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Research Article

DETERMINANTS OF SOLID WASTE DISPOSAL PRACTICES AMONG HOUSEHOLDS

[1,] *Isaac Kwasi Henyo, [2]Dr. Daniel Buor, [3]Divine Odame-Appiah and [4]Seth Agyemag

[1]Faculty of Education, Catholic University of Ghana, Fiapre, Ghana
[2, 3,4]Department of Geography and Rural Development, Kwame Nkrumah University of Science and Technology, Ghana

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Abstract

The rate of waste generation is alarming, especially in developing countries where governments spend considerable financial resources to manage waste. It is anticipated that, by 2050, the world will generate 73% more municipal solid waste than in 2020. As a result, thisstudy examined the factors that determine household solid waste disposal practices in the Sunyani Municipality. In this quantitative study, asurvey research design was adopted, and questionnaires were administered to 354 respondents. Both inferential and descriptive statistics were employed to analyse the data collected, which were entered into SPSS (version 24.0). The study found that domestic solid waste accounted for the majority of urban waste, due to the large volumes generated by households and the varied types of solid waste dumped daily. Households used polythene bags/sacks, covered and uncovered containers and standard waste bins as receptacles to store waste for a maximum of one week before final disposal. Public dumping (Central container) was the mostcommon method of solid waste disposal. However, the study found that the association between the status of place of residence, household income level, and the process of solid waste disposal was statistically significant. The municipality's current approach to waste disposal warrants attention, and recommendations are provided. The study recommends that waste managers educate residents on the benefits of sorting solid waste into various components before disposal. More waste containers should be provided to serve all residents living in low-, medium-, or high-income areas. The Theory of Planned Behaviour (TPB) was adopted in this studyto clarify the factors influencing human behaviour and decision-making. The Theory of Planned Behaviour (TPB) is a psychological theory that links beliefs to behaviour. The study confirmed that personal attitudes encompass the overall evaluation of behaviour, including both positive and negative approaches to solid waste management. Philosophically, the Environmental Ethics ideology, which emphasises the intrinsic value of nature, is reflected in the study. Central to this ideology is the interconnectedness of the environment and the responsibility residents have to protect it to maintain ecological balance. The Integrated Sustainable Waste Management (ISWM) framework is a holistic approach to waste management that prioritises sustainability and efficiency. It encompasses waste reduction, efficient collection systems, recycling, and resource recovery, as well as environmentally responsible disposal methods when necessary.

Keywords: Siddha Medicine, Hindu Sacred Plants, Anticancer Activity, Ethnopharmacology, Phytochemicals, Traditional Medicine, Rasayana Therapy, Oxidative Stress, Apoptosis and Medicinal Plants.

INTRODUCTION

Waste is any material which comes from domestic, commercial, and industrial sources arising from human activities which has no value to people who possess it and is discarded as useless (Adewumi & Ajibade, 2015) while the Ghana Statistical Service (GSS, 2021) defines solid waste as the range of garbage materials (food waste, garden waste, plastic waste, scraps, and others) arising from animal and human activities that are discarded as unwanted and useless. The rate of waste generation is very high, especially in developing countries, where governments spend considerable financial resources, often between 20%-50% of the government's budget, to manage waste (World Bank, 2019). It is anticipated that, by 2050, the world will generate 73% more municipal solid waste in a business-as-usual scenario than in 2020. The increase in waste generation is driven by economic development, urbanization and population growth (World Bank, 2021). World Bank (2021) asserted that high-income countries produce the most waste per capita. In contrast, middle-income countries like Ghana are projected to see the largest increases in both per capita and total waste generation over the next 30 years, driven by rapid economic and population growth.

***Corresponding Author:** *Isaac Kwasi Henyo,*
Faculty of Education, Catholic University of Ghana, Fiapre, Ghana

Urbanisation will additionally contribute to this process as higher urban consumption patterns replace rural ones (World Bank, 2021). Waste collection rates vary widely with national income levels. In high-income countries, collection rates are close to 100%. However, in lower-middle-income countries, collection rates are 51%, while in low-income countries they are only 39%. Uncollected waste in low-income countries is typically managed independently by households and is openly dumped, burned, or, less commonly, composted. Collection rates are substantially higher in urban areas than in rural areas, as waste management tends to be an urban service (World Bank, 2021). Globally, 33% of waste is openly dumped; 37% is disposed of in various types of landfills; 19% is recovered via recycling and composting, and 11% is treated in incinerators. Open dumping is prevalent in low-income countries, where 93% of the waste is burnt or dumped. In Ghana, about 12,710 tons of solid waste is generated daily, with only 10% collected and disposed of at designated dumping sites (Lissah et al, 2021). A significant challenge in the management of solid waste in Ghana is the collection and disposal process, which are labour-intensive and often not effective. In urban cities in Ghana, issues relating to proper solid waste disposal is a significant challenge for the local government authorities. For instance, the Ghana Statistical Service (GSS, 2021) found that tricycles accounted for 13.2% of solid waste collection methods and are essentially an urban phenomenon. Also, 1 in 10 households (11.1%) does not have

