban development deals with shifting river boundaries and increased flood threats. Riverbank migration endangers rural populations, environmentally sensitive zones, and protected wildlife habitats, necessitating integrated river basin management that balances human and environmental demands (NDMA Report, 2023). Anthropogenic causes such as deforestation and unregulated riverbank construction exacerbate riverbank instability, particularly in sub-Himalayan regions with young, unconsolidated sediments that are very vulnerable to monsoon-induced flood events (Sarker et al., 2012).

Remote sensing, GIS-based hydrological modeling, and spatial analysis tools such as the Digital Shoreline Analysis System (DSAS) have allowed for the exact measurement of erosion and accretion rates, as well as the forecasting of future bankline positions. Over the last five decades, these tools have improved our understanding of the Brahmaputra's river dynamics, informing disaster mitigation, land management strategies, and prioritizing sensitive areas for cost-effective interventions (Debnath et al., 2023; Nath & Medhi, 2021). Sustainable infrastructure design, which includes embankments, flood control systems, and river ports, necessitates accounting for the natural migration behaviors of riverbanks, as traditional engineering solutions may fail or have detrimental downstream consequences if natural dynamics are ignored. Ecosystem-based techniques that include bioengineering, reforestation, and

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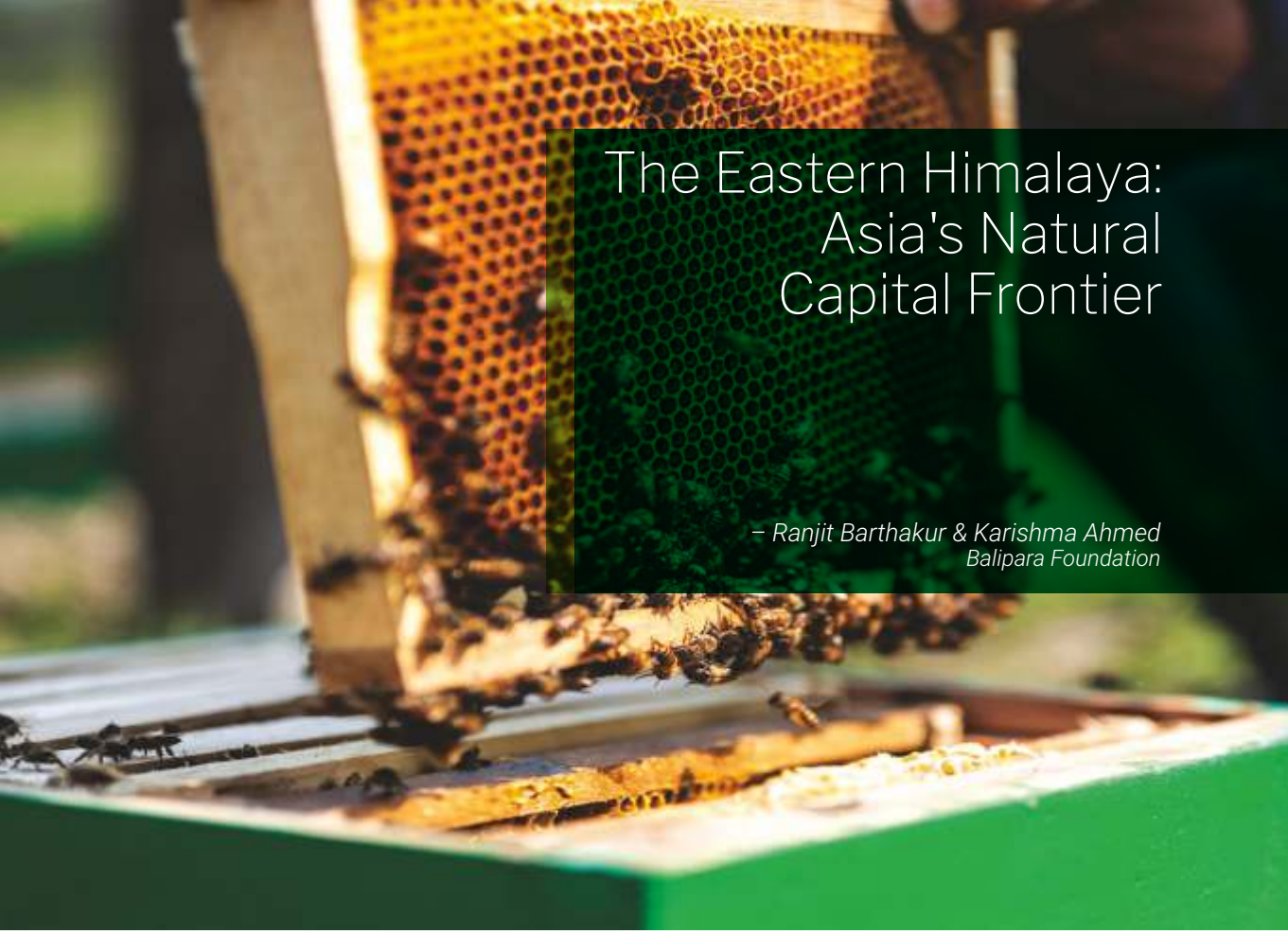
community participation have gained popularity for stabilizing riverbanks while protecting riparian ecosystems (NDMA Report, 2023).

Additionally, altering banklines in Northeast India, particularly along the Brahmaputra and its tributaries, has substantial implications for social welfare, economic advancement, and environmental sustainability. These dynamic river systems are constantly reshaping landscapes and lifestyles, necessitating continuing scientific observation, research, and adaptive management. Addressing these difficulties requires interdisciplinary teamwork that includes scientific understanding, government policy, and community engagement. Building resilience against natural disasters and fostering sustainable development in this environmentally rich but vulnerable region are fundamentally dependent on understanding and managing these evolving river systems using advanced geospatial technologies, integrated basin management, and sustainable, nature-based solutions that balance human and ecological interests for long-term prosperity.

