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Solid Waste Management Contribution to the Attainment of the Sustainable Development Goals

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Abstract

Solid waste management (SWM) has the potential to contribute to the achievement of many of the sustainable development goals (SDGs), even though SWM is not specifically mentioned in any of the 17 SDGs. This study assesses the potential of SWM contribution to the attainment of the SDGs, using Wa Municipality in Ghana as a case study. The study adopted an explanatory sequential research design and applied both quantitative and qualitative research methods. The study revealed that the Wa Municipality's SWM system involves some solid waste (SW) storage, collection, transport, and final open dumping of the SW without treatment, which does not present opportunities for SWM to contribute to the attainment of some of the SDGs. Improvements in SWM, through the adoption of appropriate SWM processing technologies will substantially contribute to better living conditions and better health for residents and possibly lead to the attainment of some of the SDGs in the Wa Municipality.

Keywords: Solid Waste Management; Waste Disposal; Open Dumping; Sustainable Development; Sustainable Development Goals; Wa Municipality.

Introduction

Appropriate waste management is recognised as an essential prerequisite for sustainable development (SD) (Saravanan *et al.*, 2021). Initially, waste management was focused on removing potentially harmful substances or materials away from human settlements (Ahmed *et al.*, 2021), however, as the environmental, social and economic implications of unsustainable consumption leading to growing waste generation became apparent, waste management began to shift from a mere pollution prevention and control exercise, towards more holistic approaches that regard waste as a resource. This is because it has been realised that the prosperity and environmental sustainability of cities are intimately linked (Obura, 2020).

Therefore, it is generally assumed that any country can preserve the environment while maintaining economic growth (Hickel *et al.*, 2021; Jahanger *et al.*, 2022). However, this is a fallacy as Hamón *et al* (2020) point out that a degree of commitment is required from all stakeholders, particularly at the local level, if SD is to be achieved. They maintain that nowhere are the commitments of cities to environmental sustainability more vital than in low – and – middle-income countries, where urban demographics are growing rapidly and the current total population accounts for 82 per cent of the world population.

This underscores the need for a striking balance between growth and prosperity, and the continuous depletion of natural resources. Schönfeld and Ferreira (2021) allude to the vital importance of economic growth but observe that, if any city is to achieve prosperity, its economic growth must be sustainable. This calls for the optimisation of limited resources through the adoption of appropriate solid waste management systems (SWMS) to harness the full resource potential of solid waste (SW) for sustainable development (SD).

Borowy (2021) observes that discussions of SD typically reach back to the definition of the concept developed by the Brundtland Commission in its landmark publication 'Our

Common Future'. As a result, most definitions of SD are drawn from the Brundtland report's definition. SD is defined in the Brundtland report of 1987 as:

> *'…… development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.'*

Consequently, the global community through the United Nations (UN) adopted the Millennium Development Goals (MDGs) in 2000 with a broad vision to fight poverty in its many dimensions as highlighted in the Brundtland report. These have produced the most successful anti-poverty movement in history (United Nations, 2015), but were replaced by the fairly ambitious 17 sustainable development goals (SDGs), to be achieved by 2030.

The 17 SDGs with 169 targets were launched at a UN summit in September 2015 with the overall objective of achieving SD in its three dimensions – economic, social and environmental – in a balanced and integrated manner by 2030 (United Nations, 2015). Solid waste management (SWM) has the potential to contribute to the achievement of many of them, even though SWM is not specifically mentioned in any of the 17 goals. Accordingly, Ali and Bella (2016) observe that despite the contribution of improved SWM to the development agenda, it did not feature explicitly in the MDGs. They further posited that as a crosscutting sector, improving SWM is relevant to key development priorities, including health, employment and the environment which are key components of SD.

In addition, Javier *et al* (2020) indicate that there were several places where the MDGs and the modernization of waste management came together and that though not quantified, waste management contributed to the achievement of the MDGs on livelihoods and poverty (MDGs 1 and 7), the health-related MDGs 4, 5 and 6, and MDG 8, which was on

global partnerships. Table 1 below outlines the contribution that improved SWM made to the MDGs.

