

**ASSESSMENT OF OPEN DUMPING OF SOLID WASTE IN
MOUNTAINOUS AREAS OF CENTRAL HUNZA**



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A thesis submitted to Bahria University, Islamabad in partial fulfilment of the requirement
for the degree in B.S in Environmental Sciences.

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DEDICATION

We, with immense pleasure, dedicate this research to our beautiful homeland Hunza Valley.
This research is also dedicated to our respected parents and teachers.

ABSTRACT

This academic thesis aims to thoroughly examine solid waste management (SWM) practices in Central Hunza's mountainous region, with a specific focus on the harmful impacts caused by open dumping. The primary goal is to provide insights that can lead to the development of sustainable solutions tailored to the area's unique geographical challenges. The research will explore current waste management methods and their impacts on the environment. Additionally, it will identify potential pathways for implementing sustainable waste management practices that align with Central Hunza's delicate ecosystem. Central Hunza faces a significant challenge due to mismanaged solid waste, particularly through open dumping, which threatens its natural beauty and contaminates air, soil, and water. This thesis will analyze existing waste management techniques, from basic disposal methods to advanced treatment facilities, to understand their strengths, weaknesses, and gaps. By doing so, it aims to improve waste management practices in mountainous regions. Moreover, the study seeks to propose sustainable solutions tailored to Hunza's needs by drawing from both global best practices and local knowledge.

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ABBREVIATIONS

SWM	Solid Waste Management
MSW	Municipal Solid waste
GB	Gilgit Baltistan
EPA	Environmental Protection Agency

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CHAPTER 1

1. INTRODUCTION

1.1. Overview

Gilgit-Baltistan, situated in the northern part of Pakistan, boasts a stunning landscape defined by its rugged mountains, deep valleys, and glaciers. Home to some of the world's highest peaks, including K2, it is a region of immense natural beauty. Culturally diverse, Gilgit-Baltistan is inhabited by various ethnic groups such as Baltis, Gilgitis, and Shinas, each with its own distinct language and traditions. While Balti, Shina, and Burushaski are among the main languages spoken, Urdu and English are also prevalent, especially in urban areas. Administratively, Gilgit-Baltistan is self-governing with its legislative assembly and chief minister, though it lacks full provincial status and is governed directly by the federal government (Karrar et al., 2018). The region's economy relies on agriculture, livestock farming, and tourism, with its fruit orchards and trekking routes attracting visitors from around the globe. Strategically positioned at the crossroads of South Asia, Central Asia, and China, Gilgit-Baltistan holds significance for trade and transportation, as well as in the context of territorial disputes between India and Pakistan (Holden, L. (2019).

Hunza, situated in the Gilgit-Baltistan region of northern Pakistan, exhibits a rugged terrain that epitomizes unadulterated grandeur. The region is situated amidst the Himalayan and Karakoram Ranges, at an altitude ranging from 2,500 to 3,500 meters above sea level. The landscape includes mountains with snow-covered summits, glaciers, and steep valleys. The Batura Glacier, Passu Glacier, and Hispar Glacier are important geographical features that constitute segments of the world's most extensive glacier systems.(Baig et al., 2019) The Hunza River carves deep ravines across the region, creating a picturesque landscape adorned with unique geological formations. Despite the adverse weather conditions, the region sustains a diverse environment, including several species of fauna such as Marco Polo sheep, snow leopards, and Himalayan ibex(Mihai et al., 2018).

Hunza holds ecological importance that goes beyond its breath-taking landscape. The glacial meltwater plays a vital role as a primary source of freshwater for the area and sustains agriculture by facilitating terraced fields and irrigation channels. The local communities, whose traditional customs are influenced by the demanding terrain, depend on these resources for their sustenance(Baig et al., 2019). Moreover, the expanding tourism sector in the region requires the implementation of appropriate measures to safeguard the fragile ecosystem. Ensuring the

sustainability of tourism is essential for achieving a harmonious equilibrium between the economic advantages of tourism and the imperative to save the environment and biodiversity(Baig et al., 2019). Furthermore, as Hunza is confronted with the consequences of climate change, such as the shrinking of glaciers and changes in rainfall patterns, it becomes crucial to closely observe and track these transformations. This is necessary not only for the local community to adapt to these changes, but also for global climate initiatives. The mountainous landscape of Hunza is not only a captivating sight, but also a crucial ecosystem that necessitates preservation and sustainable methods to protect its ecological importance for future generations(Hussain et al., 2016)

1.2. Research Problem

The research topic focuses on the prevalent incidence of open dumping in the hilly areas of Central Hunza. This is a major problem that is exacerbated by the lack of sustainable solutions tailored to the specific challenges encountered in the region. The unique topographical characteristics and environmental conditions of mountainous areas present particular difficulties for waste management, resulting in the prevalent practice of open dumping due to the absence of tailored solutions. This not only poses immediate threats to the local ecology and human health, but also underscores a broader issue of neglecting the unique waste management needs of the region. In order to tackle this study issue, it is imperative to examine the environmental, socio-economic, and infrastructural factors that contribute to the practice of open dumping in Central Hunza. The primary objective is to provide solutions that are applicable to the specific circumstances of the area and may successfully improve this pressing issue in a way that can be maintained over time.

1.3. Research Objectives

The Objective of this study is as follow:

1. To Assess the current status of Solid Waste Management in Central Hunza.
2. To Propose sustainable solutions for study area.

1.4. Research Questions

Based on Research objectives the following are Research Questions:

1. What is the current state of solid waste management (SWM) in Central Hunza, and how does it affect the local environment and community well-being?
2. What effective techniques may be recommended for Solid Waste Management (SWM) in mountainous areas, particularly taking into account the unique challenges and environmental considerations of sites like Central Hunza?
3. What are the precise environmental and public health consequences of open dumping, and how do these impacts change across various regions and communities?

1.5. Justification of the study

A region-specific solid waste management (SWM) plan is necessary to tackle the special challenges posed by the unique terrain and biological characteristics of mountainous regions. Mountainous locations require specialized waste management strategies due to their

distinct climatic conditions, diverse topography, and unique ecological characteristics that differ from flat habitats. (Hussain, 2023). Erosion and runoff are significant considerations due to their potential to disseminate litter and engender environmental issues. The dynamic terrain of mountainous areas requires specific measures to address this matter, including waste management and erosion prevention. In addition, the steep terrain poses accessibility issues, which highlights the need for a targeted plan that considers factors like transportation infrastructure limits and the geographical dispersion of population centers. Furthermore, environmental preservation and the use of sustainable practices are the top priorities in a solid waste management (SWM) plan that is geographically tailored. In addition to being important suppliers of freshwater, mountainous terrain are home to a wide variety of ecosystems. If we want to keep these areas' unique flora and fauna alive and reduce the likelihood of water contamination, we must create waste management methods that are compatible with conservation goals. In addition, this approach recognizes the value of cultural understanding and the need of community participation. By tailoring waste management programs to the specific cultural traditions of mountain communities, this study ensures that they are both efficient and foster a sense of local ownership and participation. Researching a region-specific solid waste management (SWM) strategy in mountainous terrains is crucial for developing resilient and sustainable waste management methods that can withstand these environments, safeguard ecological diversity, maintain water resources, and involve local communities effectively.