References

- Nath, M. J., & Medhi, H. (2021). River bank line shift caused by Brahmaputra in Morigaon district, Assam (1996–2021). International Journal of Lakes and Rivers.
- National Disaster Management Authority. (2023). Study of Brahmaputra River erosion and its impacts. NDMA Technical Report.
- Sinha, R. K., et al. (2012). RS-GIS based assessment of river dynamics of Brahmaputra River in Assam. Journal of Remote Sensing and GIS.
- Sarma, K. K., et al. (2007). Bankline migration and erosion of Burhi Dihing River. Journal of Geomorphology and River Morphodynamics.
- Debnath, J., et al. (2023). Assessing impacts of current and future changes of the Brahmaputra River using DSAS. Environmental Monitoring and Assessment.
- Sarker, A., et al. (2012). Study on bank erosion and bankline migration of Subansiri River in Assam. Journal of Hydrology and River Basin Management.



The Eastern Himalaya: Asia's Natural Capital Frontier

– Ranjit Barthakur & Karishma Ahmed
Balipara Foundation

The **Eastern Himalaya** represents Asia's Natural Capital Frontier, a region where the wealth of nature and the wellbeing of humanity intersect most visibly. As a frontier, it is both a threshold and a test: the boundary between depletion and regeneration, and the space where Asia's next model of sustainable growth must be defined.

Stretching across Northeast India, Bhutan, Nepal, Bangladesh, and Myanmar, the Eastern Himalaya forms the ecological core of the continent. It is part of the **Third Pole,** the largest freshwater reserve outside the Arctic and Antarctic. The rivers born here - the Brahmaputra, Ganges, Yangtze, and Mekong among others sustain over **three billion people.** Together, these mountain systems regulate Asia's water, food, and climate security. To safeguard the Eastern Himalaya is, therefore, to safeguard the very foundations of Asia's prosperity.

The Third Pole Connection: A Shared Ecological Destiny

The Eastern Himalaya and the Third Pole are not separate entities; they are an interconnected system hydrologically, climatically, and ecologically. The Third Pole's glaciers feed the Eastern Himalaya's rivers; its snowfields shape monsoon patterns that nourish forests and farmlands downstream.

Scientific assessments show that even if global warming is limited to 1.5°C, the Himalaya will still warm by nearly 2°C, leading to the loss of up to 80% of glaciers by 2100. This glacial retreat will disrupt the flow of rivers such as the Brahmaputra and Ganges, destabilising entire ecosystems and livelihoods.

When the glaciers of Tibet retreat, water availability in the Eastern Himalaya declines, affecting hydropower, agriculture, and fisheries. When deforestation or mining occurs in the lower Himalayan slopes, it reduces the land's ability to absorb water, heightening flood risks downstream. The Eastern Himalaya thus acts as both a buffer and a barometer of the Third Pole's health when one is disturbed, the other reverberates.

This interdependence underscores a fundamental truth: Asia's ecological security cannot be compartmentalised. The Third Pole and the Eastern Himalaya form a single natural infrastructure, whose stability determines the resilience of nearly one-fourth of humanity.

The Value of Nature: From Invisible Wealth to Economic Foundation

Despite its vast ecological significance, the Eastern Himalaya's natural capital **remains** largely undervalued in economic planning. Its forests, rivers, and wetlands are treated as extractable resources rather than productive assets. As **Lord Nicholas Stern** wrote in *The Economics of Climate Change* (2006), the failure to account for nature's value represents "the greatest market failure in history."

Building on this argument, **Professor Sir Partha Dasgupta** in *The Economics of Biodiversity* (2021) and his 2025 book *On Natural Capital: The Value of the World Around Us* argues that humanity's economic systems are "drawing down nature's capital faster than it can regenerate." Dasgupta calls for redefining prosperity through **inclusive wealth** encompassing natural, human, and social capital.

For the Eastern Himalaya, this means recognising forests as infrastructure, rivers as living systems, and biodiversity as economic capital. Ecosystem services such as carbon sequestration, flood control, pollination, and water filtration provide immense value worth billions annually yet remain invisible in national accounts. Integrating natural capital accounting into policy can transform these services from background benefits into central economic assets, driving investment and innovation in restoration, renewable energy, and sustainable livelihoods.

The Naturenomics™ Approach: Linking Ecology and Economy

The Naturenomics™ philosophy, developed by the Balipara Foundation, provides a pathway for this transformation. It links ecological health with economic growth by

demonstrating that the prosperity of communities depends on the regeneration of natural systems.

Across the Eastern Himalaya, this principle is reflected in initiatives such as **bamboo-based** bioeconomies, community-led forest restoration, and regenerative agroforestry. These models align with Dasgupta's call for economies that invest in nature rather than extract from it creating green jobs, revitalising ecosystems, and ensuring long-term resilience.

Such approaches also reflect a deeper truth of the Eastern Himalaya: that local and indigenous communities are not just beneficiaries but custodians of natural capital. Their knowledge systems rooted in balance, reciprocity, and coexistence hold the keys to regenerating the region's ecological economy.

The Geopolitics of Ecology: Interdependence Across Borders

The Third Pole and the Eastern Himalaya span multiple political boundaries but operate as one ecological continuum. The rivers, forests, and monsoon systems that sustain Asia do not recognise borders. An upstream hydropower project in one country can alter sediment flow and fisheries in another; deforestation in one valley can amplify floods downstream.

To sustain Asia's natural capital frontier, regional cooperation is essential. Shared data, joint watershed management, and cross-border climate adaptation plans can align ecological resilience with economic development. A Trans-Himalayan Natural Capital Partnership, underpinned by shared valuation frameworks and financing mechanisms, can ensure that the benefits of restoration and conservation flow equitably across nations.