Table 1: Contribution of improved SWM to the MDGs

Millennium Development Goals	Contribution of solid waste management
Goal 1: Eradicate extreme poverty and hunger	Provided employment opportunities for the poor through informal–sector self-employment in waste collection and recycling
Goal 2: Achieve universal primary education	Provided opportunities to deliver education for thousands of children through their parent's involvement in waste picking
Goal 3: Promote gender equality and empower women	Provided equal opportunities for men and women in the waste sector and strengthened the role played by women
Goal 4: Reduce child mortality	Improved livelihoods of mothers and reduced children's direct contact with waste
Goal 5: Improved maternal health	Reduced exposure of pregnant women to chemicals in hazardous waste in the community and the waste sector
Goal 6: Combat HIV/AIDS, malaria and other disease	Effective waste management reduces the risks of healthcare waste and eliminates breeding sites for disease vectors
Goal 7: Ensure environmental sustainability	Reduced waste generation, improved efficiency in collecting, handling and disposing of waste, reduced greenhouse gas (GHG) emissions, improved urban environment
Goal 8: Develop global partnership for development	Promoted waste management technology transfer in developing countries

Source: Adapted from (Ali and Bella, 2016; Pujara *et al.*, 2019; Javier *et al.*, 2020)

Similarly, SW has the potential of contributing to the achievement of the SDGs. Ali and Bella (2016) observed that apart from goal 11, target 6 which specifically captures SW, SWM in general has the potential to contribute to a further 40 SDG targets. However, it would be impossible for SW in low – and – middle-income countries to contribute to the achievement of the SDGs, if SWM is not re-tooled through the implementation of

appropriate SWM systems, though SWM has the potential to contribute to SD at the macroeconomic level as well as directly in the waste management sector (Magazzino, Mele and Schneider, 2020). The linking of macroeconomic effects such as gross domestic product (GDP) growth and population, and the effect on economic driving forces for technological development of waste management can direct SWM in a sustainable direction.

Waste generation varies as a function of wealth, and the wealth of a country depends on macroeconomic effects such as GDP and population which also influence consumption patterns (Magazzino *et al.*, 2021). Therefore, an increase in GDP and population will lead to an obvious increase in SW generation. Though this will present a challenge to municipal authorities in low – and – middle-income countries in terms of effectively managing high volumes of waste, the increase in SW generation will equally present opportunities for technical developments of some of the elements of the waste management system such as SW processing/treatment and disposal.

For the sustainability of the waste management system, technical developments such as SW processing/treatment and disposal could incorporate the dimensions of SD (e.g. job opportunities, a cleaner environment and less stress on the municipal budget for waste management). Thus, this concept will make it possible to capture the interaction between waste quantities and waste management costs when assessing future waste quantities, which could contribute to the three dimensions of SD (environmental, social and economic). For instance, the economic benefits of SW can be realised when efficient practices are introduced into production and consumption, valuable materials are recovered and people find jobs and pursue business opportunities. On the other hand, social benefits will accrue when communities are lifted out of poverty and health problems are solved or lessened. Also, environmental benefits will be generated when impacts are reduced or eliminated, water and air quality are improved and greenhouse emissions are reduced. Thus, this study assesses the potential of SWM contribution to the

attainment of some of the SDGs, using the Wa Municipality in the Upper West Region of Ghana as a case study.

