Direct Research Journal of Public Health and Environmental Technology

Vol. 10(1), Pp. 7-13, January 2025,

https://journals.directresearchpublisher.org/index.php/drjphet

Research Article
ISSN: 2734-2182

Impact of Solid Waste Management on Environment and Community Safety in Khartoum locality-Sudan

Noon Mohamed Shibrain[1], Hassan Ibrahim Ali Mofadel[1, 2], Manal Awad Kheiry[3], Noura Karam Mohamed Salih[4], and Mohamed Ahmed Elhabib[2]

[1]Department of Environment and Ecology, Faculty of Geographical Environmental Sciences, University of Khartoum, Sudan.
[2]Department of Business Development, Kenana Sugar Company, Khartoum, Sudan.
[3]Department of GIS and Remote Sensing Faculty of Geographical Environmental Sciences, University of Khartoum, Sudan.
[4]Department of Microbiology, Faculty of Veterinary Medicine, University of Bahri, Sudan.
Corresponding Author email: hassan.mofadel@kenana.com; hmofadel@gmail.com

ABTRACT

Solid Waste Management (SWM) represents one of the most critical environmental and public health challenges in rapidly urbanizing regions. In Khartoum Locality, Sudan the exponential growth in waste generation, fueled by population increase and urban sprawl, has overwhelmed existing waste management systems. This study investigates the status of SWM in Khartoum Locality, Sudan, revealing significant challenges. Data from interviews, secondary sources, and a questionnaire survey highlight a system plagued by inefficiencies. Waste collection methods involve various container sizes for different areas (markets, squares, residential complexes) and scheduled household collection. However, the system is hampered by inadequate container provision (80% of respondents reported a lack of containers). Survey results indicate that most respondents (93%) use plastic bags for waste disposal, and a majority (62%) lack designated collection points in their areas. This contributes to widespread waste accumulation (observed by 80% of respondents), attributed to both insufficient waste workers (16%), lack of citizens' interest in proper disposal (11%) and both reasons combined (73%). Furthermore, public awareness campaigns on hygiene are severely lacking (95% reported no awareness sessions). Waste collection truck frequency varies, with some areas seeing collections only once a week (35.5%) or not at all (32.5%). A near-unanimous majority (96%) believes the entire SWM process requires assessment and improvement, emphasizing community involvement. The study also found that waste accumulation negatively impacts community health, aesthetics, and psychological well-being. The research concludes that Khartoum Locality's SWM system is deficient, negatively impacting both community safety and the environment.

Keywords: *Community Safety, Environmental Sustainability, Impact of Waste Disposal, Khartoum Locality, Solid Waste Management*

Article information
Received 2 November 2024
Accepted 20 December 2024
Published 7 January 2025
DOI: https://doi.org/10.26765/DRJPHET604482902

Citation: Shibrain, N. M., Mofadel, H. I. A., Kheiry, M. A., Salih, N. K. M., and Elhabib, M. A. (2025). Impact of Solid Waste Management on Environment and Community Safety in Khartoum locality-Sudan. Direct Research Journal of Public Health and Environmental Technology. Vol. 10(1), Pp. 7-13. This article is published under the terms of the Creative Commons Attribution License 4.0.

INTRODUCTION

Solid waste, a persistent environmental challenge, arises from various human activities, including domestic, commercial, industrial, healthcare, agricultural, and mineral extraction. This waste, often discarded without proper consideration, can lead to significant environmental pollution and public health risks. The increasing global population exacerbates the problem, as it directly correlates with higher waste generation (Puri *et al.*, 2008). Improper waste disposal practices, such as littering in public spaces, can attract pests like flies, insects, and rodents, which can transmit diseases. Uncollected waste often decomposes, emitting foul odors and contributing to the spread of infectious diseases. Moreover, the indiscriminate dumping of waste in landfills can contaminate soil and water bodies, harming ecosystems and endangering human health (Abubakar *et al.*, 2022). Inappropriate waste disposal also can lead to contamination of water sources, soil, air pollution, and spread of harmful pathogens, such as bacteria and viruses, which can cause diseases like Salmonellosis,

