

## Effect of solid waste disposal in Benadir Marine Environment, Somalia

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### Abstract

Somalia's coastal region, home to approximately 6 million residents, faces a significant litter problem, worsened by inadequate waste management infrastructure due to years of civil unrest. Each of these coastal residents generates approximately 0.6 kg of solid waste per day, adding up to an alarming 3.5 million kg daily. Notably, more than 320,000 kg of this waste consists of plastic, with over 270,000 kg being improperly managed. This study specifically focuses on Benadir, a coastal region containing Somalia's highest population density, and highlights the consequences of poor waste disposal practices in its marine environment. Without proper classification or consideration of its origins and type waste, dumping leads not only to coastal pollution but also poses health risks for those living nearby. The GIS techniques of data Acquisition and observational were utilized in this research for the mapping and framing the coastal population and waste disposal in vulnerable sites. Two major locations in Benadir have been identified as particularly problematic due to their damaging effects on both the coastal populace and the area's aesthetics. By examining the pressing issue of solid waste disposal in Benadir's marine environment, this study aims to assess the effect of solid waste disposal on the Benadir marine environment and propose sustainable solutions to mitigate its impact

**Keywords:** Plastic wastes; Marine Litter; Coastal Pollution; Marine Solid waste; Benadir Region.

### 1. Introduction

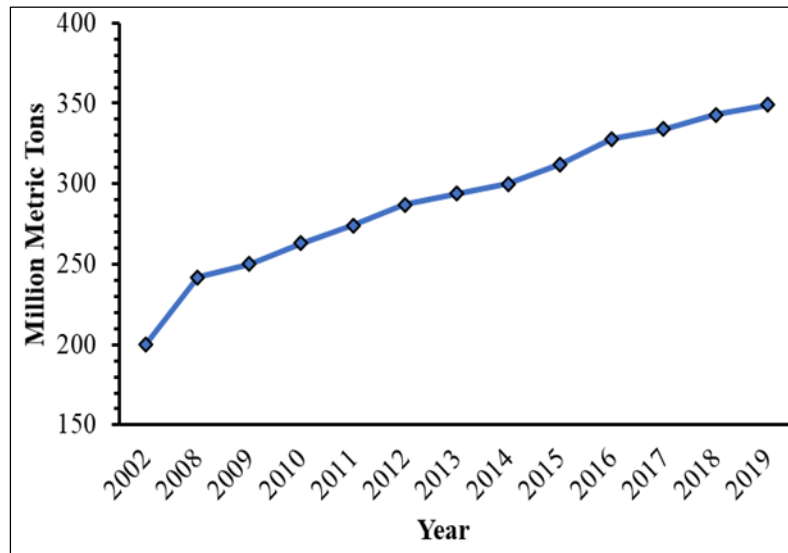
The effect of disposed waste in the marine environment is dramatically increasing and the dumping of wastes into the sea shores is getting considerable attention due to its consequences in marine animals. The world's Annual plastic production has increased substantially, from 1.5 million in the 1950s to an approximate of 299 million in 2013. However, less than 10% of the plastic garbage produced worldwide has so far been recycled. The other material was simply dumped in landfills and our oceans, with incineration accounting for a slightly bigger share (12%). Somalia which ranks the bottom of the environmental performance index has no formal recycling of wastes neither there is a waste distinction due to its nature. Most of the wastes produced are dumped pits beside the sea shore regardless of their hazardousness or incinerated the outskirts of the city [1].

Plastic is already a common material in Somalia, used for everything from food packaging to eating utensils. The use of plastics in the pharmaceutical and cosmetic industries is currently growing in popularity, and the standard method of recycling wastes has not yet been implemented. Through poor management and improper disposal of sewage and plastic wastes, coastal landfill operations, and litter carried through streams, plastics from landfills enter the ocean [2]. If not, the plastic produced by the cosmetics corporate in Somalia adopt systematic and conventional way of handling

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waste, and the majority of it finds its way into sewage systems and water currents that travel to the ocean. Many marine creatures have perished as a result of this. It is estimated that 5.25 trillion micro and Nano plastics pollute the world's marine Environment, and oceans act as a sink for these particles [3].