2.0 Materials and Methods

2.1 The Study Area

The study area was the Wa Municipality. The Wa Municipal Assembly (WMA) is one of the 11 administrative and political districts in the Upper West Region of Ghana. The district was upgraded to a municipal status in 2004 and this has changed the structure of the area significantly. The municipality lies between latitude 1°40'N and 2°45'N and longitude 9°32 to 10°20W, thus covering an area of approximately 23,474 square kilometres which is about 32% and 2.56% of the total land area of the region and the country respectively. The Wa Municipality is located in the southern part of the region and shares administrative boundaries with, the Nadowli-Kaleo District to the North, the Wa East District to the South-East and the Wa West District to the Southwest (Wa Municipal Assembly, 2012). Wa the municipal capital is the commercial and political seat of the region. The population of the municipality according to the 2021 population and housing census stands at 200,672 with 98,493 males and 102,179 females; the males constitute 49.1% and females represent 50.9%; and about 28.6% of the population reside in rural localities (Ghana Statistical Service, 2021). In addition, the Municipality has a household population of 190,962 with a total of 49,500 houses; the average household size in the municipality is 3.9 persons per household.

The study communities selected through cluster sampling technique, a probability sampling method which is used when the study population is large, particularly populations that are geographically widely dispersed were Degu and Airport Residential Areas, Bamahu and Dobile Residential Areas, and Zongo and Fongo Residential Areas, representing two (2) residential areas in high-income, middle-income, and low-income residential dwellings in the Wa Municipality respectively. The selected residential areas for the study are shown in the Wa Municipality's map in Figure 1.

