Good Practice Options for Sustainable Solid Waste Management in Mountain Areas of India, Nepal, and Pakistan

WORLD BANK GROUP

Korea Green Growth Trust Fund

Publications in this Study

India: Sustainable Solid Waste Management in Mountain Areas

Nepal: Sustainable Solid Waste Management in Mountain Areas

Pakistan: Sustainable Solid Waste Management in Mountain Areas

Technical Guidance Report: Sustainable Solid Waste Management in Mountain Areas of India, Nepal, and Pakistan

Good Practice Options for Sustainable Solid Waste Management in Mountain Areas of India, Nepal, and Pakistan

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January, 2021

Supporting the Development of Sustainable Solid Waste Management Strategies for the Mountainous Regions of India, Nepal and Pakistan

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Foreword

Waste management has become a major challenge all over the world, particularly in low- and middle-income countries. In this context, governments and communities are increasingly recognizing that, outside of large cities, waste management is also clearly a fast-growing critical issue in environmentally-fragile areas. Mountains—a prime example of environmentally-fragile areas—face competing challenges of high poverty as well as, in specific locations, increasing impacts from tourism-related development. Geographical remoteness, limited access to civic infrastructure, lack of capacity, and topographical and temperature variations due to altitude differences complicate waste management. These mountain features make the provision of actions and services to address growing volumes of unmanaged waste even more challenging in mountain areas of India, Nepal, and Pakistan.

The impacts of growing volumes and evolving composition of unmanaged waste in mountain areas are increasing rapidly. Uncollected solid waste contributes to flooding, open burning leads to air pollution and causes respiratory ailments, and haphazardly dumped waste creates eyesores that may eventually have a negative impact on tourism. Poor waste management practices also affect areas downstream. Litter, in particular plastic, is carried in streams and rivers from mountains to the plains, and eventually to the oceans.

Addressing these challenges come with tremendous opportunities. Cleaner areas help provide a more attractive environment for tourism. Waste, if treated as a potential resource, can create jobs and new business opportunities for local entrepreneurs, in addition to being used as an energy source and fertilizer substitute. Adopting a landscape approach in management practices in mountain areas can increase coordination, awareness, and lead to behavior change around waste generation and segregation.

This study represents a first attempt to examine solid waste management in unique and ecologically-sensitive mountain areas. For this, I want to congratulate and thank the World Bank team behind this endeavor, especially the Country Management Units (CMUs) who led the team, as well as the clients and the stakeholders who contributed towards this study. The *Korea* Green Growth Trust Fund (KGGTF) deserves a special mention here.

The report is tailored to the South Asia Region—in particular India, Nepal, and Pakistan—and offers examples of successful implementation and coordination of SWM plans that have led to a positive change in SWM practice. It offers examples that could be implemented, scaled-up, or adapted to mountain areas in these three countries, not only in the Himalayan region but elsewhere as well. These practices may also be applicable to mountain areas in other countries.

We hope this report will contribute to furthering dialogue that can lead to much-needed action, including improving analytics and tools, engaging with stakeholders, and contributing to policy and institutional development to support local development.

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Abbreviations

3 Rs	Reduce, reuse, recycle
ALF	Area-level federation
ASA	Advisory Services and Analytics
BBMP	Bruhat Bengaluru Mahanagara Palike (Municipal Corporation of Bengaluru)
C&D	Construction and demolition
CCP	City Corporation of Panaji (India)
CKNP	Central Karakoram National Park (Pakistan)
cu. m.	Cubic meter
DMC	Dehradun Municipal Corporation (India)
DNPWC	Department of National Park and Wildlife Conservation, Ministry of Forests and Environment (Nepal)
ENB	Environment, Natural Resources, and Blue Economy
ENCORE	Enhancing Coastal Ocean Resource Efficiency
ECOSS	Eco-tourism and Conservation Society of Sikkim (India)
ELV	End-of-life vehicles
EPR	Extended producer responsibility
ESIC	Employees' State Insurance Corporation, Ministry of Labour (India)
FIFA	Fédération Internationale de Football Association
FMPL	Forum Masyarakat Peduli Lingkungan (Indonesia)
GDP	Gross domestic product
GET	Gili Eco Trust (Indonesia)
GIS	Geographic information system
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (German Corporation for International Cooperation)
GPS	Global positioning system
GSDP	Gross state domestic product
HDPE	High-density polyethylene
IAS	Indian administrative service

IHR	Indian Himalayan Region
ISWM	Integrated solid waste management
KCC	Khanchendzonga Conservation Committee
kg	kilograms
KGGTF	Korea Green Growth Trust Fund
KKAWF	Karim Khan Afridi Welfare Foundation (Pakistan)
KU	Kathmandu University (Nepal)
kW	Kilo watt
MCI	Metropolitan Corporation Islamabad (Pakistan)
MoE	Ministry of Environment (Maldives)
MRF	Materials recovery facility
MSW	Municipal solid waste
NGO	Non-governmental organization
NIMBY	Not in my backyard
NMA	Nepal Mountaineering Association
PA	Protected area
PET	Polyethylene terephthalate
PHSMC	Panchgani Hill Station Municipal Council
PLEASE	Plastic Free Rivers and Seas for South Asia
RFID	Radio frequency identification
SADC	Southern African Development Community
SAMCLF	Swachh Ambikapur Mission City Level Federation
SAR	South Asia Region
SAWI	South Asia Water Initiative
SDG	Sustainable development goal
SEDEMA	La Secretaría del Medio Ambiente (Mexican City Ministry of Environment)
SERNANP	National Service of Natural Protected Areas (Peru)
SHG	Self-help group
SNP	Sagarmatha National Park (Nepal)
SNPBZ	Sagarmatha National Park and Buffer Zone (Nepal)

SPCC	Sagarmatha Pollution Control Committee
sq. km.	Square kilometer
SWM	Solid waste management
SWMTSC	Solid Waste Management Technical Support Center
STFP	Sustainable Tourism Foundation Pakistan
TAT	Thailand Authority of Tourism
TPD	Tonnes per day
TUF	Tourism user fees
UIAA	International Climbing and Mountaineering Federation
UN-HABITAT	United Nations Human Settlements Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
UNWTO	United Nations World Tourism Organization
WEEE	Electrical and electronic waste
WTE	Waste-to-energy
WWF	World Wildlife Fund

Currency Units & Exchanges Rates

Currency Units	Exchange Rates (Effective as of December 27, 2020)	
Bhutanese Ngultrum (Nu)	$1 = Nu 73.59	Nu 1 = $0.01
Georgian Lari (GEL)	$1 = GEL 3.27	GEL 1 = $0.31
Indian Rupee (Rs)	$1 = Rs 73.59	Rs 1 = $0.01
Indonesian Rupiah (Rp)	$1 = Rp 14,106.85	Rp 1 = $0.00007
Japanese Yen (¥)	$1 = ¥103.30	¥1 = $0.01
Korean Won (₩)	$1 = ₩1,100.10	₩1 = $0.0009
Maldivian Rufiyaa (Rf)	$1 = Rf 15.40	Rf 1 = $0.06
Nepalese Rupee (Nr)	$1 = Nr 118.29	Nr 1 = $0.008
Pakistan Rupee (PRs)	$1 = PRs 160.31	PRs 1 = $0.006
Thai Baht (B)	$1 = B30.01	B1 = $0.03
All dollar amounts are US dollars unless otherwise indicated.		

1. Introduction

Solid waste management (SWM) is a vital responsibility of municipal governments worldwide and is one of the biggest challenges faced by urban authorities. Waste generation is increasing at a rapid pace, exceeding the financial and technical capacities of local governments to collect, treat, and dispose of this waste. Additionally, solid waste also has significant negative externalities on human health and the environment, which are seldom factored into the true cost of SWM.

In the South Asia Region, India, Nepal, and Pakistan share one common geographic characteristic—the high peaks of the Himalayan mountain range. This unique mountain ecology presents an opportunity for these economies to leverage this natural asset for economic growth. But mountain ecosystems are fragile and must be well maintained to maintain their ecological integrity and environmental sustainability. Continued urbanization, a rapidly increasing population, and a steady influx of tourists in the South Asian Himalayan region are straining these fragile ecosystems and are a significant cause of indiscriminate solid waste practices, including inadequate waste collection, open dumping, and the burning of waste.

Nevertheless, there are several good practices along the SWM chain that are being implemented in this region—and elsewhere—that are worth showcasing.[1] The aim of this report is to showcase SWM practices (1) currently underway in India, Nepal, and Pakistan that could be scaled-up and adopted across mountain communities, and (2) operational in other countries or in other sectors that could be applied to this region. In this way, mountain communities can learn of, and be inspired to adopt, innovations that can greatly improve service delivery and resource efficiency.

1.1 Background

The World Bank, along with generous support from the World Bank Group's Korea Green Growth Trust Fund (KGGTF), initiated a study on solid waste in mountain areas in India, Nepal, and Pakistan. This study represents the first attempt of the World Bank to examine SWM issues in these unique, ecologically-fragile areas that face concurrent challenges of high poverty and increasing pressures from tourism development.

The study—*Supporting the Development of Sustainable Solid Waste Management Strategies for the Mountainous Regions of India, Nepal and Pakistan*—was aimed at the following objectives:

1. Analyze the current situation regarding SWM in the mountainous regions of India, Nepal, and Pakistan; and
2. Provide data regarding region-specific models and technical recommendations that can be used by the World Bank in sectoral dialogues with country representatives to promote sustainable SWM to reduce negative impacts from the lack of collection, lack of treatment, and improper disposal methods in the mountainous regions of these three countries.

A field study was undertaken due to the lack of quantitative data available in mountainous regions of all three countries. It was informed by two main components: waste sampling and a qualitative survey. Waste sampling

1 The various steps involved in the management of solid waste—starting from generation to storage, collection, transport, transfer, treatment (including recycling), and finally disposal—are collectively referred to as the SWM chain.

was carried out primarily at households, commercial establishments, and hotels in order to understand waste generation and composition in mountain areas. Moreover, given the importance of awareness in sustainable behavior to improve the overall SWM scenario, qualitative surveys were conducted among residents and foreign and domestic visitors. The field study's waste sampling data and the qualitative survey analysis form the basis for three country-specific reports.

The target areas for this project were Himachal Pradesh state in India, Khyber Pakhtunkhwa province in Pakistan, and the Annapurna Conservation Area in Nepal. Field studies were conducted between May and September 2019. Details of the field studies in the three countries are provided in Figure 1.1.

Figure 1.1: Field study overview in India, Nepal, and Pakistan

	India	Nepal	Pakistan
State/province/area	Himachal Pradesh	Annapurna Conservation Area	Khyber Pakhtunkhwa
Districts	Kullu and Kangra districts	Kaski	Abbottabad and Swat districts
Locations	Kullu, Manali, Dharamshala, McLeod Ganj, and Triund	Ghandruk, Chhomrong, Kimche, and Syauli	Abbottabad city, Nathia Gali, and Mingora
Time frame (2019)	June	May and September	July
Individual samples	85	388	75

1.2 Publications in this Study

Five reports make up the set of publications for this study, which together serve to inform positive change in the SWM sector in mountain areas in the South Asia Region. This document—*Good Practice Options for Sustainable Solid Waste Management in Mountain Areas of India, Nepal, and Pakistan*—offers examples of successful implementation and coordination of SWM plans that have led to a positive change in SWM practice in India, Nepal, and Pakistan, and other countries, including the Republic of Korea, Mexico, and Georgia. It includes examples of successful SWM policies and practices that have led to positive improvements in the SWM sector. It thereby offers examples that could be implemented, scaled-up, or adapted to mountain areas in these three countries, not only in the Himalayan region but elsewhere as well. These practices may also be applicable to mountain areas in other countries.

The three country-specific reports on India, Nepal, and Pakistan provide overviews of the municipal solid waste management scenario in each country. Furthermore, the reports investigate the impacts and challenges of mountain waste, including a detailed analysis of the data collected from the field study undertaken for this project. The reports present recommendations and specific actions—tailored to mountain areas—to improve SWM systems and practices. In conclusion, suggestions for further World Bank and donor engagement are provided.

The *Technical Guidance Report: Sustainable Solid Waste Management in Mountain Areas of India, Nepal, and Pakistan* summarizes the key findings and current understanding of mountain waste in the three countries. It provides an overview of the unique issues faced in the Himalayan region through a comparative analysis of solid waste management issues faced by each country. Based on the field study conducted for this project, as well as on experience and observations, recommendations are presented as a framework of overarching approaches with specific, implementable actions not only to improve current SWM practices, but also to mitigate the negative impact of solid waste in mountainous regions. The actions are presented in a phased manner, considering that implementation of a mountain waste plan or policy may progress according to different time frames in different countries. The report concludes with suggested areas of World Bank and donor engagement to promote sustainable SWM in mountainous regions.

1.3 Structure of this Report

Chapter 2 provides an overview and synthesis of the good practice options presented in this report. There are countless examples of SWM practices in the South Asia Region and beyond that could have been included. This report is not meant to be a comprehensive list of good practice SWM options by any means, but a selection of examples to give the reader a sense of the various solutions that are possible in the pursuit of improving SWM in mountain areas.

The good practices are presented as individual chapters from Chapters 3 to 22.

2. Linking Good Practice Options for Mountain Waste Management

Solid waste management (SWM) is a complex undertaking. It requires intense coordination amongst various stakeholders, constant collaboration through partnerships, sustained behavioral and mindset change, and financial resources to bring all the pieces together.

No one size fits all, and while SWM is a challenge faced around the world, both in developing as well as developed countries, it requires customized local solutions. SWM can be properly managed only with a clear understanding of how much and what types of waste are generated, how much funding is available, how policies and regulations either hamper or benefit operations, what institutional frameworks exists, what the infrastructure requirements are, as well as how waste trends are likely to change in the future given the long lifespans of waste infrastructure. All of this must be coupled with a deep understanding of how local culture, individual behavior, regulatory enforcement, topography, climate, and socio-economic conditions affect the sector.

To achieve sustainable growth, the World Bank's Environment, Natural Resources, and Blue Economy (ENB) Global Practice is working regionally to meet the goals of a clean, green, and healthy environment. Projects and studies in the South Asia Region (SAR) related to this Advisory Services and Analytics (ASA) activity on mountain waste are summarized in Box 2.1.

With this understanding, the idea behind the good practice options presented in the following chapters is to present snapshots of how solid waste is managed at various locations in various countries. What works in one place may not work in another. Nevertheless, this report shares waste management practices around the world that have been implemented and that have worked, despite facing numerous challenges. Figure 2.1 summarizes the various topics, and the numbers in parentheses provide the chapter number for ease of reference. Table 2.1 classifies each good practice option according to its relevance along the SWM chain, for integrated solid waste management (ISWM), and by type of mountain settlement.

These good practices have been chosen either because they have been implemented in mountain areas or are relevant to and can be adapted to mountain areas. Various practices from the three countries in this project—India, Nepal, and Pakistan—are presented, as well as from other locations around the world. Map 2.1 shows the locations of the various good practices presented in this report.

Figure 2.1: Good practice options profiled in this report

(Numbers in parentheses refer to chapter numbers in this report)

SWM policies	Citywide SWM initiatives	Initiatives along the SWM Chain	Protected mountain regions
• National legislation and policies on SWM - Republic of Korea (3) • Eco-tourism policy - Sikkim, India (4) • Tourism user fees - Examples from Bhutan, Indonesia, the Maldives, and Thailand (5) • SWM in small island developing state - Maldives (6) • Zero Waste Policies - Kamikatsu, Japan and Bogota, Colombia (7)	• Ambikapur, India (8) • Panchgani, India (9) • Panaji, India (10) • NGO initiatives - Waste Warriors, India (11) • Dehradun, India (12) • Bani Gala, Pakistan (13)	• Segregation - Mexico City, Mexico (14) • Composting - Nepal (15) • Transport and transfer - Bengaluru, India and Mestia, Georgia (16 and 17) • Disposal - Nanjido, Republic of Korea (18)	• Central Karakoram National Park, Pakistan (19) • Sagarmatha National Park, Nepal (20) • Mount Everest, Nepal (21) • Machu Picchu, Peru (22)

The first example focuses on national-level policies and legislation on SWM. In the 1980s, the Republic of Korea had a nascent SWM sector. Within a relatively short period of time, it transformed the SWM sector, making the country a leader in urban planning, green growth, and circular economy. **Republic of Korea: Policy and Legislative Responses to Solid Waste Management** (Chapter 3) shows how political will and determination can bring about lasting and substantial benefits.

Shifting focus from national-level waste policies in Korea to a state-wide policy on eco-tourism, Chapter 4 on **Sikkim, India: Policy for Sustainable Tourism** focuses on how a small state government in India balanced the need for and benefits from tourism with environmental protection and waste management. While governance and political will are key aspects, it is important to note that without enforcement and monitoring, the best initiatives are doomed to fail. Moreover, without enforcement, policies remain ineffectual. This example also highlights the role that citizens can play in implementing regulations.

Numerous cities and countries, as well as protected areas such as national parks, have instituted tourism user fees (TUFs) or taxes to manage the costs of tourism. For while tourism can be a boon to many under-developed areas, it also poses a strain on infrastructure, waste management, and other services. **Responsibility and Sustainability through Tourism User Fees** (Chapter 5) shows the link between tourism and SWM, and provides examples of how developing countries (Bhutan, Indonesia, the Maldives, and Thailand) are using tourism fees to preserve the environment and provide SWM services.

Maldives: Towards Sustainable Waste Management in a Small Island Developing State (Chapter 6) is an example of how an archipelago is working to overcome SWM challenges similar to those faced by mountain areas: remote communities, increasing waste generation (particularly plastics) from tourists, vast distances

to transport waste, lack of nearby facilities for recycling or treatment, and lack of space for disposal, not to mention the impacts of climate change.

Kamikatsu, Japan and Bogota, Colombia: Zero Waste Policies (Chapter 7) shows two examples of cities that focused on reducing future generation of waste. In Japan, the primary motivation was to reduce pollution and costs from incinerating waste, while in Bogota, Colombia it was to incorporate the informal sector to gain social and financial advantages, as well as to advance SWM goals such as increasing recycling and diverting waste from disposal.

The next few examples focus on how positive change was brought about by government officials who championed SWM and made it a priority for their respective areas as well as by local NGOs. Here, source segregation and door-to-door collection were seen as the key first steps to achieving sustainable SWM. **Ambikapur, India: A Participatory Approach to Managing Solid Waste** (Chapter 8) is an excellent example of this and highlights how important political will is in bringing about sustained change. Ambikapur went from being poorly ranked in cleanliness ratings in 2014 to number 1 in its category in 2020.

The example of **Panchgani, India: From *Kachra* Point to *Swachh Bharat* Point** (Chapter 9) shows how the town worked with the private sector to achieve many of its objectives. In contrast, **Panaji, India: Solid Waste Management Requires Sustained Efforts** (Chapter 10) shows that even ambitious and forward-thinking waste plans require constant support and buy-in from city officials to succeed. These systems cannot run on their own steam even once they are up and running. Continued policy support needs to be provided by decision makers if initiatives are to remain successful and viable.

Himachal Pradesh, India: Waste Warriors - Transformation through Replicable Models of Solid Waste Management (Chapter 11) provides another look at how the NGO is working to bring about change in India's mountain areas. Various initiatives are described. In Chapter 12, **Dehradun, India: Improving Waste Management One Step at a Time,** the work of Waste Warriors and its successes in Dehradun and the surrounding mountain areas is looked at in detail.

In Bani Gala, Pakistan, a local NGO is working diligently to raise awareness and build community involvement without outside funding. Operational costs are managed through user fees. The success of this project will result in **Bani Gala, Pakistan: A Community-driven Model towards Zero Waste** (Chapter 13) being adopted across numerous communities in Pakistan.