Since open dumping is an unsustainable waste disposal strategy with widespread and severe ramifications, it is necessary to examine its impact on the ecosystem and human health. To start, open dumping is a major threat to the environment since it often pollutes both soil and water. Garbage has the potential to leach harmful chemicals into the soil, endangering local ecosystems and agricultural regions. (Hussain, et. al 2016). In addition, water reservoirs can be contaminated by the discharge of open landfills, which endangers aquatic life and the water's cleanliness. The process of decomposing organic waste in open landfills also emits greenhouse gases such as methane, which significantly contribute to the phenomenon of global warming. In order to mitigate the adverse impacts on local ecosystems and the worldwide environmental issues it engenders, it is imperative to comprehend the environmental ramifications of open dumping. Open dumping poses a direct threat to human health. Proximity to open dumps heightens the vulnerability of nearby communities to respiratory ailments, dermatological issues, and other health ramifications stemming from the

exposure to perilous substances, including infectious agents and toxic chemicals. (Hussain et al., 2010) Studying the health impacts of open dumping is essential in order to raise awareness about its risks and to advocate for public health policies that protect vulnerable communities. In addition, the study lays the groundwork for effective waste management norms and legislation to be developed. It is critical to quantify and assess the related health and environmental implications of open dumping in order to improve policymakers' awareness of the harmful consequences on these fronts. Next, we may utilize this data to implement stringent rules for garbage disposal, advocate for new methods of waste management, and fund infrastructure projects that will help lessen these negative impacts. Investigating the health and environmental effects of open dumping is crucial for understanding the gravity of the problem, developing targeted solutions, and creating long-term waste management strategies that put people's health and the environment first.

1.6. Scope and Limitations

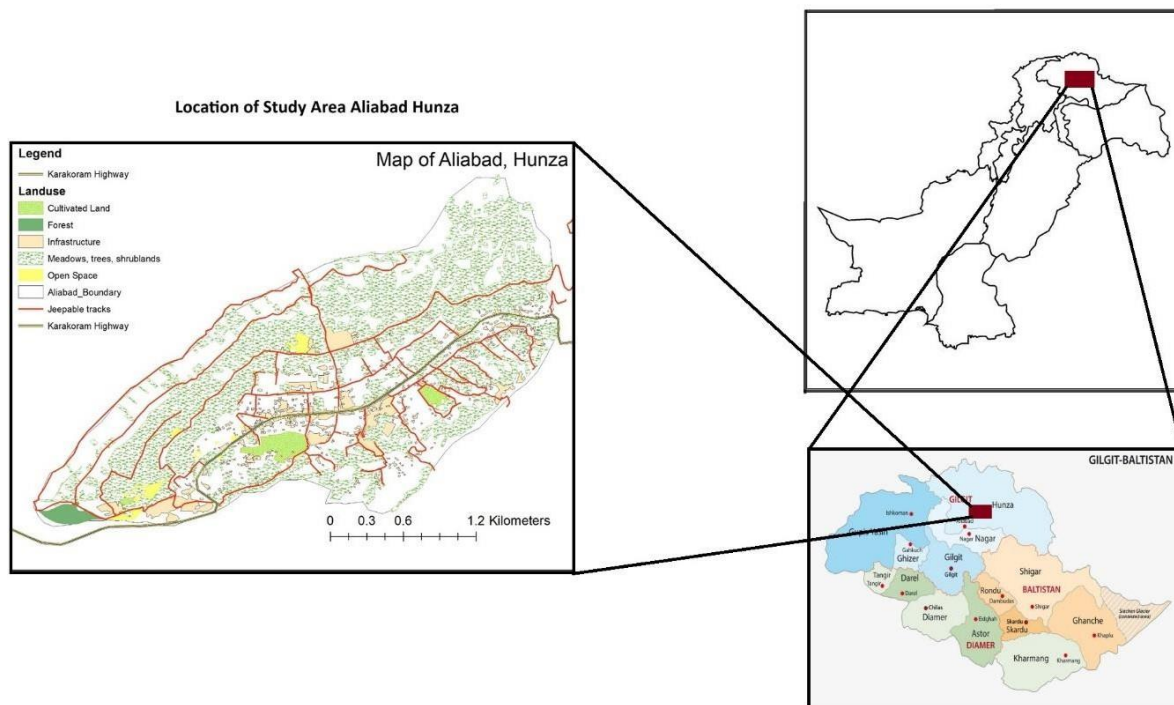
This research focuses on the consequences of inadequate waste management in the mountainous region of Gilgit Baltistan in Pakistan. The research will focus on many districts in Gilgit Baltistan to examine the intricacies of waste management and their impacts in this particular geographic context. The study will investigate the impacts of altering waste disposal methods on the environment throughout the past decade, spanning from 2012 to 2022.

Apparently inadequate or nonexistent government waste management data for Gilgit Baltistan is a major limitation of our research. Because of their isolated position, mountainous regions may face a data shortage because of the irregular upkeep of accurate records. (Uddin, et al., 2010) In addition, gathering qualitative data, especially on local perspectives on waste management, would be difficult for the study. Disparities in culture and language may make it harder to understand each other and communicate effectively, which might compromise the reliability and thoroughness of the study. In addition, it may be challenging for the research to get data that really reflects the local viewpoints on waste management systems and their environmental effects. The study process is subject to facing several impediments. Field accessibility in alpine environments is a significant barrier due to the potentially severe weather conditions and difficult terrain. Thorough planning and efficient allocation of resources may be required to overcome logistical challenges that may occur while collecting data on-site. Another challenge is in engaging local individuals to partake in the study by means of questionnaires and interviews. Overcoming cultural and

linguistic barriers and effectively promoting the study's significance to the communities will be crucial. A further potential hindrance is the requirement for multidisciplinary collaboration, which is essential for addressing the complex waste management challenges in mountainous regions. In order to have a comprehensive understanding of Gilgit Baltistan's waste management situation, it is necessary for environmental scientists, sociologists, and public health professionals to collaborate. However, this collaboration might present logistical and organizational difficulties.

1. Locale (Hunza Valley)

Central Hunza, situated within the breath-taking expanse of Gilgit-Baltistan, Pakistan, is renowned for its striking natural beauty and cultural significance. Geographically, it is nestled amidst towering peaks, including the prominent Rakaposhi and Ultar Sar, which punctuate the skyline with their snow-capped summits. The region is traversed by the Hunza River, whose pristine waters carve through the rugged terrain, contributing to the picturesque landscape. Central Hunza's topography comprises verdant valleys adorned with terraced fields, where apricot orchards flourish, adding splashes of color to the panoramic vista. Culturally, Central Hunza embodies a rich tapestry of traditions and customs deeply rooted in its history. The indigenous population, known as Hunzukuts, embraces visitors with warmth and hospitality, epitomizing the region's inclusive ethos. Festivals such as "Jashn-e-Baharan," celebrated with fervour and enthusiasm, offer glimpses into age-old practices and communal bonds that have withstood the test of time.



Map I: Aliabad, Hanzal (Dr.baig, *n.d.*).

1.7. Significance of SWM for Environmental Preservation and Public Health

Improper waste disposal techniques can severely affect air and water quality, resulting in considerable contamination. Pollutants emitted into the air during waste incineration endanger people's respiratory health. Poisons leaching into soil and water as a result of poor waste disposal pose another potential concern to human and animal health. SWM reduces greenhouse gas emissions greatly by increasing recycling and composting, hence slowing the rate of climate change (Michel Devadoss et al., 2021). Reduced demand for energy and raw materials is another advantage of proper waste management, which contributes to resource preservation. It protects public health by limiting the spread of diseases associated with improper rubbish disposal, improving community aesthetics, and preventing habitat destruction. Compliance with environmental legislation ensures responsible practices, while recycling and waste-to-energy initiatives produce economic benefits, resulting in job creation and sustainable growth (Memon, 2010). Effective SWM is fundamentally a multifaceted approach that supports public welfare, economic prosperity, and environmental conservation.

1.8. Solid Waste Management in Mountainous Regions

Despite the numerous benefits to mountain ecosystems, solid waste management (SWM) is more challenging in mountainous regions due to their distinctive topography. A review of the relevant literature reveals that recycling, trash disposal, and collecting are

particularly problematic in hilly areas across the globe. Inaccessible and steep places make it harder to use conventional waste management procedures, which leads to more illegal dumping and more environmental harm. Poor waste management may have devastating consequences for delicate alpine ecosystems, including the destruction of habitat and pollution of water sources. When these difficulties are addressed, innovative solutions emerge. Recycling programs and awareness campaigns are examples of community-based waste management initiatives that have been demonstrated to be effective in supporting sustainable waste practices in mountainous locations (Shrestha et al., 2018; Pradhan et al., 2020). More efficient garbage collection and tracking is possible with the use of modern technology and smart waste management systems (Kumar et al., 2019). The research shows that in order to implement SWM methods in mountainous areas that are both effective and sustainable, it is necessary to use context-specific approaches that consider the unique physical and environmental characteristics of these areas.