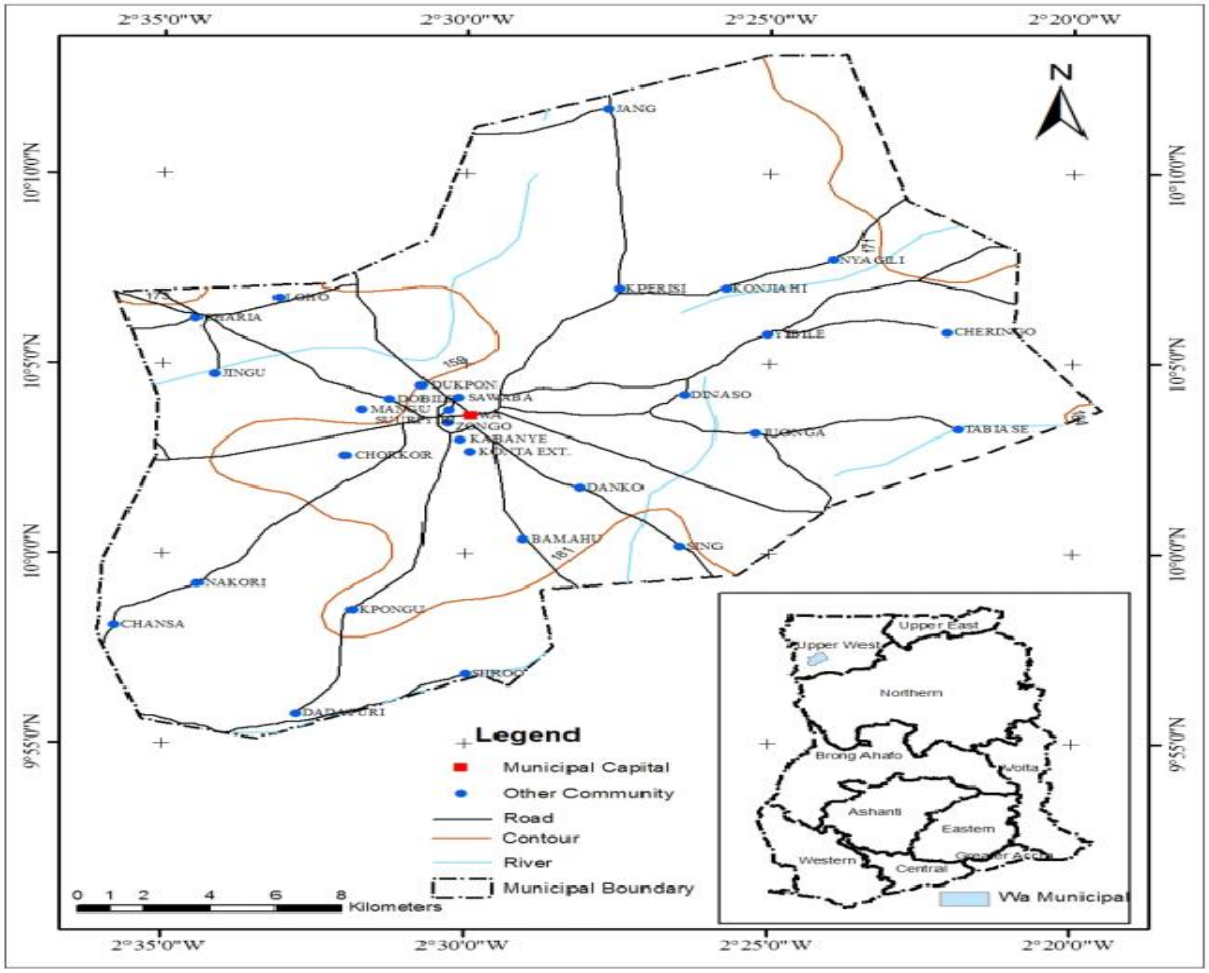

Figure 1: Map of the Wa Municipality

2.2 Data Collection, Processing, and Analysis

The study adopted an explanatory sequential research design and applied both quantitative and qualitative research methods. An explanatory sequential design entails first gathering quantitative data and then qualitative data to further illuminate or elaborate the quantitative findings (Hendren *et al.*, 2022). This strategy is justified by the fact that, while quantitative data and findings give a broad image of the study topic, more analysis, particularly through the acquisition of qualitative data, is required to enhance, expand, or explain the overall picture (Dawadi, Shrestha and Giri, 2021). The Quantitative data, mainly households' SWM practices were collected using questionnaires. The

qualitative data was also collected by some portions of the questionnaires in addition to some interviews with study officials and community members.

In collecting the data for the study, the municipality was clustered into three clusters based on income levels of the residential areas namely, high-income, middle income and low-income residential areas, and two residential areas in each cluster were selected for the study. The selected residential areas for the study were Degu and Airport Residential Areas, Bamahu and Dobile Residential Areas, and Zongo and Fongo Residential Areas, representing two (2) residential areas in high-income, middle-income, and low-income residential dwellings in the Wa Municipality respectively. Sixty (60) households each from low-income, middle-income, and high-come residential dwellings living in compound-houses, semi-detached, and single-unit dwellings respectively (totalling 180) formed the households sample size. The researcher applied stratified simple random systematic sampling in selecting the 60 uniform households in the various residential dwellings, as a systematic sample is obtained by selecting items at uniform intervals (Abbott *et al.*, 2021). Though this household sample size was small, as the Wa municipality's household population was 190,962 (Ghana Statistical Service, 2021), it was "big enough" to be of scientific and statistical significance (Staller, 2021).

Consequently, questionnaires were administered to the household respondents. The questionnaire comprised of the demographic variables and the SWM practices of the respondents in the Wa Municipality. The questionnaires were administered to the respondents with the assistance of three (3) persons who were recruited and trained by the researcher to perform the task. In addition, the researcher held informal interviews with staff of the waste department of the Wa Municipal Assembly and Zoomlion Ghana Limited, the only private waste collection company operating in the Wa Municipality. The informal interviews with these institutions aimed to enable the researcher to gain more insight into the SWM situation in the municipality.

3.0 Results and Discussion

3.1 Demographic Characteristics of Household Respondents

A total number of 180 questionnaires were administered to six communities, namely Degu and Airport Residential Areas, Bamahu and Dobile Residential Areas, and Zongo and Fongo Residential Areas, representing two (2) residential areas in high-income, middle-income, and low-income residential dwellings in the Wa Municipality respectively.