The amount of disposed wastes in Somalia is unidentified but from the sharp increase of the estimates of waste plastic production in the world the disposal of wastes in Somalia is likely to surge in the last decade. As depicted in the graph plastic wastes produced around the globe accounted approximately 350 million metric tons in the year 2019. Most of those wastes find their way to the sea pollute it and endanger marine animals [4].



**Figure 1** Global Plastic production [4].

### 1.1. Nature of solid waste

Solid waste is a regular byproduct of human activity that is produced in large quantities. Several items made of plastic that people utilize each day are regarded as single-use, practical, and disposable. Plastics therefore make up a significant portion of garbage, and significant amounts are currently collecting as marine litter [5]. According to reports, plastic marine debris is thought to make up 75% of all litter in the ocean and is piling on beaches [6], on the shorelines of even the most distant islands [7], at the sea surface [8], in the deep sea [9], and in arctic sea ice [10]. Marine plastic debris was initially recognized as a potential global threat to the marine environment in the 1980s, about 30 years after the beginnings of mass production. Little floating debris that was caught in surface-towing plankton nets was one of the earliest types of plastic debris to be reported in the ocean [11].

### 1.2. Consequences of wastes in Benadir, Mogadishu

Waste disposal in the Somali marine environment has been a growing concern for both public health and marine biodiversity conservation. With rapid urbanization and population growth, particularly in Benadir, Mogadishu, the issue of waste management is becoming increasingly critical. Inadequate waste disposal practices in Benadir, Mogadishu have led to significant health consequences among its population. The coastal communities face a higher risk of exposure to diseases, as they rely on the heavily polluted water for their day-to-day activities. The picture demonstrates solid wastes washed up on the shore of Wadajir district of Mogadishu, Benadir.

Poor waste management has resulted in severe marine pollution, posing a threat to marine biodiversity. Solid waste materials such as plastic bottles, bags, food containers, tires, metals, and other household debris are frequently dumped directly into the ocean that flow into the ocean. The waste disposal crisis in Somali marine waters, particularly in Benadir, Mogadishu, is a pressing concern. As the urban population grows, so does the urgency to address these health and marine pollution issues. A robust waste management policy and framework must be implemented to preserve the region's natural resources and protect public health.



**Figure 2** Solid wastes washed up on the shore of wadajir



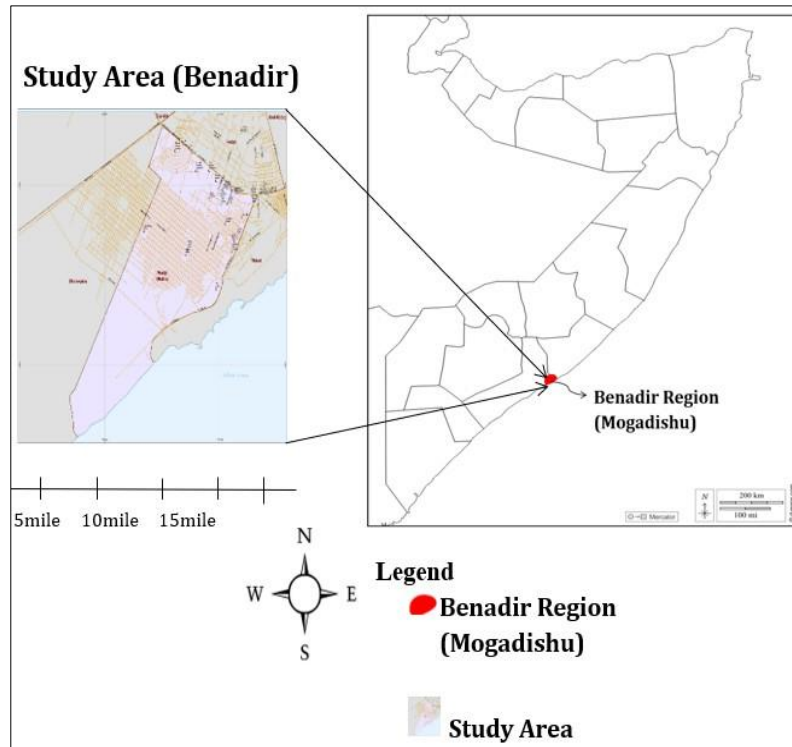
**Figure 3** Dumped Plastic Wastes in wadajir shore

