ONE HIMALAYA ONE POLICY

INDIA'S G20 PRESIDENCY AND SUSTAINABLE DEVELOPMENT IN THE HIMALAYA:
OPPORTUNITIES, STRATEGIES AND POLICY RECOMMENDATIONS

SUBMITTED TO

NITI AAYOG, New Delhi, Government of India
and
PMO, Government of India, New Delhi

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INDIA'S G20
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Snow covered Himalayan peaks at Malari village, Joshimath.

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FOREWORD

India's G20 presidency and its inclusive theme *'Vasudhaiva Kutumbakam'* or *'One Earth One Family One Future'* clearly emphasizes a people-centric approach to address global challenges and facilitate sustainable economic development in tune with the 2030 Agenda for Sustainable Development Goals (SDGs), Antalya Summit, and Addis Ababa Action Agenda on Financing for Development (AAAA). The G20 presidency provides ample opportunity for India to dwell in diverse arenas, such as education, agriculture, tourism, health, trade, digital economy, employment, energy transition, climate sustainability, environment, and culture to make noteworthy contributions. With an aim to promote equity, access, and affordability, the main goals of sustainable development, the G20 University Connect, a focused group of experts, is engaging with the higher educational institutions and universities through special lectures, exposure workshops, and discussions in getting new and region-specific strategies to achieve these goals.

The Indian Himalayan Region (IHR) is key for the sustainable development of India as it plays an enormous role in the provisioning of water, biodiversity, food, energy, etc. The region supports not only the upland population but also the downstream people and ecosystems. Moreover, it also forms key border areas with multiple countries; and its water is also a source of green and renewable energy. However, despite a rich resource base, the people of the region are often poor and live in a subsistence economy. The region is also sensitive to natural and man-made disasters, including climate change. The sustainable economic, social, and environmental development of the Himalayan region requires a shared vision at the national and regional levels.

The present policy document is based on a detailed discussion organized by the HNB Garhwal University, Srinagar, Uttarakhand on the IHR under the theme India's G20 Presidency and Sustainable Development: Opportunities and Strategies' on April 17, 2023, in collaboration with G.B. Pant National Institute of Himalayan Environment (GBPNIHE), Research and Information System for Developing Countries (RIS), Kalinga Institute of Indo-Pacific Studies (KIIPS), and Indian Himalayan Central Universities Consortium (IHCUC). In a follow-up meeting on April 21, 2023, it was collectively decided to bring out a document for consideration by the policy planners to enable them to address some of the challenging problems for the sustainable development of the IHR. It is appropriate for India to emphasize sustainable development goals as it aims to collaborate with all nations for creating the Pro-Planet People under Mission LiFE by bringing simple lifestyle changes in day-to-day behaviour.

This document discusses the important trends and challenges in select sectors for the sustainable development of the IHR. The chapters of the policy document cover Himalaya- a treasure of unique bioresources, climate change and preparing a climate-resilient society, changing land use and land cover, disaster preparedness and mitigation, preserving culture and heritage, women and energy insecurities, creating an environment for sustainable economic opportunities, and solid waste management. Although significant progress and technological advances have been made in these sectors, still a lot is to be done. The region deserves a secure life for over 50 million people living across IHR. Its natural resources including water, food, and biodiversity should be managed sustainably against all natural, anthropogenic, and climate change disasters. I congratulate all the partner institutions for highlighting some important issues related to IHR in the global development agenda. I am sure that the document would bring a common understanding of select trends and challenges that are key to the development of the Himalayan region. At the same time, it would also help to mobilize concerted actions from all stakeholders to address various challenges thus contributing to achieving sustainable development of the Himalayan region.

New Delhi

21.06.2023

(Dr. V K Saraswat)

Chandpur fort, Chamoli, Uttarakhand

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Gold Mask From Malari, Chamoli, Uttarakhand

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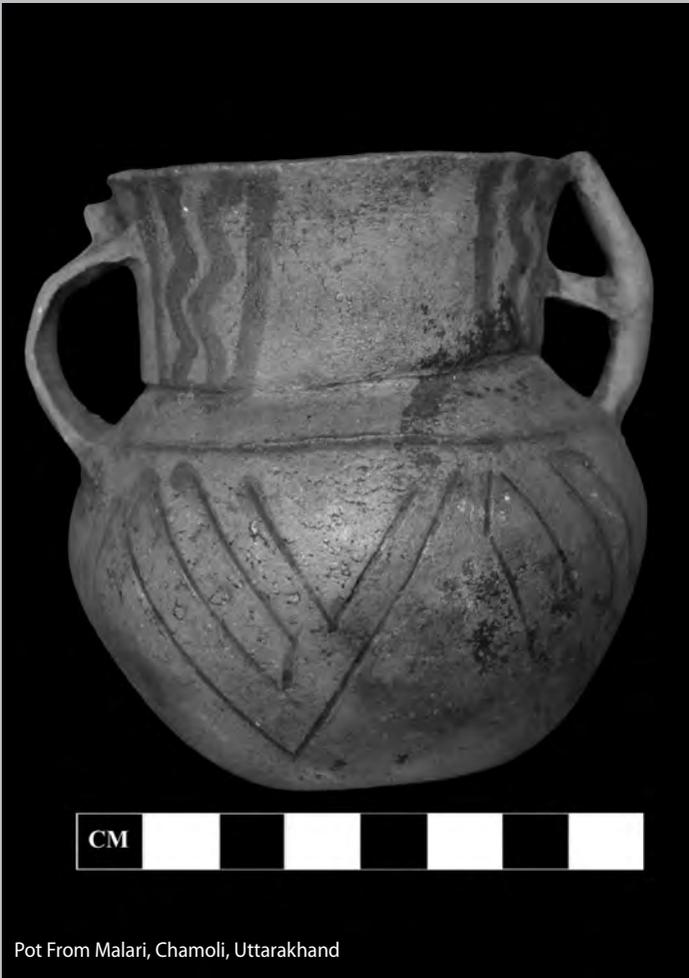
Pot From Malari, Chamoli, Uttarakhand

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Pot from Spiti Valley, HP

Borderland Archaeology through cultural remains of past

EXECUTIVE SUMMARY

The G20, comprising the world's wealthiest nations and emerging economies like India, Brazil, South Africa, and Indonesia, represents a substantial portion of the global population, trade, and GDP. India's G20 presidency, as the largest democracy and fastest-growing economy, offers a significant opportunity for the country to strengthen its global role. This is reflected in the theme of "*Vasudhaiva Kutumbakam*" or "One Earth, One Family, One Future," emphasizing a people-centric approach to address global challenges and facilitate sustainable economic development. Under the presidency, India has taken five key pledges during its "Amrit Kal." These include ensuring full access, equity, and affordability to food, fuel, and fertilizer for all people, striving to become a fully developed country by 2047, liberating from colonial mindsets, affirming multilateralism, enhancing awareness of India's rich cultural heritage, and addressing environmental concerns. These pledges demonstrate India's commitment to confronting climate change challenges, promoting the national and global good, and tackling pandemics, as evidenced by initiatives such as providing COVID vaccines to countries in the Global South and conducting evacuation efforts in Ukraine.

While global political, economic, and security dynamics have changed significantly, India has emerged as an important global player. The Government of India has prioritized the concerns of developing countries and taken steps to address them seriously. However, achieving sustainable development goals by 2030 has become increasingly challenging due to the COVID-19 pandemic, the Ukraine war, global inflation, and shortages of food, energy, and fertilizer, disproportionately impacting millions in developing countries. India's G20 presidency seeks to address these challenges by becoming the voice of the Global South and forging partnerships for green growth, connectivity, digitalization, and health security. Amidst threats to the global order, the economy, and the burden of debt on developing countries, India aims to mitigate the adverse impacts faced by the South. India's emergence as the fastest-growing economy, commitment to democratic values, inclusive growth, and peace, along with its skilled and young workforce, positions it as a significant player on the global stage.

Through the G20 presidency, India aims to engage its workforce in finding creative solutions for climate change mitigation, promoting agriculture and food security, driving digital transformation, and improving social and economic policies. Managing energy transition and working towards sustainable economic recovery in the post-pandemic world are major goals for India's G20 presidency, with a focus on the welfare of human beings. The G20, including six nuclear powers and influential emerging economies, holds substantial global influence. In the current turbulent global political landscape, with Russia and China facing scrutiny for their actions, India's G20 presidency provides a unique opportunity for the country. With its emphasis on sustainable development in the Himalaya region, India can showcase its commitment to global issues and engage its workforce in addressing challenges such as climate change, agriculture, digitalization, and social well-being.

In conclusion, India's G20 presidency presents a significant opportunity for the country to strengthen its global role and contribute to sustainable development. By prioritizing the welfare of human beings and engaging in collaborative efforts, India can make substantial progress in achieving its goals while addressing the challenges faced by the Global South. A conscious effort is made to mobilize a variety of stakeholders (students, researchers, academicians, policy makers and others) together with the developmental process through the national level one day workshop entitled "India's G20 Presidency and sustainable development: Opportunities and Strategies," which was held at HNB Garhwal University (A Central University) Srinagar-Garhwal, Uttarakhand, on April 17th, 2023.

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INTRODUCTION

India has long believed that people should be at the centre of development. This belief is reflected in the theme of India's G20 presidency, "*One Earth One Family One Future*". India's G20 presidency provides an opportunity to make significant contributions to the achievement of sustainable development goals particularly focusing on the interests of the Global South to create a more equitable global growth process. Sustainable development is crucial for all societies, regardless of their growth trajectory. India has been calling for a transformed globalization process that is sensitive to the needs of the Global South. The three key elements of the SDGs are poverty alleviation, public health security, and climate action. These are all important issues that have a significant impact on the lives of people in developing countries. India and other countries have made progress in alleviating poverty, but the economic impact of the pandemic has been devastating. The pandemic has also highlighted the need for greater attention to public health security. The pandemic and climate change have put immense pressure on global supply chains. India is committed to advancing the cause of equitable climate justice. To do this, India is trying to activate and lead a mass movement for proactively protecting and preserving the environment. India is also eager to build a solar coalition for global resilience by taking up the initiative of "*One Sun, One World, One Grid*".

India's presidency of the G20 is a significant opportunity to address global challenges, including poverty, food insecurity, and climate change. However, it will be a challenging task to impress upon such a diverse group of countries, especially given the short time frame. Nevertheless, India can use its presidency to steer the G20 towards achieving its goals, and to set a precedent for future G20 presidencies. The Ukraine war has exacerbated the global energy crisis and has made it more difficult for developing countries to switch to clean energy. India will need to use its diplomatic skills to ensure that the G20 makes concrete commitments to address these challenges. It will also need to come forward to help the most vulnerable countries, such as those in the European Union, who are struggling to cope with the impact of war on energy prices. The G20 summit in Delhi will be an opportunity to discuss and elaborate on these issues at the global, regional, and local level. It is also an opportunity to suggest strategies for achieving the goals of sustainable development. India has a responsibility to use its presidency to address the challenges facing the world, and to leave a legacy for the future.

In addition to the global challenges, India should also use its presidency to address the specific needs of mountain communities which are facing several challenges, including climate change, poverty, and lack of access to resources. India can use its presidency to raise awareness of these challenges, and to work with other G20 countries to find solutions. Mountains cover about 24% of the earth's land surface and support a significant proportion of global biodiversity. They also provide freshwater to hundreds of millions of people, including marginalized and poor populations. The Himalaya which is one of the largest, youngest, and highest mountains in the world, is spread across seven countries: India, Pakistan, Afghanistan, China, Bhutan, Nepal, and Myanmar. The region occupies a special place in the mountain ecosystems of the world for meeting the needs of water, food, fuel, biodiversity, food, energy, etc. not only to the upland population but also to the downstream people. Further, the region is facing

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severe challenges due to climate change, natural hazards, unsustainable land use, unplanned development, and socioeconomic dynamics thus require immediate attention of the scientific community and policy makers for timely reversal of these long-term and detrimental impacts.

The Indian Himalayan region (IHR) is a unique geographical and geological entity, composed of different social, cultural, and environmental structures. The region covers a geographical area of approximately 591 thousand sq km and constitutes 18% of India. Approximately 4% of the country's total population lives in the region, representing more than 170 ethnic communities with distinct socio-cultural environments. The region bears great global significance due to the geo-climatic role of its cryosphere and the river systems supporting lives for several civilizations. Recognized as one of the 34 global biodiversity hotspots, the forest cover rich region of the Himalaya is a treasure for present and future generations. Its huge cultural diversity makes the region a centre of knowledge for heritage, religion, and spiritualism. The region is also source of innumerable ecosystem goods and services. Tourism has also emerged as a major activity in the region and is playing an important role in the rural economy. With the globalizing economy, changing population dynamics, threats of climate change, the Himalaya is undergoing resource depletion, ecological imbalance, and economic un-sustainability as long-term impacts. The Eastern Himalaya situated at the confluence of Indo-Malayan, Palearctic, and Sino-Japanese biogeographic zones is ecologically diverse and harbour a rich flora and fauna. It is home to two hundred linguistically and culturally diverse inhabitant tribes which are mainly dependent on nature for their livelihoods. Human population in the region has also increased enormously during last few decades resulting in depletion of natural assets and resources, biodiversity loss and frequent natural extremities. Global Forest Watch estimates that North-east India lost 11,400 km^2 of forest cover from 2001 to 2017. However, its large river systems and abundant land provide an amazing resource base to tap into renewable energy through solar plants and hydropower. The Northeast Himalayan states cover 7% of the country's total land mass but contain 25% of the carbon stock of the country which provides a huge scope to increase carbon stock through restoration of native species and aggressive agroforestry initiatives.

The western Himalaya which is comparatively drier and less diverse in biodiversity is also facing problems of land use change. Population growth, expansion of road connectivity, and booming tourism sector have contributed significantly to urban growth in the western Himalaya. Tourism is a major source of revenue for the region, but also has several negative environmental impacts if not managed scientifically. Urbanization is another major driver of environmental change. Studies have shown that built-up areas in the region have grown significantly in recent decades. For example, western Himalaya has experienced a growth rate of 14.5% from 1985 to 1995 and 19.5% from 1995 to 2005, Garhwal Himalaya have seen an annual growth rate of 3.75-3.88% in built-

up area, and areas surrounding lakes in the Kashmir valley have seen a net growth rate of more than 3000% from 1994 to 2018. The unplanned urbanization is imparting several environmental impacts like diminished resource quality and quantity, increased conflict for resources, invasion of alien species, homogenization of habitats and simplification of biota. In addition, climate change is also having a significant impact and the region has seen a rising trend in extreme warm events, temperature-based indices, and a falling trend in extreme cold events.

Since 1987, sustainable development has been a global priority which involves integrating environmental, economic, and social development concerns. However, despite the implementation of several international and national policies and programs, the results have been mixed. This is due to a lack of scientific knowledge on how to integrate ecological and socio-economic development across spatial and temporal scales. Current scientific understanding is based on a narrow range of socio-ecological systems which limits our ability to generalize and predict future changes. Similarly, sustainability of traditional resource management systems has been assessed based on value judgments and short-term diagnostic analysis, rather than rigorous scientific analysis. Further, limited knowledge exists on the interaction of environmental and socio-economic changes across spatial and temporal scales. There is no unifying research methodology for developing sustainable development policies and programs. As a G20 leader, India seeks to contribute towards establishing a safer, stable, and prosperous world. The country is in early years of its *AmritKaal* and contributing towards making the 'world a better place to live' which will truly make India a *Vishwa Guru*. During this significantly important era of the country, devising scientifically sound and feasible policy framework and its effective implementation becomes important for sustainability of the Himalayan region. To address the Himalaya specific challenges, there is a need for multi-stakeholder dialogues and partnerships to devise region-specific solutions, strategies, and actions to achieve sustainable development goals. This is aligned with the expectations of the Hon'ble Prime Minister of India, who has invited all citizens of the country to share ideas and provide suggestions in this regard. The Himalayan region is particularly important for sustainable development due to its unique ecological and socio-economic importance. The resolution of its problems and sustaining its diversity is nations prime duty, as without sustaining the Himalayan ecosystem, humanity's survival cannot be assured. Thus, to address these challenges, HNB Garhwal University Srinagar, Uttarakhand in collaboration with G.B. Pant National Institute of Himalayan Environment (NIHE) Almora, Research & Information System for Developing Countries (RIS) New Delhi, Kalinga Institute of Indo-Pacific Studies (KIIPS) New Delhi and Indian Himalayan Central Universities Consortium organized a day-long round-table discussion. The focal issues for discussion revolved around India's G20 presidency, political discourse; environment and climate sustainability; agriculture and livelihoods; socio-political, cultural, and ancient civilizational historical roots

and routes; disaster risk reduction, bioresource management and employment; education and energy transitions, health, trade and investment, and eco- friendly and cost-effective tourism. Based on the deliberations, a set of key issues and challenges of the IHR and related policy recommendations and way forward has been prepared for further necessary actions at the government level.

The introductory chapter of this report presents an overview of the crucial themes that will be extensively discussed in the subsequent chapters. These themes encompass a wide range of topics, including the role of shaping global political discussions and advancing the interests of developing countries through inclusive decision-making processes that take into account the perspectives of all nations. The significance of cooperation and collaboration among G20 members is underscored as essential for addressing political challenges and fostering stability and peace.