Cholera, Dysentery, Dengue fever and Malaria. Improper air can cause respiratory diseases like Asthma, Bronchitis, and Lung infections. The risks of soil contamination and water pollution could otherwise lead to severe health issues such as toxic chemicals and hazardous substances (e.g., heavy metals, plastics, and medical waste) can leach into the soil and water, threatening public health as well. Poor waste management leads to hazardous conditions such as open dumping, which attracts rodents, insects, and scavengers, all of which can affect human health by spreading diseases like leptospirosis, typhoid, and hepatitis and also managing waste reduces the breeding grounds for disease-carrying vectors, such as mosquitoes, rats, and flies, which thrive in waste dumpsites as well as stated by World Health Organization (2018); Jha and Goel (2013); Ghose, *et al*., (2019).

Effective solid waste management is essential for sustainable development and public well-being. It involves a comprehensive approach that includes waste reduction, recycling, composting, and disposal. By minimizing waste generation and maximizing resource recovery, we can mitigate the negative impacts of solid waste on the environment and human health (Abubakar *et al*., 2022).

In the Khartoum area, waste has grown to be one of the main issues endangering both human safety and the environment. Mismanagement of waste collection and proper disposal has a significant detrimental effect on safety. To sum up, the findings of the study carried out in Khartoum State by Mofadel *et al*. (2016) showed that the classification of waste provides insight into how waste can be used in accordance with the waste master plan for Khartoum State using an efficient and successful combination of waste management, including the use of common approaches as crucial tools in creating an integrated waste management plan.

The benefits of various initiatives around the world to integrate the informal sector are evident: national and local government agencies have partnered with informal workers to collect or recover waste which highlighted by Wilson *et al*. (2006). Informal workers have run recycling and sorting facilities, set up small businesses or cooperatives, and supplied valuable materials to the domestic or global recycling market (Wilson *et al*., 2006).). These experiences demonstrate that collaborating with the unorganized recycling sector offers a genuine chance to enhance resource efficiency and waste management in low- and middle-income nations while assisting in the fight against poverty The preferred option is to integrate the informal sector into waste management planning, building on their practices and experience, while working to improve efficiency and the living and working conditions of those involved in Khartoum State. Studying the realities of solid waste and the effectiveness of management in the Khartoum area is the foundation of this research's significance. It draws attention to issues including the amount of solid waste generated daily in the Khartoum area, the nature of the garbage, the collection and disposal techniques, and the impact of solid waste management on public safety. Based on the ongoing arguments the main objective of this study is to highlight the impact of solid waste management in the Khartoum Locality area on the environment and community safety. The specific objectives include evaluating solid waste management methods and approaches in the study area and highlighting the challenges and limitations facing waste management.

METHODOLOGY

Study area

The capital of Sudan, Khartoum, is situated near the meeting point of the White and Blue Niles and occupies 20,000 square kilometers. It is home to 8,643,559 people, or around 15% of the total population of the country. As seen in (Figure 1), Khartoum State is made up of seven localities: Khartoum, Bahry, Omdurman, Karary, Umbadda, JabalAulia, and Sharg Elnile; it also includes three cities: Khartoum, Khartoum North (Al-Khartoum Bahary), and Omdurman. Although Khartoum has a hot desert environment, flooding is a major problem in several parts. At roughly 400 meters above sea level, it is a level inland city (Mofadel et al., 2016).

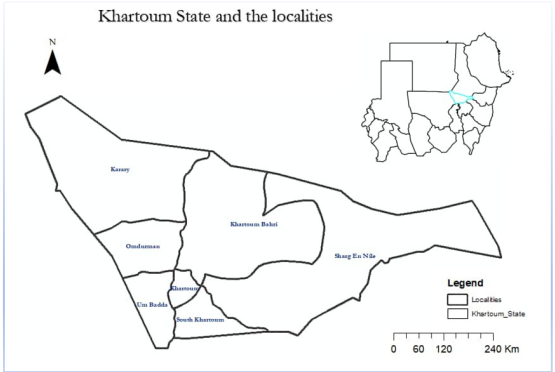


Figure 1: Map show Khartoum State and its Localities.

