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WHY DOES SUB-SAHARAN AFRICA STRUGGLE TO IMPLEMENT A SOLID WASTE
MANAGEMENT SYSTEM? A CASE STUDY IN GHANA.

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ABSTRACT

Only 44% of waste is formally collected in Sub-Saharan Africa (Kaza et al. 2018). That makes solid waste management a major concern in the region. The development of an appropriate plan for the improvement of the system requires understanding the factors influencing its current state. Hence, this research analyses the potential of broader stakeholder engagement, particularly the perspective of the surveyed households from an urban area in Ghana. Our findings show an overall high willingness to be involved in the system and its decision-making management, despite poor knowledge on the topic.

Key words: Sustainable Solid Waste Management; Sub-Saharan Africa; Stakeholder Engagement; Individual Households' Survey in Ghana

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1. INTRODUCTION

As of 2016, the world generated an average of 2.01 billion tonnes of municipal solid waste (MSW). Facing a growing population and rapid urbanisation, worldwide, waste generation is expected to increase by 70% reaching 3.40 billion tonnes in 2050. However, this increase will not be equally spread around the world. In low-income countries (LIC) over 90% of waste ends up in unregulated dumps or is openly burned. Sub-Saharan Africa, producing 174 million tonnes of waste in 2016, comprises most LIC. Suffering the most rapid urbanisation, its waste is expected to more than triple by 2050 (Kaza et al. 2018). This fact, and increasingly higher material living standards, are a roadblock for efficient waste collection, leading rapid development to go together with increasing unhealthy urban environmental conditions and filth. Hence, while in Europe there's a 90% waste collection rate, in SSA only 44% of waste is formally collected, falling drastically outside urban areas (Kaza et al. 2018). In developing countries, several studies have highlighted the challenge of involving a broader range of local key stakeholders and giving them autonomy in the processes of creating a sustainable SWM system (Yeboah-Assiamah et al. 2017, Fobil et al. 2008, Wilson et al. 2013). This research used an online survey to households in an urban area in Ghana aiming to study the problem and role of local stakeholders. The conclusions are in line with literature review in the region of SSA, highlighting the importance of broader stakeholder engagement in the SWM system, from planning, to disposal and to evaluation.

The remainder of the paper is organised as follows. In section 2, a brief literature review is presented. Section 3 describes the research settings and methods. In section 4, the results and discussion are presented. In section 5, conclusions and recommendations are offered. Finally, the appendices include the map of the studied location, waste collection and stakeholder maps, and an analysis of the roles stakeholders have in the six Action Plan strategies.

2. LITERATURE REVIEW

2.1. A Sustainable Solid Waste Management System

A sustainable, and consequently successful, SWM system addresses both the physical and the “soft” governance aspects (Wilson et al. 2013). The physical issues regard the technical and tangible elements of SWM which consist of collecting, disposing and recycling of waste (Appendix 2, Figure A2). The “soft” governance elements regard barriers countries face when implementing a system, for example, social stigma, or the challenges of adapting people to a new waste paradigm. Hence, sustainability requires the integration of community and regional-specific needs (Yeboah-Assiamah et al. 2017). Nevertheless, one does not work without the other. In the past, the physical factors have often been the norm and, by excluding the governance aspects, have contributed to persisting poor waste management (WM) in many developing nations (e.g. as good as a waste collection system or modern technology are, if the communities are not effectively educated and engaged, the system overall will not work). Thus, the sustainability of a nation, or a system, goes beyond its physical capital, such as GDP, since it does not assess, for instance, the environmental cost for future generations of exploiting current natural resources. Rather, it must include natural, human and social capital, similar to the “governance” aspects, such as the investment on education or inclusivity (Heal 2012).

2.2. Overview of the SSA region

Effective WM comprises around 19% of municipal budgets in LIC, where the process is the most expensive (Kaza et al. 2018). Hence, for countries with lower financial resources, this is a limitation in what concerns creating proper WM and sanitation facilities. In SSA, the less developed cities and those with higher rates of uncollected waste experience worse urbanisation control. This is influenced by the persistence of slums and the complexity of the informal sector that takes over when human and technical resources to support the SWM system are lacking (Louikil and Rouached 2019). An analysis in 13 SSA countries classified

80% of the evaluated landfills at level 0 or 1 out of 5, which translates in low or non-existent levels of control of dumpsites, allowing for uncontrolled burning. These landfills are often non-engineered systems (e.g. don't have lining nor leachate collection systems, and no gas collection), which creates potential environmental hazards such as groundwater contamination. However, poor monitoring and data collection do not permit an accurate evaluation of contamination levels. Furthermore, with the few existing landfills with clay lining relying on imports, the system is increasingly economically unsustainable. Therefore, this demands that communities find lining materials using local content and suppliers (Idowu et al. 2019). Past analysis also highlights that collection indicators are normally created to fit developed countries' situations. Louikil and Rouached (2019) enhance that proper assessment and measurement in developing countries require indicators adapted to their own reality.

