Ministry of Housing and Urban Affairs
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ICIMOD

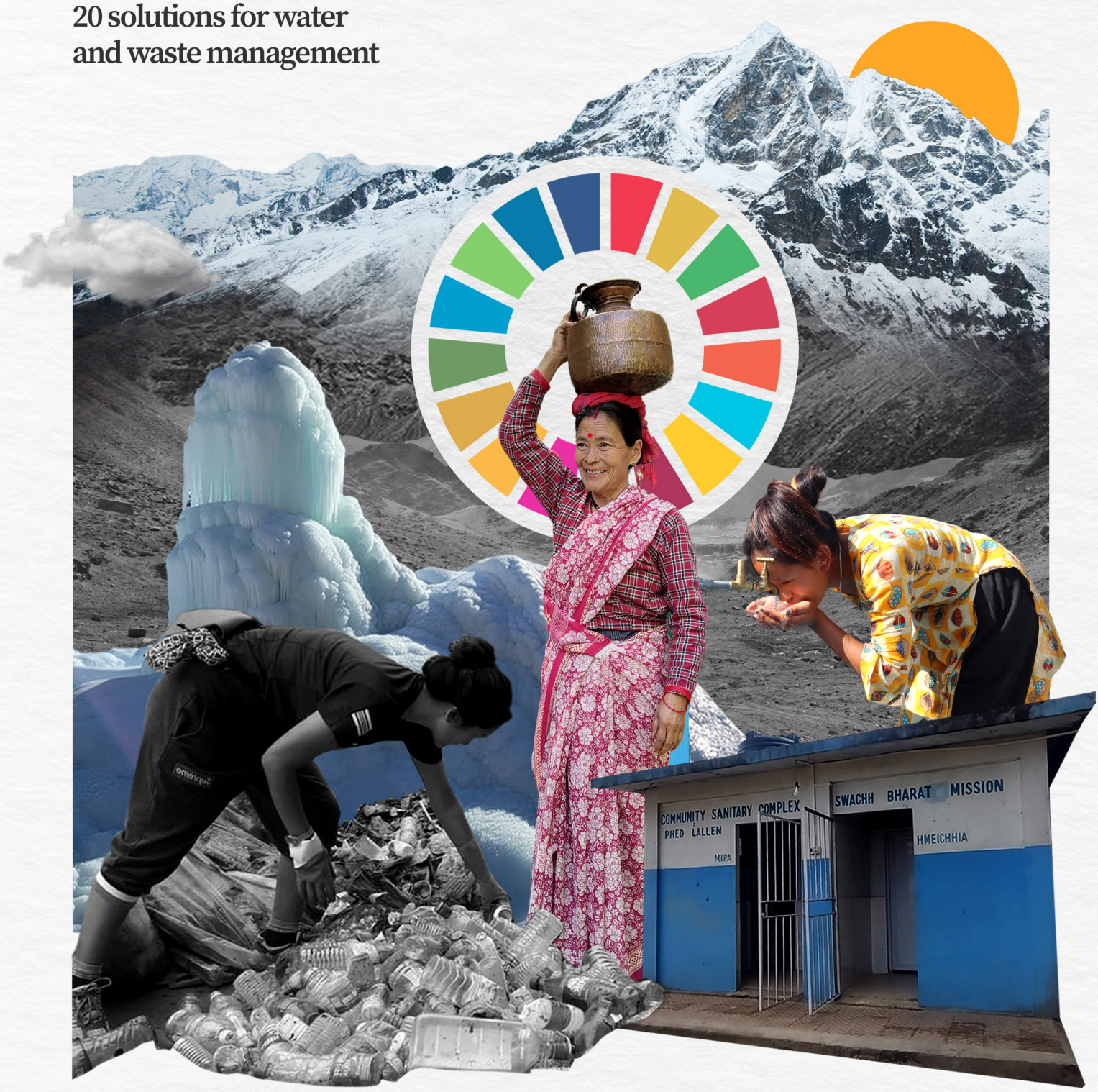
PARVAT-MANTHAN
Manifestation of Clean and Sustainable Hill States

National Institute of Urban Affairs

BILL & MELINDA GATES foundation

Untold stories from the Himalaya:

20 solutions for water and waste management



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Graphics and layout
Sudip Kumar Maharjan, ICIMOD

Maps
Narayan Thapa, ICIMOD

Copy editing
Lena Michaels, ICIMOD

Untold stories from the Himalaya:

20 solutions for water and waste management

Editorial team

Mahreen Matto, NIUA

Erica Udas, ICIMOD

Shantanu Padhi, NIUA

Barsha Rani Gurung, ICIMOD

Sugat Bajracharya, ICIMOD

Tanya Ahmed, NIUA

Prasesh Pote Shrestha, ICIMOD

Anant Mitra, NIUA

Samuel Thomas, ICIMOD

Madhav Dhakal, ICIMOD

Scientific evaluation committee

Deepak Sanan
Former IAS, Former Additional Chief Secretary, Government of Himachal Pradesh

S. Vishwanath
Advisor, Biome Environmental Solutions Pvt Ltd.

Arnab Pratim Dutta
Senior Journalist

Contributors

Roshan Rai, Integrated Mountain Initiative (IMI)

Snehit Prakash, Bremen Overseas Research and Development Association (BORDA) South Asia

Authors of solutions

Solution 1: Deon Sajan

Solution 2: Anant Bhaskar Garg

Solution 3: Urmi Buragohain & Girbani Deka

Solution 4: Suryanarayanan Balasubramanian

Solution 5: Santosh Dahal

Solution 6: Bivor Maharjan

Solution 7: Shivani Singh

Solution 8: S.A. Abbasi & Tabassum Abbasi

Solution 9: Anisha Dey

Solution 10: Mandeep Kaur

Solution 11: Upasna Chopra

Solution 12: Rikesh Gurung

Solution 13: Vishal Mishra

Solution 14: Divya Negi

Solution 15: Prashanna Man Pradhan

Solution 16: Buddha Bajracharya

Solution 17: Stanzin Odsal

Solution 18: Asma Yousuf

Solution 19: Asma Yousuf

Solution 20: Priyadarshinee Shrestha

Message from the Director General, ICIMOD

As we navigate the complexities and challenges of a triple planetary crisis of biodiversity loss, climate change and air pollution, the Hindu Kush Himalaya (HKH) is witnessing sweeping socioeconomic changes and rapid urbanisation.

The accelerated pace of urbanisation in the region, combined with subpar infrastructure and poor urban planning, has given rise to the haphazard expansion of settlements and infrastructure, overextraction of resources, and environmental degradation. The consequential influx of people from rural to urban centres is creating enormous pressures on biodiversity, water, energy, and sanitation systems with increased waste and pollution, impairing the living conditions of people in hill towns and cities.

There is no silver bullet or 'one-size-fits-all' solution to address these complex and pressing challenges, but there are proven science-based solutions, traditional practices, innovative technologies, and institutional and governance approaches from the mountains that can be shared for wider replication and scaling through customisation to local contexts.

This compendium on integrated water management and waste and sanitation solutions from the Himalayas aims to do just that. A joint effort by ICIMOD, NIUA, IMI, and BORDA South Asia, it showcases 20 promising solutions from Bhutan, the Indian Himalayan Region and Nepal that can be replicated to benefit other hill towns and cities facing similar challenges.

This compendium is a testimony to the power and promise of collaboration and knowledge sharing that could make the HKH region greener, more inclusive, and climate resilient. I hope that the solutions presented here will inspire and guide policymakers, practitioners, and communities in their collaborative efforts to create a sustainable future for the mountains and mountain communities.

Warm regards,

Pema Gyamtsho
Director General, ICIMOD

Message from the Director, NIUA

It is with great pleasure that I introduce this compendium as a testament to the resilience, innovation, and dedication of communities across the hill cities and towns of the Himalayan Region. This compilation captures a wide range of solutions and practices addressing water conservation, sanitation, waste management, and disaster risk reduction, highlighting the profound commitment to sustainable living and environmental stewardship exemplified by these regions.

This compendium presents a series of case studies alongside community-based initiatives that showcase the creativity and resourcefulness of our mountain communities. From pioneering water conservation strategies and traditional spring-shed management techniques to waste reuse practices and climate-responsive adaptation measures, these case studies reflect the evolving dialogue on sustainable urban development tailored to the unique challenges of mountainous landscapes. The compendium also highlights nature-based solutions and indigenous approaches to water and waste management that continue to support environmental and societal resilience amid the growing challenges of climate change.

This compendium would not have been possible without the invaluable contributions of authors, practitioners and researchers from government agencies, academic institutions, and non-governmental organisations, who shared their knowledge and expertise. Their work enriches our understanding and sheds light on key findings and solutions essential for fostering sustainable and equitable practices in water and waste management, which support the health and well-being of both communities and ecosystems.

The stories shared here offer a wealth of knowledge for all those engaged in shaping liveable and resilient urban futures. I extend my heartfelt appreciation to all contributors for their unwavering commitment and for lending their voices to this vital dialogue. May this compendium inspire continued action and collaboration as we strive for a sustainable and resilient urban future.

Warm regards,

Debolina Kundu

Dr. Debolina Kundu
Director (Additional Charge)

Acronyms and abbreviations

AIM	Atal Innovation Mission
AIR	Automated Ice Reservoir
BORDA-SA	Bremen Overseas Research and Development Association - South Asia
CCRM	Child Centered Risk Mapping
CHIRAG	Central Himalayan Rural Action Group
CLRM	Community Led Risk Mapping
CSC	Community Sanitary Complex
DEWAT	Decentralised Wastewater Treatment System
DPR	Detailed Project Report
DRR	Disaster Risk Reduction
ENPHO	Environment and Public Health Organization
EPR	Extended Producer Responsibility
FSM	Faecal Sludge Management
FSTP	Faecal Sludge Treatment Plant
GOAL	Gyandhara Opportunities for All with Learning
HKH	Hindu Kush Himalaya
HRDEF	HaritaDhara Research Development and Education Foundation
ICIMOD	International Centre for Integrated Mountain Development
IHR	Indian Himalayan Region
IMI	Integrated Mountain Initiative
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
IUWM	Integrated Urban Water Management
KLD	Kilo Liters per Day
LEDeG	Ladakh Ecological and Environmental Group
LiFE	Lifestyle for Environment
MDGs	Millennium Development Goals
MLD	Million Litres per Day
MoU	Memorandum of Understanding
MRF	Material Recovery Facility
NbS	Nature-based Solutions
NIUA	National Institute of Urban Affairs
NWSC	Nepal Water Supply Corporation
QR	Quick Response
RCC	Reinforced Cement Concrete
RDF	Refuse-Derived Fuel
RFP	Request for Proposals
SDG	Sustainable Development Goals
SHEFROL	Sheet Flow Root Level
SHG	Self Help Group
STEAM	Science, Technology, Engineering, Art and Math
SWM	Solid Waste Management
THC	The Himalayan Cleanup
ULB	Urban Local Bodies
USD	United States dollar
VIPNET	Vigyan Prasar Network
WASH	Water, Sanitation, and Hygiene
WATSAN	Water and Sanitation
WMC	Water Management Committee
WSS	Water Supply System
WUC	Water User Committee
WUSC	Water Users and Sanitation Committee
WWTP	Wastewater Treatment Plant

Content

Executive Summary

The Hindu Kush Himalaya (HKH), a region of immense natural beauty and ecological significance spans an area of 595,000 km^2 across the eight countries. It is the 'water tower of Asia' with the headwaters of 10 major river systems supporting about 1.9 billion people. However, the region is facing severe challenges due to rapid and unplanned urbanisation, climate change and environmental degradation. Rapid glacier retreat in a warming climate threatens future water supplies while concretised development will further disrupt hydrological patterns and reduce groundwater recharge leading to water scarcity and food insecurity. Increased population and rapid urbanisation also bring challenges on waste and sanitation services hampering the health of ecosystems and people.

The Parvat Manthan Forum aims to build a collaborative and responsive platform that provides support to hill towns and cities in engaging with each other and central governments. The forum seeks to help these regions become more inclusive, sustainable, and climate-resilient in urban water and sanitation management. Its purpose is to bring together Himalayan towns and cities to act collectively toward achieving the UN Sustainable Development Goals (SDGs), particularly SDGs 6 (Clean Water and Sanitation) and 11 (Sustainable Cities and Communities). This initiative aligns with the UN's Decade for Action to achieve the SDGs, as well as the explicit recognition of the "human right to a clean, healthy, and sustainable environment" at COP27.

Under the Parvat Manthan forum, the National Institute of Urban Affairs (NIUA), in collaboration with the International Centre for Integrated Mountain Development (ICIMOD) and supported by the Bremen Overseas Research and Development Association - South Asia (BORDA-SA) and the Integrated Mountain Initiative (IMI), is publishing the compendium *Untold stories from the Himalaya: 20 solutions for water and waste management.* This compendium, ideated by NIUA, focuses on integrated water and waste management solutions specifically tailored for mountain regions. It documents best practices, innovative solutions—including technological advancements, business models, and community-driven actions—and initiatives from hill towns and cities in Bhutan, India's Himalayan states, and Nepal.

The primary aim is to showcase scalable solutions addressing key water and waste management challenges that can be replicated in other mountain towns and cities facing similar issues. Over 80 submissions were received through an open call, contributed by development organizations, independent professionals, private sector experts, think tanks, community-based organizations, and others involved in sustainable Water, Sanitation, and Hygiene (WASH) solutions in mountainous areas.

The compendium highlights 20 innovative solutions that have been screened and implemented to address water and waste management challenges in the mountainous context. These solutions provide strategic recommendations for:

1. Sustainable urban planning that embraces inclusive and resilient practices tailored to the unique needs of mountainous regions.
2. Development of climate-resilient infrastructure capable of withstanding natural disasters and climate impacts to ensure long-term sustainability.
3. Encouragement of community ownership and participation in environmental management and disaster risk reduction.
4. Formulation of mountain-specific policies and allocation of resources to support sustainable development in the region.

