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Nepal: Sustainable Solid Waste Management in Mountain Areas



Publications part of 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

Nepal: Sustainable Solid Waste Management in Mountain Areas

January, 2021

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

Nepal: Sustainable Solid Waste Management in Mountain Areas
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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 Nepal, but the recommendations and related actions are designed to guide discussions and actions in other mountain areas in the region and elsewhere. Recommendations have been developed using an integrated waste management framework, and related implementable actions are presented in order to overcome solid waste management challenges faced in mountain areas. A phased approach has been suggested to allow for flexibility, as implementation may follow different time frames and recommendations may be adopted concurrently.

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
ABC	Annapurna Base Camp
ACA	Annapurna Conservation Area
ACAP	Annapurna Conservation Area Project
ADB	Asian Development Bank
AEPC	Alternative Energy Promotion Centre
ASA	Advisory Services and Analytics
C&D	Construction and demolition
CAMC	Conservation Area Management Committees
CBO	Community-based organization
CSR	Corporate social responsibility
cu. m.	Cubic meter
DNPWC	Department of National Parks and Wildlife Conservation
DoE	Department of Environment
DoHS	Department of Health Services
DoI	Department of Industries
DoT	Department of Tourism
DUDBC	Department of Urban Development and Building Construction
DWSS	Department of Water Supply and Sewerage
EIA	National Environmental Impact Assessment
ENB	Environment, Natural Resources, and Blue Economy
ENCORE	Enhancing Coastal Ocean Resource Efficiency
ENPHO	Environment and Public Health Organisation
EPR	Extended producer responsibility
FNCCI	Federation of Nepalese Chamber of Commerce and Industries
FY	Financial year
GDP	Gross domestic product

GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (German Corporation for International Cooperation)
HCI	Healthcare institution
IEE	Initial environmental examination
IHR	Indian Himalayan Region
ILM	Integrated landscape management
ISWM	Integrated solid waste management
JICA	Japan International Cooperation Agency
K-eco	Korea Environment Corporation
kg	Kilograms
KGTF	Korea Green Growth Trust Fund
km	Kilometer
KU	Kathmandu University
LNG	Liquefied natural gas
m	Meters
MoCTA	Ministry of Culture, Tourism and Civil Aviation
MoFAGA	Ministry of Federal Affairs and General Administration
MoF	Ministry of Finance
MoFE	Ministry of Forests and Environment
MoHP	Ministry of Health and Population
MoICS	Ministry of Industry, Commerce and Supplies
MoUD	Ministry of Urban Development
MoWS	Ministry of Water Supply
MSW	Municipal solid waste
NEIA	National Environmental Impact Assessment
NMA	Nepal Mountaineering Association
NGO	Non-government organization
NPC	National Planning Commission
PET	Polyethylene terephthalate
PforR	Program-for-results

PLEASE	Plastic Free Rivers and Seas for South Asia
PPP	Public-private partnership
RBW	Readily biodegradable waste
RDF	Refuse-derived fuel
SAR	South Asia Region
SAWI	South Asia Water Initiative
SHG	Self-help group
SNP	Sagarmatha National Park
SNPBZ	Sagarmatha National Park and Buffer Zone
SPCC	Sagarmatha Pollution Control Committee
SRF	Solid recovered fuel
sq. km.	Square kilometer
sq. m.	Square meter
SWM	Solid waste management
SWMRMC	Solid Waste Management Resource Mobilization Centre
SWMTSC	Solid Waste Management Technical Support Centre
TA	Technical assistance
TDF	Town Development Fund
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNWTO	United Nations World Tourism Organization
VDC	Village Development Committees

Currency Units & Exchanges Rates

Currency Units	Exchange Rates (Effective as of December 27, 2020)	
Nepalese Rupee (Nr)	\$1 = Nr 118.29	Nr 1 = \$0.008
All dollar amounts are US dollars unless otherwise indicated.		



Executive Summary

Nepal conjures up images of the Himalayas, climbing expeditions, tranquility in nature, and adventure holidays, making the country one of the most sought-after destinations for nature-based tourism. In 2018, tourism contributed to eight percent of Nepal's GDP (Nepali Sansar 2019). With a flourishing tourism industry, on the one hand Nepal benefits immensely in terms of economic growth and foreign exchange income. On the other hand, tourism adds to the pressures on the environment and can have negative impacts on local pollution. Increases in solid waste generation are one such adverse impact, leading to environmental consequences that cause pollution, increased health risks, and harm to natural ecosystems, while also creating negative impacts on the global climate.

Solid Waste Management in Nepal

Nepal generates approximately 1.7 million tonnes of municipal solid waste (MSW) annually, of which just over half is biodegradable waste. While municipalities are implementing practices such as door-to-door collection and increasing the role of the private sector in service provision, roadside collection and open dumping and burning of MSW is still common. Current waste management systems are lacking due to poor levels of public awareness, inefficient institutions and technical capacity, outdated and inadequate infrastructure, and a shortage of financing.

Around 77 percent of the country's land area comprises hills (*pahad*) and mountains (*himal*) and is home to approximately 50 percent of its population. Waste segregation practices are far superior in rural and semi-urban areas of hilly and mountain areas than in cities. Almost all biodegradable waste from households is either composted or fed to animals. While this takes care of the biodegradable portion of MSW, the non-biodegradable fraction is steadily increasing. A combination of factors, such as the rate of urbanization, improved connectivity and road access, market linkages, as well as political changes leading to rural-urban migration, result in increasing volumes of waste being generated.

Tourism is a key challenge for the solid waste management sector. In Nepal, tourism waste in high-altitude remote areas that are popular with trekking and mountaineering groups is putting a strain on the natural environment. While tourism brings with it many obvious benefits, it also generates huge amounts of solid waste that need to be collected, transported, treated, and disposed of. As a result, the cycle of tourism may contribute to its own demise due to the underdeveloped nature of solid waste management (SWM) systems in mountain areas.

While all settlements—whether mountainous or not—face SWM challenges, mountain areas tend to face additional ones. These challenges are by virtue of their location, characterized by remoteness, topography, scattered settlements, sensitive and fragile ecosystems, lack of infrastructure and road networks, and poor institutional and financial capacity. This makes service provision in mountain areas all the more demanding compared to the plains.

Ecologically-sensitive areas as well as mountainous regions face some similar challenges when it comes to SWM. Table ES.1 summarizes the challenges faced by all areas regardless of location, as well as the challenges unique to mountain areas and eco-sensitive areas. Moreover, not all mountain areas are the same,

and vary by many localized factors, such as topography, climate, access, seasonality, waste volumes and types, and the impact of tourism. It is clear then that mountain areas require a suite of bespoke waste management solutions.

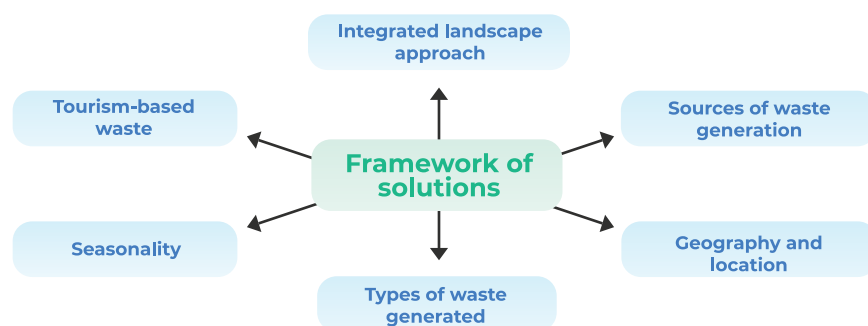
Table ES.1: Comparison of SWM challenges in mountain, non-mountain, and eco-sensitive areas

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

Recommendations

This study recommends that solutions need to be steadily built on a framework in order to successfully and sustainably manage mountain waste. The framework consists of various, and related, factors shown in Figure ES.1.

Figure ES.1: Framework of solutions on mountain waste management



This report presents various recommendations and implementable actions that may be adopted in a phased manner in order to overcome SWM challenges faced in mountain areas. A phased approach has been suggested to allow for flexibility, as implementation may follow different time frames, and recommendations may be adopted concurrently. Actions are applicable to all mountain settlement types (mountain cities/towns, rural villages with road access, remote areas that are not connected by road, and high-altitude regions for trekking and mountaineering); hence, actions would need to be selected based on the appropriate local scenario.

The proposed recommendations to manage solid waste in mountain areas are generally aligned with the integrated solid waste management framework and are summarized in Figure ES.2.

Background of this Regional Study on Sustainable SWM in Mountain Areas

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 World Bank, with funding from the Korea Green Growth Trust Fund, initiated a study—*Supporting the Development of Sustainable Solid Waste Management Strategies for the Mountainous Regions of India, Nepal and Pakistan*—with the following objectives:

- Analyze the current situation regarding SWM in the mountainous regions of India, Nepal, and Pakistan; and
- 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 in the mountainous regions of these three countries.

A field study was undertaken due to a lack of quantitative data available in mountainous regions. In Nepal, a field study was conducted in the Annapurna Conservation Area (ACA) at four sites: Ghandruk, Chhomrong, Kimche, and Syauli in May and September 2019. The field study provides a snapshot of the current SWM scenario as well as confirmation of waste trends that one would expect to see in mountain areas.

Figure ES.2: Summary of recommendations for sustainable SWM in mountainous regions

Institutions, Financing, and Stakeholders

- Develop local government policies and regulations in line with national guidelines and standards
- Operationalize the SWM system at the local government level through technical capacity development
- Involve local communities and CBOs in waste segregation and collection
- Create systemic opportunities to bring in economies of scale, engage the private sector as well as other stakeholders
- Enable integration of the informal sector to engage in waste management services
- Enable collaboration of related agencies, such as tourism, forest, and natural resource management
- Establish a monitoring and enforcement system to improve and sustain waste management services

Data Availability and Awareness of SWM Issues

- Coordinate with various agencies to improve data collection, availability, and to create public awareness
- Start data gathering as a continuous exercise in order to make better decisions, set targets, and monitor policy implementation
- Increase public awareness on managing waste and impacts of SWM in mountain areas
- Introduce and expand training programs to build capacity of local government staff and decision makers

Waste Generation and Segregation

- Enable source segregation to allow for value extraction and recycling of both biodegradable and non-biodegradable materials
- Enable separation of biodegradable waste for useful purposes at the household or community level
- Involve local communities and CBOs by considering various aspects, such as income generation
- Create policies to manage other wastes (C&D, hazardous, health-care, e-waste) in mountain cities

Waste Collection, Transfer, Storage, and Transport

- Improve waste collection systems and upgrade service delivery
- Establish waste storage and/or transfer systems to manage waste
- Enable sorting and processing of non-biodegradables for higher monetary returns
- Find innovative ways to collect and transport waste from mountain areas that are particularly challenging due to remoteness, topography, and lack of road network









Waste Treatment and Disposal

- Ban the open dumping and burning of waste
- Find suitable alternatives for treatment of non-biodegradable waste and for waste disposal

The data collected during the course of the field study was collected via a two-pronged approach. Firstly, waste sampling was undertaken to identify the types of waste being generated, as well as quantity and other factors. Secondly, qualitative surveys were carried out to understand the mindset and awareness level of residents, commercial establishments, and tourists in these areas.

The key findings from the field study are summarized in Figure ES.3.

Figure ES.3: Key findings from the Nepal field study

-  Plastic waste is an important part of waste generated in mountain areas, whether from households or tourist-related activities
-  Segregating waste into biodegradable and non-biodegradable fractions is commonly practiced among households and hotels, despite no formal segregation system
-  Collection coverage is lacking in most mountain areas
-  Most biodegradable waste is buried on household property, followed by composting and use as animal feed
-  Waste is commonly disposed of in valleys and waterways. Open burning of solid waste, especially non-biodegradable waste, is also a frequent occurrence
-  Willingness to pay for SWM services is common
-  Litter and garbage on trails are environmental issues commonly cited by tourists
-  Awareness of waste management practices and its impact are generally poor

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.

Three country-specific reports on India, Pakistan, and this one on Nepal—***Nepal: Sustainable Solid Waste Management in Mountain Areas***—provide overviews of the MSW 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 SWM 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 mountain 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 mountain regions.

The ***Good Practice Options for Sustainable Solid Waste Management in Mountain Areas of India, Nepal, and Pakistan*** document offers examples of successful implementation and coordination of SWM plans that have led to positive change in SWM practice in India, Nepal, 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 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.



1. Introduction

Nepal, a small, landlocked Himalayan nation sandwiched between India and China, comprises mostly of mountainous terrain with wide geographical diversity. Topographical variations range from tropical lowlands to the highest peak in the world, Mount Everest (8,848 meters). This makes Nepal rich in biodiversity, climatic variety, unique ecosystems, and cultures that combine to attract tourists from all over world. Nepal conjures up images of the Himalayas, climbing expeditions, tranquility in nature, and adventure holidays, making the country one of the most sought-after destinations for nature-based tourism.

In 2018, tourism contributed to eight percent of Nepal's GDP (Nepali Sansar 2019). With a flourishing tourism industry, on the one hand Nepal benefits immensely in terms of economic growth and foreign exchange income. On the other hand, tourism adds to the pressures on the environment and can have negative impacts on local pollution. Increases in solid waste generation are one such adverse impact, leading to environmental consequences that cause pollution, increase health risks, harm natural ecosystems, while also creating negative impacts on the global climate.

Reliable estimates on the quantity and characteristics of municipal solid waste (MSW) are not readily available in mountain areas, as these vary significantly depending on tourist influx, regional characteristics, and seasonal factors. In addition, mountain areas present unique challenges such as sudden spikes in the quantity of waste

generated during tourist season, widely varying waste characteristics including large volumes of plastic and other special wastes (for example, mountaineering equipment), and constraints of land availability for waste treatment and disposal, especially due to a number of environmental sensitivities in these areas. All of these factors require specific policies and models of solid waste management (SWM) in mountain regions.

1.1 Geography

For a country of its size, Nepal has tremendous geographic diversity. The land area is divided into three zones, coinciding with ecological belts that run from east to west, as described below and summarized in Table 1.1.

Terai, meaning plains, is a lowland area and is essentially an extension of the Gangetic plain. Also known as the “grain house”, it is the most fertile part of the country and where most of the crops are grown in Nepal. It consists of dense forests, national parks, and wildlife reserves. Due to the relatively flat terrain, it is more developed and densely populated than the other two zones and supports a much larger proportion of the country’s population on a smaller portion of the land.

Pahad, meaning hill, is the hilly and mountainous region of Nepal that does not generally receive snowfall. It comprises fertile landscape with hills, picturesque valleys, and lakes. The population distribution in this zone varies considerably, with dense population in the valleys and very low numbers above 2,500 meters. Kathmandu is located in this zone, so although the terrain is quite rugged, this area is still much more developed compared to the mountains.

Himal is the high mountain region that receives snowfall and is considered an arctic climatic zone. In terms of land area, it covers 15 percent of the total area of Nepal. It comprises the unbroken Himalayan range with 90 peaks, of which eight are higher than 8,000 meters, including Mount Everest. Given the harsh terrain and climate, transportation and communication facilities in this zone are very limited (Nepal, MoHP 2012).

Table 1.1: Comparison of the three topographical zones in Nepal

	Terai (lowland)	Pahad (hills)	Himal (mountains)
Altitude range (meters)	Generally below 610	610- 4,876	4,877-8,848
Land area (%)	23	42	35
Population, 2011 (%)	50	43	7

Source: Nepal, MoHP 2012

Poverty is generally more widespread in mountainous regions than in the plains (FAO 2007). Many mountain communities have multiple, pressing concerns, such as economic development and food security, and as a result waste management is not given as much importance (Wilson 2007). In mountain areas of developing countries, 39 percent of people are food insecure, compared to an average of 12.5 percent in the plains (FAO 2015). Table 1.2 presents a poverty profile of Nepal, comparing population below the poverty line in the country as a whole to the population living in the Himalayan mountain region. As the table shows, in Nepal 25.2 percent of the total population in the country lives below the poverty line, compared to 42.3 percent in the mountain region.

Table 1.2: Poverty profile of Nepal (2011)

Total population (millions)		Population below the poverty line (millions)		Population below the poverty line (%)	
Countrywide	Mountain region	Countrywide	Mountain region	Countrywide	Mountain region
26.5	17.8	6.68	7.53	25.2	42.3

Sources: Nepal, CBS 2011a; Nepal, CBS 2011c

In Nepal, poverty incidence in mountain areas (42.3 percent) is significantly higher than the national average (25.2 percent), the mid-hills (24.3 percent), and the *terai* or plains (23.4 percent) (Nepal, CBS 2011c). The poverty gap index, which measures the severity of poverty by considering how far, on average, the poor are from the poverty line, is also higher in mountain areas than in the *terai* and mid-hills regions.

1.2 Key Solid Waste Management Challenges in Nepal

In Nepal, waste segregation practices are far superior in rural and semi-urban areas of hilly and mountain areas than in cities. Almost all biodegradable waste from households is either composted or fed to animals. However, this only takes care of the biodegradable fraction of the waste. The availability of more products due to improved connectivity and market access as well as increasing tourism contributes to an increase in non-biodegradable waste. Scrap shops that deal with recyclable materials are prevalent in many mountain regions of Nepal that are accessible by vehicles, and these businesses have minimized waste at source down to 25-30 percent (ADB 2013). Areas that are not accessible by a road network have a harder time getting their recyclables to the market. It is commendable that many remote communities are already segregating their waste at source and that there is a ready network of recycling entrepreneurs in these areas.

In addition to solid waste generated by inhabitants of these areas, waste from tourism is also a key challenge in this sector. Tens of thousands of tourists travel to Nepal every year for leisure holidays, trekking, and mountaineering expeditions in the Annapurna Conservation Area (ACA), the Sagarmatha National Park (SNP)/Khumbu region (on the way to Mount Everest), and the Manaslu Conservation Area, among others. While tourism brings with it many obvious benefits, it also generates huge amounts of solid waste that need to be collected, transport, treated, and disposed of. Tourist hotspots—like Nepal—need to be mindful that the cycle of tourism may contribute to its own demise due to the underdeveloped nature of SWM in mountain areas.

According to a survey done by the Nepal Central Bureau of Statistics, most urban residents consider SWM to be the most important environmental problem in urban areas of Nepal (ENPHO and WaterAid n.d.). With the adoption of a new Constitution in 2015, Nepal redefined its administrative structure so that 63 percent of the population is now considered to be urban and the remaining 37 percent rural (Nepal, CBS 2019). A combination of factors, such as the rate of urbanization, improved connectivity and road access, market linkages, as well as political changes leading to rural-urban migration, result in increasing volumes of waste being generated. Almost 60 percent of urban municipalities are located in the mountain regions of Nepal and are home to an estimated 9 million people.¹

¹ For this study, a municipality is considered to be in a mountain region if it is located in *pahad* or *himal* areas, at an altitude above 1,000 meters.

1.3 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 analyzing the current situation of SWM in mountain areas and providing recommendations for sustainable SWM to reduce negative impacts from the lack of collection, lack of treatment, and improper disposal methods in these countries. Specifically, the project has the following objectives:

- Analyze the current situation regarding SWM in the mountain regions of India, Nepal, and Pakistan; and
- 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 in the mountain regions of these three countries.

A field study was undertaken due to the lack of quantitative data available in mountain regions of all three countries. It was informed by two main components: waste sampling and a qualitative survey. Waste sampling 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 public awareness and individual behavior to improve SWM, 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 of the three country-specific reports in this study.

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

Figure 1.1: Overview of field study 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	Chandruk, Chhomrong, Kimche, and Syauli	Abbottabad city, Nathia Gali, and Mingora
Time frame (2019)	June	May and September	July
Individual samples	85	388	75

1.4 Publications in this Study

Five reports make up the set of publications in this study, which together serve to inform positive change in the SWM sector in mountain areas in the South Asia Region. Three country-specific reports on India, Pakistan, and this one on Nepal—*Nepal: Sustainable Solid Waste Management in Mountain Areas*—provide overviews of the MSW 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 SWM 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 mountain 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 mountain regions.

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 SWM plans that have

led to positive change in SWM practice in India, Nepal, 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 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.

1.5 Overview of this Report

Chapter 2 of this report discusses the current landscape of the SWM sector in Nepal. It explores key solid waste data in Nepal, such as MSW generation rates, composition, collection efficiencies, and treatment and disposal options. This chapter also features comparisons of these key indicators between Nepal and the South Asian Region, as well as globally. Furthermore, it provides an overview of key policies and laws as well as institutions relating to SWM. Lastly, the chapter discusses the role of the informal sector in Nepal and how SWM is currently funded in the country.