Methods of data collection and analysis

The study was carried out in the Khartoum locality area from September to December 2022 to evaluate the local waste management system and its effects on the environment and public safety. Primary data was gathered by asking interviewers in the Khartoum Locality a series of questions using a contractive questionnaire and conducting in-person interviews with researchers, officials, and subject-matter experts for the purpose of collecting information that can support the research findings and interpretations. Over 150 interviewees were covered by the questionnaire, and nearly 100 people answered it. Statistical Package for Social Sciences (SPSS), IBM SPSS Statistics for windows, version 20 Armonk, NY, USA: IBM Corp. was used to analyze the study data. The numbers and percentages were tabulated in the form of the frequency distribution, mean; and standard deviation calculated using descriptive analysis. Using Cross Tab

Analysis, knowing the relationship between two variables.

RESULTS AND DISCUSSION

Key-note interviewers and secondary data outcomes

Key notes interviews and secondary data obtained give details on Khartoum locality and solid waste management status, waste collection methods and transportation and disposal of solid waste. The elaboration on these issues is as follows:

Khartoum locality and solid waste management status

The city of Khartoum is considered one of the populated cities with a tremendous solid waste generation where its management has become one of the main challenges facing local officials and Khartoum Locality in particular. In Khartoum State, solid waste managed in a traditional way that has a lot of randomness and lack of possibilities and the absence of scientific methodology until the issuance in 2001 of a decision by the Governor of Khartoum to form a high state committee to develop a solid waste management plan. It followed by formulating a project in 2007 to clean up the Khartoum State including Khartoum Locality for proper collection from the site roads to transfer station and then to landfills using different vehicles and trucks specifically introduced to such purposes. The project is failed to clean all generated waste only in the best cases 60% of the generated waste is going to be collected through the system. This is clearly stated by Mofadel *et al.* (2016) and Wilson *et al.* (2006) that is due to many reasons such as lack of community awareness, increasing the informal recyclers in the streets and reducing the budget of the maintenance of the different vehicles and trucks. Informal recyclers called Nakasha and Barkata in Sudan. Nakasha the waste pickers that pick the waste staring in front of the houses, the streets and even in the tracks of waste collection, whereas Nakasha referred to the waste pickers in the landfill (Mofadel *et a*l., 2016). This is confirmed by all interviewers in this study.

Waste collection methods in Khartoum locality

The results of this study revealed that the collection in Khartoum Locality is done through a different container. These containers are distributed in residential complexes, squares, markets, shops and large commercial centers. The types of containers used are as follows:

(a) A container (6) cubic yards for markets and sovereign and main streets.
(b) Container (5) cubic yards for large squares.
(c) Container (12) cubic meters for residential complexes such as Al-Nasr and Jasmine Complex.

Collection of the waste also being from homes at specific point agreed upon by the people in the residential areas through the following stages:

(a) The worker entered the whistle a quarter of an hour before entering the vehicle
(b) Entering the vehicle while adhering to the specified paths from the first street north south or east west considering the secondary streets and houses that overlook the streets and squares within the work area.
(c) Lifting waste by workers, considering the method of storage, if it is in bags that are lifted in the cart and if it is in pots, it is discharged and returned to its people.
(d) Ensure the complete filling of the cart.

Collection is also made on the streets; however, the streets are classified as follows:

(a) Sovereign Streets.
(b) Main Streets.
(c) Secondary Streets.

The on-street waste management process determines the lengths of sovereign and main streets and cleans the streets by workers, and the waste collected in transport containers and bags or containers of different sizes. These uses of collection are like all Khartoum State localities as confirmed by Amel (2022).

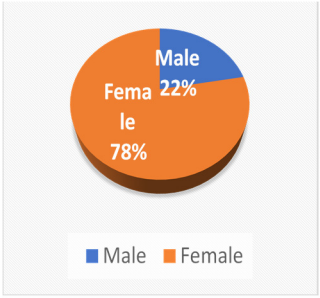
Transportation and disposal of solid waste in Khartoum locality