This compendium serves as a knowledge repository, offering practical and innovative solutions that can be scaled and replicated across the region. It is hoped that this resource will inspire and guide policymakers, practitioners, and local communities in building a more resilient and sustainable future for the Himalayas.

Introduction

The HKH spans eight countries and stretches 3,500km across Asia. It is vital for the food, water and power security of about 1.9 billion people and is a habitat for countless irreplaceable species. It is also acutely fragile—and absolutely frontline to the impacts of the triple planetary crisis.

Rapid and unplanned urbanisation, combined with the extensive use of Reinforced Cement Concrete (RCC) in construction, has disrupted the region's delicate ecological balance. This has led to altered hydrological patterns, reduced groundwater recharge, and diminished access to essential water for drinking, agriculture, and energy generation. As a result, mountain communities are facing increased vulnerability to water scarcity, food insecurity, and heightened health risks.

Moreover, the climate crisis is further exacerbating these challenges. According to the Intergovernmental Panel on Climate Change (IPCC), the Himalayas are one of the regions that are most vulnerable to climate change. Alterations in the water cycle, particularly the retreat of glaciers, threaten future water supplies and pose increasing pressures on an already strained municipal service system in the region (Chauhan et al., 2023). For instance, nearly 50% of the springs in the Indian Himalayan Region (IHR) are drying up, affecting over 200 million people (NITI Aayog Report, 2018), while studies from Nepal show a 30% reduction in spring discharge over 30 years (Chapagain et al., 2017).

The State of India's Environment 2024 report highlights that the mountainous region is at a tipping point, with several irreversible changes in the climate system already underway (Narain, 2024). These changes are increasing the frequency and severity of mountain hazards such as landslides, flash floods, and cloudbursts. Extreme rainfall, often triggered by changing monsoon patterns, further exacerbates risks, damaging infrastructure and livelihoods (Wester et al., 2019).

Additionally, glacier melt and shifting snowmelt patterns are directly influencing the frequency of these hazards and impacting water availability, as detailed in the IPCC's Sixth Assessment Report (IPCC,2023). The result is significant risks to infrastructure, communities, and economies in the region, making it crucial to implement climate-resilient infrastructure that can withstand such disasters (Sati, V. P., & Litt, D. (2011, September).

Urbanisation in this region cannot be stopped, but it can be steered and planned toward sustainable development. This involves adopting climate-resilient planning and infrastructure that meets the region's unique needs, while also addressing the growing socioeconomic aspirations of mountain communities. However, applying one-size-fits-all strategies from the plains to the mountains has led to inefficiencies and further vulnerabilities. Context-specific planning, guided by data-driven evidence, is essential for sustainable growth.

There are immense sustainability and institutional challenges in delivering reliable basic services. The challenges in providing basic municipal services, such as water and waste management (sanitation and solid waste), in the mountainous region are complex and

multifaceted. These challenges include geographic remoteness, limited infrastructure, high costs for implementation, transportation, and services, capacity constraints, and harsh climatic conditions. Additionally, the region's issues are exacerbated by the pressures of tourism and the impacts of climate change. A significant obstacle to maintaining infrastructure is the lack of capacity for ongoing operations. However, the most pressing challenge is institutional accountability which remains a major issue, hindering effective service delivery. Existing systems often focus more on asset creation – e.g., purchasing and installing new infrastructure – rather than the operation and maintenance of existing services. This issue is especially pronounced in mountainous areas, where urban local bodies (ULBs) face difficulties in securing adequate funding.

This underscores the need for strategic investments and context-specific solutions, supported by enabling policies:

- **Planned urban land use:** Focus on reducing emissions while enhancing climate resilience.
- **Resilient infrastructure:** Ensure increased access to resilient and affordable urban services and infrastructure.
- **Waste management:** Prioritize zero-waste practices and implement localised solutions.
- **Sustainable service delivery:** Allocate funds for ongoing infrastructure maintenance, shifting the focus from initial projects to long-term operational sustainability.

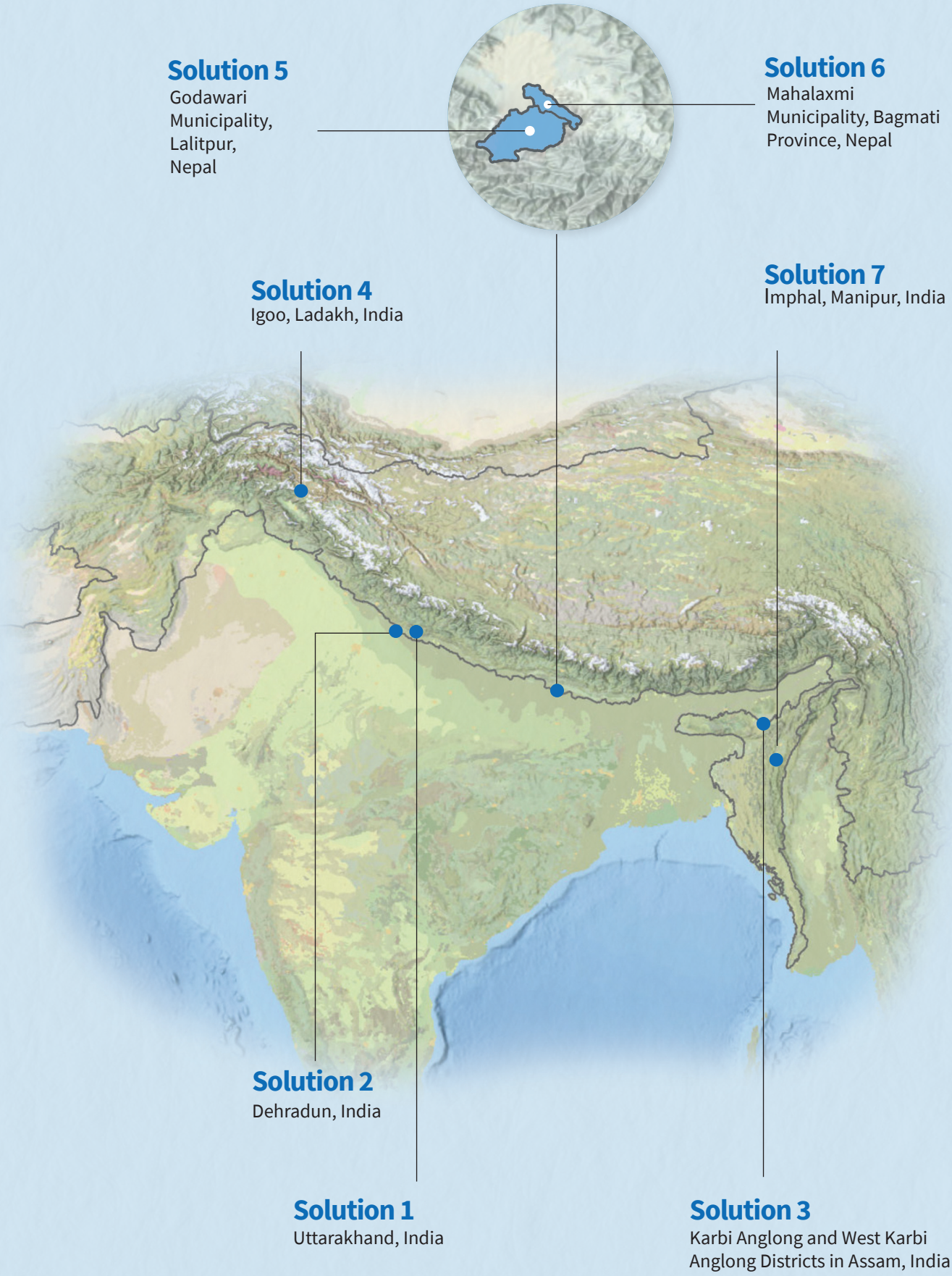
Given the challenges posed by climate change, it is crucial that the Parvat Manthan Forum serves as a platform for regional knowledge sharing across Himalayan countries to develop integrated, context-specific solutions to water, waste management, and sanitation challenges. This platform facilitates collaborative action to improve the climate resilience of mountain urban centres, addressing both the immediate needs of the communities and long-term sustainability goals.

Need for compendium

Through the regional Parvat Manthan Forum, NIUA along with its partners ICIMOD, IMI, and BORDA South Asia is showcasing grounded knowledge based on research and field-tested pilots in this compendium titled ***Untold stories from the Himalaya: 20 solutions for water and waste management.*** This publication is envisaged to capture the best practices and solutions from Bhutan, the IHR and Nepal. The solutions fall under two themes (a) integrated water management and (b) waste management and sanitation.

The compendium is the first publication of its kind, serving as a comprehensive knowledge repository that integrates innovative technologies, business models, practical and cost-effective solutions, approaches, and indigenous community-based practices. It is designed to be a valuable resource for other hill towns and cities facing similar challenges, offering proven strategies for replication and scaling.

Integrated water management


Solution 5
Godawari Municipality, Lalitpur, Nepal
Solution 6
Mahalaxmi Municipality, Bagmati Province, Nepal
Solution 4
Igoo, Ladakh, India
Solution 7
Imphal, Manipur, India
Solution 2
Dehradun, India
Solution 1
Uttarakhand, India
Solution 3
Karbi Anglong and West Karbi Anglong Districts in Assam, India
Integrated water management solutions
Hindu Kush Himalaya

1

Revitalising springs for sustainable water security: A springshed management and development initiative

Uttarakhand, India

Deon Sajan
Central Himalayan Rural Action Group (CHIRAG)

Problem statement

The IHR is experiencing severe water shortages due to both human activity and climate change. These shortages disrupt key aspects of life, including livelihoods, health, and education. Urgent action is needed to address this crisis, with sustainable water management and climate-resilient practices essential to ensure long-term water security and community well-being.

Solution/intervention

The goal of this project was to ensure the long-term sustainability of these springs, enhancing their flow from seasonal to perennial sources with more consistent discharge throughout the year. To achieve this, the project focused on revitalising the springs through comprehensive springshed development and management. A key emphasis was placed on implementing innovative strategies and promoting community ownership and participation to ensure sustainable outcomes.

As part of the solution, the project introduced a detailed springshed development and management plan, which included the formation of water user committees led by women to oversee the restoration of the springs. A hydrogeological survey was also conducted, alongside a capacity-building programme designed to equip local communities with the technical knowledge and skills necessary to maintain these vital water sources for future generations. To further enhance water availability, the project proposed integrating rooftop rainwater harvesting systems at suitable locations, enabling the collection and storage of rainwater for alternative uses and providing an additional water supply during dry periods.

Preparation/innovation to address the problem

The initial process began with a pre-feasibility assessment of the springs, which was used to determine whether intervention in a spring was feasible. This was followed by a baseline survey to gather socio-economic and cultural information about the beneficiary population. Next, village-level institutions were formed, and capacity-building efforts for stakeholders were carried out. The subsequent step involved technological and hydrogeological assessments, which were followed by the preparation of a detailed treatment plan. Finally, awareness and advocacy activities, along with implementation and monitoring, were conducted.

Result and impact

The springshed management interventions directly address the water scarcity burden, particularly for women and children. The intervention helped to empower women and children by dedicating the reduced water collection time to other activities such as education, livelihood, childcare, skill development, etc. It enhances water discharge and maintains a balanced ecosystem,

Solution contributes to

ensuring reliable water availability for communities. The increased water availability promotes better sanitation and hygiene practices, particularly among women and children, leading to a reduction in waterborne diseases. Furthermore, the project creates employment opportunities and promotes water conservation awareness within communities.

Potential for scaling the project

The intervention successfully revived 610 Himalayan springs in the financial year 2023-24, directly benefiting over 125,000 people. Around 460 village-level institutions are now actively managing their water resources, and the initiative generated employment worth ₹12.81 crore. The project's approach to springshed management, which combines community involvement with sustainable practices, has proven effective across various districts of Uttarakhand. Core strategies such as pre-feasibility assessments, baseline surveys, formation of village-level committees, capacity building, awareness and advocacy, implementation, and monitoring are adaptable to different contexts within the IHR.

610
Himalayan springs revived

125,000+
people directly benefited

2

Empowered communities: Capacity building on water and waste management solutions

Dehradun, Tehri Garhwal, Uttarakashi, Pauri Garhwal, Haridwar, Uttarakhand, India

Anant Bhaskar Garg

HaritaDhara Research Development and Education Foundation

Problem statement

Climate change-induced disasters in hilly states pose significant challenges for water conservation and management, waste management, and Water, Sanitation, and Hygiene (WASH) in both urban and rural areas. Capacity building in the hilly states of India is crucial to address the unique challenges of water and waste management in these regions. Due to the difficult terrain, climate change impacts, and lack of infrastructure, the local population often lacks the necessary skills, knowledge, and resources to effectively manage water and waste. Strengthening the capacity of communities, local authorities, and stakeholders through targeted training and engagement is essential for building resilience and sustainability in these areas.

Solution/intervention

HaritaDhara Research Development and Education Foundation (HRDEF) is committed to advancing progress towards sustainability and the SDGs. Studies reveal that quality climate education, and the development of 21st-century skills are often overlooked in mainstream education. To address this gap, HRDEF focuses on providing high-quality, skill-based education that empowers students and youth with the knowledge and tools to tackle future challenges related to climate action and sustainable development. More specifically, HRDEF is actively engaged in conducting workshops and training sessions aimed at building the capacity of youth and communities. These initiatives focus on adaptive, preventive, and mitigation measures, such as using educational games, hands-on activities for water conservation, waste management, biodiversity audits, eco-brick making, and other practical approaches. The goal is to empower local communities with the knowledge and skills to tackle environmental challenges effectively.