1.9. Identification of successful strategies implemented in similar contexts.

Several efficient solid waste management (SWM) methods have been used in hilly areas worldwide. These solutions share comparable situations and might serve as illustrative instances. Promoting community involvement and active participation is a notable approach. The engagement of local communities in the decision-making and execution of waste management leads to heightened consciousness, accountable trash disposal practices, and the formation of recycling initiatives driven by the community. Illustrative instances of this phenomenon may be observed in the Solu-Khumbu area of Nepal, as documented by Pradhan et al. (2020). Smart cities in India exemplify the integration of technology into waste management systems (Kumar et al., 2019). Smart waste management technologies, such as sensors and data analytics, can improve the efficiency of garbage collection, provide real-time monitoring, reduce operational costs, and boost overall efficacy. These efficient strategies emphasize the need of integrating technology into sustainable solid waste management (SWM), promoting community involvement, and tailoring solutions to the specific cultural and geographical conditions of mountainous areas.

1.10. Open Dumping: Environmental and Health Implications

A prevalent and perilous method of discarding waste is through open dumping, which carries significant ramifications for both the ecosystem and human well-being. Leachate, a hazardous liquid, is formed as a result of waste decomposition, and its impact on soil

pollution is the first among several impacted locations. As water infiltrates the soil, it diminishes soil fertility and poses a threat to crops. Furthermore, water pollution arises when leachate infiltrates subterranean or surface water sources, posing a threat to aquatic ecosystems and those residing in regions with limited access to clean water.(Siddiqua et al., 2022). At the same time, nearby inhabitants are exposed to air pollution and health hazards related to the respiratory and cardiovascular systems owing to the release of gases such as methane and volatile organic compounds from the decomposition of organic waste at landfill sites that are not covered. The cumulative impact manifests as a multifaceted attack on human well-being, whereby individuals experience a diverse array of ailments due to their direct exposure to pollutants present in the air, water, and soil. Moreover, the proximity of disease vectors to dumpsites exacerbates health hazards. In order to address these consequences, it is imperative that we effectively adopt waste management strategies from the outset. The programs should prioritize recycling, appropriate waste management, and the establishment of hygienic landfills. In order to safeguard the environment and the well-being of communities severely impacted by open dumping, a number of crucial measures must be taken(Hussain et al., 2016).

1.11. Case studies illustrating the impact of improper waste disposal in mountainous environments.

2. Himachal Pradesh, India: A Case Study

Untamed waste disposal techniques have caused substantial environmental degradation in the mountainous state of Himachal Pradesh. Improper solid waste disposal in open dumpsites has led to soil pollution, which in turn affects agricultural regions and poses a threat to the fragile mountain ecosystems. The pollution of local water supplies caused by leachate from these dumpsites has impacted both surface and subsurface water sources. The impact on human health becomes evident when populations experience an increased prevalence of waterborne illnesses due to the use of contaminated water. This case demonstrates the urgent requirement for improved waste management systems tailored to address the particular challenges faced in hilly locations(Thakur et al., 2021).

3. Annapurna Conservation Area in Nepal: A Case Study

Inadequate waste disposal methods have resulted in issues inside Nepal's Annapurna Conservation Area. The aesthetic landscape and biodiversity in this region have been severely ravaged by the accumulation of solid waste, mostly plastics, at exposed landfill sites. The

leakage of pollutants from these landfills has caused significant harm to aquatic life and downstream communities by contaminating previously uncontaminated mountain streams. The health of the local population and the unique ecosystems of the mountainous region have been negatively impacted by air pollution, which has been worsened by the incineration of waste in open areas. This case study emphasizes the challenges of garbage disposal in remote mountainous areas, as well as the importance of preserving the ecosystem. It underscores the necessity for implementing sustainable waste management solutions.

4. The Andes Mountains in Peru: A Case Study

The concern of improper waste management in the Andes Mountains has become pressing and has wide-ranging consequences. The process of soil erosion and degradation, resulting from the practice of open dumping in rural regions, has heightened the vulnerability of mountainous terrains to landslides and other natural disasters. These locations are already burdened with a substantial environmental impact as a result of the widespread presence of non-biodegradable waste. Furthermore, the poisoning of rivers and streams by leachate from dumpsites has adversely affected aquatic ecosystems and the communities relying on these water sources, leading to a deterioration in water quality. Mountainous regions are prone to experiencing natural catastrophes due to the degradation of the ecosystem, as illustrated by this case study in a cascading sequence(Doughty, 2016).

CHAPTER 2

2. MATERIAL AND METHODS

2.1 Research Design

(Hossain & Shams, 2020) explains research design as plans and procedures to conduct research that comprises broader assumptions and methods of data collection as well as analysis in a detailed way. Whereas, selection of a research design is concerned with the nature of research problem or addressable of an issue, personal experiences of researcher(s), and the audience(s) for the study. According to Creswell (2014), the origin of qualitative research lies in social sciences, such as anthropology, sociology, humanities and evaluation. Whereas, narrative research deals with inquiries based on humanities that includes questioning individual(s) about stories related to lives. For my research, I have framed narrative style qualitative research with help of open-ended questions. Here, descriptive research design and narrative strategy assisted me to equip my study with exploration of ascribed meanings related to individual(s) and group(s) with reference to human and social problems. Creswell (2009) believes that “the process of research involves emerging questions and procedures, data typically collected in the participant’s setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data. Creswell (2014) states that qualitative research originated in social sciences including anthropology, sociology, humanities, and assessment. Narrative research involves conducting inquiries rooted in the humanities, which entail interrogating individuals about tales pertaining to their life. I conducted narrative style qualitative research for my study using open-ended questions. Descriptive research methodology and narrative technique helped me investigate the assigned meanings associated with individuals and groups in relation to human and societal issues. (Sharma et al., 2018), states that research comprises developing questions and processes, collecting data in the participant's context, analysing data by moving from specific details to larger themes, and interpreting the data's significance.

2.2 Mixed-methods approach involving quantitative and qualitative data

In Central Hunza, the issue of open dumping presents significant challenges to the local community and environment. To comprehensively understand the impacts of this practice, a mixed-methods research approach is employed. The study integrates both quantitative and qualitative methods to provide a holistic perspective (Sharma et al., 2018). Quantitative data is gathered through structured survey questionnaires distributed among residents, businesses, and local authorities.

These surveys aim to capture data on the frequency and types of waste being dumped, the proximity of dumpsites to residential areas, and perceptions regarding health and environmental impacts. Concurrently, qualitative data is collected through interviews and focus groups with key stakeholders such as community leaders, waste management officials, and residents living near dumpsites. Through these qualitative methods, the study explores in-depth insights, perceptions, and experiences related to open dumping, including its causes, consequences, and potential solutions (Ajibade et al., 2021). The integration of quantitative and qualitative data allows for triangulation, enhancing the validity and reliability of the findings. Thematic analysis is employed to identify recurring themes and patterns emerging from the qualitative data, which are then linked with quantitative metrics to provide a comprehensive understanding of the issue. The study's findings aim to inform evidence-based recommendations for mitigating the adverse effects of open dumping in Central Hunza, thereby contributing to sustainable development efforts in the region.

2.3 Unit of Data Collection

Below mentioned Units of Data Collection assisted my research to extract data related to open dumping in our locale who reside in different areas of Hunza.