Furthermore, the chapters 2-8 explore the diverse challenges and opportunities encountered by countries in their pursuit of sustainable development. Key issues such as poverty, inequality, and limited access to healthcare and education are recognized as significant obstacles that require innovative approaches for effective resolution. Moreover, the potential of sustainable development to stimulate economic growth, generate employment opportunities, and drive social progress

is emphasized. These chapter also emphasize the urgent need for collective action to mitigate the impacts of climate change and enhance resilience against natural disasters. It highlights the importance of adopting sustainable practices, promoting renewable energy sources, and implementing effective strategies for disaster risk reduction. Recognizing that addressing climate change necessitates international cooperation and shared responsibility, the chapter underscores the critical role of collaboration in tackling the complex challenges posed by climate change. Additionally, the report acknowledges the significance of preserving cultural heritage and history, as well as advocating for sustainable development. Cultural preservation is identified as a catalyst for promoting sustainable tourism and empowering local communities. The integration of indigenous knowledge and practices into sustainable development strategies is emphasized as a means to ensure a holistic and inclusive approach. Advocacy is also recognized as essential for raising awareness about the value of cultural diversity and heritage.

As the report progresses, these thematic areas will be further explored and analysed offering valuable insights and strategies (*Chapters 2-8*) and recommendations for policy formulation (*Chapter-9*). The collaborative efforts of scholars, experts, policymakers, and representatives from various institutions will contribute to a comprehensive understanding of the issues at hand and chart a way forward for relevant ministries and government departments.

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Mount Khagchendzonga view from Yuksam-Dzongri trek, West Sikkim.

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CLIMATE CHANGE AND PREPARING A CLIMATE RESILIENT SOCIETY IN THE HIMALAYA

Warming over the Himalayas exceeds the global average rise in temperature having different annual/ seasonal warming rates over its different sub-regions (Wester et al., 2019). Increasing trends of temperature has been reported over the middle mountains of Nepal by 0.12°C/yr (Shrestha et al., 1999) and 0.4°C/yr (Hingane et al., 1985) in the Himalayan region. This rise in temperature in sensitive regions like the Himalaya can significantly alter existing bio-physical and socioecological landscapes. The Himalayan region is a source to largest number of glaciers on earth and is thus considered as the Water Tower of the Asia. However, retreating glaciers in the region due to the increasing global temperature has been highlighted as a major concern which could influence the geohydrology of the globe very severely. The highest rate of retreat in the Himalaya has been observed in the Brahmaputra basin whereas the Indus and the Ganga basin are experiencing significant retreat, while the Karakoram region is experiencing the least retreat. Parbati glacier in Himachal Pradesh has retreated by approximately 19.4 meters at a rate of 0.36 metres per year between 1970 and 2016. The retreat of the glaciers and the changes in precipitation patterns are having a significant impact on the people and ecosystems of the Himalayan region.

Table-2.1: Rate of increase/decrease of the seasonal average maximum, minimum temperatures (°C) and precipitation (mm) at glacier-fed and non-glacier fed region of the Indian Himalayan Region computed by linear regression slope (b) during 1979-2014.

Seasons	Basin	Glacier-fed basins			Non-glacier-fed basins	
		Sindh	Parbati	Dhauliganga	Ranganadi	Imphal
Summer	Maximum	0.011	0.15*	0.064*	0.005	0.011
	Minimum	0.01	0.141*	0.08*	0.038*	0.014
	Precipitation	4.632*	-2.233	0.45	7.29	0.789
Winter	Maximum	0.227*	0.166*	0.047*	0.172*	0.065*
	Minimum	0.117*	0.158*	0.033	0.115*	0.017
	Precipitation	-0.635	-1.17	-1.491	-2.775	-0.312

*Indicate trend statistical significance at 95% confidence level (+ for increasing and – for decreasing) (*after* Kuniyal *et al.* 2021)

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The glaciers provide water for irrigation, drinking, and hydroelectric power to a large size of upland and lowland population in the Himalaya. However, the ongoing changes in precipitation patterns are making it difficult to predict the availability of water in the region which is having a negative impact on agriculture, water supply, and energy production. For example, in the Sindh Basin, there has been a statistically significant decrease in winter precipitation. Similarly, Dhauliganga Basin is also experiencing a decrease in winter precipitation. Particularly, non-glacier fed basins are experiencing an increase in maximum and minimum temperatures, while precipitation patterns are varied. The warming and variable precipitation patterns are severely impacting the people and ecosystems of the region (Table 2.1).

Similarly, other climate change induced impacts include increasing incidences of landslides. According to the Global Landslide Catalog, (https://catalog.data.gov/dataset/global-landslide-catalog) Jammu and Kashmir has reported 284 landslide incidents, while Uttarakhand has reported 224 incidents. These landslides are often caused by heavy rainfall, which is becoming more frequent due to climate change. The number of heat days in the Himalayan region has also increased. Between 1969 and 2019, almost all states in the region have recorded heat days ranging from 1 to 52 days. A study on *Cedrus deodara* reported that the low latitude region of the Himalaya is projected to experience a reduction in tree growth of 34% and 38%, respectively, by the end of the 21st century under the RCP 4.5 and RCP 8.5 scenarios. This is likely due to rising temperatures throughout the growing season.

Table-2.2: Average Black Carbon aerosol concentration reported earlier over the Himalayan region.

Station	Latitude (°N)	Longitude (°E)	Altitude (metres)	Study period	BC ($\mu g\ m^{-3}$)	References
Hanle	32.50	78.50	4520	Aug 2009 - Jul 2010	0.077	Babu *et al.* 2011
Srinagar city (J&K)	33.90	74.60	1600	Jan 2013 - Dec 2013	6.0	Bhat *et al.* 2017
Kullu	31.90	77.10	1154	Jul 2009 - Mar 2012	2.8	Nair *et al.* 2013
Dehradun	30.33	78.04	700	Jan 2011- Dec 2017	3.85	Kant *et al.* 2020
Manora Peak	29.40	79.50	1958	Nov 2004 - Dec 2007	1.0	Dumka *et al.* 2010
Mukteshwar	29.26	79.37	2286	Sep 2005 - Sep 2007	0.81	Hyvarinen *et al.* 2009
Darjeeling	27.01	88.15	2200	Jan 2010 - Dec 2011	3.4	Sarkar *et al.* 2015
Dibrugarh	27.30	4.50	111	Jun 2008 - May 2009	9.5	Pathak *et al.* 2010

Increasing amount of black carbon has been highlighted as a major culprit for the warming in the Himalaya. As per the studies, highest aerosol radiative forcing and heating rate were observed at Patiala from October 2008 to September 2010, with a positive ARF_{ATM} of 48.82 Wm^{-2} and a heating rate of 1.37 K Day^{-1} (Table 2.2). Overall, these studies provide insights into the regional variability of aerosol radiative forcing and heating rates, highlighting the need for continued research and monitoring to better understand the impact of aerosols on the Himalayan climate. A better understanding of aerosol optical and microphysical properties through can improve the modelling of aerosol effects in view of aerosol-climate implications via modifications in atmospheric warming and changes in the snow/glacier albedo over the Himalayan region (Fig 2.1 & Fig 2.2).
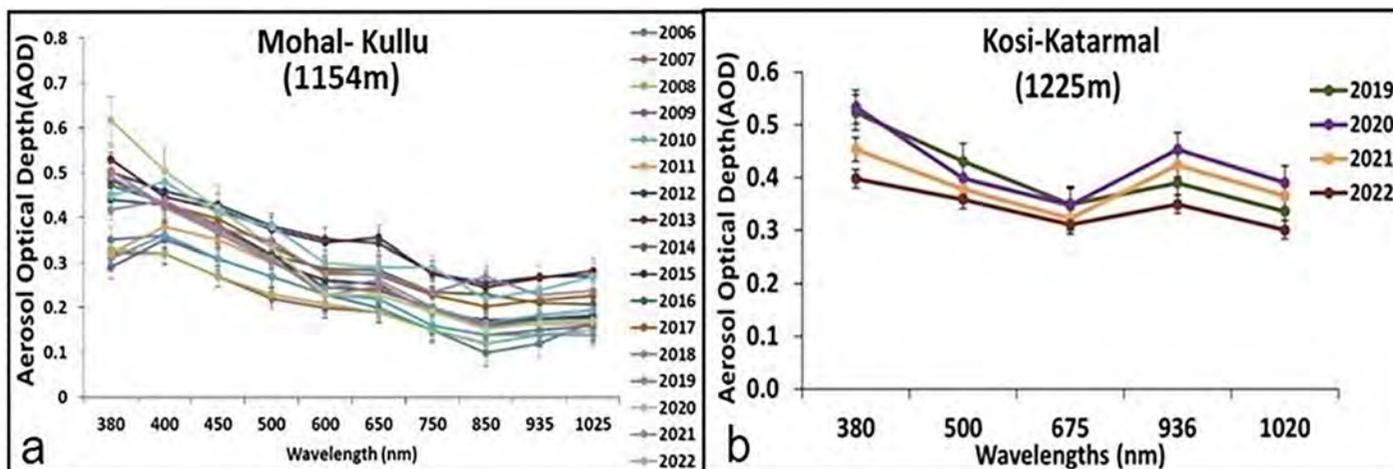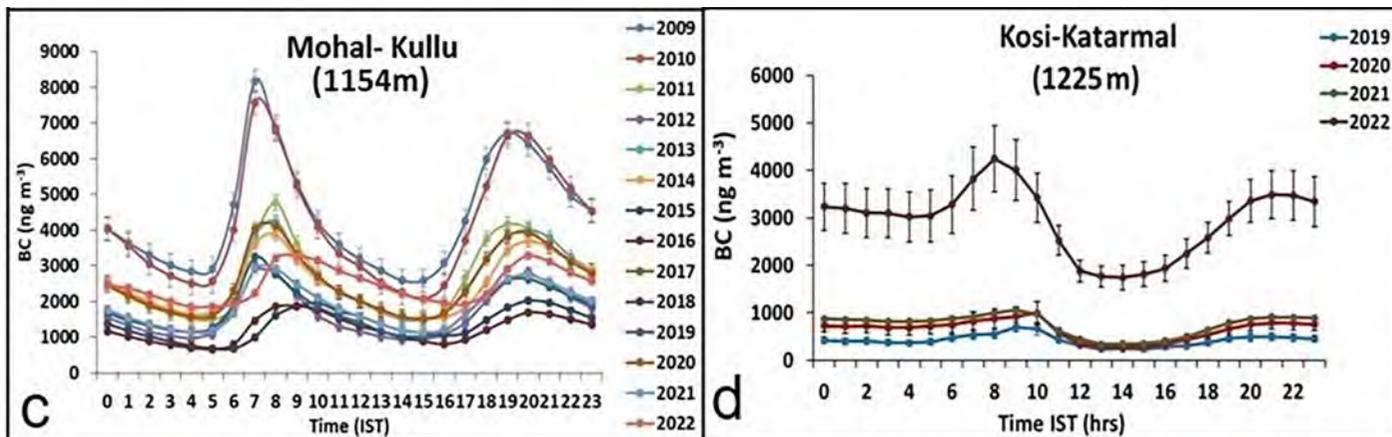
Fig. 2.1: Long term monitoring of black carbon by NIHE at Mohal Himachal Pradesh and Katarmall, Uttarakhand
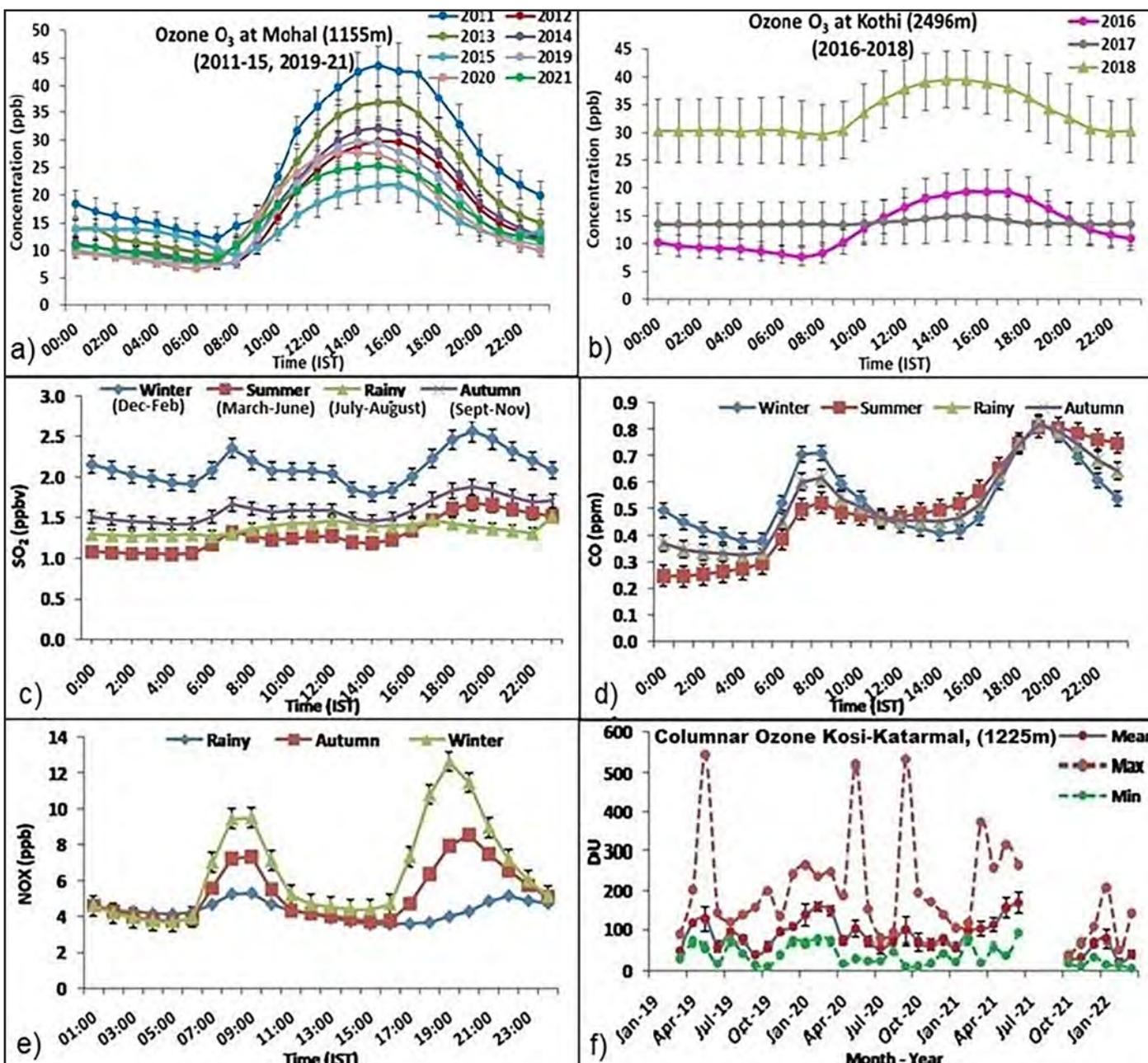

Fig. 2.2: Long term monitoring of air quality parameters by NIHE at Himachal Pradesh and Uttarakhand