For several years, HRDEF has been working on educational games designed to teach sustainability concepts and the SDGs. Their efforts have been showcased at international platforms, highlighting the role of games in advancing SDGs, building sustainability awareness, and fostering a healthy planet. HRDEF also encourages the integration of Science, Technology, Engineering, Arts, and Mathematics (STEAM) education to promote a sustainable 21st-century lifestyle and the Lifestyle for Environment (LiFE) initiative. As systemic change requires sustained effort over time, HRDEF remains dedicated to this long-term mission, creating lasting impact through education and engagement.

Preparation/innovation to address the problem

Engaging with youth, community members, and professionals to address local challenges and develop solutions, such as educational games and hands-on, project-based scenarios, is a key focus. The initiative involves designing and facilitating activities that help youth and communities understand and work on water and waste-related issues through workshops, training, and various interactive settings.

Solution contributes to

Youth are also supported in developing mobile apps on SDGs, COVID-19, and sustainability, along with hands-on activities such as quizzes, model-making, and other creative expressions. These activities aim to increase their motivation for sustainability. Students and youth participating in the after-school Gyandhara Opportunities for All with Learning (GOAL) programme are empowered with self-confidence, equipped to excel in life, and inspired to contribute to building a sustainable future.

Result and impact

Over the past 10 years, HRDEF's work has impacted over 35,000 youth, 1,280+ principals and teachers, and 960+ women through workshops, interactions, and training programmes. HRDEF has planted and protected, and encouraged communities to plant, fruit trees as part of their climate action efforts, contributing to biodiversity conservation.

Potential for scaling the project

HRDEF are actively implementing their projects and initiatives across several districts in Uttarakhand, other states in India, and in cities globally. As mentors for the Atal Innovation Mission (AIM) and Climate Reality Project (an initiative of Nobel Laureate Al Gore), HRDEF are leading efforts to advance climate change and sustainability education in schools, colleges, universities, and communities, with the potential to replicate the work in other regions.

The approach was selected by HundrED, a Finland-based organisation, for its innovative gamified curriculum, where HRDEF was recognised as one of 12 global winners. This recognition highlights the scalability of the model, which can be adapted to other areas.

Impacted over

35,000+
youth

1,280+
principals and teachers,

960+
women through workshops and trainings

3

Mapping traditional knowledge and indigenous water stories of the Karbi people

Karbi Anglong and West Karbi Anglong districts in Assam, India

Urmi Buragohain and Girbani Deka

Place Making Foundation and Centre for Karbi Studies

Problem statement

The Karbi people are one of the prominent indigenous tribes of Northeast India, with a profound cultural belief in the importance of maintaining a harmonious relationship with water. For the Karbi, water is not only a vital life source that sustains their physical well-being but also a cornerstone of their spiritual and cultural identity. This reverence reflects their deep understanding of water as a force that nurtures both the environment and their community's way of life.

However, indigenous knowledge systems, particularly in cultures where oral traditions prevail – such as among the Karbi people in Assam – are under threat. The strain on water resources can be partially attributed to the erosion of these traditional customs, which have long promoted living in harmony with nature. This delicate balance has been disrupted by unsustainable development that disregards traditional wisdom, and further exacerbated by increasing climate variability, leading to water stress in the form of shortages and the deterioration of water quality.

Solution/intervention

A growing global consensus recognises that integrating traditional knowledge and solutions into water management strategies can improve the resilience of ecosystems and communities in the face of climate change. By using participatory approaches and open-source technology to preserve and share place-based oral traditions, we can safeguard these valuable knowledge systems. This ensures that they continue to play a crucial role in sustaining both the environment and the cultural heritage of indigenous communities, such as the Karbi, for future generations.

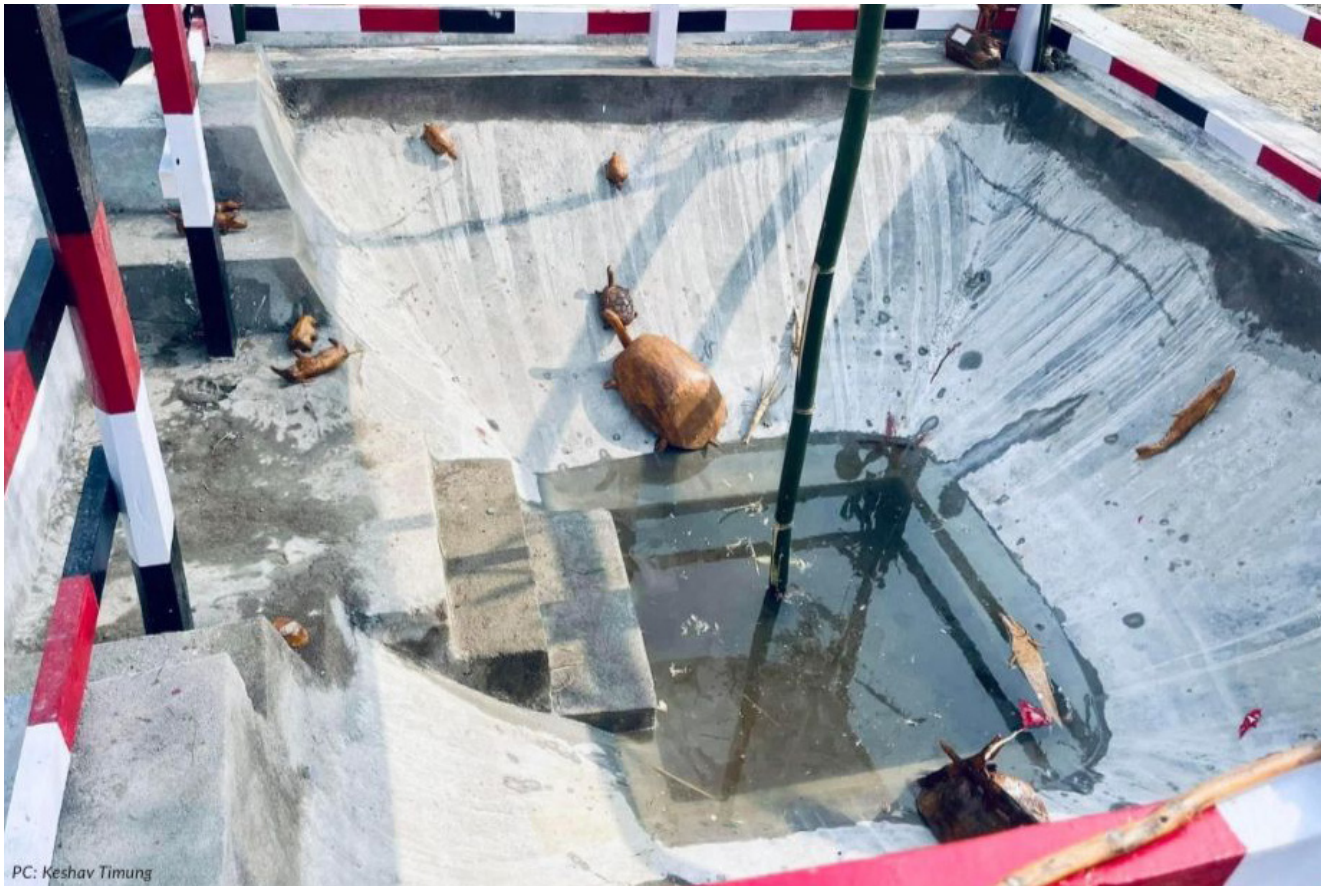
An urgent need exists to document and preserve indigenous knowledge related to water conservation within these communities. One potential solution is to engage the community in mapping their oral traditions through open-source geo-storytelling applications. This enables the detailed capture and preservation of their local water management practices, ensuring that this knowledge is not lost and can be passed down to future generations.

Preparation/innovation to address the problem

In the first phase, in collaboration with the Centre for Karbi Studies, other local partners were identified, and their roles were defined. This was followed by assembling and training the project team, obtaining equipment, and conducting participatory mapping. The second phase included designing the digital map, processing media recordings, building the interactive map, validating data, stories, and permissions, and installing the open-source application in preparation for the launch.

The innovative aspect of the solution is the participatory mapping approach using open-source technology, resulting in a low-cost product that can be made available both online and offline.

Solution contributes to



PC: Keshav Timung

Result and impact

The primary beneficiaries were around 500 people from the Karbi community in Karbi Anglong and West Karbi Anglong Districts, who were directly involved in the mapping and documentation process. The secondary beneficiaries were the wider Karbi population, spread across various districts of Assam, totalling over 8 lakh people, who can access this map.

Anticipated results from implementing the solution include the participatory documentation of oral traditions using open-source technology, as well as the preservation and dissemination of Karbi traditional knowledge – not just within the Karbi community, but to the broader public.

Potential for scaling the project

The project has strong potential for scaling due to several key factors. First, the open-source nature of the technology and infrastructure makes it adaptable and easy to extend to other communities. The infrastructure requirements are minimal and can be expanded to handle larger data volumes as needed. Additionally, process standardisation will streamline the replication of mapping efforts, allowing for rapid and efficient implementation in new areas. Furthermore, there are comparable success stories of similar projects that have been successfully scaled by other indigenous communities worldwide, highlighting the viability of this approach on a larger scale.

Benefited

500

people

4

Automated ice reservoirs to combat water scarcity in mountain communities

Igoo, Ladakh, India

Suryanarayanan Balasubramanian

Acres of Ice

Problem statement

Irrigated agriculture is essential for the livelihood security of mountain communities, where water scarcity is a recurring challenge, particularly due to glacial retreat and seasonal snow-cover dynamics. Half of the world's glaciers could disappear by 2100.

Acres of Ice estimates that around 14 million people are affected in over 14,000 villages across 16 countries in the Hindu Kush Himalayas and the Andes Mountain ranges. In India alone, approximately 2,000 villages face water insecurity due to glacial retreat. These estimates are based on global population data for areas located above 3,500 meters in elevation within glacial regions. This is a strict criterion, meaning the actual number of affected people is likely much higher. For example, countries with glaciers but with population centres at lower altitudes, such as those in the Alps, are not included in this estimate. In total, 16 countries are severely impacted by accelerated glacial retreat. Bolivia appears to be the most affected, with over 32% of its population living above 3,500 metres, while a significant portion of Xizang's (China's Tibet Autonomous Region) population also resides near glaciers.

Therefore, we have to upscale our adaptation strategies to support billions of people, which are threatened by depleting water supplies. This is especially concerning in some cold-arid mountain regions like Ladakh, where more than half the irrigation water is supplied by glaciers. To prevent desertification of these mountain villages, improved glacial water management techniques are required. One of the most notable examples of community-based water management is the construction of ice stupas – artificial ice reservoirs. These structures, built by farmers in more than 50 mountain villages worldwide, store meltwater during the colder months and release it during critical periods of water scarcity, significantly enhancing water availability.

However, while ice reservoirs offer an effective solution, current construction methods are labour intensive and require significant maintenance, limiting their scalability.

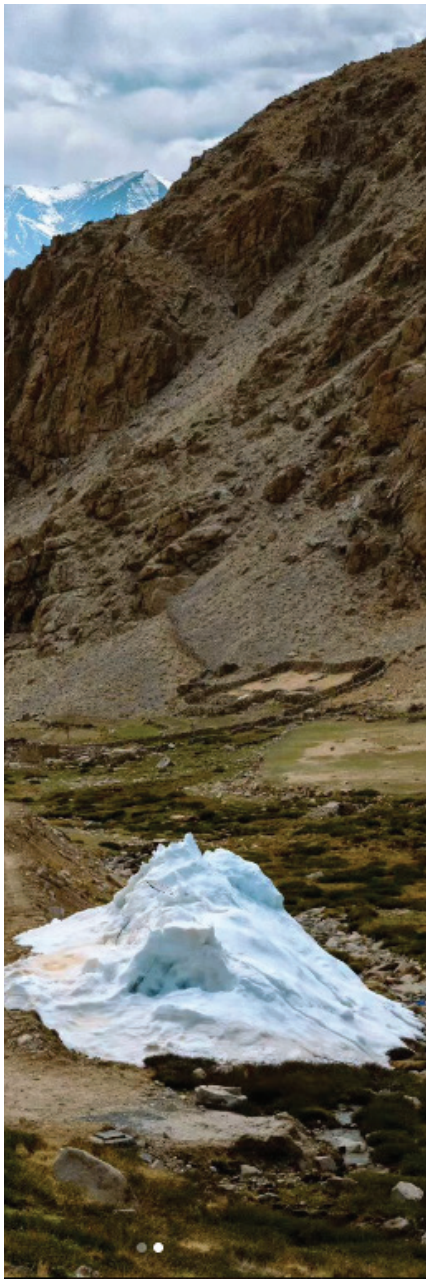
Solution/intervention

To tackle this challenge, Acres of Ice – a collective of farmers, engineers, and scientists dedicated to forging a resilient future – is pioneering an automated construction strategy. This innovative approach has the potential to boost irrigation water supply by up to ten times, all while eliminating the need for ongoing maintenance. This scalable solution has the potential to transform the use of ice reservoirs across regions such as the Hindu Kush Himalayas (HKH), Andes, and the Alps.

Ice reservoirs can play a crucial role in preventing drought-like conditions in specific catchments, but their widespread adoption has been hindered by the labour and resources required for construction and upkeep. With the introduction of automated technologies, Acres of Ice aims to dramatically reduce manpower needs while increasing water storage capacity by more than tenfold. These innovations could transform ice reservoirs into artificial glaciers of considerable size, with the potential to rival natural glaciers in terms of their ability to provide water over time. By siphoning meltwater from

Solution contributes to

glacial lakes in the Himalayas, artificial glaciers could be created at a scale that ensures a perpetual water supply for local communities. Over time, these small, man-made glaciers could accumulate and become a sustainable, perennial source of water for the surrounding catchment areas.