In Chapter 3, the report investigates the current situation regarding SWM in the mountain areas of Nepal. Further information regarding the parameters of the study, such as which areas were chosen and why, are also discussed. The analysis of the quantitative data gathered from the waste sampling and the qualitative information gained from the survey is then summarized for further analysis. A case study conducted in the SNP by Sagarmatha Pollution Control Committee (SPCC) in 2018-19 is also included in this chapter. The data for the SNP are based on secondary information and no data sampling or field work was undertaken by the World Bank as part of this overall study on sustainable solid waste practices in mountain areas in India, Nepal, and Pakistan.

Chapter 4 looks at the complexity of managing solid waste in mountain areas as well as the various challenges and opportunities that arise. It presents why mountain areas face unique challenges in managing solid waste. It also discusses how mountain areas relate more commonly to other eco-sensitive areas, such as protected areas, small islands, and polar regions, compared to urban and rural areas in non-mountain regions. The chapter concludes with the various SWM challenges common in Nepal's mountain areas.

Based on the SWM challenges specific to mountain areas described in the previous chapter, Chapter 5 proposes a framework or foundation on which solutions can be steadily built and presents recommendations and related implementable actions along a phased approach. A phased approach is suggested as it allows for flexibility by respective national, provincial/state, or local governments. The recommendations are suggested based on an integrated solid waste management approach.

In conclusion, Chapter 6 briefly summarizes the role of the World Bank in the SWM sector and how it can provide support to clients to improve SWM services and practices in mountain areas in the South Asia Region and elsewhere.



2. Overview of the Solid Waste Management Sector in Nepal

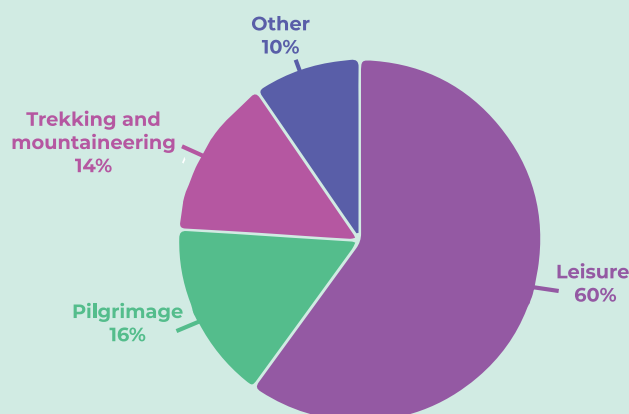
The South Asia Region, of which Nepal is a part, generated 334 million tonnes of waste in 2016, including both urban and rural waste (Kaza et al. 2018). Sandwiched between two regional superpowers—India and the People’s Republic of China—Nepal is a small country but a popular tourist destination (see Box 2.1 for a summary of the impact of tourism in the country). By way of population, Nepal falls in the middle of the eight countries that make up South Asia. In terms of GDP per capita, it is second from the bottom, after Afghanistan (World Bank 2020).

Current waste management systems, as described in further detail in this chapter, are lacking due to poor levels of public awareness, inefficient institutions and technical capacity, outdated and inadequate infrastructure, and a shortage of financing. The data presented in this chapter outlines the municipal solid waste (MSW) challenges faced by Nepal’s current approach to solid waste management (SWM). From generation to the collection, treatment, and disposal of MSW in the country, it is apparent that more needs to be done to protect against severe environmental and health-related threats to the country, its economy, and its people.

Box 2.1: Tourism in Nepal

The diverse landscape and wildlife in Nepal offer great opportunity for further development of the tourism sector in the country. According to a sector analysis, in 2018/19 Nepal received over 1.17 million international tourists in 2018—an increase of 25 percent in 2017. According to the World Travel and Tourism Council’s annual research report, Nepal’s tourism sector generated revenue of Nr 240.7 billion, an increase of more than 23 percent from 2017, and supported over 1.05 million jobs directly and indirectly in 2018. Tourists visit Nepal primarily for pilgrimage, trekking and mountaineering, leisure holidays, and other unspecified reasons, shown in Figure B2.1.1.

Figure B2.1.1: Tourism visits to Nepal (2018)



Source: Nepal, MoCTA 2019

The UN World Tourism Organization (UNWTO) reports that nature and adventure travel are among the fastest growing segments of the tourism industry globally, making nature-based tourism development a suitable option for Nepal’s economic development. Mountaineering, trekking, hiking, nature walks, birding, canoeing, and jungle safaris are all examples of nature-based tourism in Nepal.

Managers of protected areas consider tourism an important driver of sustainable economic development and a means of creating employment for people living in and around the parks, while simultaneously conserving ecosystems and biodiversity (Nepal, MoFE 2018). For instance, the Annapurna Conservation Area (ACA), one of the most visited destinations in Nepal, has shown that tourism in protected areas has provided new economic opportunities for rural communities. It has invoked positive change and promoted conservation by raising awareness among visitors. By raising the profile of biodiversity conservation and protected-area management at local and national levels, the ACA has supported the generation of additional funds for conservation.

At the time of writing this report, the COVID-19 pandemic has severely impacted the various sub-sectors of tourism in Nepal, such as airlines, hotels, tourist vehicles, restaurants, and tour companies. According to the Nepal Ministry of Culture, Tourism and Civil Aviation, it is estimated that the tourism sector could lose \$160 billion in 2020, while hundreds of thousands of those working in the tourism sector are at risk of losing their jobs.

Sources: Nepal, MoCTA 2018; Nepal, MoCTA 2019; Nepal, MoFE 2018; Nepali Sansar 2019

2.1 Municipal Solid Waste Generation

According to the World Bank's *What a Waste 2.0—A Global Snapshot of Solid Waste Management to 2050* study, Nepal generated nearly 1.8 million tonnes of waste in 2016. It is estimated that MSW generation in Nepal will increase to 2.2 million tonnes in 2030 and over 2.9 million tonnes in 2050, based on current urbanization and population growth rates (Kaza et al. 2018).

Nepal's MSW generation of 0.17 kg per person per day is considerably less than the global (0.74 kg per person per day) and the South Asia regional (0.52 kg per person per day) averages (Kaza et al. 2018). Table 2.1 shows the MSW generation figures for Nepal, compared to both the global and regional averages, along with forecasted MSW generation values for 2030 and 2050. The table also provides current and estimated population values for the country.

Table 2.1: Comparison of Nepal's MSW generation and population to global and regional averages

Indicator	Global	South Asia	Nepal
Waste generation, 2016 (million tonnes/year)	2,010	334.23	1.77
Waste generation per capita, 2016 (kg/person/year)	0.74	0.52	0.17
Waste generation, 2030 projected (million tonnes/year)	2,590	466.24	2.21
Waste generation, 2050 projected (million tonnes/year)	3,400	661.18	2.97
Total population, 2016 (millions)	7,424	1,771	27
Urban population, 2016 (millions)	4,036	587.08	5.16
Urban population growth (annual rate %)	2.02	2.51	2.96
Rural population, 2016 (millions)	3,387	1,184	22.1
Rural population growth (annual rate %)	0.16	0.63	0.43
Total population, 2030 projected (millions)	8,548	285	33
Total population, 2050 projected (millions)	9,733	2,293	35

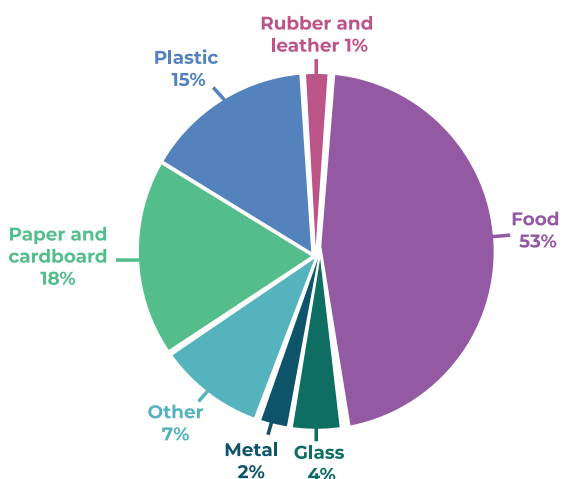
Sources: Kaza et al. 2018; UNDESA 2019; World Bank 2020

2.2 Municipal Solid Waste Composition

Nepal is similar to other countries in the region, in that MSW primarily constitutes biodegradable (organic) waste. According to the *What a Waste 2.0* (2018) report, 53 percent of Nepal's waste comprises biodegradable waste (food and garden/green waste). Paper and cardboard is another important waste category at 18 percent, while plastic waste, another important waste stream due to its ability to pollute waterways and longevity in the environment, constitutes 15 percent (Kaza et al. 2018). Figure 2.1 illustrates the MSW composition in Nepal from the *What a Waste 2.0* (2018) study.

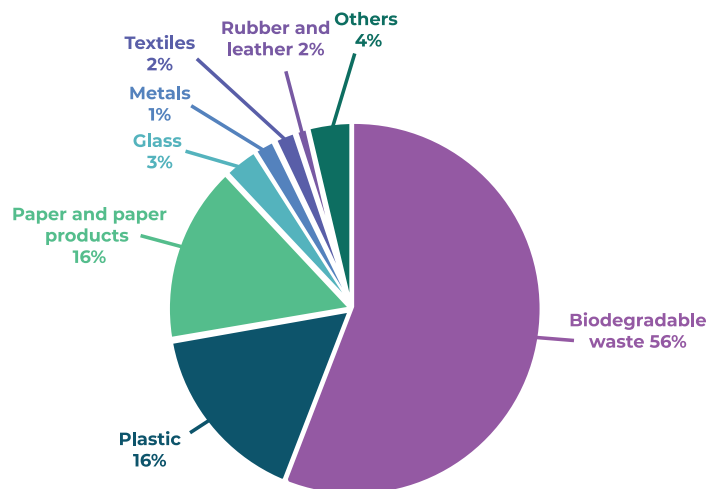
The ADB study in 2012 (see Box 2.2 for information on the study) calculated waste generation for households, commercial establishments (for example, shops, hotels, and restaurants), and institutions (for example, offices, schools, and colleges). The overall MSW composition of all three sources combined is similar to that provided by the World Bank report, and is shown in Figure 2.2.

Figure 2.1: Nepal MSW composition from World Bank report (2016)



Source: Kaza et al. 2018

Figure 2.2: Nepal MSW composition from ADB study (2013)



Source: ADB 2013

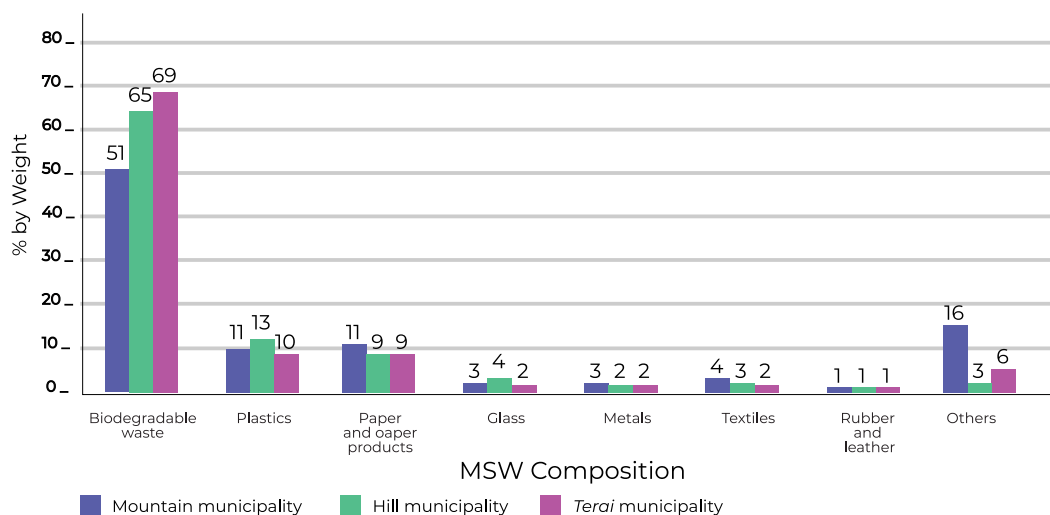
Box 2.2: Nepal SWM Study by the Asian Development Bank

The Asian Development Bank (ADB) conducted an in-depth study—*Solid Waste Management in Nepal - Current Status and Policy Recommendations*—of all 58 municipalities in Nepal in 2011-12. At the time, Nepal was divided into 58 municipalities and 3,913 villages. The 58 municipalities covered a population of 4.5 million and accounted for 17 percent of the total population in the country. Baseline surveys were undertaken as technical assistance (TA) to derive comprehensive data on solid waste management, including generation and composition of municipal solid waste. The data are comparable with countries in South Asia and those with a similar level of economic development. The study found that urbanization, lack of public awareness, and inadequate municipal management together contribute to the strain on Nepal's environment. The study, published in 2013, provides eight policy recommendations, including improvements in data management and dissemination, promoting the 3 Rs, and strengthening local government capacity.

Source: ADB 2013

The ADB study (2013) also looked at the composition of household waste based on geographical area, which showed that composition varied greatly based on geographical location. Figure 2.3 shows the average household waste composition of municipalities in different ecological regions: mountain, hill, and *terai*. The study observed that the biodegradable fraction was higher in the *terai* municipalities than in the mountain and hill regions. This may be due to the fact that in hilly and mountain areas biodegradable waste is composted and used as animal feed, and as such may not be considered as waste.

Figure 2.3: Composition of household waste in Nepal's three geographical areas (%)



Source: Adapted from ADB 2013

2.3 Municipal Solid Waste Segregation

Source segregation practices are still in the nascent stage in Nepal. The ADB study (2013) shows that only 21 out of 58 municipalities surveyed have implemented activities to promote waste segregation at source (ADB 2013), despite the prevailing law and rules clearly mandating that local governments carry out source segregation. Kathmandu and Bhaktapur have initiated compulsory waste segregation practices in core city areas. Some municipalities, such as Waling, Illam, Kirtipur, Shankrapur and Dhankuta, are already successfully implementing source segregation. According to the study, what has worked in these places is community awareness and managing MSW services through community participation. In rural areas, kitchen waste, cow dung, and agricultural waste are segregated from other wastes and used as animal feed, fuel, or composted.

The ADB study (2013) further showed that more than 25 percent of household waste could either be reused or recycled, excluding biodegradable waste. However, there is no formal system for reuse or recycling in most municipalities in Nepal. Most households separate their recyclables and sell them to the formal or informal sectors, but large amounts continue to be improperly disposed of.

2.4 Municipal Solid Waste Collection

The average collection efficiency of municipalities is estimated to be about 62 percent (ADB 2013). Door-to-door collection and on-time collection systems by the private sector and municipalities are best practices that are currently being implemented in many municipalities. Nevertheless, roadside collection is still common practice in many municipalities. Recently, some municipalities in mountain regions, such as Waling, Kirtipur, Dhankuta, Bhaktapur, Illam, and Tansen have started door-to-door collection systems and on-time collection systems.

2.5 Municipal Solid Waste Treatment and Disposal

Open dumping and burning of MSW is common in Nepal, both in rural and urban areas, although Nepal does have some sanitary landfill facilities. Box 2.3 provides information regarding sanitary landfills in Nepal, with an in-depth look at the one in Dhankuta. It is estimated that approximately 85 percent of municipalities in mountain regions do not have appropriate disposal sites (ADB 2013). As a result, waste is openly dumped in river banks, forests, or on mountain slopes after which the waste is burned.

Out of the total waste generated by the municipalities, it is estimated that 2,551 tonnes of municipal waste is dumped openly every day in Nepal (Nepal, MoFE 2019). It is general practice for municipalities to burn the waste at dump sites. According to the now-defunct Solid Waste Management Technical Support Centre (SWMTSC), in many municipalities household and industrial hazardous waste, including healthcare waste, is directly mixed with MSW and dumped together at final disposal sites.

In rural areas, combustible wastes, such as paper and plastics, are burned openly within household premises or in the street. Uncontrolled burning of waste in open areas is a significant source of carcinogens such as dioxins, furans, and black carbon, a short-lived climate pollutant that contributes to climate change (CCAC n.d.). Burning waste is often deliberately set to recover recyclables or may start out on its own due to the reaction of combustible materials. As such, it contributes to air pollution and exacerbates health issues such as respiratory diseases for the population residing in the area. In addition, in some areas of Nepal, such as the Mustang region, burning waste is seen as a cultural taboo as it is believed that smoke from burning drives away good spirits.

2.6 The Informal Sector in Nepal

As is common in similar developing countries, the informal sector in Nepal plays an important role in the collection and sorting of recyclable materials. While there is no official definition of an informal sector, it is broadly understood to be individuals or small businesses working in waste collection, trading, and recycling. These workers typically lack proper wages and benefits and work under poor conditions. Given the nature of their job, they are often considered unsanitary and are not respected for their roles in keeping cities free of trash, enabling recycling, and protecting the environment. This discrimination is prevalent in Nepal as well. This is in sharp contrast to the formal sector, represented by government sanitation workers or those who work in the private sector in solid waste collection, handling, or disposal. These workers are recognized by the public as playing a key role in keeping their cities clean and receive fixed salaries and benefits and have defined work hours.

Large numbers of people work in the informal sector scattered throughout Nepal, particularly in areas that are accessible to vehicles. Waste pickers visit door-to-door and purchase reusable or recyclable material, which they then sell to nearby scrap shops or *kavadiwalas*. There are informal sector associations in practically every district of Nepal, especially in the hill and *terai* regions. These associations coordinate with one another to sell recyclable material to large recycling plants in the *terai* region or to sell to large industries in neighboring India. There are a number of paper and steel factories set up by Indian companies in Nepal itself. Figure 2.4 illustrates the informal sector process in Nepal.

Box 2.3: Sanitary landfills in Nepal: An in-depth look at the Dhankuta Landfill

A number of sanitary landfill facilities are currently in operation in Kathmandu, Lalitpur, Pokhara, Ghorahi, Dhankuta, Nepalgunj, and Sisdoile. The Birgunj and Banchare Dada landfill sites in Okharpauwa are still under construction at the time of publication of this report.

Khadabari, Bhaktapur, Kamalamai, Bhimeswor, Baglung, Tulsipur, and Amargadhi municipalities have controlled dump sites, ensuring that they follow minimum environmental criteria such as daily waste cover. However, the landfill site itself is not constructed with any environmental protection measures (for example, landfill liner to control leachate, drains, or vent pipes).

Sanitary landfill in Dhankuta

The Dhankuta municipality lies in the mid-hills/mountain region of Nepal. It is located in the eastern Province 1 in Nepal. Dhankuta municipality is recognized as having one of the best municipal solid waste management systems, and in 2017 was declared a “clean city” by the Government of Nepal, with a prize of Nr 1 million. But this was not always the case.

In 2009, when solid waste management problems became untenable, Dhankuta residents got together to do something about it. Since then, the municipality has established a landfill of around 60 sq. m. at a cost of Nr 40 million to handle 10 tonnes of waste every day for the next 25 years.

The municipality also contracted the private sector for waste collection and management services. Sixteen sanitation workers use an on-time waste collection system, visiting different routes each day to ensure collection coverage in all areas. Streets are swept daily by sanitation workers and residents, and together with the placement of waste bins in strategic locations, this has decreased litter to a minimum.

Collected waste is taken to a waste management service center. Biodegradable waste is used as animal feed and also composted, while recyclable materials are recovered at the center. The private sector earns revenue from selling the recovered waste to scrap-dealers, ensuring a win-win situation for all involved parties.

Non-recyclable waste is disposed of at the sanitary landfill site. The old waste disposal site has been covered and converted into a public garden. The site is used as a model for other municipalities and is visited by representatives from other areas in the country.

