



Assessing the Role of Solid Waste Management Initiatives in Dhaka for Improving Health Outcomes and Alleviating Poverty

Nahid Aktar¹

ABSTRACT

This study examines the challenges of solid waste management in Dhaka, the capital city of Bangladesh. It investigates how ineffective waste management practices impact vulnerable populations' health and perpetuate poverty. Through a comprehensive review of existing literature and analysis of relevant data, the study identifies a gap in scholarly discussions regarding solid waste management's health and poverty implications for at-risk groups. The research aims to provide insights into the current state of solid waste management in Dhaka, assess its effects on health and poverty, propose potential improvement solutions, and evaluate the responses of the government and stakeholders to these challenges. The findings indicate that populations exposed to inadequate waste management face higher health risks, hindering their ability to escape poverty and contribute to society. The study emphasises the need to upgrade Dhaka's solid waste management system, advocating for implementing effective waste management legislation, infrastructure investments, and public education and awareness campaigns. The study highlights the urgent need for improved solid waste management in Dhaka to address health and poverty concerns. The government and relevant stakeholders must proactively enhance waste management practices, ensuring a healthier and more sustainable future for the city and its residents.

Keywords: Solid waste management, Public health, Human Development, Vulnerable populations, Waste disposal, Waste containment, Sustainable development.

Introduction

Waste management is a growing concern in urban areas around the world, and Dhaka, the capital city of Bangladesh, is no exception (Prodhan & Kaeserb, 2019). For many years since gaining independence, Bangladesh has grappled with a multitude of challenges, and one persistent problem that continues to haunt the nation is unregulated waste management. Despite numerous efforts and initiatives, the issue still needs to be solved, raising questions about its feasibility and manageability (Alam et al., 2017). With a population of over 21 million as of 2021², Dhaka generates an enormous amount of solid waste daily, creating a significant challenge for waste management in the city. The inadequate disposal of waste not only poses environmental threats but also has a substantial impact on public health and

¹ Author(s): Nahid Aktar, Designation: Adjunct Faculty, University/Organization Name: Dhaka International University, Email id: snahidaktar@gmail.com

²Dhaka, Bangladesh Metro Area Population 1950-2023, Source: <https://www.macrotrends.net/cities/20119/dhaka/population>

poverty³. This paper delves into the intricate relationship between solid waste⁴ management, public health, and poverty alleviation in Dhaka, shedding light on the urgent need for practical solutions to address this persistent challenge and pave the way for a healthier, more prosperous future. Examining the root causes and underlying factors that have hindered progress aims to highlight why the problem persists and explore potential solutions. This research study uncovers the intricate links by comprehensively analysing the intersections between waste management, public health, and poverty alleviation. It offers innovative approaches to transform this crisis into an opportunity for wellness.

Background of the research

The Human Development Index (HDI)⁵ is a summary measure of the average attainment of critical dimensions of human development: a long and healthy life, knowledge, and a decent standard of living. Pro-poor policy⁶ and significant investments in people's capabilities through education, nutrition, health and employment skill can expand and provide sustained progress. With human development at the centre of this research, it transpires that the economic growth of a segment of a country's population does not automatically translate into overall human development. HDI is created to measure the development of a nation. It should consider all classes of people and their potential rather than relying on the economic growth of a particular population group.

Human development is critically linked to several factors. Involuntary discernment sieves⁷ are needed to identify areas for people to fit into the great wheel of economic circulation (UNDP, 2013). In Bangladesh, where the urban population is the leading financial driver, their opportunity or ability to participate in the economy is either accelerating or decelerating economic growth. According to the World Bank, the slum population in Dhaka was approximately 2.6 million people in 2013; constant moving in and out is a reality, and the few opportunities in slums often lead to violence. At the same time, low incomes and living standards symbolise family violence, intolerance, unsatisfied aspirations and fear of a cloudy future.

ICDDR⁸ (2012) found that 4500 women and 1600 men in the slums of Dhaka, 85% of women reported that their husbands limited their access to health care; 21% also said being physically abused during pregnancy. Regrettably, all these factors undermine the path of human development (Manju N., 2012). A New York Times study has shown that education, healthy lifestyles, and economic

³ Proadhan, A. S. U., & Kaeserb, A. (2019). Municipal Solid Waste Management in Dhaka City: Present Status, Problems, and Probable Solutions—A Review. *Book: Environmental Thoughts, Part-I*.

⁴ Resource Conservation and Recovery Act (RCRA, 1976) states that "solid waste" means any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material resulting from industrial, commercial, mining, and agricultural operations, and from community activities—nearly everything we do leaves behind some waste.

⁵ The Human Development Index (HDI) is a statistical measure of a country's progress in terms of its citizens' health, education, and standard of living. It is based on three indicators—life expectancy, educational attainment, and gross domestic product (GDP) per capita—and is calculated by the United Nations Development Programme (UNDP). United Nations Development Programme (UNDP).

HDI is the geometric mean of normalised indices for each of the three dimensions (Human Development Reports, 1990). "Human Development Report." Accessed April 13, 2021. <https://hdr.undp.org/en/content/human-development-index-hdi>.

⁶ The pro-poor policy is a type of policy that aims to reduce poverty and promote economic development by targeting the needs and interests of the poorest members of society. It focuses on improving access to resources and services, strengthening the rights of the poor, and providing them with the means to increase their incomes. Pro-poor policies often include measures such as providing access to education, health care, and financial services; reducing inequality; and promoting economic growth. Source: World Bank, "Pro-Poor Policies and Programs," 2013.

⁷ Involuntary discernment sieves are psychological mechanisms that help us to automatically sort information and make decisions. They are the mental shortcuts we use to make decisions quickly and efficiently, such as the halo effect or the availability heuristic. These mental shortcuts help us quickly process information and make decisions without having to think through all the possible options. Falk, E. B., & Fischhoff, B. (Eds.). (2013). *Heuristics and biases: The psychology of intuitive judgment*. Cambridge University Press.

⁸ International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B), "About ICDDR, B," accessed November 15, 2012, <http://www.icddrb.org/about-icddrb.htm>.

insecurity increase violence, which calls for more research to address barriers to achieving progress so that the city can accelerate human development by including people from all walks of life⁹ (Robert, J. (2013).

This is due to unsanitary settlements and the underdevelopment of human resources, keeping them away from the benefits of turning them into a highly skilled workforce (International Labor Organization 2009). The endemic presence of debilitating diseases like malnutrition-based anaemia, intestinal helminths, tuberculosis, infectious diseases, and sexually transmitted infections hampers human development. These are mainly due to uninhabitable living conditions in the slums, where waste disposal is so irregular, perhaps virtually non-existent (Tabassum, 2012). All fingers point to the current slum lifestyle that leads to chronic physical ailments that cause the youth to lose initiative, and illiteracy fuels low per capita income and adds to the influx of people into runaway slums.

Research Question

How do solid waste management practices impact the health and well-being of vulnerable populations in Dhaka, Bangladesh?

Hypothesis

Poor solid waste management practices in Dhaka harm the health and well-being of vulnerable populations, including increased risk of infectious diseases and physical and mental health risks.

Implementing effective solid waste management practices in Dhaka will improve health and well-being outcomes for vulnerable populations, including reduced risk of infectious diseases and physical and mental health risks.

Problem Statement

Bangladesh, a country with six seasons and a warm climate, faces significant challenges in solid waste management. Dhaka, the capital city, has a high poverty rate, with 55% of the population living below the poverty line and around 50% of the poor residing in slums. Unplanned urbanisation has led to a rapid increase in the slum population, reaching about 3 million in a short period. Land scarcity is a pressing issue, hindering the provision of adequate housing, schools, offices, and other facilities. In response to the budget shortfall of Dhaka City Corporation (DCC), several private organisations and NGOs have stepped in to bridge the gap. However, most management programs primarily focus on affluent areas, neglecting the needs of slums and lower-income groups. To address these issues, the research aims to analyse the effects of these challenges and propose improvement solutions. Additionally, the study seeks to develop an efficient waste management and disposal system that can effectively tackle these problems.

The Aim and Objective of the Research

This study aims to evaluate the impact of improper solid waste management (SWM) on human health in Dhaka, Bangladesh, and to propose potential solutions for improving the local environment and offering continued development opportunities to socially and economically disadvantaged groups. In particular, the research objectives are to review the prevalence of waste-borne diseases, including bacterial, fungal, viral, food contamination-related and airborne droplet transmission diseases, in the environment near densely populated areas; examine how inadequate SWM affects Dhaka's most vulnerable populations; and evaluate potential solutions that could be implemented to address the issue. The study further investigates how waste-borne diseases negatively affect the income, efficiency, productivity and prosperity of vulnerable populations and how addressing the problem could improve the health status of city dwellers, particularly affected communities, allowing them to earn more, work more, and afford better living conditions such as schooling, medical treatment and nutrition.

Scope of the Study

This study examines the status of solid waste management in Dhaka, Bangladesh and its impact on health and poverty alleviation. It looked at how poor solid waste management is harming the health of the most vulnerable communities and exacerbating poverty by examining the most recent data on the topic, finding gaps in the literature on the health of vulnerable groups and poverty reduction, and

⁹ Richard Machacek, "Low Incomes and Living Standards: A Symptom of Family Violence, Intolerance and Fear of the Future," The New York Times, November 4, 2013, <http://www.nytimes.com/2013/11/04/opinion/low-incomes-and-living-standards-a-symptom-of-family-violence-intolerance-and-fear-of-the-future.html>.

examining the impacts of SWM in both poverty and health. The state of the situation was assessed in terms of how it affects public health and poverty reduction efforts to understand the problem more thoroughly and suggest ways to improve the current system.

The Rationale of the Study

The study's principle is to analyse the current situation of SWM in Dhaka, its impact on health and poverty alleviation and to promote the development of practical solutions to address the critical issues associated with SWM in Dhaka (S.A. Chowdhury, 2011). The central proposition of this study is that inadequate SWM in Dhaka affects citizens' health and increases poverty. The study also suggests that the government should adopt a multi-pronged approach¹⁰ to tackle the SWM problem by implementing effective legal measures, investing in infrastructure and promoting public education and awareness. The study also proposes that technology and innovative solutions should strengthen the current system. This study's findings will help shed light on policymakers, non-governmental organisations and other stakeholders regarding the importance of SWM and its impact on health and poverty alleviation in Dhaka.

The Significance of the Study

The study exploring the impact of solid waste management on health and poverty alleviation in Dhaka City is significant for several reasons. Firstly, it addresses a critical issue of public health concern in Dhaka, where poor solid waste management practices have led to environmental pollution and health hazards, particularly for vulnerable populations. Secondly, it focuses on poverty alleviation in the context of solid waste management and provides insights into how effective solid waste management practices can contribute to poverty alleviation efforts. Thirdly, it contributes to the existing literature on the link between solid waste management, health, and poverty. The study is significant because it addresses a critical public health issue, contributes to poverty alleviation efforts, and fills a gap in the literature on the link between solid waste management, health, and poverty.