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Ongoing initiatives

The Government of India has taken several steps to address the challenges of climate change and its impact on the Himalayan region. National Mission for Sustaining the Himalayan Ecosystem (NMSHE) was initiated in 2014 to promote research, capacity building, and sustainable development practices in the region. Many glaciological studies have been conducted to monitor the changes in the glacier mass balance and to assess the risks of Glacial Lake Outbursts Floods (GLOFs). A network of automatic weather stations and monitoring stations is being established to monitor the glacial melt. Disaster Management Authorities (DMA) and State Disaster Response Fund (SDRF) have been established in different Indian Himalayan states to respond to Glacial Lake Outbursts Floods (GLOFs) and other natural disasters. Different scientific organisations have been conducting surveys and mapping of glaciers and glacial lakes in the Himalayan region to prepare an inventory which will help to identify potentially dangerous glacial lakes prone to Glacial Lake Outbursts Floods (GLOFs). Remote Sensing (RS) and Geographical Information System (GIS) technologies have been used to document glaciers and glacial lakes in the Himalaya. The Government of India is committed to addressing the challenges of climate change and its impact on the Himalayan region. However, to establish a comprehensive glacier monitoring and research network, dedicated financial resources and manpower shall be allocated to strengthen the existing scientific research and monitoring initiatives. Training for professionals working in disaster management, water resource management, and climate change adaptation are also required. Governments should also prioritize fostering a culture of environmental stewardship and sustainable practices among local communities in the Himalaya.
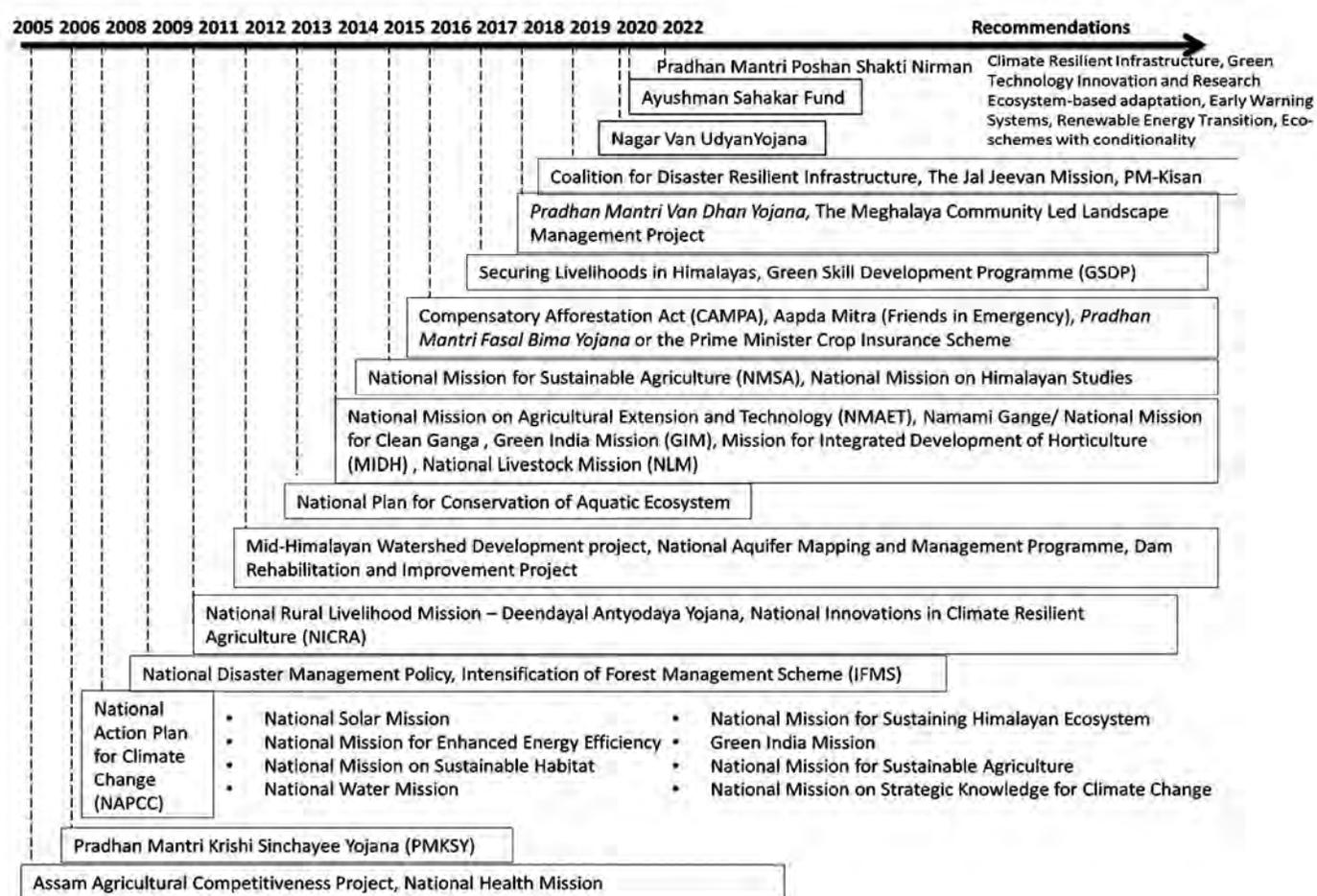
Fig. 2.3: Major policies and interventions by Government of India for mitigation of climate change in the country.

Climate Smart Communities

Capacity building for climate-smart communities is an essential component of sustainable development. It aims to equip individuals, organizations, and communities with the knowledge, skills, and resources necessary to effectively adapt to and mitigate the impacts of climate change. Real-time monitoring and early warning systems are needed to help communities prepare for and respond to climate-related hazards. These systems can be used to track weather

Farmers at the Harvest, Gunji Village, Byans Valley, Pithoragarh.

patterns, identify potential hazards, and warn communities of impending danger. Climate resilience villages can be created by supporting Himalayan communities in developing their villages to be more resilient to climate change.

Institutional interventions to strengthen local government and community organizations will play a key role. Similarly technological interventions to improve infrastructure and access to water and energy are equally important. Knowledge interventions to raise awareness of climate change and its impacts are also important for development of resilience in the societies. Switching to renewable energy sources is a major action that can be taken to reduce carbon emissions and glacier melt. Water harvesting and conservation systems can be developed to reduce the wastage of water by collecting excess water during wet season and using it during the dry season. Efficient irrigation systems can help to deliver water to crops and other areas where it is needed. Improving water conservation practices will immensely help in development of improved water management system in the Himalaya. Adaptive strategies need to be opted as early as possible to enhance water resource management, promote sustainable agriculture, and ensure the resilience of ecosystems and communities.

Establishing a protocol and mechanism for carbon credits

The IHR has a carbon stock of approximately 3000 Mt, which is about 40% of India's total carbon pool. To make the carbon market beneficial for both emission reduction and nature conservation, it is important to establish a regulatory framework and standardized protocols. This includes strengthening and streamlining the pricing and verification methodologies for carbon credit. Clearer demand signals would help buyers and sellers have more confidence in their project plans. To achieve this, collaboration between industries, government, scientific organizations, and communities is essential. This would allow for the establishment of a common platform for standardizing pricing, permittable allowances, and trading protocols.

Preserving the Himalayan glaciers

India can contribute to preserving the Himalaya's natural heritage and securing the well-being of its people for generations to come by acknowledging the gravity of the issue of Himalayan glacier melting and taking collective action. The Himalayan glacier melting crisis demands immediate attention from policymakers, scientists, and society. It is a wake-up call to address the broader issue of climate change to protect and conserve these invaluable natural resources. By taking decisive actions, we can hope to safeguard the Himalayan glaciers for future generations and ensure the long-term sustainability of the region's ecosystems, biodiversity, and water security. The involvement of all stakeholders, i.e., governments, businesses, and individuals, is essential to realize the reduction in carbon emission and glacier melting in the Himalaya.

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Research and development

Increased financial and institutional support should also be provided for scientific research and monitoring initiatives that focus on glacier mass balance, renewable energy generation, sustainable agriculture, hydro-morphology, ice flow dynamics, and glacial lake development.

Collaboration with national and international Research & Development institutes, Non-Government Organisations (NGOs), Community Based Organisations (CBOs), and policymakers is important for conducting transdisciplinary research on disaster risk reduction and resource conservation through resilience building. International collaborations and dialogues are also essential for research and the formulation of regulations regarding transboundary and shared resources, including river systems. Bottom-up plans for both urban and rural development should be implemented based on ground-level assessment and need-based studies. Inclusiveness for socio-economic classes and gender should be a priority in the entire planning process. It is also essential to conduct comprehensive assessments of development projects, including policy implications such as compensatory afforestation, Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Reservoir Level Maintenance (RLM), Sustainable Land Management (SLM) etc., and to make localized and context-specific modifications.

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Peaks of Panchachuli Glaciers, Darma Valley, Pithoragarh.

HIMALAYA: TREASURE OF UNIQUE BIORESOURCES

The IHR is a treasure trove of biological resources. It is home to nearly 1000 tree species, 675 wild edibles, and 1,740 species of medicinal value. These resources have the potential to contribute significantly to the local economy and to the global health. The Himalaya is home to a wide variety of medicinal plants, many of which have been used for centuries by traditional healers which has a potential to treat a wide range of diseases, including cancer, diabetes, and heart disease. The region is also a source of a wide variety of edible plants, including fruits, vegetables, and grains which are an important source of food for the people of the region. Wild edible plants can also be used to produce value-added products, such as jams, jellies, and juices. The region is also home to a number of aromatic plants, which are used to produce essential oils and are used in aromatherapy, cosmetics, and food flavouring. The bioresources of the Himalaya are a valuable asset to the region and the world.

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GLORIA (Global Observation Research Initiative in Alpine Environments) protocol based long term monitoring in Byans valley.

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Alpine ecosystem near Pindari, Bageshwar, Uttarakhand.

Despite its diverse ecology the region is facing a number of challenges, including deforestation, overgrazing, and climate change. These challenges are threatening the region's biological diversity and its ability to provide goods and services for livelihoods of its people. Thus, in order to address these challenges, it is essential to promote sustainable development in the Himalaya. Development of methods and technologies for using the region's resources in a way that does not damage the environment and that benefits the local people is very important. Sustainable use of Himalayan bioresources shall be promoted through encouraging the cultivation of medicinal and aromatic plants and by promoting agroforestry, and adopting ecosystem-based approaches. Developing small-scale industries which uses green and eco-friendly technology is very important for sustainable utilization of the diverse bioresources in the Himalaya.

Challenges of Bioresources Management

There are many challenges like lack of infrastructure, coordination, integration, and employment opportunities in the Himalayan region which hamper the sustainable and efficient utilization of bioresources. The lack of infrastructure, such as small-scale industries for semi-processing, value addition, postharvest treatment, storage, product development, certification, marketing, and information systems, makes it difficult to utilize bioresources in a sustainable and efficient manner. The lack of coordination, collaboration, cooperation, and networking between diverse stakeholders, such as scientists, forest officials, industrialists, Non-Government Organisations (NGOs), and local people, makes it difficult to develop and implement effective bioresources management and utilization plans. The lack of integration of cross-sectoral linkages and interdependencies between different line agencies/departments makes it difficult to develop and implement policies and programs that address the challenges of bioresources management and utilization in a holistic manner. The inadequate employment opportunities and livelihood options in the Himalaya region lead to out-migration of people, particularly youth, which further exacerbates the challenges of bioresources management and utilization.

Fig. 3.1: Depiction of a diverse assemblage of bioresource in the Himalaya

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To preserve the bioresources heritage of the Himalaya a number of interventions are required. Investing in infrastructure development, such as small-scale industries, to improve the efficiency of bioresources utilization is the first step. Strengthening coordination and collaboration between stakeholders to improve the planning and implementation of bioresources management and utilization programs. Integrating cross-sectoral linkages and interdependencies to develop and implement policies and programs that address the challenges of bioresources management and utilization in a holistic manner. Finally, by creating employment opportunities and livelihood options we can reduce out-migration and improve the sustainability of bioresources utilization.

Strategies for sustainable bioresources management in IHR

Agricultural diversification and integrated farming

Integrated farming, which combines crop cultivation, animal husbandry, agroforestry, fisheries, mushroom cultivation, and poultry, is rare in the Himalaya. Instead, most farms focus on only some of these components. The Himalaya has several niches for the production of fruits, cereals, millets, vegetables, animal husbandry, agroforestry, and fresh water or cold-water fisheries. There are also opportunities for the cultivation of underutilized crops, such as Buckwheat, Amaranth, and Upland rice. In addition, the region is well-suited for the cultivation of high-value crops, such as apples, kiwi fruit, peaches, citrus fruits, and figs. Wheat, rice, barley, and maize are the main cereal crops in the Himalaya. These crops are more productive under irrigated conditions, but their productivity under rain-fed conditions depends on the amount and distribution of rainfall. The Himalaya has a long history of traditional farming practices, which have led to the development of a variety of landraces that are in high demand in the market. However, the market supply of these crops is limited due to low yields and inefficient production systems. To increase the productivity and efficiency of integrated farming in the Himalaya, it is important to invest in research and development, extension services, and infrastructure. By doing so, farmers can increase their yields and profits, while also improving the sustainability of their operations.

Promotion of Millets and other nutrient rich crops

This year has been declared as the **International Year of Millets** by United Nations. Millets are a group of crops that are grown in dryland areas with low rainfall and poor soil fertility and thus are climate-resilient, as they can tolerate drought and heat better than other crops, such as wheat and rice. Millets are also a good source of nutrients, including protein, fiber, and vitamins. The highest production of finger millet in the India is in Uttarakhand which include foxtail millet, barnyard millet, proso millet, kodo millet, and little millet etc. To make millet cultivation more sustainable, it is important to intercrop millets with legumes to improve soil fertility and reduce the need for fertilizer and risk of pests and diseases. The Himalaya shall be promoted for cultivation and large-scale production of millets for fulfilling the nutritional security of the local inhabitants and other citizens of the country. In addition to millets, several indigenous varieties of local vegetable are cultivated and used by local inhabitants in the Himalaya. These plants can be used to improve cropping systems and promote local economic development.

Innovation in agricultural industry

Agri-tourism is another potential source of income for farmers in the Himalaya. Homestays can be linked with agri-tourism by developing gardens of medicinal plants, floriculture, horticulture, or dairy farms. Developing sustainable village models by promoting cooperative or corporate farming will boost the economy and create jobs in the region. Self-help groups and self-employment can be the objectives of the model village to harness natural resources for the long term. This will also promote youth in agriculture and small-scale agro-based industries. The use of post-harvest technologies in the processing of crops and fruits is essential to increase productivity and economic value of the produce. This sector of rural agricultural economy is relatively new in the Himalaya and thus there is huge potential for innovation.

Biodiversity conservation and management

In general, biodiversity conservation has been highlighted as an issue of global importance. In India, through Biological Diversity Act, 2002, Biodiversity Management Committees (BMCs) have been established across the nation at the local level to promote conservation, sustainable use, and documentation of biological diversity at the grassroots level. BMCs are mandatory for all local bodies, including villages and municipalities and are mandated with preparing a Peoples Biodiversity Register (PBR), conserving and sustainably using biological resources**, r**egulating access to biological resources and associated traditional knowledge**, s**haring benefits from the commercial utilization of biodiversity**,** promoting traditional ecological knowledge and practices, raising awareness and undertaking educational activities related to biodiversity conservation BMCs are instrumental in fostering community participation and empowering local communities in biodiversity conservation efforts. Further, Ministry of Environment, Forest and Climate Change (MoEFCC) has introduced guidelines for compensatory mitigation to restore ecosystems affected by the diversion of forest land for development projects. This includes the requirement for developers to undertake ecological restoration activities as a condition for obtaining forest clearance. The Compensatory Afforestation Fund Act, 2016 (CAF Act) was enacted to ensure the utilization of funds collected from industries for diverting forestland to non-forest purposes. These funds are thus utilized for afforestation, regeneration of degraded forests, wildlife protection, and infrastructure development.

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CHANGING LAND USE AND LAND COVER IN THE HIMALAYA

Land use change has affected almost one-third (32%) of the global land area in the past six decades, four times greater than previous estimates (Winkler et al., 2021). The patterns of global land use change are complex, with evidence of afforestation and cropland abandonment in the Global North, but deforestation and agricultural expansion in the South. Like other parts of the globe, the Himalayan region is also facing rapid land use changes due to population growth, urbanization, agriculture, tourism, infrastructure development, and climate change. These changes have significantly impacted the environment, biodiversity, and local communities in the region. Subsistence farming practices, which were traditionally sustainable, have witnessed expansion of agricultural land through deforestation and conversion of forests into agricultural fields due to the increasing population. Similarly, forests are cleared for timber extraction, fuelwood collection, and infrastructure development, which is disrupting the delicate ecological balance, leading to soil erosion, landslides, and loss of habitat for many plant and animal species.

The Himalayan vegetation cover varies with altitudinal variations, soil characteristics, and minor changes in temperature and precipitation. A number of alien plant species have invaded the natural habitats lost due to climate change (Lamsal et. al., 2018). In higher altitudes, change in temperature leads to a compositional change in vegetation structure and a substantial decrease in alpine and sub-nival vegetation (Dolezal et. al., 2016). As per the FSI report, the decrease in forest cover is highest in this region Uttarakhand, Nagaland, Manipur and Mizoram. Forest fire events are gradually increasing over the years which highly impacts the forest structure and stability, 42,522 forest fire events have been reported in Uttarakhand state (Mina et al., 2023). *Pinus roxburghii* forests are highly prone and vulnerable to forest fires.

Unplanned urbanization

The unplanned urbanization in Himalayan regions exhibits various disturbances in the ecosystem and threatens the mountain towns. The construction of multi storied buildings, hydropower plants, road construction, tunnel and blasting severely trigger the inbuilt tectonic instability in the Himalayan ecosystems and leads to various natural disasters. Improper management of muck generated from construction activities leads to soil erosion, landslides, flood and other environmental problems. As per the Global Construction Review, the construction of hydropower plants in Joshimath exacerbated the flooding because construction activity eroded the riverbanks.

According to the 2011 Census, about 12.07 million people live in different towns and cities located across the entire stretch of the Indian Himalayan Region (IHR), constituting

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27.50 percent of the total population of the region (Table 4.11). Interestingly, more than one-half of the entire urban population of the region is concentrated in Jammu & Kashmir (3.43 m) and Uttarakhand (3.04 m). This urbanization has been driven by various factors, including economic opportunities, infrastructure development, migration, and tourism. (Tiwari et al., 2018). During recent years, the trends of rural outmigration has further increased due to depletion of agricultural resources, impact of climate change on farming system and rural livelihood and increasing frequency and severity of natural disasters in the region (Tiwari and Joshi, 2015). Importantly, urbanization in the states of Northeast India is not driven by manufacturing rather it is fueled by service sector coupled with wholesale and retail trade (Firdos 2020). However, sustainable urbanization in the IHR is crucial to ensure the region's long-term socio-economic development while preserving its ecological integrity.