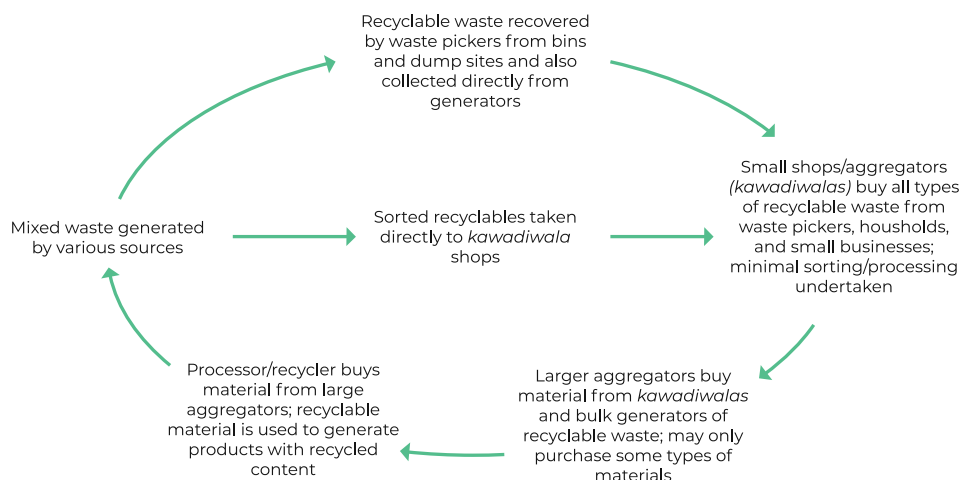
Sources: ADB 2013; World Bank 2017

While there are no formal numbers of waste pickers, it is estimated that there are 15,539 waste workers in Kathmandu Metropolitan City itself who are engaged in various kinds of waste management activities, and most of this workforce comprises informal workers (Sapkota et al. 2020).

According to another study, the informal sector recovers about 135 tonnes per day of recyclable material, such as paper and cardboard, plastics, metals, rubber, glass bottles, and batteries in Kathmandu Valley, which represents only about 50 percent of the estimated generation of these materials. It is estimated that the total fraction of reusable and recyclable waste may be 271 tonnes per day in Kathmandu Valley alone (SWMTSC 2013).

The same study reveals that the economic benefit of selling recyclable waste is Nr 2.66 million per day, which is equivalent to Nr 971 million over the course of a year. This presents an opportunity for considerable revenue generation, which could be utilized by municipalities for more sustainable SWM practices (SWMTSC 2013).

Figure 2.4: Schematic representation of the informal sector in Nepal



2.7 Governance and Policy

The Government of Nepal adopted a new Constitution in 2015, creating the Federal Democratic Republic of Nepal. The new republic has three levels of administration: federal, provincial, and local. Administratively, the country is divided into seven provinces, which are further divided into 753 local levels consisting of 460 rural municipalities (or *gaupalikas*) and 293 urban municipalities (276 municipalities + 11 sub-metropolitan cities + six metropolitan cities).

The Constitution empowers local governments to provide a basic level of health and sanitation services to all citizens. Article 30 of the Constitution provides each citizen with the fundamental right to live in a clean and healthy environment. Accordingly, victims of any damage caused by environmental pollution or degradation have the right to obtain compensation from polluters.

Nepal is one of a few developing countries to have a separate law specifically relating to SWM. The key legal instruments and regulations currently dealing with SWM in Nepal are summarized in Table 2.2. The Solid Waste Management Act of 2011 and its supporting Regulation in 2013 were created under the old Constitution. Its provisions included transferring responsibility to local governments for infrastructure along the SWM chain.² Healthcare facilities and industries were responsible for managing their own waste. The Act also authorizes local governments to collect service fees (tariffs) for SWM, prescribes the basis for fixing such fees, and describes procedures for the collection of fees and their usage. The Act also prescribes pecuniary punishment and imprisonment for offenders. Table 2.3 provides some of the key provisions in the SWM Act 2011.

² 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.

At the time of publication of this report, the federal government is in the process of drafting a new umbrella act on SWM in line with the 2015 Constitution. The new Act is likely to continue several provisions of previous acts, regulations, and guidelines and build on experience in the present context, given the mandates and roles of the three tiers of government. Going forward, it is necessary to strengthen the capacity of local governments, promote appropriate technologies and practices, build institutions, formulate regulations and guidelines, and ensure sustainable financing for SWM. At the same time, local governments, as per the 2015 Constitution, are empowered to formulate their own regulations with regard to SWM.

While there are numerous laws and policies related indirectly and directly to SWM, they are rarely enforced and poorly implemented. One detailed assessment concluded that “national government does not provide sufficient tools and agencies lack the background and implementation capacity to successfully handle waste” (Dangi et al. 2017). Municipalities require local resources and commitment from the federal government to implement policies that are already in place.

Table 2.2: Key legal instruments governing SWM in Nepal

1978	The Tourism Act was promulgated to make necessary arrangements for tourists and to protect the economic interests of the country through tourism development.
1987	The Solid Waste (Management and Resource Mobilization) Act created the Solid Waste Management Resource Mobilization Centre (SWMRMC), renamed Solid Waste Management Technical Support Centre (SWMTSC) when the SWM Act 2011 was passed.
1992	One of the goals of the Municipality Act was to make cities accountable for waste dumped in the streets and to enforce collection and proper disposal. Local entities were permitted to generate earnings from the sale of waste and carcasses.
1993	A requirement in the Environmental Policy and Action Plan was for local wards to collect and deliver waste to central collection points; the municipality would then process the waste before appropriate disposal. Due to lack of resources, this policy was not implemented.
1996	The Solid Waste Management National Policy required every local body, especially municipalities, to create a separate unit dealing with sanitation, including SWM.
1996	Although the Solid Waste Act was enacted almost a decade earlier, the Environment Protection Act was the first comprehensive law protecting the environment and balancing economic development and biodiversity management.
1997	Environment Protection Rules were enacted the year after the Environment Protection Act but together they were critiqued as ineffective because they lacked enforcement and standards. ³
1999	The Local Self-Governance Act stated that waste disposal, cleanliness, and sanitation were the duties of local ward committees and that municipal governments were responsible for collection, transportation, and disposal of waste. It enabled municipalities to collect waste disposal fees from individuals and impose fines of up to Nr 15,000 for not disposing of waste in designated locations.
2002	The Mountaineering Expedition Rules were framed based on the Tourism Act 1978. Mountaineering expedition teams are mandated to comply with prescribed conditions to prevent environmental pollution when mountaineering and are asked to pay a refundable deposit for waste management, which is returned after the team deposits the waste in a location specified by the government upon completion of the expedition. Appendix 2 provides the relevant portions of these rules.
2005	Following the Environment Protection Act 1997, SWMRMC published the National Environmental Impact Assessment (NEIA) Guidelines for SWM Projects for Municipalities of Nepal , providing instructions for municipalities to develop initial environmental examinations (IEEs) and environmental impact assessments (EIAs) prior to the start of a SWM project.
2011	The Solid Waste Management Act and its supporting Regulation 2013 were formulated based on the old Constitution and included various provisions for individuals, the private sector, and local governments summarized in Table 2.3. A Solid Waste Management Council was to be formed under the Local Development Minister for policy making and coordination.

³ The Environment Protection Act 1996 and the Environment Protection Rules 1997 together are referred to as EPA 1997 (Dangi et al. 2017).

Table 2.2: Key legal instruments governing SWM in Nepal (contd.)

2015	Adoption of the new Constitution of Nepal
2017	The Local Government Operation Act defined the clear roles and responsibilities of urban and rural municipalities after the 2015 Constitution was formulated. MSW management is one of the main responsibilities for local government. The Act permitted local-level governments to engage with private sector enterprises for SWM. Municipalities could regulate, monitor, and facilitate hazardous waste management, including slaughterhouse and healthcare waste management. According to the Act, municipalities should prioritize environmentally-friendly technologies and carbon minimization programs.
2018	The Public Health Service Act had legal provisions to implement the right to basic, regular, and quality health services and emergency health services. In order to control the adverse effects on human health from environmental pollution and waste, the government could create standards for collecting, reusing, refining, disposal, and regulation of waste. Provincial and local-level governments were expected to comply with the standards.
2019	The Environment Protection Act was the fundamental law regarding environmental preservation and pollution control. The law dictated that all people/groups traveling in the Himalayas or other mountain regions for trekking, mountaineering, sightseeing, or any other purpose were prohibited from causing pollution that could have a negative impact on the environment.

Table 2.3: Key provisions of the SWM Act 2011

Individuals and Private Sector	Local Governments
<ul style="list-style-type: none"> • SWM can be undertaken using the PPP model • Mandatory waste segregation at source into two categories: biodegradable and non-biodegradable • Hazardous, medical, and chemical waste to be managed under prescribed standards by industries/institutions/individuals that generate the waste • Individuals/institutions/organizations are responsible for minimizing waste at source 	<ul style="list-style-type: none"> • Responsible for taking steps to promote and achieve 3 Rs • Responsible for construction and operation of sanitary landfills under prescribed standards • Competitively contract and provide licenses to private sector companies or NGOs for SWM services • Charge fees (tariffs) from customers for waste collection and other SWM services • Punish any individual/organization/institution guilty of committing offences • SWMTSC (now defunct) to be established to assist local governments with technology development and capacity building

2.8 Institutions Related to Solid Waste Management

The new Constitution (2015) and the Local Government Operation Act 2017 reiterated that urban and rural municipalities are mainly responsible for MSW management. However, institutional coordination has proven inadequate due to limited technical and financial resources, and local governments face severe challenges in managing MSW. The institutional framework for SWM in Nepal is shown in Figure 2.5.

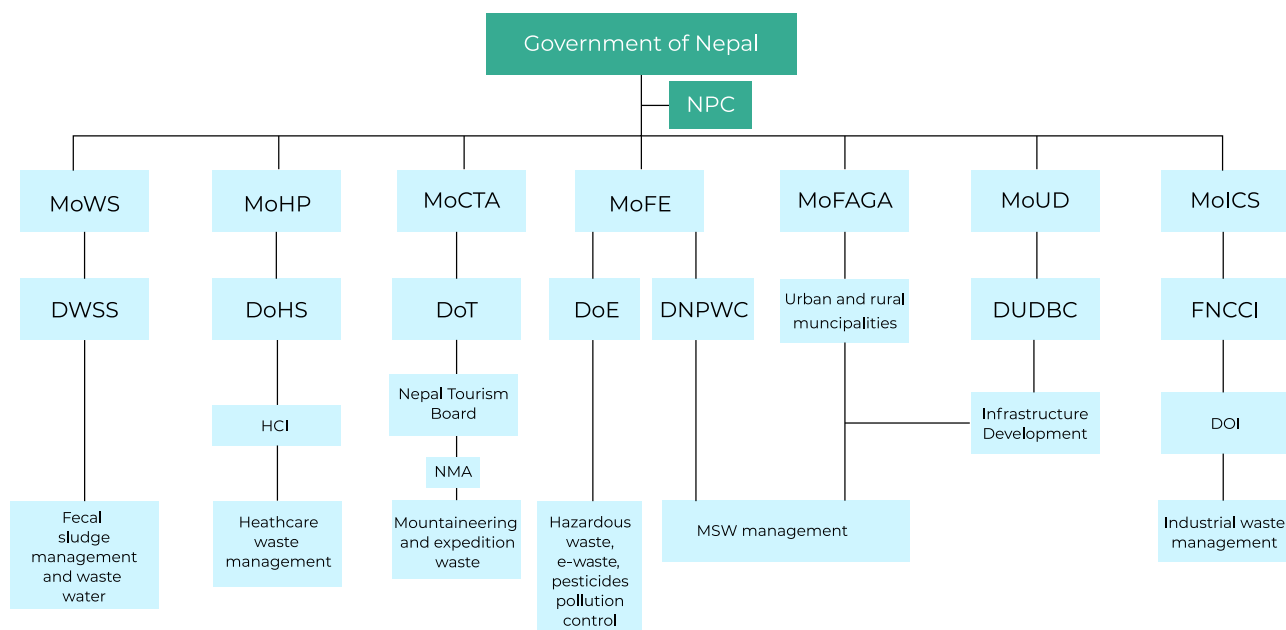
At the federal level, the Ministry of Federal Affairs and General Administration (MoFAGA), Ministry of Urban Development (MoUD), Ministry of Finance (MoF), and Ministry of Forests and Environment (MoFE) are the key ministries overseeing the technical, operational, financial, and environmental aspects of SWM. The Ministry of Water Supply (MoWS) is responsible for providing effective, sustainable, and quality water supply and sanitation. The Ministry of Industry, Commerce and Supplies (MoICS) monitors and manages industries in Nepal, including industrial waste.

The MoFE is responsible for developing pollution control standards for various industries under the Environment Protection Act 1996 and Regulation 1997. MoFE is also responsible for passing necessary regulations, policies, and programs on hazardous waste management and e-waste, and developing EIA and IEE guidelines. MoFE also plays an important role in developing guidelines to control the use of plastic bags. The Department of Environment (DoE) conducts environmental monitoring of various institutions and industries, as well as various activities to control air, water, and soil pollution in Nepal. The Department of National Parks and Wildlife Conservation (DNPWC), which also comes under MoFE, has jurisdiction over national parks and conservation areas such as Mount Everest, Annapurna, and Manaslu. All activities in the national parks and conservation areas, including waste management, are governed by the DNPWC. In the case of the Mount Everest region in the Sagarmatha National Park, DNPWC plays a major role including issuing permits for construction of waste management infrastructure, providing financial assistance for pollution control, and coordination on other matters.

After a federal system of government was adopted in 2015, local governments have been empowered with greater authority on local environmental management. Thus, urban and rural municipalities with technical support from MoFAGA, DoE, the Department of Water Supply and Sewerage (DWSS), the Department of Urban Development and Building Construction (DUDBC), the Department of Health Services (DoHS) and the Alternative Energy Promotion Centre (AEPC), are now mandated as responsible for MSW, fecal sludge management, and wastewater treatment (Local Government Operation Act 2017).

The Department of Tourism (DoT) is responsible for all the necessary policies and programs relating to tourism development, including mountaineering expeditions and trekking. Tourism agencies, local-level governments, and local NGOs monitor and manage mountaineering expedition and trekking waste along the main trekking routes in Nepal. The Nepal Mountaineering Association (NMA), an NGO, works with DoT and has the authority to issue climbing permits for 27 peaks in Nepal.

Figure 2.5: The institutional framework for SWM in Nepal



Source: Adapted from Gyawali 2019

Key: DNPWC: Department of National Parks and Wildlife Conservation; DoE: Department of Environment; DoHS: Department of Health Services; DoI: Department of Industries; DoT: Department of Tourism; DUDBC: Department of Urban Development and Building Construction; DWSS: Department of Water Supply and Sewerage; FNCCI: Federation of Nepalese Chamber of Commerce and Industries; HCI: Healthcare institution; MoCTA: Ministry of Culture, Tourism and Civil Aviation; MoFAGA: Ministry of Federal Affairs and General Administration; MoFE: Ministry of Forests and Environment; MoHP: Ministry of Health and Population; MoICS: Ministry of Industry, Commerce and Supplies; MoUD: Ministry of Urban Development; MoWS: Ministry of Water Supply; NPC: National Planning Commission

2.9 Financing Solid Waste Management in Nepal

Local governments are responsible for financing infrastructure and resources for SWM activities from their own budgets and internal sources of income, but most lack the funds to do so. While SWM is a major contributor to municipal expenditure, most municipalities do not earn any revenue from SWM services. Local governments may also receive grants from the federal government, based on recommendations by the National Natural Resources and Fiscal Commission, in the form of special grants, conditional grants, or complementary grants (Nepal, MoF n.d.; Shrestha 2018).

A survey carried out by SWMTSC estimated that municipalities spent on average 13 percent of their total expenditure on SWM. On a per capita basis, municipalities spent on average Nr 97 per resident per year to provide SWM services while NGOs and private companies working in this sector charged fees ranging from Nr 30-200 per household per month for waste collection services (World Bank 2014).

National ministries and departments such as MoFAGA, DWSS, DUDBC, DoE, DoHS, and AEPC support local governments in the implementation of MSW management and wastewater treatment facilities in various municipalities, with financial and technical support from various developmental partners, such as the World

Bank, ADB, JICA, GIZ, and UN-Habitat. This financial support may be both in the form of grants or soft loans. Likewise, the Town Development Fund (TDF) also provides soft loans or grants, depending on the project proposals submitted by the municipality.



3. Solid Waste Management in Mountain Areas of Nepal

A key element of this report is the discussion of the state of solid waste management (SWM) in mountain areas of Nepal. In order to identify specific challenges, this chapter summarizes the results from the field study undertaken for this project. In addition, the report also presents results from a previous study conducted by the Sagarmatha Pollution Control Committee (SPCC) undertaken in the Sagarmatha National Park and Buffer Zone (SNPBZ) in 2018-19. The SNPBZ encompasses the Mount Everest trekking route and base camp, and hence is a popular destination for tourists.

Tourism is a major source of income and livelihood for many of Nepal's remote communities. Local economies in tourist areas have developed specifically to accommodate tourists. For instance, inhabitants convert part of their homes into homestays and lodges, while small shops cater to backpackers, and local people work as porters and guides. A number of communities have existed in these areas for centuries. The only path to preserve their livelihood while striking a balance with the desired increase in tourism revenue is to engage in nature-based tourism. This is the lifeline for these areas, not only to protect the communities' way of life, but also the environment and the pristine beauty that attracts visitors in the first place.

The fine line, then, is how solid waste is managed. If not done correctly, it will eventually lead to a decline in tourism, create new environmental issues, and lead to human health problems. Tourism may be extremely important to communities in these regions; however, a majority of Nepal's population lives in hilly and mountain areas, and these areas—whether frequented by tourists or not—are facing mounting SWM challenges.

It is worth noting that the Government of Nepal has encouraged local efforts to improve SWM practices in mountain areas; however, these efforts will stall unless further financing for service delivery and infrastructure is provided along with improved institutional coordination. Recognizing that tourism and SWM are co-dependent is a good start, but more needs to be done by the institutions in power in order to actualize real change. The remainder of this report will look at the current situation and challenges of SWM in Nepal's mountain areas, while considering recommendations and opportunities for improvement.

3.1 Field Study Overview

A key element of the World Bank's *Supporting the Development of Sustainable Solid Waste Management Strategies for the Mountainous Regions of India, Nepal and Pakistan* project, funded by the Korea Green Growth Trust Fund (KGGTF), was to enhance the quality of data, given its insufficient availability in mountain areas of the three countries.

The field study has two components: waste sampling and a qualitative survey. It is the aim of this study to present data, identify challenges, and make recommendations that may be applied widely to mountain areas in all three countries under this study.

Due to time limitations and other constraints, the sample size for the field study was small so the results (provided in Appendix 1) should not be considered statistically significant and caution must be used when citing this data. The field study can thus be considered to provide a snapshot of the current solid waste scenario as well as confirmation of waste trends that one would expect to see in mountain areas in these three countries.

In Nepal, a field study was undertaken in the Annapurna Conservation Area (ACA) in 2019 by Korean consultants, Korea Environment Corporation (K-eco), in cooperation with its local partner, Environment and Public Health Organisation (ENPHO), to analyze SWM practices in tourist destinations in higher mountain regions. The issue of seasonal variations of waste due to tourist flows and remoteness of the area were also considered.

A case study conducted in the Sagarmatha National Park (SNP) by Sagarmatha Pollution Control Committee (SPCC) in 2018-19 is also included in this chapter. The data for the SNP are based on secondary information and no data sampling or field work was undertaken by the World Bank as part of this overall study on sustainable solid waste practices in mountain areas in India, Nepal, and Pakistan.

3.2 Location and Geography

Since its launch in 1986 as the first conservation area in Nepal, managed by the National Trust for Nature Conservation, the Annapurna Conservation Area has become the most popular trekking destination in Nepal. The ACA, located in the Annapurna range of the Himalayas, is the first protected area to allow local residents to live within its boundaries as well as to own private property and maintain their rights and access to the use of natural resources.

The Annapurna Conservation Area Project (ACAP) has brought about numerous positive benefits to the region. From a solid waste perspective, a home-grown—yet sophisticated—system has developed over time to manage waste. Here are some of the developments currently in place in ACA that could be scaled up in other mountain areas of Nepal as well as in other regions:

- Biodegradable waste is separated from other wastes and either composted or used as animal feed.
- Cans are battered into plates by local employees and transported to factories in the plains on pack animals.
- Cardboard is also carried down to the plains in a similar manner.
- Beer bottles are collected sold to local distilleries.
- “Mothers’ groups” consisting of women’s committees, organize regular clean-up drives to collect and dispose of litter.
- To reduce single-use plastic water bottles, safe drinking water stations are set up in villages along trekking routes. Hikers can buy ionized water at these stations at half the price of mineral water.
- Other efforts not related to waste management include switching from wood to kerosene in an effort to keep costs down, and using subsidized solar panels to heat water (Shahabuddin 2015).

Unfortunately, as there are no options currently available to manage it, plastic waste is burned.