Focusing on segregating recyclable waste at home, **Mexico City, Mexico: Bartering Recyclables for Food** (Chapter 14) provides an innovative example of how recyclable waste is exchanged for locally-produced agricultural products, presenting numerous co-benefits for the SWM sector as well as for local farmers and socially vulnerable groups. It is also a novel way of getting the community involved and generating awareness on waste segregation and recycling in an informal setting.

Segregating biodegradable waste for composting or other means has multiple co-benefits, at the local level (less odor, vermin, scavenging animals) as well as a global (climate change mitigation) level. While many rural and remote mountain communities in Nepal already practice various forms of composting as described in Chapter 15 on **Nepal: Composting in Mountainous Regions,** the support of NGOs to provide technical support is key. The chapter also describes the benefits of composting and how these easily-adaptable methods are currently being used in Nepal and can be scaled-up in similar areas.

Moving on to transport and transfer of waste. **Bengaluru, India: Using GPS for the Solid Waste Management Sector** (Chapter 16) shows how the use of smart mapping and the use of GPS can optimize waste collection where collection points may be far off or outside city limits, to ensure timely and efficient collection, monitor where the waste is being taken, and even monitor dumping behavior. This could be particularly useful in mountain areas where settlements are scattered and waste collection and transport services are costly and need to cover large distances. Given the remoteness and the scattered nature of communities in mountain areas in Georgia, Chapter 17 on **Mestia, Georgia: Mini Transfer Stations in Mountain Villages** describes how storage and transfer facilities can prevent mountain communities from dumping and burning their wastes due to lack of disposal facilities.

Against the regulatory backdrop of Korea, presented in Chapter 3, **Nanjido, Republic of Korea: From Dump Site to Eco-Park** (Chapter 18) describes how an unsanitary dump site on Nanjido Island in Seoul underwent a massive clean-up effort in 2002 to convert it into an eco-park. The factors that enabled this transformation included political will, development of legal and regulatory interventions, inter-departmental coordination, and establishment of facilities to treat landfill gas and leachate.

In terms of SWM in high-altitude mountain areas, **Central Karakoram National Park, Pakistan: Waste Management in a High-Altitude Protected Area** (Chapter 19), and **Sagarmatha National Park, Nepal: Proactive Solid Waste Management for Communities and Tourists** (Chapter 20) both describe how solid waste is managed in protected areas in these countries and in local communities. Both examples show how tourism is the main source of waste and how NGOs play a key role in creating awareness and preserving the natural environment.

Mount Everest, Nepal: Clean-Up Campaign 2019 (Chapter 21) describes how the largest clean-up campaign was conducted on Mount Everest in a coordinated effort by multiple parties. This annual effort helps to successfully manage waste on the mountain, generate awareness, and strengthen public participation in waste management. This example highlights the difficulty of managing solid waste from mountaineering and trekking expeditions. With these activities gaining popularity across the world, the waste that is generated in high-altitude areas can no longer be ignored.

While Mount Everest has its own unique aspects, the final chapter focuses on a highly popular, high-altitude tourist destination without the isolation and ruggedness of Mount Everest. Chapter 22 on **Machu Picchu, Peru: Saving World Heritage through Strategic Collaborations** provides an example from another part of the world facing similar challenges. It describes how the area is facing severe waste management challenges and adopted a suite of initiatives led by a local NGO to overcome these issues.

Box 2.1: Related regional World Bank projects

This Advisory Services and Analytics (ASA) activity on sustainable management of solid waste in mountain areas is spread across the Himalayan regions of India, Nepal, and Pakistan. It represents the first attempt by the World Bank to examine solid waste management in ecologically-sensitive areas that face unique challenges. The lessons and recommendations from this study may also be applicable to mountain areas in other regions and countries.

Other current regional projects across SAR that integrate the environment, including water resources, with improved waste management practices include PLEASE and SAWI. A PROBLUE study in Pakistan looks at the impact of marine pollution in the Arabian Sea. These projects are further described below.

Plastic Free Rivers and Seas for South Asia (PLEASE): The objectives of the PLEASE project are to strengthen innovation as well as coordination of circular economy approaches across South Asia in all SAR countries. The project consists of three components that will be implemented over a period of five years and hopes to sharply drive innovation and results for plastics waste and plastic pollution reduction that would lead to cleaner coasts, rivers, and seas across the region.

South Asia Water Initiative (SAWI): The South Asia Water Initiative (SAWI) is a multi-donor trust fund in support of a program of activities to develop a shared understanding of trans-boundary river pollution across countries in South Asia (Afghanistan, Bangladesh, India, Nepal, Pakistan, Sri Lanka), with a particular focus on plastics. Projects under SAWI include assessments of plastics leakage and pathways into rivers, identifying commonly used and problematic single-use plastics, and water quality and related pollution data collection and analysis, among others.

In the three countries of this regional study on mountain waste, SAWI-funded projects include:

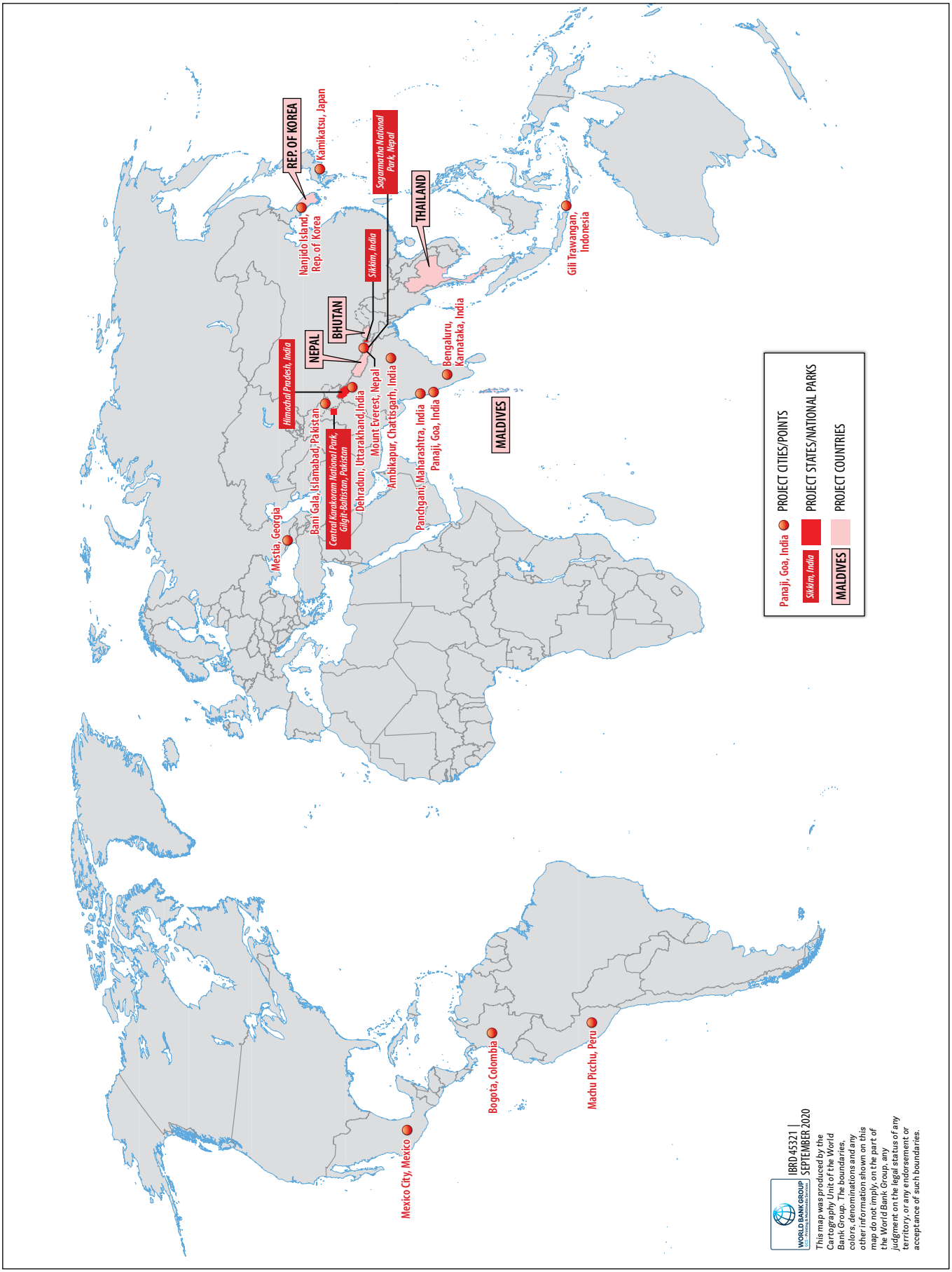
- *India:* The study will inform Enhancing Coastal Ocean Resource Efficiency (ENCORE) Program on plastic waste management activities that are (1) suitable for communities' engagement, (2) cost effective, (3) sustainable, and (4) easy to upscale.
- *Nepal:* Studies on plastic material flow analysis, estimating plastic leakage in five cities across Nepal, including in the Kathmandu Valley, and estimating the types and quantities of plastic healthcare waste expected to be generated during the COVID-19 pandemic.
- *Pakistan:* This study looks at plastic pollution at selected sites across the Indus River Basin to understand the volume and nature of plastic load in the river. Targeted recommendations to stakeholders will include policy and institutional solutions and behavior change.

Pakistan Marine Pollution & Marine Waste Management: The Pakistan Marine Pollution & Marine Waste Management study, funded by PROBLUE, aims to present a diagnostic analysis of marine pollution (including solid waste, plastics, sewage, industrial wastewater, and microplastics) and develop recommendations for a roadmap to control marine pollution and marine waste management. The study will inform the first-of-its-kind PLEASE project to combat plastic pollution ending up in rivers and seas. PROBLUE is a World Bank-administered multi-donor trust fund that supports the sustainable and integrated development of marine and coastal resources in healthy oceans.

Table 2.1: Summary of good practices by relevance to SWM chain, ISWM, and by type of mountain settlement

Case study area	Topic	SWM Chain						Integrated SWM						Types of Mountain Areas			
		Segregation/ composting at source	Collection, transport, transfer	Sorting and processing	Recycling	Treatment	Disposal	Policies and institutions	Financial viability/user fees	Infrastructure	Informal sector	NGO/CBO participation	Private sector participation	Mountain cities/ towns	Rural areas (connected by road)	Remote areas (no road network)	Mountaineering/ trekking
Republic of Korea	Policy and Legislative Responses to Solid Waste Management			✓	✓	✓	✓	✓						✓	✓	✓	✓
Sikkim, India	Policy for Sustainable Tourism							✓				✓		✓	✓	✓	✓
Bhutan, Gili Trawangan (Indonesia), Maldives, Thailand	Responsibility and Sustainability through Tourism Tax							✓	✓	✓		✓	✓	✓	✓	✓	✓
Maldives	Towards Sustainable Waste Management in a Small Island Developing State			✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	
Kamikatsu, Japan and Bogota, Colombia	Zero Waste Policies	✓		✓	✓	✓		✓	✓	✓	✓			✓	✓	✓	✓
Ambikapur, India	A Participatory Approach to Managing Solid Waste	✓	✓	✓	✓	✓			✓	✓	✓	✓		✓	✓	✓	
Panchgani, India	From Kachra Point to Swachh Bharat Point	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Panaji, India	Solid Waste Management Requires Sustained Efforts	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	
Himachal Pradesh, India	Waste Warriors - Transformation through Replicable Models of Solid Waste Management	✓	✓	✓	✓	✓				✓	✓	✓		✓	✓	✓	
Dehradun, India	Improving Waste Management One Step at a Time	✓	✓	✓	✓	✓			✓	✓	✓	✓		✓	✓	✓	
Bani Gala, Pakistan	A Community-driven Model towards Zero Waste	✓	✓		✓				✓	✓	✓	✓		✓	✓	✓	
Mexico City, Mexico	Bartering Recyclables for Food	✓	✓		✓			✓				✓	✓	✓	✓		
Nepal	Composting in Mountain Regions	✓				✓				✓		✓		✓	✓	✓	
Bengaluru, India	Using GPS for the Solid Waste Management Sector		✓							✓			✓	✓	✓		
Mestia, Georgia	Mini-Transfer Stations in Mountain Villages		✓	✓				✓		✓		✓		✓	✓	✓	✓
Nanjido, Republic of Korea	From Dump Site to Eco-Park			✓	✓	✓	✓	✓	✓	✓			✓	✓			
Central Karakoram National Park, Pakistan	Waste Management in a High-Altitude Protected Area		✓	✓		✓	✓		✓			✓	✓			✓	✓
Sagarmatha National Park, Nepal	Proactive Solid Waste Management for Communities and Tourists	✓	✓	✓		✓	✓			✓		✓	✓		✓	✓	✓
Mount Everest, Nepal	Clean-Up Campaign 2019		✓	✓		✓			✓	✓		✓	✓			✓	✓
Machu Picchu, Peru	Saving World Heritage through Strategic Collaborations		✓	✓	✓	✓				✓		✓		✓	✓	✓	✓

Map 2.1: Locations of the good practice options presented in this report



3. Republic of Korea: Policy and Legislative Responses to Solid Waste Management

The first waste management law in the Republic of Korea, called the Waste Cleaning Act, was enacted in 1961 to manage general household waste. In 1977, another law—the Environmental Preservation Act—was enacted that specifically targeted large quantities of industrial waste. It was not until the 1980s that Korea essentially dealt with all its waste—general and industrial waste—with one single systematic law, the Waste Management Act of 1987. The Act set the tone for waste management goals to reduce and recycle as well as introduced regulations on landfill gas treatment.

Korean laws and regulations on waste management quickly evolved in the early 1990s as an integrated response to the closure of the Nanjido dump site in Seoul, as well as to achieve objectives for regional development and broader urban planning. The focus of solid waste management (SWM) policies evolved in Korea in three major phases as described in this chapter. Key legal developments in the country and how they transformed and modernized the SWM sector are also mentioned.

Phase I: From "Safe Treatment and Disposal" in the 1980s to "Recycling" in the 1990s

In the 1990s, Korea introduced preventive waste management policies based on waste reduction and promotion of recycling. The relevant policies are described below.

The Act on the Promotion of Saving and Recycling of Resources (1992) was created to promote waste reduction and recycling. The implementation of this law, along with other consecutive regulatory and policy interventions, led to an increase in the recycling rate to 84.4 percent by 2015 and a reduction of domestic municipal solid waste generation to 0.97 kg per person per day.

The Act on International Transfer and Treatment of Wastes was also enacted in 1992 in order to qualify Korea to participate in international waste management activities and follow international obligations.

The Act on Promotion of Installation of Waste Treatment Facilities and Support for Neighborhood Areas (1995) was enacted to speed up regulatory processes relating to the installation of new incinerators and sanitary landfill facilities for waste treatment. At the same time, the Act aimed at minimizing the potential social concerns that would arise from the "not-in-my-backyard" (NIMBY) phenomenon and could deter the establishment of new waste treatment sites in and around neighborhoods. The law enables proactive resolution and mediation of social conflicts through assistance for affected areas.

With regard to the management of landfills, the Post-Landfill Closure Management Regulation was added in 1996 to the Waste Management Act (1986), in addition to the Landfill Gas Treatment Regulation, to ensure effective landfill gas recovery and to address pollution from landfill gas and leachate. The regulation on after-closure management coincided with the recovery of the Nanjido dump site that had been discontinued three

years earlier. Until 1996, the regulations only specified the depth of waste being buried and the amount of soil used to cover the waste at the site. The new regulation focused on engineering solutions for proper landfill management and obligatory environmental management for a period of 20 years post-closure of the landfill. In 2010, the time period for post-closure environmental management was extended to 30 years. Furthermore, regulations requiring the government's inspection of landfill construction and closure also arose at this time.

Some other policies and systems implemented to promote recycling in the 1990s included:

- Minimizing the generation of packaging material
- Regulations to deter single-use products
- Landfill discharge fee and other waste fee systems that applied the principle of pay-as-you-throw (including volume-based disposal fees). These fee systems were instrumental in the separate collection of recyclables in a short period of time.
- Promotion of recycling industries.

Phase II: From Recycling to Integrated Solid Waste Management and Circulation of Waste in the Early 2000s

In the 2000s, the goal of waste management shifted from recycling to integrated solid waste management (ISWM) and to using wastes effectively. This meant minimizing the use of landfills and, alternatively, finding other ways to treat MSW.

In 1992, the Act on the Promotion of Saving and Recycling of Resources was amended and divided into two different acts, based on two categories of wastes: Construction and demolition (C&D) waste and electrical and electronic waste (WEEE). The resultant acts were the Promotion of Construction Wastes Recycling Act (2003) and the Act on Resource Circulation of Electrical and Electronic Equipment and Vehicles (2007). Some construction projects are obliged to use recycled aggregate by presidential decree. For instance, the 2003 Act mandates the use of recycled aggregate in the construction of new roads longer than four kilometers, sewage treatment facilities, and industrial parks larger than 150,000 square kilometers. A Construction Waste Management System has also been established to link the recycled aggregate demand to supply, providing information on volume, quality, and so on, that is produced or in demand.

The Act on Resource Circulation of Electrical and Electronic Equipment (WEEE) and Vehicles of 2007 created an environmental safety assurance system to address increasing concerns around proper handling and management of hazardous materials from WEEE and end-of-life vehicles (ELV). The Act includes four main requirements: Restrictions on hazardous materials; innovative designs for efficient recycling; systematic collection and recycling of WEEE; and recycling of ELV. The scope of the new legislation required all WEEE to follow the Korean extended producer responsibility (EPR) system. Producers and importers were required by law to provide information on product recyclability and follow the 'Recycling Methods and Standards by Product Category' prescribed by the government, among others.

Some of the parallel policy changes in the 2000s to promote resource utilization included:

- Replacing the "deposit" system for landfill usage with an "extended producer responsibility" system (2003)

- Prohibition on direct landfilling of food waste (2005) and separation of food waste at the household level using a radio-frequency identification (RFID) system; biodegradable (food) waste is either composted or converted into biogas at public or private facilities
- Energy generation through the use of waste-to-energy (WTE) technology, landfill gas, refuse-derived fuel (RDF), sewage sludge-to-fuel, and so on, implemented through the establishment of waste-energy towns[2]
- Introducing measures for recycling waste metal resources (2009).

Phase III: Towards a Resource Recirculation-Based Society and Zero Waste Policy by 2020

The establishment of a resource recirculation society has been a pan-governmental undertaking with all relevant agencies working collaboratively to present the First Framework Plan for Resource Circulation 2011-2015 (2011). The Framework lays the foundation for upcycling waste resources, reducing greenhouse gas emissions, and promoting green growth.

The Act for Promotion of Transition to a Resource Circulation Society (2013) promotes the collection and transport of recyclables through free collection of large-sized domestic electronic equipment waste, consolidation of the sorting system, increased installation of facilities for the energy utilization of waste resources, and other aspects that build a "recycling society". It also promotes the creation of a market for recycled products and support for related industries.

The Framework Act on Resource Circulation (2018) aims to close the gap between Korea's resource-poor and high-energy consuming society by generating economic, social, and environmental benefits from reduced pollution from waste. The provisions of the framework "can be divided into three categories, each of which is establishing a basis for resource circulation, promoting resource circulation and supporting recycling industries." The Act also imposes resource recirculation goals for enterprises generating massive quantities of waste (industrial waste) and for local authorities (municipal waste). It lays the ground rules and responsibilities regarding waste treatment. The general principle of the law is to charge a "waste disposal fee" for using landfills or incinerators if the waste can be recycled instead.