Waste is transported from the transfer station by heavily trucks cart to the final landfills. The transfer station is in Rumila with an area of 22,000 m^2. Thereafter waste is transferred to the landfill in Taiba al-Hasnab at Khartoum south with a journey that takes 3 hours. Sometimes the waste transferred to Abuwlaidat landfill in Omdurman in the autumn with a journey that takes 4 hours due to the difficulty of reaching Taiba al-Hasnab landfill during rainy season. The final disposal of the waste is to Taiba al-Hasnab landfill with an area of 42 acres made up of two cells. The landfill began to be used in 2007 and has a shelf life of 20 years and receives 24-26 trucks per day. The main recycler players are Nakasha and Barkata. They have markets located in different areas in Khartoum Locality. The recycler can collect equivalent of 1 ton per day from metal cans, plastic bottles, tin, iron, aluminum and others. The collected recyclable materials are sold by individual (Nakasha or Barkata) to different interested buyers as follows:

(a) Kilogram of plastic for 100 SDG
(b) Kilogram of tin for 100 SDG
(c) kilogram iron for 300 SDG

Survey outcomes using questionnaire

The results of the survey using questionnaire showed that females constitute of 78% whereas the males are only 22% of the responders as presented in (Figure 2).



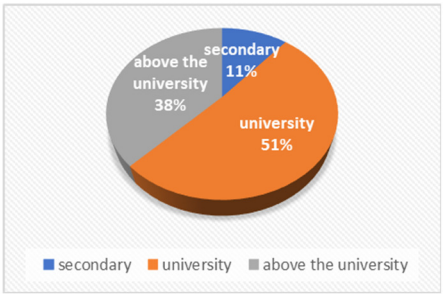


Figure 2: The Interviewers gender: **Figure 3:** The interviewers' education level.

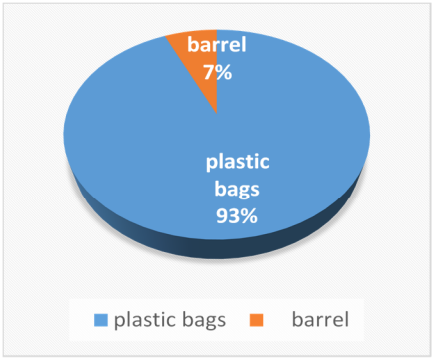


Figure 4: Method of waste handling

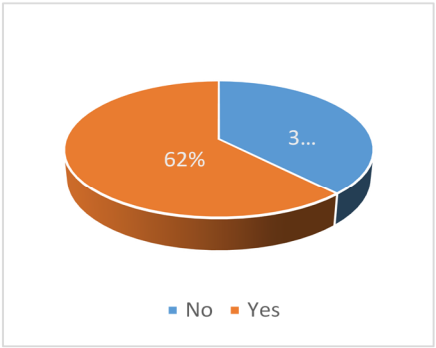


Figure 5: Existing points of collection in the households for disposal

The education level of the interviewers showed that graduated people are at almost 51%, whereas those who have higher university degrees represented 38% and 11% had secondary education level (Figure 3).

The methods of waste handing in the households from the interviewers and community prospective showed that 93% of the responders use plastic bags to dispose of waste and only 7% of the responders use barrel as shown in (Figure 4). The survey results revealed that 62% of the responders have no point in collecting waste and only 38% do have a point in waste collection in their area as presented in (Figure 5). This means most of the waste being put randomly with no specific areas which will result from huge contamination of the environment and community safety as will be a source of hazards.

The survey results indicated that most of the respondents, 80%, said responsible authority did not provide any containers for waste disposal surrounding their areas, whereas only 20% yes that the authority provides containers in their areas as presented in (Figure 6). Since there are no dedicated containers for collecting waste, this situation gave the chance for Nakasha to open the waste bags and that resulted in different contamination aspects in the areas and continuously put the community safety at-risk. This situation resulted in a huge accumulation of waste in the study as indicated by interweavers as 80% noticed accumulation of waste in their areas whereas only 20% didn't notice such waste accumulation. This clearly indicated a defect in the waste management handling and process in the study areas. These results in line with all observations noticed by several researchers in Khartoum state for instant Amel (2022); Salma *et al.* (2017) and Mofadel *et al.* (2016). However, the survey results responded that the reasons and causes for such waste accumulation are: 16% indicated that due to lack of workers, 11% indicated that due to lack of citizens' interest to dispose of waste properly and at the time of tracks arrivals. Thus 73% of interviewers indicated that both reasons (lack of workers and lack of citizens' interest) are the main cause of the waste accumulation in their areas. This situation is coupled with poor transportation equipment.