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## **2. Methodology**

### **2.1. Study area**

The study area for this research is the Benadir region in Mogadishu, the bustling capital city of Somalia. As the most populated city in the nation, Mogadishu is home to over two million residents. The city is situated in the southern part of the country and boasts a moderate climate. A significant portion of its residents reside along the coastline, where they enjoy easy access to breathtaking beaches. These scenic shorelines not only create a picturesque landscape but also serve as a magnet for thousands of local tourists each month. Mogadishu holds a remarkable position within Somalia due to its vibrant urban atmosphere and extraordinary natural beauty. In addition to the inviting beaches, visitors and locals alike are drawn to the lush meadows and pastures that surround the province. These green spaces contribute to the diverse character of the region, making it an ideal location for this study.



**Figure 4** The study area is situated in the southern part of Somalia, specifically within the Benadir region, Mogadishu. A map of the area highlights the specific location being studied, with arrows indicating key points of interest within Mogadishu, Somalia

## 2.2. Study design

In this study, Geographic Information System (GIS) techniques were employed to acquire and analyze data for mapping and framing coastal population and waste disposal vulnerabilities in the Benadir region. The research methodology incorporated a combination of both qualitative and quantitative approaches to collect comprehensive and accurate data. The quantitative methods facilitated the gathering of numerical data, while the qualitative techniques allowed for a more thorough understanding of the scope and impact of waste disposal practices in the area. By employing these complementary approaches, the study was able to analyze the complex relationships between spatial distribution, coastal population demographics, and waste management practices at vulnerable sites throughout the region. The GIS-based techniques used for data acquisition and observation played a critical role in spatial analysis and helped us identify patterns and trends associated with waste disposal sites along the coast. This valuable information allowed for targeted recommendations and provided a solid foundation for future waste management strategies aimed at mitigating adverse environmental effects in the Benadir region.

## 2.3. Data collection and Data acquisition

During the third quarter of 2022, the process of gathering information started using GIS technology, direct observations, and pre-existing data from various sources. A field survey was conducted in the target research area, where waste disposal sites were visited and documented as evidence. Most of the data used in the research was obtained from existing GIS databases, including information on waste management strategies, waste origins, disposal methods, and their impact on both the environment and public health. Additionally, secondary data was acquired from a range of relevant sources such as books, published and unpublished written materials, thesis papers, dissertations, journal articles, and reports. The National government archives' environmental status reports serve as a vital resource for obtaining insights into construction waste management approaches.

## 2.4. Analyzing data

In simpler terms, we started by gathering information or raw data from a geographic information system (GIS), which helps collect and manage spatial data. Next, we transferred this data to a popular spreadsheet software called Excel for better organization and accessibility. To perform a deeper analysis of the collected data, we made use of software called the Statistical Package for Social Science (SPSS). This software is specifically designed to analyze and interpret complex

data sets. Once the analysis was complete, we created easy-to-understand summary tables, and graphs, to visually represent the results. These graphical representations helped convey important findings effectively. The main focus of our study was to identify the leading sources of trash generation, understand their impact on the environment, and discuss various health problems and concerns caused by different types of solid waste.

### 3. Results and discussion

The assessment of Somalia's coastal region, particularly focusing on Benadir, yielded significant insights into the implications of inadequate waste management practices prevalent in the area. With over 6 million residents generating about 3.5 million kg of solid waste daily, it is evident that the coastal region faces a pressing challenge. The study's findings are alarming, as over 320,000 kg of this daily waste is plastic, with 270,000 kg being improperly managed. As a consequence, the marine environment in Benadir experiences devastating pollution levels that disrupt both its natural habitat and human livelihoods.

The application of GIS techniques allowed for data acquisition and observational mapping of the coastal population and waste disposal sites. Two major areas in Benadir were identified as having a particularly detrimental impact on the local environment and population due to poor waste disposal practices. The consequences encompass not only increased pollution levels along the coastline but also pose significant health risks to the residents living nearby.

Marine pollution in these hotspots adversely affects the aesthetics of the coastal landscape, as well as endangers valuable coastal resources relied upon by numerous livelihoods. Furthermore, without proper classification or consideration of waste origins and types, indiscriminate dumping exacerbates health hazards for coastal communities.