Some other policy and legal interventions during this phase are summarized below:

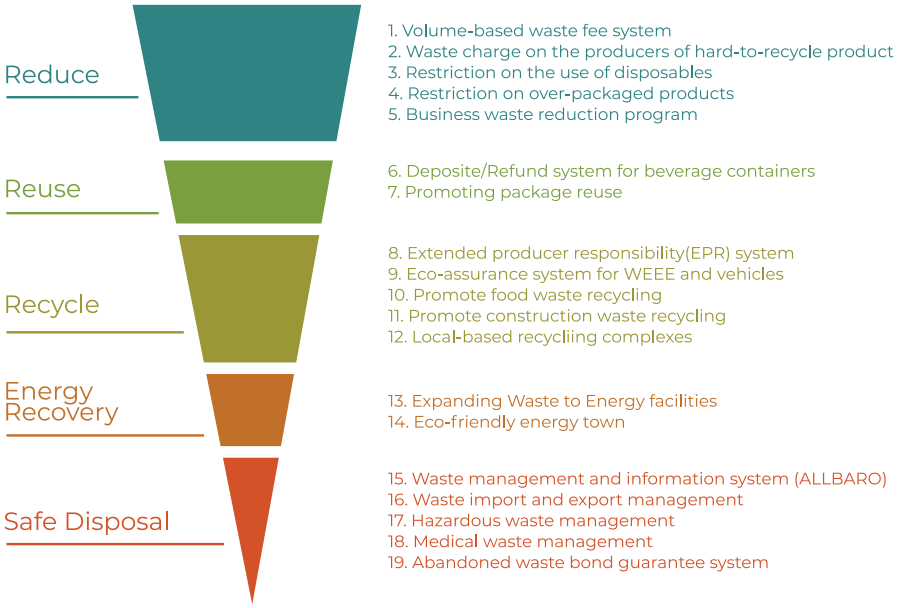
- Prohibition of leachate from biodegradable (both livestock as well as food) waste into marine discharges of sewage sludge (2012-2013). This allowed sludge to be used as a source of energy in thermal power plants, while food waste was utilized as feedstock in biogas plants
- Landfilling of biodegradable waste and untreated waste was strongly regulated
- Producers of hard-to-recycle products shared the cost burden of waste disposal. Plastic goods' manufacturers entered into voluntary agreements with the Ministry of Environment, and those that met recycling goals were exempted from waste charges
- *Master Plan for the Management of Recyclable Wastes: Especially Plastic Waste* (May 2018) aims to reduce plastic waste by 30 percent by 2022 and by 50 percent by 2030 using a suite of strategies, including the establishment of a production-consumption cycle that curbs the generation of plastic waste at source

2 Waste-energy towns are being designed and planned in a way to use their own wastes to produce energy for the township. So far, one has been established in Seoul and 11 other towns are under development.

- *Master Plan for Resource Circulation for Establishing the Circular Economy & Society 2018-27* (2018) aims to establish a circular economy system by improving resource circulation efficiency through the entire production process (targeting production, consumption, waste management, and recycling). The goal of this master plan is to increase the waste recirculation rate from 70 percent to 82 percent and reduce the landfilling rate from 9 percent to 3 percent by 2027. It also aims to reduce waste generation by 20 percent.

In addition, there are many other interventions such as bans and restrictions on the usage and free distribution of single-use items; regulations on packaging methods and materials; deposit/refund schemes (called "bond money") for bottles, and so on. For instance, the deposit/refund scheme is being utilized by beverage producers and the amount of bond money is about 40 percent of the cost of manufacturing a new bottle. Figure 3.1 shows the various waste-related policies along the solid waste management hierarchy that have been introduced in Korea over the years.

Figure 3.1: Waste-related policies along the SWM hierarchy in Korea



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4. Sikkim, India: Policy for Sustainable Tourism

Where – Sikkim, India

Sikkim is the second-smallest state in India with an area of 7,097 sq. km. and is the least populous, having a population of just over 600,000 (2011). Situated in north-eastern India, it is part of the Indian Himalayan Region (IHR), comprising 11 mountain states and two union territories.[3] The elevation of the state ranges from 280 to 8,586 meters.

Sikkim, surrounded by the Himalayan landscape, has an abundance of biodiversity, which makes it a prime eco-tourism destination for both domestic as well as international tourists. Labeled a "biodiversity hotspot" of global value, it harbors a broad diversity of flora and fauna, various climatic zones, a range of forest types with an overall green cover of 50 percent across the state, and is home to the highest peak in India and the third-highest on Earth—Kanchenjunga (also known as Khangchendzonga).

Realizing the value of these natural resources, the state government of Sikkim considers eco-tourism to be a priority sector, and thus developed a comprehensive eco-tourism policy in 2011. Across India, Sikkim is recognized for tourism policies that embrace sustainability principles. While Sikkim is a model state for promoting eco-tourism products, infrastructure, solid waste management (SWM) concepts, and capacity-building efforts, it is nevertheless challenged by mass tourism, amongst other challenges.

The focus areas of the eco-tourism policy include sustainable tourism, incentivizing local participation by introducing eco-tourism-based alternative income sources, regulating the influx of tourists at sensitive spots, and introducing components of the local culture and values. With a majority of Sikkim's population dependent on agriculture and tourism for sustenance, the policy stresses on integrating local cultures with nature-sensitive tourism practices, promoting homestays, cycling routes, local cuisines to minimize fast-food packaging, and enforcing the state-wide plastic ban.

What – Two Sides of the Tourism Coin

Tourism contributes significantly to Sikkim's gross state domestic product (GSDP), having brought in as much as 7.68 percent (Rs 144,735) in 2016/17. Local authorities aim to make tourism a Rs 15-billion sector by 2020/21, with a sharp focus on eco-friendly tourism options. However, with an influx of tourism comes the issue of waste management, among others. Tourism-driven plastic use is the highest waste contributor in the state, with plastic water bottles, multi-layered plastics, Tetra Paks, and food wrappers forming the crux of the problem. On average, authorities clear away as much as 800 kilograms of waste from trekking trails annually. The Khangchendzonga National Park, a UNESCO world heritage site that covers 35 percent of the state's area, brings in as many as 8,000 tourists annually, leaving a bulk of waste to be managed. Currently, damages due to increasing tourism include aesthetic degradation, deforestation, and loss of vegetative cover, wildlife, and agro-diversity. It is predicted that potential future damage will include air pollution and a decrease in water quality as well.

3 The 11 mountain states are Arunachal Pradesh, Assam, Himachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim, Uttarakhand, and West Bengal.

How – Volunteer Efforts and Plastic Bans

The Sikkim state government identified the problem of plastics early on, and in 1998 the state became the first in the country to ban disposable plastic bags. Following this, the use of plastic water bottles in government offices and at government events was also banned. This was followed by a ban on the use of Styrofoam and Thermocol products. The motivation to take these steps was that these non-biodegradable and non-recyclable products were claiming considerable space at disposal sites and were potentially hazardous, thus contaminating groundwater and surrounding areas.

More recently, the Gangtok-based Eco-tourism and Conservation Society of Sikkim (ECOSS) has been working with other organizations like WWF and the *Swachh Bharat Abhiyan* (Clean India Mission) on the Zero-Waste Himalaya project, which aims to tackle tourism-generated solid waste in the Himalayan region. The project has been actively campaigning and lobbying the state government to effectively implement the plastic ban in Sikkim.

Several local bodies have also stepped up to support responsible tourism and generate employment. For instance, the Khanchendzonga Conservation Committee (KCC), an NGO, has been raising awareness about eco-tourism in Yuksom, western Sikkim, since 1996. The organization organizes training for locals from smaller villages to be naturalists, guides, trekking cooks, porters, and pack animal operators.

Young volunteers across Sikkim also got together to start the '*Himal Rakshak*' or voluntary mountain guardian program, which was piloted in 2006 for conservation. The group runs awareness and monitoring campaigns throughout Sikkim, and volunteers have taken on the responsibility of monitoring and reporting any suspicious behavior by tourists or potential poachers. As a biodiversity hotspot, Sikkim's species are constantly under threat from poachers, with incidents of tourists trying to smuggle rare species reported as well.

Why – Slow Winds of Change

A 2018 study carried out by a Pune-based NGO called eCoexist found that after the plastic ban was imposed and enforcement increased, around 66 percent of the shops in Sikkim had switched to using bags made of paper or old newspapers; however, around 34 percent were reported to still use plastic bags. Plastic food wrappers still constitute a high percentage of the waste generated, and there is no facility to recycle plastics. Volunteers and environmentalists are pushing for plastic to be used in road construction. It is estimated that construction of a one kilometer-long road requires a tonne of plastics, reducing the burden on disposal sites and more importantly, minimizing the presence of plastics in the environment.

After mass-awareness campaigns, Sikkim's residents have switched to single-use items made of biodegradable material such as paper, leaves, and bagasse. Government offices switched from plastic water bottles to reusable water bottles and large dispensers for events and meetings. Locals and tourist vehicle drivers in small villages in some parts of the state worked together to strictly confiscate any plastics carried by tourists and are currently planning to introduce bamboo water bottles.

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5. Responsibility and Sustainability through Tourism User Fees

Where – Tourism Hotspots Worldwide

Tourism user fees (TUFs) are fees levied on tourism-based activities to generate revenue that can be used for improvement and maintenance of tourism infrastructure, conservation, and waste management of the tourist destination. TUFs levied on eco-tourism can also generate significant revenues for conservation, particularly in developing countries and protected areas (PAs) catering to wildlife-based or ecologically-sensitive tourism.

TUFs can be structured around many activities and levied in many different ways, such as:

- *Entrance fees:* Charged to visitors entering PAs or other sensitive areas.
- *Tourism-based taxes:* Taxes can be levied at hotels, airports, and other collection points, and channeled towards waste management or conservation.
- *Licenses and permits:* Private firms operating within or outside PAs (for example, tour operators, guides, and cruise ships) and individuals participating in specific recreational activities (for example, diving, fishing, and camping) can be charged for licenses or permits.
- *Concession fees:* Companies or businesses called "concessionaires" that provide services such as lodging and food within the boundaries of PAs can be charged fees to operate their businesses.

What – Tourism and Solid Waste Management

Tourism is fast emerging as an important source of revenue for countries all over the world. The UN World Tourism Organization (UNWTO) estimates that total international tourism receipts and passenger transport together was as much as $1.7 trillion in 2019. However, there are multiple negative impacts tourism can have on the environment and resources of a place, including putting a large demand on energy, resources, and an even larger pressure on the waste management system.

According to 2011 estimates by the UNEP, 14 percent of all solid wastes are produced solely by tourists annually. The UNEP also estimates that waste generation in tourist locations varies from 1 to 12 kilograms per person, depending on location, season, environmental laws of the country, and the type and number of accommodations. Most establishments that make up the tourism-provision sector such as hotels, bars, and restaurants, use large quantities of disposable single-use consumer goods which require little to no maintenance. This contributes significantly towards solid waste generation and negatively impacts the environment. Added complications from tourism include the fact that tourists are not always conscious of an area's solid waste management (SWM) measures and the seasonal nature of tourism puts varying degrees of pressure, not to mention cost, on SWM infrastructure and services.

Overview of Tourism Fees in Developed and Developing Countries

Table 5.1 provides examples of the types of tourism fees levied in various places, ranging from small islands to popular city destinations. It is interesting to note that in many PAs, tourist fees vary depending on where the

tourist comes from. Generally, domestic tourists pay lower fees than international tourists do, as shown in Table 5.2.

Table 5.1: Examples of tourism fees

Country	Tax levied ($)	Notes
Caribbean islands	Ranges from $15 (Bahamas) to $51 (Antigua and Barbuda)	Added to the hotel cost or a departure fee that is often included in the price of an airline ticket or cruise
Bali, Indonesia	$10 per person	Departure tax, differs by airport
Croatia	$1.22-1.53	Per person per night, applies during peak summer season
France	$1.75 onwards	Tourist tax (“taxe de séjour”) implemented in places considered tourist towns and used to maintain tourism infrastructure
Japan	$9.25	"Sayonara tax" paid by international visitors as they leave the country and used to enhance tourism infrastructure while protecting the unique culture
New Zealand	$24	Per person, used for conservation and tourism infrastructure
Romania	1% of room rate	Major cities charge a city tax, while mountain and sea towns charge a “rescue” tax
The Netherlands	7% of room rate; transiting tourists pay $9.5 per 24-hour period	Land tourist tax and a water tourist tax

Table 5.2: Examples of tourist fees in protected areas

Country	Protected area	Entrance fee (adult)
Ecuador	Galápagos National Park	• Fee depends on age and nationality • International: $100 • Domestic: $6
Indonesia	Komodo National Park	• International: $11 (Mon–Sat), $16 (Sun and public holidays) • Nationals: $0.40
South Africa	Kruger National Park	• International: $23 • Regional (SADC): $11.5 • Citizens/residents: $6 All of the above charged on a daily basis
USA	Everglades National Park	• Private vehicle: $25 • Motorcycle: $20 • Pedestrian/cyclist: $8 All of the above for a seven-day period
Zimbabwe	Victoria Falls World Heritage Site	• International: $30 • Regional (SADC): $20

How – Examples of Implementation and Planning

1. Tourism Fees in Developing Countries and Small Island Developing States

Bhutan

Bhutan is a small Buddhist kingdom located at the eastern edge of the Himalayas with an estimated population of 754,388 (2018), making it one of the least populous nations in Asia. The terrain ranges from subtropical forests to sub-alpine habitats. The natural beauty, along with its rich cultural history, makes Bhutan an ideal tourist location. However, the country's fragile Himalayan ecosystem, coupled with a massive influx of tourists, has made the region very susceptible to damage. In 2018, Bhutan saw a tourist inflow 274,000 tourists, equivalent to 36 percent of the country's population.

Until recently, Bhutan did not levy a tourist fee on tourists from India, Maldives, and Bangladesh, leaving a potential stream of revenue untapped as 66 percent of tourists in 2018 were from India alone. With rising concern regarding the fragile ecology, habitat protection, and cleanliness, coupled with the need for additional revenue to maintain the pristine condition of the country, in 2020 Bhutan expanded its tourist fee structure to include Indian, Maldivian, and Bangladeshi tourists.

Called a "sustainable development fee", these visitors are required to pay a fee of Nu 1,200 per day, which is approximately equivalent to $16. Visitors from other countries pay a minimum fee of $250 per person per day during the peak season and $200 per person per day in the off-season, making Bhutan the country with the highest tourist fee in the world.

Gili Trawangan, Indonesia

Gili Trawangan is the largest island in an archipelago of three islands referred to as the Gili Islands located off the coast of Lombok in Indonesia. The tropical island is 6 sq. km. in size, with rich coral reefs and a shipwreck just offshore, making it a popular SCUBA diving location. As of 2010, the island had a population of approximately 4,439, consisting of Indonesians and some Western expatriates.

As a small island, infrastructure and resources are limited on Gili Trawangan. Electricity is provided by a generator, and the island does not have a sewage treatment system. Transportation is by horse-drawn carts on dirt roads, as motorized vehicles are not permitted. Gili Trawangan is located within the Gili Matra Marine Natural Recreation Park, a nationally-designated marine park preserved for research, science, education, recreation, and tourism purposes.

Tourism is the largest economic activity on the island and a significant revenue earner. In recent years, tourism here has undergone rapid, uncontrolled growth. This has resulted in a number of adverse ecological effects including coral reef degradation and beach erosion. Furthermore, tourism has added to other challenges including a strain on already inadequate resources, improper solid waste management, and a lack of awareness amongst tourists.

With a boom in tourism, Gili Trawangan outgrew its waste management system resulting in several problems including collection inefficiencies, improper open-pit disposal, limited waste diversion, and burning, dumping, and littering practices. In 1996, a community-based organization called 'Forum Masyarakat Peduli Lingkungan' (FMPL), meaning "concerned citizens group for the environment") was created to serve as the

island's waste management authority. In 2000, the Gili Eco Trust (GET) was formed by a group of owners of tourism businesses and dive shops concerned about the degradation of Gili Trawangan's marine environment due to the severe SWM problem. GET introduced, and now collects, a tourist eco-donation fee of Rp 50,000 from tourists through dive shops. This donation funds sustainability projects, as well as recycling campaigns, clean-ups, and awareness drives on SWM.

The Maldives

The Maldives is an archipelago of 1,190 coral islands in 26 atolls in the Indian Ocean. These islands are very low-lying and are at great risk from climate change. Around 394,450 people occupy 198 islands and around 70 percent of the inhabited islands have a resident population of fewer than 1,000 people.

The Maldives hosts around 101 tourist resorts and 157 live-on safari boats that take tourists to the archipelago's SCUBA diving and snorkeling areas. Tourism is the dominant sector for the Maldivian economy, contributing over 30 percent to the country's GDP and to 60 percent of foreign exchange receipts.

Tourism accounts for 21 percent of the approximately 860 tonnes per day (TPD) of solid waste discarded in the Maldives. A majority of solid waste from tourism (134 TPD) comes from resorts, of which 40 percent is biodegradable (food) waste and 38 percent is landscaping (that is, garden/green) waste. Safari vessels contribute a smaller fraction of around 8 TPD, of which food waste makes up 67 percent. Recyclables amount to only three percent of discarded material, while the remaining is classified as residuals.

Tourist resorts are spread over 80 islands, making efficient waste collection logistically difficult. Additionally, the nearest formal recycling facilities are in India so distance hinders the potential for recycling. Waste has been dumped on Thilafushi Island since the 1970s, and the waste is often burned or informally recycled by waste pickers to reduce ever-increasing volumes.

In 2013, penalties and fines for littering and non-compliance came into effect under the Waste Management Regulations. The country also introduced a new Green Tax on tourists to help fund environmental protection programs by the government. Starting in 2015, tourists were charged $6 per person per day, and it was estimated that this tax would generate approximately Rf 3.1 billion within three years. Environmental Police Units were set up to enforce regulations and to impose fines, which ranged from $6.50 for littering, and between $650-6,485 if a concerned authority failed to provide waste collection services.

2. Tourist Fees in Protected Areas

Thailand

Thailand is a country in Southeast Asia known for its beaches, cultural heritage, ancient ruins, and history. It is among the most popular tourist destinations in the world. Tourism is a major revenue generator in Thailand, contributing 6-7 percent of the country's GDP. In 2016 alone, over 32 million tourists visited Thailand, resulting in revenue of B2.5 trillion. As with any tourist destination, a large influx of tourists brings with it huge SWM challenges and major pollution. Thailand generated 27 million tonnes of waste in 2016, adding additional pressure on the natural environment and threatening the kingdom's wildlife. To mitigate the damage, the Thailand Authority of Tourism (TAT) banned all single-use plastics in 2018.

In 2015, the TAT introduced entrance fees to 31 PAs to generate revenue for maintenance. The pricing was determined by the estimated tourism potential, natural beauty, sensitivity of the region, availability of public amenities and resources, and state of infrastructure for each national park. Entrance fees were charged based on park classification. For instance, parks under group 1 charged adult fees ranging from B80 (Thai national) to B400 (international tourist) and parks under group 4 are free for everyone.

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6. Maldives: Towards Sustainable Waste Management in a Small Island Developing State

Where – The Maldives

The Maldives is an archipelago of 1,190 coral islands in 26 atolls in the Indian Ocean. These islands are very low lying and are at great risk from sea level rise caused by climate change. Around 394,450 people occupy 198 islands and around 70 percent of the inhabited islands have a resident population of fewer than 1,000 people. The Maldives is home to 101 tourist resorts and 157 live-on safari boats that take tourists to the archipelago's famed SCUBA diving and snorkeling areas. Tourism is the dominant sector of the Maldivian economy, contributing to over 30 percent to the GDP and to 60 percent of foreign exchange receipts.

What – An Island of Rubbish

The biggest challenges related to solid waste management (SWM) in the Maldives are an increasing population and subsequent increase in the amount of waste generated. Plastic and non-biodegradable fractions are of more concern as the tourism industry grows. Tourist resorts are spread over 80 islands, making efficient waste collection logistically difficult. The Maldives government attempted to implement several waste management initiatives but funding remains a major hurdle. Additionally, the nearest formal recycling facilities are in India, thus hindering the potential for recycling. The scattered nature and geographical distance of the islands also makes the establishment of centralized waste management systems difficult.