Literature Review

Controlling severe urban solid waste in Dhaka is a complex and challenging question in the rapid extension of city inhabitation. Since the wastes production type in the area is both physical (Physical parameters are food waste, papers, card boards, plastic, rubber, synthetic, glass, garden, horticulture, drain silt, construction debris, etc.) and chemical compositions (Chemical compositions are organic matter, C/N ratio, moisture content, calorific value etc.), its management should be well planned, regular, transporting, recycling etc. are stipulated (Azom et al., 2012).

Hassan, R. (2013), in his work "The History of Waste and its Impact on People's Health", emphasises that the difficulties associated with waste and its impact on people's health can be traced back to the beginning of urbanisation. According to a report by the World Health Organization in 2012, the increased urban population and the growth of villages into towns and then cities have led to an exponential growth in the amount of waste generated.

This, in turn, has led to a heightened risk of communicable diseases and physical and mental health hazards. To mitigate this risk, it is necessary to contain and dispose of the waste safely and effectively (World Health Organization, 2012). Dyer C (2013) noted that the appalling conditions of indiscriminate waste dumping into waterways, empty lands, and access roads gave rise to epidemics like the "Black Plague" that destroyed the large population of Europe in the 14th century. Similar conditions were also experienced in the other continents. Human development standing firm on disease-free health conditions will ensure the rise of national financial growth if the country provides every aspect of well-being, such as a healthy environment for its inhabitant.

Conceptual Framework

The conceptual framework for this research is based on the Human Development Index (HDI) and its three components: health, education, and income. This framework will measure the impact of solid waste management on health and the poverty alleviation of vulnerable populations in Dhaka. Leading main indicators used to measure health outcomes include life expectancy, infant mortality rate, and access to essential health services. Literacy rate and access to educational services will measure the education component. Income will be measured by the proportion of people living below the poverty line, per capita income, and employment rate. The research will also examine the correlation between solid waste management and health outcomes, such as illness due to waste

¹⁰ A multi-pronged approach is a strategy used to address a complex problem or issue. It involves utilizing multiple strategies, such as educational programs, policy initiatives, and regulatory changes, to tackle the problem from different angles. This term was first coined in the late 1990s and has become widely used since then. It gained particular prominence in the early 2000s when the US government adopted a multi-pronged approach to tackling poverty.

contamination, productivity, and human development. It will investigate how improved solid waste management can lead to improved health and productivity and increased human development for vulnerable populations in Dhaka.

Challenges and Prospects of Municipal Solid Waste Management in Dhaka: Towards Healthy Human Capital

Building a clean and healthy human capital will be significantly impacted by the difficulties and opportunities of municipal solid waste management in Dhaka, Bangladesh. Poor waste management techniques cause several issues, such as agricultural land contamination, which lowers crop yields and impacts MERS earnings, making it difficult for them to escape poverty. Scavengers who rely on collecting recyclables will also lose their jobs due to the closing of rubbish dumps. Addressing these issues and improving waste management procedures is crucial to building a clean and healthy environment and maintaining the population's well-being and economic success rate.

Determining the Geographic Scope: Study Field

Dhaka, the capital of Bangladesh, is situated in a hot and humid climatic region, which accelerates the decomposition of waste materials and causes unpleasant odours and corrosive substances to pose perseveres to the city's residents. The adverse effects of this climate on waste management are particularly detrimental to the well-being of the people living near waste sites (Rahman et al., 2005). Under the Köppen climate classification, Dhaka experiences a distinct monsoon season, with an average annual temperature of 25 °C (77 °F) and monthly variations ranging from 18 °C (64 °F) in January to 29 °C (84 °F) in August. Most of the city's average annual rainfall of 1,854 millimetres (73.0 in) occurs during the monsoon season, lasting from May to late September.

The combination of air and water pollution and its hot and humid climate resulting from traffic congestion and industrial waste poses a significant problem that adversely affects public health and overall quality of life in urban areas (M. Hasan et al., 2008). Furthermore, the construction of high-rise buildings and other real estate developments has led to the alarming pollution and erosion of water bodies and wetlands surrounding Dhaka, posing a threat to the region's biodiversity.

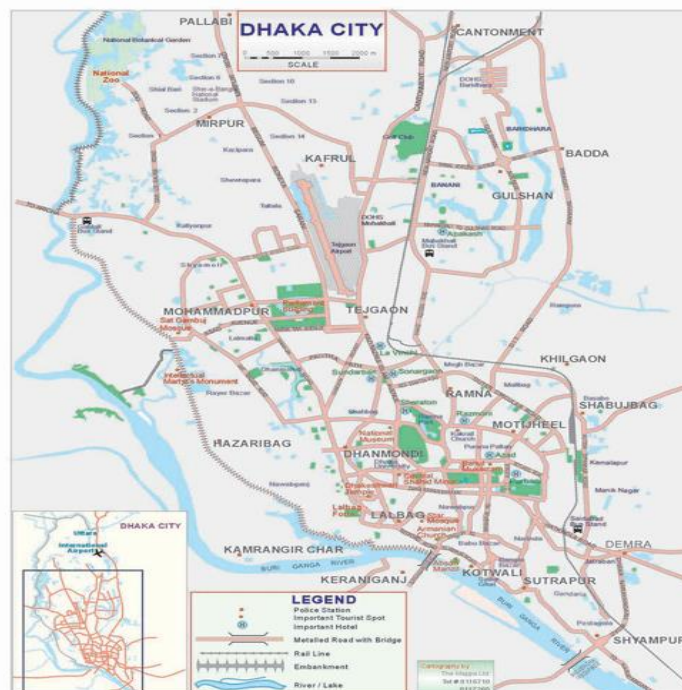
Spanning an area of 1464 square kilometres, Dhaka accommodates an astounding population of 15 million people. Between 23° 43' 23" North latitude and 90° 24' 31" East longitude, Dhaka is positioned along the Buriganga and Shitalkha rivers (Alamgir et al., 2011). As one of the most densely populated cities in the world, Dhaka faces substantial challenges in managing the enormous volume of municipal waste generated daily. The outdated waste management system employed by the Dhaka City Corporation (DCC) struggles to cope with these demands, aggravated by insufficient equipment and workforce. The prevalence of illiteracy and lack of awareness among the population also exacerbates the existing problems (M. Hasan et al., 2008).

For a visual representation of the study area's location, please refer to Image 1.

Mapping the Complexity: Visualizing Dhaka's Urban Landscape and Waste Management Challenges

Drawing upon the invaluable resource of the Dhaka City Map by Al-Muyeed (2011), it visualises the city's intricate urban landscape, providing a crucial foundation for understanding the spatial dynamics of waste management and its impact on public health and poverty alleviation.

Figure 1: Dhaka City Map: Understanding the Spatial Dynamics of a Metropolis.



Source: Al-Muyeed, M. A. (2011). © All rights reserved.

Navigating the Complexity: Defining and Categorizing Solid Waste

At the core of the research lies a clear understanding of the term 'solid waste,' this work explores its comprehensive definition, encompassing various forms and sources, setting the stage for a holistic analysis of its management and implications for public health and poverty alleviation in Dhaka. Waste materials are no longer helpful or suitable for their intended purpose, and they can be broadly categorised into two main types: solid waste and liquid waste. Solid waste refers to dry, unwanted materials that individuals discard and can be potentially harmful or of no value. It can further be classified as hazardous or non-hazardous based on its characteristics (EPA, U.S., 2012).

Figure 2: SWM Process in Dhaka



Source: Nature Study Society of Bangladesh (2020). © All rights reserved.

The term 'solid waste' encompasses dry, unwanted materials that individuals discard and can be potentially harmful or of no value. It includes municipal, industrial, commercial, sewage sludge, agricultural and farming, demolition, and mining waste. Solid waste can be classified as hazardous or non-hazardous based on its characteristics (EPA, U.S., 2012). Municipal waste refers to various types of waste generated in urban areas, such as garbage, refuse, sludge, and other waste materials.

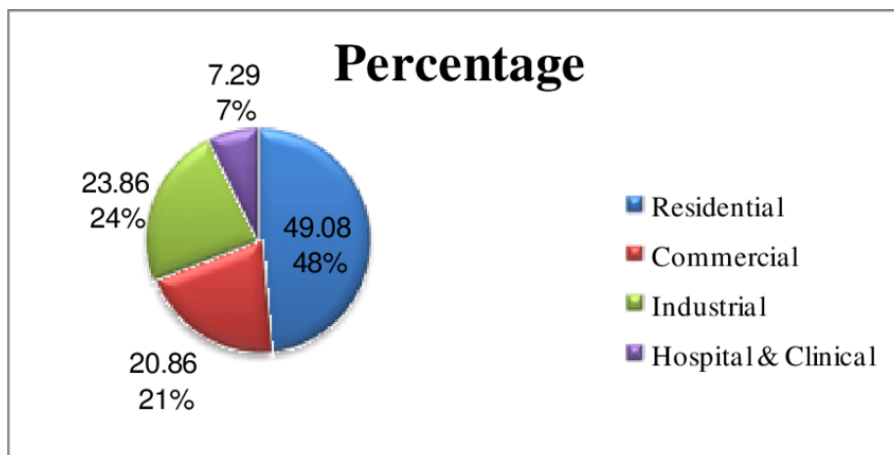
In urban areas, household solid waste is commonly known as residential or household waste. Waste from industrial, commercial, institutional, or agricultural activities and street sweepings are categorised based on their specific sources. Food waste from food preparation or leftovers is often called garbage. The responsibility for collecting solid waste lies with the municipal authority or city corporation (EPA, U.S., 2012; OECD, 2003).

Solid Waste Generation Per Day

Analysing the percentage of total solid waste generation per day provides valuable insights into the scale and magnitude of the waste management challenge, emphasising the need for comprehensive strategies and sustainable practices to address the ever-increasing volume of waste and mitigate its environmental impact. According to the study conducted by Memon (2002), the percentage of total solid waste generation per day states that 48% of Dhaka city is residential waste, 24% industrial waste, 21% commercial waste and 7% hospital and clinical waste. However, the nature of solid waste is changing over time and with urban expansion.

Figure 6:

Figure 7: Percentage of total solid waste generation per day



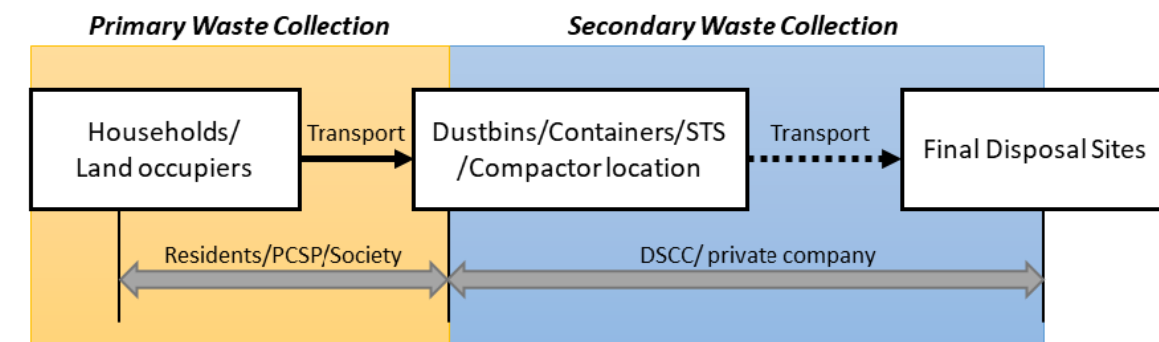
Source: (Menon, 2002). © All right reserved

The unsorted polythene and plastic materials mixed with food waste are constantly causing problems for human health, the environment and drainage systems. They are non-biodegradable¹¹ and regularly pose health risks. They remain intact in the soil as natural processes cannot decompose them, so appropriate recycling¹² is required to separate the waste material.