Way Ahead: Investing in Asia's Natural Capital Future

The way forward lies in embedding nature at the centre of Asia's growth strategy. This requires:

1. **Natural Capital Accounting:** Integrating ecosystem valuation into national budgets and corporate reporting, ensuring that every development decision reflects ecological costs and benefits.
2. **Nature-Positive Finance:** Mobilising green bonds, biodiversity credits, and payment-for-ecosystem-service mechanisms to fund restoration and community-led regeneration.
3. **Regional Cooperation:** Creating cross-border frameworks under the Third Pole initiative for water governance, forest management, and data-sharing.
4. **Community Stewardship:** Recognising indigenous and local communities as investors in resilience, ensuring equitable benefit-sharing from ecosystem services.
5. **Education and Policy Reform:** Mainstreaming the Naturenomics™ philosophy across universities, think tanks, and policy networks to reframe development through an ecological lens.

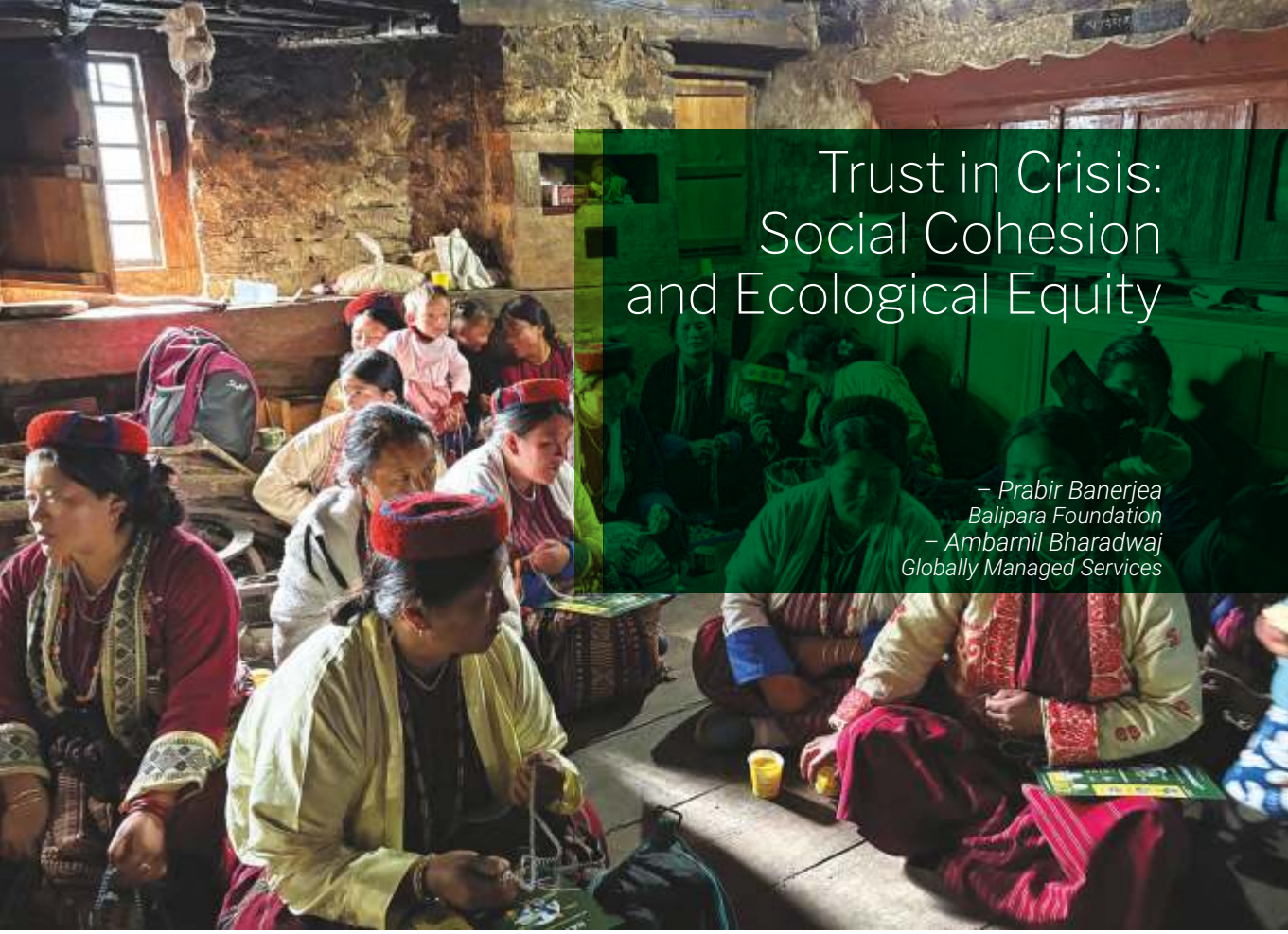
As Stern observed, "The transition to a low-carbon and climate-resilient economy is the growth story of the twenty-first century." For Asia, that story begins in its mountains.

The Eastern Himalaya is not a distant wilderness, it is the living infrastructure of Asia's future. If nurtured wisely, it can anchor a new economic order where prosperity is measured not by extraction, but by regeneration; not by consumption, but by balance.

When the Third Pole falters, the Eastern Himalaya trembles. But when the Eastern Himalaya thrives, all of Asia breathes easier. That is the promise and the responsibility of stewarding Asia's Natural Capital Frontier.

References

- Stern, N. (2006). *The Economics of Climate Change: The Stern Review*. HM Treasury.
- Dasgupta, P. (2021). *The Economics of Biodiversity: The Dasgupta Review*. HM Treasury.
- Dasgupta, P. (2025). *On Natural Capital: The Value of the World Around Us*. Ebury Publishing.
- Adapted data from *The Hindu Kush Himalaya Assessment Report* (ICIMOD, 2023).