Thilafushi is an artificial island that was originally a large lagoon called Thilafalhu. In the early 1990s, Malé, the capital of the Maldives, was faced with a serious municipal solid waste (MSW) disposal challenge and the authorities decided to reclaim the Thilafalhu lagoon as a waste disposal site. All the waste collected from the nearby islands was brought to Thilafushi and dumped there. Initially, waste pits with a volume of 1,060 cu. m. each were dug into the sand, and the excavated sand was used as a cover over the waste along with construction debris. Since there was no waste segregation, all the waste was mixed.

By 2005, space was also running out at Thilafushi, and the excess waste was being used to reclaim land and increase the size of the island. It was estimated that the island was growing at a rate of one square meter a day. The dumped waste was burned almost daily to reduce its volume, exuding billowing clouds of toxic fumes.

In 2011, dumping at Thilafushi was temporarily banned due waste that was floating away from the island, although Malé continued to take its waste there. By 2019, it was reported that the site was at full capacity.

It was estimated that each tourist in the Maldives produces as much as 3.5 kg of waste per day, a Malé resident 1.8 kg per day, and the remaining island inhabitants 0.8 kg per person per day. Tourism accounts for 21 percent of the approximately 860 tonnes per day (TPD) of solid waste discarded in the Maldives. Urban areas contribute to 65 percent of the total waste generated and island communities, 35 percent. A major fraction of the tourism-generated waste is plastics. UNICEF estimates as many as 280,000 plastic bottles are used and discarded daily in Malé.

A majority of tourism-based solid waste—approximately 134 TPD—comes from resorts, of which 40 percent is food waste and 38 percent is landscaping waste. Safari vessels contribute a smaller fraction of around 8 TPD, of which food waste makes up 67 percent. Seventy percent of the waste generated by island communities is biodegradable. Recyclables amount to only 3 percent, and the balance is classified as residuals. According to UNICEF, the Maldives imported around 104 million plastic bags in 2018 alone.

How – Taxes, Penalties, and Plans

Due to the scarcity of land available for disposal, and the distances from waste generation sources to treatment and disposal facilities, the Maldivian government introduced a number of measures to manage its SWM challenges.

The Maldives introduced a new Green Tax on tourists to help fund environmental protection programs managed by the government. Waste Management Regulations drafted in 2010 came into effect in February 2013, which included penalties and fines for littering and non-compliance. Starting in 2015, tourists were charged $6 per person per day, and it was estimated that this tax would generate approximately Rf 3.1 billion within three years. Environmental Police Units were set up to enforce regulations and to impose fines for littering. Boat owners were required to place collection bins on their vessels and were fined if caught dumping waste into the ocean.

On January 1, 2016, the state-run Waste Management Corporation officially started operations by taking over the waste management function for Malé Region. This included the daily transfer of waste from Malé to Thilafushi, the waste management of Villimalé, an island near Malé, and the disposal of waste at the Thilafushi site.

In 2018, the Ministry of Education launched a nation-wide ocean exploration program for schools that was aimed at creating awareness and inculcating love for the ocean in students. Soon after, the Maldivian government banned all single-use plastics in schools, striving to make all schools plastic-free zones. In 2019, the Maldives government passed a law to ban all single-use plastics by 2025, extending the ban to the import of plastic bags as well. By early 2020, some atolls had already banned plastics, with many resorts taking eco-tourism approaches by replacing plastic bottles and toiletries with reusable sustainable materials.

The Maldivian government, with help from the Asian Development Bank and the Japan Fund for the Joint Crediting Mechanism, is planning to establish a waste-to-energy (WTE) plant with a 500 TPD capacity, an 8-megawatt output with a surplus energy recovery facility, an air pollution control system, and a landfill for safe disposal of residues and bottom ash. The WTE facility will minimize the land requirement for waste disposal, produce renewable energy to address electricity shortages in the Maldives, and enable certified greenhouse gas emissions reductions.

Why – Pan-island Integrated and Sustainable Waste Management

Most islands burn their waste and to end that practice, the Maldivian Ministry of Environment (MoE) proposed the creation of an “eco-centro” waste-to-wealth center on each island that will sort, recycle, and reuse island waste. Maalhos was the first inhabited island to establish a waste-to-wealth center and ban the open burning of waste. At the Maalhos eco-centro, food and other biodegradable wastes are composted and turned into fertilizer-like output. Metals and bottles are shredded or ground down and turned into materials of economic value. Plastics are recycled or upcycled to create useful objects.

In 2019, the state-run Waste Management Corporation collaborated with an environmental organization to establish a plastic recycling laboratory in Malé. The first of its kind in the Maldives, this laboratory has the capacity to process up to 100 kg of plastic a day. Plastics are upcycled into items such as phone covers, files, and flower pots.

The MoE installed a regional waste management center on Vandhoo Island in 2019, as part of a $6 million project that was financed by the Abu Dhabi Fund for Development. The Vandhoo Waste Management Center also functions as a WTE unit and has an estimated capacity of up to 500 kW of electricity daily, to meet the 250 kW per day requirement of the island. The plant can process 52 TPD of waste daily from 45 inhabited islands, 30 resorts, and nine industrial islands.

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INDULATEX S.A.

7. Kamikatsu, Japan and Bogota, Colombia: Zero Waste Policies

Japan: Municipal Leadership to Implement Zero Waste

Where - Kamikatsu, Japan

Kamikatsu is a quaint town located on Shikoku island in Southeastern Japan. The town has a small community of 2,000 residents who followed a traditional waste management approach until the late 1990s. Mixed household waste was sent to incinerators or disposed of and openly burned at dump sites. Recycling was not common, nor was any waste collection system in place. Plastic pollution was not seen as a public health issue. However, as waste volumes continued to increase over time, air pollution became a significant concern.

What – Challenges to Implementation

Due to a relatively small municipality budget, investing in a waste-to-energy (WTE) facility was deemed financially impractical. Transferring waste from Kamikatsu to other municipalities was costly and inefficient, and thus unsustainable in the long-term. As a result, officials decided to reduce the amount of municipal solid waste (MSW) going to incinerators and landfills and set a goal towards zero waste. The implementation of this goal was challenging as the community found it labor-intensive and confusing.

How – Small Steps Leading to Big Achievement

The municipality of Kamikatsu was the first in Japan to make a “Zero-waste declaration” in 2003 and commit to eliminate waste by 2020 without resorting to landfills or incinerators. As of 2018, the total waste generation in the town was 286 tonnes per year, of which 81 percent of the waste was diverted.

The seeds of zero-waste were sown even before the formal declaration was made. A Kamikatsu Recycling Plan was formulated in 1994. In 1995, subsidies worth ¥42,000 and ¥52,000 were introduced for the purchase of electric composter and compost bins, respectively, to encourage households to compost biodegradable waste. The municipality began by sorting waste into nine categories in 1997 under the Act on Promotion of Sorted Collection and Recycling of Containers and Packages. Within a year, segregation was expanded to 22 waste categories and by 2016 the municipality had established an extensive waste sorting system with 45 distinct categories. Products that were made of different materials were separated, and there were multiple sub-categories for paper and plastic. Regulations required that all non-biodegradable household waste be washed, dried, sorted, and brought to the waste collection facility for final waste segregation.

The Zero-waste Academy, established in 2005, provided a crucial role in engaging and educating residents about the different categories of waste, what zero waste means, why is it important, and how it will benefit communities. The Academy also provided services to turn waste into useful, upcycled products. Residents were encouraged to recycle and reuse and discouraged to purchase new products that may end up as waste.

Community participation has been pivotal in running this waste management system as residents themselves separate and bring the waste to the waste center. There is no waste collector hired by the municipality. The

facility also started a *Kuru-kuru* (meaning circular) and craft center, where people can leave items they no longer require, such as clothes and furniture, and can exchange them for other goods. Residents also volunteer to make new products, such as teddy bears, out of discarded materials.

Since 2017, a Zero Accreditation Scheme for businesses was introduced to certify stores, encourage customers to shop at these establishments, and help stores reduce waste generation and conduct waste audits. Manufacturers are encouraged to produce products with minimal waste generation.

The zero-waste ambition has saved the municipality a third of its annual waste management costs. Recycling has also resulted in economic benefits to the community. Materials such as metal scraps and paper are sold by the municipality to offset some of its waste management costs.

Bogota: Zero Waste Program

Where – Bogota, Colombia

Bogota, the capital of Colombia, is a hill town located in the central part of the country in a fertile upland basin at an elevation of 2,640 meters in the Northern Andes Mountains. Bogota contributes approximately 26 percent (equivalent to 6,500 tonnes per day) of the total MSW generated by Colombia (25,000 tonnes per day). MSW, the majority of which was not pre-treated, was disposed of in the Doña Juana Landfill.

What – Lack of Proper Waste Practices

About 65 percent of the waste disposed of in Bogota every day comprises biodegradable waste, leading to odor arising from disposal sites due to decomposition. Marketplaces in the city alone generate 70 tonnes per day of biodegradable waste.

In addition, the city was reliant on informal waste pickers to collect recyclable and reusable materials. The informal sector, which was not officially integrated into the solid waste management (SWM) system, collected and recycled about 16 percent of the total waste disposed of. This led to ad hoc recycling practices which were marred by lack of transparency and technical training, sometimes violent competition, inadequate remuneration and living standards, and malpractices such as child labor and infringement of basic rights. The Constitutional Court in 2011 recognized the rights of these informal workers and recommended their integration into the formal SWM system.

The city lacked the legal and regulatory framework to implement the waste hierarchy and reduce waste generation at household and marketplaces. There was also limited technical capacity and infrastructure to organize, train, and monitor the informal waster workers to enhance participatory waste management.

How – Bringing about Positive and Inclusive Change

Bogota's Zero Waste Program (called *Basura Cero*) aimed to reduce waste generation at source and increase recycling through community, corporate, and work force participation. It demonstrated how incorporating the informal sector can be more beneficial both financially as well as socially rather than replacing the system altogether.

The program was integrated into the Bogota's City Development Program—"Bogota *Humana*"—in 2012 to address six priority areas of waste management to improve urban development. These priorities included waste segregation at source, extended producer responsibility (EPR), recycling, reduction in landfill disposal, reuse of construction waste, and hazardous and toxic wastes management.

The model, based on the 3 R principle of reduce-reuse-recycle, was introduced through regulatory and legislative interventions that focused on social inclusion, conscious consumerism, and improving waste collection and disposal systems in the city. The program diverted 20 percent of the MSW from landfill by 2016.

The initiative is led by the Special Administrative Unit Public Services (UAESP) in collaboration with several stakeholders including the city government, intra-governmental institutions, private sector, local NGOs, and community and citizen groups. The program instilled social and cultural change in citizen behavior on consumption, waste generation, and enhanced public ownership of SWM systems. This was done through a series of educational and awareness-building programs developed for the private sector and community organizations. These educational opportunities changed citizen perception of waste in the city. Dedicated training programs were also designed for waste picker organizations and employees on technical processes and new technologies for recycling. The Zero Waste Program also helped regularize informal waste pickers by recognizing them as paid labor, providing them an appropriate salary that further improved their social status and living standards. In addition, regular meetings were conducted with waste pickers to discuss the progress of the program.

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8. Ambikapur, India: A Participatory Approach to Managing Solid Waste

Where – Ambikapur, India

The *Swachh* Ambikapur Mission City Level Federation (SAMCLF) started in 2015 as a unique project initiated to clean up the city of Ambikapur in Chattisgarh state, India. Like most cities in the country, the large population and poor solid waste management (SWM) infrastructure make for poor and sometimes hazardous living conditions for city residents. Under the leadership of motivated administrators and citizens, Ambikapur's ranking in the *Swachh Survekshan* cleanliness ranking of India's cities has been steadily improving. Box 8.1 summarizes the city's rankings in the *Swachh Survekshan* surveys.

How – The Self-Help Group Model

An IAS officer, Ritu Sain, was a key proponent of this project. She was responsible for designing the low-cost, self-sustainable Ambikapur model while she was the District Collector in 2014. Realizing that any implementation of a SWM plan would be challenging given the lack of funds and low level of awareness among the city's residents, she adopted a "participatory, viable and replicable" model by involving stakeholders and communities.

From day one of the SAMCLF project, efforts were made to involve elected representatives, religious leaders, self-help groups (SHGs), community-based organizations, institutions, and local residents to develop a common consensus on the growing issue of waste and overfull dump sites located on the outskirts of the city. It was agreed upon by all that the waste posed a serious environmental threat, as well as aggravated health concerns for the residents of the city and should be taken seriously. It was at this point that the *Swachh* Ambikapur Mission project was founded.

The activities implemented by the SAMCLF can be broadly categorized into three segments:

1. Ensuring community participation for waste segregation at source;
2. Door-to-door collection of waste; and
3. Waste segregation at secondary and tertiary segregation centers, including the sale of biodegradable and non-biodegradable items.

Community Participation

To educate residents on the benefits of source segregation, large-scale awareness campaigns were conducted in all administrative wards and across multiple associations, for example, resident welfare associations, market associations, and religious institutions, to spread the message and create awareness about source segregation.

Box 8.1: Ambikapur's rankings in *Swachh Survekshan* surveys

Swachh Survekshan is an annual survey of cleanliness, hygiene, and sanitation in cities across India. Launched in 2016 as part of the *Swachh Bharat Abhiyan* (Clean India Mission), the survey is recognized as the largest cleanliness survey in the world, which covered 4,242 cities in 2020. Ambikapur's rankings have drastically increased since 2014, when it ranked 372 out of 476 cities. Since the implementation of *Swachh* Ambikapur Mission City Level Federation (SAMCLF), here are the city's recent rankings:

2017

- Ranked #15 nationally out of 434 cities
- Awarded India's Cleanest City in the <200,000 population category
- Ranked #1 in Chattisgarh state
- Certified "dust bin free" city

2018

- Ranked #11 nationally in the >100,000 population category
- Awarded India's best city in the Innovations and Practices category

2019

- Ranked #2 nationally out of 4,237 cities
- Ranked #2 in the >100,000 population category
- Achieved 100 percent "dust bin free" city
- Existing dump site has been fully remediated and converted into a park

2020

- Ranked #1 in the 100,000 – 1,000,000 population category
- One of only six cities nationally to receive a 5-star ranking by the Ministry of Urban and Housing Affairs

The following activities were conducted:

- *Swachhta* (cleanliness) road rallies
- Door-to-door awareness campaigns
- Street plays
- *Swachhta* competitions in schools and colleges
- Billboards and distribution of leaflets
- Distribution of blue and green waste bins for wet and dry waste, respectively
- Bike rallies
- Road sweeping drives
- User charges for households when door-to-door collection was initiated.

A total of 450 SHG members and 13 area-level federations (ALFs) were involved in community participation to create awareness among residents on source segregation as well as the use of individual household latrines and community and public toilets.

Door-to-door Collection

In 2015, a training program was organized for women volunteers. Five hundred women were hired to start door-to-door collection work. Teams of three members were formed and each team was assigned 100 households from where they had to collect waste daily. The members were organized into SHGs and formed a city-level federation, the *Swachh Ambikapur Sahakari Samity*. By 2016, all 48 administrative wards of the city were receiving door-to-door collection service.

As of 2019, around 447 members from 34 SHGs involved in 18 ALFs are responsible for door-to-door collection of waste from over 27,000 households and more than 4,500 commercial entities and other establishments. Members work from 7 am to 5 pm daily, collecting waste and working at secondary segregation centers. Each member has a uniform of a green sari, white cap, and yellow gloves. Approximately 45–50 tonnes of waste per day are collected and processed daily.

Waste Segregation

The collected waste is taken to secondary segregation centers, each of which consists of three to four SHGs. Each center is equipped with either manual or battery-operated tricycles, depending upon the size and number of households/commercial establishments in each ward. The workers segregate the waste into 24 categories of biodegradable and non-biodegradable waste. Biodegradable waste is composted and sold to government agencies, such as agriculture and horticulture departments, as well as to farmers. Listed vendors purchase recyclable, non-biodegradable material at fair prices. Thus, an ALF on average earns Rs 400,000–500,000 per month from the sale of biodegradable and non-biodegradable waste.

In addition, tertiary segregation centers have been developed for further segregation of non-biodegradable items. These centers are responsible for segregating non-biodegradable waste into 169 categories and generally handle waste that exceeds the capacity of secondary segregation centers.

Why – Reaping the Benefits

The city spent Rs 60 million to set up the entire collection and sorting infrastructure under SAMCLF and has already earned one-third of that through user fees and the sale of compost and recyclables. The project has several social, economic, and environmental benefits.

Socially, the city has become more aware of SWM issues and challenges. Citizens' perspectives have changed from waste as something to be disposed of to a "resource". It is widely accepted that the active participation of residents in the entire process from waste segregation to disposal was the cornerstone of the success of the *Swachh* Ambikapur Mission. The incremental implementation and engagement of various stakeholders at every step have led to the strengthening of this model and a change in citizen behavior towards waste management in Ambikapur.

This is reflected in the reports of SHG members that some households have started collecting non-biodegradable items at home to sell and have stopped disposing of them as waste. SHG members earn roughly Rs 6,000/month, creating livelihood opportunities for hundreds of underprivileged women.

The city has accrued a number of economic benefits. While it was envisioned that decentralization would reduce costs, since 2015 the city has seen more savings and reduced costs related to collection and transport. Overall, the project saves the municipal corporation 52 percent of SWM costs per year, of which collection and transport-related costs alone account for over 41 percent of the savings. It was noted that when the municipal solid waste collection system migrated from wage labor to a community structure, worker efficiency improved so significantly that the requirement for the number of workers fell by more than 50 percent. Operational expenses at the dump site also declined due to the decrease in the amount of waste being disposed of there. Moreover, user charges of up to Rs 1,600,000 per month were collected by the city, and the sale of non-biodegradable wastes generated a monthly revenue of Rs 400,000-–600,000.

Environmentally, 30–35 tonnes of biodegradable waste is processed daily to generate compost, thus diverting this amount that would otherwise have been disposed of in an unsanitary dump, which would have resulted in methane emissions from its decomposition and in leachate production. By receiving clean, segregated waste, there has also been a reduction in the need for chemical disinfectants, which has resulted in a savings of 8 percent.

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9. Panchgani, India: From Kachra Point to Swachh Bharat Point

Where – Panchgani, India

Panchgani is a small hill station in Maharashtra state, with a population of around 14,984 (2011) and an average influx of about 1–1.2 million tourists annually. The town is divided into 17 administrative wards with the Panchgani Hill Station Municipal Council (PHSMC) being responsible for solid waste management across all wards.

The town generates about 7.2 tonnes of municipal solid waste (MSW) per day, comprising a biodegradable fraction of 84.89 percent, a non-biodegradable fraction of 15 percent, and a small inert fraction of 0.11 percent.

What – Lack of an Efficient Waste Management System

Until late 2013, Panchgani had a large municipal dump site. The waste collection system comprised of large dumpsters spread across the town and 51 workers that catered primarily to the town's tourist population.

Due to insufficient labor to collect the generated MSW, not all households were serviced and residents often discarded their unsegregated waste by the roadside and in abandoned areas, leading to a serious problem. The collected waste was segregated at the dump site by privately-contracted staff.

The town had no proper waste management system and as a result, waste was dumped in the open. The biggest challenge faced by the PHSMC was segregation of waste post-collection. Additionally, the humid and wet climate of the hill station made the dump site a potential health hazard due to the generation of leachate. Incidentally, the climate also posed a significant challenge to the council's initiative to treat wet waste through vermicomposting, following which they switched to mechanical composting.