any receptacle for solid waste generated (GSS, 2021). As a result, the World Bank (2021) in their "Bridging the Gap in Solid Waste Management" report indicated that, "the environmental impact of inadequate waste management practices and the growing quantities of globally generated waste give serious reasons for concern." The substantial quantities of waste that either go unmanaged or are inadequately managed are unacceptable. At the same time, quantities are only increasing. This rapid increase in quantities alone will require significant effort to maintain the status quo. Without drastic improvement in waste collection coverage and waste recovery and disposal practices, the scale of current environmental impacts will increase markedly. The Organisation (WHO, 2017) has stated that improper disposal of medical waste can cause diseases such as parasitic infections, lung infections, skin infections, HIV, hepatitis B and C viruses, candida, meningitis and bacteraemia. However, in Ghana, only a third (33.4%) of households have their solid waste collected, and the proportion is strikingly higher in urban areas (51.4%) than in rural areas (5.8%). Most rural households (57.3%) use public dumps or open spaces for solid waste disposal, compared with 24.6% in urban households. The most prevalent method of disposing of uncollected solid waste is burning (77.5%), with nine in 10 urban households (88.0%) and seven in 10 rural households (66.8%) burning their uncollected solid waste (GSS, 2021). Residential solid waste poses significant environmental challenges, and the District or Municipal Assemblies are generally responsible for waste management. They have to provide effective waste management for the inhabitants. However, they often face many challenges beyond their capacity to handle, due to a lack of operational resources.Household waste is usually generated from various sources where different human activities occur. Results from many studies show that solid waste generated in developing countries is mainly from households (55–80%), followed by market or commercial areas (10–30%). The latter consists of variable quantities generated from industries, streets, institutions and many others (Nabegu, 2016).

Generally, municipal solid waste is heterogeneous. Thus, they vary physically and chemically. They include textile materials, food waste, plastics, paper, rubber, leather, batteries, and many others that are difficult to classify. The heterogeneous nature of municipal solid waste is a significant obstacle to sorting and processing it. Consequently, there is a need for a fractional process and sorting of the solid wastes before they can be put to use. However, success in solid waste separation depends mainly on public awareness and the active participation of waste generators in different communities (Valkenburg, Walton, Thompson, Gerber, Jones, & Stevens, 2018). Increased generation of solid waste leads to sanitary-related problems and affects basic services such as sanitation facilities, water supply, waste management, and transport infrastructure. Solid waste is one of the important challenges to the environment. The inadequate waste management causes alteration of the ecosystems including air, water, and soil pollution; thus, it represents a real threat to human health. However, a holistic assessment of the efficient or quality of waste management services cannot be complete without views from patron of the waste service so provided (Udofia *et al.,* 2018). Cities in Africa along with most developing countries are facing the same serious problems related to municipal solid waste. This is a poverty-related problem and most of these developing countries fail in solid waste management due to the limited resources which compete with other problems for attention (Okot-Okumu & Nyenje, 2017). It is noted that solid waste and its composition is influenced by socioeconomic factors such as average family size, number of rooms at home, income level, and employment status (Sankoh, Yan &Conteh, 2015).

Oelofse *et al.* (2018) posit that solid waste collection mainly involves people and a means of transport to a transfer station, treatment facility, or final dumping site. Kadafa, Manaf, and Sulaiman (2014) pointed out that there are three major phases of waste collection in Africa. These, according to them, are the informal phase, the primary phase, and the secondary phase. The informal and primary phases are the ones from household to community collection points. Formal institutions, such as urban councils and private operators, are responsible for the secondary phase (Owusu-Nimo, Oduro-Kwarteng, Essandoh, Wayo & Shamudeen, 2019). Wastes are usually transported from community transfer points to landfills or final disposal sites. The unplanned siting of dump sites or communal containers could pose a threat to water resources, particularly rivers and streams. Eventually, boreholes, hand-dug wells and other groundwater sources are also affected (Kretchy *et al.,* 2019; Boateng *et al.,* 2019; Owusu-Nimo *et al.,* 2019).

In Sub-Saharan Africa, waste collection systems such as communal container collection methods appear most dominant in many nations (Awuah, 2018; Lloyd, 2019; Lagerkvist, and Dahlen, 2019). In this kind of system, common containers (waste bins) are provided at dedicated points within neighbourhoods for households to drop off their solid waste. Trash collection vehicles then pick up these containers empty off the trash at designated disposal spots and return the containers to their original locations. However, this trash collection method is fronted with several difficulties most of the time leading to uncollected waste. Thus, there is an overflow of waste, ground dumping at collection sites, and at unauthorized spaces (Atkinson *et al.,* 2019). Private operators have also been utilized in waste collection. They collect waste directly from households by door-to-door approach.