Table-4.1: Demographic situation of Indian Himalayan Region

State/UT	Urban Population	% Urban Population to the total population
Jammu & Kashmir	34,33,242	27.38
Himachal Pradesh	6,88,552	10.03
Uttarakhand	30,49,338	30.23
Hill district of West Bengal*	7,27,963	39.42
Hill Districts of Assam**	1,75,455	14.99
Arunachal Pradesh	317369	22.9
Manipur	834154	32.5
Meghalaya	595450	20.1
Mizoram	571771	52.1
Nagaland	570966	28.9
Sikkim	153578	25.2
Tripura	961453	26.2
Indian Himalayan Region	**1,20,79,291**	**27.50**

Migration

As per the ICIMOD report, 200 million inhabitants of the Himalayan region suffer from huge economic crises, poverty, infrastructure, education, health, and various other basic amenities. Labour migration is a major livelihood strategy for rural people of the Himalayan region. Unplanned migration is often explained by urban pull and rural push causes. A study conducted in Uttarakhand, India (Hoffmann et al., 2019) stated that socioeconomic possibilities such as education, job, and urban facilities act as pull factors for rural populations to migrate to cities. A report prepared by Rural Development and Migration Commission, in May 2018, estimated that 5.2 lakh people migrated out of Uttarakhand during the period of 2008 and 2018 due to better job opportunities, education and health.

While traditional cultural practices and identities remain strong, globalization and modernization have also led to the adoption of new cultural elements and influences. Investors from big cities are investing their money to develop tourism-related businesses on the lands of economically weaker sections in the mountains of the Himalaya. The region is also experiencing local and regional outmigration, as well as significant demographic changes characterized by population growth, migration patterns, urbanization, socio-economic transformations, environmental concerns, and cultural diversity. These changes present both opportunities and challenges for the region, emphasizing the need for sustainable development practices that balance economic growth with environmental preservation and social well-being. Overall, the land use and demographic changes in the Himalayas are driven by a complex interplay of socioeconomic, demographic, and environmental factors. Addressing these challenges requires sustainable land management practices, conservation efforts, and the integration of environmental considerations into development planning. It is crucial to strike a balance between development aspirations and the preservation of the unique and fragile ecosystems of the Himalaya.

Strategies for land use management in Indian Himalayan Region (IHR)

Integrated land use planning

The Himalayan region is facing several challenges related to land use change like urbanization, agricultural expansion, aridification, infrastructure development, deforestation, soil erosion, water scarcity, and climate change. Thus, to address these challenges in a comprehensive manner an integrated approach is required for the land use planning. This approach should consider ecological, social, and economic factors, and should involve stakeholders from local communities, government agencies, environmental organizations, and scientific experts. By taking a comprehensive and integrated approach, it is possible to develop land use plans that are both sustainable and beneficial to the local community. A mountain specific Land Use Policy shall be devised based on data driven and evidence based scientific insights specifically for the Indian Himalayan States. For effective implementation of such a policy, necessary education and training shall be provided to the administration and field staff who will ultimately ensure the on-ground implementation of the guidelines for all future urbanization and industrial activities.

Sustainable agriculture and forestry

Another important action is to promote sustainable agricultural and forestry practices. These practices should minimize soil erosion, preserve biodiversity, and conserve water resources. Sustainable agricultural practices such as crop rotation, cover cropping, and no-till farming shall be promoted at large scale. Sustainable forestry practices include

Agricultural fields of Kaub Village, Narayanbagar, Chamoli.

Anthropogenic pressures due to pasture, tourism and other activities at Gangotri-Govind Landscapes.

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planting trees that are native to the region, using selective logging methods, and managing forests for multiple uses, such as timber production, recreation, and water supply. Increasing forest cover is another important action that can be taken to address the challenges of land use change in the Himalayan region. Forests play a number of important roles in the region, including providing watershed protection, regulating climate, and supporting biodiversity. Forest cover can be increased through programs such as the Green India Mission and the National Afforestation Program. These programs provide financial incentives for landowners to plant trees and for governments to establish new forests.

Protection of cultural heritage

The unique cultural heritage of the Himalayan region should also be recognized and preserved by implementing policies that protect historical sites, traditional architecture, and indigenous knowledge systems. These policies can help to ensure that the region's unique culture is passed on to future generations. Community-based ecotourism can be promoted as a way to address the challenges of land use change by preserving the natural and cultural heritage, through providing economic opportunities and environmental awareness in the local communities. Ecotourism can be promoted by developing sustainable tourism infrastructure, such as trails, lodges, and restaurants, and by educating tourists about the importance of conservation.

Finally, the challenges posed by population growth and outmigration should also be addressed through policies that promote sustainable population growth and regulate land holding and purchase rights. By taking these actions, it is possible to ensure that the Himalayan region can continue to support its growing population and that its unique natural and cultural resources can be preserved for future generations.

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Yak tourism at High altitude pastures of Yumthang Valley, North Sikkim.

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DISASTER PREPAREDNESS AND MITIGATION IN THE HIMALAYA

The collision of two continental plates created the lofty Himalayan mountains, which are home to unique biodiversity. The Himalayan geology is highly fragile due to shearing and fracturing, and the rocks are further weakened by earthquakes and extreme weather. In the early 1970s, it was realized that human activities like deforestation, overgrazing, and agricultural clearing were also contributing to the fragility of the Himalayas. These activities led to fuelwood shortages, soil erosion, landslides, flooding, and sediment deposition. The theory that human activities were causing environmental degradation in the Himalayas was highly debated. However, recent studies using state-of-the-art techniques have shown that human activities have been impacting the Himalayas for at least 4000 years. The most recent disasters, such as the 1970 and 2013 floods, are a result of this long-term degradation. In the past, traditional wisdom and customs were used to protect the Himalayan ecosystem. For example, in the cold arid desert of the Northwest Himalayas, people used water harvesting practices to conserve water. In the earthquake-prone central and eastern Himalayas, people-built houses using methods that made them more resistant to earthquakes and in the ecologically sensitive alpine pastures, people followed unwritten rules to prevent overgrazing. These traditional practices were effective in protecting the Himalayan ecosystem for centuries. However, they have been largely abandoned in recent years due to the advent of accelerated modernization and unregulated construction. This has led to an increase in environmental degradation, which is putting the unique and fragile Himalayan ecosystem at risk in the form of different disasters like floods, landslides, earthquakes, avalanches, etc.

The Himalayan glaciers' retreat due to warming has triggered the increased formation of glacial lakes and glacial lake outburst floods and permafrost degradation affecting humans and ecosystems. For example, ~500 glacial lakes have been reported in Chamoli district, whereas 40.92% are situated at a higher elevation of 5000-6000 m (Nautiyal et al., 2022). The increasing winter temperature is also a serious concern for glacial melt (Bhutiyani et al., 2010; Nautiyal et al., 2022) which is leading to accelerated melting of the glaciers (Patel et al., 2021). Various localized anthropogenic activities such as deforestation, anthropogenic and tourism activities, and increased fossil fuel burning in the Himalayan region have further led to environmental pressure (Pandit et al., 2014). As the glaciers recede, the downstream ecosystems face the risk of disrupted water flow, altered nutrient cycles, and habitat loss. Melting glaciers disrupt the delicate balance of the water supply, posing severe challenges to both water and energy security in the region (Laghari, 2013). Lake outbursts, avalanches, floods, and landslide disasters cause substantial economic losses and death in populated downstream valleys.

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Extreme events disrupt infrastructure and can enhance poverty levels within local vulnerable communities. These vulnerabilities are increased because of the location of the region in high seismic zones (Zone IV, V).

Appreciating the terrain's vulnerability, people of the Himalayas since generations have evolved methodologies to live in harmony with the surrounding landscape by developing a symbiotic relationship with nature. This is eloquently demonstrated in the traditional agriculture practices, religious beliefs, customs, and local architecture. Below are a few examples of village site selection, house construction, customs, and value systems to protect and conserve fragile high-altitude pastures.

Village site selection

The locations of the Himalayan villages were strategically selected, usually on the middle slope of the watershed with forest on the upper slopes. Even in areas where flat river terraces were available, the village location was kept much above the riverbed to prevent any threat posed due to floods. Similarly, forests were protected and propagated above the village, whereas agricultural fields were terraced on the middle slopes around the village. Such distribution of land use/land cover not only helped in recharging the village springs but also maintained an uninterrupted supply of nutrients from the forest into the agricultural fields. In addition, on the saddles (above the village), shallow ponds (*khals*) were created to collect monsoon water for the steady recharging of the village springs. Thus, it can be said that at a micro level, it was an interdependent system of various components meticulously protected from undue tempering to maintain its sustainability.

Construction technology

The housebuilding technology which evolved through centuries by trial and error, has an implicit component of earthquake resistance technology besides being designed to protect from extreme weather conditions, particularly in the middle and higher Himalayan valleys. The building construction technology relied upon strict adherence to the customs enforced by religious and societal value systems. On steep slopes or near a stream, the site for a village was invariably sheltered by a rocky ledge (like an eyebrow) (e.g., the Badrinath temple). Before the construction of a house, the land was qualitatively inspected for load-bearing capacity, the soil was assessed for its binding strength, and the foundation was laid before the monsoon so that the required compaction was attained before the construction of the upper structure. Locally dressed stones were cut in a manner that different shapes and sizes were put in their respective places and the gaps were filled with flat stones. Traditionally, the technique is known as *Jor-Tor* or *dhajji-deewar* in local parlance. Well-dressed rectangular stones that are locked by a single flat stone on top constitute the stone masonry structure with rubbles plugging the space in between. Emphasis was given to the corner walls, where a single stone was dressed in a manner that it should extend perpendicular to either side of the walls and was popularly called *koniya stone* in local parlance.

Similarly, wooden beams (like modern tie beams) were laid at a certain height to unify the structure as one unit and called are as *kath-kuni*. The roof was invariably thatched with wood and/or covered by slates in a slanting manner. Many such houses exist where evidence for this technique can be seen, though their condition is pitiable due to poor maintenance.

Increasing disasters in the Himalayas

Over the years, the Indian Himalayan Region (IHR) is combating the threat posed both by increasing human interventions and climate change. With the growing population, natural resources have come under severe risk. Consequently, not only are the resources marginalized, but local inhabitants are forced to occupy areas otherwise considered unsuitable for safe housing and agricultural practices. The examples are the 1998 Madhya Maheswari Ganga disaster, where the damage was found to be concentrated along the seasonal streams
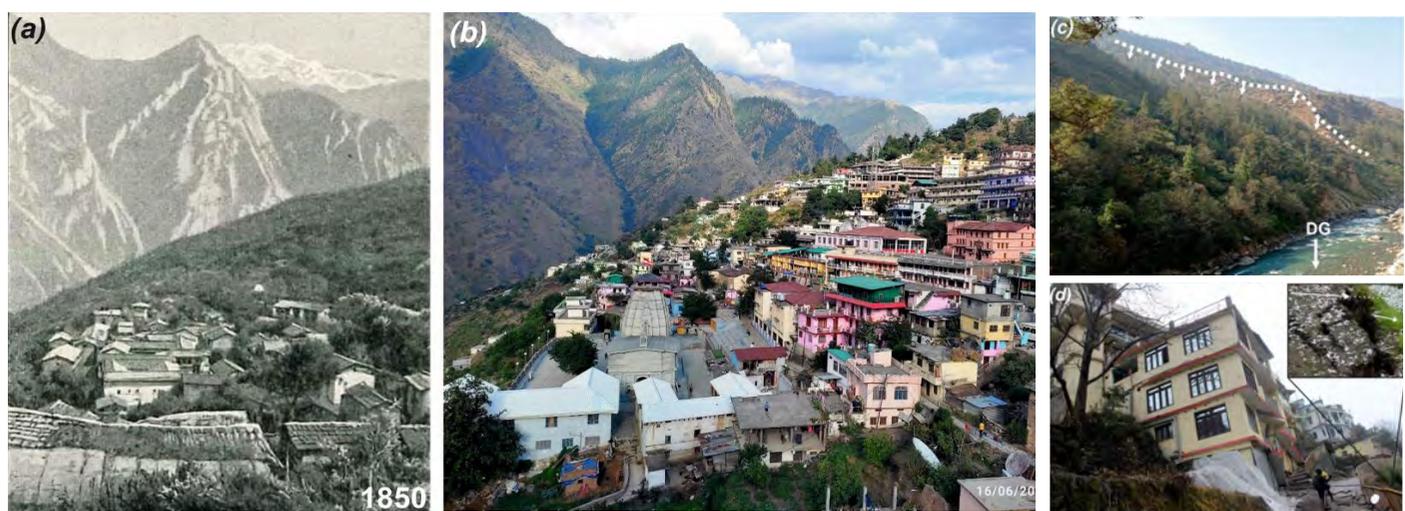
Fig. 5.1: Photos of the Joshimath town (a) in 1850 A.D. and (b) at present. (c) Zone of road subsidence marked in August 2022 and (d) cracks in buildings and roads developed due to subsidence January 2023.

that people were forced to occupy. Similarly, in August 2010 the Leh cloud burst caused damage to locations that virtually clogged the free flow path of the amphitheater valleys (valleys vacated by retreated glaciers from the geological past). In 2012, the bridges over the Beas River in Himachal Pradesh and landslides damaging the houses in Dharmshala were testimony to the fact that we have defied the terrain boundary conditions and constructed multi-storied buildings on precariously stabilized slopes. In June 2013, the Kedarnath floods also stand as testimony to the fact that both natural and anthropogenic factors amplified the magnitude of the disaster (Nautiyal and Maikhuri, 2017).

More recently, the Joshimath subsidence has raised national concern about the safety of Himalayan towns. To date, we have no clear answer as to what really accelerated the subsidence that was going on since the early 1970s. These are the anthropogenic challenges in which society together can certainly reduce its impact on the life and property of the hill society. In addition to this, the threat posed by climate change is looming over the Himalayas. According to Easterling et al., (2000), one of the major concerns of climate is an increase in extreme events such as extremely high and low temperatures and increased extreme precipitation events. The present situation of land subsidence is one of the recent examples of disasters (Fig 5.1).

Conserving high-altitude environment

Studies suggest that high-altitude environments throughout the Himalayas are comparatively less studied, even though elsewhere in the mountain world they have long been recognized for their fragility and lack of resiliency (Ives and Barry, 2019; Price, 1981). Since the climatic conditions are quite stressed, the surface is continuously creeping (because of the freeze and thaw processes), and as a result, the soil is thin and immature. Similarly, the plant growth is stressed (slow) and any undue tempering with the fragile topsoil takes decades to heal. In fact, the high-altitude environment covers around three percent of the earth's surface but is overwhelmed by more than 10,000 species of plants inhabiting this zone (Rana et al., 2019), thus, making Himalayan ecosystems one of the most biodiverse habitats in the world per unit area (Körner and Kèorner, 1999). They are also important as highland water catchments for lowlands; resources of natural products (e.g., edible and medicinal plants); and for the sustainability of local agropastoral economies through seasonal agriculture, animal husbandry, and the ecotourism trade (Byers, 2005).

Traditionally, knowing the significance of the high-altitude pastures, the locals treated them as the abode of God, and customs were made to preserve the sanctity of the terrain. For instance, a common practice was to remove shoes while walking on the pastures. Only those flowers were offered to Gods, which will not hinder the plant's regeneration. Wearing red cloth was discouraged as it disturbed the wildlife. Loud talking/shouting was forbidden as that might activate the avalanches or disturb the habitat of animals. Recycling of

house construction material was promoted from generation to generation and is believed to have harboured the blessings of older generations. All these practices were enforced by religion, and disobeying these would mean inviting the fury of gods. These customs minimized damage to the sensitive ecosystem of high-altitude pastures, which is a storehouse of innumerable medicinal plants. Besides this, above the alpine zone lies the climate-sensitive snow line and glaciers (cryosphere); hence, care was taken not to crowd the high-altitude as it might adversely impact the health of the cryosphere.

Extreme hydro metrological events

The essential characteristic of the mighty Himalayas is the relationship between precipitation amount and elevation. In recent years, causes and consequences of spatial variability in precipitation, particularly on erosion and sedimentation patterns within and outside the Himalayan mountains, have drawn considerable attention as an essential indicator of global climate change (Bookhagen and Burbank, 2006). It has been observed that a strong relationship between topography, relief, and rainfall exists. Interestingly, topographic relief dictates the nature and magnitude of extreme precipitation events responsible for most of the disasters in the Himalayan region, impacting the infrastructures, habitat sites, and population. Compared to the western and eastern Himalayas, where a single orographic barrier exists, in the central Himalayas, two peaks of focused rainfall occur in the frontal regions throughout the Himalayas at an average elevation of ~1200 m at the boundary between the outer and lesser Himalayas whereas, the second peak occurs ~2000 m (southern slopes of the Higher Himalaya). During extreme weather events, an abrupt rise in orography provides necessary uplift to the air which cools adiabatically and sometimes results in extreme precipitation (cloud bursts). Most of the disasters are associated with extreme rainfall events and are triggered mainly from the southern mountain (the boundary between the lesser and higher Himalayas) and are associated with landslide-induced flash floods. As mentioned above, floods in the Himalayas are associated mainly with landslides, popularly known as Landslide Lake Outburst Floods (LLOFs). Although we cannot rule out the contribution of Glacial Lake Outbursts Floods (GLOFs), compared to the frequencies of LLOFs, the GLOFs are less frequent. Although under the global warming scenarios, there is a projection that GLOFs are going to be on the rise. LLOFs are largely associated with the damming of the tributary rivers, particularly in areas of constricted channel width (gorges). The landslide debris usually obstructs the constricted channel course, which leads to temporary damming of the river flow, resulting in temporary lakes. As the backwater pressure of the lake water exceeds the barrier's retention capacity, the accumulated water gushes downstream with mighty force inundating otherwise safe settlements. Most of the settlements are located on the middle slopes. However, in areas where the fluvial terraces exist people would prefer to exploit such flat areas adjacent to the rivers.