How – Driving Positive Change

Segregation at Source

Panchgani previously had around 21 *kachara kundis* or large community bins which were emptied by *ghanta gadis. Ghanta gadis* are waste collection vehicles where a collector sounds a horn or rings a bell and waits for residents to bring their waste to the collection vehicle. Due to the lack of waste segregation in this block collection method, the PHSMC decided to do away with *ghanta gadis* and switch to a door-to-door collection system. With the help of corporate funding, the municipality provided two color-coded waste bins to each household in the town: Blue bins for wet (biodegradable) waste and green for dry (non-biodegradable) waste. Non-segregated waste was refused at source. Under the *Swachh Bharat* and *Swachh Maharashtra* Missions, the PHSMC conducted ward-wise training for residents on waste segregation and transitioned to a door-to-door collection system. The PHSMC targeted commercial establishments and schools in the first phase and then rolled out the door-to-door collection model to households. The municipal council started its segregation campaign in 2013 and by 2017, the city had achieved 100 percent segregation at source, including commercial establishments and bulk generators.

The segregation system transitioned to further segregating waste into sanitary waste where residents are required to separately wrap waste such as diapers and sanitary napkins. These wastes are picked up along with dry waste for further segregation. After collection, dry waste is segregated into eight categories: Glass, clothes/rags, sanitary waste (sanitary pads and diapers), plastic bottles and other plastic waste that can be granulated, plastic wrappers that can be shredded and converted to furnace oil, footwear, coconut shells and wood, and healthcare waste.

Collection and Transport

PHSMC outsourced the collection and transport of waste to a private contractor. The municipal council provides protective gear such as gloves, coats, and footwear to staff, along with insurance. The contractor uses three tractors and two vehicles for door-to-door collection twice a day. Tractors were chosen due to the hilly terrain. As user fees, PHSMC charges 10 percent of property tax for residential areas and 25 percent of property tax for commercial areas and institutions. The collection and management of medical waste have also been outsourced to a private company.

Being a small hill station, Panchgani is classified as an eco-sensitive zone, which limits the kind of waste facilities that can be established there. Given this criterion, Panchgani only has a composting plant, while recyclables are sent to Pune, a town two hours away, and sanitary and healthcare wastes are sent to Satara, approximately an hour away from Panchgani.

Processing and Disposal

There is one composting facility in town, known as *Swachh Bharat* (Clean India) Point, where 3.5 tonnes of wet waste are brought every day. After the failure of its vermicomposting initiative, the PHSMC decided to shift to a mechanical composter that now produces compost and enables the council to earn revenue. The compost is sold to farmers at Rs 5 per kilogram.

In 2019, the council planned to set up a 6-tonne per day biomethanation plant and invited tenders for the same. Under the guidelines issued by the PHSMC, bulk wet waste generators including resident welfare associations, parks, and gardens compost their wet waste on-site.

The previous waste disposal site called the *Old Kachra Depot* (Old Garbage Depot) has been rehabilitated into a public park called *Swacch Bharat* Point that is now a major tourist attraction.

Enforcement

In Panchgani, single-use plastics less than 50 microns and Thermocol are banned under guidelines issued by the PHSMC. To move towards a zero-plastic town, the council has imposed strict fines and conducts regular raids to confiscate banned plastics. Fines are also imposed for littering and for non-segregation of waste. As an alternative to plastic, self-help groups supply cloth bags to shops, and most vegetable vendors offer home-stitched cloth bags.

To sustain the process of segregation and to overcome challenges, *Swachhagrahis* are appointed to monitor day-to-day activities in all 17 wards. Under the *Swachh* Bharat Mission guidelines, *Swachhagrahis* are volunteers who help with waste collection and other related tasks. They can be locally-accredited social health activists, auxiliary nurse midwives, or youth organizations. *Swachhagrahis* are considered the key motivators of the *Swachh Bharat Abhiyan* (Clean India Mission), charged with the responsibility of bringing about behavioral change with respect to sanitation and waste. Additionally, ward councilors are in charge of conducting routine inspections. The PHSMC also runs campaigns to create public awareness and train residents and commercial entities on proper segregation practices.

Being a major tourist attraction, Panchgani devised a way around the issue of waste disposal tourists might face in a bin-free city. Each tourist is handed an eco-friendly bag for a small deposit fee in which tourists are required to collect their waste. This fee is refunded when the trash bag is deposited upon the tourists' departure, ensuring that there is no littering.

Why – The Cleanest City in India

The efforts of the PHSMC, under the leadership of Mayor Laxmi Karhadkar, who is in her fourth term, have resulted in a number of successes:

- Within four years of implementation, Panchgani achieved 100 percent segregation at source.
- In the 2018/19 financial year, PHSMC revenue related to MSW included Rs 400,000 as user fees, Rs 950,000 from the sale of compost, and Rs 185,000 in fines.
- The town processes nearly 90 percent of collected waste.

- In the *Swacch Survekshan* 2018, an annual cleanliness survey conducted by the central government across thousands of towns and cities in India, Panchgani won the award for the 'Cleanest City in West Zone' (<100,000 population category) and was also recognized as the Cleanest City in the country (<100,000 population category).

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10. Panaji, India: Solid Waste Management Requires Sustained Efforts

Where – Panaji, India

Panaji is the capital city of Goa, India's smallest state. It is the largest city in the state, with a core population of 40,017 and an urban agglomeration population of 114,759 that includes satellite towns. The city ranks very high on the cultural heritage index and is a popular tourist destination. As the capital city, Panaji (formerly known as Panjim) hosts a big fraction of Goa's tourists, witnessing a large floating population.

The 7.56-sq. km. city is divided into 30 administrative wards under the jurisdiction of the City Corporation of Panaji (CCP). In 2017, the city generated an estimated 80 tonnes of municipal solid waste (MSW) a day and as much as 200 tonnes a day during peak tourist seasons.

How – Initial Plans

When the CCP first introduced source segregation, it implemented door-to-door collection of waste in two streams. Residents of Panaji were provided two color-coded bins at subsidized rates: black for dry (non-biodegradable) waste and green for wet (biodegradable) waste. Waste was collected by trained sanitation workers who deposited the segregated waste in new, larger color-coded community trolley bins with lids. Once full, these community bins were emptied into municipality trucks that transported the segregated waste to the only dump site in Panaji. In 2005, the dump site was closed due to poor management.

In 2008, CCP divided the city's 115 residential colonies into 12 zones to enable better waste management and effective implementation of its strategies. This zonation has persisted to date, and each zone has dedicated sanitation workers and a supervisor assigned to monitor MSW management.

In 2011, CCP initiated a five-way source segregation system, including four fractions of dry waste. This was aimed at improving the efficiency of segregation and recycling. Pink bins were used for paper and cardboard, brown for plastics, black for glass and metals, white for non-recyclables, and green for wet waste. Bulk waste generators like hotels and restaurants were assigned bags with the same color-coding instead of bins.

Wet waste is processed at three centralized facilities and between 65 to 70 decentralized community plants. Residential complexes are encouraged to compost on-site, with excess waste collected by CCP staff. Market-generated wet waste (primarily vegetable and floriculture) is sent to a four tonne per day (TPD)-capacity composting plant near the market itself. In 2016, it was estimated that Panaji was composting as much as 70 percent of all wet waste generated in the city.

All dry waste is sent to 12 waste sorting centers, one for each zone, and then taken to a materials recovery facility (MRF) run by CCP, which has a dry waste processing capacity of seven TPD. At the MRF, the dry waste is further segregated into 20 different fractions and processed accordingly. Salvaged recyclables (about three TPD) are then auctioned to vendors at the site itself. Thermocol is shredded and broken down into smaller chunks that are either recycled or sold to vendors to generate additional revenue. The combustible non-recyclable waste (four TPD) is sent for co-processing to cement plants in the neighboring state of Karnataka. It was estimated that by 2016 nearly 2,464 tonnes of non-recyclable waste had been sent to cement kilns. Between February 2014 and October 2015, around 926 tonnes of recyclable material was sold by the MRF, contributing substantially towards additional revenue.

Despite a well-planned structure of the five-pronged segregation approach, the CCP failed to cater to sanitary waste and healthcare waste. In addition, the CCP decided to switch from a decentralized approach to a centralized system by building waste management facilities on the outskirts of the city. This resulted in Panaji dropping in the *Swachh Survekshan* (national cleanliness survey of cities across India) rankings: In 2017, Panaji ranked #90 and by 2019 it had dropped to #337.

By 2017 there were reports of only seven dry waste sorting centers and 50 wet composting centers that were functional. The existing waste management facilities were stretched beyond capacity and several large illegal mixed-waste dumping sites came into existence.

Even with the decline in the waste management system, the municipal corporation is still collecting user fees. Households pay Rs 365 and hotels pay between Rs 300–10,000 per year. The CCP also continues to earn

revenue from selling recyclable materials to waste dealers and non-recyclable waste to cement kilns across the state border.

Why – Towards a Zero-Landfill, Bin-Free City

In 2003, much before the *Swachh Bharat Abhiyan* (Clean India Mission) or *Swachh Survekshan* city cleanliness rankings were adopted by the central government, Panaji adopted a decentralized solid waste management system. At the time, overflowing bins raised concerns over odor issues, pests, and stray animals drawn to the garbage, as well as on potential disease outbreaks. In a bid to overcome land constraints, including the lack of a sanitary landfill site, CCP introduced various changes including the introduction of a door-to-door collection system and source segregation for all waste generators in its jurisdiction. Within a decade, it became a zero-landfill, bin-free city.

However, it should be noted that despite all efforts, Panaji struggled to maintain its status of a zero-landfill city as the various interventions were not sustained.

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11. Himachal Pradesh, India: Waste Warriors - Transformation through Replicable Models of Solid Waste Management

Where – Himachal Pradesh, India

Waste Warriors is an NGO involved in solid waste management (SWM). Established in Dehradun, Himachal Pradesh, the organization works on projects in the region as well as in several parts of India. Waste Warriors focuses on the 3 Rs, composting, and the importance of proper waste disposal systems to tackle India's ever-growing solid waste problem.

Even before formally registering as Waste Warriors, a group of volunteers called the *Mountain Cleaners* worked on tackling SWM challenges in McLeod Ganj, home to the Tibetan government-in-exile, in 2009. In 2012, Waste Warriors was formally established by seven individuals who organized clean-up drives in Dharamshala, McLeod Ganj, and along trekking trails in Himachal Pradesh. By 2016, it had 60 members and in 2020 had grown to over 90 members. Waste Warriors expanded their work to reclaim a children's playground in Dharamshala and to clean-up the Triund and Bhagsunag trekking trails, which were littered with waste from multiple expeditions. They also expanded operations to Jim Corbett National Park where they educated villages in the buffer zone on the importance of segregating waste and assisted in setting up a waste management system there.

As an NGO, Waste Warriors mainly receives funding from corporations, private funding agencies, and partnerships with government agencies.

How – Train, Segregate, and Empower

Waste Warriors is involved in promoting practical, community-led SWM initiatives in rural, urban, and protected areas. It implements replicable models of resource management, innovative practices, research, and education to bring about behavioral change among residents. In parallel, Waste Warriors also works to improve working conditions for waste workers by launching awareness drives and changing stereotypes about the image of waste workers. The organization works in three key locations: Dharamshala, Dehradun, and Jim Corbett National Park.

Training

Waste Warriors provides SWM training and awareness programs to educate residents about the importance of waste segregation, composting, and recycling. The organization also offer consultancy services to provide advice and to create SWM action plans.

Waste Collection

Waste Warriors run a regular waste collection schedule in three locations. For instance, in Dharamshala, it has established a door-to-door collection system where staff ensure that waste is segregated at source so that recycling becomes an effective option. Different waste bags are assigned for recyclable, non-recyclable, and wet waste. Waste Warriors workers separate the recyclables into different categories, which are then sold to *kabadiwalas* or scrap shops. The non-recyclable waste is sent to disposal sites while wet waste is composted. This segregation and recycling ethic is also extended to large public gatherings and events, where Waste Warriors teams actively manage the waste generate and segregate as much as possible for recycling.

Empowering Waste Workers

A key focus of Waste Warriors is to empower waste workers. The organization provides equipment such as brooms, bags, protective gloves, masks, and uniforms. In addition to the training it provides to workers, Waste Warriors also pays fair wages, provides medical insurance, and contributes to the workers' Provident Fund or pension.

Why – Triund, the Cleanest Hiking Trek in India

Waste Warriors has had significant achievements and has also been recognized for its work. Some of the highlights include:

- In 2015/16, Waste Warriors collected over 175 tonnes of waste from Jim Corbett National Park, 191 tonnes from Dehradun, and 273 tonnes from Dharamshala.
- The organization has so far collected and processed over 4,223 tonnes of waste from Bhagsunag and Triund. This resulted in Triund being recognized as the cleanest hiking trek in India.
- In Dharamshala alone, Waste Warriors has saved an estimated 46 acres of landfill area by segregating and processing recyclables.
- Waste Warriors was awarded the Mountain Protection Award by the UIAA International Mountaineering and Climbing Federation in 2016 and the Emerging NGO Award in 2017 by Socio-Political Observer of India (SPO India), among others.

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12. Dehradun, India: Improving Waste Management One Step at a Time

Waste Warriors is a Dehradun-based non-profit waste management organization that undertakes waste collection services, waste management consultancy, and other related projects in several parts of India. Established in 2012 in Himachal Pradesh, the organization stresses on the 3 Rs, waste composting, and the importance of proper waste disposal systems to tackle India's ever-growing solid waste problem. In Chapter 12 on Waste Warriors, India: Transformation through Replicable Models of Solid Waste Management, there is more information on the organization. This chapter describes the work conducted by Waste Warriors in Dehradun, capital of the Himalayan state of Uttarakhand.

Where – Foothills of the Himalayas

Dehradun has a population of over 578,000 (2011) and is at an elevation of 1,466 feet. It is a popular tourist destination due to its pleasant weather and hill station characteristics and often acts as a layover for tourists traveling to higher altitudes. As a tourism hotspot, the city faces major solid waste management (SWM) challenges such as dumping of mixed waste, unsightly street litter, overflowing bins, and choked drains. The city is divided into 100 wards which are maintained and managed by the Dehradun Municipal Corporation (DMC).

What – Lack of Awareness and a Mountain of Waste

The state of Uttarakhand has a total of 912 wards, and as of 2018, only three percent were following 100 percent segregation of waste at source. Furthermore, 21 percent still did not have 100 percent door-to-door collection of municipal solid waste (MSW). Dehradun has a population of over 1.2 million, putting immense pressure on the already weak SWM system in the city. Additionally, despite being a popular tourist destination, Dehradun lacks a waste management system that can cater to the large amounts of MSW generated with an increasing influx of tourists. The waste produced by the city has increased from 51 tonnes per day (TPD) in 2002 to 292 TPD in 2015, a nearly six-fold increase. It is currently estimated to be more than 300 TPD, of which 25-30 tonnes (approximately 10 percent) comprises plastics alone. In a 2018 review, it was found that nearly 60 percent of residents were unaware of proper waste management practices and more than 40 percent of the waste was left untreated.

How – Initiatives to Improve Waste Management in 2019/20

Model Ward 21

In 2019-20, the Waste Warriors devised a plan to establish a model ward in Dehradun with a proper SWM system that could serve as a model for the rest of the city. The initiative began in Ward 21, with an estimated residential population of 8,500.

The Waste Warriors team started by collaborating with the Nagar Nigam, or city municipality, and community representatives to include the stakeholders in the decision-making process. Extensive awareness programs

were carried out to disseminate knowledge about SWM practices, the importance of segregation, the current state of the city, and potential solutions. Through this, households were encouraged to segregate waste at source.

At the time of writing this report, around 80 percent of the 1,500 households are segregating waste at source and the informal dumps in the ward have been cleared away. A hundred residents have stepped up as *Swacchta ke Sipahi* (cleanliness soldiers), and are taking charge of waste management in their areas. Shops in a commercial complex that struggled with cleanliness and waste management were given garbage bags and now segregate their recyclables.

Dehradun City

The Waste Warriors expanded this model to the rest of the city in collaboration with the DMC. Given the lack of financial resources, the DMC sought and obtained external funding from corporations to set up a ward-wise waste management system comprising door-to-door waste collection and segregation. Waste Warriors Green Workers served more than 1,700 households while the DMC catered to the rest. The funding also helped Waste Warriors provide regular monthly wages and insurance to more than 50 Green Workers.

The Waste Warriors initiated a worker training plan to implement and execute SWM plans. As with model Ward 21, they carried out training and awareness programs, explaining the importance of segregation and recycling in waste management. Most communities now segregate wet and dry waste into separate bags which are collected by a DMC vehicle, some of which is brought to the Waste Warriors segregation facility for secondary segregation.

In 2019/2020, Waste Warriors sent 521 tonnes of total waste to the DMC facility from which almost 70 tonnes of recyclables were recovered. These recyclables were further segregated into more than 15 waste categories before being sent for recycling or being sold to scrap shops. Over the course of the year, more than five tonnes of multi-layered plastic packaging was sent to the Public Works Department to be used in road construction. The Green Workers maintained 44 community waste bins and collected over 30 tonnes of waste from the bins alone. They also collected and composted six tonnes of dry leaves from public spaces in 12 leaf composting enclosures.

To maximize efficiency, Waste Warriors also engaged with 120 businesses across Dehradun and provided door-to-door waste collection services; 50 wet waste bins were provided and the workers collected around 13 tonnes of waste from these businesses.

Sahastradhara, Dehradun: Towards a Zero-Waste Tourist Destination

Sahastradhara, meaning thousand-fold spring, is a popular tourist destination located in Dehradun. It is the site of a small stream that flows through the hills and is marked by natural sulfur springs which are believed to have therapeutic qualities.

One of the most popular tourist destinations in all of Uttarakhand, Sahastradhara struggled with waste generated by tourists. With no proper facility for waste collection and disposal, the area was marked by overflowing waste bins, dirty lanes, and waste in the water and along waterways.

In 2019, the Waste Warriors initiated a clean-up program intended to make Sahastradhara a zero-waste tourist destination. The organization conducted a clean-up drive and collected around 200 kilograms of waste. A solid waste management system was established and awareness programs were conducted. Waste Warriors collaborated with local authorities and installed 50 waste bins in the market. Residents were urged to segregate waste into recyclables, non-recyclables, and wet waste. Waste Warriors workers provided door-to-door waste collection facilities to 120 establishments, targeting bulk generators like hotels, shops, and restaurants. Green Workers were provided with cycle rickshaws to collect the waste and transport it to a temporary Decentralized Waste Management Centre assigned by the Uttarakhand Tourism Department where the waste was stored and segregated. Five permanent staff collect waste from the establishments, maintain the bins, clean the streets, and also keep the riverside litter-free.

Through awareness campaigns, the Waste Warriors prevented the open burning of waste by the riverside and dumping of waste into the river. So far, it has segregated over 18 tonnes of waste generated in Sahastradhara.

While residents are beginning to segregate at source, the main challenge is generating awareness among the floating tourist population that contributes greatly to the waste generated.

Waste Warriors has faced several challenges along their one-year journey in Dehradun such as:

- Behavioral change: Addressing the lack of awareness and people's negative perceptions of waste and waste workers is a continuing challenge to segregation.
- Work force: Waste Warriors has taken on a huge responsibility to provide its workforce with training, but also to ensure that workers get adequate protection and coverage under government programs, such as the Ministry of Labour's Employees' State Insurance Corporation (ESIC) and medical insurance.
- Operational: Operational challenges continue, such as dealing with contractors, bureaucratic factors, and lack of statutory authority to initiate programs.
- Infrastructure: Lack of funding hampers the development of proper infrastructure. For instance, the waste segregation facility was not sufficiently large to handle recyclables, which at times got wet during the monsoon rains. This, in turn, made it difficult to obtain good re-sale value from scrap shops.