Administratively, the ACAP is divided into seven Unit Conservation Offices and stretches across Manang, Mustang, Myagdi, Kaski, and Lamjung districts, covering 7,629 sq. km. of former 57 Village Development Committees (VDCs). After the adoption of the new Constitution, the VDCs were restructured into 15 rural municipalities that fully or partially fall within the ACA. Entry fees into the ACA are collected from tourists, which are then ploughed back to support the Conservation Area Management Committees (CAMC) for conservation and development activities as well as to manage, utilize, and protect natural resources of the ACA. Some facts about the ACA are provided in Table 3.1.

Table 3.1: Important facts about Annapurna Conservation Area

Area: 7,629 sq. km.
Elevation range: 790-8,091 meters
Population: 91,688 (2011)
Key sectors: Tourism
Number of Tourists: 180,093 (2018)
Tourist-resident ratio: 1.96

Sources: NTNC 2019; NTNC and ACAP 2019

According to a solid waste study conducted in the ACA in 2011, plastic waste comprised the majority of litter found in the ACA, and more waste was found near villages (70.4 percent) than along trails (29.6 percent). Data was collected along the Annapurna Circuit trail over 100-meter transects, as well as 100 meters around major villages. Out of the 2,030 pieces of solid waste identified and categorized, non-biodegradable waste made up the largest proportion (80.8 percent). Within this category, plastic waste made up the majority of litter, accounting for 56.8 percent of the total amount of waste quantified in the study. Plastic waste included food wrappers, bags, bottles, and other plastic. Within the biodegradable waste category, which made up 16.7 percent of the waste found, clothes, fabric, and shoes accounted for the largest portion, followed by paper and cardboard. Readily-biodegradable waste (kitchen waste, plants, and fine organics) was the least common type of waste encountered within the ACA (2.5 percent) (Magditsch and Moore 2011).

3.3 Field Study Site Descriptions

Site locations: Ghandruk, Chhomrong, Kimche, and Syauli

District: Kaski

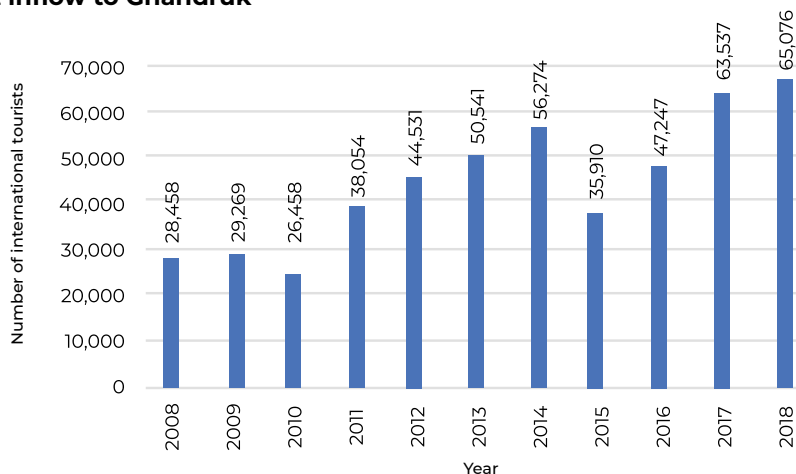
Area: Annapurna Conservation Area

Ghandruk is a tiny village located on one of the most frequently visited trekking trails in Nepal and is popular with national and international visitors. Approximately 1,250 visitors per day in the peak season visit Ghandruk, as per the ACAP office based there. In 2017 and 2018, over 65,000 tourists visited Ghandruk, proving tourism is a key source of income for the area. The small village is on the much-used trail to the Annapurna Base Camp (popularly known as the “ABC” trek) and is one of the largest villages in Kaski District in terms of size. The topography of Ghandruk is varied with hill terraces, steep slopes, lowland valleys, gorges, and high-alpine sheep grazing areas. Weather-wise, Ghandruk has a pleasant climate throughout the year. With the exception of the monsoon period (July and August), trekking takes place year-round.

Tourism in the ACA has steadily been increasing over time, as shown in Figure 3.1, showing the tourist inflow to Ghandruk. The dip in tourist inflow in 2015 was the result of the massive Gorkha earthquake. Popular tourist

destinations and infrastructure were affected, hindering the tourism sector in Nepal, including in Ghandruk and Chhomrong.

Figure 3.1: Tourist inflow to Ghandruk



Source: Ghandruk, Birethanti Checkpost 2019

Chhomrong is another village in the Annapurna area and a popular overnight stop for those trekking to Annapurna Base Camp. There is only one trekking route from Chhomrong to ABC, so most tourists who are passing through Chhomrong village can be considered to be going to ABC. Chhomrong is situated in a small valley just beneath the peak of Annapurna South and is the last permanent village. Spread over a hillside, it has stunning views. The only way to reach Chhomrong is on foot, about four hours away from Ghandruk, as there are no roads or airstrips connecting the village. Tourism is thought to be the primary source of income as over 30,000 tourists visited Chhomrong in 2017 and 2018. As the number of tourists has increased with every passing year, so too have a large number of lodges, hotels, and shops to meet the growing demand. The average annual temperature in Chhomrong is 14.2°C. Table 3.2 provides some more general information regarding Ghandruk and Chhomrong.

Table 3.2: Key facts about site locations

Key information	Ghandruk	Chhomrong
Total population (2018)	2,318	1,947
Number of households	612	490
Average household size	3.78	3.79
Elevation (meters)	2,012	2,170

3.4 Methodology of the Field Study

The data assimilated during the course of the field study was collected via a two-pronged approach: the use of waste sampling in order to identify the kinds of waste being generated as well as quantity and other factors, and a qualitative survey undertaken in specific key areas in order to understand the mindset and awareness level of residents in these areas. Further details on the components of the study in Nepal include:

- *Waste sampling:* This was done at source to determine the amount and composition of generated and discarded waste by different sources. Sources included households from low-, middle-, and high-income backgrounds and tourist establishments (hotels and restaurants).
- The waste sampling assessment was conducted at two different times in the year, given the variable flow of visitors to the region. The first assessment was conducted in May 2019, which is considered to be the end of the spring tourist season. Consultations with the Ghandruk Hotel Management Committee showed that hotel occupancy for the month was only 20 percent, which is considered off-peak.
- The second assessment was conducted in September 2019, which is regarded as the beginning of the peak tourist winter season. Local hotel owners confirmed that tourist occupancy was 90 percent, which is indicative of the peak tourist season.
- *Qualitative survey:* Interviews were conducted with residents, domestic and foreign tourists, and commercial establishments (hotels) in order to better understand their behavior and habits with respect to SWM, as well as their level of awareness of waste management in mountain regions.
- In general, the targets of the qualitative surveys were local residents, domestic and foreign tourists, and hotel staff. For the qualitative survey in Nepal, households, tourist establishments (hotels), and tourists were interviewed. The data gathered from the qualitative survey are summarized in Table 3.3.

Table 3.3: Qualitative survey summary

Household survey	Hotel survey	Tourist survey
<ul style="list-style-type: none"> • Socio-economic information • Waste generation, types of waste, segregation, and management • Waste collection services • Environmental awareness • Effort and willingness to better manage solid waste 	<ul style="list-style-type: none"> • Waste generation, segregation, and management practices • Waste collection services • Waste management in the area • Waste related to tourists • Staff training 	<ul style="list-style-type: none"> • Visit type and purpose of visit • Awareness of environmental problems in the area • Waste generation by tourists • Prioritization of waste management in mountain regions

3.5 Respondents and Sample Size

This section provides details about the waste sampling and qualitative surveys conducted as part of the field study in the ACA. Waste sampling was conducted twice, in May 2019, considered off-peak tourist season, followed by September 2019, which is considered peak tourist season. The qualitative surveys were conducted in May 2019. Tables 3.4 and 3.5 provide summaries of the field study in terms of types of respondents, sample size, samples collected, and surveys conducted.

3.5.1 Waste Sampling

For the first sampling assessment, four sites were chosen for household surveys: Ghandruk, Chhomrong, Kimche, and Syauli. In addition, 42 hotels/homestays in Ghandruk were sampled. Due to time constraints for the second sampling assessment, only 35 households and 36 hotels/homestays in Ghandruk were sampled. For both assessments, respondents were asked to collect waste over a 24-hour period to determine the quantity of waste generated and to analyze different categories of waste in households and hotels/homestays.

It should be noted here that during the first assessment, households were asked to exclude biodegradable waste in their waste collection for sampling. This is because biodegradable residues are not considered waste but used as a resource for composting or animal feed. However, it was observed that some biodegradable waste was included along with non-biodegradable waste, resulting in a lack of accurate information on biodegradable waste generation by households. For the second assessment, therefore, households were instructed to include all wastes (biodegradable and non-biodegradable) in their sample collections.

Table 3.4: Nepal field study: Waste sampling summary

Time period	May 2019 (Off-peak tourist season)				September 2019 (Peak tourist season)
Field study site	Ghandruk	Kimche	Syauli	Chhomrong	Ghandruk
Waste sampling conducted	54 households 42 hotels	70 households	40 households	111 households	35 households 36 hotels
Total samples	317				71

3.5.2 Qualitative Survey

The qualitative survey was conducted in May 2019 in Ghandruk and Chhomrong, and included households, hotels, and both domestic as well as foreign tourists as summarized in Table 3.5.

Table 3.5: Nepal field study: Qualitative survey summary

Time period	May 2019 (Off-peak tourist season)				
Sampling sites/nationality	Ghandruk	Chhomrong	Ghandruk	Nepalese	Foreign
Number of samples	206	112	53	17	33
Total samples by type	318 households		53 hotels	50 tourists	

3.6 Key Findings from the Field Study

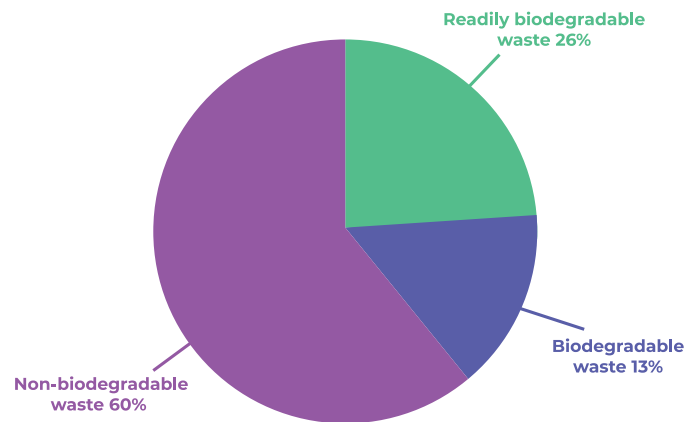
The key findings from the waste sampling and qualitative surveys and observations from the study are summarized in this section. Please note that due to small sample sizes, as shown in Tables 3.4 and 3.5, these values should not be considered representative and are only meant to provide a snapshot of solid waste practices in the sample locations. It is suggested that further corroborative research be done prior to any decisions being taken based on the data at hand. The data collected during the field study are summarized in Appendix 1. Boxes 3.1 and 3.2 provide detailed descriptions of household waste management in Ghandruk and Chhomrong and commercial (hotel) waste management in Ghandruk, respectively.

3.6.1 Waste Sampling

Waste Generation and Composition:

- Waste generation from households decreases closer to mountain regions.
- Plastic waste at tourist spots is the main constituent in mixed waste.
- The biggest waste fraction from both households and hotels is non-biodegradable waste,⁴ when all non-biodegradable waste components are combined together, as shown in Figure 3.2. Details of waste components are provided in Appendix A1.
- As a single category, readily biodegradable waste (RBW) makes up the largest fraction for both households and hotels, and in a similar proportion (approximately one-fourth of total waste consisted of RBW).
- In order from most to least, households generate food and green waste, plastic, glass, metal, rubber/leather, and juice boxes, as shown in Figure 3.3.
- In order from most to least, hotels generate food and green waste, followed by plastic, glass, batteries, metal, rubber/leather, and juice boxes, as shown in Figure 3.4.
- It is worth noting that after biodegradable (food and green) waste, plastic waste makes up the largest component of waste from sampled households and hotels.

Figure 3.2: Average waste composition from households and hotels sampled (%)



⁴ Non-biodegradable waste for this field study includes plastic bags, bottles and packaging, glass, aluminum, metal, batteries, cigarette butts, rubber/leather, batteries, bones/eggshells, and juice boxes.

Figure 3.3: Waste composition from households sampled (%)

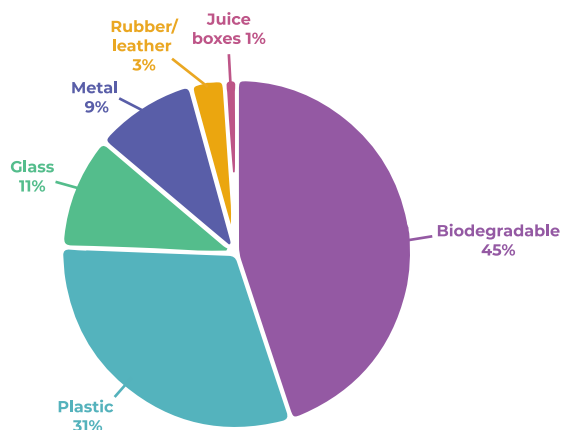
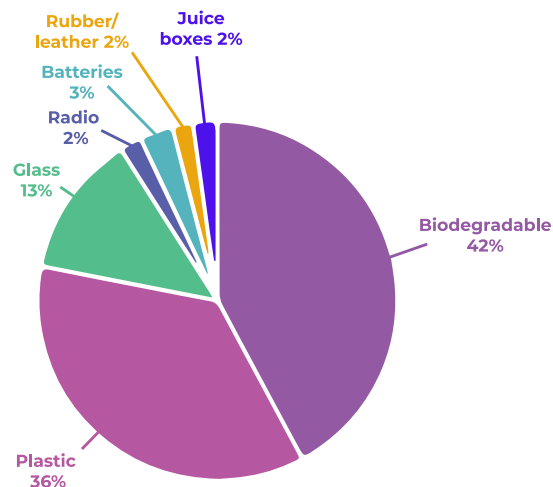


Figure 3.4: Waste composition from hotels sampled (%)



Segregation, Collection, and Disposal:

- During peak tourist season, hotels sort their waste into more fractions than during off-peak tourist seasons.
- Despite no formal segregation system, source segregation of biodegradable waste is common.
- Despite some communities segregating waste at source, there is no efficient separate collection system.
- Regular waste collection services are not available in low- and middle-income residential areas.
- As such, the proportion of waste that is disposed of in ravines/valleys and near rivers remains high in mountain cities.
- The open burning of non-biodegradable waste occurs frequently.

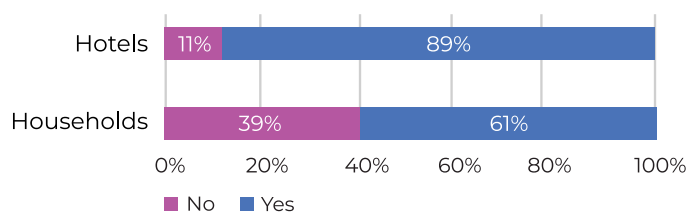
3.6.2 Qualitative Survey

Households

Segregation, Collection, and Disposal:

- More than half the households surveyed say they segregate their waste into biodegradable and non-biodegradable fractions. Figure 3.5 shows the percent of households and hotels surveyed that segregate their waste in Nepal.
- A sub-set of respondents is aware that service providers are available, but few make use of it. Over 71 percent of the households surveyed say they do not have regular garbage collection service in the area.
- The majority of the biodegradable waste is buried within the household property, followed by composting and use as animal feed.
- With regard to non-biodegradable waste, the most common method practiced by households is to burn it.
- Other options in order of practice include burying, disposal in a communal bin, selling, and providing to a waste collector.

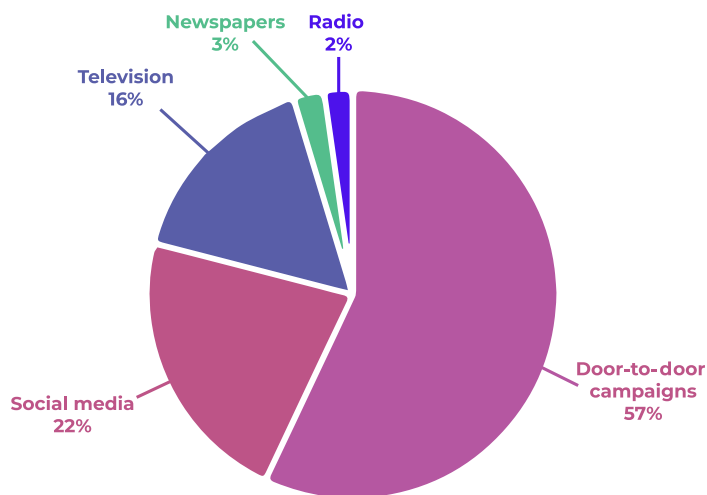
Figure 3.5: Percent of households and hotels segregating waste



Environmental Awareness:

- More than half the respondents surveyed say that they had taken part in sanitation campaigns, but the survey did not ask for more details on what type of program.
- Respondents were asked what their two main environmental concerns were. The primary concern, ranked from most to least, is road construction, adequate sanitation facilities, safe drinking water, employment, and SWM.
- The second concern, ranked from most to least, is safe waste management, employment, adequate sanitation facilities, increase in tourists, and safe drinking water.
- This shows that SWM is a topic of concern and other issues also have an impact on it, either positively or negatively. For instance, an increase in tourism will generate more waste, but the sector may provide employment opportunities. Moreover, if roads connect these areas, they would be able to transport recyclables for sale down to the plains more easily.
- Respondents were also asked what the most effective way was to build awareness, as summarized in Figure 3.6. From most to least, respondents chose door-to-door campaigning, followed by television and social media. Newspapers and radio were selected by only a very small fraction.

Figure 3.6: Awareness-raising methods according to sampled households



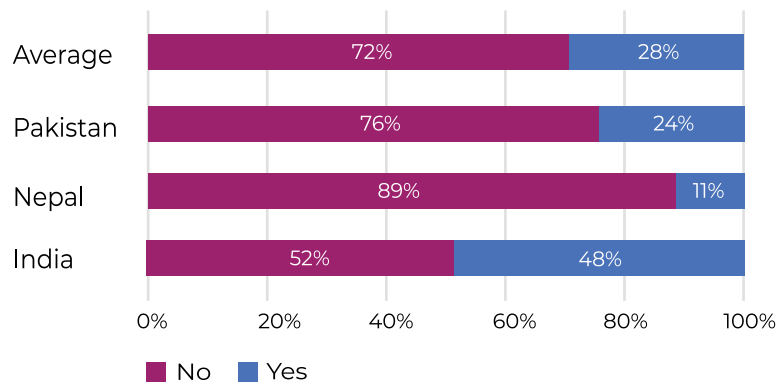
Willingness to Pay:

- Among households sampled in all three countries, Nepal has the highest proportion of respondents willing to pay for SWM services. This is not unusual, as is the case in many other low-income country cities around the world. Residents are willing to pay for services if they perceive that the standard

of service is efficient. Figure 3.7 shows the willingness to pay for SWM services among sampled households in all three countries.

- The majority are willing to pay Nr 200 or below per month, with a small fraction willing to pay Nr 400 and above.
- For those who were not willing to pay, the reasons provided are dissatisfaction with the current service, households not being able afford it, it is the government's responsibility, and it is not needed.

Figure 3.7: Willingness to pay for SWM services among sampled households



Hotels

Waste Composition and Segregation:

- The majority of hotels generate a large quantity of biodegradable waste.
- The overwhelming majority of waste generated by tourists is plastic packaging.
- The largest component of non-biodegradable waste from hotels is plastic bags and bottles.
- A large number of hotels segregate their solid waste into biodegradable and non-biodegradable fractions, as shown in Figures 3.8 and 3.9.
- The non-biodegradable fraction is further segregated into plastic bags and bottles, paper, glass, and metals by a majority of the hotels.

Waste Collection and Disposal:

- Waste from hotels is primarily collected in plastic bags, followed by waste bins.
- About half of respondents are aware of a waste collection service and those who were aware, used it. The collection service was equally divided between daily, weekly, and three times a week.
- For those hotels that segregate their waste, the biodegradable fraction is treated in the following ways, from most to least popular: composted, used as animal feed, provided to waste collector, buried, and finally a small fraction disposed of the waste far from the hotel. Figure 3.8 shows the distribution of the various practices followed by hotels sampled in the study.
- With regard to the non-biodegradable fraction, the primary ways to manage it are to provide it to a waste collector, followed by burning, selling, disposing it in a communal bin, and burying the waste, as shown in Figure 3.9.