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Impending threat due to earthquake

Earthquake is a reality in the Himalayas and people in the past learned to live with them by devising house-building technologies that could withstand the earthquake tremor or inflict less damage to life. Traditional house-building techniques have successfully demonstrated during past earthquakes in the Himalayan region that the constructional design has an inherent safety component. This was observed during the 1905 Kangra earthquake when the traditional *kath-kunni* houses in Kullu Valley made up of timber, remained unaffected. Similarly, in Uttarkashi, the traditional 100 years old multi-storied buildings called *pherols* have been found to incorporate basic features of earthquakes that can withstand earthquake shocks. Although earthquake prediction is still a distant dream, much effort is being made toward utilizing various precursors; for example, changes in ground temperature, chemical changes in groundwater, the radon concentration level of natural springs, monitoring of the creep events in the mountainous region, besides continuous monitoring of the seismographs along with computer simulation. Today Japan and USA are pouring a substantial number of resources to make the earthquake prediction a reality. Even after having one of the richest databases, Japan failed to predict the 1995 Kobe earthquake, and the San Andreas Fault constantly threatens California. We may be able to predict it with reasonably good accuracy but yet, it would require building infrastructure to meet the challenge posed by this deadliest calamity. Also vital is the awareness campaign among the masses with a view to preparing them to face such eventuality.

Long-term strategy for environmental upgradation of the vulnerable areas

Himalaya is inherently vulnerable, as discussed above, however in the past, there were less frequent incidences with less population, and thus the damage caused to life and property was comparatively less. With the growing population and increase in infrastructure demands, the threat perception for sustainable living is at an all-time high risk. Given this, there is a need for a paradigm shift in our approach toward how we look at the terrain. Most importantly, our perception of terrain

suitability needs to be recalibrated, considering that resources are finite and our growing demand is infinite. Considering that the Himalayas is primed for earthquake disasters and the central Himalayas lie in the seismic gap, implying that it is destined for a major earthquake, we must revisit our house-building technologies. Learning from traditional wisdom, house-building technologies must be blended with state-of-the-art modern technologies to save precious lives and create aesthetically better houses in the IHR. Under the projected global warming scenario, flash floods and landslides are going to impact the terrain in times to come. Therefore, there is an urgent need to assess the threat potential of the valleys that are likely to get inundated which can be readily done by assessing past flood magnitudes. Once we know the threat perceptions, the buildup areas can be comfortably put above the threatened elevations during the eventuality of a flash flood.

We need to have a long-term strategy for the environmental protection of vulnerable areas and viable mitigation planning. Ecological diversity, geographical vividness, and environmental fragility have limited the desired benefits of past developmental planning in the IHR. In addition to this, it has been realized that lack of an integrated approach (appreciation for terrain boundary conditions) further marginalized the fruits of the development for the land and people. For example, harnessing the river water for power and irrigation, connecting remote localities with motorable roads, and biomass utilization for rural development are some of the areas where success seems to be still a distant dream. One of the reasons identified is the lack of a detailed scientific database of geological fragility, terrain carrying capacity, natural resource availability, temporal monitoring of the terrain changes, delimitation of the fragile watersheds, integrated preventive strategies towards the calamities such as landslides, flash floods, forest fire, etc. have not been addressed in a holistic manner. In fact, our approach towards dealing with the disasters which are always looming over the IHR is showing an increasing trend; the policies are reactive and not proactive. As rightly pointed out, pointing the finger at natural causes creates a politically convenient crisis narrative that is used to justify reactive disaster laws and policies (Raju et al., 2022).

PRESERVING CULTURE AND HERITAGE OF THE HIMALAYA

The International Borders often face unique security challenges due to their geographic location, historical context, and cultural complexities. Borderland archaeology can offer substantial benefits by providing valuable information on historical patterns, cultural identities, and territorial disputes. Borderland archaeology in the Himalaya can be used as a soft tool in forming the second line of defence for National Security. Borderland archaeology is an interdisciplinary field that may combine the methodologies and techniques of Archaeology, Anthropology, History, and Geography to study the antiquity and integrity of borderland areas. The IHR consisting of seven states and Union Territories, namely Ladakh, Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, West Bengal and Arunachal Pradesh shares its international border with Pakistan, Nepal, Bhutan, Bangladesh and China.

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Singpo Ethnocultural Dance at Manau Poi, Arunachal Pradesh.

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Various issues have been witnessed by India in recent past along this international borderland including security concerns, political tensions, migration and refugee, cultural and ethnic frictions, infrastructure and connectivity. On contrary these regions also offer opportunities for cooperation, cultural exchange, economic partnerships, and peaceful coexistence between nations. A review of the literature shows that China in recent years has not only carried out extensive explorations to map the diverse range of archaeological sites in Tibet bordering Indian side but it has also been carrying out large scale excavations in Tibetan region since many years. It suggests that the Chinese national cultural heritage administration equally promotes more archaeological investigations in the Western part of Tibet.

Therefore, keeping in view of this, a new policy needs to be drafted and executed to promote and provide special funding to carry out large scale archaeological investigations to map the archaeological and heritage sites and also conduct excavations of important sites in borderland area of Indian Himalayan region. This would not only establish the antiquity of the culture in this archaeologically neglected part of India but would open a new avenue to develop "on site heritage and small archaeological museums" this would also promote the tourism activity in the trans Himalayan region. For example, it may be pertinent to add that, if this concept see the light of the day and implemented in right earnest particularly in borderland region of Uttarakhand, it would act as a catalytic agent for the vibrant village scheme which has been recently launched by Government of India. This concept can be implanted in all other Himalayan states in consultation with the defence authorities. There is no denying of the fact that such chain of archaeological sites and associated small museums would act as a soft tool in forming the second line of defence for National Security of India.

Adi tribe of Arunachal Pradesh.

Archaeological investigations in Himalaya

Archaeological investigations are restricted to providing material evidences to support historical theories of the region but in wider perspective it is significant for a nation by preserving cultural heritage, providing historical insights, promoting tourism and economic development, supporting education and research, facilitating legal protection and conservation, and fostering international collaboration. In light of this, several archaeological expeditions have been conducted in different regions of IHR. These archaeological investigations yielded sites ranging from Palaeolithic, Neolithic, Megalithic and Historical periods are found in different geographical contexts. In Arunachal Pradesh state the most recognized archaeological sites are Daphabum area, Kamla and Kurung valleys, Parsi-Parlo and Daporijo, Shergaon, Jamiri, Monyul, Thembang Fortified Village in Dirang, Naksha Parbat, Bhishmak Nagar, Itafort, and Malini. Similarly, in Uttarakhand, Malari is most important site located in Indo-Tibetan border. This site was initially discovered by S.P.

Dabral in 1968 but the archaeological context of the burials was noticed by the department of History and Archaeology, HNB Garhwal University in 1984. This site provides wide range of archaeological material indicating the cultural and historical significance of it (Bhatt *et.al.* 2014). The Department also investigated the borderland area of Kinnaur and Spiti district of Himachal Pradesh between 2011 to 2016. These archaeological expeditions yielded burial remains with other antiquities and evidences of pyrotechnology from Kinnaur valley dated to *c.*500BCE while Spiti valley yielded upper paleolithic and Mesolithic tools from surface as well burial remains as found from Kinnaur in this Trans-Himalayan region. similarly, some of the archaeological exploration also conducted in Jammu, Kashmir and Ladakh region which also highlighted the evidences of human settlements belongs to prehistoric period to historical age.
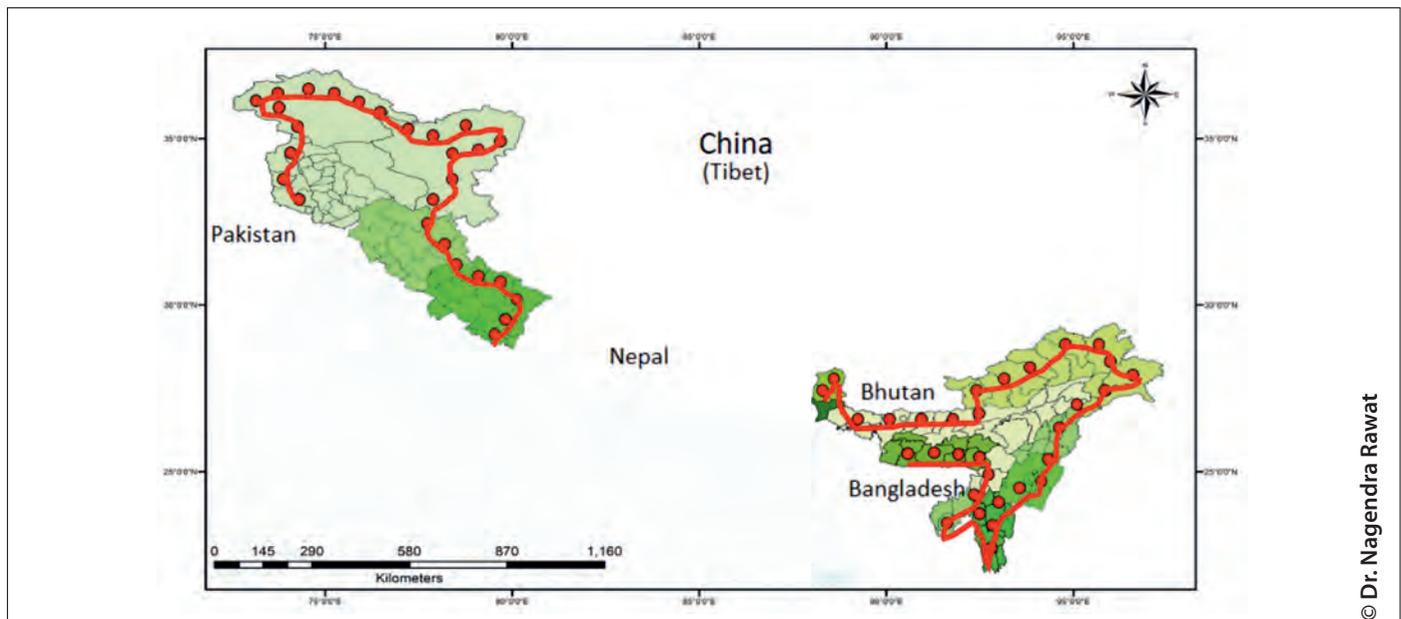

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Fig. 6.1: Hypothetical Archaeological sites mapped in Borderland area of IHR, which may form a Second line of defence in National security.

Need of promoting Borderland Archaeology in IHR

However, several Universities and institutions are exploring the borderland from archaeological perspective but it seems that such an important archaeological evidences could be taken as an important cultural tool to construct as the second line of defense in this porous tough borderland terrain which once was culturally very active and high trade activity was flourishing across such large trans –Himalayan region from North-West Himalaya to Mustang in Nepal through Indian Himalayan region when it was borderless chain of mountains. Therefore, the following points can be taken into consideration to boost-up the borderland archaeology in Indian Himalayan Region:

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Young artists performing at Amrit Yuva Kalotsav' in Sangeet Natak Academy, Itanagar, Arunachal Pradesh.

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(i) Border Control and Surveillance: Archaeological research in border regions can aid in developing effective border control and surveillance strategies. The study of ancient defensive structures, such as forts, walls, and watchtowers, can provide insights into historical approaches to border security. Understanding these structures can help in designing modern defense systems and identifying potential vulnerabilities. It is needed to mention here that, there are several forts and watchtowers has already been identified in the bank of river Dhauli Ganaga in Indo-China Border. These medieval strategic sites were used for specific communication network in medieval age. Therefore, keeping view of the significance of medieval forts and watchtowers these sites need to be revived and reused for present day border security. Additionally, the analysis of ancient migration patterns and settlement dynamics can inform border patrol strategies, identifying potential routes and locations for illegal activities.

(ii) Cultural Diplomacy: Promoting cultural diplomacy in border regions is essential for building positive relationships with neighboring nations and ethnic communities. Borderland archaeology can contribute to cultural diplomacy efforts by highlighting shared heritage and common historical narratives. By conducting joint archaeological projects and facilitating cross-border collaborations, nations can foster mutual understanding, trust, and cooperation. Such initiatives can lead to increased stability and reduced tensions in border areas, ultimately enhancing national security.

(iii) Preservation of Heritage: Border regions often contain significant archaeological sites and cultural heritage that are vulnerable to destruction and looting. Protecting and preserving these resources is crucial for maintaining national identity and security. Borderland archaeology can provide valuable data on the location and significance of archaeological sites, enabling authorities to prioritize their protection. Moreover, involving local communities in archaeological

projects fosters a sense of ownership and responsibility, reducing the risk of cultural heritage destruction.

(iv) Methodologies and Technologies: Advances in archaeological methodologies and technologies have greatly enhanced the capabilities of borderland archaeology. Remote sensing techniques, such as aerial surveys, satellite imagery, and LiDAR, can help identify hidden archaeological features and monitor border activities. Geographic Information Systems (GIS) facilitate the integration of archaeological data with spatial information, aiding in decision-making processes related to border security. Collaborative research platforms and digital databases enable efficient data sharing among researchers, policymakers, and security agencies.

Strategies for borderland security

Promotion of borderland archaeology in Indian Himalayan Region (IHR) is very significant from many perceptions as mentioned above. This soft tool of national security can be initiated with following strategies-

Prepare a Web-based data base of existed Archaeological sites

A detailed digital database (with geo-tagging) of all the reported/ explored archaeological sites is primary need. The web-based database should be available in public domine so that each citizen of the country may know about it. It will also attract new scholar in the area to explore new sites of historical and cultural significance. The web-based database may be used by international scholars for their references.

Support and Promote borderland Archaeology

Supporting and promoting borderland archaeology in IHR is not only important for cultural understanding but also for national security. Border regions of IHR often hold significant

Dubdi Monastery, Yuksum, West Sikkim, The Oldest monastery of Sikkim.

Hunting dance by Lepctha, the indigenous community of Sikkim

historical and archaeological sites that can provide valuable intelligence and strategic insights. Firstly, borderland archaeology can uncover ancient fortifications, defensive structures, and military installations that were once crucial for border defense. Studying these sites can provide historical context and lessons for modern-day security challenges. By understanding the strategic thinking and defensive techniques of past civilizations, we can enhance our own border security measures. Furthermore, archaeological investigations in borderlands can shed light on past conflicts, territorial disputes, and cultural clashes. Understanding the root causes and dynamics of these conflicts can inform diplomatic efforts and conflict resolution strategies, promoting stability and peace in border regions. Focusing in borderland archaeology also contributes to the preservation and protection of cultural heritage in these areas.

Develop archaeological sites as a tourist attraction/ destination

Borderland tourism is a significant tool to perform regular surveillance in the area. Particularly, the heritage tourism is a major limb in this direction. Some examples can be taken from the Pilgrimage sites of Badrinath and Kedarnath located in the borderland of Uttarakhand Himalayan. Among the hundreds of tourist destination these two historical temples are the centre of tourist and pilgrims who come every year in millions number. The frequent and regular visits of tourist significantly control the encroachment of China in this region as compared to another region of Uttarakhand like Pithoragarh. Therefore, taking the importance of historical and Archaeological sites as tourist destination government should develop large number of Heritage Tourist Destination in IHR borderland.

Accelerate academic researchers in Borderland (IHR)

There is need of hour to make the access of borderland area easier to the academic researchers so that a good number of research can be carried in the Borderland area of IHR. More academic researchers will produce more publication which will enhance the citation of the sites in national/international academic landscape. More citation of borderland sites will get more attention all around the world. The large number citation of sites indirectly protects it from any kind of physical or literary intrusion.