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13. Bani Gala, Pakistan: A Community-driven Model towards Zero Waste

Where – Bani Gala, Pakistan

Bani Gala is a small suburb of Islamabad, the capital of Pakistan, consisting of about 1,000 households. It is located on the eastern bank of Rawal Lake. The economic profile of the community is mixed. While a segment of the community is affluent, the majority of homes in the area comprise small holdings of less than 150 sq. m., primarily occupied by poor and middle-class residents.

What – Indiscriminate Dumping of Waste in Waterways

Households in Bani Gala generate approximately 5–6 kilograms of waste every day. Since no formal waste collection systems exist, the waste is collected by informal waste pickers and then dumped in open areas and along the Korang tributary banks and nearby ravines. The system is highly informal and haphazard, resulting in health hazards and an uncomfortable living situation for the local community.

How – Working Towards Zero Waste

Realizing the gravity of the situation, Amal, a registered civil society organization working towards zero waste communities in Pakistan, joined hands with the Karim Khan Afridi Welfare Foundation (KKAWF), another local civil society organization. Together, they established the Zero Waste Bani Gala project. The project is aligned with the goals of the *Clean, Green Pakistan* strategy of the Government of Pakistan.

As a part of this project, a community-based model was adopted to manage the waste generated in Bani Gala. A management committee was formed at the local level to design, manage, and monitor the project. This committee included representatives from the local government—the Metropolitan Corporation Islamabad (MCI), civil society, Amal, KKAWF, and local residents.

Integrated Solid Waste Management System

The project was formally launched in October 2019 and since then has provided a full range of services to Bani Gala residents. More than 300 households are participating and have agreed to segregate their waste into wet (biodegradable) and dry (non-biodegradable) fractions by using a two-bin system. Dry waste is collected at regular intervals and is sent for recycling, while the wet waste is transported to a disposal site. At present, there is no treatment for biodegradable waste, but there are plans to convert it to compost in the future.

Users are charged a nominal fee of approximately PRs 500-700 per month and are encouraged to download and use the Amal app to introduce them to the concept of a smart waste management system. Amal has also introduced an efficient complaint redressal system by providing users with a dedicated helpline to lodge complaints or to make suggestions for service improvements.

Green Center-Waste Recycling Facility for a Circular Economy

Prior to launching the project, residents paid private collectors for waste collection services. These collectors segregated valuable material which was then sold to the local *kabaria* or scrap shops, while the remaining waste was dumped in waterways and ravines in the surrounding areas. The entire process was unregulated and functioned without proper environmental safeguards.

Amal planned to formalize the waste collection system by connecting all service providers along the waste management chain, bringing them under one umbrella to provide efficient services and creating value addition by increasing recycling activities. Waste pickers and *kabarias* are now included in the network for environmentally-friendly recycling at Amal's Green Center that has been established in the area. Furthermore, MCI has allotted land for a transfer station and Amal's Green Center has been established with a recycling capacity of 10 tonnes per day.

Raising Awareness

To raise awareness regarding the two-bin system and other elements of integrated solid waste management (ISWM), Amal prepared and distributed awareness-raising materials, including brochures and banners, and launched a social media campaign to encourage behavior change in the community.

Amal also carries out door-to-door awareness activities regularly through which team members and volunteers meet with residents, influencers, and community elders to promote the project's activities and the benefits of an ISWM system.

Community Involvement

To formally launch the project and involve the community and other stakeholders, the Clean Green Bani Gala Festival was held on October 25, 2019. Mr. Malik Amin Aslam, Federal Minister and Adviser to the Prime Minister of Pakistan for Climate Change, and other community leaders participated along with the members of the community. Stalls were established displaying awareness materials and activities of the various projects being implemented by Amal and its partners, including GHS, a waste management company, and DrTech, an environmental technology company focusing on urban development, circular economy, and Sustainable Development Goals in Pakistan.

Amal's team is also joining forces with schools in the area to raise awareness among children as the main behavior change agents in the community. With the help of these schools, Amal's team hopes to make the Zero Waste Bani Gala Project a success story to be emulated across communities across Pakistan.

Why – Project Sustainability

Amal is using an innovative approach to ensure the sustainability of the project without funding from developmental partners or government resources. Operational costs are managed by collecting monthly fees from member households. Fees are nominal and are set by the community-based management committee that is steering and monitoring the project.

In the future, the project also envisages meeting some of the operational costs through increased recycling activity at the Green Center. The initiative will also lead to the creation of environmentally-friendly jobs for informal workers involved in waste collection and segregation activities.

Photo 13.1: Poster in Urdu explaining the source segregation process initiated by Amal

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14. Mexico City, Mexico: Bartering Recyclables for Food

Where – Mexico City, Mexico

Mexico City is the densely populated capital of Mexico, with a population of 8.85 million (2015). The city is responsible for generating almost 16 percent of Mexico's GDP and has a minimum altitude of 2,200 meters above sea level. It is surrounded by mountains and volcanoes that reach elevations of over 5,000 meters.

What – Growing Waste Concerns

Mexico City generates over 13,000 tonnes of municipal solid waste (MSW) every day, with the added problem that only roughly 15 percent is recycled. After the main Bordo Poniente landfill reached its maximum

capacity and was closed, the city's waste management concerns increased considerably. To decrease the amount of MSW sent to landfill and to encourage waste prevention and recycling, the Mexican City Ministry of Environment (SEDEMA) launched several initiatives to manage the city's waste. In 2012, SEDEMA launched an initiative called *Mercado de Trueque* or barter market to trade segregated household recyclables for locally-produced agricultural products, to reduce the amount of recyclable materials being landfilled.

How – Waste-for-Food Barter Markets

The market takes place in public places such as parks or plazas on the second Sunday of each month at different points around Mexico City, from the early hours until the fresh produce runs out. Each citizen can trade up to 10 kilograms of waste per market day of recyclables. Approximately 170 volunteers are needed to operate each market. The market is further supported by NGOs and staff from other departments within SEDEMA.

People visiting the market take their recyclable waste, which is identified and weighed, to be exchanged for green points. These green points are then redeemed for food from local producers such as vegetables, sauces, and jams.

The barter market developed strategic partnerships with 80 local producers and several recycling companies by 2014. The companies that are responsible for collecting the waste gather at the market and transport the segregated materials to recycling facilities at their own cost. In exchange for the recyclables, these private companies provide in-kind donations to the city government in the form of environmental education materials.

SEDEMA publishes specific data on each market with exact amounts of each waste collected online each month. These include paper, cardboard, high-density polyethylene (HDPE), polyethylene terephthalate (PET), aluminum, glass, flexible packaging, electronic waste, and oil. The website also shows the equivalent benefit achieved from recycling, such as trees that were spared, liters of water saved in the making of paper, the volume of waste that was not buried, kilowatts of electricity saved, and the amount of carbon dioxide not emitted, among others. See Table 14.1 for a snapshot of waste collected and the resultant benefits accrued for January to April 2019.

Table 14.1: Snapshot of waste sold and resultant benefits accrued from January to April 2019 from SEDEMA website (in Spanish)

Edicion	Lugar	Fecha	Papel	Tetrapack	Carton	Pet	Alunimio	Lata fierro	Vidrio	HDPE	Empaques flexibles	Electronicos A B C D E	Total de residuos	Litros de aceite acopiado*	Tickets ingresados	Asistentes
ENERO	Bosque de San Juan de Aragan	13/01/19	720.00	750.00	490.00	402.00	59.00	145.00	1,590.00	210.00	-	790.00	5,156.00	30	964	1,928
FEBRERO	Bosque de tlalpan	10/02/19	940.00	1350.00	1,245.00	966.00	102.00	430.00	2,870.00	588.00	-	1,051.00	9,542.00	130	1,721	3,442
MARZO	Bosque de chapultepec	10/03/19	790.00	865.00	806.00	915.00	86.00	490.00	2,638.00	545.00	-	953.00	8,088.00	60	1,565	3,130
ABRIL	Zoologico de Los Coyotes	14/abr/19	1,974.00	1,150.00	1,720.00	1,900.00	225.00	356.50	2,870.00	360.00	46.00	2,043.00	12,644.50	80	1,856	3,712

MES	*ARBOLES QUE SE EVITARON TALAR PARA TRANSFORMARLOS EN PAPEL	*LITROS DE AGUA AHORRADOS QUE SE UTILIZARIAN PARA FABRICAR PAPEL	LITROS DE COMBUSTIBLE QUE NO FUERON UTILIZADOS	*M3 DE BASURA QUE NO FUERON ENTERRADOS	KILOVATIOS AHORRADOS	** KG AHORRADOS DE MATERIA PRIMA	** KG DE CO2 NO EMITIDOS AL AMBIENTE	** LITROS DE AGUA SIN CONTAMINAR	**KILOMETROS DE INFRAESTRUCTURA HIDRAULICA SIN AFECTAR
ENERO	33.3	62,720.00	2,940.00	4	11,368.00	-	-	30,000	3,000
FEBRERO	60.1	113,120.00	5,303.00	7	20,503.00	-	-	130,000	13,000
MARZO	41.8	10/03/19	790.00	865.00	806.00	-	-	60,000	6,000
ABRIL	82.0	224.616	1,176	178	83,794	12,627	15,397	80,000	8,000

Source: SEDEMA n.d.

Why – Awareness, Recycling, and Waste Minimization

The overall objective of these markets was to build an educational program promoting a culture of recycling and local consumption among the population of Mexico City. The city created the barter market to explore sustainable alternatives to using landfills, as well as develop and maintain a culture of waste minimization and recycling. An additional aim of the project was to provide support to local producers and maintain traditional forms of agriculture in the rural areas of Mexico City. The market served to raise awareness among attendees, show that waste is a resource, and that the use of new materials can be reduced. The barter market is very popular among citizens, with more than 2,000 citizens participating in the market every month.

The markets have helped maintain agricultural communities in and around Mexico City, offered local products and services thereby reducing transportation costs, and provided a model for other regions in the country to emulate. But the markets do not only benefit local agricultural producers who receive subsidies from the city in the trading process; they also benefit the private waste industry by generating jobs in collecting and reusing valuable recyclables.

For citizens, it is not only an opportunity to learn about segregation and the value of recyclables to reduce the amount of waste disposed of in landfills but also to consume healthy and fresh agricultural products that generate comparatively fewer GHG emissions from transport as they are grown closer to the consumer.

Cities around the world would benefit from this approach to foster awareness of the value of recyclables among urban citizens, all while supporting local agricultural production or other local products and services that can be offered in exchange for recyclable waste. Projects such as these particularly benefit the low-income population, irrespective of country or region, generating important social and economic co-benefits.

The next challenge is to communicate that it is not enough to just recycle but also to minimize solid waste generation in the first place.

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15. Nepal: Composting in Mountainous Regions

Where – Nepal

Households in Nepal traditionally managed their waste by themselves, especially in historic cities such as Kathmandu, Lalitpur, and Bhaktapur. Household waste, being primarily biodegradable, was composted to use as a fertilizer substitute in gardens and fields or was used as animal feed. Over time, these practices were gradually lost due to changes in occupation and lack of space as cities began to grow. As a result, mixed household waste was dumped in the streets, creating a nuisance as well as a public health risk.

As cities in Nepal began to expand, the government encouraged the public to minimize waste at source as much as possible. In the 1990s, GIZ initiated a project in Kathmandu Valley to start three composting plants to process hundreds of tonnes of biodegradable waste. To support this initiative, waste was deposited in

containers to help with waste collection. As a result, the practice of household composting declined in urban areas. However, in rural and remote mountain areas, it is still practiced.

What – Too Much Biodegradable Waste, Too Few Plants

In many places, waste collection is done door-to-door and the biodegradable fraction is taken for composting. The final compost product is sold in local markets. Unfortunately, despite the strong drive towards this sustainable method of waste management, a large percentage of biodegradable waste remains in the waste that is taken to dump sites.

A solid waste survey was conducted by the now-defunct Solid Waste Management Technical Support Center (SWMTSC) in 60 newly-formed municipalities in 2016. While these municipalities did not represent all the municipalities in Nepal, they were semi-urban and approximately 50 percent of them were in the *terai* (plains) region. A key finding of the survey was that neither municipal nor community compost plants were found in the municipalities surveyed. The study further uncovered that approximately 51 percent of households in these municipalities were already practicing source segregation and composting in traditional ways, such as those described below. These practices were found primarily in rural municipalities.

In addition, the findings revealed that household biodegradable waste of all municipalities, in general, was qualitatively viable for producing compost, despite rural households sorting and composting waste more proactively. That said, no municipalities had community or municipal composting plants to manage such large amounts of biodegradable waste.

How – Common Composting Methods

Pit Composting

Farming communities make up the majority of semi-urban and rural settlements in the mountain areas of Nepal, where the primary occupations are livestock farming and agriculture. Biodegradable waste generated by these households is often used as animal feed, while cow dung and other animal excrement are used in pile or heap composting.

Residents of these communities commonly practice pit composting by digging pits in their gardens and burying the kitchen waste along with dry leaves and fodder. When the compost matures, it is used as organic fertilizer for gardening and farming.

Household Bin Composting

Household composting is common practice in the mid-hill and high mountain regions of Nepal, including in densely populated cities in these regions. To encourage this, the metropolitan cities of Kathmandu, Lalitpur, and Pokhara, together with other municipalities, have distributed over 1,000 composting bins each year within their municipalities. The SWMTSC also distributed thousands of composting bins to municipalities under its Waste Minimization at Source program.

Drum composting has been used by households in rural areas. Once biodegradable waste is filled in the drum, the compost is ready in six to eight weeks, after which it is used in home gardens. Box 15.1 provides details of

how a household drum is used for composting. SWMTSC distributed 4,000-5,000 composting bins as well as waste segregation bins every year to various municipalities.

Box 15.1: Household drum composting

A common drum composting bin is hexagonal in shape and has a 100-liter capacity. The drum is divided into two layers or segments inside the bin by an iron net or frame. An upper inlet is used to put waste in the drum and an outlet on one of the six sides at the bottom of the bin is where the ready compost is removed from. There are tiny holes in the six sides to allow for aeration. The bin is placed in a well-ventilated area and a few inches above the ground. First, thin layers of paper or straw are placed inside the iron frame to prevent waste from dropping into the bottom segment. A few inches of top soil or compost are then added and moistened. Biodegradable waste, especially wet waste such as fruits and vegetable peel that have been chopped into 1–2 inch pieces, are mixed with dry waste such as straw, rice husk, and dry leaves to balance the C/N ratio. A small amount of water is added regularly to keep the moisture level balanced at 60 percent. A microorganism solution can be added regularly to a level just above the waste in the bin to speed up the growth of nitrifying bacteria and thus, the composting process. The waste is turned regularly with the aid of tools for proper aeration inside the bin and to speed up the composting process. The compost is ready in six to eight weeks, after which it is removed from the outlet at bottom of the bin.

Household Vermicomposting

Household vermicomposting is another composting process used in mountainous regions of Nepal. In this process, red earthworms (a special species of red earthworm such as *Eisenia fetida* or *Lumbricus rubellus*) that eat decaying food are placed in compost bins. These earthworms are used to convert small pieces of biodegradable waste into humus-like material known as vermicompost. The higher the number of earthworms, the faster the compost is produced, making it the fastest method of high-quality composting, producing excellent organic fertilizer for nurseries and farming. It adds necessary nutrients to the soil, improving soil texture and increasing the water-holding capacity of the soil. The benefit of this method has pushed the Government of Nepal to promote the practice of vermicomposting for households in many hilly and mountain areas of Nepal.

Why – The Benefits of Composting

Composting has long been one of the most efficient ways to manage biodegradable solid waste. As more than 50 percent of municipal solid waste (MSW) generated in Nepal is of biodegradable origin, managing this fraction through composting at source significantly reduces the amount of MSW that needs to be collected, transported, and treated.

The benefits of composting include:

1. Reducing the volume of biodegradable waste that would otherwise make its way to dump sites or landfills, thereby reducing transportation miles and related costs;
2. Extending the lifespan of landfills by reducing the amount of waste that requires disposal;

3. Reducing the production of harmful greenhouse gas emissions, such as methane, through the anaerobic decomposition of biodegradable waste;
4. Reducing the need for chemical fertilizers as compost contains nitrogen, phosphorous, and potassium that crops and plant need in order to grow; and
5. Creating jobs at community and municipal levels, adding various benefits to the community.

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16. Bengaluru, India: Using GPS for the Solid Waste Management Sector

With the second-largest population and seventh-largest land area, India has a five million-kilometer network of roads and over 45 million businesses, which are growing and changing rapidly. Only 10–20 percent of these businesses are currently located on maps, and the gap is only expected to grow. With more than 100 languages and dozens of different cultures, the requirements and uses of the users will change just as much. To keep up with this growth and a wide variety of needs, maps need to advance technologically and adapt just as rapidly. The importance of smart maps in India is huge. India's infrastructure and population are estimated to grow by a large margin within the next few decades. Between 2007 and 2013, India's road network expanded by 25 percent and the number of businesses increased by 33 percent.

The Government of India launched the Smart Cities Mission in 2016, which is a countrywide urban renewal initiative that involves upgrading infrastructure, technologies, and amenities to make cities better, more sustainable, and citizen-friendly. The target is to make 100 smart cities by 2023, with Bengaluru being one of them.

The Smart Cities Mission is supported by the World Bank with financing from the Korea Green Growth Trust Fund to specifically demonstrate the importance of enhancing information and communications technology (ICT) for city planning and management. Information collected through various smart sources can be collated and analyzed to get updated, accurate, and comprehensive information on the ground.

Where – Bengaluru, India

Bengaluru is the 741-sq. km. capital city of the southern state of Karnataka, with a population of 6.8 million. The *Bruhat Bengaluru Mahanagara Palike* (BBMP), the fourth largest municipal corporation in India, is in charge of waste management in the 198 administrative wards of the city, which together generate more than 4,500 tonnes of municipal solid waste (MSW) daily.

What – Missing Vehicles and Uncollected Waste

Currently, only around 2,200 tonnes of this waste is processed. The BBMP has 4,200 auto-tippers and 550 compactors for SWM, not all of which are used daily for waste collection for various reasons. With only 50 percent of the waste being collected, 10 percent of the vehicles reported "missing" from duty, and no way to monitor the vehicles, the solution was to devise a mapping system that would track as well as optimize the routes taken by the collection vans.

Why – Uncovering a Garbage Scam and Optimizing Waste Collection

In 2018, following several complaints of MSW not being collected, the BBMP decided to install GPS in all the waste disposal vehicles. Upon further investigation of the fleet of vehicles and suspicions over the contractors' resistance to using GPS, the BBMP unearthed a huge scam wherein the contractors had provided an "inflated number of vehicles" and almost a thousand vehicles were "missing". Despite the BBMP incurring estimated losses of $5.5 million over fake vehicles, future scams were averted. Installing GPS would also allow the monitoring of driver behavior on collection rounds and at the dump sites, as well as monitoring where the waste was being dumped. Cities like Indore, Mysuru, Bhopal, Chandigarh, and Tiruchirappalli which had already implemented GPS monitoring of MSW disposal vehicles reported positive results and streamlined waste collection processes.

How – Tracking Waste Transportation

It was estimated that installing GPS trackers on waste collection vehicles would reduce the distance traveled by 80 percent through route optimization, and reduce an estimated 109 tonnes of carbon dioxide emissions annually. At present, 355 vehicles have been fitted with GPS trackers in a pilot study to assess efficiency.

Currently, several other cities in India including Kozhikode, Agra, Aurangabad, New Delhi, and Rajkot, to name a few, are also testing and implementing similar systems.

Smart Mapping in Mountain Terrains

Smart mapping of mountain cities and remote mountain towns could be beneficial. Currently, remote sensing techniques are being applied in hilly and mountain areas for hazard assessment, natural resource management, terrain visualization, and ecological and hydrological modeling.