Trust in Crisis: Social Cohesion and Ecological Equity

– Prabir Banerjea
Balipara Foundation
– Ambarnil Bharadwaj
Globally Managed Services

We live in a time when crises no longer come one at a time. Climate instability, biodiversity collapse, volatile markets and social divides are converging like the tributaries of a monsoon-fed river — fast, forceful and reshaping the terrain beneath our feet. In moments like these, the most decisive resource is not merely technology or finance, but trust: the social capital that makes cooperation possible and resilience achievable.

Trust is deeply practical. It enables communities to protect forests, manage watersheds and share resources because they believe in the fairness of the process and the integrity of those involved. Without trust, even the most well-funded environmental or development project becomes a negotiation of suspicion. With trust, communities become custodians, innovators and partners.

At Balipara Foundation, we have seen repeatedly that restoration succeeds not only when ecosystems revive, but when social cohesion strengthens. Communities must believe that conservation is not a sacrifice imposed on them, but a shared pathway to well-being. Equity — in decision-making, in benefits, in responsibilities — is the scaffolding that holds this trust upright.

Yet trust is not only institutional; it is cultural. In the Eastern Himalaya, traditions have long taught that nature is not a commodity but kin. Sacred groves protected for generations, river rituals that remind us of our dependence on flowing waters, and oral histories that frame forests as living ancestors — these practices embed an ethic of reciprocity. They cultivate a worldview in which humans collaborate with the omnipresent and all-prevailing forces of nature, rather than confront them. Restoration, viewed through this lens, is an act of obeisance as much as an act of science.

It is here that cultural heritage becomes a powerful ally in ecological equity. When restoration is anchored in traditions — in festivals, community rituals, local governance norms and ancestral land practices — trust gains depth and continuity. Conservation then feels less like a project timeline and more like a reaffirmation of identity. Balipara Foundation's own community nurseries, traditional bamboo restoration models, and participatory mapping exercises have shown that blending cultural wisdom with scientific approaches produces results that are ecologically robust and socially accepted.

This is where collaboration supersedes confrontation. Instead of imposing solutions, we must co-create them. Instead of viewing local communities as beneficiaries, we should see them as equal custodians. Inclusive governance — where women, youth, Indigenous knowledge holders and marginalised groups have real voice — becomes a non-negotiable element of trust-building. Transparent financial processes, community-controlled conservation funds, and clear benefit-sharing agreements reinforce a belief that progress is mutual.

Ecological equity extends this principle outward. It demands that those who contribute least to environmental degradation should not bear the highest costs of restoration. Equitable access to forests, water, biodiversity markets and climate finance is essential. Mechanisms like community-managed nature trusts, payments for ecosystem services and responsible ecotourism bring fairness into practice, transforming conservation into livelihood security.

Monitoring must also evolve. We can no longer evaluate success purely by hectares planted or carbon sequestered. Social indicators — trust levels, women's leadership, cultural continuity, income diversification and perceptions of fairness — tell us whether restoration is truly community-owned. Ecological resilience and social cohesion must be measured side by side.

Policy-makers and funders have a critical role in shaping this new paradigm. Support should prioritise long-term partnerships over short-lived interventions. Finance must align with ecological timeframes — decades, not grant cycles. Policies must respect customary land rights and acknowledge cultural institutions as legitimate governance

structures.

As we gather at the Eastern Himalayan Naturenomics Forum, I urge fellow practitioners to embrace both humility and imagination. Let us experiment boldly, document honestly and share generously. Let us uplift community-led models, celebrate traditional ecological knowledge and design incentives that reward stewardship rather than extraction.

The Eastern Himalaya offers reasons for optimism. Its communities have preserved cultural traditions that inherently value balance, reciprocity and reverence for nature. When science meets this cultural ethos, when policy aligns with equity, and when collaboration replaces confrontation, transformation becomes not only possible but inevitable.

As we navigate this era of overlapping crises, trust must guide our collective path — trust among communities, trust between institutions and citizens, and trust in nature's ability to regenerate when given space and respect. Social cohesion and ecological equity are not parallel goals; they are inseparable. Stronger communities nurture healthier ecosystems, and thriving ecosystems reinforce cooperative, peaceful societies.

If we honour this interconnectedness — culturally, socially, ecologically — future generations will inherit not the scars of crisis, but the strength of a region that chose collaboration over conflict, reverence over dominance, and trust over fear.

That journey begins with believing in one another, and in the enduring wisdom of nature itself.

Restore Trust: Community Involvement and the Ethics of Sustainability

– Ashok Kumar Gupta & Rabijeeta Lahkar
Balipara Foundation

In the global search for sustainability, one principle stands out as the most powerful driver of lasting change. It is the principle of trust. Policies, technology, and investments can support conservation, but they cannot succeed without the trust and participation of the people who live closest to nature. Sustainability becomes real only when communities believe in it and see themselves as partners in shaping the future of their landscapes.

Community-led conservation has come of age across the Eastern Himalayas, from the riparian plains of Assam to the far-flung forested hills of Arunachal Pradesh and Nagaland. These are regions where ecological vulnerability and cultural richness blend. These are also places where trust between people and nature has been strained by extractive practices, displacement, and the vagaries of climate change. Restoring trust here is integral to ecological revival.

This is the philosophy with which the Balipara Foundation works. Conservation cannot be imposed from the outside; it must grow from within communities who see themselves as custodians of their land. The initiatives which the foundation has helmed to promote habitat restoration, agroforestry, community nurseries, and indigenous knowledge revival have shown that ecological transformation becomes possible when the communities are empowered as equal stakeholders in the process.