The Problem of intrusion in the borderland of Sikkim, Assam, Arunachal Pradesh, Uttarakhand and Ladakh done by China is a huge matter of concern for national security. Therefore, taking this matter into consideration the Government of India has already taken some initiatives from military point of view, but the discussion mentioned above make it very clear that now some policies should be drafted and practiced from academic perspective. Archaeological investigations in the IHR have already yielded significant findings, ranging from prehistoric settlements to historical sites. The policy of promoting borderland archaeology will increase the number of ancient or medieval sites in the area which can be developed as the point of attraction for tourist, academicians, researchers or for local inhabitants also. In this direction, the 'Vibrant Villages programme' initiated by central government is welcoming step which primarily focused to boost economic activity, provide employment, and stem migration in these areas but the matter of national security seems absent in it. Therefore, on one hand the initiation of borderland archaeology not only enrich the history and culture of existing villages, but it will also explore new sites / settlements of national importance. By examining the interplay of culture and archaeology with security, one can explore how they can play a crucial role in forming the second line of defence, operating as a soft tool that by nature is a non-coercive instrument or approach utilized to achieve certain objectives, particularly in the realms of diplomacy and conflict resolutions. At this point, it also pertinent to add that however, the finding of Heritage Property in borderland area could an item of conflict from imperial perspective but having the concept of *Vasudhaiv Kutumbakam* (वसुधैव कुटुम्बकम) as a moto of G-20 same Heritage Property need to consider as Shared Heritage of both the nations. This concept of **'Shared Heritage of Borderland Area'** will play an important role in fulfilling the aim of G-20, 2023 *Vasudhaiv Kutumbakam* (वसुधैव कुटुम्बकम) **One Earth, One Family and One Future**. By implementing these strategies and recognizing the importance of borderland archaeology, India can harness the power of its historical and archaeological heritage to strengthen national security, promote cultural understanding, and foster peaceful coexistence in the Indian Himalayan Region.

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07
CHAPTER

WOMEN AND ENERGY INSECURITIES: CREATING ENVIRONMENT FOR SUSTAINABLE ECONOMIC OPPORTUNITIES

India is poised to become the global leader in terms of its working-age population by 2030, with a staggering 1.03 billion individuals, comprising 68% of its total population. This projection surpasses China's estimated working-age population of 0.97 billion and the United States' figure of 0.22 billion. However, within this demographic shift lies a concerning trend of declining female labor force participation rates (LFPR). Despite India's growing workforce, women's engagement in the labor market has been decreasing. This decline in female LFPR raises important questions about gender equality and economic empowerment, warranting attention and intervention. In addition to labor force challenges, India grapples with energy insecurities that significantly impact women's health and the environment. Limited access to reliable and clean energy sources is leading to adverse health outcomes, particularly for women who bear the responsibility of household chores such as cooking and water collection along with contributing towards environmental degradation. Another critical issue emerging from energy insecurities which largely inflict mountain and rural women in India is time poverty. Traditional gender roles and societal expectations often burden women with numerous responsibilities, leaving

them with little time for self-care, education, or economic activities outside their homes. The burden of time poverty disproportionately affects women, hindering their ability to participate fully in economic, social, and political spheres. Energy insecurities mainly in the mountain and rural regions pushes the women towards meeting out such energy deficits leading to their higher time spending towards non-economic activities resulting in their lesser participation in economically gainful activities.

Mountain women and energy securities

Mountain women in mountain regions traditionally share an important association with the natural resources which ranges from their engagement with forest resources along with dependency and exploring the natural sources of water. Their association with natural resources mainly with the forest arrays from governance, management, protection and to the large extent livelihood generation through it. The gender-based observations reveals the very high rate of engagement of females with the free access resources relatively to the males of these regions. Further due to the

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poor economic status of rural households and inadequate infrastructural facilities, firewood, water and fodder become necessities for these households, pushing women towards collecting/fetching them, as they are traditionally meant to be engaged in non-cash income-generating activities. The limited participation in sectors/activities and the high time spent by women in the agricultural sector and collecting fuel wood and fodder also indicates the cultural and traditional value of the work women do (World Bank, 2004), which only pushes them towards unpaid activities or keeps them engaged in unpaid and lower remunerative sectors. The two concerns emerging due to women engagement with free natural resources for accommodating energy securities are leading to two major concerns of 'time poverty' and health issues for them. The problem of 'time poverty' that was emerging due to larger time spending of women in these activities which are not considered as economical although they create indirect savings for the households and hence reflects higher time spending by them even after availability of energy alternatives.

The other factor which has more recently enhanced the women time spending in such non-economic activities is the climate change. Forest degradation and depletion of traditional water conservation and preservation practices has over stressed the accessibility of firewood, fodder, Non-Timber Forest Products (NTFPs) and water which holds more impact on women than their counterparts. Due to increasing difficulty in their access mainly due to their rapid depletion has forced the women to give more time to access these resources which further reduces their time spending in social, cultural, households' activities along with other income generating and self-development activities.

Energy insecurities a growing concern

India's growing population and escalating energy demands have resulted in energy deficits. The increasing number of people in the country requires more energy to power various sectors. However, the limited availability of domestic fossil fuel resources has led to a heavy reliance on imports, which now make up a significant proportion of India's total primary energy requirements. This reliance on imports has resulted in rising import bills, adding financial pressure to the country's energy sector. To address energy challenges and support the population's energy needs, the Indian government has increased its public expenditure on energy support. Notably, initiatives like the Prime-Minister Ujjwala Yojana have been implemented to provide clean cooking fuel to households below the poverty line while adding to the financial burden on the government. Among these steps to improve energy access through other alternatives, concerns have also grown regarding hydroelectric power generation. The environmental impact of building dams for hydroelectric projects, including displacement of communities and loss of biodiversity, has raised significant environmental concerns. It is crucial for India

to address these environmental challenges while ensuring energy security for its growing population.

Sustainable alternative for meeting energy insecurities

There is a need for making a concerted macro level effort to undergo a larger shift towards green energy generation, particularly solar energy, with the aim of reducing dependency on hydro energy and fossil fuels. This transition recognizes the importance of a diversified and sustainable energy mix. However, this shift necessitates a substantial capital expenditure (CAPEX) to increase the infrastructure for renewable energy. To address this, there should a growing emphasis on mainly two aspects:

Larger penetration of Decentralized renewable energy (DRE)

A larger penetration of decentralized renewable energy (DRE) plays a vital role in equipping the population with sustainable energy alternatives. This not only reduces long-term energy costs for individuals but also alleviates the financial burden on the government, which would otherwise be required to support energy alternatives reliant on fossil fuels and other environmentally harmful sources. By embracing DRE, the harmful impacts on biodiversity and climate that arise from non-renewable energy sources can be mitigated. This transition towards decentralized renewable energy not only promotes financial savings for individuals but also fosters environmental preservation and supports long-term sustainability.

Development of decentralized renewable energy (DRE) systems

Introducing DRE technologies in India, coupled with the training of local manpower, not only makes the adoption of such alternatives more feasible but also creates employment opportunities within the sector. By promoting green energy, particularly in mountainous and rural areas, India can significantly reduce the dependence of women in these regions on forests for energy resources. This, in turn, provides them with safer and cleaner energy alternatives, while also saving their time and effort previously dedicated to collecting natural resources. The introduction of decentralized renewable energy systems not only contributes to a greener and more sustainable future but also empowers local communities, especially women, by improving their access to reliable and cleaner energy sources.

Green technology initiatives can play a crucial role in utilizing energy as a means of creating income and employment opportunities, particularly for mountain and rural women who heavily rely on forest resources to fulfill their energy requirements. By introducing and promoting green technologies in these regions, such as improved cookstoves,

biogas plants, and solar-powered solutions, the burden on forest resources can be reduced. Moreover, the adoption of these technologies can empower women by providing them with access to cleaner and more efficient energy sources, enabling them to engage in income-generating activities and contributing to their overall economic empowerment.

By combining the resolution of the energy crisis through renewable energy adoption and implementing green technology initiatives, India can address multiple challenges simultaneously. This integrated approach not only promotes sustainable energy practices but also creates a conducive environment for income and employment generation, particularly for marginalized groups like mountain and rural women who heavily depend on forest resources for their energy needs. Such initiatives can lead to a more equitable and inclusive energy landscape, fostering economic empowerment and environmental conservation in these communities.

Decentralization of energy generation in mountain and rural regions

A roadmap towards the decentralization of energy generation in mountainous and rural regions involves several key steps. Firstly, the focus is on bringing solar energy to the doorstep of households, primarily through rooftop solar installations. This approach empowers individuals to generate their own clean energy and reduces their dependence on centralized power grids.

Additionally, solar farming presents an opportunity to utilize barren land effectively. By converting unproductive and unused areas into solar farms, communities can generate a significant amount of renewable energy, contributing to the local energy supply. This utilization of barren land for solar energy generation aligns with the principles of decentralization and promotes efficient use of resources.

The decentralization of energy generation brings various benefits. At the individual household level, it leads to a reduction in electricity costs, as households become self-sufficient in meeting their energy needs. Moreover, the generation of solar energy presents a revenue-generating opportunity, as surplus energy can be sold back to the grid or neighbouring communities. For increasing the usage of solar and other green energy sources a larger behavioural change through a 'Nudge' must be brought out the which should touch each and every household in the country. This behavioural change could be brought about with a larger thrust by government on such energy sources thereby aiming towards changing the behaviour of the individuals leading to meet the G20 goal of "lifestyle for environment".

Furthermore, the utilization of wasteland for solar farming not only repurposes unproductive land but also helps decrease the pressure on the environment. By shifting towards decentralized energy generation, reliance on non-renewable energy sources decreases, leading to a reduction in carbon emissions and environmental degradation. In areas with non-arable land or unfavourable climates for crop cultivation, the space beneath solar panels can be utilized for livestock grazing. This dual-use approach maximizes the land's potential by combining solar energy generation with sustainable agricultural practices. It provides a valuable income source for mountain and rural communities, allowing them to generate revenue from livestock while also benefiting from clean energy production.

Additionally, various green energy solutions can contribute to sustainable income and employment generation in these communities. Solar cold storage systems enable the preservation of agricultural produce, reducing post-harvest losses and extending shelf life. This not only ensures food security but also creates opportunities for income generation through improved market access and value addition. Solar pumping systems offer an efficient and sustainable solution for irrigation in remote areas, reducing dependence on traditional fuel-powered pumps. This enables farmers to cultivate their land more effectively, leading to increased agricultural productivity and income. Solar crop drying provides an environmentally friendly method for drying crops, reducing post-harvest losses and enhancing the value of agricultural produce. This can be particularly beneficial for communities engaged in crop production, as it allows them to preserve and market their harvest effectively. Furthermore, solar-powered pesticides sprayers offer an alternative to conventional pesticide application methods. By utilizing renewable energy, these sprayers reduce environmental contamination while ensuring effective pest management, contributing to sustainable and safer agricultural practices. These green energy solutions not only provide income opportunities but also promote employment generation within the mountain and rural communities. By adopting these technologies, communities can harness the potential of renewable energy while simultaneously enhancing their livelihoods and fostering sustainable development.

Government support

The government should prioritize several key areas to promote sustainable energy practices. Firstly, a gender analysis of the energy sector is crucial to ensure equitable participation and address any gender disparities in access, decision-making, and benefits. This analysis helps in developing policies and programs that empower women and promote gender equality in the energy sector.

Secondly, there should be a focus on labor-saving technologies and initiatives that reduce drudgery, particularly for women who often bear the burden of energy-related tasks. By introducing energy-efficient appliances and alternative energy solutions, such as clean cooking technologies, the

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government can alleviate the physical and time constraints faced by individuals, especially women, while improving their quality of life.

Creating a skilled workforce for green jobs is another essential aspect. The government can establish and strengthen Industrial Training Institutes (ITIs) and other vocational training centres to equip individuals with the necessary skills for the growing demand in the green job sector. This enables the workforce to actively contribute to the renewable energy and sustainability sectors while promoting economic growth.

Conducting awareness campaigns at the community level is crucial for promoting community participation and acceptance of green energy solutions. These campaigns can educate the public about the benefits and importance of renewable energy, encouraging widespread adoption and support for sustainable practices leading to a major behavioural shift towards "lifestyle for environment".

Additionally, initiatives like the National Rural Livelihoods Mission (NRLM) can play a significant role in promoting green energy adoption. Through the provision of microcredit with a continuous flow model, such as the "Pay as you go" model, individuals in rural areas can access affordable financing for renewable energy systems, making them more accessible and affordable.

By prioritizing gender analysis, labor-saving technologies, skilled workforce development, community awareness campaigns, and innovative financing models, the government can pave the way for a sustainable energy future, foster economic growth, and improve the well-being of communities across the country.

The implementation of decentralized solar energy and supported technologies brings about numerous benefits which could be made popular and adaptable at micro level through behavioural change brought about by a "Nudge" through government campaigns at larger scale. The shift towards green energy not only reduces time poverty and alleviates drudgery among women but also enables them to engage in more productive activities thereby improving their overall well-being. Additionally, it promotes women-led development, empowering women to take leadership roles in the renewable energy sector. This approach also reduces migration by providing employment opportunities and sustainable livelihoods in rural areas, thereby decreasing dependence on urban regions. Moreover, it fosters growth in sectors such as agriculture and tourism, contributing to the economic development of rural communities. Furthermore, the adoption of decentralized solar energy reduces the government's financial burden on fossil fuels in the long run, paving the way for a more sustainable and cost-effective energy landscape. Ultimately, it plays a crucial role in alleviating environmental pressures by reducing carbon emissions and promoting clean energy sources, thereby contributing to a greener and healthier planet.

Addressing these complex challenges requires comprehensive strategies that promote gender equality, sustainable energy solutions, equitable distribution of household responsibilities, and proactive measures to mitigate the impacts of climate change. By recognizing and acting upon these issues, World can ensure a brighter future for its growing working-age population and create an inclusive society where women can thrive and contribute to the nation's development.

SOLID WASTE MANAGEMENT IN THE INDIAN HIMALAYAN REGION

The IHR is an eco-sensitive area that continually struggles due to the increased volume of trash produced by both inhabitants and visitors, resulting from poor waste management infrastructure, illicit dumping practices, lax enforcement of Solid Waste Management (SWM) laws, and low public awareness. Despite current efforts, comprehensive waste management and sustainable development goals have failed to be effectively implemented. To address this issue, it is crucial to prioritize strong infrastructure for resource recovery using Waste-to-Energy (WtE) techniques, secure trash disposal in sanitary landfills, and active public involvement. Additionally, implementing specialized waste technologies, increasing capacity, and enacting environmental levies can generate the necessary funds to support and advance SWM initiatives.

As the IHR faces increasing strain from rapid economic transition, it becomes even more important to implement IHR-specific plans that emphasize conservation and socio-economic development. The allure of the young towering mountains, magnificent landscapes, expedition areas, and religious spots across the IHR attracts millions of tourists annually, with an expected rise to 240 million by 2025 (Aayog, 2018). However, the downside of this economic growth is the unmonitored activities that result in unchecked solid waste generation. Tourism-related activities such as trekking and expeditions already generate about 8.395 million tonnes per year (MT/Y) of solid waste, posing a concern for the ecologically sensitive areas (Kuniyal, 2005; Aayog, 2018). The waste generated varies throughout the year due to seasonal fluctuations in tourist inflow, further burdening waste collection, transportation, treatment, and disposal facilities. The lack of waste management education, awareness programs, and formal management systems leads trekkers and campers to leave waste behind in delicate locations.

The unprecedented amounts of waste significantly impact the wildlife in the Himalayas, altering the hunting abilities of critically endangered species. Moreover, approximately 11 million urban populations in the IHR generate about 1.905 MT/Y of solid waste, with only a fraction being collected, treated, or landfilled (CPCB, 2019). This highlights the urgent need for improvement in the waste management system across the Urban Local Bodies (ULBs) of the IHR. The untreated waste is often disposed of unscientifically through various informal means such as open burning and dumping in gorges and rivers, which pollutes freshwater streams. Conversely, the approximately 32 million rural populations of the IHR lack efficient waste disposal options, placing a cumulative burden on these topographically fragile mountains.

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Solid Waste Management: Issues & Challenges in the Indian Himalayan Region

SWM becomes increasingly significant as the population expands, especially in the ecologically vulnerable IHR, where it represents a major environmental challenge. Considering the IHR's sparse population, the increase in tourism has a substantial impact on the growth of solid waste. Communities living in mountainous areas are seriously threatened by the lack of adequate SWM facilities (Table 8.1). Although the highlands are more distant, have a different terrain than the plains, are becoming more urbanised, and have a harsher temperature than the plains, managing SWM in these locations is difficult. Ineffective disposal techniques, such as open dumping and burning, have been used as a result of waste management challenges, and these methods have a negative impact on the IHR's delicate ecology. While burning generates pollutants that contribute to glacier melt, openly deposited unsorted garbage pollutes freshwater streams. Additionally, the extreme cold conditions in the region render traditional biodegradable waste treatment methods like composting, vermicomposting, and anaerobic digestion inefficient.