The survey results highlighted poor awareness done by waste management authorities in Khartoum State for the importance of hygiene during dealing with waste at any stage as the major majority of 95% confirmed lack of awareness, whereas only a few of them 5%) answered they received awareness cessions in importance of hygiene as presented in (Figure 7).

The trucks came frequently to pick up the waste from the different areas of study. The interviewers indicated that the truck came once a week (35.5%), twice a week (26.5%), three times and a week (12.5%) and 32.5% of the interviewers didn't see the track coming any time to pick waste as shown in (Table 1). Based on this survey majority of the respondents, 96% assumed that the whole process of waste management including collection, transport and disposal operation of waste in their areas need to be assessed and properly handled by the authorities coupled with strengthening the role of community in waste management practices. Only 4% see that the authorities are properly handling waste management processes in

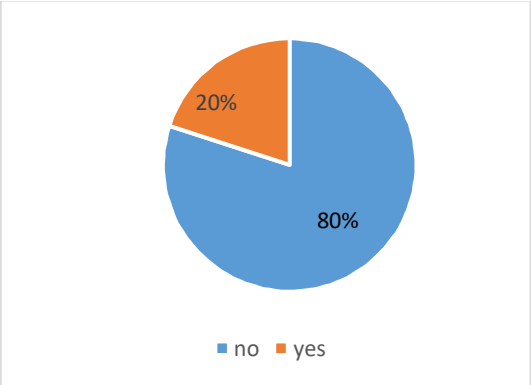


Figure 6: Responsible authorities provide containers for waste collection.

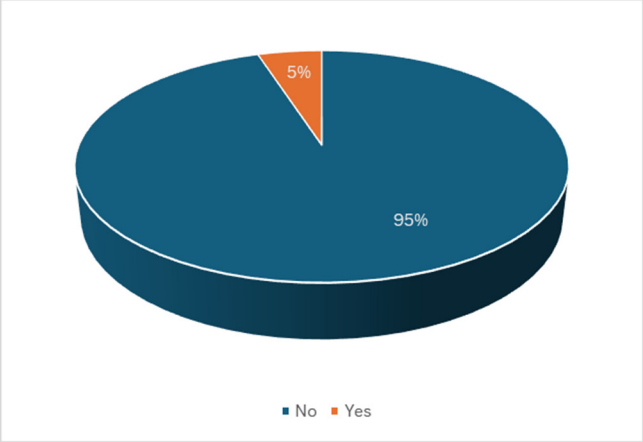


Figure 7: Responsible authorities give awareness of citizens on the importance of hygiene.

Table 1: How frequently the tracks pick the waste from different areas

Frequent times of truck for picking waste	Percentage of responders
Once a week	35.5
Twice a week	26.5
Three times a week	12.5
Responders didn't see the truck	32.5

Table 2: The descriptive statistics for the different parameters include mean and standard deviation.

Descriptive Statistics	Mean	Std. Deviation
Gender	1.7955	0.40803
Education	2.2667	0.65366
What are your waste types?	1.9091	1.17766
What are the ways to save your waste?	1.0667	0.25226
Is there a waste point collection in your area?	1.3778	0.49031
Does the responsible authority provide waste container collection?	1.2000	0.40452
Is there a waste accumulation in your area?	1.8000	0.40452
Causes of waste accumulation?	2.7222	0.61464
Does responsible authorities' awareness of citizens of the importance of hygiene?	1.0227	0.15076
How many times during the week pass waste?	2.1163	1.00497
What is your assessment of collection, transport and disposal operations?	1.9773	0.15076
the impact of waste and accumulation on the community	2.9333	0.25226