Ghana finds itself in an environment where waste is rather seen as a problem than a resource(Connelly, 2017). The 2022 Environmental Performance Index (EPI) which offers a data-rich sustainability scorecard that translates cutting-edge scientific findings into policy insights, using 40 performance indicators across 11 issue categories, the EPI ranked Ghana 170 out of 180 countries in terms of their national efforts to protect environmental health, enhance ecosystem vitality, and mitigate climate change. With a scorecard of 27.7, Ghana placed 45th in the Sub-Sahara (EPI, 2022). There is the need for many studies in the area of waste management to uncover the various approaches used by households to dispose of solid waste in order to identify ways of changing waste to resource. Sustainable Development Goal Six is about ensuring availability and sustainable management of water and sanitation for all. Explicitly it is captured as, "Ensure availability and sustainable management of water and sanitation for all."Water sources are better preserved if open defecation is ended and sustainable sanitation systems are implemented (UNDP, 2017). Waste mismanagement imposes a significant burden on ecosystems and threatens to undermine public health,while industrialized countries in the Global West score highly in this issue category, countries in Southern Asia and Sub-Saharan Africa earn low scores in Waste mismanagement (EPI, 2022). The way and manner and

conditions under which solid waste collection, keeping and disposal is done poses a major environmental problem in African cities and urban areas. Improper management of such waste is leading to problems that affect soil, water, air, and aesthetic beauty. There is, therefore, an increase in greenhouse gas emissions which results in health disorders (Weigand, Fripan, Przybilla&Marb, 2013; EPI, 2022)

Those at risk from improper disposal of solid waste include those living in areas of poor waste disposal methods. This includes children, waste workers, and workers in facilities directly linked to waste materials. Other high-risk group include population living close to a waste dump and those whose water supply has become contaminated either due to waste dumping or leakage from landfill sites. Uncollected solid waste also increases the risk of injury and infection (Kretchy *et al.,* 2019; Boateng *et al.,* 2019; Owusu-Nimo *et al.,* 2019). Organic domestic solid waste poses a serious threat, since they ferment, creating conditions favourable to the survival and growth of microbial pathogens. Direct handling of solid waste can result in various types of infectious and chronic diseases, with the waste workers and the rag pickers being the most vulnerable (Francis-Xavier *et al.,* 2018; Hussein & Mona, 2018). As a result, this study examined the various approaches used by households to dispose of solid waste in the Sunyani Municipality.

Theoretical Framework

The Theory of Planned Behaviour (TPB) is a well-known social psychological theory that explains the factors affecting human behaviour and decision-making. It was proposed by Azjen in 1985 and links beliefs to behaviour. The TPB focuses on three key factors that influence human actions. First, personal attitudes involve our overall assessment of the behaviour, including the positive and negative aspects we associate with it. Second, subjective norms relate to our perception of others' attitudes and expectations regarding the same behaviour, rather than their actual opinions. Lastly, perceived behavioural control concerns our belief in our ability to perform and manage the behaviour, taking into account internal factors like self-efficacy and motivation, as well as external factors such as available resources and support. Collectively, these elements significantly influence a person's intention to carry out a specific action, which in turn affects their actual behaviour. According to TPB, an individual's intention to perform a particular behaviour is the main determinant of whether they will actually engage in it. This intention is shaped by three main components: their attitude towards the behaviour (perceived benefits and disadvantages), subjective norms (social pressures and perceived expectations), and perceived behavioural control (their confidence in their ability to perform the behaviour). These factors were found to collectively influence the waste management practices of respondents in the study. The TPB has been widely applied to various aspects, including respondents' use of different waste collection containers, the duration waste is kept at home, and the selection of waste disposal methods. Theory of Planned Behaviour is a useful framework for understanding waste disposal practices. Pongpunpurt et al., (2022), found that knowledge and subjective norm were significant predictors of waste separation intention and behaviour in a housing community. Siahaan (2020), found that attitudes and the availability of trash cans influenced proper garbage disposal behaviour in public places. Apinhapath (2014), combined community mapping and the Theory of Planned Behaviour to propose an effective method for solid waste management. Taylor and Todd (1995), developed an integrated waste management behaviour model based on the Theory of Planned Behaviour, which successfully explained intentions to engage in recycling and composting.