Following are Units of Data Collection that are used as tool to collect data from locale:

- UDC1. Community people
- UDC 2. Stake Holders
- UDC 3. EPA

2.4 Surveys

This survey aims to collect information regarding the prevalence and impacts of open dumping in the mountain areas of Central Hunza. Local participants and communities are essential in understanding the extent of this issue and exploring potential solutions. Responses will be kept confidential and used only for research purposes.

2.5 Focus Group Discussions

This particular type has been used for only two interviews under UDC-1, UDC-2 and UDC-3. With prior consent, I have recorded 3 hours 37 minutes and 45 seconds, which are further transcribed as per need in chapter of findings. However, two respondents from a focus group interview demanded deletion of the audio record and I agreed. Ultimately, the aim was

to fetch more detailed data on the topic as per diverse opinions of participants. In order to

obtain diverse views, participants were included from various backgrounds. These interviewees include researchers, professionals, and various members from the community.

2.6 Sampling

a. Simple Random Sampling

To ensure a representative sample for the survey on open dumping in the mountain areas of Central Hunza, a random selection methodology is employed to target households, businesses, and local authorities. The selection process begins with the compilation of a comprehensive list of households within the study area, obtained through census data or local administrative records. Using random sampling techniques such as simple random sampling or systematic random sampling, a subset of households is randomly chosen to participate in the survey. Similarly, a list of businesses operating in the area is compiled, including shops, restaurants, and other establishments. From this list, businesses are randomly selected to participate in the survey, ensuring diversity across sectors and sizes. Additionally, local authorities such as municipal offices, waste management departments, and community leaders are identified and randomly sampled to provide insights from a governance perspective. This random selection approach minimizes bias and ensures that the survey captures a diverse range of perspectives and experiences related to open dumping in Central Hunza's mountain areas. By engaging with a varied selection of stakeholders, the survey aims to gather comprehensive data to inform effective strategies for addressing the issue of open dumping and promoting sustainable waste management practices in the region.

b. Stratification based on geographic and demographic factors

In addition to random selection, the survey on open dumping in the mountain areas of Central Hunza employs stratification based on geographic and demographic factors to ensure a more nuanced understanding of the issue. Geographic stratification involves dividing the study area into distinct geographic regions or zones, such as villages, valleys, or specific mountain ranges. This allows for targeted sampling within each stratum to capture variations in open dumping practices and their impacts across different geographical contexts. Furthermore, demographic stratification involves categorizing respondents based on demographic characteristics such as age, gender, occupation, and socioeconomic status. This ensures representation from diverse demographic groups within the sampled population, enabling the survey to account for variations in attitudes, perceptions, and experiences related

to open dumping.

By stratifying the sample based on both geographic and demographic factors, the survey aims to achieve a more comprehensive and representative sample, thereby enhancing the validity and generalizability of the findings. Stratification also facilitates subgroup analysis, enabling researchers to examine differences and similarities in responses across various geographic and demographic categories. Ultimately, this approach enables a more nuanced understanding of the complex dynamics surrounding open dumping in Central Hunza's mountain areas and supports the development of targeted interventions tailored to specific contexts and populations.

2.7 Interviews

Key informants for this study were selected based on their expertise and involvement in Solid Waste Management (SWM) issues in the mountain areas of Central Hunza. This included community leaders who have a significant influence on local decision-making processes, as well as environmental experts with a background in waste management, sustainability, or related fields. The selection process involved consultation with local organizations, government agencies, and community members to identify individuals with relevant knowledge and experience.

Potential key informants were contacted through email, phone calls, or in-person meetings to explain the purpose of the study and invite their participation in an interview. Efforts were made to ensure diversity in the selection of informants, representing various geographic locations within Central Hunza and a range of perspectives on SWM issue.

2.8 Interview Protocol

The interview protocol included a series of open-ended questions covering topics such as current SWM practices, community engagement, environmental concerns, policy and governance issues, and recommendations for improvement. The protocol allowed for flexibility to probe deeper into specific areas of interest and to capture unanticipated insights that emerged during the conversation.

CHAPTER 3

3. RESULT AND DISCUSSIONS

3.1 Solid Waste Management Practices

Figure 1 shows the familiarity level of solid waste management practices of residences in Central Hunza. Half of the respondents (50%) were very familiar with solid waste management practices while 40% were somewhat familiar and only 10% of the respondents were not familiar with solid waste management practices in central Hunza.

In Gender wise calculation about 55% and 37% of males and 48% and 42% of females were very familiar and somewhat familiar respectively with practices of solid waste management practices while only 8% and 12% of males and females were not familiar to solid waste practices in central Hunza.

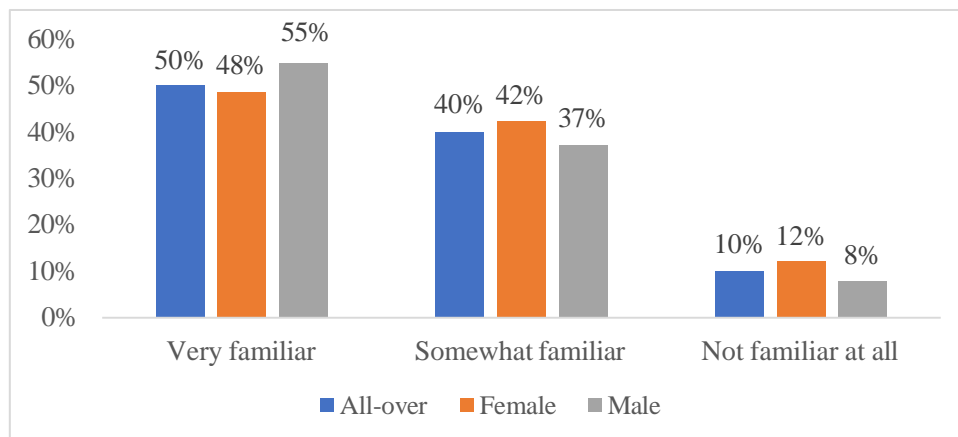


Figure 1: Percentage of familiarity with Solid Waste Management Practices

3.2 Segregation of Home Waste

In solid waste management practices, segregation of home waste is one of the important ways and Figure 2 shows the percentage of the segregation of home waste in central Hunza. About 44% of respondents always segregated their home waste, 36% sometimes while 9% of the respondents never segregated their home waste.

As most females are involved in the segregation of home waste, which is also reflected in this study, about 47% of female respondents always segregated their home waste while only 2% of them were never involved in the segregation of home waste. In the case of males 43% of them always, 33% sometimes, 8% rarely, and 15% never segregated their home waste.

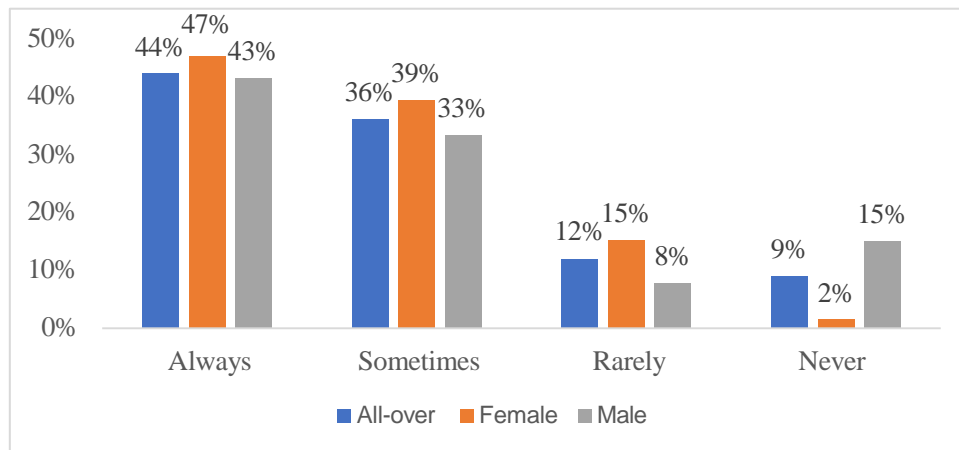


Figure 2: Percentage of Segregation of Home Waste

3.3 Awareness of designated waste disposal areas in locality

To manage solid waste, the district administration of Hunza has designated specific areas. The figure 3 shows awareness of people about those specific areas. About 76% of respondents were aware of the areas and only 24% were not aware of the waste disposal areas.