Existing Waste Management of Dhaka City Corporation

Examining the existing waste management practices of Dhaka City Corporation sheds light on the current status of waste management infrastructure, challenges faced, and opportunities for improvement, calling for strategic interventions and innovative solutions to address the city's waste-related issues.

Figure 3: Examining the existing waste management practices of DCC



Source: "Clean Dhaka Master Plan 2005–2015"

¹¹ Non-biodegradable materials are materials that cannot be broken down by natural processes or organisms. Examples of non-biodegradable materials include plastic, metal, glass, and certain synthetic fabrics.

¹² Recycling is the process of collecting and processing materials that would otherwise be discarded and turning them into new products. It helps to reduce the consumption of raw materials, reduce energy usage, and decrease emissions of greenhouse gases. Earlier, recycling was seen as a way to reduce the amount of waste going to landfills, conserve natural resources, and reduce the amount of energy needed to make new products. National Recycling Coalition, "The Basics of Recycling", 2011, <http://www.nrc-recycle.org/basics.asp>

Collection: The first stage is the collection, where waste is gathered from on-site storage locations such as secondary disposal sites (SDS), transfer stations, and transfer points. SDS serves as a storage facility for bulk waste, which is later transported to designated locations for processing, recycling, treatment, or final disposal. The selection of these sites is based on factors like population density, space availability, accessibility, and local considerations.

Figure 3: DCC Waste Picking Service



Transportation: Transportation of the collected waste is carried out using motorised vehicles. Municipal Solid Waste (MSW) is collected from SDS, while non-motorized vehicles are used to transfer community bins to SDS. The responsibility for waste collection from secondary points and transportation lies solely with the city authorities. The waste is transported to the Ultimate Disposal Site (UDS) using garbage trucks and carriers.

(i) Waste collection from dustbin by open truck (before 2005)
 At dustbins in which people dispose of waste, unsanitary conditions were present all day long, and waste loading by the cleaners from the dustbins to the truck was difficult.

(ii) Waste collection by container carrier (from 2005 to 2010)
 Although the efficiency of the collection by container carrier is high, the containers still created unsanitary condition and aggravated traffic congestion.

Recycling: Recycling plays a crucial role in solid waste management. First, mobile shoppers visiting households door-to-door purchase recyclable materials such as newspapers/paper, broken glass, metals, and plastics. Secondly, a section of the impoverished population collects recyclable and non-recyclable waste materials from dustbins, containers, roads, and dumping sites, engaging in small-scale business activities. Additionally, entrepreneurs mainly produce organic compost from organic solid waste, particularly organic food. The potential value of organic waste is often overlooked, despite its significance and the possibility of converting it into valuable organic compost.

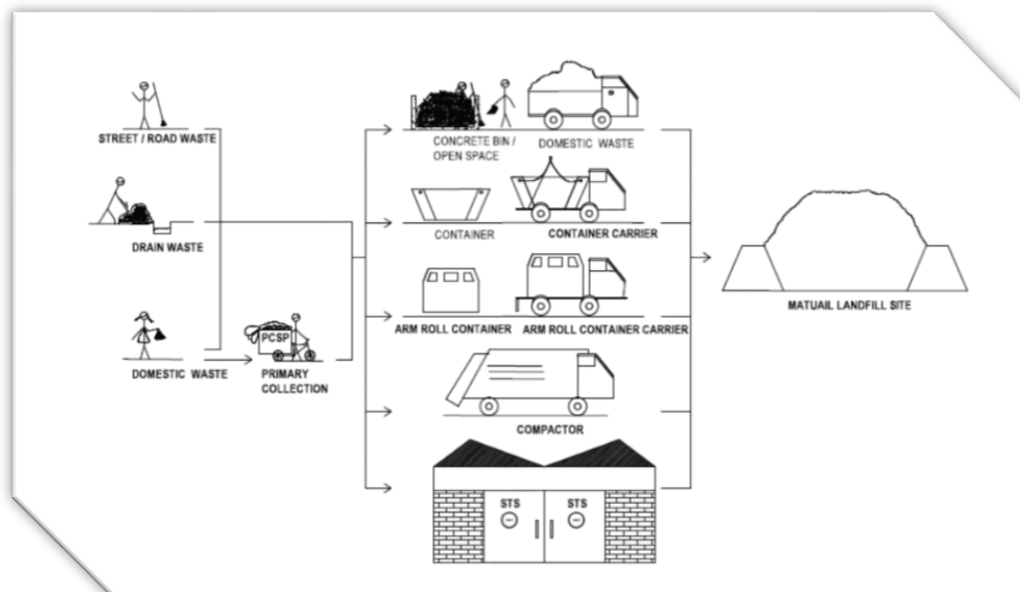
Final Disposal: Final disposal of the waste occurs at the designated dumping sites. Currently, waste is disposed of in lowland areas, including the Matuel site located about 3 km away from the city corporation area. Unfortunately, some minor sites are managed without proper soil cover and compaction, leading to unregulated waste disposal. Inadequate waste management practices result in uncollected waste being dumped in open spaces, roads, and drainage systems, causing significant environmental degradation and health hazards.

Waste collection and transport flow from source to final disposal

Analysing the waste collection and transport flow from the source to final disposal is crucial in understanding the efficiency, challenges, and potential solutions to ensure proper management and environmentally sustainable practices in handling waste. The diagram illustrating the waste collection and transport flow from the source to final disposal, as explained by the JICA Project Team, provides a

comprehensive visual representation highlighting the interconnected processes involved in managing waste effectively and underscores the importance of a well-designed system for ensuring environmental sustainability and public health.

Figure 5: Waste collection and transport flow from



Source: JICA (2005) Project Team © All rights reserved

Waste management in Dhaka suffers from poor implementation, primarily due to inadequate funding and supervision, despite the city's high population density. The lack of proper maintenance and segregation of toxic waste from municipal solid waste exposes the city's residents, especially those living in slums and near waste dump zones, to health risks associated with direct exposure to toxic waste.

The Climate and Clean Air Coalition (2012) study highlighted the following issues regarding solid waste management (SWM) in Dhaka:

Administrative Units: Dhaka is divided into two administrative units, Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC), responsible for waste collection and disposal in their respective areas. However, the collection rates are estimated to be only 40-60% in DNCC, with an overall collection rate of approximately 42% for the entire city (DNCC and DSCC) as of 2007.

Uncollected Waste: Waste that remains uncollected is often deposited in open bins, leading to the accumulation of odours, rodents, and clogged stormwater and sewer systems. The uncollected waste is also prone to accidental and deliberate burning, contributing to various health and environmental impacts. Inadequate waste collection is particularly evident in slum areas.

Solid Waste Master Plan: Dhaka has made some progress under its 2005 Solid Waste Master Plan, which introduced a new system for regular household waste collection through a network of collection bins across the city. However, the plan was set to expire in 2015, raising concerns about implementing a new project.

Spatial Dimensions of Waste Management: Disposable Area of the Population

The table depicting the disposable area of the population, as presented by Kundu in 2009, offers valuable insights into the spatial requirements and challenges associated with waste disposal, emphasising the need for efficient urban planning and waste management strategies to accommodate the growing population's waste generation while preserving the environmental integrity of the area.

Table 1: Source: Disposable area of population

Percentage of population	Disposal Area
50%	West enclosure/bin
20%	Roadside area
20%	Drain
10%	Open Ground

Source: Kundu, CA, (2009) © all rights reserved

This table (Kundu, CA, 2009) provides a breakdown of the percentage of the population in Dhaka, Bangladesh, that disposes of their waste in different areas. The most significant portion (50%) of the population disposes of their waste in the west enclosure/bin, followed by 20% in roadside areas, 20% in drains and 10% in open ground.

This data provides insight into how Dhaka is managing its waste, and it is evident that 50% of the population is disposing¹³ of their waste correctly through bins and other enclosed areas. However, a significant portion of the population is still disposing of their waste in drains and open ground, which could lead to environmental and health issues. Dhaka needs to continue improving waste management practices to ensure that their population disposes of their waste responsibly.

Poverty, Migration, and the Strain on Dhaka: Challenges and Human Suffering

The relationship between poverty, migration, and urban pressures in Dhaka underscores the need for holistic approaches that address socio-economic inequalities and urban planning deficiencies and provide sustainable solutions for improved well-being. The rapid migration to Dhaka, driven by economic opportunities and escape from poverty, strains infrastructure and resources, leading to widespread human suffering (United Nations Department of Economic and Social Affairs, 2013; Iyengar & Dholakia, 2012). Comprehensive measures are necessary to address these challenges and promote inclusive development, including addressing slums and substandard housing (BBS, 2012-2013).

Impact of Urban Population Growth and Lack of Strategic Planning on Dhaka City

Rapid urban population growth in Dhaka, fuelled by rural-urban migration, has led to socio-economic and environmental challenges (Akash et al., 2018). The absence of strategic planning and targeted growth measures exacerbates these issues. The local government's inadequate response includes needing more employment strategies, human resource development programs, and integrating essential aspects like environmental conservation and disaster risk management into the city plan (BBS, 2012). Effective urban management strategies are crucial for mitigating negative consequences and promoting sustainable development in Dhaka.

¹³ The source is a fact sheet on solid waste management in Dhaka City, Bangladesh, published by the Climate and Clean Air Coalition. According the source, only 40–60% of Dhaka's waste is collected and transported to the city's two landfills. Uncollected waste is deposited in open dumps and common areas. The fact sheet includes information on a source separation pilot program launched in 2012 and linkages in waste recycling. The fact sheet can be found at:

https://www.waste.ccacoalition.org/sites/default/files/files/city_fact_sheet/Dhaka_MSW_FactSheet_0.pdf

Table 2

Growth of Urban Population in Bangladesh								
	1974		1981		1991		2001	
	Number	%	Number	%	Number	%	Number	%
Urban	6273603	8.78	13535963	15.05	20872204	18.73	28605200	23.1
Rural	70124397	91.79	76376037	84.95	90582981	81.27	101424549	76.9
Total	76398000	100	89912000	100	111455185	100	130029749	100

Source: Bangladesh Bureau of Statistics

Source: Bangladesh Bureau of Statistics ©All rights reserved

Table 2 presents the growth of the urban population in Bangladesh from 1974 to 2001, demonstrating a steady increase from 8.78% in 1974 to 15.05% in 1981, 18.73% in 1991, and 23.1% in 2001. This data highlights the continuous growth of urban areas, leading to various problems and raising concerns about housing security. Simultaneously, the rural population in the country experienced a notable decline during the same period.