Philosophical foundation of the study

Environmental ethics is a branch of ethics focused on the moral principles guiding our relationship with the environment. It highlights the intrinsic worth of nature, responsibility, sustainability, and recognition of non-human rights. At its core is the idea of interconnectedness and the duty humans have to safeguard the environment, considering the ecological footprint of their actions. Environmental ethics also explores environmental justice issues and plays a vital role in shaping policy and encouraging sustainable practices that respect the environment and all its species. This philosophy stresses the moral obligation of individuals and societies to protect the environment and foster sustainable practices. Applying this philosophy can lead to more environmentally aware waste management methods. Akinyele (1997) concentrates on the eco-ethical perspective of toxic waste dumping and investigates the motivations behind this damaging practice. Schwartz (2008) links moral philosophy to nuclear waste disposal, proposing that a container-repository system in thermodynamic equilibrium is ethically acceptable. Omar *et al.,* (2018) studied the Islamic ethics of waste management and emphasise the role of Islamic teachings in promoting sustainable environmental health.

Conceptual framework of the study

The Integrated Sustainable Waste Management (ISWM) framework is a comprehensive approach to waste management that prioritises sustainability and efficiency. It covers waste reduction, effective collection systems, recycling, resource recovery, and environmentally responsible disposal methods when needed. ISWM stresses public awareness and education, government policies and regulations, technological innovation, economic viability, social inclusivity, and environmental sustainability. The ISWM methodology has been successfully implemented in the waste management sector for the past 15 years. Topić and Biedermann (2015) apply the ISWM model based on the Life-Cycle approach to the region of Republika Srpska, highlighting the need for strategic and managerial reforms to handle waste in a cost-effective and environmentally sound way. This concept is highly applicable to the Sunyani Municipality, as the study area lacks a well-organised waste management system. Waste management is mostly left to individuals, whose poor managerial skills impact the community as a whole. Memon (2010) discusses the implementation process of ISWM, including baseline studies, goal setting, and establishing monitoring systems, emphasising the importance of resource recovery and recycling. Wilson et al. (2015) address the lack of consistent data in solid waste management and introduce an indicator set for benchmarking ISWM performance in cities, covering both physical components and governance issues. An interview with sanitation officers at the Asufufu dumpsite revealed that there is no data on the volume of solid waste dumped daily at the site. The number of truckloads of waste is not recorded, which hampers planning.

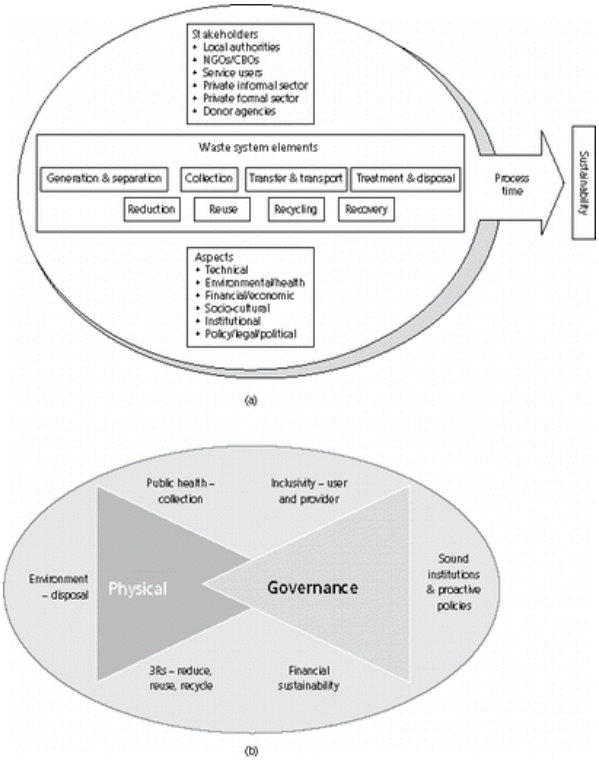

Fig. 1 ISWM framework (Topić & Biedermann, 2015)

MATERIALS AND METHODS

The study was conducted in the Sunyani Municipality. Sunyani Municipality is one of the twelve (12) Administrative Districts in the Bono Region of Ghana. It lies between Latitudes 7° 20'N and 7° 05'N and Longitudes 2° 30'W and 2° 10'W, sharing boundaries with Sunyani West Municipality to the North, Dormaa East District to the West, Asutifi District to the South, and Tano North District to the East. The Municipality covers a total land area of 829.3 square kilometres (320.1 square miles) with a population of 193,595, accounting for 16.0% of the entire Bono region (GSS, 2021). Sunyani serves as the Regional Capital for Bono Region (GSS, 2021; Sunyani Municipal Assembly, 2023). The municipality was selected based on its population size, economic activities, and the amount of waste generated by residents. Sunyani has been praised as a clean and well-maintained city with a thriving economy, which is mainly agrarian, with 40% engaged in agriculture while the rest are employed in services, commerce, and industry (Sunyani Municipal Assembly, 2023). The most common method of solid waste disposal is by public dump in containers, followed by open space dumping and burning of solid waste (GSS, 2014).