Preparation/innovation to address the problem

Acres of Ice plan to supply automation kits to build artificial glaciers in desertifying mountain villages. This kit will have their custom designed controller, valves and fountains along with a manual on how to decide the pipeline layout and water source. Users can then download the software from their website to activate the controller and build an ice reservoir by assembling all the components using their manual. If internet is available, the user can also observe and control this system via the web dashboard. Acres of Ice will also use these kits to defuse thousands of glacial lakes to build and maintain artificial glaciers.

Result and impact

Through the use of the automation technology during the past winter, Acres of Ice were able to revive the tradition of building ice reservoirs in Igoo. The automated ice reservoir (AIR) reduced monitoring visits from every other day to twice a month, avoided pipeline freezing events, and made fountain pipeline systems resilient and responsive to erratic weather events. It stored more than 4 million litres of water to use efficiency of more than 80% compared to just 20% for traditional ones which are typically 1 million litres in volume. Moreover, these structures grow throughout the year by finding ideal weather windows to operate the fountain spray. Thereby, this upgraded technology can yield a perennial ice reservoir that compounds in size every winter and compensates for the lost ecosystem services of natural glaciers. Therefore, Acres of Ice have kept the AIR operational across the spring and summer season to test whether it can preserve the ice reservoir until next winter starts.

Another crucial intervention was the establishment of a 3-member Water Management Committee (WMC) in the village. The WMC was funded by villagers and were trained by Acres of Ice. From mastering mechanised valves to effortlessly managing the system with a push of a button, they are now capable to operate the AIR for the next few years.

5

A community-managed and self-sustained water supply system for Lapse Kotdanda

Godawari Municipality, Lalitpur, Nepal

Santosh Dahal
Environment and Public Health Organization

Problem statement

In Nepal, approximately 40,000 water supply schemes of various types and scales, including rural, semi-urban, and urban systems, are in operation. These schemes rely on different management structures; rural and semi-urban systems are typically managed by water user and sanitation committees, while urban systems are overseen by utilities like the Nepal Water Supply Corporation (NWSC). However, significant challenges persist, as exemplified by the Lapse Kotdanda Water Supply System in Godawari Municipality, which serves around 722 people. The system's infrastructure, including the reservoir tank and transmission pipeline, deteriorated to the point of dysfunction, forcing the community to resort to unsafe water sources.

Water scarcity remains a critical issue in Nepal. According to a 2020 joint report by WHO and UNICEF, only 18% of the population has access to safely managed drinking water year-round. Despite efforts to achieve the Millennium Development Goals (MDGs), with access to non-piped water sources rising from 36% in 2000 to 44% in 2017, the proportion of people with safely managed water sources has decreased from 24% to 18% over the past two decades.

In the semi-urban areas of Godawari Municipality, the Lapse Kotdanda Water Supply System serves not only the local population of 722 residents but also 200 students. The challenges faced by this community are reflective of broader issues in the region like deteriorating infrastructure, poor water quality, and seasonal factors such as monsoon floods. These issues complicate water management for the water user committee, forcing the community to rely on unsafe alternatives and undermining efforts to ensure a sustainable water supply.

Solution/intervention

In response to these challenges, ENPHO (Environment and Public Health Organization), with support from Bremen Overseas Research and Development Association (BORDA) through the Integrated Urban Water Management (IUWM) project, initiated a community-led, self-sustained Water Supply System project in Godawari Municipality. This project aimed not only to restore the damaged infrastructure but also to empower the local community to take responsibility for the management and long-term sustainability of their water supply system. The specifics of the intervention were as follows:

Gravity-fed and eco-friendly
The system uses gravity, requiring no external energy, making it cost-effective and eco-friendly.

Community-led and self-reliant
A water user committee inclusive of women and marginalised groups handles system management, monitoring, revenue generation, and maintenance.

Solution contributes to

Climate and disaster resilient structures
Modernised infrastructure enhances climate resilience, protecting against disasters like landslides and floods.

Water quality and safety
The committee implements a water safety plan and conducts field tests to ensure water quality.

Trained human resources
Trained personnel manage the system, implement safety plans, perform maintenance, and monitor usage.

Controlling non-revenue water
Bulk metres are installed to control non-revenue water and minimise water loss in key distribution networks.

Regulatory mechanism
The committee enforces rules on usage, installs metres, maintains a tariff system, and ensures record-keeping.

Accountability and transparency
The committee ensures equitable water distribution and financial transparency through public audits.

Preparation/innovation to address the problem

The preparation of the Detailed Project Report (DPR) incorporated disaster-resilient components, capacity-building packages, and basic infrastructure for the Water Supply System. Construction responsibilities, outlined in the DPR, were shared among the project, municipality, and community, within budget constraints and funding from local and project resources. Disaster resilience components included site selection, intake structure protection with gabion walls, runoff diversion, gabion chain-link fencing for intrusion prevention, and pipeline excavation to guard against forest fires. Training sessions strengthened the user committee's capacity in operation, maintenance, and Water Safety Plans to ensure quality water distribution. A community-based office streamlined administrative tasks, while systematic tariffing and record-keeping enhanced transparency and financial sustainability. Through infrastructure support and training, the project aims to foster community ownership and responsibility, creating a self-sustaining water supply system for Lapse Kotdanda.

Result and impact

The intervention has transformed the community, providing round-the-clock access to drinking water for 722 residents, and freeing them from reliance on unsafe sources. This shift embodies SDG 11's ethos of inclusive, resilient cities. Community-led management fosters local pride and ownership, ensuring successful system operation. Contributing to SDG 13, the gravity-fed design withstands climate challenges, while stringent water quality standards are maintained. Regulatory measures curb water loss, fostering accountable development. This holistic approach enhances Lapse Kotdanda's well-being, aligning with SDG 6.1 for universal water access. Additionally, the implementation of a regulatory mechanism, controlling non-revenue water coupled with accountability and transparency measures, not only safeguards the system but also fosters responsible community development practices, creating a holistic and sustainable impact.

Potential for scaling the project

Decentralised, community-managed water supply schemes are in high demand among municipalities, with neighbouring regions also requesting DPR preparation. Plans are advancing to replicate this successful model in Changunarayan Municipality through the BORDA/ENPHO project. Nepal boasts approximately 40,000 similar projects overseen by water user committees. The water distribution system in rural areas mirrors that of Lapse Kotdada, underscoring considerable potential to replicate and scale this initiative across diverse rural and semi-urban areas in Nepal.

6

Transforming rain into resource: Community rainwater harvesting

Mahalaxmi Municipality, Bagmati Province, Nepal

Bivor Maharjan

Environment and Public Health Organization

Problem statement

Mahalaxmi Municipality which lies within the Kathmandu Valley, characterised by both urban and semi-urban clusters, is undergoing rapid urbanisation. Even though all households have their own water wells, insufficient water in them is forcing people to rely on other expensive sources of water, such as jar water and water trucks. This situation indicates the necessity of utilising sustainable methods for managing water in this municipality. Therefore, a household rainwater harvesting system can serve as an environmentally friendly way to minimise water scarcity since it captures rainwater discharge. There is, however, limited awareness, technical knowledge, and regulatory constraints on rainwater harvesting systems, resulting in unsustainable water supplies and increased water stress for this municipality.

Solution/intervention

The rainwater harvesting initiative in Mahalaxmi Municipality was designed to address water scarcity by capturing and utilising rainwater. A key focus of the project was the conservation of urban water sources, with rainwater harvesting seen as an effective solution to reduce water scarcity. Dug wells, with their high infiltration rates and recharge potential, were identified as ideal for enhancing groundwater levels. This approach is supported by evidence suggesting that increasing rainwater harvesting systems can significantly recharge groundwater through these wells (WaterAid, Nepal, 2011).

The project implemented rainwater harvesting systems in four households as a demonstration, with plans for scaling up across the municipality to alleviate water scarcity in urban areas. The programme included raising community awareness, training local plumbers, and advocating for broader adoption of these systems by local government. The demonstration has already reduced households' reliance on other water sources, providing a sustainable solution to water stress in the community.

Preparation/innovation to address the problem

When the solution was being implemented, some major steps were taken to address issues. Urban communities and local bodies were educated on the concept and benefits of rainwater harvesting through awareness campaigns. Local plumbers were trained in technical courses to increase the skilled human resources for rainwater harvesting systems, which would be a valuable addition to municipal resources. Households willingly contributed NPR 20,000 which showed a readiness to install and utilise rainwater harvesting as a possible model. Regular monitoring programmes monitored effectiveness, allowing adjustments to ensure long-term success. These efforts were made during the implementation to promote the widespread adoption of rainwater hasrvesting and minimise water stress in Mahalaxmi Municipality.

Solution contributes to

Result and impact

The rainwater harvesting programme in Mahalaxmi Municipality had a positive impact across several key areas. It significantly improved groundwater recharge in the dug wells of the four demonstration households, ensuring a reliable water supply. This enabled the households to thrive in rooftop farming, using water from the recharged wells, which enhanced local food security. Additionally, the programme reduced dependency on costly alternative water sources.

A trained local plumber also saw a surge in his rainwater harvesting business, expanding his work opportunities. Other notable outcomes included improved water supply for households and increased food production through rooftop farming. Overall, these results contributed to the sustainable development and enhanced resilience of Mahalaxmi Municipality.

Potential for scaling the project

There are several indicators that suggest the solution has potential for scaling. People have visited the demonstrated houses to see the efficiency of rainwater harvesting. A plumber has also scaled up his entrepreneurship by installing rainwater harvesting systems in other households besides plumbing work. The local government has recognised the cost-effectiveness of the solution. Therefore, with significant results, the solution can be replicated in similar urban areas where challenges of water scarcity need to be addressed. The demonstrated benefits of rainwater harvesting make it a viable option for municipalities seeking sustainable water management solutions.

- Improved groundwater recharge
- Ensured reliable water supply
- Reduced dependency on costly water sources

7

Shivani Singh
AG Horizon

Rejuvenating Lamphelpat Wetland for flood mitigation and sustainable water management

Imphal, Manipur, India

Problem statement

Lamphelpat Wetland, is located in the western part of Imphal, the capital city of Manipur, which is part of the IHR. Imphal city faces annual flooding during the heavy monsoon due to breaches in the embankments of the Nambul and Luwangli rivers. With Lamphelpat dried up and encroached upon, there is no space for water absorption or escape, causing runoff to flood the city. This flooding directly impacts the livelihoods of residents and the local economy. In the summer, the city also experiences a shortage of drinking water due to the lack of water reserves.

Upon rejuvenation, Lamphelpat has the potential to act as a natural reservoir during the monsoon season, storing excess water and releasing it during the dry months to the Nambul and Luwangli rivers.

Solution/intervention

The focus of the Lamphelpat Wetland Project was on increasing the water detention capacity and restoring the stormwater drainage system and natural channels/streams in the catchment area of Lamphelpat. This project incorporates collaborative efforts of various stakeholders such as government agencies, local communities, and consulting organisations. This rejuvenation project not only addresses the mitigation of flash floods in Imphal city, but it also reduces threats to biodiversity, local livelihoods, and natural heritage.

As a Transaction Advisory to the Water Resources Department, Government of Manipur, AG Horizon revived the Lamphelpat waterbody to alleviate urban flooding, providing a sustainable water source for Imphal City. The total cost of this project was INR 650 crores. The project is being supported by the New Development Bank (2021) through a loan of USD 70 million while further assistance has been requested from the Government of India.

Preparation/innovation to address the problem

Multiple initiatives were taken up during the lifecycle of this project, such as creating access to development funds and government schemes. The project followed the model of blended finance with funding coming from an MLFA loan and a central grant. Secondly, to enhance the natural drainage system around Lamphelpat, re-sectioning and dredging of the 4 major rivers in Manipur – Imphal, Nambul, Iril and Kongba – for which Lamphelpat acts as a catchment, was done. Thirdly, the project ensures the adoption of international best practices in water risk management by implementing Internet of Things (IoT) based water quality monitoring, a real-time SMART flood risk management system, and utilising command-and-control systems for rainfall monitoring.

Result and impact

The rejuvenation project yielded several positive outcomes:

Ecological: Improved water quality increased green cover, and the return of several native species. The wetland's natural flood control capacity was restored, reducing the risk of floods in surrounding areas.

Solution contributes to

Economic: Enhanced livelihoods for local communities through sustainable practices and eco-tourism, leading to increased income and job opportunities.

Social: Strengthened community bonds and increased participation in wetland management, fostering a sense of ownership and responsibility among residents.

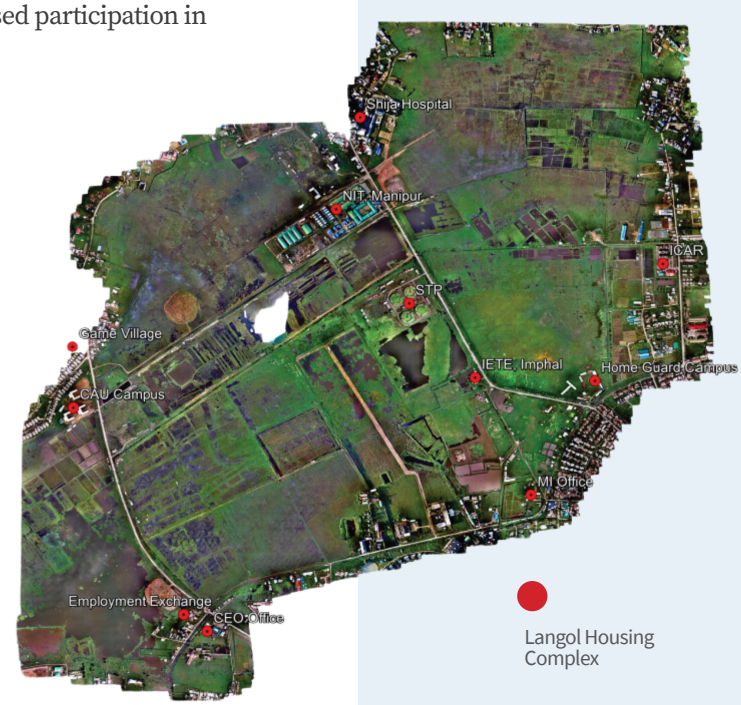
Educational: Greater awareness and understanding of environmental issues among the local population, particularly the youth.