Table-8.1: Scenarios of SWM challenges in general, mountain, and eco-sensitive areas

SWM in all Areas	SWM in Mountain Areas	SWM in Eco-Sensitive Areas
Poor awareness and adoption of SWM practices	Topography and geology (e.g., steepness, ruggedness, soil stability)	Remoteness of settlements
Lack of waste segregation	Remoteness of settlements	Distance to developed infrastructure make waste collection and transport challenging
Inadequate collection and storage facilities	Scattered and low-density areas generating low volumes of waste	Tend to attract tourists
Poor or obsolete transportation options	Diverse temperature and weather conditions	Depending on the area, tourists may visit all-year long
Lack of or poorly functioning treatment facilities	Sensitive environmental and ecological conditions	Sensitive environmental and ecological conditions
Improper waste disposal techniques	Vulnerability from seismic activity	Space constraints for waste treatment and disposal
Competing priorities for local governments	Lack of road networks making access difficult	
Lack of skilled and technical capacity	Special types of waste generated (e.g., mountaineering waste), which require treatment and disposal	
Lack of institutional coordination	Waste transport requires vehicles suitable to mountain regions	
Lack of funding and poor cost recovery	Limitations of space for waste treatment and disposal	
	Poor socio-economic conditions in general	
	High variability of waste generation due to tourist seasons	

Problem solving approaches

While local governments are mainly responsible for MSW management, an institutional framework exists at all levels of government: central, state, and local. There are various ministries, authorities, and departments that contribute to SWM in some way or another. At the central level, the key environmental regulatory authority is the Ministry of Environment, Forest and Climate Change (MoEFCC). The MoEFCC establishes policies, sets goals, and facilitates the implementation of policies. The Central Pollution Control Board (CPCB), a statutory organization under the MoEFCC, sets environmental standards, is responsible for coordinating the activities of state-level pollution control boards, and provides technical assistance and training, among other duties. At the state level, the state pollution control boards (SPCBs) are responsible for implementing legislation and comprehensive systems related to prevention and control of environmental pollution. World Bank (2020) recommended a framework-based solutions in order to successfully and sustainably manage mountain waste. The framework consists of various, and related, factors shown in Fig. 8.1.

Institutions, Financing and Stakeholders			
• Develop local government policies and regulations in line with national guidelines and standards. • Operationalize the SWM system at the local governments level through technical capacity development	• Involve local communities and CBOs in waste segregation and collection. • Create systemic opportunities to bring in economies of scale, engage the private sector as well as other stakeholders	• Enable integration of the informal sector to engage in waste management services. • Enable collaboration of related agencies such as tourism, forest and NRM	• Establish a monitoring and enforcement system to improve and sustain waste management services
Data Availability and awareness of SWM issues			
• Coordinate with various agencies to improve data collection, availability and to create public awareness	• Start data gathering as a continuous exercise to make better decisions, set targets and monitor policy implementation	• Increase public awareness on managing waste and impacts of SWM in mountain areas	• Introduce and expand training programs to build capacity of local government staff and decision makers
Waste Generation and Segregation			
• Enable source segregation to allow for value extraction and recycling of both biodegradable and non-biodegradable materials	• Enable separation of biodegradable waste for useful purposes at the household or community level	• Involve local communities and CBOs by considering various aspects such as income generation	• Create policies to manage other wastes (C&D, hazardous, healthcare, e-waste) in mountain cities
Waste collection, transfer storage and transport			
• Improve waste collection systems and upgrade service delivery	• Establish waste storage and/or transfer systems to manage waste	• Enable sorting and processing of non-biodegradables for higher monetary returns	• Find innovative ways to collect and transport waste from mountain areas that are particularly challenging due to remoteness, topography and lack of road network
Waste treatment and disposal			
• Ban the open dumping and burning of waste		• Find suitable alternatives for treatment of non-biodegradable waste and for waste disposal	

Fig 8.1: Integrated solid waste management framework in mountain regions (World Bank 2020).

India is one of only a handful of nations that has developed SWM regulations specifically for hilly and mountainous regions, which is significant given that over 29 percent of the nation may be categorized as hilly or mountainous. The wording of the rules that apply specifically to hilly and mountainous areas is provided in Box 1.1 and was published by the MoEFCC in the Indian Gazette (MoEFCC 2016). Additionally, in 2016 (CPHEEO 2016), the Indian Ministry of Urban Development (MoUD) released recommendations for garbage collection in hilly locations in its Municipal Solid garbage Management Manual - Part II: The Manual. Several ministries and departments such as the Ministry of Urban Development, Ministry of Chemicals and Fertilizers, the Ministry of New and Renewable Energy (MNRE), Ministry of Housing and Urban Affairs (MoHUA) and Ministry of Agriculture and Farmers' Welfare at the central and state level work on the issue of SWM, demonstrating the need for multi-level governance and intra-ministerial cooperation. These examples also show the level of institutional coordination required at different stages of waste management. Furthermore, The NGT is a quasi-judicial authority established by the National Green Tribunal Act 2010, provides a forum with regard to solid waste, in this regard the NGT has already heard numerous cases and passed judgment on state governments, private parties, and even the government's own regulatory bodies. The IHR-specific SWM rules (SWM 2016) were revised to address the escalating issue, offering detailed guidelines for establishing solid waste treatment facilities and promoting waste-to-energy (WtE) initiatives. However, further attention is needed to ensure proper collection, segregation, treatment, and disposal of solid waste throughout the IHR. Key steps for resource recovery include door-to-door collection, source segregation, covered transportation, proper treatment, and disposal. Adopting waste recycling, composting, anaerobic digestion, refuse-derived fuel (RDF), and gas recovery from landfills are crucial for transforming waste into valuable products. Additionally, policy initiatives like the "ban on single-use plastic" (CPCB 2022a, CPCB 2022b) and "polluters to pay" play a pivotal role in achieving effective SWM in the IHR (CPCB 2021). Research and technology advancements, capacity building programs,

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mass awareness campaigns, and the policy initiatives have great potential to improve SWM practices in the IHR (PWM 2016, PWM 2019a, PWM 2019b).

Strategies for the waste management in IHR

Strengthening Waste Collection Infrastructure

The IHR needs to build strong waste collection systems in rural and hilly areas, especially in smaller cities and distant villages, in order to solve the issues of solid waste management (SWM). To ensure efficient waste collection, this calls for investments in infrastructure, labour, and vehicles. The system can effectively accommodate the IHR's varied geographic and demographic characteristics by deploying collection stations and streamlining collecting routes. To obtain the resources and knowledge required to build and maintain a dependable garbage collection system, cooperation between the government, local governments, and pertinent stakeholders is important.

Establishing a Waste Management Commission/Board in each state in IHR

Addressing the pressing waste management challenges in the IHR necessitates the establishment of a Waste Management Commission or board in each state. Currently, the region lacks a coordinated approach to waste management policies, resulting in ineffective implementation and suboptimal outcomes. The creation of dedicated commissions at the state level, endowed with the necessary authority and resources, would enable a more streamlined and comprehensive approach to waste management. These commissions should consist of experts from relevant fields, collaborating with government departments and stakeholders. Such an endeavor would facilitate the formulation and execution of comprehensive waste management policies tailored to the unique environmental and socio-economic characteristics of the IHR.

Improving Waste Disposal Methods

Significant environmental difficulties are brought on by the IHR's pervasive practise of depositing rubbish in open landfills close to rivers. To fight this, policies must place a high priority on the development of appropriate waste disposal practises that reduce contamination and safeguard the surrounding ecosystems. Waste should be disposed of mostly in sanitary landfills that are constructed in line with environmental rules. Additionally, by utilising waste-to-energy plants, pollution levels can be decreased while also utilising the potential energy contained in garbage. Promoting the use of vermicomposting and composting as methods for handling biodegradable trash can provide organic fertiliser and lessen the need for chemical substitutes. It is crucial to invest in research and development to explore innovative and sustainable waste disposal methods that are compatible with the unique geographical characteristics of the IHR.

Extended Producer Responsibility (EPR)

The proper implementation of Extended Producer Responsibility (EPR) norms is essential to addressing the issues related to waste produced by fast-moving consumer goods (FMCG) brands. Although reverse logistics in hilly areas can be expensive, authorities should actively encourage and enforce EPR compliance among FMCG brands. In doing so, businesses make sure that their plastic garbage is collected and recycled. To encourage sustainable waste management practises and promote compliance, penalties and incentives might be used. Also encouraged by policies should be the use of eco-friendly packaging materials, a decrease in the usage of plastic in general, and a rise in consumer awareness of sustainable product options.

Strengthening Interdepartmental Collaboration

Policies should provide interdepartmental coordination a high priority between pertinent governmental organisations in order to accomplish comprehensive and efficient waste management in the IHR. The effective implementation and monitoring of waste management efforts depend on close collaboration between many departments, including those of the Ministry of Environment, Forest and Climate Change, the Ministry of Drinking Water and Sanitation, the Tourism Department, and the Panchayati Raj Department. Interdepartmental cooperation can increase the effectiveness and impact of waste management policies and practises by coordinating strategies, pooling resources, and streamlining operations.

Promoting Awareness and Behavior Change through capacity building

The policies addressing the IHR's solid waste management concerns should prioritise raising awareness and encouraging behaviour change among inhabitants, tourists, and enterprises. Public campaigns, education programmes, and community involvement efforts all play an important part in highlighting the importance of proper waste management practises. These activities can help establish a feeling of ownership and responsibility in individuals and communities, encouraging them to properly dispose of waste and prevent littering. Furthermore, incentives such as prizes for sustainable waste management practises can work as catalysts for positive behaviour change, supporting the adoption of responsible waste management habits throughout the IHR.

Supporting Livelihood Opportunities for informal waste collectors/workers

The potential for waste management to create employment opportunities for local populations should be taken into account in policies intended to address solid waste management in the Indian Himalayan Region. Policies can foster an environment where trash workers can engage in long-term employment by encouraging the development of

official garbage collection and segregation systems. In order for trash professionals to handle waste properly and safely, training programmes are established to improve their skills and knowledge. Additionally, policymakers should put an emphasis on developing market connections for substitute items created from recycled materials in order to generate demand for recycled goods and promote regional economic development. It's also essential to address the social stigma attached to waste management careers in order to draw more people to this industry and create sustainable employment opportunities for local communities.

Data Collection and Research

The key challenge for the stakeholders is to develop policies that should place an emphasis on enhancing data collection systems and undertaking in-depth research on waste production and composition. The development of targeted solutions and the distribution of resources are hampered by the lack of reliable information on the scope and nature of the waste problem. Policies should place a strong emphasis on fostering the development of reliable data gathering systems that record data on waste generation rates, waste kinds produced, and current waste management procedures. This information can help policymakers understand trends and patterns so they can build programmes that are supported by data and successfully address waste management.

Encouraging Innovation and Technology

Given the unique geographical features of the Himalayan region, policies should actively encourage the exploration and adoption of innovative waste management technologies and practices. The challenging terrain necessitates solutions that can overcome logistical barriers and improve waste management efficiency. Policies should facilitate the identification and dissemination of appropriate technologies, such as decentralized waste processing units or community-based composting systems, which can be tailored to the specific needs of the region. Supporting research and development initiatives that focus on waste management innovations will foster a culture of innovation and enable the region to keep pace with evolving waste management practices. By encouraging the adoption of technology-driven solutions, policies can contribute to the sustainable management of waste in the Indian Himalayan Region.

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WAY FORWARD & POLICY RECOMMENDATIONS

1. Climate Smart Infrastructure

A climate smart infrastructure including early warning systems, disaster preparedness, energy efficient constructions, water management systems, and transport networks shall be developed in the Indian Himalayan region. Integrated systems, including meteorological, hydrological, remote sensing and seismological observations shall be developed and modern tools like artificial intelligence and machine learning shall be used to implement advanced early warning systems. Local communities shall be sensitized and educated on the ongoing adverse impacts of climate change and model climate smart villages and towns shall be developed to promote climate change resilience and adaptation in the Himalaya. Climate smart infrastructure shall maximise use of renewable energy like solar, wind, geothermal energy, rainwater harvesting, passive heated building, fossil fuel free transportation, climate smart agriculture, agroforestry, silviculture, afforestation and watershed management. Such infrastructure will help in reducing the carbon emission and thus will ultimately help in development of a climate resilient and adopted society in the Himalaya.

2. Bioresource Application and Management Policy

The Himalaya is home to a variety of bioresources which holds enormous potential in terms of the region's economic security. Thousands of species are used traditionally in different sectors including healthcare, food, fuelwood, fodder, timber, gums, resins, dyes etc. Phytochemical analysis has reported a wide range of pharmaceutical and nutraceutical compounds in the Himalayan plants. Thus, for harnessing the wide economic potential of the Himalayan bioresources in a sustainable manner, a comprehensive Bioresource Application and Management policy shall be formulated for the Himalayan region. Ecologically abundant and economically viable species shall be promoted for commercial scale production of diversified products. On the other hand, rare species with high economic potential shall be promoted through wide scale cultivation in the Himalayan region for economic prosperity of the indigenous farmers. Small scale industries shall be promoted and established within the region particularly focusing on local entrepreneurship for enhancing economic opportunities to the mountain youth and communities. Protected area network, such as national parks and wildlife sanctuaries shall be increased for dedicating significant geographic area to protect the regions biodiversity. Intensive surveys shall be conducted to identify areas covered by invasive alien species, and such areas shall be promoted for cultivation of native economic plant species for their industrial and commercial usage.

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3. Integrated Land use Policy

Integrated land use policy is a planning approach that seeks to balance the economic, social, and environmental needs of the mountain communities. Such policy for the Himalaya would need to consider the unique characteristics of the region, including its fragile ecosystem, biodiversity, and the socioeconomic needs of the local communities. In the Himalaya, integrated land use policy shall include sustainable agriculture practices, such as terracing, crop rotation, agroforestry and the use of organic fertilizers to reduce soil erosion and improve water conservation. The policy shall prioritize the protection of important habitats, such as forests, wetlands, and alpine meadows, to maintain ecosystem services and preserve the rich biodiversity. Forests in the Himalaya are critical for various purposes, including timber production, watershed management, and carbon sequestration. The policy should promote sustainable forestry practices, emphasizing reforestation, afforestation, and the use of non-timber forest products to balance economic development and environmental conservation. Sustainable management of water resources, including measures to reduce water pollution, ensure equitable water distribution, and adapt to the impacts of climate change on water availability shall be considered seriously. The policy shall also encourage the development of ecotourism initiatives that promote responsible tourism practices, respect local cultures, and contribute to the well-being of the local communities. It should address the challenges of infrastructure development in remote areas while minimizing the ecological footprint. The Himalaya is prone to various natural hazards, including landslides, earthquakes, and glacial lake outburst floods. The policy should integrate disaster risk reduction strategies, including early warning systems, land-use planning, and the development of resilient infrastructure, to enhance the region's preparedness and response to such events. A participatory approach involving local communities, indigenous people, and relevant stakeholders is crucial for the successful implementation of any land use policy in the Himalayas. The policy should ensure the inclusion of local voices in decision-making processes and promote capacity building to empower communities to actively engage in sustainable land management practices. It is important to note that formulating and implementing such a policy requires a comprehensive assessment of the specific context and challenges faced by different regions within the Himalaya. Local knowledge, scientific research, and collaboration among various stakeholders would be essential for the successful integration of land use practices in the region.

4. Promotion of cultural tourism and research

The Himalayan region is home to a variety of cultures which have evolved in the diverse landscape and valleys of the region. The region with its immense natural beauty and cultural diversity is an ideal destination for travellers. It is thus very important to preserve and protect the rich cultural heritage of the region, including historical sites, traditional arts and crafts, religious practices, and indigenous knowledge systems. This required improvement in transportation, accommodation, and other tourism-related infrastructure in the remotest corners of the Himalaya. Further, partnerships with local organizations, promoting community-based tourism, and providing training and capacity-building programs for local guides and researchers is also important. Cultural exchange programs that allow tourists and researchers to interact with local communities and learn about their traditions, languages, and customs shall be promoted at a large scale. Research institutes, field schools, and educational programs shall be established that focus on the study of Himalayan culture, history, and environment. This can attract researchers, scholars, and students who are interested in exploring the unique aspects of the region. Collaborative research projects between local and international researchers shall also be promoted to enhance the understanding of the Himalayan region's culture, history, and ecology. Particular emphasis shall be given to the archaeology and culture of the remote and interior regions along borderline and cultural tourism shall be promoted to reduce migration, enhance economic prosperity and preserve local culture which will act as a second line of defence for the national borders. Extensive documentation and research on archaeology, monuments and culture of such regions shall be promoted to preserve the cultural heritage of the Himalayan highlands.

5. Effective Solid Waste Management

Effective solid waste management in the Himalaya require infrastructure, labour, and vehicles based on geographic and demographic characteristics of the region to ensure efficient waste collection. Waste disposal methods shall include sanitary landfills, waste-to-energy plants, vermicomposting, and composting. The creation of dedicated waste management commissions/boards at the state level, endowed with the necessary authority and resources, would enable a more streamlined and comprehensive approach to waste management. It is also important to invest in research and development to explore innovative and sustainable waste disposal methods. Extended Producer Responsibility (EPR) norms shall be enforced effectively through penalties and incentives shall be used to encourage compliance to collection and recycling plastic waste. Interdepartmental collaboration shall be ensured to improve the effectiveness and impact of waste management policies and practices. Public campaigns, education programs, and community involvement shall be organised for generation of awareness in the public on importance of solid waste management. Livelihood opportunities for informal waste collectors/ workers shall be supported through economic incentives. Innovation and technology for efficient waste management shall be popularised. Appropriate technologies shall be

acknowledged by the government and shall be supported for further research and development to foster a culture of innovation.

6. Empowering Indigenous Communities

Community initiative through institutional efforts may be a suitable alternative to allowing private property rights in shifting agriculture lands in the IHR. The security of land tenure for shifting cultivators for both the agricultural and fallow phases should be ensured. This can be done by reconsidering the classification of CPR areas and categorising them as agricultural land with adaptive forest management in the fallow period. Efforts should also be made for strengthening customary institutions for improved local-level governance and management of community-based natural resources. An effective measure to support tribal communities in recovering and building on their traditional structures for the management of CPR is to build mutual trust among stakeholders. A suitable public policy needs to be devised for the effective empowerment of community institutions in the IHR.