3.1.1 Sex Distribution of Household Respondents

The majority of the household respondents were male, 51 %, whereas the remaining percentage 49% were female. In many developing countries, gender plays a very vital role in determining and outlining individual duties regarding waste management at the household and community levels, different roles in dealing with sanitation issues are assigned to a particular gender due to socio-cultural factors. The researcher during the field observed that women and girls were mainly responsible for SW disposal in the Wa municipality, particularly transporting collected and stored SW to communal collection points.

3.1.2 Age Distribution of Household Respondents

The majority of the household respondents were between the 21 – 30 years age group (58.3%), while the minority of the household respondents were between the 51 – 60 years age group, as indicated in Figure 2. During the fieldwork, the researcher observed that the 10 – 20 and 21 – 30 age groups were mostly responsible for household waste management, especially household waste disposal.

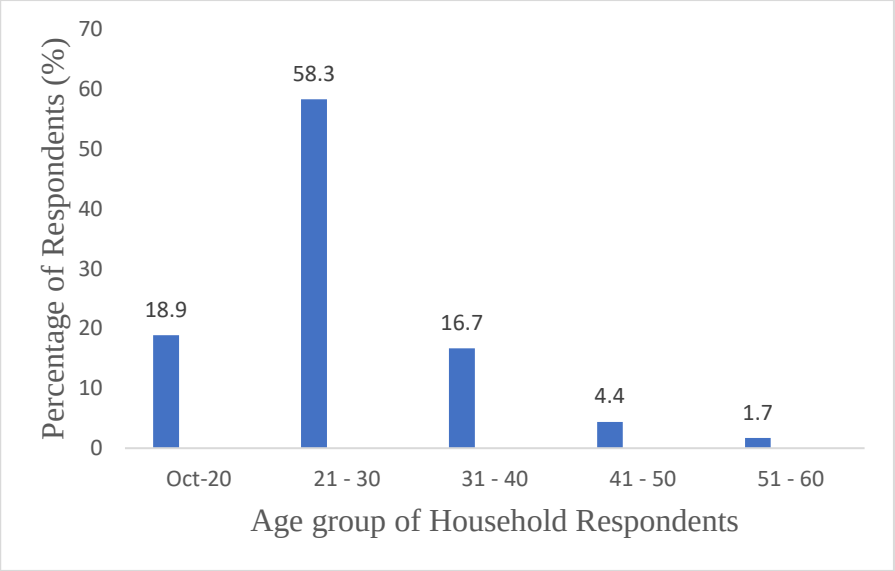

Figure 2: Age Distribution of Household Respondents

3.1.3 Education Level of Household Respondents

Out of the total of 180 household respondents, 53.9 % and 42.2 % of the household respondents had tertiary and secondary education respectively, as shown in Figure 3. Education helps to shape the attitude of people. Consequently, Fadhullah *et al* (2022) observe that people with high education levels resort to better waste management practices than people with low or no formal education.