The tourism industry faces challenges of tracking multiple tourist vehicles, multiple destinations on tour, topography, safety concerns, and optimal route selection which can all be solved using GPS tracking. The applications can further extend to optimize waste collection in mountain terrains where collection points may be far off or outside city limits, to ensure timely and efficient collection, monitor where the MSW is being taken, and even monitor dumping behavior.

The practical applications of GPS and GIS are endless. Many Indian states such as Maharashtra, Madhya Pradesh, Uttar Pradesh, Chhattisgarh, and Assam, have adopted water quality monitoring through high-resolution remote sensing and monitoring methods. Mapping rivers makes it easier to identify pollution hotspots, which is directly linked to solid waste management.

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17. Mestia, Georgia: Mini-Transfer Stations in Mountain Villages

Where – Mestia, Georgia

Mestia is a town located in the Caucasus Mountains of northwest Georgia, at an elevation of 1,500 meters. It is a small municipality facing growing solid waste management (SWM) issues, mainly as a result of the combination of increasing population levels, tourism, and living standards, as is common in other mountain areas in Georgia.

What – The High Price of Managing Mountain Waste

Around 900,000 tonnes of municipal solid waste (MSW) are generated annually in Georgia and more than 75 percent is estimated to end up at disposal sites, some of which are poorly managed. This is a significant issue in Georgia in contrast to other European countries such as Sweden, where only one percent of MSW ends up in landfills.

Georgia enacted a new waste law, the *Waste Management Code*, in 2015 to create a legal and regulatory framework to adopt the waste hierarchy. In 2016, the Georgian government adopted a *National Waste Management Strategy* for 2016-2030 and the *Waste Management Action Plan for Georgia* for 2016-2020. Currently, waste management is primarily financed by the national government. The national strategy aims to make the SWM industry fully self-sufficient by 2030 by initiating a system in which the population and private sector will fully cover expenses related to waste management. The system is expected to be gradually introduced from 2020.

Why – High Costs and Low Capacities of SWM

Georgia's mountainous regions have seen increasing issues with SWM over recent years. The new *Waste Management Code* obliges municipalities across the country to prepare SWM plans, including equipment, collection schemes, and integration with other systems such as spatial planning. SWM plans may also be prepared jointly by neighboring municipalities. This gives small and remote areas the flexibility to work together to achieve economies of scale in procurement and service provision.

The high costs associated with waste management in mountainous regions and a general lack of capacity pose a challenge in implementing suitable solutions. SWM challenges can become overwhelming in remote mountain villages where the infrastructure for waste collection and the removal of the waste is either badly organized or absent altogether. Access to these villages is difficult due to poor road conditions and erratic weather.

How – Small Transfer Stations for Big Change

The Green Movement of Georgia together with Friends of the Earth Georgia came up with a solution: They suggested setting up a series of mini-transfer stations in remote villages, using existing means and inputs from local communities.

The mini-transfer stations were used as temporary storage facilities for approximately three to six months. The storage duration depended on the size of the community and the amount of waste generated. The waste from the mini-transfer stations was picked up by the municipality and transported to the main transfer station in Mestia. The mini-transfer stations are equipped with waste segregation/separation areas to sort recyclables. Processing equipment, such as balers or compactors, were installed to reduce the volume of waste. Baling and compacting recyclables not only increases the space available but also makes it more valuable for recycling companies to purchase. Training sessions equipped local people with the skills needed to operate these mini-transfer stations.

The construction of these waste transfer stations in Mestia cost GEL 314,700 and was funded by the state budget of Georgia.

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18. Nanjido, Republic of Korea: From Dump Site to Eco-Park

Where – Nanjido, Republic of Korea

Nanjido, a small island on the Han River, was the official dump site of Seoul, the capital of the Republic of Korea. It boasted a unique ecosystem and rich biodiversity until March 1978, when the island was converted to a dump site to meet the needs of a rapidly urbanizing and growing city.

What – Biodiversity at a Dump

Nanjido was an open dump site for about 15 years with no modern technology to contain or treat the landfill gas and leachate generated. In 1993, the use of the island as a dump site was discontinued. By that time, a total of 92 million cubic meters of solid waste—amounting to two 100 meter-high waste heaps with no soil covering—had been erected on the island. The land had become uninhabitable except for the poor and vulnerable, who picked valuable recyclables from the mixed waste.

Given the economic non-viability of the vast land area (over two square kilometers), the city decided to convert the island into a “green” World Cup Park, to derive the best possible economic benefits while restoring the ecosystem on the island.

There were a few factors that played an important role in reclaiming Nanjido from a dump site, including political will, development of legal and regulatory interventions, inter-departmental coordination, and establishment of facilities to treat landfill gas and leachate, among others.

How – Opportunity and Partnership

First, the 2002 FIFA World Cup was used as an opportunity to establish a common, and more ambitious, vision of regional urban development and planning. The Seoul Metropolitan Government prioritized the environmental management of the Nanjido dump site and development of an eco-park and “New Millennium Town” as central to the preparation for the World Cup.

Second, modern, robust laws and regulations, founded on “green” principles and practices were enacted in the late 1990s to strengthen waste management in the country, especially focusing on landfills and after-closure management systems. These waste management laws and regulations were shaped by the realities of landfill management carried out in Nanjido from 1992 until its close for a faster and more environmentally-sustainable transition.

Third, the Seoul Metropolitan Government deployed all administrative powers and resources to complete the design for landfill stabilization and construction of the eco-park on schedule. To maintain a simple decision-making structure, funds from the general ordinary budget of the city were primarily used to cover expenses for landfill stabilization and eco-park construction. The total cost for the dump site stabilization (₩ 140.5 billion) as well as for the park development (₩ 82.7 billion) was ₩ 223.2 billion.

Fourth, inter-departmental coordination and partnership with private companies ensured the maximization of Seoul’s organizational capacity and simultaneous engagement with different experts to reduce the construction period for the establishment of the World Cup Park. Overall, six departments of the Seoul Metropolitan Government participated in the design and five departments participated in placing orders for construction and supervision. Nine private companies participated in the design phase, 23 contributed to the construction, and six were employed for construction supervision.

Fifth, adequate disposal and treatment infrastructure was planned in the 1980s and established to divert the flow of waste from Nanjido to these new sites, such as the Sudokwon Landfill Site. State-of-the-art resource recovery facilities were also established near Seoul three years after closure of the Nanjido dump, with the aim of generating sufficient energy to run the facilities as well as for district heating. Harmful gases are also monitored, captured, and treated. Between 1996 and 2005, four other resource recovery plants were established to implement policies intended to reduce the amount of waste going to landfills: The Yangcheon facility (400 tonnes per day (TPD)) in 1996, the Nowon Facility (800 TPD) in 1997, the Gangnam Facility (900 TPD) in 2001, and in 2005, the Mapo Facility (750 TPD), which was set up at the World Cup Park site itself.

Lastly, the cooperation between the public and private sectors played an important role in establishing and successfully operating resource recovery facilities. Four waste treatment plants also entered into voluntary agreements with neighborhood-level local governments to jointly use incineration plants. This ensured full utilization of the plant capacity in the early years. Additionally, a variety of recycling enterprises operated

together in complexes called “Resource Recycling Industry Clusters”. Wastes collected from large areas are brought to these complexes and efficiently recycled through cooperation among the enterprises.

Why – A Lower Carbon Footprint

The main achievement of this massive and well-planned undertaking by the Seoul Metropolitan Government contributed to the development of a low-carbon urban environment through integrated sustainable solid waste management. Some direct and indirect outcomes of Nanjido dump site clean-up and its conversion to an eco-park are summarized below:

- The eco-park, in effect, expanded Seoul’s recreational area by 5.3 percent.
- Imposing a disposal cost in proportion to the quantity of waste generated (that is, pay-as-you-throw or volume-based waste fees) changed citizen behavior and reduced waste generated at source. Municipal solid waste (MSW) discarded in 2017 per capita per day was 52 percent less compared to 1991.
- With a suite of laws and procedures intended to reduce, recycle, and incinerate, along with improved waste treatment facilities, only about eight percent of household waste from Seoul is presently disposed of in the Sudokwon Landfill Site.
- Landfill gas recovery and waste-to-energy technology provide electricity to 80,000 households in the Seoul metropolitan area, thus helping the city achieve its low-carbon targets.
- EPR policies, banning biodegradable waste in landfills, and the imposition of landfill charges enhanced recycling by about 86 percent and decreased landfilling drastically from 40 percent to nine percent between 1996 and 2015. This further mainstreamed the recyclables market and expanded profit-driven enterprises in the waste sector, creating around 11,000 jobs per year.
- It addressed livelihoods of waste pickers and socially-vulnerable people through strategies such as integration into the formal system, provision of safe working conditions, social safety nets, and training.
- Recirculation of resources has led to decreasing dependence on imports of natural resources.
- Converting dump sites into parks offers opportunities for urban restoration as well as for improving the local economy through international and domestic tourism.
- Model places like eco-parks are centers of education for restoration efforts, and showcase available technologies that help to foster citizen awareness and international knowledge exchange.

In 2010, Seoul received the Scroll of Honor Special Citation award from UN-HABITAT, in part for its transformation of Nanjido into an eco-friendly park. While the Scroll of Honor is awarded each year by UN-HABITAT, the Special Citation award is only presented when an outstanding achievement is recognized.

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19. Central Karakoram National Park, Pakistan: Waste Management in a High-Altitude Protected Area

Where – Central Karakoram National Park, Pakistan

The Central Karakoram National Park (CKNP) in the Gilgit-Baltistan region of Pakistan is a mountain area endowed with rich biodiversity, natural beauty, and important resources. The Park encompasses the world's largest glaciers outside the polar regions, and was declared a national park in 1993. Today it is the largest protected area in Pakistan, covering over 10,557 sq. km. in the Central Karakorum mountain range and is the highest national park in the world. It is characterized by extremes of altitude that range from 2,000 to over 8,000 meters, including K2, the second-highest peak in the world.

CKNP is home to important species such that long-term conservation and preservation need to be ensured. CKNP is a refuge not only for threatened species like Markhor, Musk deer, Urial, and Marco Polo sheep, but also for important "flagship" species such as blue sheep, ibex, lynx, and the snow leopard. It also represents an ecosystem that is a lifeline not only for people living in mountain areas but also for millions of others who live downstream. The glaciers are an important source of freshwater and, therefore, need protection from existing and future threats, both human-induced and natural.

The Baltoro Glacier in CKNP covers an area of approximately 700 sq. km. and is approximately 60 km long. It is amongst the largest valley glaciers in the world and is surrounded by some of the highest peaks on Earth. The Baltoro region is a paradise for climbers and trekkers from all over the world, with four peaks higher than 8,000 meters (K2, Broad Peak, Gasherbrum I, and Gasherbrum II) and 40 peaks higher than 7,000 meters. Today the fragile ecosystem of the area is threatened by solid waste, which has increased exponentially in the last few years.

There are 230 settlements and approximately 115,000 people living immediately adjacent to CKNP, the borders of which have been designed to exclude all villages and pasture lands. However, these communities have traditional rights to access the park area for grazing, hunting, collecting firewood, timber, and medicinal plants.

In recent years, the government and NGOs have introduced a variety of programs and policies to protect CKNP; however, conflicts due to the multiple uses of the park have led to issues relating to the park's management.

What – Waste Dumps in Pristine Habitats

The presence of a growing number of tourists and support staff in the fragile alpine environment of CKNP poses a significant challenge in managing the growing amount of solid waste and human excrement in the park. Tourists on treks and mountaineering expeditions contribute to the increasing volumes of solid waste in the pristine natural environment of high-mountain areas. Previously, there was no system in place to collect and manage the waste and, as a result, most trekking and mountaineering expeditions dumped their solid waste on the sides of trails, at camps, or in glacier crevasses.

Mountain tourism and the incremental trend towards mountaineering and trekking expeditions are adding even more strain to the fragile ecology of CKNP, especially the K2 base camp trek, starting from Askoli, which has become one of the most famous treks in Pakistan for foreign tourists, while many domestic trekkers have also started visiting this region every year.

The presence of a number of high peaks and the longest glaciers outside the polar regions covering about 38 percent of the whole park area attract a high number of visitors. To preserve the integrity of CKNP, the park has designated specific corridors where tourists are allowed to enter, with basic facilities to reduce their impact as much as possible. Data collected by the CKNP management show that 9,553 visitors have been recorded from 2011 to 2018, not including porters, guides, and other support staff. On average, one tourist requires a support team of five. So, in total, it is estimated that over 47,000 visitors entered the CKNP between 2011 and 2018.

How – Entry Fees and Projects for Change

In February 2015, a management plan for the park was finally established, following a year-long consultation with stakeholders and local communities. The plan covers ten sectors, including mining, tourism, and involvement of local communities.

The park is divided into two zones. The core zone, occupying about 7,600 sq. km., comprises the high mountain peaks, glaciers, and high-elevation mountain ecosystem. The other zone is the buffer zone, which comprises around 3,000 sq. km. of mainly lower-lying areas around human settlements and corridors providing access to different parts of the core zone.

In addition, the CKNP charges an entry fee ranging from $5-10 per person. A camping fee is also levied for those who spend a few days in the park, ranging from $5-15/night. Forty percent of the revenue is distributed to local communities and 60 percent to the CKNP Directorate. The federal government also charges its own administrative fee. In addition to other fees, there is also a $200 “pollution fee” charged per expedition.

The Ev-K2-CNR Project

The Ev-K2-CNR Project was launched in 1986 in collaboration with the Italian National Research Council. Its mission was to “provide specialized scientific support for sustainable development in high altitude areas, promoting environmental conservation and a better quality of life for local populations.” The Ev-K2-CNR Project started waste management activities in the Baltoro Glacier region in 2006 with the support of the Alpine Club of Pakistan. This collaboration resulted in the collection and removal of waste and other waste-related projects over the years, as shown in Table 19.1.

Table 19.1: Waste-related projects in the Baltoro Glacier region

Year	Collaboration
2006	Collection and removal of over three tonnes of solid waste
2008	Installation of an "Eco-incinerator" in the village of Askole to dispose of waste, the first and only one of its kind in Pakistan
2009	Removal of over nine tonnes of waste from the K2-Baltoro trekking route
2010	Removal of over 21 tonnes of solid waste and human excrement from camp sites along the Baltoro trekking route Installation of eco-toilets

Between 2015 and 2019, with support from Moncler, a famous Italian apparel brand, almost 29 tonnes of waste, including solid waste and human excrement was removed, segregated, and disposed of from the Baltoro Glacier, the K2 base camp, and Broad Peaks base camp. The collected solid waste was carried to Askole, the last village on the route to the Baltoro Glacier from Shiger, where it was segregated into tins, cartons, polythene bags, glass, paper, and other categories. The material that could be sold was transported to Skardu for sale, and the remaining burnable items were burned in the incinerator installed by the project for the disposal of waste collected from the high mountain camps. As this area is remote and only accessible on foot, the cost of shifting the solid waste from high camps to Askole is high, as it requires almost six days to walk down to Askole. For the first time in history, a dedicated expedition will climb so high as to clean up K2's high camps, beyond cleaning up the Baltoro Glacier and the base camps of the surrounding mountains at an average altitude of 5,000 meters.

Green Trekking Campaign (Promoting a Code for Eco-Friendly Trekking)

All stakeholders, including tourists, tour operators, porters, and guides, need to have greater awareness about their critical role in the area clean and in pristine condition. For this purpose, the Ev-K2-CNR Project also created awareness by organizing training workshops and promoting eco-friendly trekking ethics.

The Sustainable Tourism Foundation Pakistan, a non-profit organization promoting responsible and sustainable tourism in Pakistan, also launched an awareness campaign under the title of "Green Trekking", which promotes eco-friendly trekking and mountaineering in the mountainous regions of Pakistan. The slogan of this campaign is "take nothing but photos, leave nothing but footprints". The Green Trekking Code of Ethics seeks to educate trekkers on how to minimize their impact in fragile mountain areas. It provides guidelines in Urdu and in English related to waste management, wildlife protection, respect for local culture and traditions, toilet techniques, and water management. The waste-related guidelines are summarized in Box 19.1.

Box 19.1: Waste-related guidelines from the Green Trekking Code of Ethics

Plan to Pack it Out

- Pack items in reusable containers
- Remove unnecessary wrapping papers before you go on trek
- Minimize the non-biodegradables you bring in to the mountains
- Bring enough sturdy waterproof bags to pack out all non-biodegradable and non-burnable solid waste
- Bring durable lithium batteries from home rather than depend on inferior quality batteries

Do not litter. Burn it, Bury It or Carry It Out

- Litter is not only a sore for eyes but also harbours hazardous pollutants. All trash you or your staff, including porters, produce should be separated each day and treated properly
- Burn burnables (dry paper only); bury biodegradables such as food wastes. All non-biodegradables including glass, plastics, aluminum foil, batteries and cans etc. should be packed up and carried out to be disposed of properly. You can sell these items in the main towns and cities
- On the trail all members should carry polythene bags to collect any used paper, which you can burn in the evening

Leave No Trace

- Choose established camp sites wherever possible rather than disturbing new ground, even if it means sharing site with another group
- Avoid trenching around tents if the site is sloped and on high ground; a plastic sheet under the tent should suffice against rain seepage
- While trekking stick to the main trails, by avoiding steep shortcuts which contribute to erosion
- Don't create multiple trails across the meadows; try to leave them in their original condition
- At high elevations, trampling can wipe out an entire plant community which may not grow back for years. Loss of vegetation contributes to erosion. So don't walk through shrubs no matter how hardy they appear
- One could summarize by saying "take nothing but photos, leave nothing but footprints"
- Discourage members of your group and trekking staff from writing their names on rocks or trees; it destroys their natural beauty

Source: STFP n.d.

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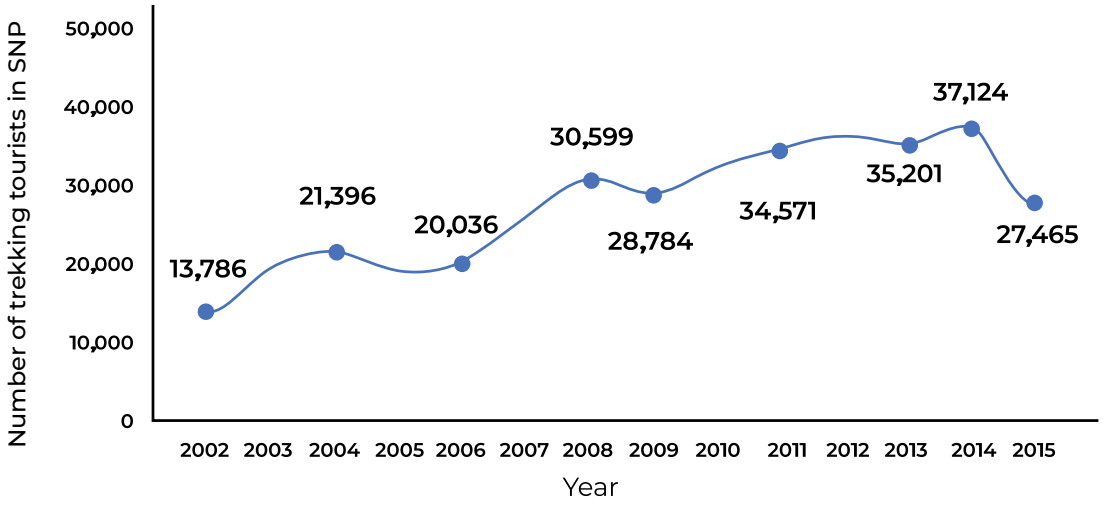
20. Sagarmatha National Park, Nepal: Proactive Solid Waste Management for Communities and Tourists

Where – Sagarmatha National Park, Nepal

Nepal's dependence on the tourism industry is well recognized and documented. The Government of Nepal has taken measures to set up segregated areas, such as the Sagarmatha National Park and Buffer Zone (SNPBZ), to preserve the pristine and delicate environment in these high mountainous regions. With that in mind, this chapter focuses on how the Sagarmatha National Park (SNP) manages solid waste in extreme conditions and what best practices may be applied to other parts of the country and even the region.