- The majority of hotels surveyed do not pay for collection services but are satisfied with collection efficiency/frequency, reliability, and cooperation.
- All hotels that receive collection service are aware of how the waste is disposed of.

Figure 3.8: Biodegradable waste disposal methods from surveyed hotels that segregate their waste

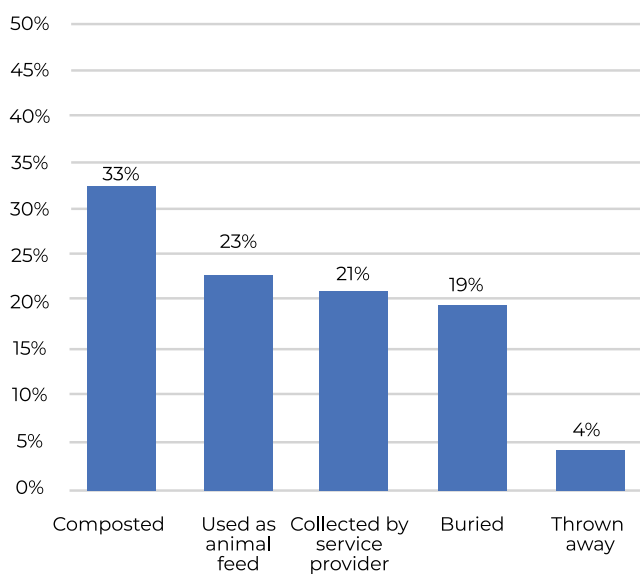
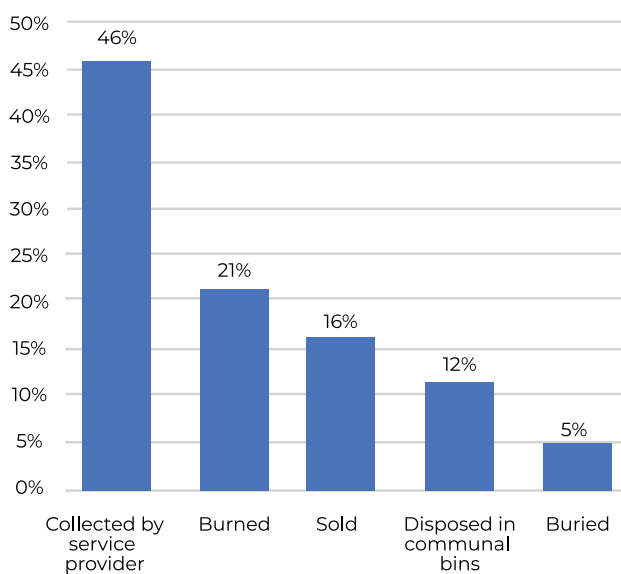


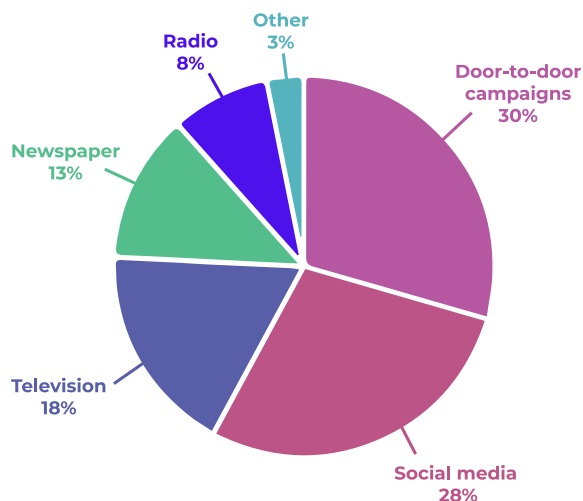
Figure 3.9: Non-biodegradable waste disposal methods from surveyed hotels that segregate their waste



Environmental Awareness and Willingness to Pay:

- An overwhelming majority of sampled hotels—over 96 percent—whether currently receiving collection service or not, are willing to pay for SWM services, but only a fraction say they are willing to segregate waste.
- In their opinion, a major problem related to SWM is littering on trails and smoke from the open burning of waste.
- The majority of hotels participate in SWM campaigns.
- The most effective way of raising awareness according to surveyed hotels, from most to least preferred, is door-to-door campaigning, social media, television, newspaper, and radio, as summarized in Figure 3.10.

Figure 3.10: Awareness methods according to surveyed hotels



Tourists

- The majority of tourists surveyed were foreigners, that is, not domestic tourists from Nepal.
- The predominant environmental issue faced in the area according to the tourists surveyed is littering on the trails, followed by openly dumped waste and fine dust, as shown in Figure 3.11. Lack of sanitary facilities, water pollution, and deforestation are also other concerns.
- Common types of waste seen by surveyed tourists include plastic bottles, food waste, and plastic packaging, as shown in Figure 3.12.
- With respect to goods purchased locally, the common types of waste generated are plastic packaging, plastic bottles, glass bottles, and batteries.
- The top priority for mountain waste management according to surveyed tourists, from most to least preferred, include campaigns on SWM, more bins available on trails, stricter policies and regulations, an increase in SWM facilities, and frequent monitoring, as shown in Figure 3.13.

Figure 3.11: Surveyed tourists' rankings of predominant environmental issues faced in the area

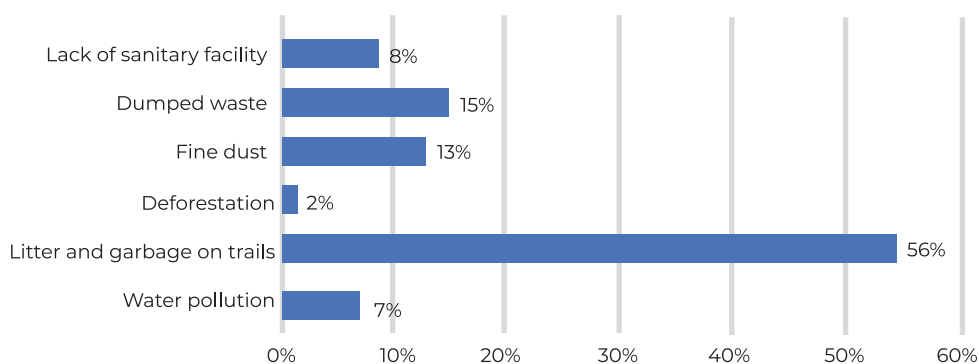


Figure 3.12: Type of waste most commonly seen by surveyed tourists

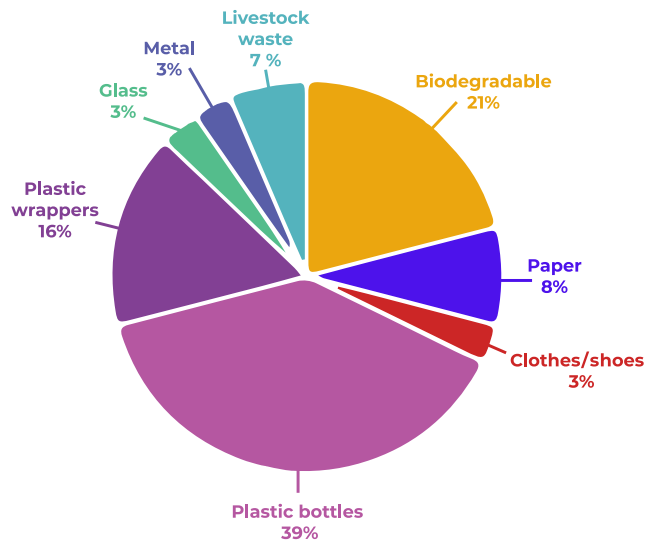
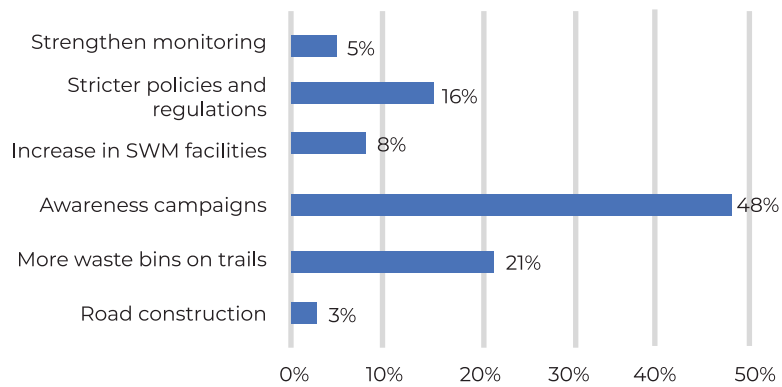


Figure 3.13: Summary of surveyed tourists' rankings of priority SWM-related actions



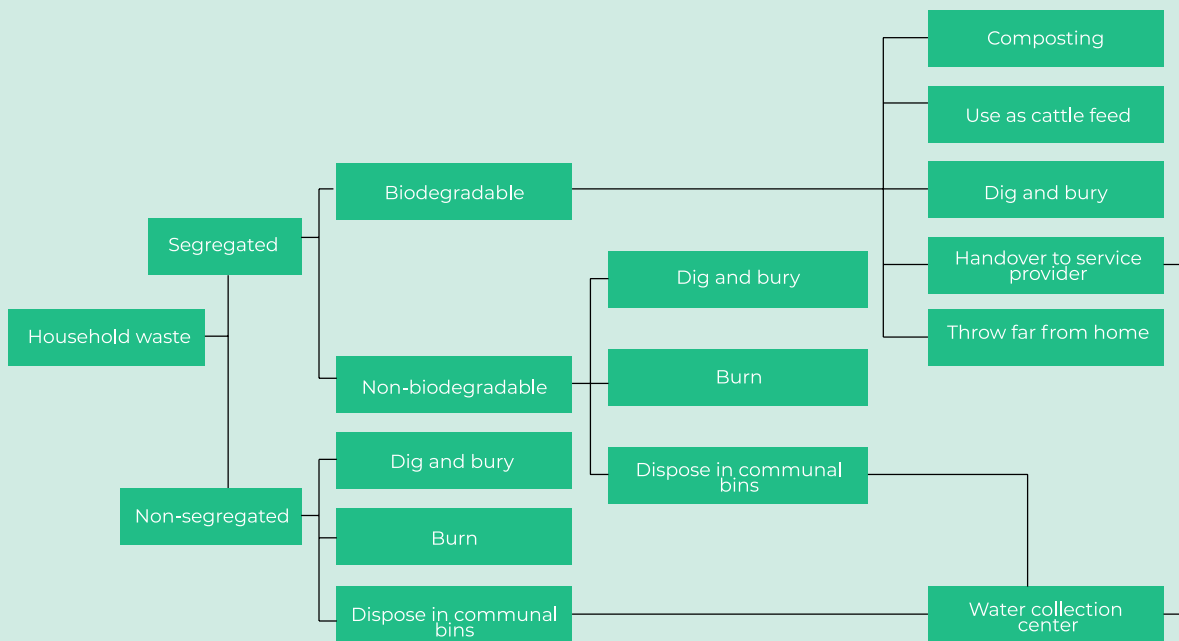
Box 3.1: Household waste management in Ghandruk and Chhomrong

Figure B3.1.1 shows a schematic that is representative of current solid waste management practices in Ghandruk and Chhomrong households. The waste that is produced is either separated or disposed of without segregation. It has been observed that all households that segregate their wastes do so into biodegradable and non-biodegradable fractions, as shown in Figure B3.1.1. Non-segregated waste is disposed of primarily in three main ways: digging and burying, open burning, or disposal in communal bins located at various locations around the village. When the bins are full, a waste collector collects and transports the waste to the waste collection center.

The segregated biodegradable fraction is commonly used for composting and for animal feed. Some households dig and bury the waste, dispose of it away from their homes, or provide it to the waste collector who takes it to the collection center. Similarly, the non-biodegradable waste is either buried or openly burned, which is perceived as harmful by the community. Segregated non-biodegradable waste is also provided to the waste collector and taken to the waste collection center.

Figure B3.1.1 shows that the waste collection center plays a significant role in community waste disposal. At the collection center, the waste is further classified as “burnable” and “non-burnable”. Except for reusable and recyclable materials, such as plastic and glass bottles, the remainder of the waste is burned or buried. The reusable/recyclable fraction (primarily glass bottles) is packed and the waste vendor is contacted to collect the packed waste.

Figure B3.1.1: Schematic of household waste management practices in Ghandruk and Chhomrong



Box 3.2: Commercial waste management in Ghandruk

As the number of tourists to Ghandruk increase, so too have the number of commercial establishments, primarily hotels and homestays. A Hotel Management Committee has been formed to safeguard the environment and to manage hotels and homestays. The committee develops initiatives to manage solid waste generated from hotels operated in Ghandruk. A waste collection center has also been established by the committee. The committee recommends that hotels and homestays separate their wastes into biodegradable and non-biodegradable fractions, with the non-biodegradable fraction further segregated into plastic bags, plastic bottles, glass bottles, metal, and paper. The committee has employed staff to collect waste from each hotel and to transport it to the waste collection center. At the collection center, the glass bottle waste is further segregated and packed. A Pokhara-based waste vendor collects the packaged bottles and transports them to Pokhara. In addition, the collection center staff collect waste from the community bins located on the trails in and around Ghandruk.

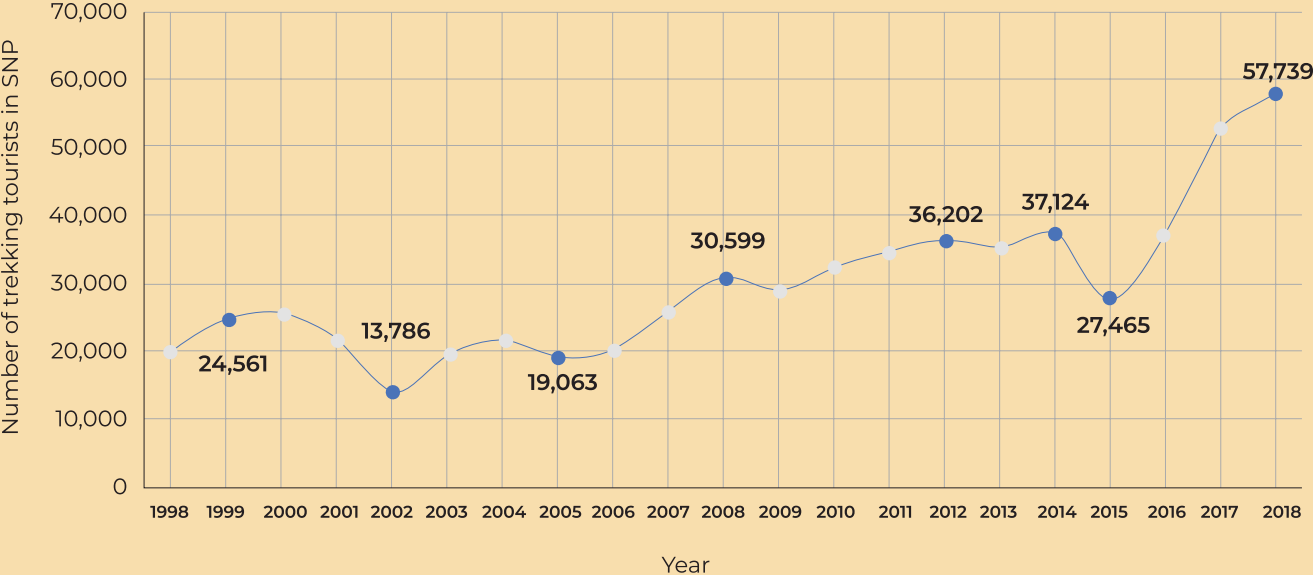
Biodegradable waste generated in hotels and homestays is managed at the property itself by composting, using as animal feed, or burying it within the compound. Non-biodegradable waste that cannot be reused is burned near the waste collection center. In addition to this initiative by the Hotel Management Committee, mothers' groups in Ghandruk also organize litter clean-up campaigns once a month. During these clean-up campaigns, donkey dung found on the routes is also collected and used for composting. Each family is required to participate in the campaign to at least clean up their own surrounding area. Non-biodegradable waste is either burned or transported to the waste collection center.

CS1. Case Study: Proactive Solid Waste Management in Sagarmatha National Park

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, in order to preserve the pristine and delicate environment in these high mountain regions. With that in mind, we look at how the Sagarmatha National Park is managing SWM in such extreme conditions and what best practices may be applied to other parts of the country. It is important to note that this information has been added to this report from a previous study and is not the product of any research funded or sourced by the World Bank (SPCC 2019).

The SNPBZ is located in the Khumbu region in northeastern Nepal. The region's elevation ranges from 2,300 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 (Nepal, CBS 2011b). In comparison, almost 58,000 tourists visited SNP in 2018, which is six times the population of the Park. The growth of tourism in the area can be seen in Figure CS1.1.

Figure CS1.1: Tourist trekking visits to SNP from 1998 to 2018



Source: SPCC 2018

CS1.1 Institutional Set-up for Solid Waste Management

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.

Since 1991, the Department of National Parks and Wildlife Conservation (DNPWC), under MoFE, has given a mandate to the Sagarmatha Pollution Control Committee (SPCC) to manage solid waste along the main tourist routes and settlements in the Khumbu region. 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 also works as a local implementing partner of the Ministry of Culture, Tourism and Civil Aviation (MoCTA) and the Nepal Mountaineering Association (NMA) to monitor waste at base camps of various mountains generated by expedition groups through the garbage declaration and clearance system. 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 working procedure 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.

CS1.2 Municipal Solid Waste Generation and Composition

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

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

A waste management study conducted by Kathmandu University (KU) in September 2007 and June 2008 in the SNPBZ found that per capita solid waste generation of tourists and locals in the area was 0.12 kg per day and 0.11 kg per day, respectively (Khanal et al. 2010). 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 kg per day. The project calculated this value based on waste generated from travelling, food intake, and accommodation. It is unclear whether the KU value is solely for local inhabitants or also includes tourist waste.

The KU study found that the majority (almost 80 percent) of the waste consists of biodegradable food waste, followed by paper, plastics, metal, glass, and inert waste (Khanal et al. 2010). However, like in other mountain regions in Nepal, biodegradable waste is considered a resource for composting and animal feed, and is not mixed with other waste. The SPCC encourages local communities and tourism businesses to segregate their waste into "burnable" and "non-burnable" categories. Burnable waste includes paper, plastics, wood chips,

and textiles, while non-burnable waste includes metal, glass, aluminum, and PET bottles. Non-burnable waste from expeditions commonly includes metal, glass, cooking stoves and cylinders, oxygen cylinders, and batteries.

With regard to expedition waste, the SPCC issues waste clearance certificates to mountaineering expedition teams after receiving their trash upon return from expeditions, which is required prior to the release of the waste deposit refund. Climbers on Mount Everest are required to bring at least eight kilograms of garbage back from the mountain as per new rules formulated in 2014. The waste deposit fund is explained in more detail in Appendix 2. The types and amount of waste generated by expedition groups in the Khumbu region in the 2017/18 financial year is summarized in Table CS1.1.

Table CS1.1: Waste generated by expedition groups in Khumbu region, FY2017/18

Waste type	Waste quantity
Burnable waste	261 tonnes
Cooking gas cylinders	1,735 cylinders
Batteries	2,170 pieces
Tins/cans	2,537 kg
Glass bottles	736 kg

Source: SPCC 2018

CS1.3 Municipal Solid Waste Segregation

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 garbage 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 garbage 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.

CS1.4 Municipal Solid Waste Collection and Transport

SPCC provides door-to-door waste collection services in hotels/lodges and shops in Lukla and Namche. SPCC also partners with 25 local groups in various places such as Thame, Thamo, Khumjung, Dingboche, Gokyo, Lobuche, Monju, Phakding, 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.

SPCC also conducts regular clean-up campaigns along major trekking trails, in settlements, and on mountains to collect discarded waste and raise awareness. SPCC was the main partner of the Mount Everest Clean-up Campaign 2019—the largest joint clean-up campaign conducted through collective public-private partnership. The campaign collected around 11 tonnes of garbage and retrieved four dead bodies from Mount Everest (Thapa 2019).

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. Up until 2018, the SPCC transported a total of 45 tonnes of non-burnable waste from Lukla to Kathmandu for recycling (Dhakal 2018; SPCC 2018).

CS1.5 Municipal Solid Waste Disposal

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 2 to 400 cu. m. in size, and all are built with walls from rocks that are locally available (SPCC 2019).

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.