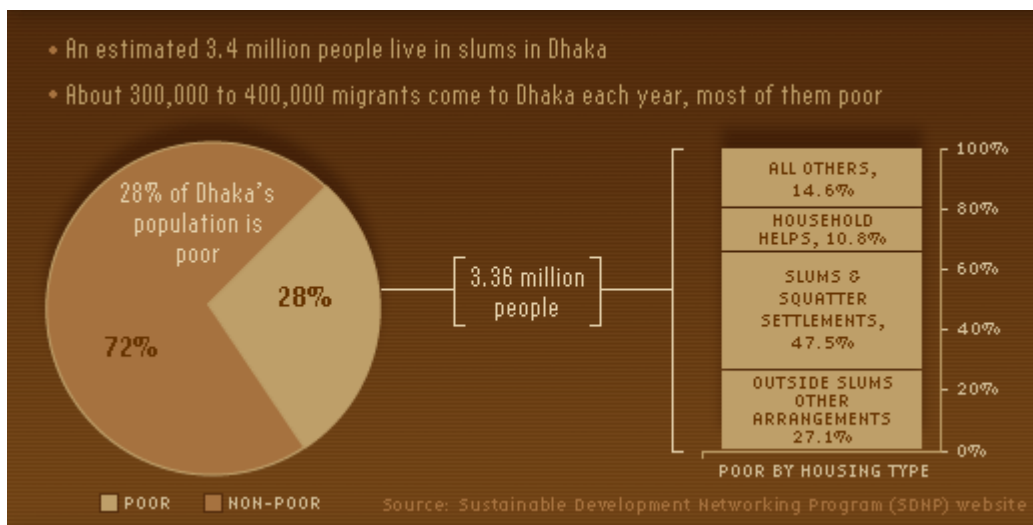
These gaps in planning and implementation hinder the overall development and well-being of the growing migrant population in Dhaka and exacerbate the existing challenges the city faces. Strategic interventions and comprehensive policies are essential to address the socio-economic disparities, improve living conditions, and ensure sustainable urban development in Dhaka.

Urbanisation and Its Impact on Slum Growth in Dhaka

Urbanisation emerges as a central factor contributing to the growth of the slum population in Dhaka. Economic globalisation has not positively impacted rural poverty alleviation in Bangladesh, where opportunities for employment and income generation in rural areas are limited. Dhaka, currently the ninth largest city in the world with a population of approximately 14.3 million, is frequently cited as one of the least livable cities globally (Banks, N. 2012).

Bangladesh has experienced significant urbanisation, with the population rising from 7.6% to around 25% between 1970 and 2005. Socioeconomic, political, and demographic factors influence this transformation. The rapid urbanisation and urban settlement patterns in Bangladesh are expected to impact the urban economy's growth, economic activity changes, income distribution among regions and social classes, demographic transition, and shifts in governance (IMF, 2013).

Figure 8: Poor population in Dhaka Slum



Source: SDNP, (2012) © all right reserved

The figure, depicting the distribution of the poor population in Dhaka slums as presented by SDNP, provides a visual representation of the concentrated poverty in these areas, highlighting the pressing need for targeted interventions and comprehensive policies to uplift the living conditions and alleviate the socio-economic challenges faced by slum dwellers in Dhaka.

It illustrates that most people in Dhaka, Bangladesh are poor, with an estimated 3.4 million living in slums and squatter settlements. This accounts for nearly half (47.5%) of the total population. Another 28% of people are considered poor, with 10.8% of households made up of helpers or workers. The remaining 14% of people live in other housing arrangements outside slums (SDNP, 2012).

This data highlights the need for improved living conditions and better access to resources for people living in Dhaka. It also underscores the importance of supporting migrants coming to Dhaka, who are likely to be poor.

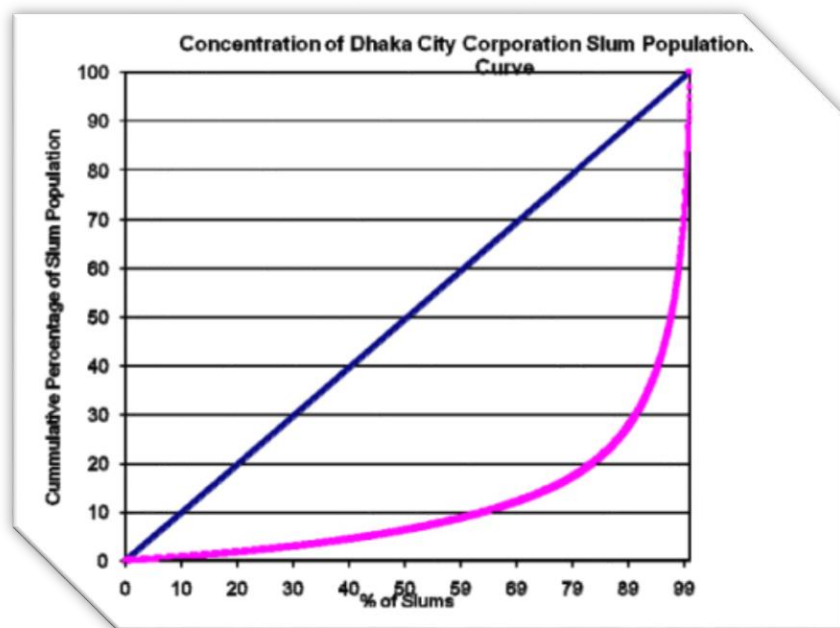
Impact of Rapid Urbanization on Poverty and Slum Growth in Dhaka

The impact of rapid urbanisation on poverty and the growth of slums in Dhaka is a critical issue that demands attention, as it highlights the complex relationship between urban development and socio-economic disparities, necessitating holistic approaches that address the root causes of poverty, promote inclusive growth, and provide sustainable housing solutions to improve the living conditions of marginalised communities in the city. The world is experiencing rapid changes and population growth, leading to increased urbanisation and the emergence of new lives every second. However, urban living comes with environmental and health-related risks, particularly in developing countries like Dhaka, where the rise of slums has created a severe waste and sanitation management crisis. Approximately 1.0 billion people worldwide lack adequate sanitation facilities (Hossain, S. 2008).

Analysing the Dhaka City Corporation Slum Population through the Lorenz Curve

The utilisation of the Lorenz curve to analyse the slum population within the Dhaka City Corporation, as presented by Angeles et al. in 2009, provides a quantitative framework to understand the extent of income inequality and spatial distribution of slums, offering valuable insights for policymakers and urban planners in formulating targeted strategies to address poverty, improve living conditions, and foster equitable development in Dhaka.

Figure 9: DCC Slum Population- Lorenz Curve



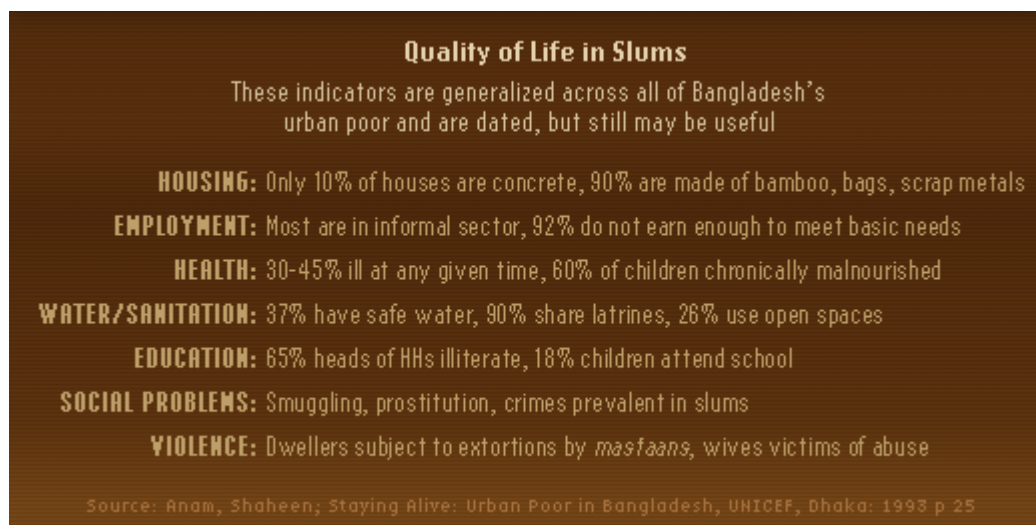
Angeles G, et al., (2009). © 2009 by Angeles G, Quimbo S, Tan S, and Subbarao, all rights reserved.

Rapid urbanisation in Dhaka has significantly increased the slum population, primarily concentrated in lower income brackets (Angeles et al., 2009). Unaffordable housing, inadequate urban planning, and limited job opportunities contribute to substandard living conditions and access to essential services (Hai et al., 2002). These challenges necessitate comprehensive urban planning, targeted poverty alleviation strategies, and improved waste and sanitation management for sustainable and inclusive urban development (Angeles et al., 2009).

Analysis of Living Conditions in Dhaka's Slums

Analysing living conditions in Dhaka's slums reveals residents' daunting socio-economic realities, necessitating comprehensive interventions to address housing, sanitation, healthcare, and livelihood challenges (Haddad et al., 1999). The provided image from UNICEF (1993) depicts the quality of life in Dhaka's slums, highlighting the grim situation faced by low-income urban residents in Bangladesh.

Figure 4: Quality of life in the slum

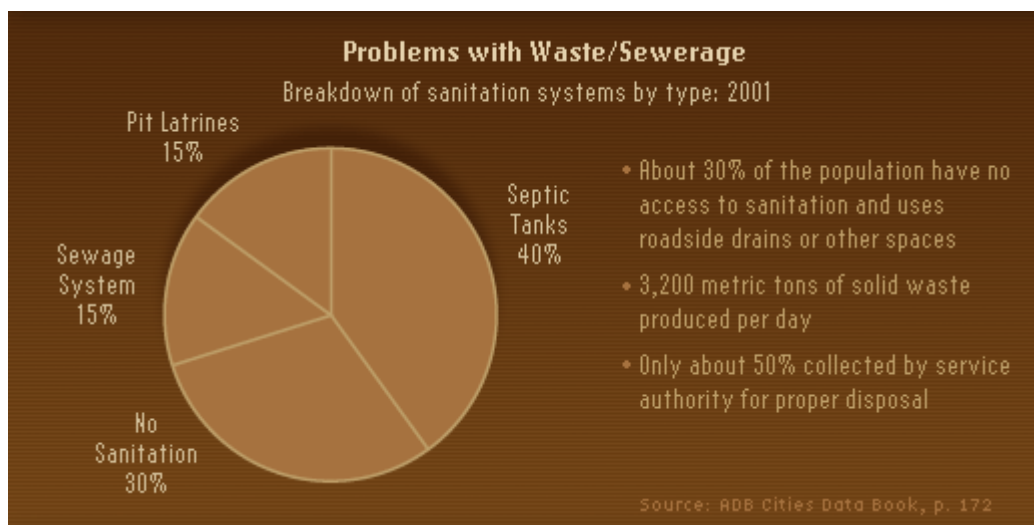


S Anam, 1993 p. 25. Copyright © 1993 by UNICEF, Bangladesh. All rights reserved.