their areas. The survey results revealed that waste accumulation has an impact on community safety and environment. The majority 93% of the responders that the accumulation of waste resulted in bad smile, appearances of diseases and has psychological disorders for the citizens, whereas 7% sow the impact on the asthenic appearance and landscape distortion for the living beauty. Table 2 shows the analysis done by SPSS for all parameters raised in the questionnaire such as mean and standard deviations. The research concluded that there is a defect in the process of proper waste management in Khartoum locality, which negatively affected community safety and environment. The research is successful in achieving its objectives, but there is shortcoming in obtaining the current Khartoum locality solid waste management after the Khartoum local cleanness project in 2007. The proposal for future study is to put framework, for solid waste management plan for Khartoum locality, regarding technological, economic, social, administrative and political factors. Furthermore, involvement of enterprises in waste management through a certain mechanism provides a combination of restrictive and expansionary tools which can ensure the maximum possible and most secure energy saving.

They can be used relating to all subjects of the economic system. The given statement and the example of the problem of scarce resources limit optimal allocation with the help of the economic performance improvement programs can be of great practical importance for enterprises as stated clearly by Malevskaia-Malevich and Demidenko (2017) and Elkhidir *et al.* (2016) is crucially needed.

Conclusion

Khartoum Locality's solid waste management system exhibits profound inefficiencies, with inadequate infrastructure, limited public awareness, and insufficient governmental support undermining its effectiveness. These challenges not only compromise environmental sustainability but also jeopardize community safety and public health. Addressing these issues requires an integrated approach, combining technological innovations, policy reforms, and community engagement. To advance towards a sustainable and resilient waste management system, it is crucial to enhance infrastructure capabilities, ensuring adequate resources for waste collection, transportation, and disposal. Public awareness campaigns must be intensified to foster a culture of proper waste handling and recycling among citizens. Governmental support should be bolstered through dedicated funding, policy reforms, and the establishment of strict regulatory frameworks. The integration of informal waste pickers into the formal waste management system presents a unique opportunity to leverage existing local expertise while improving livelihoods and reducing environmental impact. By adopting innovative technologies, promoting community participation, and enforcing stringent regulations, Khartoum Locality can significantly improve its waste management practices. This multifaceted approach not only protects public health and safety but also contributes to broader environmental sustainability goals. By implementing these strategies, Khartoum Locality can transform its waste management challenges into opportunities for growth and development, ultimately achieving a cleaner, healthier, and more sustainable environment for all its residents.

Study contribution

This research makes several important contributions to the field of solid waste management, particularly within the context of Khartoum Locality. Firstly, it provides a detailed assessment of the current waste management practices, highlighting the inefficiencies and challenges faced by local authorities. This assessment is crucial for understanding the specific needs and limitations of the locality, paving the way for more targeted and effective interventions. Secondly, the study underscores the significant role of the informal sector in waste management. By documenting the activities of informal waste pickers (Nakasha and Barkata), this research brings attention to their contributions and the potential benefits of integrating them into the formal waste management system. This insight is vital for policymakers aiming to enhance resource efficiency and support the livelihoods of informal workers. Lastly, the research offers a comprehensive set of recommendations for improving waste management practices. These recommendations are based on empirical data and thorough analysis, providing a practical roadmap for local authorities and stakeholders to follow. The study's findings and suggestions can serve as a valuable reference for other regions facing similar challenges.

Avenues for further research

While this study provides a robust analysis of solid waste management in Khartoum Locality, further research is needed to expand its findings and address the remaining gaps. Conducting long-term studies would be beneficial to monitor the implementation and effectiveness of the recommended waste management practices. Such longitudinal studies will help in understanding the impact of interventions over time and in making necessary adjustments. Exploring the potential of emerging technologies, such as the Internet of Things (IoT) and Artificial Intelligence (AI), can enhance waste management efficiency. Research should focus on how these technologies can be integrated into the existing infrastructure and their cost-effectiveness. Performing economic analyses is essential to evaluate the financial feasibility and potential economic benefits of different waste management strategies. This includes conducting cost-benefit analyses of waste-to-energy projects, recycling programs, and other sustainable practices.

Investigating the role of community engagement and participation in waste management is another critical area for future research. Exploring effective methods for increasing public awareness and involvement, as well as assessing the social impact of improved waste management practices, will be valuable.

Conducting comparative studies between Khartoum Locality and other regions with successful waste management systems can provide valuable insights and best practices that can be adapted to the local context.