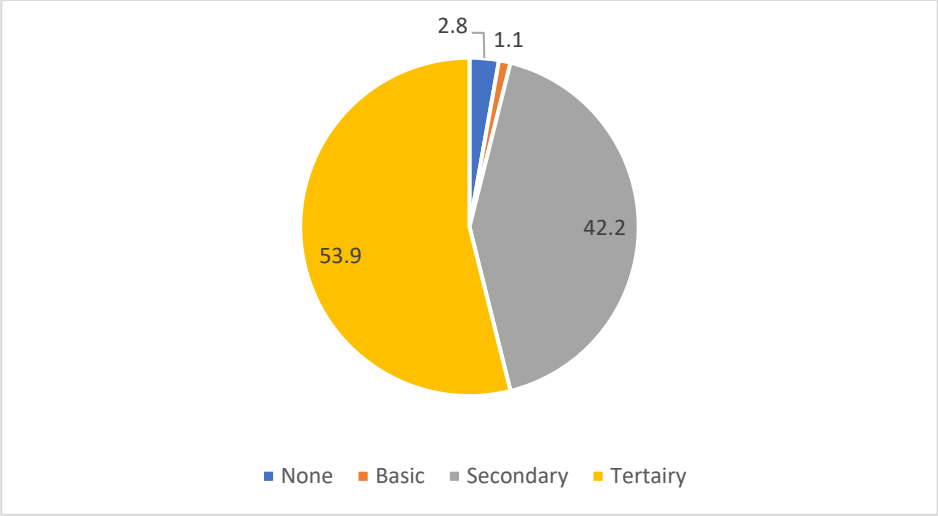

Figure 3: Level of Education of Household Respondents

3.2 Solid Waste Management Practices

Waste collection is the key element of waste management that links waste generators to the waste management system. The findings from the household survey indicated that 75.6 % of the household respondents had access to waste collection services, whereas 24.4 % of the household respondents were not provided with any waste collection service and had resorted to improper SW disposal practices such as burning and disposal into pits. Figure 3 illustrates the SW collection and/or disposal methods by the household respondents. Furthermore, out of the percentage of respondents that had access to waste collection services, 11.7 % of the household respondents, who could afford to pay for the collection of their waste, were covered by the private waste collection company, ZGL, whereas the remaining percentage of the household respondents (88.3 %), relied on communal collection containers (CCCs) provided by the WMA for their waste collection. SW collection is a public service that has significant impacts on public health and the appearance of towns and cities (Abubakar *et al.*, 2022), and forms about 85 per cent of the total cost of waste management systems in most countries worldwide (Chen *et al.*, 2021). It is therefore important for the municipal authorities who are mostly responsible for waste collection to strive to cover all areas and not limit waste collection to areas where the residents can afford to pay for waste collection.

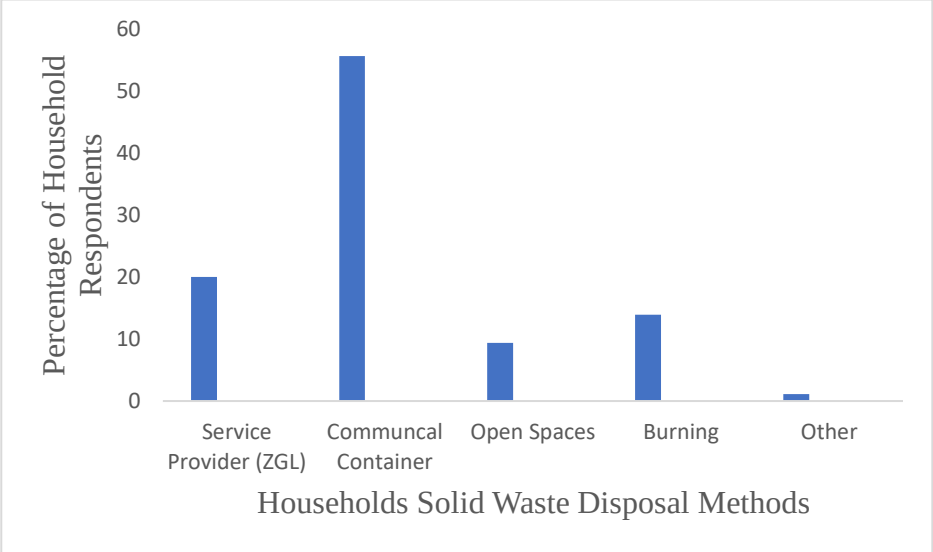

Figure 4: Household Respondents SW Disposal Methods

In addition, during the fieldwork, the researcher witnessed that there was irregular emptying of the CCCs, as some CCCs were seen overflowing with waste and children openly defecating near the CCC. Meanwhile, 88.3 % of the household respondents who had access to waste collection, relied on the CCC. Figure 5 shows a CCC with waste spillage due to irregular emptying of a CCC.