CS1.6 Municipal Solid Waste Initiatives and Results

Over the years, the 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.
- The Khumbu Pasanglhamu Rural Municipality banned the use of plastic bags (under 30 microns in thickness) and PET bottles starting in 2020.
- The 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-raising 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 (KU 2020).



4. Solid Waste Management Challenges in Mountain Areas of Nepal

Regardless of location, type of habitation, or elevation, the solid waste management (SWM) sector is complex and requires multiple aspects to work in synergy in order to provide efficient services, protect public health, and conserve the environment. In low- and middle-income countries, it is all the more challenging because SWM requires significant prerequisites. These prerequisites include local government capacity, institutional coordination, stakeholder cooperation, sustainable funding mechanisms, infrastructure, technical knowledge, public awareness, behavioral change, monitoring and enforcement, data collection and analysis, and relevant laws and policies.

The uniqueness of mountain areas adds to the challenges of managing solid waste in high-altitude areas. While SWM challenges may be shared by many types of locations, mountain areas relate to challenges more commonly associated with other eco-sensitive areas rather than their counterparts in the plains. These points are further elaborated in the following sections.

4.1 What Makes Mountain Areas Unique?

Mountain areas are unique for the following reasons: type of settlement, altitude and climate, topography and land availability, remoteness and connectivity, and accessibility by road. All these factors have a combined effect on the range of SWM services that are needed and that can be provided. Each of these issues is explained below, in the context of how mountain areas are distinguishable from settlements in the plains.

- *Settlement type:* One might assume that mountain areas are dotted with small settlements in remote areas, where waste quantities generated are negligible compared to larger cities in the plains. However, mountain settlements—especially in the three countries that are the focus of this report—range from large mountain cities that are home to hundreds of thousands of people, to small towns and rural villages that are connected to larger cities by a road or train network, to remote villages and tourist spots that can only be reached by foot and consist of few to no inhabitants. There are settlements that are tourist hotspots (for example, the “hill stations” in India and Pakistan established during colonial times), which see waves of population increases during peak season times, and others that are not popular tourist destinations.
- *Altitude and climate:* Mountain settlements in India, Nepal, and Pakistan span the gamut from low- to mid-altitude hills and plateaus offering a temperate climate to the largest concentrations of the highest peaks in the world that are characterized by extreme climate throughout the year.
- *Topography and land availability for SWM:* These are inter-related issues, where the topography may be suitable to establish SWM facilities but there is a lack of land, to where there may be ample land available but the topography may not be suitable for infrastructure such as sorting, processing, and treatment centers and landfills.
- *Seismic activity:* The Himalayan region is vulnerable to earthquakes, with major earthquakes affecting all three countries. While earthquakes also occur in non-mountain areas, development of waste infrastructure, particularly landfills, needs to be carefully considered. Landfill liners may tear, landfill

gas and leachate collection systems may shift, and landfill covers may crack following an earthquake. These outcomes can cause severe pollution to groundwater aquifers, streams, and alpine lakes that are sources of freshwater not only for mountain communities but also for settlements downstream that support millions of people.

- *Remoteness and connectivity:* The importance of road or train connectivity to mountain settlements cannot be minimized with regard to SWM. Many aspects, such as types of bins, storage containers and facilities, frequency and efficiency of collection services, and availability of treatment options, are directly related to whether mountain settlements can transport their wastes. Even in large mountain cities, neighborhoods and localities would need waste collection services to collect and transport the waste to nearby facilities. The more remote a mountain settlement is, the more difficult and costly it is to provide SWM services.
- *Accessibility by road:* Mountain areas may or may not be connected by road to larger towns nearby and to cities in the plains. Moreover, those that have road networks may not have all-weather roads and may be cut off during the monsoon and winter seasons. This adds an additional layer of complexity to SWM services as storage facilities and transfer stations may need to be developed.

4.2 Shared and Diverse Challenges

One may assume that mountain cities face the same SWM challenges as cities in the plains and that mountain villages and remote areas face the same issues as villages and remote locations in non-mountain areas. This assumption is both true as well as untrue. While all settlements face certain SWM challenges, mountain areas tend to face additional ones by virtue of their location. This makes improving service provision in mountain areas all the more demanding compared to the plains. Table 4.1 summarizes the challenges faced by all areas, regardless of location, as well as the challenges unique to mountain areas.

Moreover, not all mountain areas are the same and vary by many localized factors, such as topography, climate, access, seasonality, waste volumes and types, and the impact of tourism. It is clear, then, that mountain areas require a suite of bespoke waste management solutions. Recommendations and options for mountain areas are discussed in Chapter 5.

Table 4.1: Comparison of SWM challenges in mountain and non-mountain areas

SWM in all areas	SWM in mountain areas
<ul style="list-style-type: none"> • Poor awareness and adoption of SWM practices • Lack of waste segregation • Inadequate collection and storage facilities • Poor or obsolete transportation options • Lack of or poorly functioning treatment facilities • Improper waste disposal techniques • Competing priorities for local governments • Lack of institutional coordination • Lack of skilled and technical capacity • Lack of funding and poor cost recovery 	<ul style="list-style-type: none"> • Topography and geology (e.g., steepness, ruggedness, soil stability) • Remoteness of settlements • Scattered and low-density areas generating low volumes of waste • Diverse temperature and weather conditions • Sensitive environmental and ecological conditions • Vulnerability from seismic activity • Lack of road networks making access difficult • Special types of waste generated (e.g., mountaineering waste), which require treatment and disposal • Waste transport requires vehicles suitable to mountain regions • Limitations of space for waste treatment and disposal • Poor socio-economic conditions in general • High variability of waste generation due to tourist seasons

4.3 Shared Challenges with Other Eco-Sensitive Areas

Mountain areas face many SWM challenges that are similar to other eco-sensitive areas, such as protected areas (e.g., conservation parks, sanctuaries), small island states, remote villages in Arctic regions, and so on. These areas have the following in common:

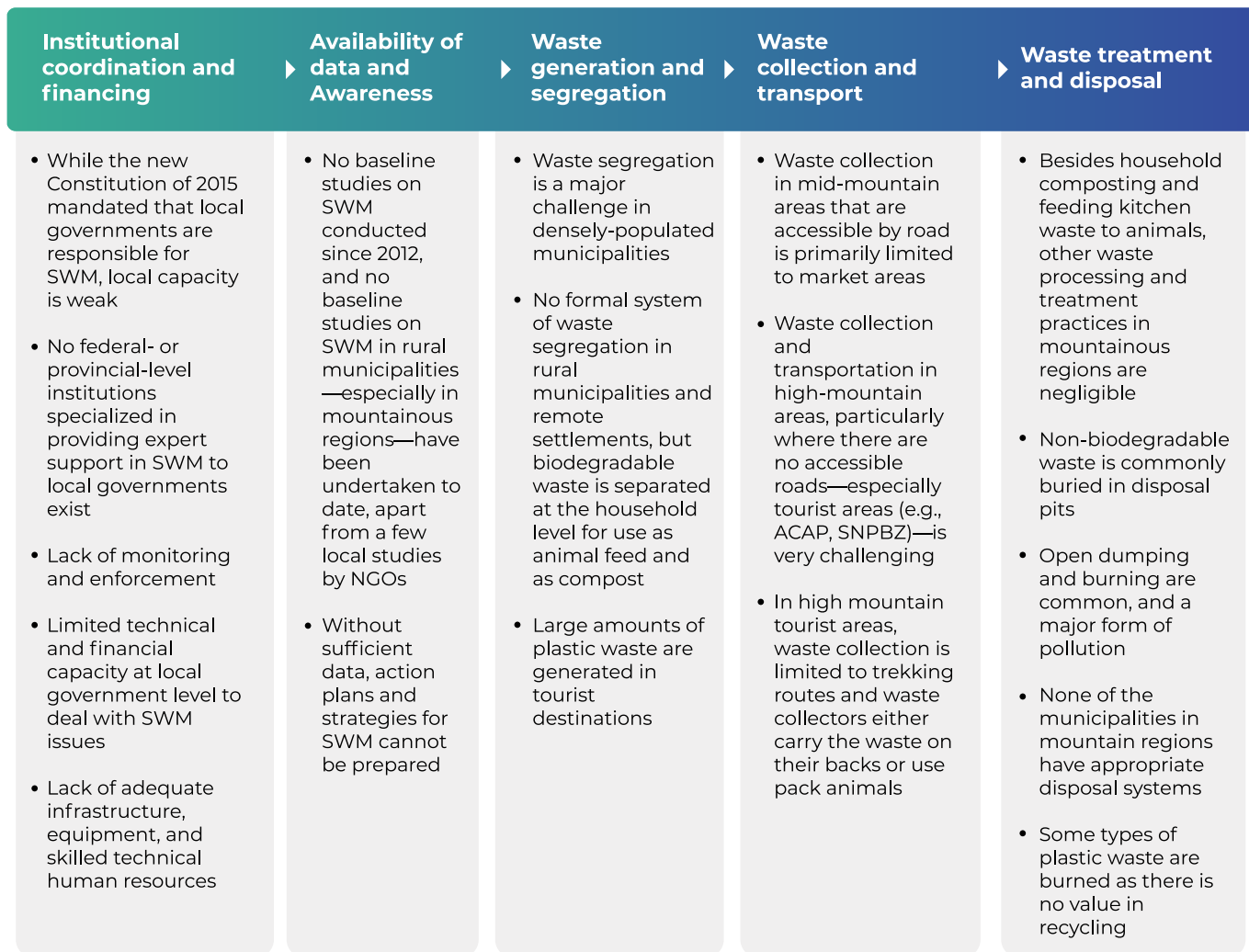
- Remoteness and distance to developed infrastructure for waste treatment and disposal make waste collection and transport challenging.
- They are scenic or have a unique landscape that tends to attract tourists. While this brings important revenue to these areas, it also adds to the waste build-up.
- Depending on the area, tourists may visit regardless of season, adding considerably to the year-round waste generated in the area.
- They often have space constraints so allocating space for treatment and disposal is not always an option.
- Decentralized waste management solutions may be better suited to these areas.

These commonalities are worth mentioning because SWM practices that have been established in other eco-sensitive areas may also be suitable to mountain areas. The *Good Practice Options for Sustainable Solid Waste Management in Mountain Areas of India, Nepal, and Pakistan* report of this study highlights examples of solid waste practices in small island states such as the Maldives and the impact of tourism fees on islands in Indonesia.

4.4 Challenges Specific to Mountain Areas of Nepal

Mountain areas are, therefore, quite complex and require considerable coordination, planning, and financing. One cannot address mountain waste in Nepal without addressing the specific challenges related to the SWM chain in mountain areas. From the lack of coordination and financing, to the poor infrastructure in place to deal with treatment and disposal, a detailed look at the current system is necessary in order to overhaul and amend it. Figure 4.1 summarizes the various SWM challenges specific to Nepal's mountain areas.

Figure 4.1: Summary of SWM challenges specific to mountain areas of Nepal





5. Recommendations and Actions for Solid Waste Management in Mountain Areas of Nepal

Based on the solid waste management (SWM) challenges specific to mountain areas described in Chapter 4 and the issues identified in the course of analysis of the field study as provided in Chapter 3, it is clear that there can be no one-size-fits-all approach to mountain waste.

Nevertheless, taking a regional perspective of the three countries in the study, it is useful to think about the range of solutions that are warranted. Any proposed recommendation would require an understanding of the following factors and their inter-linkages. Proposed recommendations and related implementable actions along a phased approach are then presented in this chapter.

5.1 The Framework to Build Solutions

When thinking specifically about mountain waste and what is needed to overcome the relevant challenges, it is important to consider a framework or foundation on which solutions can steadily be built. The following factors need to be considered: landscape management approach, sources of waste, geography and location, types of waste, seasonality, and tourism-based waste.

5.1.1 Landscape Management Approach

An integrated landscape management approach recognizes the inextricable links between forests, natural resources, and the value chains that depend on them, such as agriculture, timber, and tourism. This approach aims to ensure both an equitable as well as sustainable use of renewable natural resources such as forests, wildlife, water resources, and land, to improving livelihoods for the most vulnerable rural communities, while at the same time strengthening the health and resilience of surrounding landscapes.

Any long-term solution on mountain waste should be considered in the context of integrated landscape management. By doing so, it would help conserve, restore, valorize, and promote the sustainable use of natural resources in mountain habitats, such as forests and waterbodies (for example, streams and lakes). The approach also brings various stakeholders together around a common vision to manage trade-offs across different land use sectors within a given area (World Bank 2021). See Box 5.1 for more information on the landscape management approach.

5.1.2 Sources of Waste Generation

Solid waste in mountain areas comes from two primary sources: settlements and tourism. Settlements include communities that live in these areas, many tracing back their heritage to ancient times. Tourism denotes outsiders who are temporarily visiting one or more locations either for leisure, pilgrimage, or for adventure tourism.

In India, Nepal, and Pakistan, settlements can be classified as (1) mountain cities or urban areas, (2) mountain villages or rural areas that are generally connected by some form of road network, and (3) remote areas that are not connected by road and can only be reached by foot. SWM practices will vary depending on the type of settlement. For example, mountain cities in India, Nepal, and Pakistan have hundreds of thousands of inhabitants, all contributing to year-round waste generation, which needs to be constantly managed in terms of collection, treatment, and disposal. On the other hand, small villages and remote locations may require decentralized approaches such as household or community composting to manage their wastes.

The second source of waste generation in these areas is from tourism. Tourists contribute significantly to the amount of municipal solid waste (MSW) generated in mountain areas, be they large cities or smaller isolated hamlets. In some places, tourism is a year-round industry and, therefore, the additional waste generated requires funding and coordination with tourism service providers, among other interventions. Tourism-related waste is described in further detail in Section 5.1.6.

5.1.3 Geography and Location

While the sources of waste can provide indications of the quantity and types of waste generated, geography and location help in determining the infrastructure, equipment and vehicles, man power, and, therefore, funding required to manage the generated waste. For instance, steepness and remoteness of settlements would hamper certain types of waste collection services.

Box 5.1: Understanding the Integrated Landscape Management Approach

The idea behind integrated landscape management (ILM) is to sustainably manage landscapes by bringing together multiple stakeholders with different land-use objectives. Instead of a sector-focused approach where sectors work in isolation, the ILM approach aims at simultaneously focusing on natural resource management, development, climate change, livelihoods, and food security, as well as other socio-economic and governance issues for a defined landscape or place. In this way, the landscape-based approach is increasingly recognized as an effective means to address challenges in food security, ecosystem conservation, and climate change.

Defining the Concept

The overarching objective of ILM is to maintain social, economic, and ecological functions in a balanced manner, and to contribute to sustainable development and the reduction of negative external impacts in a region. While there are multiple ways of approaching ILM, they all share some common salient points including (1) broad stakeholder participation, (2) negotiation around multiple objectives and strategies to develop shared understanding of multi-functional landscape, (3) adaptive management, based on shared learning, and (4) place-based and decentralized processes, emphasizing the role of local actors and their empowerment. Even defining the boundary of a landscape is done through the lens of what is locally feasible and spatially informed.

Since an ILM approach includes several sectors, actors, and may even have a variety of objectives, it is important that all related institutions, even informal bodies, and stakeholders have an established, integrated framework on which to collaborate and build upon in order to achieve their common goals. It is essential that stakeholders understand the workings and dynamics of a place and use locally-appropriate mechanisms as the basis for their actions.

In the context of ILM, landscapes can include multiple, interlinked functions and can provide a variety of services (for example, food, water, shelter, livelihood, economic growth, biodiversity, climate change regulation, and human well-being). The landscape, thus, becomes an ideal unit for planning and decision-making, allowing various sector plans and programs to be integrated into a single spatial context.

Source: World Bank 2021

Mountain cities are more likely to be connected by road networks to cities in the plains, thus enabling sorting and processing of waste before the waste is shipped to a large processor or recycler. On the contrary, waste transport vehicles would not be able to reach remote locations and thus these areas would require different solutions from those in urban mountain areas.

5.1.4 Types of Waste Generated

The next consideration are the types of waste generated by these sources. Based on the type of settlement or by activity (in this case, tourism), it is possible to infer the types of waste generated. For instance, in mountain cities there is likely to be a mix of biodegradable and non-biodegradable waste, as well as special wastes such as construction and demolition (C&D) waste, healthcare waste, electronic waste, and inert/non-recyclable

waste. In rural areas and remote communities, the primary type of waste would be biodegradable. In both these areas, biodegradable waste is higher in volume and weight compared to other wastes, and could be segregated and mostly managed at source.

Understanding the types of waste generated in different communities would enable planning or pre-planning for storage and collection systems, transportation vehicle requirements, and probable treatment and disposal options. For instance, in mountain cities, biodegradable waste may be better suited to community or centralized facilities due to the lack of space. However, in rural and remote areas, composting could easily be done at the household level.

5.1.5 Seasonality

When planning appropriate SWM systems in mountain areas, it is important to consider whether waste generation follows a pattern based on tourism, employment, or some other factor. Any popular tourist area, be it a mountain city or remote village, or even a base camp, will show fluctuations in waste quantities generated based on tourist seasons. For instance, in Pakistan, the peak tourist season is from May to September, while Nepal has two tourist seasons: from March to May and from September to November.

Waste management infrastructure and services need to accommodate variations in waste amounts for collection, transport, treatment, and disposal. However, seasonality is complicated, and may change over time. For instance, in many hill stations across India the concept of peak tourist season is fading away as more families are able to afford weekend getaways. Conversely, in other countries like Nepal, not only do peak leisure tourism times vary from adventure tourism, but the climbing season takes place in a very short window of a few weeks every year depending on the weather.

5.1.6 Tourism-based Waste

Mountain areas are magnets for tourism, and this brings with it an additional set of unique challenges related to SWM. Tourism is an interesting aspect of life in mountain areas because it has the potential to be both economically lucrative as well as simultaneously detrimental to the environment.

Leisure and adventure tourism—both domestic as well as international—are bringing growing numbers of visitors to mountain areas in the three countries in this study. Tourism-related activities (and the resulting waste generated) take place in mountain cities and towns, villages that act as transit points for trekking and climbing expeditions, and in uninhabited areas (high-altitude areas for mountaineering). Specific challenges associated with tourism waste include seasonality and the fact that tourists may care less about engaging in environmentally friendly behavior while on holiday. The seasonality aspect is described in Section 5.1.5.

With regard to tourists engaging in sustainable behavior, research from the University of Queensland in Australia shows that even typically environmentally conscious travelers do not necessarily make environmentally-friendly choices while on holiday. Reasons for this include:

1. That it is the responsibility of the government or industry to manage waste
2. A lack of information and awareness on prevalent waste practices

3. Comparisons to other tourists' behavior
4. While on holiday, tourists do not want to think about their environmental responsibilities (Dolnicar 2015).

An important aspect of tourism in mountain areas is associated with adventure tourism in uninhabited areas, such as high-altitude areas where mountaineering and trekking expeditions take place. In this case, no waste management services exist. Moreover, in high-altitude areas like the Himalayas, waste—whether solid waste, human excrement, or the remains of climbers—does not decompose easily due to the low temperatures. The only appropriate waste management strategy under these conditions is Leave No Trace, and specifically for solid waste, “Pack it in, Pack it out” (LNTCOE 2020).⁵

It has been observed that when areas become popular with tourists, the non-biodegradable waste fraction such as plastic packaging, Tetra Paks, and glass generated in these areas tends to increase. In addition, adventure tourism generates specific types of waste associated with climbing equipment and supplies such as tin cans, oxygen bottles, batteries, ropes, and tents. When this happens, waste systems must adapt to the changing waste composition. In this way, tourism affects the types of waste generated, and thus will have a cascading effect on how this waste is collected, where it is transported to, and how it is treated and disposed of.

5.2 Recommendations and Actions

Understanding that solutions for SWM in mountain areas need to be devised in a framework considering waste sources, geography and location, types of waste generated, seasonality, and tourism-based waste, it is recommended that an action plan or policy specific to mountain waste be created at the national level. An action plan or policy would detail the current waste situation in mountain regions in the country, set targets for the sector (on collection, treatment, recycling, and disposal), and create guidelines on financial sustainability, public awareness, promotion of a green economy, and rehabilitation of contaminated sites.

In support of this suggestion for a specific mountain waste plan or policy, this report presents various recommendations that are supported with implementable actions. These actions have been elaborated in a phased manner, rather than in a time-bound fashion, taking into consideration that implementation of a mountain waste plan or policy may progress according to different time frames in different countries. A phased approach allows for flexibility by respective national, provincial/state, or local governments. The recommendations presented in this section are suggested taking into account an integrated approach of SWM. The concept of integrated solid waste management (ISWM) is described in Box 5.2. Box 5.3 provides a note on how to use Tables 5.1-5.5 presenting the suggested actions.