The figure illustrates that water and sanitation pose significant problems, with only 37% having access to safe water and 90% relying on shared latrines. Additionally, 26% of slum dwellers resort to open spaces for sanitation, indicating inadequate facilities (Anam, 1993). Access to necessities, including housing, healthcare, education, and employment, is severely limited. Merely 18.9% of households have access to adequate sanitation, and dwellings are often makeshift structures using bamboo and scrap materials (UNICEF Bangladesh [Shaheen Anam], 1993, p. 25).

Challenges of Waste and Sewage Disposal in Dhaka Slums

The problem with waste and sewerage in Dhaka's slums poses significant challenges to the living conditions and well-being of the socioeconomically challenged urban dwellers, calling for immediate attention and practical strategies to address inadequate waste management systems and the lack of proper sanitation infrastructure to improve the overall quality of life in these marginalised communities. The image shows the standard of living in the slums of Dhaka. It illustrates the situation faced by the urban communities with limited financial resources in Bangladesh, with key indicators of housing, employment, health, water/sanitation, education and social problems.

Figure 10: Problems with Water/Sewerage

Copyright © [n.d.] by ADB. All rights reserved—Cities Data Book, p.172.

Overall, this diagram paints a bleak picture of the situation facing the urban disadvantaged population in Bangladesh, showing that they face various challenges regarding access to housing, employment, health, water/sanitation, education and security. ADB (2004) asserts that water/Sanitation is a significant issue in slums where only 37% have access to safe water, 90% use shared latrines, and 26% have no choice but to use open spaces. Quality and quantity of lavatories are essential for slum development. There are very few semi-Pacha or pacha latrines; they can never meet the growing demand. The slums of Dhaka are characterised by inadequate access to necessities such as sanitation, housing, healthcare, education and employment. Sanitation infrastructure is limited, with only 18.9% of households having access to adequate sanitation facilities. Most dwellings are constructed of bamboo, bags and scrap metal, indicating a severe lack of access to decent housing (Andrews et al., 2004).

Employment is mainly informal, and incomes are likely below the basic needs line. Health and education are likewise compromised, with 30-45% of people being ill and 65% of households being illiterate. The prevalence of social ills such as smuggling, prostitution and crime, as well as extortion by Mastans¹⁴ and assaults on wives, further complicates matters and exacerbates the vulnerability of slum dwellers. These realities demonstrate a dire need for improved access to basic needs in the slums of Dhaka.

Poverty-driven health risks and inadequate waste management in Dhaka city

It has long been the case that poverty¹⁵ and poor waste management go hand in hand. The quality of waste management decreases with country development. A nation's economic health and cleanliness are closely intertwined. In developing nations, it is typical for most people to live in poverty and for poor pollution management in the cities. Industrial effluents and domestic wastes are significant causes of pollution which significantly impact human health and consequently are responsible for low human productivity (Gonzalez, J., 2011). According to the US Environment Protection Agency (2002),

“The combined pressure from the shrinking resource base and worsening living conditions weaken the productive capacity of the poor, make them more marginalised over time, and eventually trap them in what is often referred to as the vicious circle of poverty.”

¹⁴ Local gagsters are called Mastan in Bengali colloquia.

¹⁵ Dr Younus defines poverty as "a denial of choices and opportunities, a violation of human dignity. It means a lack of basic capacity to participate effectively in society. It means not having enough to feed and clothe a family, not having a school or clinic to go to, not having the land to grow one's food or a job to earn one's living, and not having access to credit. It means insecurity, powerlessness, and exclusion of individuals, households, and communities. It means susceptibility to violence and often implies living in marginal or fragile environments, without access to clean water or sanitation." Source: Younus, Muhammad. "What is Poverty?" Muhammad Younus. Nobel Lecture, 2006. <https://www.nobelprize.org/prizes/peace/2006/younus/lecture/>.

Ahmed and Mujeri (2013) stated that the increasing impact of urbanisation, poor sanitation systems, and untreated industrial discharges pollute land and water bodies. However, the two types of reservoirs are related to each other. Contaminated surface water affects the health of poor people who cannot choose between contaminated and non-contaminated sources. Water-borne diseases¹⁶ are the leading cause of suffering for poor people living in rural and urban areas. This, combined with the water supply problem for bathing in both regions (especially for poor households), is a significant health problem for Bangladesh. This scenario is not only related to the management of solid waste but also to liquid waste maintenance. Poverty Reduction Strategy Paper Bangladesh (2013) stated,

“Most of the liquid wastes created by the industries in Dhaka are dumped directly or indirectly into the rivers Buriganga, Balu and Sitalakhya. Estimates show that pollution from tanneries in Hazaribagh is responsible for an increase in the health-related expenditure of people living in the vicinity of the tanneries by 125 US dollars per capita.” The situation is the same for a big city like Chittagong or Khulna.

A study by Rahman et al. (2013) found that more than half of the city's population lives in poverty. Furthermore, the study concluded that the lack of proper sanitation facilities is a major cause of water-borne diseases, such as cholera and diarrhoea, in the city. The study also noted that lacking solid waste management infrastructure has increased vector-borne diseases like malaria and dengue fever. In addition, the poor air quality in Dhaka¹⁷ is mainly due to the burning of solid waste and industrial missions¹⁸. This has resulted in several respiratory diseases, such as asthma and bronchitis.

The Relationship Between Waste Mismanagement and Health Hazards in Dhaka

Globalisation, with the advent of civilisation, has changed how people consume food and their daily necessities. The Industrialization Revolution¹⁹ symbolised human growth; the more industrialised, the better opportunity to open up new business principles. The industrial revolution or globalisation has not only given us advantages or options, but many have also brought with it many major complex problems, such as creating much waste every day, which was unimaginable before the industrial age. The concept of processed food was developed later. An increasing amount of waste is inevitable due to development activities (Hassan et al., 2008).

The Effects of Waste Materials on Human Health: Risks and Consequences

The waste type in Dhaka city generates both physical and chemical compositions,²⁰ including food waste, paper, plastics, glass, construction debris, and more. Solid waste is generated from multiple sources, including domestic waste with both organic (e.g., kitchen food waste) and inorganic (e.g., brooms, wrappers, electronic utilities) components (Ahmed, 2013).

Without an organised household waste disposal system, organic and inorganic wastes are indiscriminately dumped in and around residential areas, blocking canals and creating breeding grounds for mosquitoes and other insects. This improper waste management leads to the spread of infectious diseases such as malaria, elephantiasis, cholera, and hookworm, while also causing foul smells that affect residents (Hassan et al., 2008). Improving waste management practices and implementing organised waste disposal systems are essential to mitigate the risks and consequences of waste materials on human health in Dhaka city.

¹⁶ Water-borne diseases are those caused by pathogens transmitted through contaminated water sources. These diseases include cholera, typhoid, hepatitis A, and cryptosporidiosis.

Centers for Disease Control and Prevention. (2011). Waterborne Diseases. Retrieved May 21, 2013, from <http://www.cdc.gov/healthywater/hygiene/disease/index.html>.

¹⁷ Dhaka is the capital of Bangladesh and is a densely populated city with high levels of air pollution. The air quality in Dhaka is generally unhealthy, with an average Air Quality Index (AQI) of over 150, which the World Health Organization (WHO) considers unsafe for human health.

¹⁸ Industrial emissions in Dhaka are the pollutants released into the environment from industrial activities, such as manufacturing, power generation, and construction. These pollutants can include particulate matter, greenhouse gases, and hazardous and non-hazardous materials.

¹⁹ Frederick Engels, *The Condition of the Working-Class in England in 1844* (London: Penguin Books, 1987), p. 93.

²⁰ Physical composition refers to the physical characteristics of a substance and its physical properties, such as density, melting point, boiling point, electrical conductivity, and solubility. Chemical composition refers to the chemical elements and their relative proportions that are present in a substance.

“Fundamentals of Physical Chemistry” by Peter Atkins and Julio de Paula, which was published in 2006.

Occupational Health Hazards and Challenges Faced by Waste Workers in Dhaka

Workers²¹ in direct contact with waste management, especially those who collect, transport, and have the most significant exposure to toxic substances associated with solid waste, are at greater risk due to a lack of proper uniforms and waste sorting equipment. This population may suffer more severe adverse health effects than others and has been termed a susceptible subpopulation by some authors (Linares et al., 2009).

Addressing Health Disparities: The Impact of Solid Waste

The impact of solid waste on health disparities in communities underscores the urgent need for comprehensive strategies and interventions to address inequities in healthcare access and outcomes. In Dhaka's slums, inadequate sanitation facilities and poor waste management practices contribute to health disparities among residents. Unsanitary conditions arise from haphazard garbage dumping, makeshift toilets, and contamination of water sources during the monsoon season, posing significant health risks (Rajan, 2012).

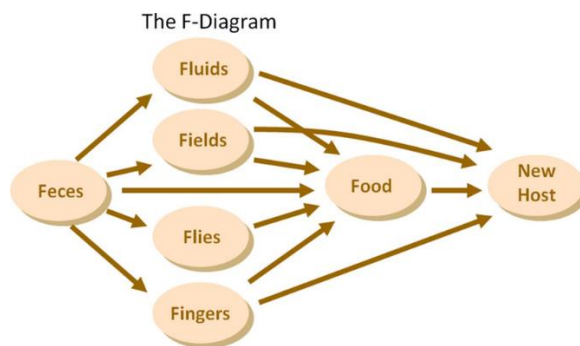
Globally, the lack of proper sanitation is a crisis affecting around one billion people, particularly in developing countries experiencing rapid urbanisation and slum expansion (Hutton, 2013). To address these health disparities, it is crucial to invest in improved sanitation infrastructure, raise public awareness about proper waste management, and foster collaboration among stakeholders (Rajan, 2012; Hutton, 2013). Implementing comprehensive solutions can mitigate the adverse health effects of solid waste and contribute to reducing health disparities in Dhaka's slums.

Public Health Concerns: Diseases Associated with Waste Contamination in Dhaka

The prevalence of diseases linked to waste contamination in Dhaka raises significant public health concerns and necessitates urgent attention and intervention. Okafor, P.O. et al. (2012), people are at risk when waste disposal is poorly managed, which directly impacts the health of city dwellers and the physical environment of a country. A recent study conducted by the Centres for Disease Control and Prevention (2011) has identified a range of diseases which can be transmitted through different pathways, including the faecal-oral route. The study has further identified an 'F-diagram' that illustrates the faecal-oral disease transmission pathways in detail.

"Human excreta and sewage, which can contaminate the environment, breed disease-vector insects, animal scavengers and rodents, and thereby cause various diseases through different routes of exposure such as faecal-oral and soil-transmitted processes."

Figure 12: The F-diagram shows the different faecal-oral transmission routes and possible barriers to preventing excreta-related pathogens from finding a new host.



Source: Wagner and Lanois, 1958

Wagner and Lanois (1958). © All rights reserved.

The 'F-Diagram' of faecal-oral diseases illustrates the transmission route of infectious diseases and highlights the various sources of contamination that affect human hosts. These sources include fluids, fingers, fomites, and flies that contaminate food (Luby et al., 2005).