Research Philosophy

The research philosophy adopted for the study is pragmatism, as pragmatists believe that truth is discovered through the process of verification (Legg & Hookway, 2020). Using quantitative and numerical methods, data was collected, and a survey research design was employed for the study. Queirós *et al.* (2017) stated that surveys are research techniques that enable the direct collection of data from participants through a series of questions arranged in a specific order. Surveys are among the most widely used quantitative methods because they allow researchers to gather information about a specific phenomenon by asking questions that reflect the opinions, perceptions, and behaviours of a group of individuals (Creswell, 2014; Antwi & Hamza, 2015). The design of this study was suitable because it allowed the researcher to obtain information directly from households regarding the various methods they use to dispose of solid waste within the municipality. Surveys are highly representative of the entire population, cost-effective, straightforward to administer and analyse using statistical techniques, and not influenced by the researcher's subjectivity. In this approach, the researcher selects a sample of participants and collects data through questionnaires or interviews (McMillan & Schumacher, 2014; Queirós *et al.,* 2017); therefore, the study employed questionnaires for data collection.

Population of the Study

The targeted population for the study was all the urban households in the municipality with a population of 156,343 (GSS, 2021). However, the average household size of urban communities of Bono region stands at 3.4 giving a household number of 45983in the municipality (GSS, 2021). Using the Krejcie & Morgan (1970) samplesizetable, a total of 354 households were selected for the study. A purposive sampling technique was used to select a household head who happens to be the one chosen by the household to be in charge of waste management in the household, making a total sample size of 354 respondents. Nonetheless, preference was given to adults aged at least 18 years, which is the legal adult age. Also, the sampling of houses was systematic to avoid concentration of respondents in few houses and to ensure fair distribution.

Instruments of Data Collection

The main instrument for data collection was a self-administered questionnaire. This was used to gather primary data for the study. However, in cases where respondents could not complete the questionnaire on their own, a face-to-face interviewer-administered questionnaire technique was adopted. The questionnaires consisted solely of closed-ended items, where respondents were required to select the option that best represented their practices. The questionnaire was divided into two sections: Section A sought information on the demographic characteristics of respondents, such as age, gender, and the number of years they had lived in the community. Section B contained items on how solid waste is collected, stored, and ultimately disposed of. Research assistants were trained to assist in the data collection. Researchers officially sought the consent of opinion leaders, especially chiefs, Municipal Assembly and participants were informed of the purpose of the study, the nature and extent of their engagement in the study. Data were verified and entered into SPSS, version 24.0. Descriptive statistics such as the use of frequencies and percentages were carried out to describe the responses provided on the various approaches used by households to dispose solid waste. Inferential statistics such as Pearson Chi-square was also used to determine association between status of place of residence, household income level and disposal method.

RESULTS AND DISCUSSION

Socio-demographic background of respondents

The socio-demographic characteristics of the respondents included their sex, age, level of education, income level, place of residence, length of stay in the community, and distance

from home to the public dumpsite. The study's respondents consisted of 28.8% (N=102) males and 71.2% (N=252) females. Most respondents were aged between 31 and 60 years (49.4%, N=175), followed by 43.2% (N=153) aged 18 to 30 years. Over 7% (7.4%, N=26) were 60 years or older. Additionally, 9.9% (N=35) had no formal education, 28.5% (N=101) had a basic level of education, 37.0% (N=131) had completed secondary education, and 24.6% (N=87) had attained tertiary education. Regarding the status of place of residence, 24.6% (N=87) indicated a low status, 56.2% (N=199) a middle status, and 19.2% (N=68) a high status. Moreover, 29.4% (N=104) indicated a low level of income, 48.9% (N=173) disclosed a middle-income level while 21.7% (N=77) were high income level earners. Respondents further indicated that, they had either stayed in the community for less than a year (5.9%, N=21) to about 11 years and above (37.9%, N=134). On distance from a public dumpsite (either open space or central container) to the homes of respondents, 7.6% (N=27) lived as close as less than 100m whiles 34.7% (N=123) lived 400m and above to the dumpsite as shown in Table 1.

Table 1. Socio-demographic background of respondents

Variable	Category	Frequency (N)	Percent (%)
Sex	Male	102	28.8
	Female	252	71.2
Age (completed years)	18-30	153	43.2
	31-60	175	49.4
	60+	26	7.4
Educational level	No Formal Education	35	9.9
	Basic	101	28.5
	Secondary	131	37.0
	Tertiary	87	24.6
Status of place of residence	Low	87	24.6
	Middle	199	56.2
	High	68	19.2
Income level	Low	104	29.4
	Middle	173	48.9
	High	77	21.7
Length of stay in the community	less than 1 year	21	5.9
	1 to 5 years	90	25.4
	6 to 10 years	109	30.8
	11 years +	134	37.9
Distance from home to community dumpsite	< 100 m	27	7.6
	100m to < 200 m	41	11.6
	200 m to < 300 m	59	16.7
	300 m to < 400 m	104	29.4
	400 m plus	123	34.7
	Total	354	100.0

Source: Filed survey, 2023

Approaches Used by Households to Dispose of Solid Waste

The items measuring the approaches used by households to dispose solid waste consisted of how solid waste is collected, stored, transported and finally disposed.