By examining these pressing concerns regarding solid waste disposal in Benadir's marine environment, this study illuminates several potential approaches to rectifying this problem. To improve waste management infrastructure in Benadir, suggestions include investing in recycling facilities and promoting reusable alternatives for plastics. Additionally, awareness campaigns targeting both residents and businesses could emphasize sustainable waste disposal practices and encourage community-led initiatives for litter clean-up along the shorelines.

**Table 1** Waste generation rate

SN.	Country	Economic	Coastal Population	Waste Generation Rate (kg/ Person/ Day)
1	Somalia	Low Income	5,971,169	0.6
SN.	% Plastic in waste stream	% Inadequately managed waste	% Littered waste	Inadequately managed plastic waste [kg/day]
1	9	85	2	271,753

### 4. Conclusion

In conclusion, the research on the "Effect of Solid Waste Disposal in Benadir Marine Environment, Somalia" reveals a significant negative impact on the marine ecosystem. The improper disposal of solid waste in the coastal region leads to the accumulation of hazardous materials, which directly undermines the balance of marine life and compromises its natural habitats. The findings emphasize the need for immediate action from both local communities and governing bodies to establish effective waste management systems, thereby mitigating any further environmental degradation.

Public awareness campaigns should be prioritized to educate locals about the consequences of their actions and promote responsible waste disposal practices. Furthermore, it is essential for the Somali government and international organizations to invest in sustainable waste management infrastructure and technologies, like recycling facilities, to address this environmental crisis. Strengthening legal frameworks and enforcing strict penalties for non-compliance will also help curb illicit dumping activities.

In addition to these measures, collaborative efforts between scientists, policymakers, and stakeholders are crucial for consistent monitoring and addressing emerging threats. This will ensure the preservation of Benadir's marine environment and pave the way for a more sustainable future for Somalia's diverse ecosystems.

### *Recommendations*

This comprehensive recommendation highlights essential measures that must be taken to address the problem and improve overall waste disposal practices in the region.

Firstly, there is a need for proper waste classification and identification of point origins. This entails gathering accurate data on the types of waste generated, their sources, and their respective disposal locations. The government and relevant stakeholders should conduct regular assessments to understand the extent of solid waste pollution across various sectors. Furthermore, effective monitoring systems should be implemented to track waste generation trends and ensure compliance with relevant regulations.

Secondly, an essential step would be raising public awareness about the importance of proper solid waste disposal for environmental sustainability and public health. Educational programs targeting communities, schools, businesses, and industries can have a significant impact on people's attitudes towards waste management. Promoting waste reduction through reuse and recycling initiatives can also help minimize the amount of waste entering Benadir marine environment.

Next, it is vital for Somalia to explore innovative and low-cost disposal techniques to supplement existing methods. One such alternative is composting - a process through which organic matter decomposes under controlled conditions to create nutrient-rich soil amendments. This method not only reduces waste volume but also provides valuable agricultural inputs to farmers at minimal cost. In addition, implementing well-designed landfills with proper lining systems can help minimize potential contamination of water resources from leached contaminants.

Another recommendation includes investing in efficient material recovery facilities (MRFs) that separate mixed solid wastes into recyclable materials. By providing job opportunities for local residents, MRFs not only support economic development but also result in diverting valuable resources from disposal sites and encouraging a circular economy mindset.

Lastly, it is crucial for Somalia to strengthen its legal framework related to waste management, pollution control, and environmental protection. Developing and enforcing stringent regulations addressing waste generation, transportation, and disposal will ensure both public and private sectors adhere to responsible waste management practices. Moreover, imposing penalties on non-compliance or illegal dumping will act as a deterrent for those contributing to the pollution of Benadir marine environment.

In conclusion, addressing the issue of solid waste disposal in Benadir marine environment necessitates a holistic approach encompassing proper waste classification, public awareness, innovative disposal methods, investment in infrastructure, and strong regulatory frameworks. By adopting these recommendations, Somalia will significantly improve its waste management systems while preserving its valuable marine resources for future generations.

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### **Compliance with ethical standards**

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#### *Disclosure of Conflict of interest*

The authors declare that there is no conflict of interest regarding the publication of this paper.

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