Potential for scaling the project

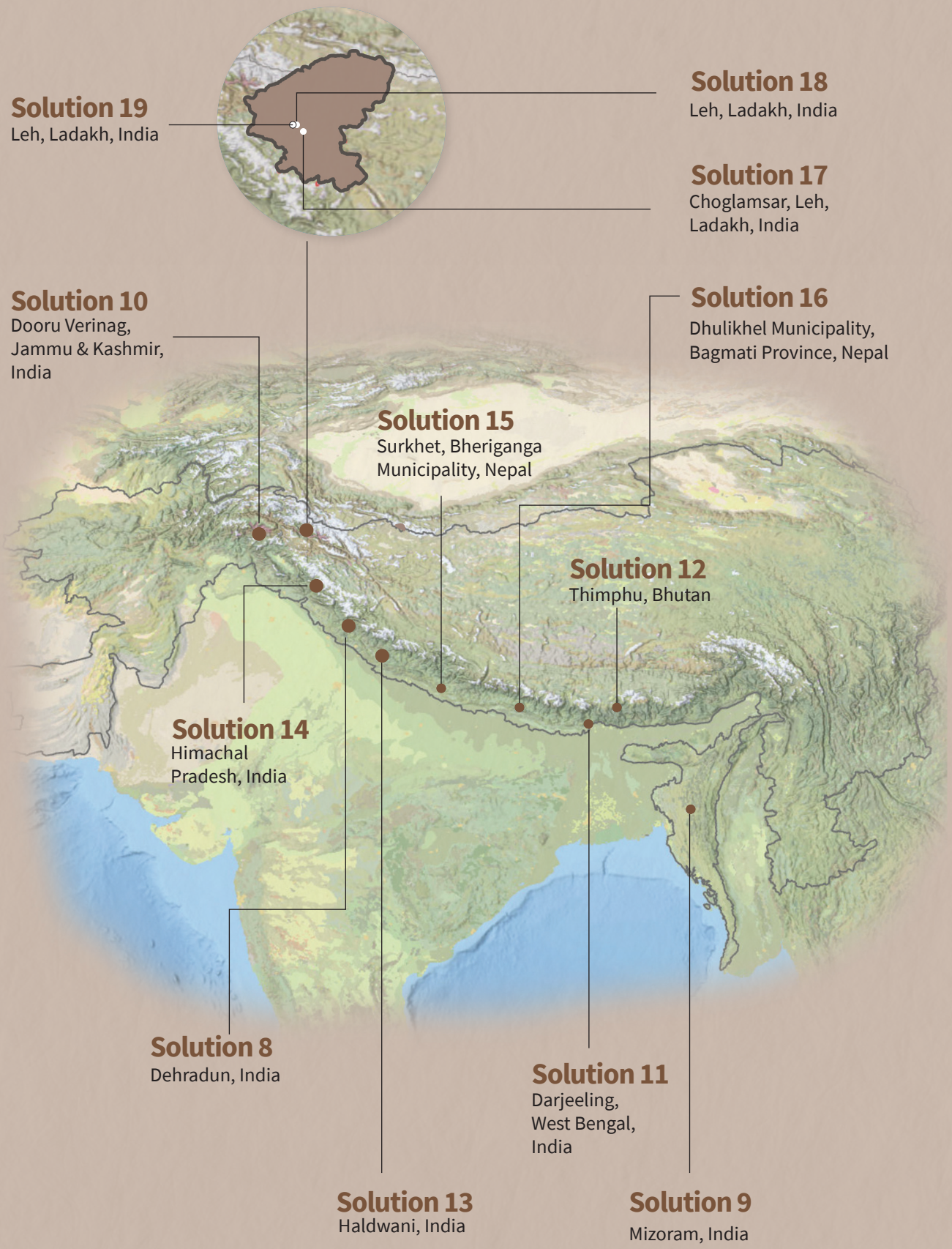
Depleting wetland are among the major climate change impacts affecting Manipur, contributing to increased flash flooding in both rural and urban areas. Additionally, during the summer months, water shortage become a significant challenge due to a poor natural drainage system and the drying up of water resources. Scaling up the wetland conservation initiative at the state level will play a key role in mitigating flooding.

The envisioned approach incorporates three key missions: (1) the rejuvenation and conservation of wetlands, (2) reducing emissions through nature-based solutions, and (3) reimagining socio-economic development in harmony with sustainability. These initiatives aim to transform Manipur into a more resilient state, better equipped to handle the impacts of climate change while fostering long-term environmental and economic sustainability.

Lamphelpat Waterbody



Waste management and sanitation


Solution 19
Leh, Ladakh, India
Solution 18
Leh, Ladakh, India
Solution 17
Choglamsar, Leh, Ladakh, India
Solution 10
Dooru Verinag, Jammu & Kashmir, India
Solution 16
Dhulikhel Municipality, Bagmati Province, Nepal
Solution 15
Surkhet, Bheriganga Municipality, Nepal
Solution 12
Thimphu, Bhutan
Solution 14
Himachal Pradesh, India
Solution 8
Dehradun, India
Solution 11
Darjeeling, West Bengal, India
Solution 13
Haldwani, India
Solution 9
Mizoram, India
Waste and sanitation solutions
Hindu Kush Himalaya
Solution 20
Key sites across the Indian Himalayan Region (IHR)

8

S.A. Abbasi

Centre for Pollution Control & Environmental Engineering Pondicherry University

Tabassum Abbasi

School of Advanced Engineering, University of Petroleum and Energy Studies

Solution contributes to

Introducing SHEFROL: An affordable and eco-friendly solution for efficient sewage treatment

Dehradun, India

Problem statement

Sewage, a byproduct of daily human activity, is the most consistently produced and widespread form of water pollution in the world. In economically developed countries, most sewage is treated before being discharged, helping to minimise its environmental impact. However, in developing countries like India, nearly 90% of sewage – amounting to an estimated 250 billion litres per day – is released untreated, causing significant damage to the receiving environment.

The root cause of this issue is not a lack of technology but rather resource constraints. In many regions, especially in developing countries, there is a shortage of funds to build sewage treatment plants or maintain them properly. This financial limitation is particularly pronounced in the Himalayan region, where resource constraints hinder effective sewage treatment, exacerbating environmental and public health problems.

Solution/intervention

To address this challenge, systems utilising the pollution-reducing abilities of aquatic macrophytes have been developed since the 1950s. While these systems are somewhat cheaper to install and maintain, they require two to four times more land area compared to conventional sewage treatment methods. However, in regions where land is scarce, such as the Himalayan region, this significant land requirement has become the primary barrier to implementing these systems effectively. The limited availability of land in these areas makes it increasingly difficult to adopt such approaches for sewage treatment.

The proposers have developed and patented a groundbreaking sewage treatment technology called SHEFROL (sheet flow root level), which is not only as effective as existing technologies but also significantly more affordable, eco-friendly, and application friendly. Developed at Pondicherry University, SHEFROL has undergone extensive testing, with several pilot plants successfully operated for multiple years. The technology has been implemented with success in treating all sewage generated by the village of Hariyawan, Uttar Pradesh, and a 1 MLD (Million Litres per Day) sewage stream in Mandidweep, Madhya Pradesh. It has also been validated in Dehradun, located at the foothills of the Himalayas. As a result, SHEFROL is now ready for deployment in the villages and towns of the Himalayan region to address sewage treatment needs. It has been shown on the basis of several studies carried out at pilot plant and full-scale that SHEFROL is more than five times cheaper yet more efficient, easy, and eco-friendly.

Preparation/innovation to address the problem

The innovation, which has been granted patent number 302282, consists of a reactor which maximises space use, minimises energy use, minimises material use, and creates operation conditions in which very efficient treatment of sewage occurs at a fast rate. Unlike other macrophyte-based sewage treatment systems, SHEFROL is not confined to aquatic or amphibious species but can also utilise terrestrials. This confers upon SHEFROL the flexibility and versatility not possible in any pre-existing technology.

Result and impact

When sewage is discharged untreated, which is happening with 90% of all sewage that is being generated in India, it adversely affects not only humans but also other terrestrial and aquatic life. It is the prime cause of very poor conditions of rivers, lakes, and ponds and is primarily responsible for several epidemics. Even though major towns and cities generally have centralised sewage treatment facilities, a sizeable fraction of their population is not covered. On the other hand, smaller towns and villages generally have no sewage treatment systems at all.

Hence, 90% of the human population and the entire environment stand to benefit if a very affordable yet effective technology like SHEFROL is implemented – in the Himalayas in particular, and India in general.

Potential for scaling the project

Several pilot plants and two full-scale plants based on this SHEFROL technology have been successfully operated since 2020 and earlier. A full-scale plant treating all the sewage of Hariyawan has been operating since 2021. And a 1 MLD sewage stream has been treated at Mandidweep. After validation in Dehradun, the technology is now ready for scaling up in the Himalayas.

90%

of the human population and the entire environment stand to benefit if a very affordable yet effective technology like SHEFROL is implemented.

9

Revolutionising sanitation in Mizoram: Innovative community-based solutions for sustainable toilet maintenance

Mizoram, India

Anisha Dey
Water Sanitation and Hygiene (WASH) Institute

Problem statement

The Swachh Bharat Mission has significantly improved toilet accessibility in India, yet challenges persist in maintaining public and community toilets. While individual toilets are well-maintained by households, public and community toilets face challenges in operation and maintenance. Mizoram presents a case where innovative solutions were needed to sustain sanitation infrastructure. While individual toilets are well-maintained, public facilities face operational hurdles. Mizoram's approach involves entrusting community toilets to the Water Sanitation (WATSAN) committee, reconstituted during local elections. Despite these efforts, sustaining cleanliness and hygiene in public toilets remains a concern. Hence, there was a need for further innovative strategies to ensure the long-term viability and effectiveness of sanitation infrastructure maintenance.

Solution/intervention

Mizoram has introduced innovative solutions to sustain its sanitation infrastructure. One such initiative involves entrusting the management of community toilets to the Water Sanitation (WATSAN) committees, which are reconstituted during local elections to ensure ongoing community involvement and accountability. In some villages, user fees are collected to help cover maintenance costs.

Another successful model integrates public toilets with local shops, where shopkeepers are responsible for maintaining the facilities in exchange for space. This mutually beneficial arrangement ensures the toilets are well-maintained while supporting local businesses. Additionally, strategically located Community Sanitary Complexes (CSCs) serve both locals and travellers, ensuring regular use and upkeep.

By creating incentives for maintenance, this approach not only benefits the community but also ensures clean, accessible sanitation for all. These efforts represent a unique combination of community engagement and business innovation, helping to create sustainable, self-sustaining sanitation solutions in Mizoram.

Preparation/innovation to address the problem

To tackle sanitation challenges, Mizoram has implemented innovative approaches. Water Sanitation (WATSAN) committees, made up of local residents, are responsible for managing community toilets, fostering ownership and sustainability. User fees are collected to cover maintenance costs. Additionally, integrating convenience stores with public toilets incentivises upkeep by encouraging shopkeepers to maintain the facilities in exchange for space. This dual approach ensures regular maintenance, improves the viability of sanitation infrastructure, and benefits both local communities and travellers.

Result and impact

The implementation of the CSCs model in Mizoram has resulted in improved sanitation accessibility and hygiene standards. By involving local committees and integrating shops with public toilets, the model fosters community

Solution contributes to

ownership and sustains upkeep. This has led to cleaner facilities and enhanced livelihoods for shopkeepers. Overall, the CSC model has positively impacted sanitation infrastructure, community engagement, and economic development in Mizoram.

Potential for scaling the project

The model of CSCs implemented in Mizoram holds great potential for scaling to other regions. By empowering local committees and integrating commercial ventures with public toilets, the model fosters community ownership and sustainability. Its adaptable nature allows for implementation in diverse contexts, addressing varied sanitation challenges across regions. Scaling this model could significantly improve sanitation accessibility, hygiene standards, and economic opportunities in communities nationwide. With proper adaptation and support, the CSC model has the capacity to have a transformative impact on sanitation infrastructure and community well-being on a larger scale.

The CSC model empowers local committees, integrates commercial ventures with public toilets, and fosters community ownership and sustainability.

10

Women-led sanitation to achieve 100% source segregation

Dooru Verinag, Jammu & Kashmir, India

Mandeep Kaur
Jammu & Kashmir Housing and Urban Development Department

Problem statement

Dooru Verinag Municipal Committee faced significant challenges in achieving 100% waste segregation at the source, despite undertaking multiple intensive awareness campaigns like '*Hara Geela, Sookha Neela*', '*Har Din Do Dustbin*', and '*Ab Aadat Badleinge Hum*'. The core issue was the lack of acceptance and responsibility among households, especially homemakers who primarily handle household waste, to segregate waste into dry and wet fractions. Despite the urban local body's efforts, the campaigns failed to bring about the desired behavioural change, and as of July 2023, during the Swachh Survekshan Field Assessment, only about 30% of waste was being segregated at the source.

This low level of source segregation posed a significant challenge for the effective management and scientific disposal of Municipal Solid Waste generated in the area. Without proper segregation at the source, the entire waste management process, including the operation of the Material Recovery Facility (MRF) and composting units, was hampered, leading to inefficiencies and potential environmental concerns.