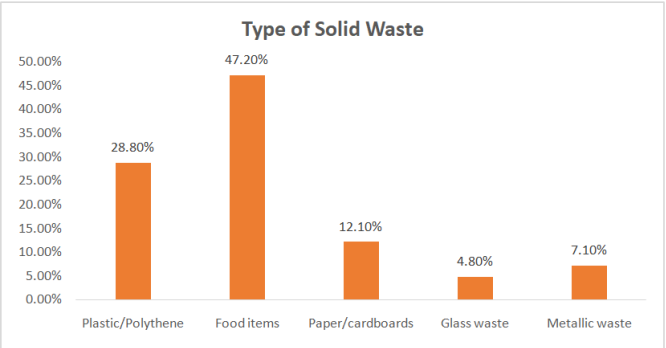

Figure 1. Type of Solid Waste

The study realized that 47.2% of solid waste generated by households in the Sunyani Municipality are food items, 28.8% is plastic/polythene waste, 12.1% ispaper/cardboard waste, 4.8% isglass waste, and 7.1% is metallic waste. This shows a higher percentage of food item waste being generated by households followed by increasing plastic/polythene waste in the Municipality. The study revealed that residents in the area utilised various waste containers, such as polythene bags (6.2%, N=22), sacks (10.7%, N=38), buckets (11.6%, N=41), covered waste bins (29.1%, N=103), uncovered waste containers (26.6%, N=94), and Zoom Lion waste bins (15.3%, N=56). The most frequently used option was covered waste bins. Households in the municipality generated between one and two polythene bags (24.3%, N=86) of solid waste daily, progressing to one Zoom Lion waste bin (ZL) in three weeks or longer (15.3%, N=56). Most households did not sort solid waste prior to final disposal (79.7%, N=282) nor compost organic waste (84.7%, N=300). Regarding temporary storage before disposal, 34.4% (N=122) indicated that waste is usually kept for 1-3 days, 26.3% (N=93) for 4-6 days, and 22.6% (N=80) for a week. About 17% (16.7%, N=59) retain their waste until the receptacle is full. Consequently, most respondents (87.0%, N=308) reported rotting (decomposition) of solid waste at home. At home, most respondents (38.4%, N=136) preferred to keep their receptacle at the side of the house, followed by 24.6% (N=87) who kept it at the back, and 22.3% (N=79) who kept it at the front. Additionally, 9.3% (N=33) preferred the kitchen, while 5.4% (N=19) kept it in a pit. Common disposal sites for solid waste included public dumps with municipal containers (54.8%, N=194). These public dumps often had an open space (23.7%, N=84), alongside options for burying (10.5%, N=37), open burning (6.8%, N=24), and indiscriminate dumping (4.2%, N=15). The most popular disposal site was the public dump with a central container. The study further examined the various approaches used to convey solid waste to disposal sites and found that the majority (34.7%, N=123) used tricycles (aboboyaa). Other means included door-to-door service (19.2%, N=68), carrying to disposal sites (14.1%, N=50), the use of wheelbarrows (3.1%, N=11) and through scrap collectors (7.3%, N=26). In all 21.5% (N=76) did convey their solid waste from their homes and either engaged in burying or open burning.

Association between Waste Disposal Method, Status of place of residence and Household Income level

The Pearson Chi-square Test was employed to determine the association between Status of place of residence, household income levelandplaces where households often disposed their solid waste (Disposal method) at a 95% Confidence interval as shown by Table 3. The study found a statistically significant association between the type of residence and the common disposal methods for household solid waste ($X2$ = 9.610, p< 0.05). Consequently, residents living in low-status homes (22.9%, N=81) tended to use open spaces for disposal, including burying, open burning, and indiscriminate dumping. The majority of those in middle-status residences (48.9%, N=173) preferred disposal in public dumps, whether in containers or open spaces, while most residents in high-status residences (15.3%, N=54) mainly used public dump containers. There is a statistically significant association between household income levels and the frequency with which households dispose of their solid waste ($X2$ = 7.154, p<0.05).