A number of the suggested actions may be initiated simultaneously, regardless of the phase they are in, and may work concurrently with one another. For example, open dumping should be banned only once waste storage sites are opened, otherwise the ban is likely to be ineffectual; fines for littering should ideally run simultaneously with awareness campaigns so that residents and tourists alike are aware of the new regulations.

⁵ Leave No Trace is a set of seven ethics principles designed to promote conservation in nature while participating in outdoor recreational activities. One of the principles is to dispose of waste properly. “Pack it in, Pack it out” essentially means taking back unused materials and waste to be disposed of in waste bins or back home and not leave them in the outdoors.

It should be noted that these recommendations and various implementable actions have been developed primarily with mountain areas in mind; however, the recommendations listed here may work for non-mountain areas as well, as a number of challenges are the same (as given in Table 4.1). While individual communities can manage certain aspects of SWM by themselves, such as household composting for small villages or remote hamlets, integrating measures by connecting sub-areas in order to provide centralized services, such as regional treatment facilities, is also needed. This will depend on local conditions, geography, and location of settlements, and hence needs to be developed at an intrinsically local level.

At each stage constant monitoring is required to see how effective programs have been:

- If something has worked, it is important to track what made it successful and how can it be scaled-up or expanded in a way that benefits the rest of the region or even the country.
- If something did not work, it is important to identify the factors behind the failure as well as the barriers to implementation so that changes can be made to support future implementation.

It is important to note that the recommendations and implementable actions provided in the remainder of this chapter are meant to propose ideas for the way forward, and should not be considered unalterable. It is expected that respective governments, should they wish with assistance from the World Bank, would develop a mountain waste plan or policy based on the specific scenario regarding mountain waste in their countries.

Box 5.2: Integrated solid waste management

Integrated solid waste management (ISWM) is a comprehensive framework for solid waste management (SWM), pictorially depicted in Figure B5.2.1. It includes all aspects of running an efficient, coordinated waste system, including the waste hierarchy, stakeholders, policy and legal, technological, financial, economic, environmental, and institutional aspects. The ultimate aim of ISWM is to manage an SWM system in a way that is environmentally, financially, and socially sustainable.

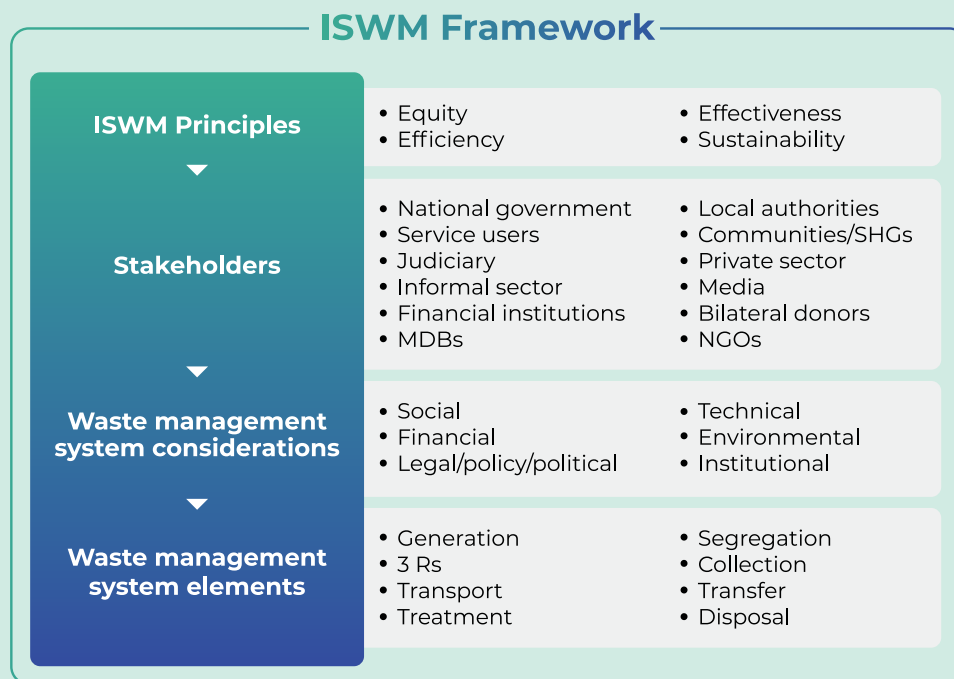
ISWM is based on four basic principles:

- **Equity:** Everyone is entitled to a functioning waste management system that protects human health as well as the environment.
- **Effectiveness:** Any SWM plan must meet its objectives; at minimum, all waste should be collected and disposed of in a safe and environmentally friendly manner.
- **Efficiency:** Maximizing benefits, minimizing costs, and optimizing use of resources.
- **Sustainability:** The system should be effective, maintained over time, and without exhausting resources.

An ISWM framework should ideally consider all aspects of government, from national waste policies and directives to local-level implementation. It is intended to be used as a practical tool to evaluate local conditions and needs and then to select the most appropriate waste strategies, given legal conditions, technical capacity, know-how, and financial capacity. For instance, a city that does not have the financial ability and technical knowledge to establish a waste-to-energy facility should not consider waste incineration in its ISWM plan.

Notice that the waste hierarchy and 3 Rs are only one aspect of the ISWM framework. A number of other factors need to be considered and fit together like a jigsaw puzzle in order to have a truly integrated solid waste management plan.

Figure B5.2.1: Illustrated representation of ISWM



Box 5.3: A note on how to use the tables on suggested actions

- Recommendations are grouped based on an integrated solid waste management framework.
- Each table focuses on a set of recommendations and related implementable actions.
- The SWM challenges identified in the course of this study have formed the basis for these recommendations.
- Proposed actions are organized horizontally into three phases loosely denoting immediate, medium-term, and long-term, with the assumption that once the actions in the first phase are achieved, the recommendations in the next phase can be worked on, and so on.
- Actions are also organized vertically in a logical flow for each phase.
- Each action proposes suggestions for which stakeholders may be most appropriate in implementing these recommendations. These may be modified depending on the local situation or change over time.

5.2.1. Recommendations Related to Institutional Coordination, Financing, and Stakeholders

Recommendations related to institutional coordination, financing, and stakeholders in mountain areas include:

- Develop local government policies and regulations in line with national guidelines and standards
- Operationalize the SWM system at the local government level through technical capacity development
- Involve local communities and community-based organizations (CBOs) in waste segregation and collection
- Create systemic opportunities to bring in economies of scale and to engage the private sector as well as other stakeholders
- Enable integration of the informal sector to engage in waste management services
- Enable collaboration of related agencies, such as tourism, forestry, and natural resource management
- Establish a monitoring and enforcement system to improve and sustain waste management services.

Based on these recommendations, suggested actions for implementation in a phased manner are presented in Table 5.1.

Table 5.1: Suggested actions related to institutional coordination, financing, and stakeholders

Issue	Phase 1	Phase 2	Phase 3
Policy/strategy for mountain waste	<p>Approach the problem of mountain waste via an ILM approach, which would provide livelihood options while at the same time preserving and protecting the environment and developing related sectors in a sustainable manner</p> <p>G I</p>	<p>Prepare a mountain SWM policy/strategy with input from all stakeholders and based on ISWM principles and considering an ILM approach</p> <p>G I N P S</p>	<p>Enforce and monitor the adoption of mountain SWM policy/strategy</p> <p>G</p>
	<p>Adopt the goal to develop a policy/strategy for mountain waste</p> <p>G</p>	<p>Convene all stakeholders at regular intervals in order to facilitate cooperation and understanding and to promote a coordinated approach</p> <p>G I N P S</p>	<p>When national policies regarding waste are created, ensure that mountain areas are not only considered, but that their unique issues are accommodated</p> <p>G I</p>
	<p>Provide policy support for development of bylaws and regulations to meet national guidelines and standards</p> <p>G I N</p>		<p>Local SWM plans should incorporate a climate and disaster waste management focus to prepare for earthquakes, landslides, and floods, especially in the seismically active Himalayan region, and the impact on waste sites</p> <p>G I N</p>
	<p>Adopt ISWM and 3 R goals for mountain waste</p> <p>G N S</p>		<p>Develop SWM plans for waste types other than MSW (e.g., healthcare, household hazardous, C&D), depending on the data collected on these waste types</p> <p>G I</p>
	<p>Acknowledge that rural areas also are an important part of SWM and can no longer be ignored. With improvements in road networks, waste composition is changing (e.g., increase in use of sachets); tourism waste also increases non-biodegradable fraction</p> <p>G</p>		
	<p>To work towards a decentralized approach, analyze the “capacity to act” of various institutions and stakeholders</p> <p>G I N P S</p>		
Institutions	<p>Establish SWM department at the local level</p> <p>G</p>	<p>Incentivize local governments and institutions to adopt policies</p> <p>G I</p>	<p>Set-up formal structures for inter-municipal cooperation to help with procurement of bins, vehicles, storage and treatment equipment, disposal facilities</p> <p>G I N P</p>
	<p>Set up facility for inter-agency cooperation (e.g., tourism, forest, natural resource management, SWM), which is essential in an ILM approach</p> <p>G I</p>	<p>Build capacity of waste management governance</p> <p>G I</p>	

Table 5.1: Suggested actions related to institutional coordination, financing, and stakeholders (contd.)

Issue	Phase 1	Phase 2	Phase 3
Financing	Review methods of user fee collection and what is most applicable and practical to implement G I	Consider various forms of sustainable financing (e.g., user fees, taxes, gate fees, EPR, etc.) G I N P S	User fee collection should be well established by now and close to 100%; can then shift to variable pricing, such as based on volume or weight generated G I
	Identify ways to support micro-enterprises; micro-loans for those who want to generate income from waste G I N S	Determine appropriate model for fee collection based on local context (e.g., polluter pays, cross-subsidy across income levels, flat fee) and how to collect it (e.g., through utility bill, property tax, door-to-door, etc.) G I	Consider other methods such as results-based financing to improve service delivery and cost recovery G I
	Identify options for segregated waste (e.g., sell in nearby cities, take to the plains) that could earn revenue for collectors of the waste G I N	Review methods to improve cost recovery G I	Initiate local-level EPR such as tourism tax through hotels, companies being responsible for collection of materials, deposit-refund schemes, eco-tax, etc. G I
	Identify options for providing small-scale financing or microloans to the most vulnerable populations G I	Initiate microfinancing on a pilot basis for vulnerable populations G N S	Institute and/or enforce refundable fees for protected areas to support waste collection, clean-up campaigns, etc. G N
			Expand micro-financing options to reach a wider section of people as well as to cover wider areas G N S
Stakeholders	Approach NGOs, SHGs, and CBOs as stakeholders and invite them to participate in the decision-making process G N S	Establish a think-tank to connect policy makers with academics, private sector, informal sector, and civil society to develop the best possible solutions G I	Establish public-private partnerships to improve efficiency in the SWM chain, if private sector participation is desired G P
	Identify ways to include or formalize participation of the informal sector in providing mountain SWM services G N S	Formalize participation of informal sector in mountain SWM services G N S	The role of local government shifts from service provision to regulation as private sector gets increasingly involved in providing SWM services G N P
	Identify whether private sector would be better suited to provide services than the municipality G I	Develop and provide incentives for reuse of materials (e.g., wood from demolition) by including informal sector as well as other stakeholders G N P	Ban single-use plastics once substitutes are available in the market G
	Encourage private sector as part of their CSR to fund clean-up activities, e.g., “adopt a highway” G P S	Promote women’s representation and leadership in committees and decision-making roles at the community level G S	Encourage development of substitutes for single-use plastics by providing initiatives G I N P S

Table 5.1: Suggested actions related to institutional coordination, financing, and stakeholders (contd.)

Issue	Phase 1	Phase 2	Phase 3
Monitoring and enforcement	Review enforcement and monitoring processes G	Initiate a score card system for citizens in mountain areas to rank implementation of policies, service delivery, cleanliness, etc. to provide an additional layer of monitoring G I N	Encourage action by citizens to participate in monitoring of mountain SWM services G N S
	Strengthen monitoring capacity and enforcement of penalties by installing cameras as a deterrent, spot fines, etc. G	Develop monitoring and evaluation capacity of civil society by supporting CBOs to use sound methodologies and systems to measure results G I N S	

Note: **G**: Government (includes all levels of government: national/central, state/provincial, and local; urban and rural local governing bodies); **I**: International/bilateral agencies, multilateral development banks, donor funds; **N**: Non-governmental organizations; **P**: Private sector; **S**: Self-help groups, including CBOs

5.2.2 Recommendations Related to Availability of Data and Public Awareness

Recommendations related to data and public awareness in mountain areas include:

- Coordinate with various agencies to improve data collection, availability, and to create public awareness
- Start data gathering as a continuous exercise in order to make better decisions, set targets, and monitor policy implementation
- Increase public awareness on managing waste and impacts of SWM in mountain areas
- Introduce and expand training programs to build capacity of local government staff and decision makers.

Based on these recommendations, suggested actions for implementation in a phased manner are presented in Table 5.2.

Table 5.2: Suggested actions related to availability of data and public awareness

Issue	Phase 1	Phase 2	Phase 3
Data gathering, analysis, and implementation; record-keeping	Conduct rapid assessments to gather data on key waste indicators to indicate how to move forward G I N	Detailed data gathering exercise to identify specific types of waste, amounts, etc., especially seasonality of waste based on tourism and climate G I	Identify other types of waste generated (e.g., healthcare, household hazardous, C&D) besides MSW which may require different procedures and processes for collection, treatment, and disposal G I N
	Set up short and long-term targets to monitor newly established systems to analyze whether they are successful or need tweaking G I	Institute recordkeeping, preferably digitally, of waste data G I	
		Establish or adopt performance monitoring/benchmarking G	
Public awareness and behavioral change	Generate public awareness through social media, websites; schools and education; door-to-door campaigns G I N P S	Create a regional/global network for knowledge sharing, capacity building for solid waste in mountain areas G I N	Strengthen ability of residents/civil society to monitor SWM activities; give them a sense of ownership through citizen reporting apps G N S
	Acknowledge the changing nature of waste (even in rural areas) and thus flexibility needed to make changes G I	Require tourism industry to be up-to-date on waste regulations and educate tourists through websites, tour companies, brochures, posters, etc. G N P S	Implement waste monitoring programs G N S
	Plan behavioral change campaigns for better SWM practices through media (e.g., press, radio, digital) and education (e.g., schools) G I N P S	Implement and expand behavioral change campaigns for better SWM practices; utilize community health workers to deliver regular training on the importance of better SWM practices G I N P S	Create regional platforms to share dialogue on mountain waste management practices G I N
			Foster community responsibility for improved SWM by building community awareness and equipping citizens with resources and training to practice those behaviors G N S

Table 5.2: Suggested actions related to availability of data and public awareness (contd.)

Issue	Phase 1	Phase 2	Phase 3
Training on SWM in mountain areas	Work with various stakeholders to encourage clean-up campaigns G I N P S	Initiate training for local government staff on practical aspects such as cost recovery, comparing technologies G I N	Build capacity of mountain communities and local governments to meet SWM challenges G I N S
	Work with mountaineering associations and tour guides to generate ideas to reduce SWM issues on trails/expeditions G N	Design data toolkits to easily gather data in hard to reach places. Make it easy to use so that anyone can use it G I N	Create training programs through regional platforms to offer wide-spread training and opportunities to learn from various regions G I N S
	Promote 3 Rs and offer training on sustainable SWM to schools and colleges N S		

Note: **G**: Government (includes all levels of government: national/central, state/provincial, and local; urban and rural local governing bodies); **I**: International/bilateral agencies, multilateral development banks, donor funds; **N**: Non-governmental organizations; **P**: Private sector; **S**: Self-help groups, including CBOs

5.2.3 Recommendations Related to Waste Generation and Segregation

Recommendations related to waste generation and segregation in mountain areas include:

- Enable source segregation to allow for value extraction and recycling of both biodegradable and non-biodegradable materials
- Enable separation of biodegradable waste for useful purposes at the household or community level
- Involve local communities and CBOs by considering various aspects, such as income generation
- Create policies to manage other wastes (C&D, hazardous, healthcare, e-waste) in mountain cities.

Based on these recommendations, suggested actions for implementation in a phased manner are presented in Table 5.3.

Table 5.3: Suggested actions related to waste generation and segregation

Issue	Phase 1	Phase 2	Phase 3
Waste generation at household and commercial entity level	Distribute waste bins for free to promote segregation into wet and dry fractions G N S	Scale-up three-stream source segregation in cities/large towns that generate considerable amounts of non-biodegradable waste, provide ways to encourage segregation G I N P S	Waste segregation at source becomes mandatory G
	Pilot source segregation into three streams, e.g., biodegradable (wet), non-biodegradable (dry), and domestic hazardous (e.g., diapers, household hazardous waste) fractions G I N S		Introduce segregation of dry waste into various categories depending on results of waste characterization studies (e.g., paper, cardboard, plastic, metal, glass) G
			Segregation of domestic hazardous waste (e.g., batteries, engine oils, paints, etc.) and storage until they can be shipped to the plains G N P S
Composting at source	Pilot or scale-up composting options such as in-vessel, vermicomposting, and biomethanation at household- and community-level G N S	Study use of biodegradable waste for biomethanation, which has multiple co-benefits like reducing use of kerosene or LNG for cooking at source level G N	Promotion of organic farming through the use of compost G N P S
	Scale-up segregation of biodegradable waste to be used as compost, animal feed, or for biomethanation in mountain areas itself G N P S	Provide subsidies for home composting techniques, such as vermicomposting or bin composting G	Phase out the use of chemical fertilizers in public parks, gardens, and nurseries and mandate the use of local compost G N P S
	Provide awareness and training on how to compost at home G I N S		Compost made from biodegradable waste can be marketed and sold to farmers, nurseries G I N P S
Generation of mountaineering/ trekking waste, waste from adventure tourism	Develop and promote awareness of guidelines for mountaineering/ trekking waste and waste from adventure tourism G I N S	Require mountaineering associations, tour guides, etc. to strictly enforce Leave No Trace/“Pack it in, Pack it out” policies G N	Institute and enforce refundable fees for protected areas to support waste collection, clean-up campaigns, etc. G N
	Introduce Leave No Trace/“Pack it in, Pack it out” to reduce waste from adventure tourism G N P S		

Table 5.3: Suggested actions related to waste generation and segregation (contd.)

Issue	Phase 1	Phase 2	Phase 3
Construction and demolition (C&D) waste	Identify companies involved in construction/renovation to use C&D waste generated by them as landfill cover G N P	Companies to begin minimal processing of C&D waste in order to make it suitable for use as landfill cover and other uses G P	Inert waste (e.g., C&D material) transported directly to nearest sanitary landfill for use as daily cover G P
	Identify other uses of C&D waste G I N	Consider policies related to using C&D waste for slope stabilization and other uses G P	Implementation of other uses for C&D waste G I N P S
Other wastes (mountaineering, healthcare, e-waste)	Understand the types and quantities of other wastes generated in mountain areas G I N S	Prepare guidelines/plans for segregation, collection, storage, and transport of these wastes to locations/facilities that can treat and dispose these wastes G I N	Implement and enforce guidelines/plans for other wastes developed in previous phase G

Note: **G:** Government (includes all levels of government: national/central, state/provincial, and local; urban and rural local governing bodies); **I:** International/bilateral agencies, multilateral development banks, donor funds; **N:** Non-governmental organizations; **P:** Private sector; **S:** Self-help groups, including CBOs

5.2.4 Recommendations Related to Waste Collection, Transfer, Storage, Processing, and Transport

Recommendations related to waste collection, transfer, storage, processing, and transport in mountain areas include:

- Improve waste collection systems and upgrade service delivery
- Establish waste storage and transfer systems to manage waste
- Enable sorting and processing of non-biodegradables for higher monetary returns
- Find innovative ways to collect and transport waste from mountain areas that are particularly challenging due to remoteness, topography, and lack of road network.

Based on these recommendations, suggested actions for implementation in a phased manner are presented in Table 5.4.