The majority of both males and females were also aware of it, about 80% of females and 75% of males knew the designated disposal areas located in central Hunza.

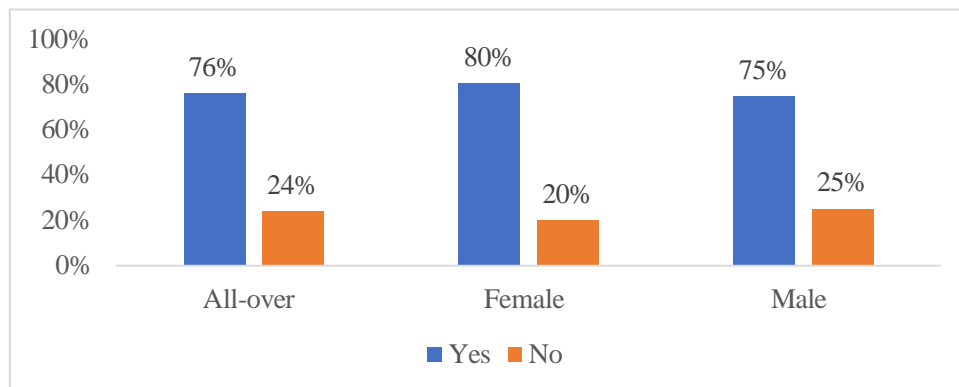


Figure 3: Percentage of Awareness of designated waste disposal areas in locality.

3.4 Open Dumping of solid waste in the mountain areas

Despite of awareness about waste disposal, local residents of central Hunza dump their solid waste in open mountain spaces. About 30% of respondents frequently and 39% occasionally dumped their waste in mountainous areas of central Hunza while 18% rarely and 13% never dumped solid waste in the open mountainous spaces.

Both males and females were involved in the open dumping of solid wastes in mountainous areas. About 32% of females and 30% of males responded frequently about dumping in mountainous areas while 4% of females and 14% of males never used open mountainous as dumping sites of their solid wastes.

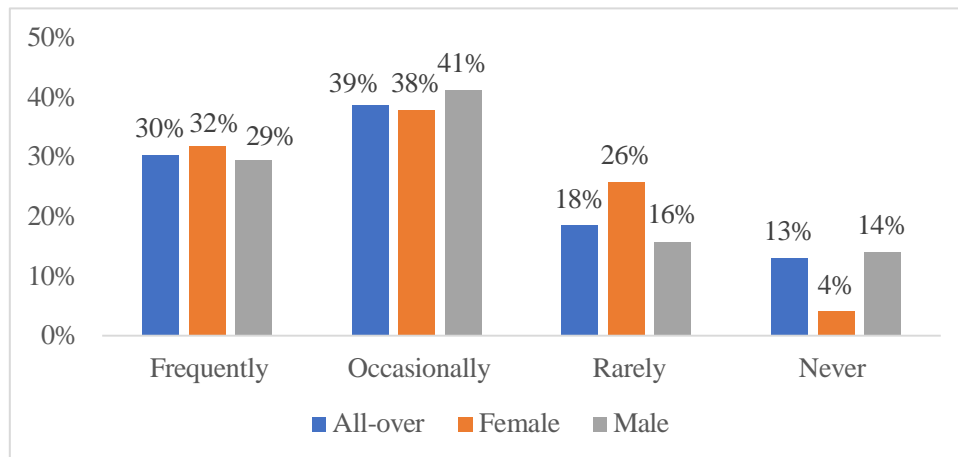


Figure 4: Percentage of Open Dumping of solid waste in the mountain areas.

Opening dumping of solid waste produces negative impacts on the environment. In this study water pollution, soil contamination, air pollution, and habitat destruction are used as environmental parameters. About 30% of respondents considered the opening dumping of solid wastes impacting all of the mentioned parameters while 14% considered habitat destruction, 11% air pollution, and 10% soil contamination as the main impacts of opening dumping of solid waste in mountainous areas of Central Hunza.

3.5 Impacts of Open Dumping of Solid Waste in the Mountain Areas

Open Dumping of solid waste impacts health along with the degradation of the ecosystem. The figure 6 shows the perception of respondents on the health of the local population due to open dumping of solid wastes. This study reveals that 82% of respondents considered negative impacts on the health of the local population as a result of the open dumping of solid wastes in mountainous areas of central Hunza. Both the majority of male respondents (71%) and female respondents (92%) considered the negative impacts of open dumping of solid wastes on the health of the local population while 21% of male respondents responded no hazard effects on the health of people.

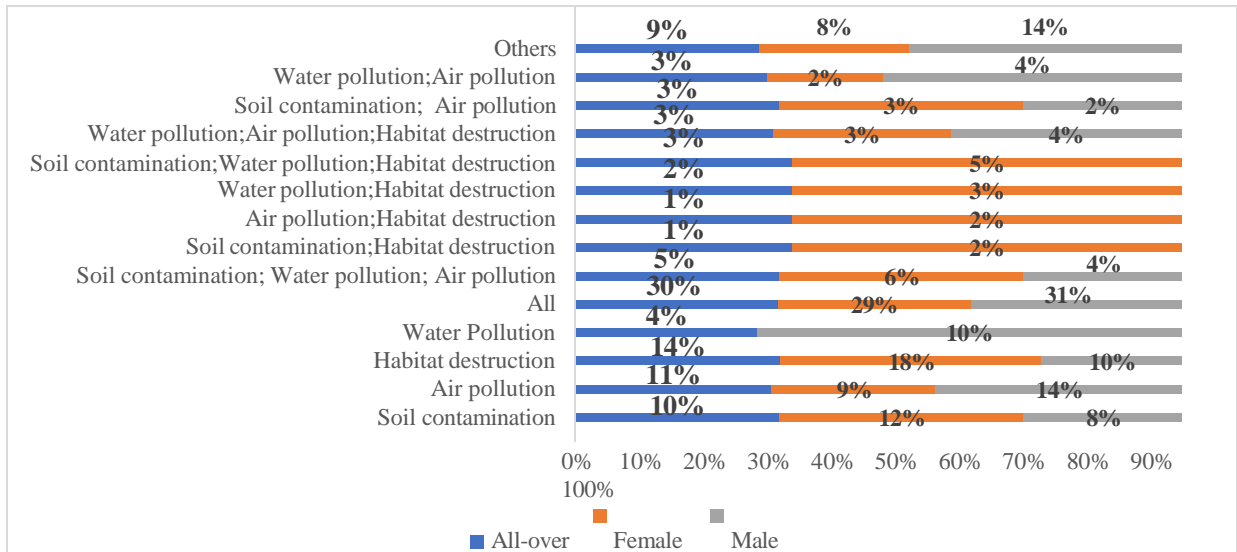


Figure 5: Environmental Impacts of Open Dumping of Solid Waste in the Mountain Areas.

3.6 Impacts of Open Dumping of Solid Waste on Health

Open dumping of solid waste in open places produces serious environmental and health issues. Figures 5 and 6 reflect people have serious concerns about the open dumping of solid waste in mountainous areas of central Hunza. Figure 7 shows the local people of central Hunza stress the improvement of solid waste management practices in central Hunza, 55% of them strongly agreed and 34% agreed for improvement in existing practices of solid waste management while 6% remained neutral and 5% disagreed on this point. In gender-wise distribution, 56% of each male and female respondents strongly agreed while 35% of female and 34% of male respondents agreed to improve solid waste management practices.