Table 2. Solid waste management practices by households

Variable	Category	Frequency (N)	Percent (%)
Type of receptacle used to store solid waste	Polythene bag	22	6.2
	Sack	38	10.7
	Bucket	41	11.6
	Covered waste bin	103	29.1
	Uncovered waste	94	26.6
	Zoom Lion Waste bin	56	15.3
Volume of solid waste generatedby household per day	1-2 Polythene full	86	24.3
	1-2 Sack full	73	20.6
	1-2 Bucket full	60	16.9
	1 Waste bin (ZL) in 1-2 weeks.	79	22.3
	1 Waste bin (ZL) in 3 weeks and above	56	15.3
Sortingof solid waste before final disposal	Yes	72	20.3
	No	282	79.7
My household composts organic waste	Yes	54	15.3
	No	300	84.7
How long is solid waste often kept at home before disposal	One to three days	122	34.4
	Fourto Six days	93	26.3
	Weekly	80	22.6
	Till the receptacle gets full	59	16.7
Ever experienced rotting (decomposition) of solid waste at home	Yes	308	87.0
	No	46	13.0
Where at home do you keep solid waste	Kitchen	33	9.3
	Back of the house	87	24.6
	Front of the house	79	22.3
	Side of the house	136	38.4
	In a Pit	19	5.4
How do you often dispose of your solid waste	Public dump (container)	194	54.8
	Public dump (Open space)	84	23.7
	Burying	37	10.5
	Open burning	24	6.8
	Dumped indiscriminately	15	4.2
How do you convey your waste to dump site	Door-to-door service	68	19.2
	Carry to a collection point	50	14.1
	Tricycle collection	123	34.7
	Wheel barrowers	11	3.1
	Scrap collectors	26	7.3
	Not at all	76	21.5
	Total	354	100.0

Table 3. Association between waste disposal method, status of place of residence and household income level

Waste Disposal Method	Status of place of residence			Household Income level		
	Low	Middle	High	Low	Middle	High
Public dump (container)	6 (1.7%)	134 (37.9%)	54 (15.3%)	7 (2.0%)	125 (35.3%)	63 (17.8%)
Public dump (Open space)	34 (9.6%)	39 (11.0%)	11 (3.1%)	49 (13.4%)	30 (8.5%)	5 (1.4%)
Burying	19 (5.4%)	15 (4.2%)	3 (0.8%)	17 (4.8%)	11 (3.1%)	9 (2.5%)
Open burning	15 (4.2%)	9 (2.5%)	0 (0.0%)	19 (5.4%)	5 (1.4%)	0 (0.0%)
Dumped indiscriminately	13 (3.7%)	2 (0.6%)	0 (0.0%)	12 (3.4%)	3 (0.8%)	0 (0.0%)
X^2(P-value)	9.610 (0.003)				7.154 (0.027)	

p-value<0.05, statistically significant, X^2: Chi-Square

Households with middle to high incomes often dispose of their solid waste in a central container, whereas low-income households frequently dispose of waste in open spaces, engage in open burning, and dump waste indiscriminately.

DISCUSSION

The study aimed to examine the different methods households in the Sunyani Municipality use to dispose of solid waste. The socio-demographic characteristics of the respondents included their sex, age, level of education, income level, residential status, length of stay in the community, and distance from home to the public dumpsite. Out of the 354 household heads selected for the study, females (71.2%, N=252) were the majority. The average age of respondents was approximately 31-60 years (49.4%, N=175). Additionally, most respondents (90.1%, N=319) had attained some form of formal education. Regarding residence status, the majority (56.2%, N=199) were classified as middle-status, while most (48.9%, N=173) fell within the middle-income bracket.

The methods used by households to dispose of solid waste focused on how waste was collected, stored, transported, and finally disposed of. The study found that, in the municipality, a significant portion of the solid waste generated consisted of food items (47.2%), with 28.8% being plastic or polythene waste, 12.1% paper or cardboard waste, 4.8% glass waste, and 7.1% metallic waste. This finding aligns with Nabegu (2016), who observed that municipal solid waste is heterogeneous in its composition. Therefore, waste varies physically and chemically, including textile materials, food waste, plastics, paper, rubber, leather, batteries, and many others that are difficult to classify. Boateng et al. (2016) similarly found that urban communities' main solid waste components were putrescible matter, plastics, paper, and inert waste. The study found that residents in the study area used various receptacles such as polythene bags (6.2%, n=22), sacks (10.7%, n=38), buckets (11.6%, n=41), covered waste bins (29.1%, n=103), uncovered waste containers (26.6%, n=94), and Zoom Lion waste bins (15.3%, n=56) to store solid waste, with the covered waste bin being the most common. A household generated an

average of 1-2 polythene bags (24.3%, n=86) full of solid waste per day. However, the majority of households did not practise sorting of solid waste before final disposal (79.7%, n=282), nor did they compost organic waste (84.7%, n=300). Boateng et al. (2016) also found that urban communities store solid waste using open containers, closed containers, and polythene bags or sacks. Nabegu (2016) reported that results from many studies show that solid waste generated in developing countries mainly comes from households (55–80%), while Valkenburg et al. (2018) agreed that sorting of solid waste before disposal is low since its success primarily depends on public awareness and the active participation of waste generators in different communities.