Why Trust Matters in Conservation

Trust is not an abstract value in conservation; it translates directly into results on the ground. Indeed, research by Nobel laureate and community resource governance pioneer Elinor Ostrom[1] has demonstrated time and again that communities which trust one another and share responsibility manage their forests, water resources, and wildlife more sustainably than any external agency. Her extensive research, available through the Indiana University Ostrom Workshop, underlines the fact that local governance strengthens long-term conservation outcomes.

In the same vein, the Intergovernmental Science Policy Platform[2] on Biodiversity and Ecosystem Services reports that when local people have ownership and decision-making power concerning ecosystems, their biodiversity flourishes. Their global assessment, underlines that conservation succeeds where it is socially just and locally anchored.

Community Stewardship in the Eastern Himalayas

The work of Balipara Foundation mirrors these globally-recognized principles. It puts communities at the center of every intervention. Habitat restoration is done through local committees, community nurseries create livelihood opportunities, and agroforestry helps families diversify crops, thereby improving soil health and generating income across seasons.

For example, the Foundation's habitat restoration programmes engage community members in de-weeding, pit preparation, plantation, and long-term maintenance. They are paid for their work, building a direct link between ecological wellbeing and household income. Community nurseries revive native species and strengthen local knowledge while creating a sustainable source of saplings that remain available long after project completion.

Through this model, trust between the community and landscape is rebuilt. People start seeing forests and fields not as depleted spaces, but as living systems that support their future. This trust strengthens collective responsibility and improves survival rates of planted saplings, ecological monitoring, and long-term care.

Ethics form the core of sustainability

There is no sustainability without ethics. Ethics demand fairness, transparency, and respect for the people whose lives depend on

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[1] Ostrom, E. (1990). Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press.

[2] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://files.ipbes.net/ipbes-web-prod-public-files/inline-files/ILK_KeyMessages_IPBES_GlobalAssessment_final_ENGLISH_lo-res.pdf

the land. It demands that conservation efforts do not place burdens on vulnerable communities but help them thrive with dignity.

The Balipara Foundation incorporates this ethical approach into every programme undertaken by it. Community members participate in the identification of land to be covered under the programme, species to be planted, and planning and monitoring aspects. It is not only land that is restored but the torn social fabric around natural resources, too. Livelihood generation, training, and access to knowledge ensure that conservation does not exclude people but ensures that it enables them to lead. This aligns with the vision of nature capital-a framework championed by the Foundation that values ecosystems as assets essential for the well-being of communities and economies.

Rebuilding Trust for a Sustainable Future

Trust is what bridges the present and the resilient future. When communities own the forests and rivers, ecological revival becomes a shared mission. It diminishes the chances of conflict, enables participation, and ensures long-term stewardship. The Eastern Himalayas, often referred to as the third pole for their immense environmental significance, need this approach urgently. The work of the Balipara Foundation shows that restoring trust is not only possible but achievable. It is through engaging the communities, respect for local knowledge, and promotion of sustainable livelihoods that conservation becomes a lived reality. The success of these initiatives proves that restoration is not only about planting trees; it's about restoring relationships, dignity, and hope.

Revalue Nature: Making Natural Capital Visible in Financial Systems

– Ashok Kumar Gupta & Nikita Kumari Verma
Balipara Foundation

Concept -Revalue Nature

Revaluing nature means making natural capital visible, measurable, and valued in our financial and policy decisions. It is a concept rooted in the understanding that ecosystems provide essential "services" from climate regulation to water purification that have real economic value. Natural systems are assets that produce value just like factories or infrastructure. When we degrade them, we face real economic losses. Financial valuation using data, metrics, and indicators helps reveal nature's contribution to GDP, business performance, and community wellbeing.

Revaluing nature is about bringing these hidden benefits clean air, freshwater, fertile soil, forests, rivers, and biodiversity into the centre of how we plan, invest, and measure progress. It means recognising nature as a form of capital, just as important as financial, physical, or human capital.

Why Financial Valuation of Nature is No Longer Optional

In the 21st century, the biggest risk to global development is not an economic crisis—it is the silent erosion of the natural systems that make all economic activity possible. Forests, rivers, soils, wetlands, grasslands, pollinators, and even the stability of our climate form the backbone of our economies. Yet, these life-supporting assets rarely appear in national budgets, corporate balance sheets, or investment decisions.

Natural capital - the stock of natural resources that delivers essential services—is still treated as an invisible asset. As a result, societies continue to take more from nature than it can regenerate. The challenge now is clear: how do we bring nature into financial systems in a way that is measurable, valuable, and accountable?

Why Financial Valuation of Natural Capital Mandatory

Traditional economics assumes nature is free and limitless. But the reality is starkly different. The economy depends on nature's services clean water, fertile land, carbon storage, flood control, and biodiversity. When these systems degrade, the cost is borne by people, businesses, and governments.

Financial valuation of natural capital does not mean putting a "price tag" on nature's spiritual or cultural worth. It means recognizing the economic value of ecosystems so that decisions reflect true costs and benefits. When a wetland prevents floods worth millions of rupees each year, failing to include this value in development plans leads to irreversible losses and expensive disasters.

How to Value Natural Capital: Tools and Approaches

Financial valuation of natural capital combines ecology, economics, and social science.

Some tools & approaches as below-

1. Ecosystem Services Valuation

   Quantifies services such as water purification, carbon sequestration, and soil fertility. For example, a forest's economic contribution can be measured by-the cost saved on water treatment, the carbon it stores & the tourism revenue it generates.

2. Cost-Based Valuation

   Estimates the cost of replacing natural services with man-made infrastructure. A wetland that naturally controls floods might save crores in engineering and disaster-management costs.

3. Market-Based Valuation

   Uses instruments like carbon markets, biodiversity credits, or conservation easements to assign tradable value to ecological benefits.