With rapid urbanisation and industrialisation kicking off, waste composition is transitioning from a majority of organic waste (Idowu et al. 2019) to be substituted by plastic materials (8.6% of MSW) (Kaza et al. 2018), due to SSA communities becoming increasingly dependent on them for their daily lives. From an economic perspective, this is a problem in SSA as that plastic depends mainly on imports from external sources since the production by local industries is insufficient (Ayeleru et al. 2020). Consequently, small and medium enterprises (SMEs) are discouraged from entering the market, which reduces the revenue for local governments. However, from an environmental perspective, anywhere in the world, plastic is a challenge as it produces persistent organic pollutants (POPs) and absorbs POPs from other sources, which has impact both on animal and human health by polluting soil and water. Open burning and landfilling are the most common practices in WM in SSA since they are the cheapest in the short-term. However, they are the least sustainable for long-term growth and most prone to produce health and environmental hazards. Hence, these inappropriate and dangerous practices make plastic management consequences particularly negative in the

region. Rwanda, for instance, has succeeded in SWM policies when it switched from plastic to paper bags, requiring local SMEs to find alternative sustainable solutions for plastic. Another highly potential avenue consists of exploring a circular economy model in the waste management sector, aiming at expanding the availability of raw materials to industries, creating new sources of revenue for governments and decreasing imports, while eliminating the burden on natural resources. Nevertheless, the level of education of populations plays an important role in this context, since most communities are not aware of the waste cycle.

Lastly, other challenges for implementing a sustainable SWM system include financial constraints and poor reconnaissance study (Yeboah-Assiamah et al. 2017). As previously mentioned, despite uncontrolled burning and landfilling being the cheapest practices in the short-term, waste recycling and composting are more beneficial in the long-term. This is because these practices significantly contribute to sustainable development as they allow for the recovery of the economic value of waste, including the provision of power and energy (Idowu et al. 2019), while also reducing greenhouse gas emissions (Couth and Trois 2012).

2.3. Waste regulation in SSA: strengths and weaknesses

Kigali, Rwanda, one of the cleanest cities in the region, relies on public-private partnership (PPPs), with exclusive franchises in 35 sectors being tendered every three years. With a 95% fee collection rate, households pay an affordable fee for the services, including local security patrols, depending on their ability to pay. Collection coverage is 88% and requires households to store their waste in individual containers collected door to door weekly, while commercial and markets' waste go into communal containers collected daily. Furthermore, in 2008, the government prohibited the manufacturing, use and sales of polythene bags, and imposed a monthly clean-up campaign for further involvement and awareness of the community (Kabera et al. 2019), a practice common to other places, such as Accra, Ghana (Abiti et al. 2017). Comparing with Maputo, Dar es Salaam, Kampala and Nairobi, Kabera et.

al (2019) identified weaknesses which allowed for the establishment of priorities for these countries' SWM. First, disposal sites are poorly controlled allowing for dumping and open burning, which makes implementing a recycling system more difficult. Besides, there is a rise of the informal sector which further contributes to a lack of waste data. Hence, despite regulations and strategies, the lack of data discourages strengthening institutional capacity, and increasing monitoring and evaluation (M&E) of operations (Kabera et al. 2019). In Kenya, legislation has progressively included structured approaches to environmental management, going as far as creating a common platform for action between stakeholders. The shift has gone from punitive regulation to, more recently, a focus on managing and addressing the problem. However, despite appropriate, these strategies lack the adequate action and have a low focus on actual environmental health outcomes (Haregu et al. 2017). Thus, the results align with some of the common challenges in the region: unregular collection services, limited coverage and poor separation of waste. Overall, there is the tendency for coverage to be more effective in developed areas which have better infrastructure, creating contrasts between urban and rural areas. The reason is that better infrastructure usually allows for higher accessibility to waste and fee collection, less crime in more regulated systems, and lower social stigma influencing the decision-making and engagement of communities. Therefore, it is common for urban areas to have access to better WM facilities (i.e. communal container), while others tend to rely on open dumping (Amoako et al. 2016), creating a disease-prone environment worsened by the existent constraints in accessing social services (e.g. hospitals are concentrated in the cities).

2.4. Broader stakeholder engagement

In the late 90s, Accra increased participation of the private sector through PPPs. This resulted in collection rates going from 51% in 1998 to 91% in 2000 (Fobil et al. 2008), but unsustainable performance in the long-term and no evidence of increased coverage in the country. Thus, the power moved from local authorities to the private sector, with PPPs

operating without municipal supervision (Oduro-Appiah et al. 2017). Hence, this high centralisation of power and lack of adequate transparency of contracts, discouraged the involvement of local authorities and communities (Yeboah-Assiamah et al. 2017).