In terms of storing solid waste temporarily before disposal, the majority of the households kept the solid waste for a maximum of one week (83.3%, N=295) before final disposal; as a result, the majority of the respondents had experienced rotting (decomposition) of solid waste at home (87.0%, N=308). The receptacles for storing solid waste were preferably kept beside or at the back of the house (63.0%, N=223). Places where respondents often disposed of solid waste (known as methods of disposal) included public dumps where municipal containers were stationed (54.8%, n=194), public dumps with open spaces (23.7%, n=84), burying (10.5%, n=37), open burning (6.8%, n=24), and indiscriminate dumping (4.2%, N=15). The most popular disposal site was the public dump (central container). Solid waste was mainly transported to disposal sites via tricycles (34.7%, N=123), door-to-door service (19.2%, N=68), carrying waste directly (14.1%, N=50), use of wheelbarrows (3.1%, N=11), and scrap collectors (7.3%, N=26). However, 21.5% (N=76) of respondents also transported waste from their homes themselves and disposed of it by burying or open burning. [Relate the methods to household status (residential status, income, and education)]

In Sub-Saharan Africa, waste collection systems such as communal container collection methods are the most common in many nations (Awuah, 2018; Lloyd, 2019; Lagerkvist, and Dahlen, 2019). In this system, shared containers (waste bins) are placed at designated points within neighbourhoods for households to dispose of their solid waste. Boateng et al. (2016) agreed that communal container collection is the primary solid waste collection method in urban communities in Ghana. The Ghana Statistical Service (2021) also reported that only about a third (33.4%) of households have their solid waste collected, with a significantly higher proportion in urban (51.4%) than in rural (5.8%) areas. The most common method of disposing of uncollected solid waste is burning (77.5%), with nine in 10 urban households (88.0%) and seven in 10 rural households (66.8%) burning their waste. Additionally, most rural households (57.3%) use public dumps or open spaces for waste disposal, compared to 24.6% of urban households. Likewise, the World Bank Report indicates that open dumping is widespread in low-income countries, where 93% of waste is burnt or dumped (world Bank, 2021). The Ghana Statistical Service (GSS, 2021) found that the use of tricycles accounts for 13.2% of waste collection methods and is predominantly an urban practice.

The study examined the relationship between the place of residence and where households usually dispose of their solid waste, finding it to be statistically significant ($X2 = 9.610$, $p< 0.05$). This suggests that the residence status low, medium, or high determines the disposal method a household uses. Additionally, there is a statistically significant link between household income level and disposal practices ($X2 = 7.154$, $p< 0.05$). Households with middle to high income often dispose of their waste in a central container, whereas low-income households more frequently dispose of waste in open spaces, engage in open burning, and dump waste indiscriminately. Similar studies also found that cities in Africa along with most developing countries face serious problems related to urban solid waste which is poverty related, making these developing countries fail in solid waste management due to the limited resources which compete with other problems for attention (Okot-Okumu & Nyenje, 2017). Sankoh, Yan & Conteh (2015) noted that solid waste and its composition are influenced by socioeconomic factors such as average family size, number of rooms at home, income level, and employment status.

Conclusion and Recommendation

The study has highlighted that domestic waste constitutes most of the urban solid waste as households generate an average volume of 1-2 polythene bags per day. The solid wastes generated are also heterogeneous in nature; mostly food items and plastics. Households in the Sunyani Municipality use varied receptacles like polythenebags, buckets, covered waste bins, uncovered waste bins, and Zoom lion waste bins for storing waste. Solid waste generated was temporally stored at home, for a maximum of one week before disposal, leading to decomposition. As an urban municipality, the use of public dumps (central containers) was popular among households. Public dumps (open spaces), burying, open burning, and indiscriminate dumping still remained viable options for households to dispose of solid waste. The use of tricycles to convey solid waste was also the most common method. However, some residents transported their solid waste from their homes and either engaged in burying or open burning.
An association between residential status, household income level, and solid disposal sites (method of disposal) was statistically significant. Residents of lower socioeconomic status engaged in open space dumping, burning, burying, and indiscriminate dumping as opposed to status medium-high-status residents who mainly used the central container. Also, households with medium-high income levels used central containers more than the low-income group who mainly used open space, burning, or burying. The study found that sorting solid waste before disposal was hardly done. It is highly recommended that waste managers educate residents on the benefits of sorting solid waste into various components before disposal. This will enhance the effective management of solid waste and encourage recycling and organic composting. More waste containers should be provided to cover all residents living in low-, medium-, or high-income areas. More waste containers should be provided to serve all residents living at low, medium, or high elevations and income levels. This will help ensure fairness, accessibility, and proper usage to prevent the municipality from indiscriminate dumping, burning, or burying of solid waste that cannot be composted. Finally, waste managers should help provide standard covered containers for households to temporarily store solid waste. Decomposition of solid waste in uncovered containers, sacks, and polythene bags could spread disease and attract insects. It can also serve as breeding grounds for insects like mosquitoes, attracting stray animals, which may ultimately cause havoc for residents.

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APPENDIX

Table 1. Table for Determining Sample Size for a Finite Population

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

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