By addressing these areas, future research can build on the foundation laid by this study, contributing to the development of more efficient and sustainable waste management systems in Khartoum Locality and beyond.

Recommendations

Based on the analysis of solid waste management practices in Khartoum Locality, several recommendations are proposed to address the challenges and improve the overall environmental and public health conditions.

Firstly, developing a comprehensive and integrated solid waste management framework tailored to the specific needs of Khartoum Locality is essential. This framework should encompass all aspects of waste management, including waste generation, collection, transportation, treatment, and disposal, as well as outlining clear guidelines for waste reduction, recycling, and composting.

Secondly, strict enforcement of existing laws and regulations related to waste management is crucial. This includes penalties for littering and illegal dumping. Establishing a dedicated enforcement agency to monitor compliance and take necessary action against violators, in collaboration with local authorities, will ensure effective implementation of these regulations.

Thirdly, public awareness campaigns play a vital role in educating the public about the importance of proper waste disposal and recycling. Promoting waste reduction practices, such as reducing consumption, reusing products, and recycling materials, can significantly impact waste management. Involving schools, community organizations, and religious institutions in promoting environmental awareness will further support these efforts.

Fourthly, adopting sustainable waste management practices, such as source separation, composting, and recycling, is recommended. Encouraging businesses to implement waste minimization and recycling programs, as well as exploring opportunities for waste-to-energy conversion and other innovative waste management technologies, can enhance sustainability.

REFERENCES

Abubakar, I.R.; Maniruzzaman, K.M.; Dano, U.L.; AlShihri, F.S.; AlShammari, M.S.; Ahmed, S.M.S.; Al-Gehlani, W.A.G.;Alrawaf, T.I. (2022). Environmental.

Amel, M. M. E. (2022). Assessment of Current Situation of Municipal Solid Waste (MSW) Management in Khartoum State, Research paper for M. Sc. Program in Safety, Security and Environment, University of Khartoum.

Elkhidir; Ahmed.M and Ishii.A (2016). Solid Waste Management Master Plan 2 in Khartoum State, Ministry of Environment, Natural Resources and Physical Development. Higher Council of Environment, Urban and Rural Promotion. pp:2,7,9-11, 21,23,47,52-53,91-92.

http://www.statista.com/statistics/1168066/largest-waste-producing-countries-worldwide-per-capita accessed on (5 October 2021:3:10 PM).

http://www.worldbank.org accessed on (12 September 2021:11:30 AM).

Jha, M. K., and Goel, S. (2013). "Impact of solid waste management practices on health in urban areas: A case study of Delhi, India." Journal of Environmental Management, 125, 94-101. [DOI: 10.1016/j.jenvman.2013.04.014]

Ghose, M., Debnath, A. S. and Ghosh, S. (2019). "Solid Waste Management in Indian Cities: Challenges and Opportunities." Waste Management. [DOI: 10.1016/j.wasman.2018.12.006].

Malevskaia-Malevich E. D. and D. S. Demidenko (2017). Recyclable Materials (Waste) Management in Enteerizarprise's Production Process, *IOP Conf. Ser.: Earth Environ. Sci. 87 042009*.

Mofadel, H; Awad, S; Mahmoud, T and Khiry, M (2016). Waste Management in Sudan: A case of Waste Characttion in Khartoum State. *GLOBALWASTE MANAGEMENT SYMPOSIUM*, January 31-February 3, 2016, Indian Wells Resort • Indian Wells, CA, USA.pp:1,7.

Puri, A., Manoj Eonkar, J. (2008). Solid-waste management in Jalandhar city and its impact on community health. *Indian J*, K. and *Occup Environ Med. 12(2): 76–81.*

Salma, M., Gasmelseed A., and Ibrahim M. (2017) Paper research of management of solid waste in Khartoum state.

Sustainability Impacts of Solid Waste Management Practices in the Global

Wilson, D. C., Velis, C. and Cheeseman, C. (2006). Role of informal sector recycling in waste management in developing countries Habitat International 30 (2006) 797–808.

World Health Organization. (2018). "Health aspects of solid waste management." WHO. https://www.who.int/news-room/fact-sheets/detail/solid-waste-management.