4. Production-Function Models

   Shows how natural inputs (pollinators, soil nutrients, rainfall) affect agricultural or industrial production.

These tools allow policymakers and businesses to integrate nature into financial planning, risk management, and long-term investments.

Making Nature Visible in Financial Systems

For decades, global finance has treated nature as an externality vital to human prosperity yet absent from the ledgers that govern economic decisions. Today, as climate instability and biodiversity loss reshape markets, the world is recognizing a simple truth. So, transforming natural capital from an invisible asset to a visible economic pillar requires three actions:

1. Integrate nature into national and corporate accounting

   Governments must update GDP frameworks to reflect ecosystem gains and losses. Companies should disclose ecological risks and dependencies in annual reports. For example - "The United Nations SEEA (System of Environmental-Economic Accounting)" provides countries with a global framework to include forests, water, minerals, and ecosystem services into national accounts in parallel to GDP.

2. Design financial instruments that reward conservation

   Green bonds, ecosystem credits, payments for ecosystem services (PES), and biodiversity funds can channel capital toward nature-positive projects. For example – "Costa Rica's PES Model" pays farmers for protecting forests that store carbon and regulate water and "Himachal Pradesh's River Basin PES" compensates upstream communities for maintaining clean water for hydropower.

3. Empower communities as custodians of natural wealth

   Local communities often hold the deepest ecological knowledge. Recognising their role, securing rights, and sharing benefits ensures long-term sustainability.

Case for India and the Eastern Himalayas

In regions like the Eastern Himalayas—one of the world's richest biodiversity hotspots ecosystems provide extraordinary value. Forests regulate monsoons, rivers support millions of livelihoods, and traditional knowledge systems maintain ecological balance. Yet these contributions rarely enter financial planning.

Valuing natural capital in such landscapes can-guide sustainable tourism, protect river basins, inform climate-resilient development, strengthen community stewardship and attract green investments and CSR funding.

For conservation NGOs, this is an opportunity to bridge science and economics showing policymakers the real cost of ecosystem destruction and the tangible benefits of restoration.

Finance that works with Nature

Making nature visible in financial systems is not just a technical shift,it is a mindset change. It means recognizing that the global economy is embedded in the natural world, not separate from it. When financial decisions reflect ecological limits, markets gain the clarity needed to invest in long-term prosperity.

The path forward is clear that integrate natural capital valuation into finance, build transparent standards, and reward activities that regenerate rather than deplete the planet's life-support systems.

Valuing Nature Is Valuing Prosperity

The economy and nature are not two separate systems, they are one. Every rupee of growth, every job created, and every supply chain depends on healthy ecosystems. Valuing natural capital is not about commercializing nature; it is about protecting the foundation of all prosperity.

By revaluing nature, we create financial systems that are honest, resilient, and aligned with the planet's limits. This is not just an environmental responsibility, it is an economic necessity.

Conclusion

Revalue Nature represents a crucial shift in how society conceptualizes the relationship between economic prosperity and ecological health. By making natural capital visible, measurable, and financially valued, businesses and policymakers can align incentives with sustainability. The result is a financial system that supports not undermines the ecosystems upon which all economies depend.

Revaluing nature is not merely an environmental goal, it is an economic imperative for a stable, resilient, and thriving future. Protecting nature is the smartest investment & it must be valued in financial system.

Climate Change: The Economy's Greatest Unpriced Risk

– *Trecy Gomes & Gaurav Barthakur*
Balipara Foundation

"Climate change" is a phrase we encounter at almost every juncture of our lives today, yet in the 21st century, the way we discuss it has become far more analytical, urgent, and grounded in lived experience. The real question is whether climate change is a recent occurrence or a phenomenon century in the making.

A common misconception is the confusion between short-term weather variations and long-term climate change. Weather changes from day to day; climate, however, shifts over centuries. What we are witnessing today, the rising temperatures, shifting seasons, melting glaciers, disappearing biodiversity are the cumulative, accelerated effects of long-term climate change. The Eastern Himalaya stands as a stark living example. The rapid retreat of glaciers in what is known as the Earth's "third pole" signals profound transformations ahead, transformations that will redefine ecosystems, livelihoods, and even geopolitics across Asia.

But the real magnitude of climate change extends far beyond the environment. It is deeply entwined with economic, social, and political systems. At its core lies one universal truth: the world is running on scarce and increasingly stressed resources. Climate disruptions amplify this scarcity, creating ripple effects across global supply chains, food systems, energy markets, and national economies.

India's agricultural landscape illustrates this clearly. For decades, India was one of the world's major producers of pulse, especially tur (arhar) dal. However, erratic monsoons, prolonged droughts, and rising temperatures have sharply reduced domestic yields. As a result, India once largely self-sufficient, now imports millions of tonnes of pulses every year from countries like Myanmar, Mozambique, and Canada to meet domestic demand. A climate-driven production shortfall has transformed into an economic vulnerability, placing pressure on prices, inflation, and food security.

Climate change is no longer a distant warning but a lived global reality. From a farmer in Assam battling unseasonal rains to a business owner in Europe adjusting for flood-driven supply chain delays, or a family in Africa coping with soaring food prices after drought, the impacts are unmistakable. Climate change has quietly become the economy's greatest unpriced risk.

Markets often treat climate impacts as externalities, issues to be addressed later or absorbed by communities, governments, or ecosystems. Because the most significant costs remain invisible in financial systems until disasters strike, the global economy appears stable on paper but is far more vulnerable in reality. Although we know climate change is happening, its true intensity feels distant, causing the issue to take a back seat in policy and decision-making.

From a global risk perspective, climate change is now interlinked with every major economic challenge of our time, energy security, inflation, migration, trade, and geopolitical tension. A heatwave in India disrupts labour productivity, which affects manufacturing outputs, which can push global prices of basic goods upward. Floods in Thailand can halt automobile production lines across continents. Drought across Africa and South Asia threatens both food security and social stability. These cascading risks prove that climate change is not an environmental issue alone but a systemic economic threat.