Key Policy Recommendations

1. Implement *"Carbon footprinting"* approach and establish *the Ecosystem Integrity Index* (EII) to evaluate environmental impacts and make them mandatory in the IHR.

2. Identify *Ecologically Sensitive Zones (ESZ)* and prioritize safer zones for sustainable developmental interventions.

3. Make biodiversity offsets compulsory, establish *a Himalayan Biobank*, and provide tangible and transferable credits to mitigate biodiversity loss.

4. Enable *biodiversity-motivated subsidies and payments for ecosystem services* to promote green cover and reduce GHG emissions in the IHR.

5. *Ban multilayer plastic* and promote eco-friendly and biodegradable packaging materials in the region, with restrictions on hazardous additives in plastics manufacturing and recycling.

6. Enhance research on *innovative sachet opening mechanisms* to reduce microplastic pollution.

7. Promote ECC (*Ecological Carrying Capacity)*-based tourism, raise awareness about tourists' carbon footprint, implement a tourism carbon tax, and utilize funds for sustainable development.

8. Promote and *safeguard the cultural diversity* of the IHR, integrate culture into development policies, protect intellectual property rights, and utilize indigenous knowledge for sustainable governance and biodiversity conservation.

9. Establish *Waste Management Boards/Commissions* at the state level to streamline waste management policies.

10. Conserve and enhance *natural carbon-rich ecosystems* like forests and wetlands to boost agricultural productivity and mitigate climate change impacts.

11. Use *a 'Climate Smart Index'* methodology and *investment planning framework* to identify and secure funding for climate-resilient and sustainable projects.

12. *Strengthen research institutions* in the IHR to address policy issues, bridge technological gaps, and contribute to sustainable development and effective governance.

13. *Empowering indigenous community institutions* for the management of CPR to adapt climate change mitigation initiatives through indigenous knowledge systems by them.

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REFERENCES

Aayog, N. I. T. I. (2018). National institution for transforming India (N.I.T.I). Contributing to sustainable development in the Indian Himalayan region. Available at: https://niti.gov.in/writereaddata/files/document_publication/Doc2.pdf. (Accessed May 14, 2023).

Bhatt, R.C., Vinod Nautiyal, P.M. Saklani, S. Nautiyal, S. Juyal and H. Chauhan. 2014. Burial Traditions in Uttarakhand and Trans Himalayas Including Tibet in The Megalithic Culture of South India, The Indian Archaeological Society, New Delhi, pp. 380-397

Bhutiyani, M.R., Kale, V.S. and Pawar, N.J., 2007. Long-term trends in maximum, minimum and mean annual air temperatures across the Northwestern Himalaya during the twentieth century. Climatic Change, 85(1-2), pp. 159-177.

Bhutiyani, M.R., Kale, V.S. and Pawar, N.J., 2010. Climate change and the precipitation variations in the northwestern Himalaya: 1866–2006. *International Journal of Climatology: A Journal of the Royal Meteorological Society*, 30(4), pp. 535-548.

Bookhagen, B. and Burbank, D.W., 2006. Topography, relief, and TRMM-derived rainfall variations along the Himalaya. *Geophysical Research Letters*, 33(8).

Byers, A., 2005. Contemporary human impacts on Alpine ecosystems in the Sagarmatha (Mt. Everest) national park, Khumbu, Nepal. *Annals of the association of American Geographers,* 95(1), pp.112-140.

CPCB (2018). Central Pollution Control Board of India (CPCB). River stretches for restoration of water quality. Available at: https://nrcd.nic.in/writereaddata/FileUpload/River_STRETCHES_Sept_2018.pdf (Accessed May 14, 2023).

CPCB (2019). Central Pollution Control Board of India (CPCB). Annual Report for the year 2018-19 on implementation of solid waste management rules (as per provision 24(4) of SWM Rules,16. Available at: https://cpcb.nic.in/uploads/MSW/MSW_AnnualReport_2018-19.pdf (Accessed May 14, 2023).

CPHEEO (Central Public Health and Environmental Engineering Organisation). (2016). Municipal Solid Waste Management Manual, Part II: The Manual. Swachh Bharat Mission, Ministry of Urban Development, Government of India. In collaboration with German Corporation for International Cooperation [Deutsche Gesellschaft fur Internationale Zusammenarbeit GmbH (GIZ)]. (Accessed May 15, 2023)

Dolezal, J., Dvorsky, M., Kopecky, M., Liancourt, P., Hiiesalu, I., Macek, M., Altman, J., Chlumska, Z., Rehakova, K., Capkova, K. and Borovec, J., 2016. Vegetation dynamics at the upper elevational limit of vascular plants in Himalaya. Scientific Reports, 6(1), p. 24881.

Easterling, D.R., Evans, J.L., Groisman, P.Y., Karl, T.R., Kunkel, K.E. and Ambenje, P., 2000. Observed variability and trends in extreme climate events: a brief review. *Bulletin of the American Meteorological Society*, 81(3), pp. 417-426.

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Firdos, S. (2020). 'Urbanisation in India's North-eastern region: Connecting theory with empirical data' in M. Amarjeet Singh and Singha Komol (eds.), Understanding Urbanisation in Northeast India. Routledge India. https://doi.org/10.4324/9781003032625.

Hingane, L. S., Rupa Kumar, K. and Ramana Murty, B. V., Long-term trends of surface air temperature in India. Int. J. Climatol., 1985, 5(5), 521–528.

Hoffmann, E.M., Konerding, V., Nautiyal, S. and Buerkert, A., 2019. Is the push-pull paradigm useful to explain rural-urban migration? A case study in Uttarakhand, India. PloS one, 14(4), p.e0214511.

Ives, J.D. and Barry, R.G. eds., 2019. *Arctic and alpine environments* (Vol. 6). Routledge.

Körner, C. and Kèorner, C., 1999. Alpine plant life: functional plant ecology of high mountain ecosystems.

Kuniyal, J. C. (2005). Solid waste management in the Himalayan trails and expedition summits. J. Sustain. Tourism 13, 391–410. doi:10.1080/09669580508668564.

Kuniyal, J.C., Kanwar, N., Bhoj, A.S., Rautela, K.S., Joshi, P., Kumar, K., Sofi, M.S., Bhat, S.U., Rashid, I., Lodhi, M.S., Devi, Ch, A, and Singh, H.B. 2021a. Climate change impacts on glacier-fed and non-glacier-fed ecosystems of the Indian Himalayan Region: people's perception and adaptive strategies, Curr. Sci., 120 (5):888-899.

Kuniyal, J. C., P. Maiti, S. Kumar, A. Kumar, N. Bisht, K. C. Sekar, S. C. Arya, S. Rai, and M. Nand. 2021b. Dayarabugyal restoration model in the alpine and subalpine region of the Central Himalaya: a step toward minimizing the impacts. Scientific Reports 11:16547.

Laghari, J. 2013. Climate change: Melting glaciers bring energy uncertainty. Nature 502:617–618.

Lamsal, P., L. Kumar, A. Aryal, and K. Atreya. 2018. Invasive alien plant species dynamics in the Himalayan region under climate change. Ambio 47:697–710.

Mina, U., Dimri, A.P. and Farswan, S., 2023. Forest fires and climate attributes interact in central Himalayas: an overview and assessment. Fire Ecology, 19(1), p.14.

MoEFCC (Ministry of Environment, Forest and Climate Change). 2016. "Notification - Solid Waste Management Rules. 2016" The Gazette of India, April 8. Ministry of Environment, Forest and Climate Change, Government of India. http://www.indiaenvironmentportal.org.in/files/file/Solid%20Waste%20Management%0Rules,%202016.pdf. (Accessed May 15, 2023).

Maikhuri, R.K. and Nautiyal, Annpurna et.al. Socio-ecological vulnerability: Assessment and coping strategy to environmental disaster in Kedarnath valley, Uttarakhand, Indian Himalayan Region. International Journal of Disaster Risk Reduction, Volume 25, October 2017, Pages 111-124.

Nautiyal, S., Goswami, M., Prakash, S., Rao, K.S., Maikhuri, R.K., Saxena, K.G., Baksi, S. and Banerjee, S., 2022. Spatio-temporal variations of geo-climatic environment in a high-altitude landscape of Central Himalaya: An assessment from the perspective of vulnerability of glacial lakes. Natural Hazards Research.

Pandit, M. K., K. Manish, and L. P. Koh. 2014. Dancing on the roof of the world: Ecological transformation of the himalayan landscape. BioScience 64:980–992.

Patel, A., Goswami, A., Dharpure, J.K., Thamban, M., Kulkarni, A.V. and Sharma, P., 2021. Regional mass variations and its sensitivity to climate drivers over glaciers of Karakoram and Himalayas. *GIScience & Remote Sensing*, *58*(5), pp. 670-692.

Price, L.W., 1981. *Mountains & man: a study of process and environment*. Univ of California Press.

Raju, E., Boyd, E. and Otto, F., 2022. Stop blaming the climate for disasters. *Communications Earth & Environment*, *3*(1), p.1.

Rana, S. K., T. D. Price, and H. Qian. 2019. Plant species richness across the Himalaya driven by evolutionary history and current climate. Ecosphere 10:e02945.

Rawat Nagendra & V. Nautiyal (2020), Exploring Chaundkot Fort in Garhwal, central Himalaya, India, *Antiquity: Published online by Cambridge University Press*: 17 July 2020.

Rawat Nagendra, Tom Brughmans , Vinod Nautiyal, Devi DuttChauniyal (2021), Networked medieval strongholds in Garhwal, Himalaya, India, Antiquity: Published online by Cambridge University Press: 15 February 2021. https://doi.org/10.15184/aqy.2021.4

Sharma, E., D. Molden, A. Rahman, Y. R. Khatiwada, L. Zhang, S. P. Singh, T. Yao, and P. Wester. 2019. Introduction to the Hindu Kush Himalaya Assessment. Pages 1–16 *in* P. Wester, A. Mishra, A. Mukherji, and A. B. Shrestha, editors. The Hindu Kush Himalaya Assessment: Mountains, Climate Change, Sustainability and People. Springer International Publishing, Cham.

Shrestha, A. B., Wake, C. P., Mayewski, P. A. and Dibb, J. E., Maximum temperature trends in the Himalaya and its vicinity.An analysis based on temperature records from Nepal for theperiod 1971–94. J. Climate, 1999, 12, 2775–2787.

Thakur A, Kumari S, Sinai Borker S, Prashant SP, Kumar A and Kumar R (2021) Solid Waste Management in Indian Himalayan Region: Current Scenario, Resource Recovery, and Way Forward for Sustainable Development. Front. Energy Res. 9:609229. doi: 10.3389/fenrg.2021.609229.

Tiwari, P.C. and Joshi, B., 2015.: Climate change and rural outmigration in Himalaya. The Journal of Change and Adaptation in Socio-Ecological Systems (CASES), 2, pp. 8–25.

Tiwari, P.C., Tiwari, A. and Joshi, B., 2018. Urban growth in Himalaya: understanding the process and options for sustainable development. Journal of Urban and Regional Studies on Contemporary India, 4(2), pp.15-27.

Wester, P., Mishra, A., Mukherji, A. and Shrestha, A.B., 2019. The Hindu Kush Himalaya assessment: mountains, climate change, sustainability and people (p. 627). Springer.

Winkler, K., R. Fuchs, M. Rounsevell, and M. Herold. 2021. Global land use changes are four times greater than previously estimated. Nature Communications 12:2501.

INDIA'S G20 PRESIDENCY AND SUSTAINABLE DEVELOPMENT IN THE HIMALAYA: OPPORTUNITIES, STRATEGIES AND POLICY RECOMMENDATIONS

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**NATIONAL LEVEL ONE DAY WORKSHOP ENTITLED
"INDIA'S G20 PRESIDENCY AND SUSTAINABLE DEVELOPMENT: OPPORTUNITIES AND STRATEGIES,"
HELD AT HNB GARHWAL UNIVERSITY (A CENTRAL UNIVERSITY)
SRINAGAR-GARHWAL, UTTARAKHAND, ON APRIL 17TH, 2023.**

Hemvati Nandan Bahuguna Garhwal University (HNBGU)

It is the only Central University of Uttarakhand state that came into existence in 1973 after a widespread mass movement of local residents for higher education opportunities in the hill areas. In 2009 it was upgraded as a Central University. The University is spread into four separate campuses, Birla Campus with an extension at Chauras, B. Gopal Reddy (BGR) Campus at Pauri (Garhwal), and Swami Ram Teerth (SRT) Campus at Badshahithaul, Tehri Garhwal with its Headquarters at Srinagar. The University aspires to achieve excellence in higher education by imparting quality education, training, and researches to contribute significantly in nation building with a particular focus on mountain region. Approximately 72 colleges and institutes are affiliated to it with 1.20 lakhs students (nearly 13000 in three campuses). Altogether the University has 14 Schools (11 in Campuses) and 50 departments, and offers 14 undergraduate, 54 postgraduate, 01 Integrated Master's, 03 Diploma and 06 PG Diploma programmes. The University offers Ph.D. in 43 subjects. The University strives to achieve the goal of bridging the gap between education, research, innovation and extension by taking all its programmes from lab to land for the betterment of community and students as per the mandate of the National Education Policy 2020.

G.B. Pant National Institute of Himalayan Environment (NIHE)

NIHE was established in 1988-89 during the birth centenary year of Bharat Ratna Pt. Govind Ballabh Pant, as an autonomous Institute of Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt. of India. It has been identified as a focal agency to advance scientific knowledge, to evolve integrated management strategies, demonstrate their efficacy for conservation of natural resources, and to ensure environmentally sound development in the entire Indian Himalayan Region (IHR). It functions in a decentralized manner with its Headquarters at Almora (Uttarakhand) and regional centres at Leh (Ladakh Regional Centre), Kullu (Himachal Regional Centre), Srinagar (Garhwal Regional Centre), Gangtok (Sikkim Regional Centre), and Itanagar (Northeast Regional Centre). The Institute undertakes multidisciplinary and holistic R&D projects related to diverse socio-cultural, ecological, economic and physical aspects of the Indian Himalayan region to ensure sustainability in the IHR. To have a focused and in dept study, the R&D activities of the institute are categorized under four thematic centres namely (i) Centre for Land & Water Resource Management (CLWRM) (ii) Centre for Socio-Economic Development(CSED) (iii) Centre for Biodiversity Conservation & Management (CBCM) and (iv) Centre for Environmental Assessment & Climate Change (CEA&CC)

Research and Information System for Developing Countries (RIS)

Research and Information System for Developing Countries (RIS) is a New Delhi–based autonomous policy research institute that specializes in issues related to international economic development, trade, investment and technology. RIS is envisioned as a forum for fostering effective policy dialogue and capacity-building among developing countries on global and regional economic issues.

The focus of the RIS is to promote South-South Cooperation and collaborate with developing countries in multilateral negotiations in various forums. RIS is engaged in inter-governmental processes of several regional economic cooperation initiatives. Through its intensive network of think tanks, RIS seeks to strengthen policy coherence on international economic issues anddevelopment partnerships

Kalinga Institute of Indo-Pacific Studies (KIIPS)

Established to study, analyse, explain, and disseminate all relevant information and developments related to Indo-Pacific region. It encompasses a wide range of issues related to diplomacy, strategy and economics, etc. The Government of India has already begun to recognize Indo-Pacific region as a reference point for its foreign policy strategy therefore, the goal of KIIPS is to monitor multifarious developments and issues in this region and bring out publications, seminar proceedings and hold workshops and symposia from time to time. By taking advantage of the digital initiatives, it also aspires to convert KIIPS as a virtual centre of knowledge.

Indian Himalayan Central Universities' Consortium(IHCUC)

The Indian Himalayan Central Universities' Consortium (IHCUC) came into existence in 2019 as a policy platform of 13 central Universities and a national institute. Currently, HNB Garhwal University, Srinagar, Uttarakhand is leading this consortium. IHCUC is a multi-institutional forum for conducting joint multidisciplinary research and share knowledge and experiences on key issues of Indian Himalayan region, such as sustainable environmental management, livelihood generation, migration, agroecology, tourism, socio-cultural, political issues. Besides HNB Garhwal University, the other partner institutions are Central University of Kashmir, Central University of Jammu, Central University of Himachal Pradesh, Sikkim University, Rajiv Gandhi University Arunachal Pradesh, Assam University, Tezpur University, Nagaland University, North-Eastern Hill University, Mizoram University, Manipur University, and Tripura University as well as CSIR-IHBT- Palampur. Recently with the support of Niti Aayog, UGC and Ministry of Education, Govt. of India this forum has brought out five thematic reports comprising *Enumeration and Valuation of the Economic Impact of Female Labor in the Hills'*, '*Agroecology in the Himalayan States with special emphasis on Marketing*,''*Development of Eco-Friendly and Cost-Effective Tourism in Hills'*, '*Opportunities of Livelihood to check Migration from Hills'*, and '*Water Conservation and Harvesting Strategies*". IHCUC also aims to increase its partnerships with other similar institutions in the IHR. It looks forward for many such ventures with the support of partner institutions in near future as well.