A recent study by WHO (2012) emphasises the role of environmental factors in the transmission of faecal-oral diseases. Proper waste and sanitation management are crucial in preventing the spread of infectious agents and diseases. Open dumping of solid waste facilitates

²¹ M. M. Rahman and A. K. M. Azizul Hoque, "Occupational Health Risks in Solid Waste Management: A Study of Waste Pickers," International Journal of Occupational and Environmental Medicine, Vol. 4, No. 1 (2013), pp. 8–14.

disease transmission and creates favourable conditions for vector breeding and unpleasant odours. Developing countries must address the psychological health risks associated with waste management and its impact on the immediate environment (Khan et al., 2012). Overall, developing countries must prioritise the proper disposal of solid waste and effective sanitation management to prevent the transmission of faecal-oral diseases. Open dumping of waste can contribute to the spread of diseases while also posing psychological health risks. Addressing these challenges is essential for safeguarding public health and well-being.

Infectious Disease Data Analysis: Insights from Dhaka National Medical College (DNMC)

A comprehensive analysis of infectious disease data from Dhaka National Medical College (DNMC) provides valuable insights into the prevalence, patterns, and risk factors associated with infectious diseases, enabling informed decision-making for effective public health interventions in Dhaka.

Table 3: Communicable diseases, incidence one-year (Sept-'12-sept'13) paediatric department from Dhaka National Medical College (DNMC) centre

Diseases	Age	Slum	Tenements	Standard area	Number of patients
Mumps	Less than 12	935	490	15	1440
Measles	Less than 12	401	160	16	577
Chickenpox	Less than 12	42	6	0	48
Flue	Less than 12	3652	1905	203	5760
TB	Less than 12	181	12	0	193
Diarrheal diseases	Less than 12	3001	1415	294	4710

Source: Dhaka National Medical College (2013)

The above diagram²² summarises data from the paediatric department of Dhaka National Medical College (DNMC) for one year (Sept '12-Sept '13) regarding the incidence of communicable diseases. The table displays the name of the conditions, the age range of the patients, the number of patients in slum areas, tenements, and common areas, and the total number of patients. The data shows that the most common communicable diseases among children in this area were mumps, measles, chickenpox, flu, tuberculosis, and diarrheal. The highest incidence was among those living in slum areas, followed by those in tenements and common areas.

Enhancing Health, Efficiency, and Productivity through Effective Waste Management Practices

The economic growth of a nation is best realised when all of its population segments can maximise development. While not all population segments may pull equally, all must be involved. In Bangladesh, 70% of the population still needs to perform better, with most females remaining unemployed. Economic growth is not simply a matter of analysing statistics but must consider human development. Factors such as nutrition, financial indicators, and growth create an environment for individuals to succeed.

²² Data from the Paediatric Department of Dhaka National Medical College (DNMC), September 2012 to September 2013. The above diagram is a table of data which provides the incidence of communicable diseases among children aged less than 12 years, in the paediatric department of Dhaka National Medical College (DNMC) over a one-year period, from September 2012 to September 2013. Specifically, the table shows the number of patients with mumps, measles, chickenpox, flu, TB and diarrheal diseases in slums, tenements and standard areas.

Economics is simple if human development and related factors are given more attention than statics. IQ²³ and EQ²⁴ rise vertically when nutrition, financial indicators and growth increase. Therefore, economic growth should consider various infrastructure-related factors, such as a healthy environment, physical and mental stability, a balanced diet, safe water, and rigorously planned waste management, to maximise human development and economic growth. (Vishwanath, T., 2012).

Collaboration and Integration of Departments in DNMC: A Case Study of Medicine and Dermatology and Venereal Diseases

The case study of the Department of Medicine and the Department of Dermatology and Venereal Diseases at DNMC in 2013 exemplifies the benefits of collaboration and integration between medical specialities, leading to improved patient care, enhanced diagnostic capabilities, and comprehensive management of dermatological and venereal diseases.

Table 4: Department of Medicine, DNMC, Department of Dermatology and venereal diseases

Diseases	Male	Female	Age	Slum	Tenements	Standard area	Number of patients
DOTS	392	118	More than 25	392	118	0	510
Gonorrhoea	864	78	More than 22	786	78	0	864
Genital Wart	57	39	more than 26yrs	82	14	0	96
Syphilitic cancrroid	703	65	more than 32 years	605	163	0	768

Source: Dhaka National Medical College (2013)

The table provides data on the number of male and female patients with three different diseases in different areas. The first column lists the diseases: DOTS (short course of directly observed treatment), gonorrhoea and genital warts. The second and third columns list the total number of male and female patients with each disease, respectively. The fourth column indicates the age of affected patients. The fifth and sixth columns list the number of patients with each disease in slum areas and houses, respectively.

The seventh column indicates the number of patients with each disease in the common area, which is zero for all three diseases. The final column lists the total number of patients with each condition. Data showed that male patients were more affected than female patients for each disease, and most patients were found in slums and tenement areas DOTS - Direct treatment and short course monitoring for TB, WHO- DNMC from September 2012 to September 2013.

Unveiling the Mental Health Emergency in Dhaka's Slums

A 2012 report by the World Health Organization (WHO) titled "Health and Development in Bangladesh" highlighted the existing health challenges in urban slums, including poor sanitation, limited access to primary healthcare, and inadequate nutrition. These factors significantly contribute to high infant mortality and low literacy rates among slum dwellers. Furthermore, the absence of vocational education, illiteracy, and lack of proper sanitation and disease prevention measures have facilitated the spread of diseases, with open pit latrines in urban slums being a major contributing factor (WHO, 2012).

²³ IQ (Intelligence Quotient): IQ is a score derived from a standardized intelligence test that is used to measure a person's cognitive abilities in comparison to the population as a whole. "IQ, Intelligence Quotient." Encyclopedia of Mental Disorders. Ed. Matthew M. White. 2nd ed. Vol. 2. Detroit: Gale, 2011. 731-732. Gale Virtual Reference Library. Web. 28 Nov. 2012.

²⁴ EQ (Emotional Quotient): EQ is a measure of a person's emotional intelligence and is often used to assess one's ability to recognize, understand and manage emotions. "Emotional Intelligence." Encyclopedia of Mental Disorders. Ed. Matthew M. White. 2nd ed. Vol. 2. Detroit: Gale, 2011. 732-734. Gale Virtual Reference Library. Web. 28 Nov. 2012.

Contextualising the Crisis

The stark reality of the situation is best exemplified by Taslima Masood, a resident of the Korail slum, who faces a dilemma each morning: either prepare food and risk getting sick or remain hungry. This reality was highlighted in a recent interview published by Star News.com (2012, p. A13).

“The kitchen is so close to the toilet,” she says. “When I cook, I cannot smell the curry, but I can smell the toilet. It disgusts me every day, but there is nothing I can do except . . . not cook. Moreover, I have to cook. “I do not want to live like this ... who wants to?”

The dire situation requires immediate attention and action from local governments, aid organisations and international bodies.

Enhancing Health, Efficiency, and Productivity through Effective Waste Management Practices

The economic growth of a nation is best realised when all of its population segments can maximise development. While not all population segments may pull equally, all must be involved. In Bangladesh, 70% of the population still needs to perform better, with most females remaining unemployed. It is clear that economic growth is not simply a matter of analysing statistics but must consider human development. Factors such as nutrition, financial indicators, and growth create an environment for individuals to succeed.

Economics is simple if human development and related factors are given more attention than statics. IQ²⁵ and EQ²⁶ rise vertically when nutrition, financial indicators and growth increase. Therefore, economic growth should consider a range of infrastructure-related factors, such as a healthy environment, physical and mental stability, a balanced diet, safe water, and rigorously planned waste management, to maximise human development and its resulting economic growth. (Vishwanath, T., 2012).

Addressing the Mental Health Crisis

Resolving the mental health crisis in Dhaka's slums requires a comprehensive approach that combines various strategies:

Increased Access to Mental Health Services: Efforts should be made to provide accessible and affordable mental health services within the slum areas, including counselling, therapy, and psychiatric care.

Awareness and Education: Initiatives aimed at raising awareness about mental health, reducing stigma, and promoting self-care practices should be implemented among slum dwellers, community leaders, and healthcare providers.

Capacity Building: Training programs should be conducted to enhance the skills of healthcare workers and community volunteers in identifying and addressing mental health issues. This can enable early intervention and support for individuals in need.

Collaboration and Partnerships: Collaboration between government agencies, non-governmental organisations, and community-based organisations is crucial for implementing sustainable solutions, resource mobilisation, and coordinated efforts to tackle the mental health crisis.

Socioeconomic Empowerment: Efforts to improve the socioeconomic conditions of slum dwellers, such as providing vocational training, job opportunities, and access to basic amenities, can have a positive impact on mental well-being.

Enhancing Solid Waste Management through the Participation of NGO/CBO/Private Organizations

Collaborative efforts between NGOs, government entities, and private organisations have shown promise in enhancing solid waste management in Dhaka. Initiatives such as the Dhaka Metropolitan Solid Waste Management project, implemented with support from the World Bank and NGOs, have improved infrastructure, provided technical assistance, and built capacity for effective waste management. Waste Concern and ESDO are successful organisations that have created economic opportunities and improved living standards through waste management activities. Awareness programs conducted by NGOs like Janno Nagrik (Sujan) of Shushashona

²⁵ IQ (Intelligence Quotient): IQ is a score derived from a standardized intelligence test that is used to measure a person's cognitive abilities in comparison to the population as a whole. "IQ, Intelligence Quotient." Encyclopedia of Mental Disorders. Ed. Matthew M. White. 2nd ed. Vol. 2. Detroit: Gale, 2011. 731-732. Gale Virtual Reference Library. Web. 28 Nov. 2012.

²⁶ EQ (Emotional Quotient): EQ is a measure of a person's emotional intelligence and is often used to assess one's ability to recognize, understand and manage emotions. "Emotional Intelligence." Encyclopedia of Mental Disorders. Ed. Matthew M. White. 2nd ed. Vol. 2. Detroit: Gale, 2011. 732-734. Gale Virtual Reference Library. Web. 28 Nov. 2012.

have also promoted the importance of proper waste management and reduction. These collaborative endeavours have the potential to address waste disposal challenges, encourage sustainability, and protect the environment while improving public health outcomes in Dhaka.

NGOs and CBOs in Dhaka have significantly contributed to solid waste collection and management, vital in promoting efficient practices and community engagement. They focus on improving infrastructure, providing technical assistance, and raising awareness about proper waste management. While the government is responsible for most waste collection, NGOs and CBOs collect waste and recyclable materials from households and street vendors. However, there is a need to enhance their capacity and financial resources. The study suggests that the government should provide more support to these organisations in their waste collection efforts.

A Case Study of JICA (2005)

The case study of JICA's involvement in promoting the participation of NGO/CBO/Private organisations in the collection of solid waste showcases the effectiveness of collaborative efforts in addressing waste management challenges, fostering community engagement, and achieving sustainable and environmentally friendly solutions in line with international development goals.

The Local Government Engineering Department (LGED) has implemented various pilot projects in Dhaka since 2013 to improve the existing waste management infrastructure in collaboration with the Government of Bangladesh and various NGOs. These pilot projects include waste segregation, composting and collection. Dhaka Ahchaniya Mission (DAM) NGO²⁷ has managed solid waste since 2013. They have implemented various projects such as Community-Based Solid Waste Management (CBSWM) project and Dhaka Solid Waste Management and Recycling (DSWMR) project. These two projects focused on improving existing waste collection systems, creating awareness about waste management and providing technical assistance.