Climate-related disasters now cost the world hundreds of billions of dollars each year, as cyclones, floods, droughts, and heatwaves grow more frequent and intense, damaging infrastructure, shrinking national GDPs, and deepening poverty. Yet behind these figures are real human stories: families rebuilding their homes, plantation workers losing seasonal incomes, and young people grappling with uncertain job prospects in climate-affected sectors.

One of the most overlooked economic impacts of extreme heat is the decline in worker productivity, especially in developing countries across Asia and Africa where millions work outdoors. Rising temperatures reduce labour hours and disrupt key sectors such as construction, agriculture, and transportation. Though often missing from economic planning, these silent losses have

a significant effect on livelihoods and national growth.

Developing economies face a sharper edge of climate risk, especially countries like India, Nepal, Bhutan, and Bangladesh where many communities rely directly on nature for their livelihoods. When rivers deplete, forests degrade, or monsoons turn erratic, it is the poorest, especially women, indigenous groups, and rural households, who suffer the most despite contributing least to global emissions. This deepens both economic and social vulnerabilities, and any disruption in the primary sector ultimately ripples through the entire supply chain, affecting everyone through higher prices, reduced availability, and declining quality of essential produce.

Yet, amidst these challenges lies a powerful but under-recognized economic ally: nature. Forests, wetlands, grasslands, and river systems provide critical buffers that reduce the economic blow of climate risks. Mangrove belts shield coastal economies from cyclones. Forests regulate rainfall and support agriculture. Healthy soils absorb water and reduce flood impacts. When nature thrives, economies become more resilient. When ecosystems break down, the cost is borne not just by biodiversity but by entire sectors, from agriculture to insurance.

Above all, we must treat climate resilience as an essential component of economic resilience. The cost of acting now is far lower than the cost of recovery later. The choices we make today, where we invest, what we protect, and how we value natural systems will determine whether future generations inherit stable, prosperous societies or economies struggling under constant climate shocks.

Climate change may be the greatest unpriced risk the world economy has ever faced, but it is also an opportunity, an opportunity to rebuild economic systems that are stronger, fairer, and deeply aligned with the planet that sustains us. If we can recognize and value this risk today, we can shape a future where both people and nature can thrive.

Health in the Anthropocene: Pollution, Wellness and Planetary Health

– Nayanika Dutta & Sunaina Baruah
Balipara Foundation

The Anthropocene has ushered humanity into a moment of profound reckoning. For the first time in our evolutionary history, human activity has become the dominant force shaping Earth's climate, ecosystems, and life-support systems. This era, marked by accelerating industrialization, ecological degradation, and growing pressures on natural resources has redefined how we understand health. No longer is wellbeing confined to hospitals, medicines, and individual choices. In the Anthropocene, the air we breathe, the rivers we depend on, the forests that regulate climate, and the stability of the biosphere itself have become determinants of human health.

Across the world, pollution has quietly evolved into a planetary-scale health crisis. Air pollution now infiltrates even the most remote landscapes, its fine particulates entering the bloodstream and reaching organs once considered protected. It is a silent companion in urban streets and rural fields alike, contributing to heart disease, asthma, neurological disorders, and millions of premature deaths. Water systems, once lifelines of civilizations, are burdened with pesticides, industrial effluents, pharmaceutical residues, and microplastics. Soil, the foundation of food security, carries

heavy metals and chemicals that affect not just crops but entire generations through bioaccumulation. Pollution is no longer an external environmental problem; it has entered human bodies, becoming an intimate part of our biological reality.

But the Anthropocene's imprint on health extends beyond the physical. As climate change intensifies storms, floods, droughts, and heatwaves, a new dimension of psychological vulnerability has emerged. Eco-anxiety, climate grief, and chronic stress are shaping the mental health of communities, especially children and youth who feel their futures tethered to a fragile planet. Urban life, once celebrated as a sign of progress, now exposes millions to overcrowding, noise pollution, insomnia, sedentary habits, and diminishing green spaces. The wellness crisis of our times lies in the collapsing balance between modern lifestyles and the ecological systems that once buffered human life with resilience and rhythm.

Yet solutions also lie within this crisis, and they are rooted in a deeper understanding of planetary health - a framework that recognises the interdependence between human wellbeing and ecological stability. Planetary health calls on us to look beyond individual symptoms and address the environmental conditions that create disease. It urges us to imagine healthcare systems that pay as much attention to air quality, freshwater access, and soil fertility as they do to diagnosis and treatment. As biodiversity erodes, we see the consequences in rising zoonotic diseases, unstable food systems, and weakened immunity. Restoring ecosystems, therefore, becomes a public health intervention as vital as vaccination or nutritional security.

This intersection between ecology and health is not new; it is a wisdom long held by indigenous communities. Across forests, mountains, and river valleys, these communities have lived with a philosophy of balance, taking only what is needed, maintaining sacred groves, observing seasonal cycles, and treating land as kin. Their traditional medicines, sustainable diets, and cultural practices remind us that wellness emerges from respect for nature's limits. As climate change disrupts rain patterns and biodiversity, these knowledge systems become essential guides in rethinking how societies can adapt and thrive.

The challenge ahead is not simply environmental management but a transformation of how economies function. Industrial agriculture, fossil-fuel dependence, and consumer-driven production have locked societies into patterns that undermine both planetary and human health. Reimagining food systems through regenerative agriculture, restoring forest corridors, embracing clean energy, and redesigning cities to prioritise green spaces and clean mobility are not merely sustainability measures, but they are pathways to better health outcomes. Urban forests cool cities and protect against heat strokes; wetlands reduce flood risks and filter water; and biodiverse landscapes strengthen immunity and mental wellbeing.