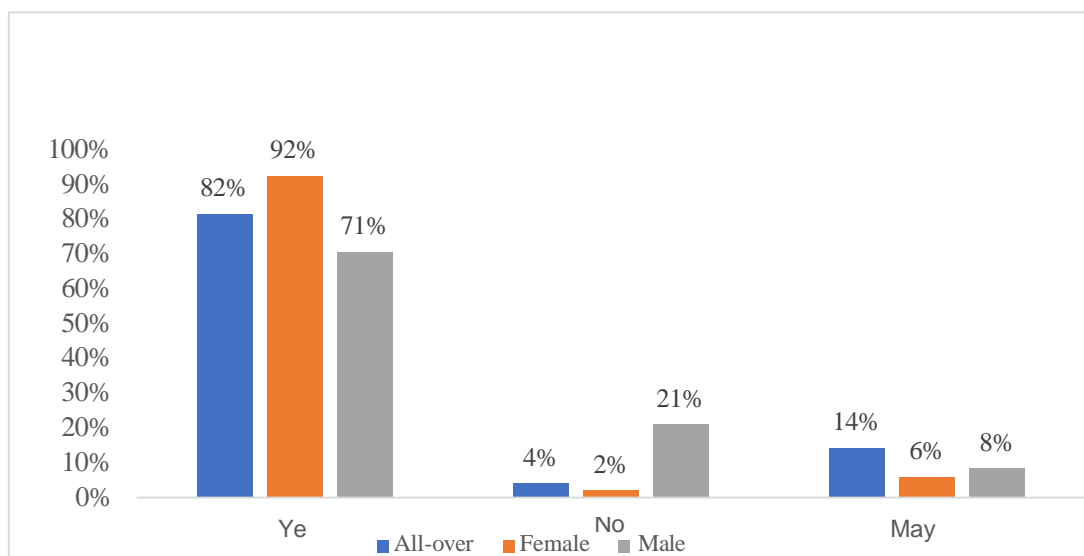


Figure 6: Impacts of Open Dumping of Solid Waste on Health of Local People (%).

3.7 Improvement of Solid Waste Management Practices

Open dumping of solid waste produces serious environmental and health issues, and to deal with this awareness of the local community plays a vital role. This study shows a majority of respondents (48%) considered local communities have moderate knowledge and awareness about the negative impacts of open dumping of solid wastes while 14% considered local communities have inadequate awareness and knowledge.

In gender-wise distribution, the majority of male respondents (44%) considered local communities have a high level of awareness while the majority of female respondents (53%) considered local communities have moderate level of awareness about the negative impacts of openly dumping solid waste on the ecosystem and health.

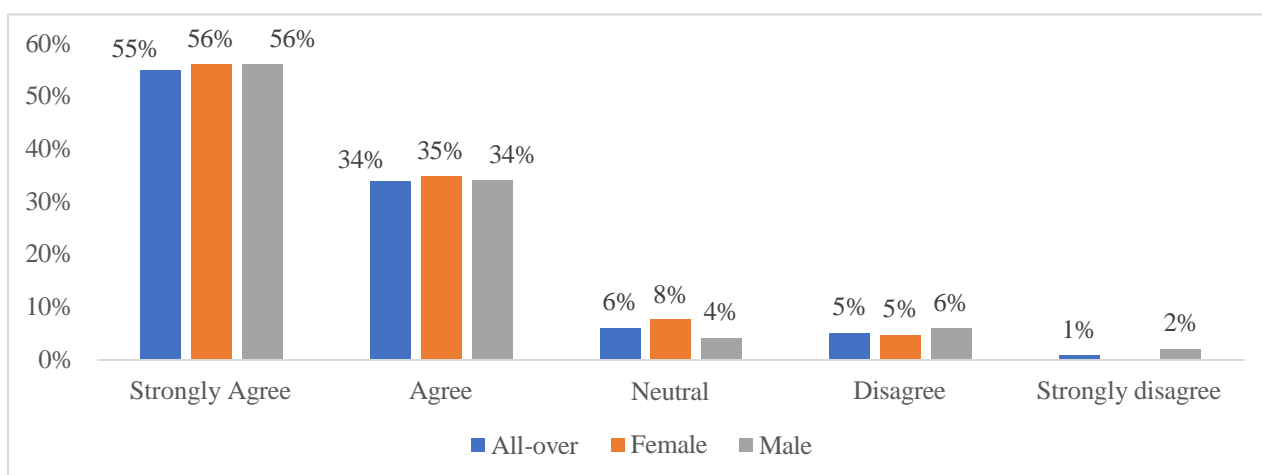


Figure 7: Improvement of Solid Waste Management Practices in Central Hunza (%).

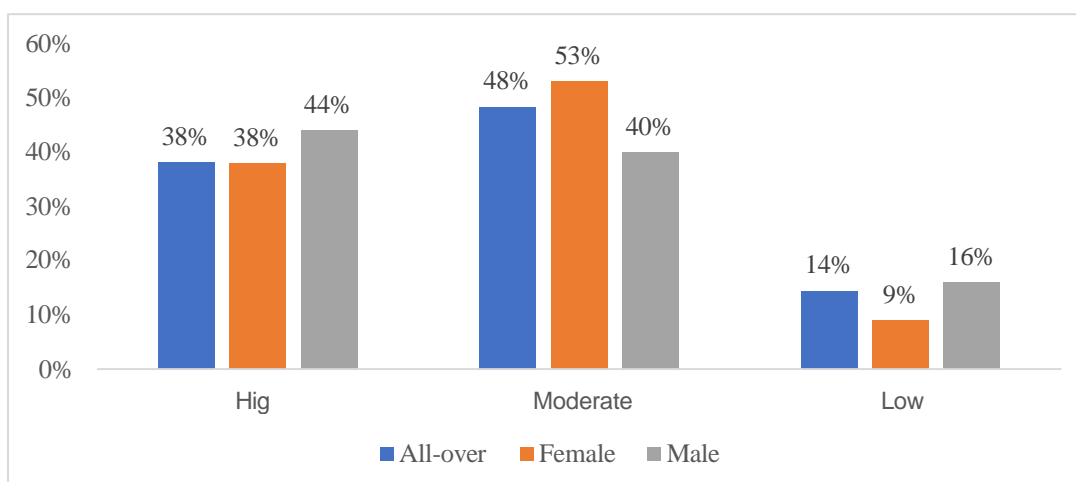


Figure 8: Awareness of Local Community of Open Dumping of Solid Waste on Environmental and Health (%).

3.8 Campaigns to Raise Awareness about Proper Waste Disposal Practices

Figure 9 shows the willingness of respondents to participate in awareness initiatives and campaigns for proper waste disposal practices. About 71% of respondents were willing to take part in the awareness campaign, 22% were indifferent, and only 8% were not willing to participate in the awareness campaign/initiatives.

The gender-wise distribution reveals female respondents are more willing than male. About 85% of female respondents showed their willingness, 15% were indifferent and only 3% were not willing to participate in awareness campaign/ Initiative. According to the male respondents, 55% were willing while 31% were not willing to become part of such initiatives/campaigns.