Bangladesh Environmental Lawyers Association (BELA) has been involved in solid waste management in Dhaka since 2013. They have provided legal aid to communities affected by waste management issues, advocating for better policies and organising public awareness campaigns.

A Review on the New Development: Insights from Studies and Reviews

New developments in solid waste management (SWM) in Bangladesh can be organised as follows:

The Transition of the Waste Collection System

The transition of the waste collection system represents a pivotal moment in addressing the shortcomings of traditional waste management approaches, as it entails implementing innovative technologies, redefining operational strategies, and fostering community participation to achieve a more efficient, sustainable, and inclusive waste management system.

Target Waste Categories for Effective Waste Management: Municipal Solid Waste, Commercial Waste, and Medical Waste

Identifying municipal solid, commercial, and medical waste as target waste categories within this master plan highlights a comprehensive approach towards efficient waste management, encompassing various waste streams and emphasising the need for appropriate strategies and solutions for each type to achieve sustainability. Waste Management Results. The table below lists the three waste categories that make up the target waste for this master plan: municipal solid waste, commercial waste, and medical waste. The master plans of Dhaka South City Corporation (DSCC) and Dhaka North City Corporation (DNCC) include effective waste collection systems, increasing landfill capacity, public awareness, community-based waste management and capacity building of stakeholders. There are concerns about the future of the Master Plan due to the withdrawal and partial implementation of the DNCC (Jerin et al., 2022).

²⁷ Overall, NGOs have been involved in pilot projects and solid waste management in Dhaka. They provided technical assistance, capacity building, legal support and public awareness campaigns to improve existing infrastructure and create awareness about proper waste management.

Collaboration with Japan International Cooperation Agency (JICA)

In 2005, the Japan International Cooperation Agency (JICA) initiated a master plan to enhance Dhaka city's SWM capacity and management skills. The project aimed to address the need for more regulatory administration and laws for waste management (Proadhan & Kaeser, 2020).

3R (Reduce, Reuse and Recycle) Action Plan for City Corporation of Bangladesh

2010 Bangladesh's Department of Environment (DoE) adopted the 3R strategy (reduce, reuse, recycle) to promote sustainable waste management practices. Despite some reforms and initiatives, Bangladesh's overall waste management system needs comprehensive and consistent waste reduction, recycling, and disposal systems, particularly in cities like Dhaka. The implementation of waste management practices has been hindered by factors such as limited public awareness, inadequate infrastructure, and insufficient resources. The National 3R Strategy formulated in 2010 aimed to reduce waste and promote recycling but faced challenges in implementation due to a lack of monitoring and coordination among responsible agencies. To overcome these challenges, increased monitoring, coordination, and clear responsibilities among agencies involved in waste management are necessary. Public awareness and education on waste segregation and recycling should be prioritised, along with infrastructure development and adequate funding. Collaboration between government agencies, local communities, the private sector, and civil society organisations is essential for establishing an effective and sustainable solid waste management system in line with global standards.

Construction of Waste Management Plants

The DoE launched a program to construct two waste management plants—one in Matuail (Dhaka South City Corporation) and another in Amin Bazar (Dhaka North City Corporation). These plants aim to produce compost fertiliser from solid waste collected in different parts of Dhaka, with a daily production capacity of 20 tonnes per plant.

Establishment of Secondary Transfer Stations (STS)

The construction of 52 STS in Dhaka North City Corporation has helped remove large quantities of waste containers from roads, improving traffic conditions. However, progress in constructing STS in Dhaka South City Corporation has been slower, with only 12 completed out of the planned 45.

Coordination of Primary Waste Collection

The Primary Waste Collection Service Provider (PWCSP), an NGO, coordinates household waste collection with the STS. In 2016-17, 340 private operators were registered with PWCSP, but there are also unregistered operators involved in waste collection.

Review of Progress and Future Outlook

The progress of solid waste management policy implementation in Dhaka shows the need for a modern and environmentally friendly approach. Current waste management practices pose health and livelihood risks. The success of the waste-to-energy project and adherence to the master plan will determine the future of waste management in Dhaka (Jerin et al., 2022). However, Dhaka's waste management situation requires more modern and eco-friendly methods to address the existing challenges effectively.

Methodology

This study employed a mixed method combining qualitative²⁸ and quantitative approaches to collect and analyse data. Data were gathered through semi-structured interviews, questionnaires, and secondary data analysis. Multiple data sources were utilised, including an extensive literature review and a purposive sample of interviewees from different socioeconomic backgrounds, including the workforce involved in waste management and affected population groups. Additionally, a cross-sectional survey was conducted among 200 slum households in Dhaka, specifically in the Korail, Mohakhali, and Kamrangirchar areas, selected based on their size, population

²⁸ Qualitative methods: Qualitative methods are research techniques that involve collecting, analysing, and interpreting non-numerical data (such as observations, interviews, and surveys) in order to gain an understanding of a particular phenomenon. Guba, E.G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational Communication and Technology*, 29(2), 75-91.

density, and accessibility. A structured, closed-ended, open-ended questionnaire was administered to collect data on waste management practices, health status, and socio-economic conditions. Descriptive and inferential statistics were employed for data analysis.

Ethical Consideration

This research study adhered to the ethical principles and guidelines outlined by the International Committee of Medical Journal Editors (ICMJE), the Belmont Report, and the Declaration of Helsinki as appropriate for research involving human participants. Formal, prospective approval from an independent ethics committee, specifically the Institutional Review Board or Human Subjects Review Committee, was obtained before the commencement of the study. This study adheres to ethical principles by prioritising the protection of human subjects and benefiting vulnerable communities exposed to waste-related health risks (Kothari, 2004). Ethical approval was obtained, and guidelines for responsible research conduct were developed to maintain high ethical standards throughout the study. Measures were taken to ensure that the benefits outweighed the risks for participants, and privacy and confidentiality were strictly upheld (World Medical Association, 2013). The research was further designed to benefit society while justifying potential risks to participants by expected benefits, aligning with the principles outlined in the Nuremberg Code²⁹.

Informed consent was obtained, respecting participants' autonomy and providing them with a clear understanding of their rights (Connelly, 2014). Cultural beliefs and practices were respected to avoid infringing upon participants' values (Connelly, 2014). Precautions were taken to prevent harm to participants and the community, and the waste management practices investigated did not pose risks to public health or the environment (World Medical Association, 2013). The study also emphasised avoiding exploitation and coercion, aiming to benefit society while justifying potential risks with expected benefits (Giordano et al., 2007). Overall, this study demonstrates a commitment to ethical principles, ensuring the well-being of participants and maximising the study's potential benefits.

Limitations

The study encountered several limitations that should be acknowledged. One primary limitation was the lack of financial support from the Dhaka City Corporation (DCC), necessitating self-funding, which affected the sample size and data quality. Access constraints for security reasons resulted in limited face-to-face interviews and data collection from specific populations. The collected data also had limitations such as multi-selectivity, a limited number of questions, and specificity. A mixed methodological approach was employed to mitigate these limitations, maintaining regular contact with hospital staff and doctors and conducting power analysis for future research. These limitations should be considered when interpreting and generalising the study findings. For future studies, a sample size of 86 participants (43 in each group) would be required to achieve a significance level of $\alpha = 0.05$. More extended follow-up studies would confirm results at 6 and 12, potentially revealing outcome variations.

Research Finding

This study conducted semi-structured interviews with 111 randomly selected participants in Dhaka city to assess the state of solid waste management and its impact on health. A systematic approach involved questionnaires, data inspection, cleaning, transformation, evaluation, and modelling. The survey included general questions about the respondents' demographics, occupations, and access to cleaning and waste disposal services. The study found that most middle- and upper-income households had regular waste disposal services, while slum dwellers faced poor waste management. Slum residents reported adverse health effects, including reduced immunity, malnutrition, chronic diseases, and anaemia, which decreased their economic productivity and income. The findings emphasise the need for improved waste management and health conditions in slum areas to enhance economic productivity and quality of life. It calls for investment in infrastructure and programs to improve waste management and provide healthcare and nutrition services in these communities.

Discussion

Solid waste management in Dhaka, Bangladesh, is inadequate and poses significant threats to public health and poverty alleviation, particularly for vulnerable populations (Haque & Alam, 2012). While some initiatives have been taken by the government and the Dhaka City Corporation (DCC, 2013), there needs to be more financial, human, and technical capacity to address the problem effectively. Poor waste management directly impacts environmental health, poverty alleviation, and economic development, leading to air and water pollution, soil contamination, and health risks (UNEP, 2012). Inadequate waste management can also hinder productivity, investment

²⁹ See, Nuremberg Code. https://research.unc.edu/human-research-ethics/resources/ccm3_019064/

opportunities and increase health costs, affecting economic development (Smart et al., 2013). To address these challenges, raising awareness, education and developing financial resources for effective policies and programs targeting vulnerable populations is crucial (World Bank, 2011). Collaboration between local and national governments, communities, and the private sector is necessary for successful implementation. Human development and economic growth are interconnected, emphasising the importance of holistic approaches and attention to factors such as health, nutrition, and waste management (UNESCO, 2011; World Bank, 2012; OECD, 2011; Klugman, 2011; ILO, 2011; UNICEF, 2012; Kandyala et al., 2011; DfID, 2012).

Conclusion and Recommendation

The study on solid waste management in Dhaka revealed that much of the city's solid waste is not managed correctly, posing a severe threat to public health and poverty alleviation. It also highlighted the potential adverse effects of improper solid waste management on public health and the environment, such as water pollution, air pollution, increased risk of vector-borne diseases, and reduced access to basic sanitation facilities. To improve Dhaka's solid waste management system and help reduce poverty, supportive strategies such as individuals and local bodies can be formed to pick up plastic bags in exchange for affordable fees, collected bags can be dumped in zonal centres, inorganic waste can be recycled into fresh raw materials, polyethene can be recycled into new raw materials, paper waste can be produced in paper mills, and bio waste can be used to generate electricity by mixing with cow dung. This study found that most middle- and upper-income households enjoyed the 6-day waste disposal service, while some had mixed opinions. It is recommended that the Bangladesh government take comprehensive steps to improve solid waste management in slums and poor areas of Dhaka, including investing in education and training for waste management professionals, creating infrastructure, and increasing public awareness.

The government should create a comprehensive waste management plan in slum areas, coordinate with NGOs and local governments, secure international funding offers, and monitor their efforts to ensure successful implementation. These initiatives can reduce health hazards, control pollution, and lower the disease curve, leading to income-generating investments, job creation, and a healthy and motivated nation. To do this, the government should develop and implement a comprehensive waste management strategy, strengthen the capacity of local government and other stakeholders, create greater awareness among citizens, increase investments in waste management infrastructure, introduce incentives for waste segregation and recycling, support vulnerable populations, encourage research and innovation, and monitor and evaluate the implementation of waste management strategies.