Solution/intervention

The committee implemented a unique strategy by forming teams of female staff members to conduct door-to-door visits and engage directly with women in the households visited. Through personal interactions and visits to the Waste Management Facility (WMF), these teams effectively communicated the importance of waste segregation. This hands-on approach led to the remarkable achievement of 100% source segregation in 16 wards.

By recognising homemakers as key stakeholders, the Urban Local Body (ULB) took a targeted approach, involving women in the process through direct communication and practical demonstrations. Homemakers were shown how dry and wet waste are processed separately at the WMF, reinforcing the importance of segregating waste at the source. This initiative, combining personalised engagement with real-world examples, resulted in a significant behavioural shift and has now become a replicable model for other ULBs in Jammu and Kashmir.

Preparation/innovation to address the problem

The ULB's innovative solution was to target homemakers directly through a dedicated team of female staff members. This gender-specific approach recognised the crucial role of women in household waste management. By forming teams of female staff to conduct door-to-door visits and interpersonal communication with homemakers, the ULB could effectively convey the importance of segregating waste at the source. Additionally, facilitating visits to the WMF provided practical exposure, reinforcing the necessity of segregation. This tailored intervention, combining personalised interactions and hands-on experiences, proved to be an effective strategy in bringing about the desired behavioural change.

Result and impact

Solution contributes to

The targeted intervention yielded remarkable results, transforming Dooru Verinag into a model for effective waste management. Through door-to-door engagement with homemakers and practical demonstrations, the ULB successfully achieved 100% source segregation of waste in 16 out of 17 wards. This significant achievement not only streamlined the operation of the WMF but also paved the way for scientific disposal and resource recovery. The remaining ward is expected to achieve 100% segregation by June 2024. The success of this initiative has turned it into a replicable model, with other ULBs adopting similar practices to promote sustainable waste management.

Potential for scaling the project

The success of this targeted intervention in achieving 100% source segregation of waste holds immense potential for scaling and replication. The key innovation of engaging directly with homemakers through dedicated teams of female staff members can be adopted by other ULBs facing similar challenges.

The door-to-door approach, combined with practical demonstrations at waste management facilities, has proven effective in promoting behavioural change and sustainable waste management practices. As the project has already been replicated in all 40 ULBs in the region, it can be further scaled up to ULBs across the state or even nationwide, contributing significantly to the goal of sustainable cities and communities.

Dooru Verinag successfully achieved

100% source segregation

of waste in 16 out of 17 wards

11

Zero Waste Andolan: A community effort to make Darjeeling's hills zero-waste

Darjeeling, West Bengal, India

Upasna Chopra
Tieedi Permaculture Foundation

Problem statement

The Eastern Himalayas are uniquely placed, geologically, socially and politically. Darjeeling is located within a vulnerable and highly disaster-prone region at the southern tip of the Himalayan arc. This Himalayan belt is also particularly vulnerable to climate change; since the beginning of the 20th century, Darjeeling's average temperature has increased by 4°C, which is twice the world's average.

A significant problem faced by the region is waste mismanagement. Waste dumping and burning have become common practices among households, shops, and institutions, polluting water, soil, and air. This challenge arises from multiple factors: a lack of awareness and willingness to segregate waste at its source perpetuates cycles of endless consumption and waste; non-existent last-mile infrastructure for waste collection and processing puts continuous pressure on already overburdened landfills, rivers and forests; unchecked tourism and the unsustainable practices associated with it are leaving a significant carbon footprint; and the unregulated waste sector leads to severe health risks and human rights violations for waste pickers.

These problems are compounding, creating further challenges in health, sanitation, pollution, and economical constraints. Additionally, rising unemployment is driving migration, leaving local youth increasingly uninspired and apathetic towards their future.

Solution/intervention

To tackle these growing challenges, Tieedi - an environmental conservation organization based in Darjeeling, practicing permaculture - launched the Zero-Waste Andolan in 2016, initially focusing on solutions for regenerative tourism. Through the Zero-Waste Andolan, a grassroots movement, they aimed to address the waste mismanagement crisis in the Eastern Himalayas by engaging communities, advocating for policy changes, and promoting extended producer responsibility. Over time, they expanded the approach to include a comprehensive set of initiatives, such as decentralised waste management, experiential environmental education, zero-waste events, and natural farming and agro produce. In 2021, Tieedi was formally registered to strengthen their commitment to fighting climate change and addressing the unique challenges faced by Himalayan hill communities. Through this integrated approach, Tieedi aims to create a zero-waste Darjeeling and a more sustainable future for the region.

Preparation/innovation to address the problem

Under each initiative in the Zero-Waste Andolan, a framework is developed with a few core components held constant. Community Ownership is fostered by mobilising local youth and villagers to actively participate in solutions through livelihood and volunteer opportunities, as well as community collectives. A focus on behaviour and mindset shift aims to create long-term change in attitudes and actions across various stakeholders. The initiatives are grounded in a bottom-up approach, with grassroots community solutions that start locally and strive to influence higher levels, meeting halfway between community-led and policy-driven efforts. Regenerative climate action is prioritised, not only to establish circular local economies but also to ensure a positive contribution back to nature.

Solution contributes to

Awareness is raised among all stakeholders and within public spaces. Experiential learning is encouraged to make environmental awareness an everyday habit. Waste collection and segregation are promoted at the source to decentralise waste management. Conscious consumption is encouraged to support local and zero-waste products. Waste processing is carried out scientifically to achieve zero waste to landfill. Product development focuses on creating innovative upcycled products while also supporting local artisans.

Result and impact

The Zero-Waste Andolan has established a decentralised waste management process that actively engages the community through home and community composting, supported by behaviour change initiatives. To date, the initiative has diverted 551 tonnes of waste from landfills and incineration, and manages over 2.5 tonnes of waste monthly. Waste is collected, segregated, and processed in 40 distinct categories at the MRF before being sent to appropriate recycling and disposal channels.

The programme has demonstrated success through zero-waste initiatives, such as converting a 1.5-acre dumping ground into a thriving permaculture forest garden, now a model for sustainable land management practices and Tieedi's current base of operations. It has empowered three villages, three schools, two monasteries, two restaurants, and over 100 households to achieve zero-waste status, showcasing its replicability across varied contexts. The West Bengal government has endorsed the zero-waste initiatives for their effectiveness in promoting zero-waste practices across Gram Panchayats (village clusters) in the region.

Active community mobilisation is another cornerstone of the Zero-Waste Andolan, achieved through grassroots efforts that have helped build an active movement. Over 150 zero-waste events, including marathons and clean-up drives, have been held, and more than 100 practitioners, farmers, and 500 children have been trained through the Everyday Environmentalism curriculum and permaculture courses.

The initiative has diverted

551 tonnes

of waste from landfills and incineration

The initiative has created sustainable livelihood opportunities by providing dignified employment within the community. Six full-time "waste crusaders" have been hired, incentivised income is offered through a cash-for-waste programme, and additional income has been generated for artisans and farmers by adding value to local products. Farmers have also received training in natural farming practices.

Recognised for its innovative approach, the Zero-Waste Andolan has received prestigious awards, including the Sabera Awards (2021, 2022, 2023) in the Environment & Consumption category. The project was featured in National Geographic's 'Himalayas to Sea, Plastic Free' documentary, which won the "Best Non-Fiction" award at the Redwood Film Festival in California. Additionally, the initiative received the "Thinkers of Tomorrow" Award (2023) from the Symphony & News18 Network for excellence in sustainability, inclusion, and employee care.

12

Rikesh Gurung

The Green Road

Solution contributes to

The Green Road: When the road is green, the city is clean

Thimphu, Bhutan and Nepal

Problem statement

Plastic pollution is a global crisis, especially in South Asia. The Green Road project addresses the escalating problem of plastic pollution, inefficient waste management, and poor road infrastructure in Bhutan. Contextual challenges include limited recycling facilities, increasing landfill waste, and costly road maintenance. By establishing a plastic recycling and eco-friendly road construction model, the project aims to reduce plastic waste, conserve resources, and create durable roads. This initiative also seeks to enhance community engagement through awareness programmes on the role of consumers at individual and national levels, generate employment, and promote sustainable practices, directly tackling environmental degradation and socio-economic issues.

Solution/intervention

The project has focused on three interconnected themes simultaneously: achieving circularity, reducing environmental impact, and lowering emissions. Hence, the solution has involved implementing a circular economy model that focuses on waste plastic collection, recycling, and utilisation in road construction. Partnering with local communities and schools, the project set up two plastic shredding machines to process waste plastics. These shredded plastics are then used to build durable and eco-friendly roads, reducing landfill waste and infrastructure costs. The shredded plastics are also used to produce flowerpots and 3D filaments. Community awareness and training programmes have been conducted to ensure active participation, while creating job opportunities and promoting sustainable waste management practices.

To date, the Green Road initiative has successfully blacktopped 157 kilometres of roads in Bhutan, replacing 780 tonnes of imported bitumen from India. Some 830 tonnes of plastic has replaced the equivalent amount of bitumen worth 626,265 USD. Each ton of bitumen is worth 674 USD. The overall objective is to implement a holistic waste management approach that actively involves stakeholders from various sectors, including school children and local businesses, through awareness programmes and advocacy. Recognising the need for an integrated plan, the company aims to achieve resilient waste management by engaging citizens and fostering strong community ties. Through these efforts, The Green Road aims to promote sustainable practices and drive innovation in the waste sector.

Preparation/innovation to address the problem

The project tackles plastic pollution and infrastructure issues through a series of strategic steps. The project conducts awareness campaigns and training programmes in schools and communities to encourage waste segregation and collection to streamline waste management efforts. The plan is to set up two additional plastic shredding machines to process collected waste plastics, and to use the shredded plastics in road construction and product development, reducing landfill waste and enhancing road durability. The project has implemented participatory monitoring to assess progress and ensure sustainability, while generating local employment and promoting sustainable practices.

Result and impact

The project has positively impacted local communities, schools, businesses, and government agencies in Bhutan. It has engaged two districts in waste collection and recycling, trained over 100 individuals in sustainable practices, and created new job opportunities. The construction of 157 kilometres of eco-friendly roads has reduced plastic waste by 830 tonnes, lowered road maintenance costs, and extended road lifespan by five years. Awareness programmes have reached 70 schools and four colleges in Thimphu, fostering environmental stewardship and community involvement in waste management.

The project offers numerous key benefits, significantly contributing to environmental sustainability and social development. It effectively reduces plastic waste, helping to prevent environmental pollution and microplastic contamination. By promoting sustainable waste management, resource reuse, and the upcycling of waste, it raises environmental awareness among communities. The initiative also empowers women by creating opportunities for their active participation in planning, implementation, and skills development, thereby advancing gender equality.

Through the use of eco-bricks made from plastic waste, the project supports a circular economy by encouraging resource efficiency and reducing reliance on energy-intensive raw materials. It helps to minimise microplastic pollution in freshwater and marine ecosystems, contributing to cleaner water and reduced environmental harm. Furthermore, the incorporation of eco-friendly materials in construction reduces greenhouse gas emissions and decreases dependency on carbon-intensive raw materials, particularly in road construction.

Additionally, by collaborating with government, civil society, the private sector, and educational institutions, the project advances Bhutan's sustainable development goals.

Potential for scaling the project

There is promising evidence for scaling the solution. The project has been successfully expanded to Paro district after receiving approval for advocacy programmes in schools and towns. Additionally, a 5-year Memorandum of Understanding (MoU) was signed with Paro district authorities to repair roads using waste plastic collected from the district. This expansion demonstrates the feasibility and acceptance of the model, highlighting its potential for replication in other regions. The community engagement, proven reduction in waste, and durable, cost-effective road construction provides a strong foundation for further scaling and broader environmental and socio-economic impact. The Department of Surface Transport under the Ministry of Infrastructure and Transportation is publishing the use of waste plastic in the Bhutan Standard Rate.

The construction of

157 kilometres

of eco-friendly roads has reduced plastic waste by

830 tonnes

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From waste collection to community empowerment: The Beni Sena project

Haldwani, Uttarakhand, India

Vishal Mishra
Nagar Nigam Haldwani

Problem statement

Nagar Nigam Haldwani has engaged private partners to provide door-to-door waste collection services in 33 out of 60 wards, while the remaining 27 wards are serviced by Nagar Nigam sanitary staff. Collection of solid waste management (SWM) user charges follows a similar pattern across these wards.

However, the annual revenue generated from SWM user charges has proven insufficient when compared to the volume of waste generated and the number of households covered by waste collection services. This shortfall has posed a significant challenge for Nagar Nigam officials, becoming a pressing concern for the Municipal Corporation.

With urban expansion and population growth amplifying the demand for waste collection and disposal services, there is a pressing call for innovative strategies in revenue generation and cost management. Effectively tackling this challenge necessitates concerted efforts among municipal authorities, private partners, and community stakeholders to ensure the enduring viability and efficacy of SWM initiatives in Haldwani City.

Solution/intervention

The Municipal Corporation, recognising the efficacy of community involvement, enlisted 60 self-help groups (SHG) known as Baini Sena to collect SWM user charges through door-to-door visits in Haldwani City in October 2022. The 60 SHGs consist of 10 members each. They underwent comprehensive sensitisation sessions facilitated by the Municipal Corporation. They were registered and provided with ID cards and registers by the corporation. Additionally, the citizens were proactively informed by the corporation about the transition to SHGs for collection of user charges within their respective wards. Nagar Nigam assigned a dedicated consultant or staff member to lead the SHGs. This individual works directly with the SHGs on behalf of Nagar Nigam. Within the span of one year, these groups have spearheaded a sweeping change in the collection of user charges in Haldwani City, embedding a framework characterised by efficiency, transparency, and accountability, extending seamlessly across an impressive 57 out of the total 60 wards. They have covered approximately 80-85% of households for user charges collection.