Figure 5: A Communal Collection Container over-flowing with waste

The consequences of poor waste management affect all members of a community and may have transient bounds. Failure of one individual to dispose of waste properly can have a very negative impact on the health and general well-being of the whole community. The spread of diseases was realized as the major effect of poor waste management in the Wa Municipality, as records from the Municipal Hospital revealed that the majority of the patients who reported at the outpatient department were diagnosed to be suffering from malaria and cholera. Disposal of SW into drains leads to the choking of drains and makes the drains serve as breeding grounds for mosquitoes and other flies that cause malaria and cholera respectively. In addition, the choked drains due to indiscriminate SW disposal have contributed to flooding at the least rain in the Wa

Municipality. Figure 6 illustrates a drain that was getting choked by illegal dumping of waste.

Figure 6: A Drain being choked by illegal dumping of waste

3.3 Solid Waste Management Possible Contribution to the SDGs

Managing SW properly has a very positive effect on society, economy and the environment. However, the current scenario of SWM in the Wa Municipality does not present opportunities for SWM to contribute to the attainment of some of the waste-reacted SDGs, as the SWM system involves some SW storage, collection, transport, and final open dumping without treatment. There was no segregation of SW at the generation point and there was no formal recovery of resources from the SW before disposal. Conversely, informal resource recovery was undertaken by informal waste collectors, who moved from house to house to collect or purchase recoverable such as metals and rubber materials, and scavengers who collected some recoverables from various open dumping sites scattered across the municipality. The SWM flow in the Wa Municipality is shown in Figure 7.

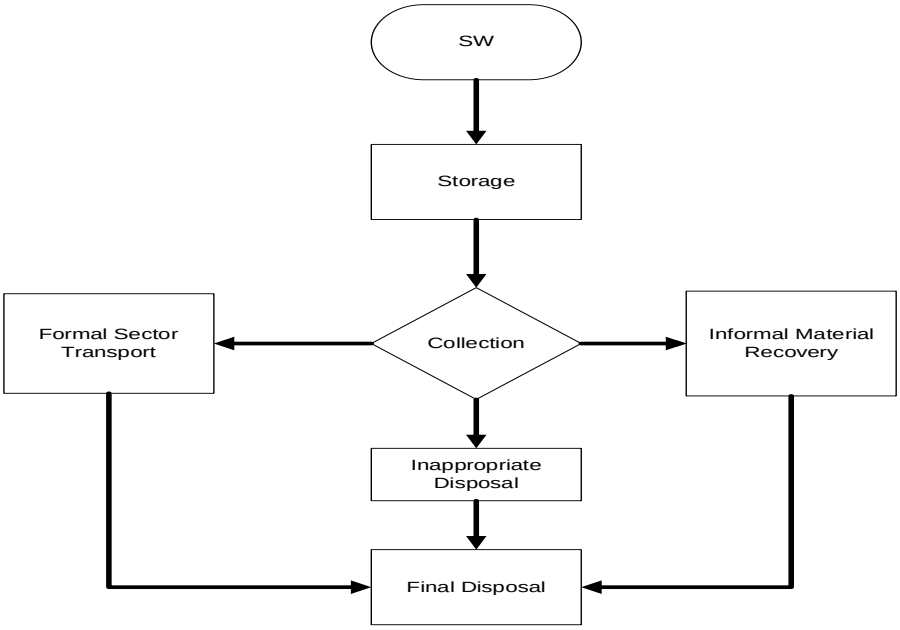

Figure 7: SWM flow in the Wa Municipality

Source: adapted from Bowan, Kayaga and Fisher (2020)

Nevertheless, Rodic and Wilson (2017) posit that SWM is a traversing issue that affects and impacts various areas of SD in each of the three sustainability domains: ecology, economy, and society; the affected areas include living conditions, sanitation, public health, marine and terrestrial ecosystems, access to decent jobs, as well as the sustainable use of natural resources. Accordingly, out of the 17 SDGs of the 2030 Agenda for Sustainable Development, at least ten (10) SDGs and their pertinent targets have a direct link to SWM (Elsheekh *et al.*, 2021; Sharma *et al.*, 2021). Table 2 illustrates these 10 SGDs and their specific targets that can contribute to the attainment of the 2030 Agenda for SD. Therefore, improvement in SWM, through appropriate SWM processing and/or disposal technologies such as composting, recycling, and the adoption of the 3Rs strategy to waste management, is required to enable SWM to possibly contribute to the attainment of some of the SDGs in the Wa Municipality.