References

- Ahmed, M. (2013). Bangladesh: Rapid urbanisation, disproportionate to per capita income, brings alarming density of slum population. *International Journal of Humanities and Social Science*, 3(4), 10–12.
- Akash, M., Jesmin, A., Tamanna, T., & Kabir, R. (2018). The Urbanization and Environmental Challenges in Dhaka City. *Social Science Research Network*. <https://doi.org/10.2139/ssrn.3152116>
- Alam, M., Hoque, M., Rahman, M., & Riah, M. (2013). Solid Waste Management in Dhaka City. *Waste Management & Research*, 31(10), 1041-1048. doi:10.1177/0734242X13504077
- Alam, O., & Qiao, X. (2020). An in-depth review on municipal solid waste management, treatment and disposal in Bangladesh. *Sustainable Cities and Society*, 52, 101775.
- Al-Muyeed, A. (2011). Dhaka City Map. Retrieved from <http://www.maps-of-bangladesh.com/dhaka-city-map.html>.
- Andrews, C. T. (2004). Water in Asian cities: utility performance and civil society views (No. 10). Asian Development Bank.
- Angeles G, Quimbo S, Tan S, and Subbarao K (2009). "Dhaka City Corporation Slum Population: Lorenz Curve," Bangladesh Institute of Development Studies.
- Azom, M. F., K. M. M. Hossain, M. R. U. Khan, M. N. Hossain, and M. B. Hossain. (2012). "Characterization of Solid Waste of Dhaka City: A Case Study." *Waste Management & Research*, 30(9), 872–81. <https://doi.org/10.1177/0734242X12455566>.

Banks, N. (2012). Urban poverty in Bangladesh: Causes, consequences and coping strategies. University of Manchester, BWPI Working Paper, p. 178.

BBS: Bangladesh Bureau of Statistics (FY 2012–2013) 4 APO, 2007 (<http://www.apo-tokyo.org/publications/fil>)

Climate and Clean Air Coalition. (2012). Solid Waste Management in Dhaka, Bangladesh. Retrieved from http://www.ccacoalition.org/sites/default/files/SWM_in_Dhaka_Bangladesh_2012.pdf.

Connelly, L. M. (2014). Ethical considerations in research studies. *Medsurg Nursing*, 23(1), 54-56.

DCC. (2013). Dhaka City Corporation. Retrieved from <https://www.dhakacitycorporation.gov.bd/>.

DfID (2012) Joint Monitoring for Human Development. Retrieved from <https://www.dfid.gov.uk/about-us/human-development/joint-monitoring-for-human-development/>.

DoE. (2010). National 3R Strategy for Waste Management. Ministry of Environment and Forest Government of the People's Republic of Bangladesh. Retrieved from <https://faolex.fao.org/docs/pdf/bgd190976.pdf>.

Dyer, C. (2013). *Waste: Understanding and managing environmental pollution*. London: Routledge.

Esdo. (n.d.). We Seek an Equitable Society free from all Discrimination. Retrieved from <https://web.esdo.net.bd/2.0/portal/?ref=home>.

Giordano, J., O'Reilly, M., Taylor, H., & Dogra, N. (2007). Confidentiality and autonomy: The challenge (s) of offering research participants a choice of disclosing their identity. *Qualitative health research*, 17(2), 264–275.

Gonzalez, J. (2011). Poverty and waste management: A vicious circle. *Waste Management & Research*, 29(5), 482-491.

Haddad, L., Ruel, M. T., & Garrett, J. L. (1999). Are urban poverty and undernutrition growing? Some newly assembled evidence. *World Development*, 27(11), 1891-1904.

Hai et al. (2002). A Study on Solid Waste Management System of Dhaka City Corporation: Effect of Composting and Landfill Location.

Haque, M. E., & Alam, K. (2012). Solid waste management in Dhaka, Bangladesh: Problems and prospects. *Waste Management & Research*, 30(6), 547-556. doi: 10.1177/0734242X12452928

Hossain, S. (2008). Rapid Urban Growth and Poverty in Dhaka City. *Bangladesh e-journal of sociology*, 5(1).

howdhury, M.H.I., 2007. Solid waste service delivery for slum areas through strengthening partnership between local government and NGOs. Unpublished PhD Thesis, Submitted to University of Technology, Berlin.

Hutton, G. (2013). Sanitation crisis in megacities: The case of Dhaka. *World Health Organization*, 24(2), 39–45. doi:10.1186/1475-9276-24-2.

ILO (2011) Economics and Human Development. Retrieved from <https://www.ilo.org/public/english/region/afpro/abidjan/publ/econdev/econdev.htm>.

Iyengar, S., & Dholakia, R. H. (2012). Access of the Rural Poor to Primary Healthcare in India. *Review of Market Integration*, 4(1), 71–109. <https://doi.org/10.1177/097492921200400103>

Jerin, D. T., Sara, H. H., Radia, M. A., Hema, P. S., Hasan, S., Urme, S. A., ... & Quayyum, Z. (2022). An overview of progress towards implementation of solid waste management policies in Dhaka, Bangladesh. *Heliyon*, e08918.

Jerin, M., Rashid, M. M., Hossain, S., & Haque, A. (2022). Assessment of environmental and health impacts due to improper solid waste management in Dhaka City, Bangladesh. *Sustainable Cities and Society*, 75, 103468.

JICA. (n.d.). Solid Waste Management Project (II) | Our Work. Retrieved from https://www.jica.go.jp/english/our_work/social_environmental/id/america/peru/c8h0vm000090rmwx.html.

Kandyala, R., Raghavendra, S. P. C., & Rajasekharan, S. T. (2010). Xylene: An overview of its health hazards and preventive measures. *Journal of Oral and maxillofacial pathology: JOMFP*, 14(1), 1.

Khan, M. M., Rahman, M. M., Islam, M. S., et al. (2012). Waste management and its direct contact with the immediate environment. World Health Organization.

Klugman, J. (2011). Human Development Report 2011. Sustainability and Equity: A better future for all. UNDP-HDRO Human Development Reports.

Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.

Kundu, C. A. (2009). Waste disposal in Dhaka, Bangladesh: A breakdown. Retrieved from https://www.researchgate.net/publication/333686172_Waste_Disposal_in_Dhaka_Bangladesh_A_Breakdown.

Linares, E., Muñoz-Lobato, F., & Morales, M. (2009). Waste management and workers' health: A risk assessment approach. *International Journal of Occupational Safety and Ergonomics*, 15(4), 439-457.

Luby, S. P., Agboatwalla, M., Painter, J., Altaf, A., Billhimer, W. L., & Hoekstra, R. M. (2005). Environmental enteric dysfunction: the new face of childhood malnutrition and growth faltering in developing countries. *Paediatrics*, 115(2), 226-236. doi:10.1542/peds.2004-1460

Memon, A. (2002). Solid waste management: A critical review. *Environmental Management*, 29(4), 429-445. doi:10.1007/s00267-002-2777-2

OECD (2011) Human Development and the Environment. Retrieved from <https://www.oecd.org/environment/outlook/human-development-and-the-environment.htm>.

Okafor, P. O., et al. (2012). Introduction to the Principles and Concepts of Waste Management. *International Journal of Environmental Research*, 5(3), 661-670. doi:10.3390/ijerph5030661

Prodhan, A. H. M. S. U., & Kaeser, A. (2020). Solid Waste Management in Dhaka City—A Review on the Present Status and Possible Solutions. *Nature Study Society of Bangladesh*.

Rahman, S. S., Shams, S., & Mahmud, K. (n.d.). *Bangladesh Centre for Advanced Studies (BCAS), Dhaka, Bangladesh* Department of Civil and Environmental Engineering, *Islamic University of Technology (IUT)* Board Bazar, Gazipur-1704, Bangladesh.

Rahman, S., Talukder, M. S., Rahman, M., Chowdhury, M. F., & Rahman, M. M. (2013). Poverty and health in urban Bangladesh: A case study of Dhaka city. *International Journal of Humanities and Social Science*, 3(15), 200-209.

Rajan, M. (2012). Sanitation and water supply in Indian cities: Challenges and opportunities. *The Indian Journal of Public Health*, 56(4), 262-267. <https://doi.org/10.4103/0019-557X.107068>

Roy, H., Alam, S. R., Bin-Masud, R., Prantika, T. R., Pervez, Md. N., Islam, Md. S., & Naddeo, V. (2022). A Review on Characteristics, Techniques, and Waste-to-Energy Aspects of Municipal Solid Waste Management: Bangladesh Perspective. *Sustainability*, 14(16), 10265. Retrieved from <http://dx.doi.org/10.3390/su141610265>.

Smart Cities Council. (2013). Solid Waste Management. Retrieved from <http://www.smartcitiescouncil.com/initiatives/solid-waste-management>.

Star News. (2012, October 21). Interview with Taslima Masood of Korail slum. Star News. "Kitchen too close to toilet disgusts renter." *The Straits Times*, p. A13.

Tabassum, R. (2012). Impact of Malnutrition-Based Anemia, Intestinal Helminths, Tuberculosis, Infectious Diseases, and Sexually Transmitted Diseases on Human Development. *International Journal of Environmental Research and Public Health*, 9(3), 1002-1017. doi:10.3390/ijerph90301002

UNDP. (2013). Voices from the Slums: Challenges and Opportunities for Economic Participation in Urban Bangladesh. United Nations Development Programme.

UNESCO. (2011). Waste Management. Retrieved from <http://www.unesco.org/new/en/natural-sciences/environment/waste-management/>.

UNICEF (2012). Financial index, nutrition & growth. Retrieved from <https://www.unicef.org/socialpolicy/index.html>.

UNICEF Bangladesh [Shaheen Anam]. (1993). Staying Alive: Urban Poor in Bangladesh. Google Books. Retrieved August 9, 2013, from https://books.google.com.bd/books/about/Staying_Alive.html?id=DnU0zgEACAAJ&redir_esc=y.

United Nations Department of Economic and Social Affairs. (2013). World urbanization prospects: The 2012 revision [Data set]. Retrieved from <https://esa.un.org/unpd/wup/CD-ROM/>.

Virgin Islands Waste Management Authority (VIWMA). (2009). Liquid Waste. Retrieved March 19, 2021, from <http://www.viwma.org/what-is-liquid-waste.html>.

Virgin Islands Waste Management Authority (VIWMA). (2011). Hazardous and Non-Hazardous Waste. Retrieved March 19, 2021, from <http://www.viwma.org/hazardous-and-non-hazardous-waste.html>.

Vishwanath, T. (2012). Human Development in Bangladesh: Challenges and Prospects. *International Journal of Interdisciplinary Social Sciences*, 6(4), 119–129. doi:10.18848/2156-5611/GCP/v06i04/44624

World Bank. (2011). Waste Management in Dhaka: An Overview. Retrieved from <https://www.worldbank.org/en/news/feature/2011/11/10/waste-management-in-dhaka-an-overview>.

World Bank. (2012). Overview of Solid Waste Management. Retrieved from <http://www.worldbank.org/en/topic/urbandevelopment/brief/overview-of-solid-waste-management>.

World Health Organization. (2012). Infectious agents and parasites for faecal-oral diseases. Retrieved from https://www.who.int/water_sanitation_health/diseases/fecaloraldis/en/.

World Health Organization. (2012). Prevention and Management of Infectious Waste. Retrieved from https://www.who.int/water_sanitation_health/medicalwaste/en/.

World Medical Association. (2013). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *Jama*, 310(20), 2191-2194.