The Municipal Corporation swiftly expanded their collaboration with SHGs, extending their involvement to include the establishment of grievance redressal systems via WhatsApp group helplines, further enhancing community engagement and service efficiency.

Preparation/innovation to address the problem

Out of 60 wards, 57 wards were covered for SWM user charges collection. Each SHG, comprising 10 members, adopted a rotational approach, with five members collecting charges in one month and the remaining five in the subsequent month. User charges receipt books, provided by the Municipal Corporation, were given to the SHGs. Between the 1st and 5th of every month, the SHGs visit the Nagar Nigam Account section to report their collections, presenting both cash and receipts. Furthermore, for online transactions,

Solution contributes to

SHGs are equipped with QR codes, enabling seamless transfers of funds directly to the Corporation's account. The SHG's workers were incentivised with individually receiving 25% of their total collection amount on a monthly basis. Observing favourable outcomes, Nagar Nigam opted to also engage SHGs in the grievance redressal mechanism via WhatsApp groups for door-to-door collection in SWM, though this is still in the initial stages.

Result and impact

Before the involvement of SHGs, the annual collection of user charges amounted to approximately nine lakh Rupees. Since their involvement, this figure has tripled to around 32 lakh per year. The integration of SHGs has also enhanced the efficiency of the grievance redressal mechanism, particularly through the establishment of cluster and ward-specific WhatsApp groups, though this initiative is still in its initial phase. Notably, there has been a significant reduction in waste dumping practices within the city limits, especially in residential areas, a change that hasn't gone unnoticed by the city's residents. The revenue generated from user charges is dedicated to enhancing sanitation practices within the city and sustaining the operation and maintenance of the current system. Moreover, the Municipal Corporation has initiated the compilation of a database for households in each ward for user charge collection. This database will be helpful to the Corporation for other significant tasks such as property tax collection. Finally, the Baini Sena has only female members, showcasing the state government's commitment to empowering women through their employment.

Potential for scaling the project

The capacity of SHGs to engage with households is impressive. SHGs have established a significant presence and representation in SWM services in Haldwani City. The household coverage for user charge collection stands at 80-85%, indicating a strong potential to achieve full coverage. This notable achievement serves as a clear indication that similar strategies can be replicated in other cities. Rudrapur and Kashipur cities have already initiated efforts in this direction within their respective wards.

Self-Help Group (SHG) workers receive

25%

incentive

of their total collection amount on a monthly basis.

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Project Clean Himalayas: Sustainable waste management and river preservation in Himachal Pradesh

Himachal Pradesh, India

Divya Negi
Healing Himalayas Foundation

Problem statement

Mountain regions face significant challenges in sustainable waste management due to factors such as remoteness, difficult topography, scattered settlements, sensitive ecosystems, and inadequate infrastructure. While tourism has become a key economic driver, it also exacerbates waste management problems. In Himachal Pradesh, for instance, tourism grew by 14.2% from 2011 to 2019, reaching 1.51 crore visitors by 2022. However, waste processing facilities are still concentrated in urban areas, leaving remote districts without proper waste management. This has led to the widespread creation of open dumpsites near water bodies that are vital sources of drinking water for millions and home to diverse flora and fauna. These unmanaged waste sites result in contamination, disease, and environmental degradation. In response, the Clean Himalayas mission was launched in 2016 to preserve the Himalayas through sustainable waste management practices. Over the past eight years, more than 1,000 clean-up drives involving over 4,000 volunteers have collected more than 800,000 kg of non-biodegradable waste. However, increasing waste volume and improper disposal continue to threaten the region's ecology, climate, and water supply.

Solution/intervention

The Clean Himalayas initiative seeks to address major gaps in solid waste management (SWM) in remote areas, where as much as 80% of waste is either dumped in rivers or left in open dumpsites, contributing to the spread of diseases. Additionally, the practice of burning toxic waste near glaciers is polluting the land, water, and air, creating serious health risks for both humans and wildlife.

To tackle these challenges, the project's goals were raising awareness about SWM, promoting education on proper waste disposal practices, and advocating for the 5Rs (refuse, reduce, reuse, recycle, rethink). Clean Himalayas also focuses on community engagement by building Material Recovery Facilities (MRFs) in remote villages and collaborating with local populations to establish sustainable waste management systems. The aim is to reduce the environmental impact of waste, safeguard the region's fragile ecosystems, and improve the health and well-being of mountain communities.

Preparation/innovation to address the problem

Healing Himalayas' initiative addresses waste management in the Himalayan region with a decentralised collection system and centralised recycling in remote, high-tourist districts. Acknowledging the ecological and cultural significance of the Himalayas, the organisation establishes MRFs in remote Himachal Pradesh. These facilities sort and process recyclables, promoting green jobs, ecosystem restoration, and sustainable waste management. Regular cleaning drives further encourage environmental stewardship. This comprehensive approach tackles tourism-related environmental issues and preserves natural resources for downstream populations. By integrating community involvement and sustainable practices, Healing Himalayas aims to create a replicable model for waste management and ecological conservation in fragile mountainous regions.

Solution contributes to

Result and impact

Healing Himalayas' initiative has improved waste management in the Himalayan region by establishing MRFs and conducting regular cleaning drives. This has restored ecosystems, promoted green livelihoods by creating jobs in waste management, and raised environmental awareness among locals and tourists. The initiative also protects water bodies from pollution, ensuring clean water for millions downstream. Beneficiaries include local communities, who gain economic opportunities and a cleaner environment, as well as tourists, who enjoy a pristine destination. Overall, it fosters ecological conservation and sustainable development, addressing environmental concerns and challenges posed by increased tourism.

Potential for scaling the project

Healing Himalayas' project demonstrates significant potential for scaling due to its innovative and replicable waste management model. The successful establishment of MRFs and effective community engagement in Himachal Pradesh can serve as a blueprint for other remote tourist regions facing similar challenges. Evidence of scaling includes the expansion of cleaning drives and facilities across multiple districts. The project's integration of local communities and sustainable practices makes it adaptable to different geographic and cultural contexts, offering a sustainable solution for waste management and environmental conservation that can be implemented globally.

Over the past eight years,

more than

1,000

clean-up drives involving

4,000+

volunteers have collected

800,000+

kgs of non-biodegradable waste

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From contamination crisis to clean water triumph: Innovative approach to water quality monitoring and management

Surkhet, Bheriganga Municipality, Nepal

Prashanna Man Pradhan

Environment and Public Health Organization (ENPHO)

Problem statement

Nepal has made notable advancements in water and sanitation in recent years, improving access to facilities and enhancing public health. However, ensuring year-round water quality remains challenging. Preventive measures are in place, but sustained quality is hindered by weak monitoring and inadequate community awareness. Nepal faces significant water quality issues exacerbated by rapid urban growth and unplanned expansion. Contamination of water sources is widespread, with 71% of all water sources and 91% of those used by the poorest quintile polluted with Escherichia coli (E. coli) bacteria. This contamination results in frequent water-borne diseases and monsoon epidemics, posing severe public health challenges. Despite recent advancements in water and sanitation, significant disparities persist, particularly at the ecological division level. Addressing these issues quickly, affordably, and accurately is crucial to improving public health and ensuring equitable access to safe water across Nepal.

Solution/intervention

To address water, sanitation, and hygiene (WASH) issues, the WASH Programme was launched in Bheriganga Municipality, located in the Surkhet district of Karnali Province in western Nepal. Surkhet is one of ten districts in the Karnali region, situated approximately 600 km west of Kathmandu. Karnali is considered one of the least developed areas in Nepal.

During the baseline survey, it was found that the Chhinchu Water Users and Sanitation Committee (WUSC) in Bheriganga Municipality was supplying non-chlorinated water to 980 households. In response to this, the WASH SDG Programme launched water quality awareness campaigns in 2018, targeting child clubs, volunteers, and community members. Over the following four years (2018-2022), a variety of public awareness initiatives focused on the importance of water quality, with programmes like Child-Centered Risk Mapping (CCRM) and Community Led Risk Mapping (CLRM) designed to empower students and community members to assess and improve local water sources.

These efforts, combined with household water treatment options, resulted in a significant reduction in E. coli contamination. This success prompted the municipality to take action, leading to the approval of the Water Management Procedure 2079, which formalised the municipality's commitment to improving water quality and sanitation practices in the region.

Preparation/innovation to address the problem

The Water Quality Monitoring Committee achieved a milestone by developing comprehensive guidelines for monitoring water quality, approved by the municipal legislative committee. The Environment and Public Health Organization (ENPHO) facilitated regular meetings with the committee to enhance these guidelines, ensuring transparency and shared understanding. Trained volunteers raised awareness through door-to-door campaigns. Plumbing technicians and volunteers promptly addressed water leakage issues, ensuring the safety of the Ramghat water supply. The Water Quality Monitoring Committee, including key municipal figures, implemented the

Solution contributes to

monitoring framework. Third-party verification by the Provincial Water Quality Surveillance Committee confirmed that treated and chlorinated water was safe to drink.

Result and impact

This collaborative effort has significantly improved water quality monitoring and established a safe water supply, enhancing community health and well-being. A specialised committee for monitoring water quality was established to ensure sustainability and safe water supply, playing a crucial role in executing water management procedures based on detailed guidelines. Consequently, approximately 140 households in Ramghat, Bheriganga Municipality-11, got access to safe drinking water. The Chhinchu water supply system also began distributing chlorinated water to consumers.

Potential for scaling the project

The project has a strong potential for scaling up due to its proven approach and effectiveness. By establishing water quality monitoring committees and implementing water management guidelines, the model can be replicated in other municipalities. Expanding volunteer training and WUSCs, and chlorination and awareness campaigns can broaden access to safe water. Collaboration with local governments and community organisations will further strengthen monitoring and maintenance. Scaling up this initiative could improve water quality and public health across Nepal, particularly in underserved areas, by leveraging community engagement and sustainable practices.

140+
households received access to safe drinking water

Water quality monitoring committee established

Water management guidelines developed

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Shreekhandapur co-treatment plant: Innovative wastewater and faecal sludge management

Dhulikhel Municipality, Bagmati Province, Nepal

Buddha Bajracharya

Environment and Public Health Organization (ENPHO)

Problem statement

The Shreekhandapur Wastewater Treatment Plant (WWTP), established in 2007 in Dhulikhel Municipality, is one of Nepal's first wastewater treatment facilities. As urbanisation increased, so did the number of households with onsite sanitation facilities, leading to higher faecal sludge generation. However, this sludge was often indiscriminately dumped in landfills, causing significant environmental and public health hazards.

A 2019 Environment and Public Health Organization (ENPHO) survey found that 14.6% of Dhulikhel's households relied on offsite sanitation. Without a faecal sludge treatment plant (FSTP), 202 m^3/year of sludge from onsite systems was dumped in temporary landfills, posing further environmental and health risks. Manual emptying of septic tanks was common, raising concerns about occupational health and safety. Meanwhile, the management of the Shreekhandapur WWTP was ineffective, highlighting the need for improved sanitation solutions. The construction of an FSTP was further delayed by the municipality's inability to allocate land and a lack of knowledge on how to address the issue. The absence of municipal policies and regulations to manage urban sanitation exacerbated the situation in Dhulikhel Municipality.

Solution/intervention

The municipality's sanitation status underscored the urgent need for faecal sludge management (FSM) interventions and the upgrade of the WWTP. Recognising the need to treat both faecal sludge and wastewater, Dhulikhel Municipality, with support from ENPHO and the Municipal Association of Nepal (MuAN), upgraded the Shreekhandapur WWTP into a co-treatment facility. The upgraded facility can now treat 50 m^3/day of wastewater and 3 m^3/day of faecal sludge, while generating 150 m^3 of biogas.

Additionally, the municipality adopted municipal-level FSM policies and regulations to ensure safe sanitation management. Training and orientation programmes for sanitation workers and municipal staff have reduced manual emptying practices and increased access to municipal desludging vehicles. These municipal initiatives and investments in wastewater and faecal sludge

Preparation/innovation to address the problem

A series of discussions engaging multi-stakeholders led towards innovative sanitation solutions. The upgradation of the WWTP to a co-treatment plant focused on complete resource recovery by generating biogas, compost, and treated water. The municipality allocated the required budget, and ENPHO provided technical support. Furthermore, the endorsement of a municipal-level FSM policy was an exemplary step taken with support of MuAN, providing a guidance for safely managed sanitation. The combined efforts finally succeeded in addressing the issue of managing wastewater and faecal sludge in scattered hill settlements and allowed for reusing treated wastewater and manure on farmlands.

Solution contributes to

Result and impact

The treatment plant is the first co-treatment facility in Nepal. It treats mechanically emptied faecal sludge from Dhulikhel Municipality and neighbouring municipalities (Banepa, Panauti) along with wastewater from the households in hilly areas of Shreekhandapur. The biogas generated by the treatment plants is connected to several households, and manure is used as fertilizer/soil conditioner, while treated wastewater is being reused by farmers for irrigation. The treatment plant has been a learning hub for municipalities, students, and professional from around Nepal and beyond, and is contributing towards a sustainable environment and enhanced public health.

Potential for scaling the project

As the first co-treatment plant in a hilly region, this facility serves as a model that can be replicated in other hilly and Himalayan cities. The co-treatment approach is particularly applicable to municipalities where both onsite and offsite sanitation systems are in use. The municipal-level policy and regulations have played a crucial role in guiding sanitation efforts and can be adopted by other municipalities lacking such frameworks. Additionally, the leadership demonstrated by the Mayor of Dhulikhel Municipality offers valuable lessons for other local governments, helping to foster greater community ownership and participation in safely managed sanitation initiatives.