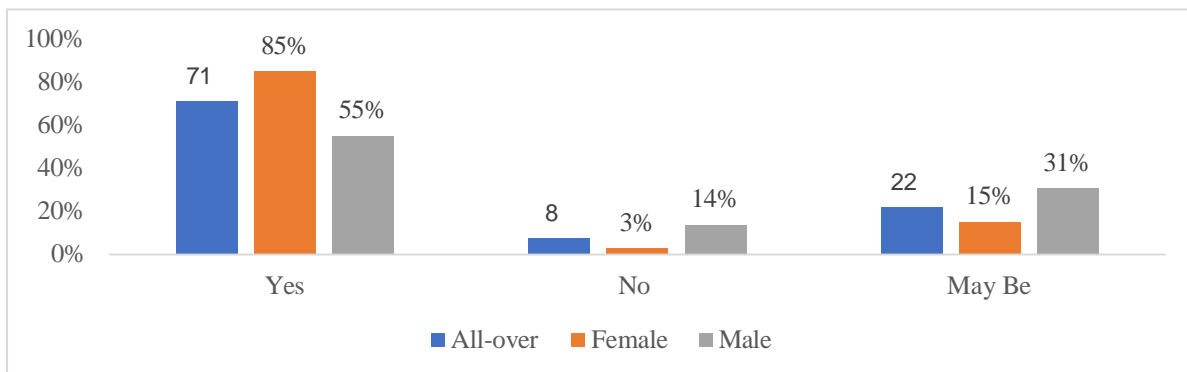


Figure 9: Campaigns to Raise Awareness about Proper Waste Disposal Practices.

CONCLUSIONS

In considering implications for future research, several avenues emerge to deepen understanding and enhance approaches to Solid Waste Management (SWM) in Central Hunza's mountain regions. Longitudinal studies offer opportunities to assess the sustained impact of implemented SWM interventions over time, tracking changes in waste generation rates, environmental quality, and community health outcomes. Further research could delve into socio-economic analyses, examining the intricate interplay between income levels, education, and cultural practices in influencing waste disposal behaviors. Exploration of emerging technologies such as waste-to-energy systems and smart waste management solutions could offer insights into innovative approaches to address SWM challenges in mountainous contexts, evaluating their feasibility and scalability. Investigating community resilience and adaptation strategies in the face of climate change impacts on SWM infrastructure provides crucial insights into building robust and adaptive waste management systems. Policy analysis is essential to evaluate the effectiveness of current SWM policies and governance structures, identifying barriers to implementation and opportunities for policy enhancement. Additionally, research into stakeholder engagement, cross-sectoral collaboration, and cultural and behavioral insights can inform the design of inclusive and context-sensitive interventions, fostering community ownership and sustainability in SWM initiatives. Comparative studies with other mountainous regions and interdisciplinary approaches integrating environmental science, social sciences, engineering, and public health offer further avenues for generating innovative solutions and advancing knowledge in SWM practices in Central Hunza's mountain areas and beyond.

RECOMMENDATIONS

Sustainable Solutions for Solid Waste Management

In addressing Solid Waste Management (SWM) challenges, community-based initiatives play a pivotal role in fostering sustainable practices and raising awareness among residents. Here are sustainable solutions focusing on engaging local communities and educating them on proper waste disposal:

I. Engaging Local Communities:

– Community Clean-Up Events

Organize regular clean-up campaigns where community members come together to collect litter and debris from public spaces, including streets, parks, and water bodies. These events not only contribute to immediate waste removal but also foster a sense of ownership and responsibility for keeping the environment clean.

– Waste Segregation Programs

Implement waste segregation at the source by providing households with separate bins for recyclables, organic waste, and non-recyclable materials. Workshops and training sessions can educate residents on the importance of segregation and how to properly sort their waste.

– Composting Initiatives

Encourage residents to compost organic waste by providing composting bins or establishing community composting facilities. Composting not only reduces the volume of waste sent to landfills but also produces nutrient-rich compost that can be used to enrich soil in community gardens and green spaces.

II. Educating Residents:

– Public Awareness Campaigns

Launch comprehensive public awareness campaigns using various media channels, including posters, flyers, social media, and community events. These campaigns can highlight the environmental and health impacts of improper waste disposal and promote responsible waste management practices.

– School Education Programs

Integrate waste management education into school curricula, teaching students about the 3Rs (Reduce, Reuse, Recycle), proper waste segregation, and the importance of

environmental stewardship. Students can also participate in practical activities such as waste audits and recycling competitions to reinforce learning.

– **Training Workshops**

Conduct regular training workshops for community members, focusing on practical skills such as composting, recycling, and waste reduction techniques. These workshops can be facilitated by local experts or environmental organizations and tailored to the specific needs and challenges of the community.

POLICY RECOMMENDATIONS

Proposing Amendments to Existing SWM Policies in Central Hunza:

- Conduct a comprehensive review of existing Solid Waste Management (SWM) policies and regulations in Central Hunza to identify gaps and areas for improvement.
- Propose amendments or revisions to SWM policies to align with international best practices and address specific challenges faced by mountain communities.
- Advocate for the inclusion of provisions promoting waste reduction, recycling, composting, and sustainable waste management practices in policy frameworks.

Advocating for the Implementation of Sustainable Practices:

- Advocate for the effective implementation and enforcement of SWM policies through collaboration with local authorities, government agencies, and relevant stakeholders.
- Lobby for increased funding and resources to support SWM infrastructure development, capacity building, and public education initiatives.
- Engage in dialogue with policymakers and decision-makers to raise awareness about the importance of sustainable waste management and garner political support for policy changes.

Community Engagement Strategies

- Strategies to Enhance Community Participation in Waste Management Initiatives:
- Conduct outreach programs and public awareness campaigns to educate community members about the benefits of waste management and encourage their active participation.
- Facilitate community-led initiatives such as clean-up drives, waste segregation programs, and composting workshops to empower residents and foster a sense of ownership over SWM activities.
- Establish community-based committees or task forces responsible for overseeing SWM initiatives and promoting community engagement in decision-making processes.

Establishing Partnerships with Local Organizations and Authorities:

- Forge partnerships with local non-profit organizations, community groups, and environmental agencies to leverage their expertise, resources, and networks in implementing SWM initiatives.
- Collaborate with municipal authorities, government agencies, and other relevant stakeholders to coordinate efforts, share best practices, and address systemic challenges in waste management.
- Create formal agreements or Memorandums of Understanding (MoUs) outlining roles, responsibilities, and mutual commitments between stakeholders involved in SWM activities.

REFERENCES

- Karrar, H. H., & Mostowlansky, T. (2018). Assembling marginality in northern Pakistan. *Political Geography*, 63, 65–74.
<https://doi.org/10.1016/j.polgeo.2018.01.005>
- Holden, L. (2019). Law, governance, and culture in Gilgit-Baltistan: introduction. *South Asian History and Culture*, 10(1), 1–13.
<https://doi.org/10.1080/19472498.2019.1576300>
- Ajibade, F. O., Adelodun, B., Ajibade, T. F., Lasisi, K. H., Abiola, C., Adewumi, J. R., & Akinbile, C. O. (2021). The threatening effects of open dumping on soil at waste disposal sites of Akure City, Nigeria. *International Journal of Environment and Waste Management*, 27(2), 127–146. <https://doi.org/10.1504/IJEW.2021.112947>
- Baig, F., Nawab, B., & Mahmood, Q. (2019). Impact assessment of sanitation system on the socio-economic aspects of local community and environment in Hunza Valley Gilgit Baltistan-Pakistan. *International Journal of Energy and Water Resources*, 3(2), 73–79. <https://doi.org/10.1007/s42108-019-00015-x>
- Doughty, C. A. (2016). Building climate change resilience through local cooperation: A Peruvian Andes case study. *Regional Environmental Change*, 16(8), 2187–2197.
<https://doi.org/10.1007/s10113-015-0882-2>
- Hossain, M., & Shams, A. (2020). Export Potential of Recycled Plastic: A Study on Bangladesh. *Asian Social Science*, 16, 12. <https://doi.org/10.5539/ass.v16n3p12>
- Hussain, A., Begum, S., Hussain, S. W., Khan, Z., & Ali, A. (2016). Analysis of Management and Environmental Effects of Municipal Solid Waste Due to Inefficient Practices Through People's Perception in Gilgit City, Gilgit Baltistan, Pakistan. *International*

Journal of Scientific Research in Environmental Sciences, 4(1), 12–16.

<https://doi.org/10.12983/ijsres-2016-p00012-0016>

Memon, M. A. (2010). Integrated solid waste management based on the 3R approach.