The SNPBZ is located in the Khumbu region in northeastern Nepal. The region's elevation ranges from 3,300 meters to the summit of Mount Everest (8,848 meters). Mount Everest is located in the SNP, which is the country's first national park to be listed as a UNESCO Natural World Heritage Site. The national park (1,148 sq. km.) was established in 1976 to conserve the world's highest ecosystem and to protect endangered wildlife and Sherpa culture, an indigenous group known for their mountaineering skills. A buffer zone (275 sq. km.) was created in 2002 to include settlements within the park boundaries. According to the 2011 Census, the total population in this rural municipality was 8,989, mostly comprising the Sherpa people. In comparison, almost 58,000 trekking tourists visited SNP in 2018, excluding mountaineering expeditions, which is six times the population of the park. The growth of tourism in the area can be seen in Figure 20.1.

Figure 20.1: Trekking tourist arrivals (excluding expedition groups) in the SNP from 1998 to 2018



What – Managing Tourism-Generated Waste

The SNPBZ is one of the major destinations for trekking and mountaineering in Nepal, especially in the autumn (September–November) and spring (March–May) seasons. With an increasing number of tourists visiting the region every year, various lodges/hotels, restaurants, and shops have been established along the trekking route. Increasing amounts of solid waste are thus generated, and managing this issue is a significant environmental challenge in the area.

In the SNPBZ, solid waste is generated from five primary sources:

- Local residents
- Commercial shops, hotels/lodges, and restaurants along the trekking route
- Institutions, such as offices and schools
- Trekking and expedition groups
- Healthcare institutions.

A study conducted by Kathmandu University (KU) in 2009 found a waste generation rate of 0.43 kilograms per person per day in the area. In 2011, the Vienna University of Technology and EcoHimal Austria, under the *Saving Mount Everest Project* found that waste generation per trekker is 0.28 kilograms per day. The project calculated this figure based on waste generated from travelling, food intake, and accommodation. It is unclear whether the KU figure is solely for local inhabitants or also includes tourist waste.

The KU study also found that the majority (almost 80 percent) of the waste consists of biodegradable food waste, followed by paper, plastics, metal, glass, and inert waste. However, as in other mountainous regions in Nepal, biodegradable waste is considered a resource for composting and animal feed, and is not mixed with other waste.

How – Policy, Segregation, and Planning

Since 1991, the Department of National Park and Wildlife Conservation (DNPWC), under the Ministry of Forests and Environment, has given a mandate to the Sagarmatha Pollution Control Committee (SPCC) to manage solid waste along the main tourist routes in the Khumbu region, including the provision of waste clearance certifications for expedition teams.

SPCC is an NGO established in 1991 with the aim of managing waste from local settlements as well as tourism waste in the Mount Everest region. The SPCC works in coordination with the Ministry of Culture, Tourism and Civil Aviation and the Nepal Mountaineering Association (NMA) to monitor expedition-generated waste at base camps of various peaks, including Mount Everest. All waste management activities are conducted in collaboration with the SNPBZ Management Committee and the local government in Khumbu Pasanglhamu rural municipality.

With the new federal structure created in 2015, responsibility for waste management has devolved to local governments in Nepal. The Khumbu Pasanglhamu rural municipality is in the process of developing a process for waste management for the Khumbu region. SPCC has extended its partnerships to youth groups, women's groups, and waste management groups in over 25 settlements in the Khumbu region.

With regard to tourist waste, the SPCC issues waste clearance certificates to mountaineering expedition teams after receiving their waste upon return from expeditions, which is required prior to the release of the waste deposit refund. The types and amount of waste generated by expedition groups in the Khumbu region in the 2017/18 financial year is summarized in Table 20.1.

The waste generated from Namche and Lukla, the two main settlements in the Khumbu region, in the 2016/17 financial year is provided in Table 20.2. The SPCC encourages local communities to segregate their waste into "burnable" and "non-burnable" categories. Burnable waste includes paper, plastics, wood chips, and textiles, and non-burnable waste includes metal, glass, gas cylinders, oxygen cylinders, and batteries.

Table 20.1: Waste generated by expedition groups in Khumbu region, 2017/18

Waste type	Waste quantity
Burnable waste	268 tonnes
EPI gas cylinders	1,905 cylinders
Batteries	2,216 pieces
Tins/cans	3,326 kg
Glass bottles	910 kg

Table 20.2: Waste collected by SPCC from local communities in Namche and Lukla, Khumbu region, 2016/17

Waste type	Waste quantity
Burnable waste	128 tonnes
Non-burnable waste	87.9 tonnes

As mentioned above, biodegradable waste is separated at source and the remaining waste is mixed together in provided waste bins. In settlements such as Namche and Lukla, where SPCC conducts door-to-door collection, SPCC staff segregate burnable and non-burnable waste before incineration.

In other major settlements, SPCC has constructed non-burnable solid waste collection centers for collecting and storing recyclable materials such as tins, cans, plastic bottles, and aluminum. As of 2019, SPCC had constructed 11 non-burnable solid waste collection centers in various settlements. Similarly, with support from a variety of organizations, SPCC has installed about 120 waste containers on various trekking routes to segregate waste into two categories: plastic and paper together and glass and tins together. Expedition teams are required to segregate their waste into burnable and non-burnable categories before leaving it with SPCC at the end of their trips.

SPCC provides door-to-door waste collection services in hotels/lodges and shops in Lukla and Namche. SPCC also partners with local groups in various places such as Thame, Thamo, Khumjung, Dingboche, Gokyo, Lobuche, and Gorakshep for solid waste collection and management. In most other settlements where there is no door-to-door collection service, households and businesses themselves transport burnable waste to nearby disposal pits and non-burnable waste to nearby collection centers.

Non-burnable waste from various settlements is transported to recycling centers in Kathmandu. For places with no road access, material with recyclable value is carried by porters and zopkyoks (a hybrid between a yak and domestic cattle) to Lukla airport. With support from Tara Air, the waste is airlifted to Kathmandu and handed over to *Blue Waste to Value,* a private enterprise based in Kathmandu with which SPCC has a recycling contract. Until 2018, the SPCC transported a total of 45 tonnes of non-burnable waste from Lukla to Kathmandu for recycling.

There are about 58 disposal pits in operation along trekking routes and in settlement areas in the Khumbu region. Some have been covered after being filled with waste, while others are still in operation. While there is no exact standard, these pits range from two to 400 cu. m. in size, and all are built with four walls from rocks that are locally available.

SPCC provides technical and financial support for the construction of disposal pits. While local groups have received training on segregating non-burnable and burnable waste prior to disposal, some places continue to dispose of both together. Burnable waste is burned in the same pits to reduce the volume of waste.

Why – Waste Minimization

Over the years, SPCC has initiated a number of steps to minimize waste in the SNPBZ:

- A ban on beer bottles since the 1990s (bottles were replaced by cans), which has been strictly implemented in the region
- More recently, the Khumbu Pasanglhamu rural municipality banned the use of plastic bags (under 30 microns in thickness) and PET bottles for soft drinks starting in 2020
- Currently, SPCC and local governments are working together to distribute cloth bags to local communities as an alternative to plastic bags in addition to conducting awareness programs
- Small-scale efforts to reuse materials have been initiated, such as reusing PET bottles to construct waste bins, reusing torn tent materials to make bags, and using waste paper to make briquettes.

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21. Mount Everest, Nepal: Clean Up Campaign 2019

Where – Mount Everest, Nepal

In Nepal, Mount Everest is known as *Sagarmatha*, meaning "forehead in the sky." Standing at 8,848 m, Mount Everest is located near the northern boundary of the Sagarmatha National Park. The park was created in 1976 to protect the mountain and its wildlife, and it became a UNESCO World Heritage site in 1979. The national park and its buffer zone are located in the Khumbu region of Nepal.

Sagarmatha National Park receives around 58,000 trekking visitors each year, excluding mountaineering expeditions, and this volume of visitors places a strain on the natural environment. For instance, deforestation is unchecked in the local area as people fell trees to build lodges and use firewood for tourists. During peak tourist seasons, the park receives as many as 500 people per day making the hike to the base camp of Mount Everest. This results in vast amounts of waste being generated with nowhere to dispose it.

However, the biggest issue of waste generation is on the mountain itself. Over 600 people attempt to summit Mount Everest every climbing season for a few weeks in the year when weather conditions are suitable. In addition, each climber has a local team to help cook, carry equipment, and guide the expedition.

What – Indiscriminate Waste Disposal

It is estimated that during the time that expedition teams spend on the mountain adjusting to the altitude, each person generates on average eight kilograms of waste, the majority of which is left on the mountain. It is common to find discarded empty oxygen canisters, abandoned tents, food containers, and even human excrement on the slopes. Coupled with this human impact, climate change is also creating a noticeable change. As higher temperatures cause snow and ice to melt, it is exposing waste that has been covered for decades but also long-frozen human remains.

According to researchers in the Nepal Himalayan region, there are two primary types of waste in the Everest region: litter from expeditions and household and tourist waste in towns and villages. Litter from climbers is strewn from base camps all the way up to the summit. This waste is primarily managed by the Sagarmatha Pollution Control Committee (SPCC), a non-profit organization working to keep the Khumbu Region clean. With support from the locals, the SPCC cleans and maintains several climbing routes. The organization has also installed over 70 trash containers along the trails and provides door-to-door waste collection in some villages.

The second type of waste is generated by lodges in towns throughout the Khumbu region. Lodge owners tend to bury what they consider burnable solid waste in pits on or near their properties. The pits contain all sorts of mixed waste: plastic, aluminum cans, glass bottles, paper, and more. When these materials are burned, they release toxic pollutants into the air and also leach chemicals into the soil and groundwater.

Another waste management issue is human excrement. Local climbers are hired to bring the waste down in barrels from base camps. Since there are no waste management or sanitation facilities, waste and sewage are emptied into big pits and wash into waterways during the monsoon season. Given the importance of the SNP watershed to thousands of people living in communities surrounding Mount Everest as well as downstream, this is a potentially dangerous health risk.

How – Overcoming Waste Challenges

The growing waste issues on Mount Everest have put the government in a tough spot—balancing environmental and health concerns with the economic benefits that expeditions bring to the country. According to Time Magazine, climbers contribute approximately $300 million to Nepal's economy annually.

In the 1980s and early 1990s, not much attention was paid to environmental conservation in the region. Expeditions frequently discarded anything that they considered unnecessary, such as depleted oxygen cylinders, to make climbing and the descent easier. It was considered good practice to bury rubbish or throw it into crevasses.

It is relatively easier to clean up base camps since they are accessible by yak and local labor is relatively inexpensive. However, waste higher up on the mountain is more of a problem. In the last three decades that Mount Everest started to gain popularity as a climbing destination and expeditions were expensive, costing thousands of dollars per expedition. However, with the dynamics now shifting to lower-priced operations and the popularity of reaching base camp, an increasing number of people, and hence waste, are becoming the new norm.

Both the government as well NGOs are working to clean up Mount Everest. In 2019, the Nepalese government launched a campaign to clear 10 tonnes of trash from the mountain. In 2014, the government launched a deposit scheme: Anyone visiting Mount Everest has to pay a $4,000 deposit, and the money is refunded if the person returns with 8 kilograms of solid waste, the average amount of waste that a single person is expected to produce during the climb. The SPCC, run by the local Sherpa people, works with the government to ensure that people have legal permission to climb and educates visitors on preserving the environment.

Why – Partnerships to Clean Nepal's Pride

The Mount Everest Clean-Up Campaign is organized annually as a way to tackle the waste issue on the mountain, generate awareness, and to strengthen public participation in waste management. In 2019, the largest ever clean-up campaign was conducted on Mount Everest with the theme "Clean Our Pride". The government, private sector, and various NGOs, along with international corporations, came together to support the event, including those listed in Table 21.1.

Table 21.1: Groups supporting the Mount Everest Clean-Up Campaign in 2019

Government	NGOs	Corporations
Ministry of Culture, Tourism and Civil Aviation	Sagarmatha National Park Buffer Zone Management Committee	Coca-Cola
Department of Tourism	Sagarmatha Pollution Control Committee	Nabil Bank
Ministry of Forests and Environment	WWF-Nepal	Prabhu Bank
Department of National Parks and Wildlife Conservation		Tara Air
Ministry of Industry		
Nepal Tourism Board		
Khumbu Pasang Lhamu rural municipality		
Nepalese Army		

It is estimated the project cost Nr 23 million. The target set for the 45-day clean-up campaign was the removal of ten tonnes of waste (five tonnes from Mount Everest and five tonnes from its foothills). Waste was split into two categories: Burnable and non-burnable waste. Burnable waste was managed in the waste recovery center in Namche town, while non-burnable waste was flown to Kathmandu for further treatment. The clean-up campaign also retrieved four bodies of climbers, which were taken to Kathmandu.

Such campaigns help to bring all the various concerned stakeholders together to preserve the pristine environment of the Himalayas. These partnerships also pave the way for future discussions and implementation of best practices to protect mountainous regions going forward.

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22. Machu Picchu, Peru: Saving World Heritage through Strategic Collaborations

Where – Machu Picchu, Peru

Machu Picchu, one of the New Seven Wonders of the World (2007), is the most visited tourist destination in Peru. Designated a UNESCO World Heritage site in 1983, the remains of the Incan Empire's citadel built around 1450 AD are located at an elevation of 2,430 meters in the Andes Mountains.

Around 1.6 million tourists (2018) visit Machu Picchu annually, reflecting a daily footfall of nearly 4,500 tourists. Tourism is a huge revenue earner for the area, bringing in nearly $4.9 billion in revenue in 2018, thus providing a huge boost to the Peruvian economy.

What – Garbage Peak on the Andes

In 2018, tourists generated an estimated five tonnes of waste per day, all of which was left behind at Machu Picchu. Plastic water bottles and food wrappers comprised the majority of the waste generated, most of which

either ended up in the nearby Vilcanota River, was burned, or simply dumped in pits dug in the ground. Used cooking oil was openly discarded by the many hotels and directly ended up in the river as well.

Solid waste management proved difficult for local authorities. Being a protected area, there were limitations on the size and capacity of waste management facilities that could be set up. Additionally, without any roads, the waste could only be transported by rail, but infrequently.

The problem reached its peak when the environment and rare flora and fauna became adversely affected by the accumulated waste. In 2006, UNESCO threatened to withdraw the World Heritage status, and in 2016, contemplated placing Machu Picchu on the list of World Heritage at Risk if waste issues were not tackled.

How – Collective Efforts to Save a World Heritage Site

The possibility of losing the World Heritage status concerned local authorities and communities deeply, as tourism is vital for the local economy. The District Municipality of Machu Picchu, along with private bodies like AJE Group and Inkaterra Asociación, a non-profit working for biodiversity conservation, started several initiatives to tackle the problem, intending to turn the area into the country's first eco-friendly zone. Some of these initiatives are described below.

Converting Cooking Oil to Bio-diesel

Several local restaurants and hotels came together to recycle used cooking oil instead of discarding it. The Inkaterra Machu Pichu Pueblo Hotel, run by the Inkaterra Asociación, spearheaded this initiative. In 2018, the Inkaterra Asociación funded a bio-diesel and glycerine plant, which was installed at the Inkaterra Machu Pichu Pueblo Hotel, to recycle used cooking oil collected from homes, lodges, and more than 200 hotels and restaurants to obtain bio-fuels. The bio-diesel plant receives nearly 6,000 liters of vegetable oil a month and processes it to produce more than 100 liters of biodiesel per day. This bio-diesel is then used by farmers in the district. The glycerine obtained through the process is used by the municipality to clean stone floors, completely replacing chemical products.

No to (Some) Plastics

The municipality stressed the importance of reducing plastics and rolled out a ban on single-use plastics to come into effect at the end of 2018, ensuring that tourists carrying any plastics would be restricted from areas listed under the ban. Local hotels and businesses were also urged to adopt a no-plastic approach and to use only recyclable bags. The local municipality also urged tourists to carry their own reusable water bottles and carry their wastes back down instead of discarding it at Machu Picchu. The next plan is to install water dispenser stations at strategic points.

Recycling

A private initiative was started to collect and recycle all plastic bottles in the area. As much as a tonne of plastics were being recycled every day but the small plant was unable to cope with the recycling requirements. The AJE Group and Inkaterra Asociación donated a plastic compacting plant in 2017 to the National Service of Natural Protected Areas (SERNANP) to cater to plastic waste collected along the Inca Trail. The plant processes up to four times more plastic bottles and has helped increase the amount of plastic processing and recycling in the area. Given the larger capacity of the new compactor, plastic waste is now processed and compacted

faster than before and is then transported to the municipality's transfer point in Pachar town 59 km away by train, where the compacted plastic blocks are further recycled. The plastic compactor's large volume has allowed plastic waste to be processed and transferred faster, ensuring that there is minimal accumulation.

Biodegradable Waste Treatment

In 2019, Inkaterra Asociación, along with AJE Group, also donated a biodegradable waste treatment plant to Machu Picchu with a capacity of seven tonnes per day. The plant processes biodegradable waste into bio-coal through pyrolysis. The bio-coal is used as a natural fertilizer, and there are plans to use it for local agriculture and to restore the Andean cloud forest.

Why – From Trash to Sustainability

The partnership of the municipality with the AJE Group and Inkaterra Asociación ensured that Machu Picchu will be able to process nearly all of its own generated waste. By 2021, it is estimated that the area will achieve its goal of becoming an eco-friendly tourist destination.

Inkaterra Asociación's efforts in Machu Picchu through the Inkaterra Machu Picchu Pueblo Hotel were recognized and awarded the German travel award, *Die Goldene Palme*, for responsible tourism in 2018. It also won the Peruvian *Líderes + 1* award for its efforts. By 2019, Machu Picchu was the first city in Latin America to sustainably manage 100 percent of its solid waste, paving the way for other cities to follow.

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Korea Green Growth Trust Fund

The Korea Green Growth Trust Fund is a partnership between the World Bank Group and the Republic of Korea, established in 2011 to support client countries as they shift to green development path. Both partners share a common goal to reduce poverty and promote shared economic prosperity in an environmentally responsible and socially inclusive way.

The Trust Fund finances on-the-ground programs as well as knowledge exchange activities, and to date has approved 144 programs in the urban, transport, information and communication technology, energy, environment, water, climate and agriculture sectors. Based on strong performance as well as increasing demand for collaborative development implementation programs, the fund has grown from US$40 million to US$138 million to support World Bank Group programs through 2026.

Supporting the Development of Sustainable Solid Waste Management Strategies for the Mountainous Regions of India, Nepal and Pakistan

The *Good Practice Options for Sustainable Solid Waste Management in Mountain Areas of India, Nepal, and Pakistan* report offers examples of successful implementation and coordination of solid waste management (SWM) plans that have led to a positive change in SWM practice in India, Nepal, and Pakistan, and other countries, including the Republic of Korea, Mexico, and Georgia. It includes examples of successful SWM policies and practices that have led to positive improvements in the SWM sector. It thereby offers examples that could be implemented, scaled-up, or adapted to mountain areas in these three countries, not only in the Himalayan region but elsewhere as well. These practices may also be applicable to mountain areas in other countries.

Other Publications in this Study:

India: Sustainable Solid Waste Management in Mountain Areas

Nepal: Sustainable Solid Waste Management in Mountain Areas

Pakistan: Sustainable Solid Waste Management in Mountain Areas

Technical Guidance Report: Sustainable Solid Waste Management in Mountain Areas of India, Nepal, and Pakistan

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