Biogas generated by treatment plants **connected to several households**

Manure used as **fertilizer/soil conditioner**

Treated wastewater reused **for irrigation**

Treatment plant serves **as a learning hub**

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Decentralised wastewater treatment system for sustainable water reuse

Choglamsar, Leh, Ladakh, India

Stanzin Odsal
Ladakh Ecological Development Group

Problem statement

The District Police Lines in Choglamsar generated wastewater that required efficient processing. Traditional methods were inadequate, leading to the need for a robust treatment system to handle and reuse wastewater sustainably.

Solution/intervention

The project implemented a Decentralised Wastewater Treatment System (DEWATS) to treat wastewater efficiently. It involved the design and implementation of a 30 KLD DEWATS at the District Police Lines in Choglamsar, Leh. The treated wastewater will be reused for irrigation in a 2000 sq m children's park. The initiative aimed to provide a sustainable, all-weather solution for wastewater treatment, ensuring the safe reuse or disposal of treated water in an environmentally responsible manner. By incorporating this system, the project has not only addressed wastewater management but also supported the greening of public spaces with treated water. The system includes primary, secondary, and advanced secondary treatment modules, ensuring treated water is safe for reuse in gardening and other non-potable purposes.

Preparation/innovation to address the problem

The project involved conceptualising a DEWATS system, preparing a detailed project report (DPR), and conducting continuous monitoring and supervision. Stakeholder consultations ensured alignment with local needs, and an innovative design catered to the climatic conditions of Leh.

Result and impact

The DEWATS system has successfully treated wastewater, making it safe for reuse in landscaping within the District Police Lines. This has led to improved water management, contributing to environmental sustainability and better hygiene conditions.

Potential for scaling the project

The successful implementation and operation of the DEWATS in Choglamsar demonstrate its scalability. Similar systems can be implemented in other urban areas facing wastewater management challenges, offering sustainable solutions for water reuse and sanitation.

Solution contributes to

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Legacy waste remediation and land reclamation in Leh

Leh, Ladakh, India

Asma Yousuf
Ladakh Ecological Development Group

Problem statement

The Bombgarh waste site in Leh has been a dumping ground for over 20 years, accumulating mixed waste without segregation, leading to severe environmental degradation, air and water pollution, and health risks for nearby residents. The lack of proper waste management practices exacerbates these issues, posing threats to the pristine environment and local community health. The Legacy Waste Remediation and Land Reclamation at Bombgarh project aimed to remediate the legacy waste through biomining, reclaim the land for productive use, and implement sustainable waste management practices to prevent future waste accumulation, thereby improving environmental quality and public health.

Solution/intervention

The Legacy Waste Remediation and Land Reclamation project aims to restore a 20-year-old waste site through sustainable waste management practices. Spanning 114,906 sq m, the site had accumulated mixed waste over the years without proper segregation or treatment, leading to significant environmental degradation.

The project involved a comprehensive waste analysis, stakeholder consultations, and the preparation of a Detailed Project Report (DPR) for the implementation of biomining. Key activities included waste quantification, issuing a Request for Proposals, and installing the necessary biomining equipment. The project employed biomining technology to segregate and process waste, which not only remediates the site but also promotes long-term environmental sustainability. Additionally, it incorporates decentralised composting and recycling practices to prevent future waste accumulation. This initiative is a model for integrating sustainable waste management, improving public health, and restoring degraded land for future generations.

By September 2023, the remediation process cleared 70,000-100,000 metric tonnes of waste and successfully reclaimed 82,000 sq m of land. This effort has significantly improved the local environmental quality, reduced health risks, and enhanced the usability of the land for future development. However, the project faced several challenges, including high service delivery costs, the need for in-situ RDF (Refuse-Derived Fuels) treatment, and delays due to the harsh climate conditions of the region.

Key learnings from the project underscore the need for specialised policies tailored to mountainous regions, as well as a more thorough project scoping process. The initiative has directly and indirectly benefited around 40,000 residents and has made significant contributions to the long-term sustainable waste management of Leh town.

Preparation/innovation to address the problem

The project commenced with stakeholder consultations and detailed site assessments to ensure comprehensive planning. The Ladakh Ecological Development Group (LEDeG) conducted waste quantification and physical characterisation, forming the basis for a robust DPR. Biomining technology was selected for efficient waste segregation and processing. The approach included floating RFPs, hiring expert consultants, and installing necessary

Solution contributes to

machinery. The project also integrated sustainable practices like decentralised composting and recycling to prevent future waste issues. Continuous monitoring, documentation, and community engagement ensured transparency, compliance, and successful implementation, transforming the degraded site into a rehabilitated and usable land area.

Result and impact

Through meticulous implementation of biomining technology and sustainable waste management practices, LEDeG revitalized Bombgarh, Leh, clearing 70,000-100,000 tonnes of legacy waste. This initiative directly benefited over 13,000 residents living within a 5km radius, reducing health risks and restoring environmental quality. By reclaiming 82,000 sq m of land, LEDeG not only mitigated pollution but also set a precedent for sustainable urban development in challenging terrains. The project's success underscores its role in fostering community health, environmental resilience, and advancing towards a cleaner, more sustainable future for Leh.

Potential for scaling the project

The project at Bombgarh, Leh exhibits significant potential for scaling despite challenges such as harsh winter conditions and high transportation costs in remote mountainous areas. The successful implementation of biomining technology, which cleared 70,000-100,000 tonnes of legacy waste, underscores its adaptability to challenging environments. Stakeholder engagement and community involvement have bolstered local support, essential for scaling initiatives in similar contexts. Addressing logistical challenges like extreme temperatures and elevated operational costs demonstrates resilience and readiness to replicate the project's success in mitigating environmental hazards and improving sanitation across regions facing comparable geographical and economic constraints.

Managed
70,000-100,000
tonnes of legacy waste

Directly benefited
13,000+
residents

Reclaimed
82,000 m²
of land

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Promoting health and dignity: WASH facility for sanitation workers in Leh

Leh, Ladakh, India

Asma Yousuf
Ladakh Ecological Development Group

Problem statement

Sanitation workers in Leh, Ladakh, face dire living conditions without proper access to basic amenities like safe drinking water and sanitation facilities. Often neglected, these workers endure health hazards exacerbated by extreme cold weather and inadequate housing. Despite their essential role in public health, they lack formal employment benefits and suffer from low pay and social stigma. The WASH facility project addresses these challenges by providing a dignified working environment, promoting health and safety, and setting a precedent for inclusive urban development in the region.

Solution/intervention

The WASH facility project in Leh, Ladakh, aims to improve sanitation workers' living and working conditions through a robust all-weather facility. The project aims to improve the working conditions and quality of life for sanitation workers in Leh, Ladakh, by constructing a comprehensive Water, Sanitation, and Hygiene (WASH) facility. Led by the Ladakh Ecological Development Group (LEDeG) in collaboration with Bremen Overseas Research and Development Association (BORDA), the facility will provide essential amenities, including improved toilets, solar-heated bathing facilities, laundry services, and clean drinking water.

The initiative addresses critical challenges faced by sanitation workers, such as inadequate living conditions and heightened health risks due to extreme weather conditions in the region. It aims not only to enhance the well-being of sanitation workers but also to serve as a model for sustainable urban development and inclusive public services. By prioritising the needs of workers and promoting health and dignity, the project is an important step towards creating equitable and resilient communities in Ladakh. The initiative includes gender-specific toilets, bathing facilities with solar-heated water, and amenities like washing machines and a water dispenser with RO system. Designed to withstand harsh winters, the facility also integrates measures like insulation and solar water heaters. By enhancing access to essential services and promoting dignity, the project mitigates health risks, enhances job satisfaction, and serves as a model for sustainable urban development in cold climate regions.

Preparation/innovation to address the problem

The project included safety and hygiene training sessions for sanitation workers, ensuring they understand and practice essential protocols. Consultations with workers gathered insights into their specific needs, informing the facility's design and features. Engaging Leh's Municipal Committee was crucial in garnering support and resources, highlighting the importance of dignified working conditions for sanitation workers through public awareness campaigns. Innovative design elements like heat-retaining structures and solar-powered amenities were incorporated to withstand harsh winters, ensuring year-round usability and sustainability of the facility. This holistic approach aimed to improve worker morale, health outcomes, and overall community appreciation for their vital contributions.

Solution contributes to

Result and impact

The WASH facility at MCL *Safai Karamchari* quarters in Leh benefitted 114 sanitation workers. It improved their working conditions significantly, providing safe sanitation, clean drinking water, and hygienic amenities. The facility's completion enhanced worker morale and job satisfaction, leading to increased efficiency in municipal services. By addressing health hazards and promoting dignity, the project positively impacted the workers' overall well-being. The collaboration between LEDeG, BORDA, and the Municipal Committee Leh ensured sustainable operation and maintenance of the facility, setting a precedent for similar initiatives in other regions facing similar challenges.

Potential for scaling the project

Scaling the WASH facility project is feasible due to successful precedents in other regions like Chikkaballapur and ongoing efforts at MRF Leh. These initiatives demonstrate adaptability across diverse contexts, validating the model's transferability. By addressing critical needs of sanitation workers universally – improving health, dignity, and efficiency – the project sets a scalable precedent. Lessons learned and stakeholder buy-in enhance replication potential, ensuring sustainable impact beyond Leh. Moreover, strategic partnerships with municipalities and development agencies bolster scalability, fostering broad adoption of comprehensive sanitation interventions in similar socio-economic settings.

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The Himalayan Cleanup: Mountain people's movement against plastic pollution

Indian Himalayan Region (IHR)

Priyadarshinee Shrestha

Zero Waste Himalaya/ Integrated Mountain Initiative

Solution contributes to

Problem statement

The waste crisis is evident in every part of the Himalayas, a result of changing production and consumption systems. Waste profiles and volumes have increased drastically, and this has overwhelmed existing waste management systems. Rapid urbanisation and tourism growth further exacerbate the problem. Waste, especially plastic, accumulates in the mountain landscapes with no mechanisms to remove or manage it. This greatly threatens fragile Himalayan landscapes, biodiversity and people. Limited awareness and ineffective policies specifically for the mountains further hinder efforts to manage waste in these fragile areas.

Solution/intervention

The Himalayan Cleanup, launched in 2018 under the theme Reflect, Switch, Demand, is a movement aimed at addressing the waste crisis in the Himalayan region. The initiative focuses on cleaning key socio-ecological sites across the Indian Himalayan Region (IHR) and conducting comprehensive waste and brand audits. These audits provide crucial data for developing evidence-based waste management strategies and advocating for systemic changes. Over its six years of operation, the movement has mobilised a network of Zero Waste Stewards across the mountain states, promoting low waste footprint lifestyles.

Through this initiative, community institutions have successfully implemented waste reduction measures, particularly targeting plastic waste, and have adopted source-based waste management practices. These actions not only help in reducing plastic pollution but also mitigate climate change by lowering methane emissions and reducing plastic waste. The movement also advocates for extended producer responsibility, calling on manufacturers to take greater accountability for the waste they generate.

The Himalayan Cleanup works on multiple levels: at the individual level, it encourages behavioural change towards a zero-waste lifestyle; at the community and institutional level, it promotes systemic changes for better waste management; and at the macro level, it advocates for policy and production-level changes, urging plastic producers to be more responsible. To date, over 50,000 volunteers have participated in the movement, reflecting a growing awareness and collective action against waste.

By cleaning up and auditing waste, the initiative helps participants reflect on their waste footprint and encourages a shift to low-waste lifestyles. The localised waste audits further inform region-specific solutions, making waste management more effective and context-appropriate. As a collective, the Himalayan Cleanup stands as the largest grassroots movement in the region, calling for producer responsibility and pushing for systemic changes to tackle the waste crisis in the mountains.

Preparation/innovation to address the problem

The Himalayan Cleanup uses collective cleanup events as a tool to understand the challenges of waste management at multiple levels. It leverages on the spirit of volunteerism, enabling connection and bonding. It challenges the narrative of blaming citizens alone for waste problems by putting emphasis

on producers' responsibility. The entire campaign is carried out through online medium making effective use of social media spaces, from volunteer registration to orientation on the waste and brand audit processes. The data collection is uniform and is app based. Collaborations are facilitated with state governments for larger outreach.

Result and impact

Over the past 6 years, 50,000+ volunteers have been part of The Himalayan Cleanup movement, and have pledged to switch to sustainable lifestyles. Over 1000 schools have participated with many of them adopting plastic free practices, limiting junk food consumption for students, etc. Local bodies and organisations have strengthened single use plastic bans and developed local solutions to reduce their waste and go plastic free.

Mountain Legislators were brought together for three rounds of discussions to build solidarity for demanding policy changes in Extended Producer Responsibility (EPR) implementation in the mountains based on The Himalayan Cleanup findings. Brand audit data contributed to global data identifying top polluters.

Potential for scaling the project

The Himalayan Cleanup has naturally scaled up over the last six years. In 2024, the SBM Grameen, Sikkim made it their campaign and the Education Department, Sikkim, took it upon themselves to implement it in their schools. The initiative can be taken up across the Indian Himalayan Region. Panchayats, traditional bodies, faith-based organisations and educational institutions have used the data from The Himalayan Cleanup initiative to move towards sustainability and insights should be scaled across the IHR.

Over the past 6 years

50,000+

volunteers have been part of The Himalayan Cleanup movement

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International Centre for Integrated Mountain Development
GPO Box 3226, Kathmandu, Nepal
T +977 1 5275222
E info@icimod.org | www.icimod.org

National Institute of Urban Affairs

National Institute of Urban Affairs
1st Floor, Core 4B, India Habitat Centre,
Lodhi Road, New Delhi - 110003, INDIA
Phone: (+91 11) 24634971, 24643576
Email: niua@niua.org Website: www.niua.in