Journal of Material Cycles and Waste Management, 12(1), 30–40.

<https://doi.org/10.1007/s10163-009-0274-0>

Mihai, F., Ionut, M., & Grozavu, A. (2018). *Assessment of Waste Dumping Practices in Mountain Creeks* (SSRN Scholarly Paper 3270795).

<https://papers.ssrn.com/abstract=3270795>

Sharma, A., Gupta, A. K., & Ganguly, R. (2018). Impact of open dumping of municipal solid waste on soil properties in mountainous region. *Journal of Rock Mechanics and Geotechnical Engineering*, 10(4), 725–739.

<https://doi.org/10.1016/j.jrmge.2017.12.009>

Siddiqua, A., Hahladakis, J. N., & Al-Attiya, W. A. K. A. (2022). An overview of the environmental pollution and health effects associated with waste landfilling and open dumping. *Environmental Science and Pollution Research*, 29(39), 58514–58536.

<https://doi.org/10.1007/s11356-022-21578-z>

Thakur, A., Kumari, S., Sinai Borker, S., Prashant, S. P., Kumar, A., & Kumar, R. (2021). Solid Waste Management in Indian Himalayan Region: Current Scenario, Resource Recovery, and Way Forward for Sustainable Development. *Frontiers in Energy Research*, 9. <https://www.frontiersin.org/articles/10.3389/fenrg.2021.609229>

Hussain, A., Begum, S., Hussain, S. W., Khan, Z., & Ali, A. (2016). Analysis of Management and Environmental Effects of Municipal Solid Waste Due to Inefficient Practices Through People's Perception in Gilgit City, Gilgit Baltistan, Pakistan. *International Journal of Scientific Research in Environmental Sciences*, 4(1), 12–16.

<https://doi.org/10.12983/ijsres-2016-p00012-0016>

Imran Hussain, Muhammad, K., Salar Ali, None Muhammad Ayub, Atia Fehmi, & Zakir Hussain. (2023). Municipal Solid Waste Management in Skardu: Current Status, and Corrective Measures. *Proceedings of the Pakistan Academy of Sciences B Life and Environmental Sciences*, 60(3). [https://doi.org/10.53560/ppasb\(60-3\)844](https://doi.org/10.53560/ppasb(60-3)844)

Uddin, M., Ahmed, M., & Khan, N. (2010). Provision of basic services in the Hunza Valley: Transition from social mobilization to social entrepreneurship. *Enterprise Development and Microfinance*, 21(3), 216–228. <https://doi.org/10.3362/1755-1986.2010.019>

Hussain, A., Farooq, M. A., Ahmed, M., Zafar, M. U., & Akbar, M. (2010). Phytosociology and structure of Central Karakoram National Park (CKNP) of Northern areas of Pakistan. **World Applied Sciences Journal*, 9*, 1443-1449.

Michel Devadoss, P. S., Pariatamby, A., Bhatti, M. S., Chenayah, S., & Shahul Hamid, F. (2021). Strategies for reducing greenhouse gas emissions from municipal solid waste management in Pakistan. *Waste Management & Research: The Journal for a Sustainable Circular Economy*, 0734242X2098392. <https://doi.org/10.1177/0734242x20983927>

APPENDIXES

KKI Tool with EPA Official/ Department dealing with waste management

**The following tool will be administered with EPA/Waste Management Department
Official/ Department**

Introduction:

Thank you for participating in this key informant interview. Your expertise as an EPA official is crucial for understanding the impact of open dumping of solid waste in the mountain areas of Central Hunza. The information collected will contribute to a comprehensive assessment of the environmental challenges in the region.

Section 1: Background and Expertise

- 1.1. Can you briefly describe your role and responsibilities as an EPA official in the region?
- 1.2. How long have you been working in the field of environmental protection, specifically in the context of waste management in mountainous areas?

Section 2: Solid Waste Management Practices

- 2.1. What is the current state of solid waste management practices in the mountain areas of Central Hunza, from the perspective of the EPA?
- 2.2. How does the EPA collaborate with local authorities and communities to implement and enforce waste management regulations in the region?
- 2.3. In your experience, what are the major challenges faced in regulating and managing solid waste in mountainous terrains?

Section 3: Impact Assessment

- 3.1. Based on your observations and data, what environmental impacts are associated with open dumping of solid waste in the mountain areas?
- 3.2. How does the EPA monitor and assess the environmental impact of open dumping on soil, water, and air quality in Central Hunza?
- 3.3. Have there been any reported incidents or cases related to health issues among the local population due to improper waste disposal practices?

Section 4: Regulatory Framework and Enforcement

- 4.1. Can you provide an overview of the existing regulatory framework governing solid waste management in the region?
- 4.2. How effective are current regulations in preventing and addressing open dumping issues in mountain areas, particularly in Central Hunza?
- 4.3. Are there any gaps or areas where the regulatory framework could be strengthened to enhance waste management practices in the region?

Section 5: Community Engagement and Awareness

- 5.1. How does the EPA engage with local communities to promote awareness about proper waste disposal practices and environmental protection in mountainous areas?
- 5.2. In your opinion, what role do community initiatives play in mitigating the impact of open dumping in Central Hunza?

Section 6: Future Recommendations

- 6.1. Based on your expertise, what recommendations would you provide for improving solid waste management practices and minimizing the environmental impact in mountainous terrains?
- 6.2. Are there any specific projects, policies, or interventions that the EPA is planning or considering for the improvement of waste management in the region?

Thank you for sharing your insights and expertise. Your input is invaluable in understanding the impact of open dumping of solid waste in Central Hunza. If there are any additional points or concerns you would like to address, please feel free to share them below.

Survey Tool with Households in Central Hunza

Study Title: Assessment of the Impact of Open Dumping of Solid Waste in Central Hunza

Introduction:

Thank you for participating in this survey. Your input is crucial for understanding the impact of open dumping of solid waste in the mountain areas of Central Hunza. Please answer the following questions honestly and to the best of your knowledge. Your responses will be kept confidential.

Section 1: Demographic Information

1.1. Name

- _____

1.2. Age:

- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65 or older

1.3. Gender:

- Male
- Female

Section 2: Solid Waste Management Knowledge and Practices

2.1. How familiar are you with the solid waste management practices in Central Hunza?

- Very familiar
- Somewhat familiar
- Not familiar at all

2.2. Do you segregate your waste at home?

- Always
- Sometimes

- Rarely
- Never

2.3. Are you aware of designated waste disposal areas in your locality?

- Yes
- No

Section 3: Impact of Open Dumping on Environment and Health

3.1. Have you observed open dumping of solid waste in the mountain areas of Central Hunza?

- Frequently
- Occasionally
- Rarely
- Never

3.2. What environmental impacts do you believe open dumping has on the mountain areas?
(Select all that apply)

- Soil contamination
- Water pollution
- Air pollution
- Habitat destruction
- Other (please specify)

3.3. Do you think open dumping of solid waste affects the health of the local population?

- Yes
- No
- Not sure

Section 4: Attitudes and Awareness

4.1. Do you believe there is a need for improved solid waste management practices in Central Hunza?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

4.2. How would you rate the level of awareness among the local community regarding the impact of open dumping on the environment and health?

- High
- Moderate
- Low

4.3. Would you be willing to participate in community initiatives or campaigns to raise awareness about proper waste disposal practices?

- Yes
- No
- Maybe

Section 5: Suggestions and Comments

5.1. Do you have any suggestions for improving solid waste management in the mountain areas of Central Hunza?

5.2. Any additional comments or observations related to the impact of open dumping on the environment and health in your area?

Thank you for completing the survey. Your input is valuable in assessing the impact of open dumping of solid waste in Central Hunza. If you have any further comments or concerns, please feel free to share them below.

ASSESSMENT OF OPEN DUMPING OF SOLID WASTE IN MOUNTAINOUS AREAS OF CENTRAL HUNZA

ORIGINALITY REPORT

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