Table 5.4: Suggested actions related to waste collection, transfer, storage, processing, and transport

Issue	Phase 1	Phase 2	Phase 3
Waste collection	Identify existing collection routes, collection schedules, and mapping, if available, to see how they can be improved and how efficiently they work G I N P S	Improve collection coverage in all areas, including streets, tourist spots, etc. G I N P S	Expand collection coverage to 100% to reach all areas G N P S
	Explore the best ways to collect waste, keeping in mind that in hilly and mountain areas, door-to-door collection may not always be possible G I N	If source segregation has commenced, separate collection of biodegradable and non-biodegradable waste required G I N P S	
	Waste collection frequency should be increased so that users of the service recognize that the government is serious about SWM; this will positively impact user fee collection G	Involve the informal sector in waste collection, street sweeping, and segregation activities through NGOs, cooperatives/associations G N S	
	Identify spots that are frequently littered (e.g., tourist spots) and set up waste collection bins there G N S		
Budgeting waste collection	Local governments to allocate budget for waste collection so that once residents see an improvement in SWM, they are likely to pay for services G	In-depth study on waste fee systems as collection rates increase to identify most suitable options G I	Enforce waste fee system, starting with a flat fee to pay-as-you-throw system eventually G
Clean-up campaigns	Increase street sweeping in crowded areas as cleanliness provides an important first impression and will make residents proud and tourists aware of the no littering policy G	Incentivize tourists and pilgrims to bring their waste back to more populated areas where waste can be sorted by giving them vouchers, discounts in areas G P	Institute refundable fees or tourist fees in protected areas to support waste collection, clean-up campaigns, etc. G N
	Implement clean-up campaigns to bring down waste left over from previous mountain expeditions G N S	Add signage in popular tourist areas regarding cleanliness and littering G N S	
Collection bins	Waste collection bins should be frequently emptied so that they are not an eyesore nor attract vermin or animals G	Upgrade waste collection bins to source-separated bins that are clearly labeled to ensure separation of waste G P	
		As far as possible, use locally-made bins as they are easily available and less expensive G N P	

Table 5.4: Suggested actions related to waste collection, transfer, storage, processing, and transport (contd.)

Issue	Phase 1	Phase 2	Phase 3
Waste storage, transfer, and sorting	Identify sites to store recyclable and non-recyclable waste before they can be taken to the plains for further processing G N S	Establish storage sites/mini-transfer stations for both biodegradable and non-biodegradable waste G N P	Establish deposit centers/ storage facilities for domestic hazardous waste G N P
	Identify sites for treatment of biodegradable waste, especially in mountain cities where households and communities lack space for individual composting units G N P S		Sorting of recyclable and non-recyclable waste at sorting/mini-transfer stations by local inhabitants to create livelihood opportunities N P S
Waste processing and upcycling	Identify ways to sort/process waste in mountainous regions in order to provide livelihood opportunities G I N P S	Work with cottage industries, provide training to women's groups to process waste before selling non-biodegradables in order to gain more value G N P S	Work with cottage industries, tourism agencies, women's groups to upcycle waste into products that can be sold (e.g., souvenirs at tourist shops) G N P S
	Identify opportunities and areas for jobs creation and local entrepreneurship (e.g., fiber-based packaging) G I N P S	Initiate micro-financing loans on a pilot basis to encourage vulnerable populations, such as the poor and women, to participate in livelihood activities G I N S	Expand micro-financing options for broader outreach both in terms of numbers of people as well as by geography G I N
Waste transport	Consider various options for transport, including non-motorized modes and pack animals, keeping in mind that not all mountain communities are connected by road G I N S	Design transportation systems based on waste characteristics (e.g., volume, moisture), which can be done only after thorough waste data is collected G I P S	Transport equipment/vehicles and labor should meet 100% collection efficiency and source segregation goals G I N P S
	Transportation options need to be considered in concert with waste segregation and collection practices, as well as taking into account transportation costs, which can be considerable in these areas G I N	Transport equipment/vehicles must be able to handle source segregated waste G I N P S	

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5.2.5 Recommendations Related to Waste Treatment and Disposal

Recommendations related to waste treatment and disposal in mountain areas include:

- Ban the open dumping and burning of waste
- Find suitable alternatives for treatment of non-biodegradable waste and for waste disposal.

Based on these recommendations, suggested actions for implementation in a phased manner are presented in Table 5.5.

Table 5.5: Suggested actions related to waste treatment and disposal

Issue	Phase 1	Phase 2	Phase 3
Waste treatment	Initiate review of various waste treatment technologies that could be applied while considering all variables (see Table 5.6 for menu of possible options) G I N	Design of treatment and disposal facilities should be done based on the characteristics of waste; this can be done only after thorough waste data is collected G I	Identify if RDF/SRF processing can be established and nearby entities that can use RDF/SRF as feedstock, such as local or regional cement plants G N
	Analyze technical options in the context of cultural norms, political and societal feasibility, as well as costs and benefits G I	As far as possible, identify and use locally-available technology as maintenance, repair, and spare parts are easily available and less expensive G I N P S	Establish combined/regional treatment and disposal facilities to provide services to multiple municipalities G I N P S
Mid- to large-scale composting	Biodegradable waste generated in sufficiently large quantities to be treated in mid- to large-scale facilities, e.g., windrow composting, bimethanation G I N P S	Identify markets for ready compost, provide certification of compost quality in order to increase revenue from composting treatment G I P	Enforce phase-out of synthetic, petroleum-based fertilizers and switch to compost; facilitate organic farming through the use of locally-made compost G I N P S
Dump sites	Identify and map out illegal waste dumps and areas where waste is routinely dumped (e.g., ravines) G I N S	Institute a complete ban on waste dumping and burning by levying large fines on offenders, at the same time that storage facilities become operational G	Close all illegal dumping areas by clearing out the accumulated waste and installing signage regarding closure G N S
Landfills	As far as possible, avoid constructing sanitary landfills in mountain areas; if unavoidable, keep in mind that topography, depth to aquifer, control of inflowing water, availability of daily cover are necessary G I N	If landfilling is unavoidable, construct smaller landfills close to densely-populated areas and away from water sources G I P	Construct sanitary landfills if only absolutely necessary; identify options for landfill sites in the plains, if possible G I P
	Initiate zero-landfill strategies for mountainous regions G I N	Develop sanitary landfill site selection criteria and operating guidelines specifically for mountain areas G I	

Note: **G:** Government (includes all levels of government: national/central, state/provincial, and local; urban and rural local governing bodies); **I:** International/bilateral agencies, multilateral development banks, donor funds; **N:** Non-governmental organizations; **P:** Private sector; **S:** Self-help groups, including CBOs

5.3 Menu of Options for Municipal Solid Waste Collection, Transport, and Treatment of Mountain Waste

Keeping in mind that waste collection, transport, and treatment are challenging in hilly and mountain areas, a menu of broad options for these SWM services are presented in Table 5.6. The table also shows which mountain area(s) a particular option might be most suited to. Some of these methods are already used in mountain regions and are highlighted in the *Good Practice Options for Sustainable Solid Waste Management in Mountain Areas of India, Nepal, and Pakistan* report. Many of these options may be applicable (or modified to suit) non-mountain areas also; however, the options have been presented here based on their applicability to mountain areas. It should be noted that this is not meant to be an exhaustive list, and there may be other options that may be better suited depending on the local context.

Table 5.6: Menu of options for collection, transport, and treatment of mountain waste

Option	Mountain cities and towns	Rural areas with road access	Remote areas not connected by road	High-altitude areas (mountaineering/ trekking waste)
Collection and Transport				
Use of pack animals to collect non-biodegradable waste			✓	✓ (base camps)
Use of non-motorized options (e.g., tricycles, animal-drawn carts)		✓	✓	
Use of locally-available motorized options (e.g., three-wheelers, tractors)	✓	✓	✓	
Use of containerized handcarts, three-wheelers for segregated waste	✓	✓		
Use of dump trucks and waste transport vehicles suitable to mountain regions	✓	✓		
Workers collect non-biodegradable waste in back-packs provided by service provider ⁸			✓	✓ (base camps)
Drop-off waste at specific collection points	✓	✓	✓	✓
Pooling resources through inter-municipal cooperation to improve service delivery and reduce costs	✓	✓	✓	
Special non-biodegradable wastes (e-waste, climbing equipment): Ensure collection through EPR/deposit fees, which factor in costs of transportation to nearest processing/disposal center	✓	✓	✓	✓
Treatment				
Biodegradable waste: Composting at source (e.g., pit, bin, vermicomposting, pile)	✓	✓	✓	
Biodegradable waste: Composting at community-level (e.g., bin, vermicomposting, black soldier fly larvae)	✓	✓	✓	✓ (base camps)
Biodegradable waste: Medium- to large-scale composting	✓	✓		

⁸ This option is provided in *Swachh Bharat Mission* guidelines for hilly areas in India (CPHEEO 2016).

Table 5.6: Menu of options for collection, transport, and treatment of mountain waste (contd.)

Biodegradable waste: Community-scale biomethanation to be used output as cooking or energy source	✓	✓	✓	✓ (base camps)
Biodegradable waste: Combine household and animal/ livestock waste to improve biomethanation		✓	✓	
Biodegradable waste: Large-scale composting facilities	✓			
Non-biodegradable, recyclable waste: Sorting and minimal processing for value addition at transfer stations	✓	✓	✓	
Non-biodegradable, non-recyclable waste: Conversion to RDF/SRF for use in nearby cement, WTE plants	✓	✓		
Non-biodegradable waste: Upcycling waste for local use and tourists	✓	✓	✓	



6. Looking Ahead: Role of the World Bank and other Donors

The World Bank finances and advises on solid waste management (SWM) projects using a diverse range of products and services, including traditional loans, development policy financing, Program-for-Results (PforR), results-based financing, and technical advisory services. World Bank-financed waste management projects encompass the entire waste management chain, from generation to collection and transportation, and finally treatment and disposal.

Since 2000, the World Bank has committed over \$4.7 billion to more than 340 SWM programs in all six regions of the World Bank. Numerous initiatives to develop infrastructure and technical assistance have been implemented. For instance, the following projects in South Asia itself:

- In Nepal, a results-based financing project of \$4.3 million increased user fee collection and improved waste collection services in five municipalities, benefitting 800,000 residents.

- In Pakistan, a \$5.5 million-dollar project supported a composting facility in Lahore in market development and the sale of emission reduction credits under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC). Activities resulted in reductions of 150,000 tonnes of carbon dioxide equivalent and expansion of daily compost production volume from 300 to 1,000 tonnes per day (World Bank 2019).

World Bank engagement in SWM is supported through valuable partnerships such as with the Korea Green Growth Trust Fund, which provided funding for this project.

National and state/provincial governments are generally supportive of efforts to accelerate improvements to the SWM sector although this is fundamentally a municipal function and challenges have to be addressed at the municipal level. Support to clients to improve SWM services and practices in mountain areas in the South Asia Region—and elsewhere—could include the following, as summarized in Figure 6.1:

Client engagement: The World Bank supports its client countries in the form of analytical advisory activities as well as through operations. The World Bank supports infrastructure creation and service provision through various financing mechanisms such as traditional loans, program-for results, results-based financing, private sector financing and guarantees, to name a few. It can guide client countries on capacity building, training, and initiating pilot studies. It also supports the development of institutions, promotes institutional coordination, and facilitates inter-municipal cooperation in order to enable economies of scale through green procurement policies.

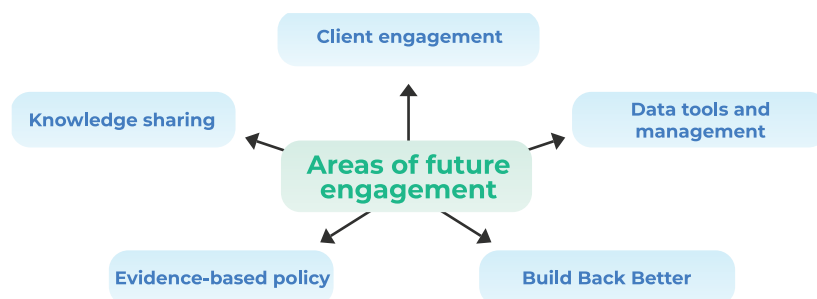
Data tools and management: There is a significant need for a well-defined system to collect and use SWM data from mountain areas. This is required in order to make informed decisions, as data is the backbone of any policy. Assistance could be provided in the form of rapid data assessments, devising robust data collection, recordkeeping, and monitoring systems.

Build Back Better: Like many other countries, India, Nepal, and Pakistan face unprecedented challenges of managing the consequences of the COVID-19 pandemic. While all three countries have initiated stimulus packages to include investments and drive the creation of jobs, not all stimulus spending has long-term benefits. The World Bank has started a sustainability checklist through a new initiative, Build Back Better, to help policymakers identify potential projects, policies, and measures that are best suited for inclusion in a stimulus package, with the key objective to deliver both short- and long-term gains. Combining the Build Back Better approach with landscape management techniques or nature-based solutions could have numerous long-term potential benefits in these three countries, and elsewhere. Particularly in mountain areas, it can help create green jobs in the SWM sector.

Evidence-based policy: In-depth examination is required about which laws and policies support the development of better waste strategies in mountain areas. If current policies do not support better SWM implementation, the World Bank can effectively support clients in this regard. In addition, it can also help to coordinate various sectors to adopt a landscape approach.

Knowledge sharing: The World Bank can assist in setting up a knowledge-sharing network especially for mountain waste in order to learn from similar communities about how they manage specific challenges. Policy think-tanks, such as the ones created specifically for SWM in Korea, connect government agencies with academia and communities, thus supporting and sharing research and enhancing coordination, not only in mountain areas but also in the rest of the country.

Figure 6.1: Potential areas of future World Bank engagement for mountain waste



To achieve sustainable growth, the World Bank supports improved natural resource management, environmentally-friendly fiscal policies, greener financial markets, and effective waste management programs. In South Asia (SAR), 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. Box 6.1 summarizes related ongoing World Bank studies in the region.

Box 6.1: 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.

Appendix 1: Nepal Field Study: Waste Sampling Data Summary

The data collected during the waste sampling in the Annapurna Conservation Area (ACA) in Nepal as part of this study are presented here. Tables A1.1-A1.4 provide a summary of the waste collected and sampled, while Table A1.5 and Figure A1.1 provide the average compositional analysis of the waste samples.

It should be noted here that due to the relatively small sample size, these data should be used with caution when making generalizations about the waste generation or composition in ACA or, broadly, in mountain areas of Nepal.

Table A1.1: Waste quantity sampled at households and hotels for the Nepal field study (May 2019, off-peak tourist season)

Total sampled numbers	Total waste generation per day	Total waste generation per unit	Waste generation per person
275 households	84.75 kg	0.308 kg per household per day	0.160 kg per person per day
42 hotels	3.70 kg	0.088 kg per hotel per day	

Table A1.2: Composition of waste sampled at various locations for the Nepal field study (May 2019, off-peak tourist season)

Clusters	Readily biodegradable waste (kg/day)	Biodegradable waste (kg/day)	Non-biodegradable waste (kg/day)	Total waste (kg/day)
111 households (Chhomrong)	15.97	9.27	31.47	56.72
54 households (Ghandruk)	4.55	1.47	5.39	11.41
42 hotels (Ghandruk)	1.81	0.21	1.68	3.7
70 households (Kimche)	1.39	1.67	5.38	8.44
40 households (Syauli)	2.32	1.35	4.58	8.25

Table A1.3: Waste quantity sampled at households and hotels for the Nepal field study (September 2019, peak tourist season)

Total sampled numbers	Total waste generation in households	Total waste generation per unit	Waste generation per person
35 households	23.57 kg	0.673 kg per household per day	0.178 kg per person
36 hotels	154.71 kg	4.29 kg per hotel per day	

Table A1.4: Composition of waste sampled at various locations for the Nepal field study (September 2019, peak tourist season)

Clusters	Readily biodegradable waste (kg/day)	Biodegradable waste (kg/day)	Non-biodegradable waste (kg/day)	Total waste (kg/day)
35 households (Ghandruk)	15.86	1.75	5.96	23.57
36 hotels (Ghandruk)	81.88	5.45	67.38	154.71

Figure A1.1: Average composition of waste samples from Nepal (%)

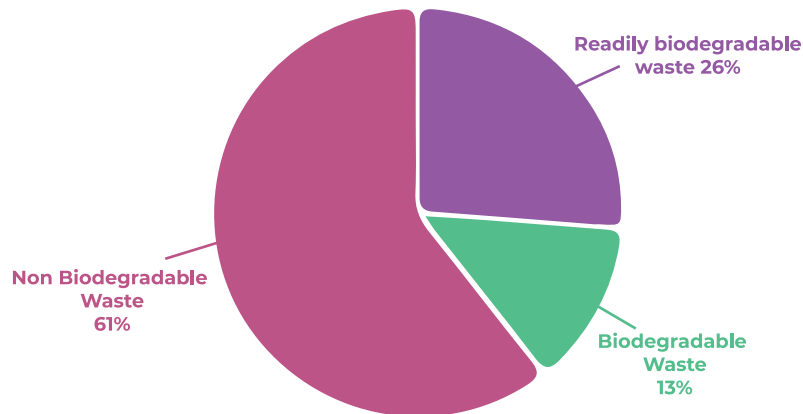


Table A1.5: Average composition of waste samples from Nepal (%)

Waste classification	Waste component	Household average (%)	Hotel average (%)	Total average (%)
Readily-biodegradable waste	Kitchen waste	26	24	25
	Plant residue and fine organics	2	0	1
	Total: Readily-biodegradable waste	28	24	26
Biodegradable waste	Paper and cardboard	7	7	7
	Clothes, fabric, shoes	9	3	6
	Wood and straw	0	0	0
	Fur/hair, miscellaneous	0	0	0
	Total: Biodegradable waste	16	10	13
Non-biodegradable waste	Plastic bottles	7	4	6
	Plastic bags	6	17	11
	Glass	11	13	12
	Aluminum	10	2	6
	Cigarette butts	0	0	0
	Rubber/leather	3	2	3
	Batteries	0	3	2
	Bones/eggshells	0	8	4
	Plastic food wrappers	17	15	16
	Juice boxes	1	2	2
Total: Non-biodegradable waste	56	65	60	
Total		100	100	100

Appendix 2: Mountaineering Expedition Rules

The Mountaineering Expedition Rules 2002 were framed based on the Tourism Act, Chapter 4, in reference to the Provisions Relating to Mountaineering/Expeditions.

As per the provision “amount shall be deposited” in the rules, mountaineering expedition teams are required to deposit an amount as prescribed by the Ministry of Culture, Tourism and Civil Aviation for “garbage management”. The amount deposited is returned only after the submission of evidence of waste management.

The rules also classify the waste generated by mountaineering expedition teams into three categories for the purpose of waste management, as shown in Figure A2.1. The figure also provides examples within each waste category and the waste treatment/process to follow for each waste type.

Figure A2.1: Nepal SWM rules for mountaineering expeditions

Waste Type	Waste that can be destroyed	Waste that can be recycled	Waste to be re-imported
Example	Tissue, paper, cardboard, decomposed food, and cotton bags	Tins, cans, plastics, and reusable gas cylinders	Oxygen bottles, used batteries, and climbing equipment
Treatment/ Process	Destroy or dig and cover so that it will not adversely affect public places; or follow instructions, if available	Bring to Kathmandu and hand over to relevant institution	Remove the waste and export it to country of origin

If a team member or liaison officer of the expedition team dies during the trip, then to avoid the body falling into a glacier lake, the expedition team must bring the body to a lower altitude from the base camp.

The deposits required for mountain expedition teams currently are shown in Table A2.1.

Table A2.1: Waste management deposits required for mountain expeditions

Mountains in the Khumbu and Annapurna Himalayan range	Mount Everest	\$4,000 or equivalent Nr
	Mountain peaks above 8,001 m except Mount Everest	\$3,000 or equivalent Nr
	Mountain peaks above 7,001 m and Amadablam Mountain	\$2,000 or equivalent Nr
	Mountains between 6,500-7,000 m	\$1,000 or equivalent Nr
	Mountains under 6,500 m	\$500 or equivalent Nr
Mountains of the other Himalayan ranges	Mountains over 8,000 m	\$3,000 or equivalent Nr
	Mountain under 8,000 m	\$500 or equivalent Nr

Source: GoN 2002

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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 \$40 million to \$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 *Nepal: Sustainable Solid Waste Management in Mountain Areas* report provides an overview of the municipal solid waste management scenario in the country. Furthermore, the report investigates the impacts and challenges of mountain waste, including a detailed analysis of the data collected from the field study undertaken for this project. The report presents recommendations and specific actions—tailored to mountain areas—to improve solid waste management systems and practices. In conclusion, suggestions for further World Bank and donor engagement are provided.

Other Publications in this Study:

India: 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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