Ultimately, health in the Anthropocene demands a collective shift in ethics. It asks us to acknowledge that the wellness of one species depends on the wellbeing of all others, and that economic growth cannot come at the cost of ecological collapse. It requires governments, researchers, communities, and industries to collaborate on creating environments where both people and nature can flourish. The choices we make today on how we consume, produce, build, farm, and govern, will define the health of future generations.

Why the Eastern Himalayan Naturenomics™ Forum Matters in a World of Rising Global Risks

– Ranjit Barthakur
Balipara Foundation

We stand today at a critical intersection, where survival, technology, and the economy converge to define the future of our planet. AXA's Future Risks Report 2025, which integrates viewpoints from all over the world and more than 50 countries, shows that many of the world's major risks and challenges are interlinked, and at the core of those challenges are human beings and their attitude toward nature.

Bhutan's glaciers, sprawling across roughly 1,034 square kilometers, are the lifeblood of major river systems that fuel livelihoods and hydropower. However, the signs of change are undeniable.

For the tenth consecutive year, climate change has been ranked the single greatest global risk. But the report makes something else clear: climate change is not just an environmental issue. It is a risk multiplier driving displacement, economic instability, food insecurity and geopolitical tensions. It is not a threat of the future but a lived crisis of our present.

This is why platforms like the Eastern Himalayan Naturenomics™ Forum are no longer desirable, they are indispensable.

The AXA report on global risks provides insight into a world that, while interconnected, contains overlapping and compounding vulnerabilities. The global top ten risks – climate change, geopolitical instability, cyber threats, potential AI misuse, social unrest, depletion of resources, and economic fragility – depict a world that is under severe pressure. These risks are no longer siloed; they are enmeshed. Cyber risks are a part of geopolitical risks, economic inequality drives social unrest, and loss of ecosystems results in displacement and violence. Health threats, climate change, and poor social services combine with demographic pressure and inequity in stitched global systems. With interconnected risks, one principle is clear – without ecological balance, no systems, economic or social, or technological, will be safe or robust.

The Naturenomics™ Response

The core belief that guides Naturenomics™ is that today's economic growth often flourishes at the cost of nature. It reminds us that true prosperity cannot come from exploiting natural systems but from living in harmony with them. Ecosystem ecology is not a lesser or alternative path, it is the only sustainable way forward to meet our future needs while restoring balance between people, economy, and the planet.

The Eastern Himalayan Naturenomics™ Forum (EHNF) aims to reinstate the interlinkages of ecology and the economy and begins to transform development anchored to the value of nature. Development options based on 'Natural Capital' of the region and recognition of the ecosystems can form the basis of sustainable development. The Forum seeks to ascribe measurable values to natural capitalism, and visible and measurable ecological wealth, and makes economic development progress synonymous with the health of the environment.

As the name implies, the Eastern Himalayan Naturenomics™ Forum (EHNF) offers collaboration to all stakeholders and the state, the market, science, and society to carve out resilience for people and the planet. Prosperity goes beyond economic growth, and sustainable prosperity must be anchored to the balance of progress of civilization and the natural world.

The core of Naturenomics™ is the action-oriented movement: from redesigning agricultural practices and restorative natural ecosystems to engaging communities for sustainable development and empowerment in climate adaptation. It is the setting of sustainable living examples, where economic regeneration goes hand in hand with ecosystem restoration.

Three Immediate Global Needs

The next steps to take before 2025 must include focused efforts on impact. Three pivotal alterations championed by the Forum are shifts that must be implemented worldwide to attain sustainable equity.

The first is the need to add economic value to the environment. Natural capital - the economy, forests, watersheds, and biodiversity, needs to be weighed within economic strategies, risk calculations, and the economy as a whole. What is not valued is negatively attributed to a lack of management. For us to keep the systems that support all life, economically valuing systems is vital.

The second is to change systems to be regenerative. The dominant extractive frameworks of industries and economies must be replaced with regenerative systems - agriculture that mends and improves the soil, energy systems that purify and renew the air, and economies that restore dignity and purpose to the people. Regenerative systems must be at the center of and the primary focus of all progress.

The third is to harmonize justice with the ecological transition. The journey to equity must include all social dimensions, and the people must be facilitators and climate stakeholders, not bystanders. Trust must guide policies, ethics must serve as the compass for technology, and businesses must uphold the social contract. The true value of sustainability can only be realized when justice and economic systems are anchored in the restoration of life.

A Future We Must Build Together

Modernity has been built on the flawed idea that humanity stands above nature but all of the crises we face today are failures of the human imagination and not science. Nature must not be thought of as a resource but rather a relationship to be engaged.

The Naturenomics™ Forum is a chance to renew that relationship with humility and with a high degree of collaboration and urgency. These are global risks that cannot be resolved in isolation. In the coming decade the choice we must make is not between the economy and the ecology but between survival and decline.

Natural capital is the only way to build resilient societies, stable economies and a just world and that is the most important investment we can make. There is no longer time for conversation of any sort, only the time for the commitments must be now. This will only be accomplished by the inclusion of Natural Capital in every single economic framework and decision. It is imperative that we plan, invest, and track advancements with the ecosystems value in mind. Moving away from extractive economies is a necessity; we need to invest in the restoration and regeneration of the earth's ecosystems, as well as the restoration of the energy systems that sustain our civilizations. Collaborative governance is essential to ensure that resilience is the focus of innovations.

Finally, it is time to create a global Naturenomics™ coalition for a future that relies not on what we know, but the speed at which we deploy already existing knowledge. More than just a dialogue, the Eastern Himalayan Naturenomics™ Forum is written as a blueprint of an ecological renaissance that restores our relationship with nature and in long term formulates balance for humanity.

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