Table 2: 10 SGDs that can contribute to the attainment of the 2030 Agenda for SD

Sustainable Development Goal (SDG)	Specific Target	Solid Waste Management Possible Contribution
SDG 1: No poverty	1.4: Ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources and financial services, including microfinance	Reuse and recycling have a significant potential for job creation
SDG 3: Good health and well-being	3.2: End preventable deaths of children under 5 years 3.3: End malaria and combat water-borne diseases 3.9: Reduce illnesses from hazardous chemicals and air, water and soil pollution, and contamination	Effective SWM can prevent the spread of diseases, which will lead to good health and well-being
SDG 6: Clean water and sanitation	6.3: Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous materials	Environmentally sound management of all wastes, particularly hazardous wastes (either chemical or biological hazardous wastes), can prevent water pollution
SDG 7: Affordable and clean energy	7.2: Increase the share of renewable energy in the global energy mix	Effective waste collection and the application of waste-to-energy technologies can contribute to the energy energy mix
SDG 8: Decent work and economic growth	8.1: Promote inclusive and sustainable economic growth, employment and decent work for all	In developing countries, SWM services are often provided by individuals and small and microenterprises. Any measures applied to support them will improve livelihoods
SDG 11: Sustainable cities	11.1: Ensure access for all to adequate, safe, and affordable basic services; upgrade slums 11.6: Reduce the adverse environmental impact of cities; special attention to waste management	Access for all to adequate, safe, and affordable solid waste collection services
SDG 12: Responsible consumption and production	12.4: Environmentally sound management of chemicals and all wastes to minimize their adverse impacts on human health and the environment 12.3: Halve global food waste and reduce food losses along production and supply chains 12.5: Reduce waste through prevention, reduction, recycling, and reuse	Elimination of uncontrolled dumping and open burning substantially reduces waste generation through prevention and the 3Rs (reduce, reuse, recycle) and thereby creates 'green' jobs
SDG 13: Climate action	13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	Adequate SWM practices can prevent emissions of large amounts of greenhouse gases
SDG 14: Life below water	14.1: Prevent marine pollution of all kinds, in particular from land-based activities, including marine debris	Extending waste collection to all and eliminating uncontrolled dumping will prevent waste (particularly plastics) from ending up in the oceans.
SDG 15: Life on land	15.1: Ensure the conservation of terrestrial and inland freshwater ecosystems and their services	Avoidance of indiscriminate solid waste disposal

Source: adapted from (Rodic and Wilson, 2017; Elsheekh *et al.*, 2021; Sharma *et al.*, 2021)

4.0 Conclusion

Effective SWM contributed to the attainment of some of the MDGs, particularly MDGs on livelihoods and poverty (MDGs 1 and 7), health-related MDGs 4, 5 and 6, and MDG 8, which was on global partnerships. Similarly, appropriate SWM has the potential to contribute to the achievement of many of the SDGs, even though SWM is not specifically mentioned in any of the 17 SDGs. The study assessed the potential of SWM contribution to the attainment of some of the SDGs, using the Wa Municipality in Ghana as a case study. The study adopted an explanatory sequential research design and applied both quantitative and qualitative research methods. The study revealed that the current scenario of SWM in the Wa Municipality involves some SW storage, collection, transport, and final open dumping of the SW without treatment, which does not present opportunities for SWM to contribute to the attainment of some of the waste-related SDGs. Improvements in SWM in the Wa Municipality, through the adoption of appropriate SWM processing technologies will substantially contribute to better living conditions and better health for residents and possibly lead to the attainment of some of the SDGs, as SWM is an integral component of actions for achieving some of the 17 SDGs.

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Conflict of interest declaration

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