2.4.1. The informal sector

In 2018, Medina and Schneider found that the size of shadow economies in SSA hold some of the highest average values, above 36% of GDP. In fact, it is estimated that Accra suffered a 71% increase in informal service providers in the WM sector in the past years (Oduro-Appiah et al. 2019). Some of the common constraints in SSA are the unavailability of resources and inefficient SWM systems. Hence, the informal sector plays a key role in addressing such challenges unmet by the government regulated agencies. Previously, the informal sector has led to higher collection coverage and recycling rates, resulting in municipality savings (Oduro-Appiah et al. 2019). In Abidjan, Côte d'Ivoire, this is the preferred service for household waste collection, as it has greatly contributed to the clean up of areas in the city (Andrianisa et al. 2016) not covered by the national SWM plan. However, there are roadblocks. Besides tax contribution constraints and a higher complexity of the overall system, the informal sector creates an unstructured process. The reasons are the limited data, and the accumulation of waste at transfer stations or open dumpsites close to the population. In turn, these create health risks, poor collection capacity and infrastructure, together leading to spillages. Furthermore, workers are poorly paid, and, in Abidjan, basic equipment (e.g. wheelbarrows) is used, leading to potential injuries. In Kumasi, Ghana, informal collection relies on workers with low knowledge on the process and its consequent health risks, encouraging poor safe work practices (Asibey et al. 2019). Nevertheless, as presented, the informal sector is highly lucrative for governments and crucial for ongoing development and waste collection success, which, together, make a compelling case for its regulation.

2.4.2. Local authorities and communities

Low engagement and poor education on the topic have contributed to inefficient municipal SWM and low recycling rates in SSA. When assessing urban slums in Uganda, it was found that, despite residents' high willingness to participate in waste separation and composting, the lack of knowledge on best practices, responsibilities, and consequences of poor WM influenced the unsatisfactory practices (Mukama et al. 2016). Further research on households' perspective, in Ghana, highlights the former's willingness to actively participate in municipal SWM. However, the lack of involvement by government agencies and private companies leads households to gradually becoming less engaged (Cobbinah et al. 2017). When assessing the quality of waste collection in Accra and Maputo, it was found that, despite an above 75% waste collection coverage, both cities score low to medium in user inclusivity and local institutional coherence (Oduro-Appiah et al. 2017). In the case of South Africa, the limited availability of resources makes it difficult for municipalities to engage the community in the operations of SWM. On the other hand, the community attributes the responsibility for its poor contribution to WM authorities. Building on this misalignment, authorities believe that difficulties stand, not only in members reluctance in participating, but also in creating awareness on WM aiming at clarifying that waste is everyone's responsibility (Kubanza 2020).

In the past, governments have unsuccessfully relied on laws and penalties to incentivise communities to comply. With the rise of mobile usage and accessibility in the region, mobile persuasive technology has the potential for raising effective awareness and education on SWM. Nkwo (2019) found that community members are interested in customised and social strategies. These can be provided by mobile technology, enabling governments to set reminders, to praise outstanding behaviour-citizens, or to educate on best practices, issues and consequences.

Concluding, the community plays an important role in the region, namely because of the influence of social paradigm beliefs, such as strong religious positions (Agyeiwaah 2020). Therefore, a working relationship between communities and local authorities must be a priority

for sustainable SWM – one relying on communication and awareness regarding the process, and the environmental and health costs for local populations.

2.5. The Sustainable Development Goals (SDGs) in the context of solid waste management

When aiming at an effective SWM system, the SDGs directly targeted are “Sustainable cities and communities” and “Ensure sustainable consumption and production patterns”. According to the SDG index report, most countries in SSA, due to a high incidence of slums, score low on infrastructure. Additionally, the MSW collection per kg/year/capita is very low, which was expected, particularly knowing that data from the informal sector data is not accounted. Thus, this further translates in poorly managed plastic waste and ocean health (SDG Center for Africa and Sustainable Development Solutions Network 2019). Nevertheless, communities recognise that addressing the landfilling system in SSA can potentially meet some of the SDGs. This can be achieved by re-evaluating landfill sites, closing those under poor conditions, and creating detailed corrective intervention measures to be implemented in the others (Idowu et al. 2019). In turn, this will potentially reduce environmental and human hazards, improving air, water and soil quality conditions. Yet, Dilekli and Cazcarro (2019), point out that, to achieve the SDG targets, high final demands from SSA compared to developed nations will be required. In turn, this will demand an increase in trade (i.e. imports of inputs such as chemicals and energy products), making the region more dependent on external sources. Hence, it is worth considering a circular economy model, since it allows the region to recover the value of waste and boost its economy by promoting organic growth.

3. RESEARCH SETTING AND METHODS

3.1. Ghana overview

As of 2019, Ghana’s population amounts 30.4 million. Besides, Ghana is characterised by a growing economy holding a GDP PPP per capita of 5.637 USD (The World Bank 2019),

and a Human Development Index¹ (explain in footnote) of 0.596 (United Nations Development Programme 2019). Ghana's most common waste treatment is disposal, generating 0.51kg of waste per capita per day, above the 0.46kg average in Sub-Saharan Africa (Kaza et al. 2018). In 2017, waste collected in Accra amounted GHS 27.113.919 (\$10.845.568), including plastic, mixed glass, paper and metal. This is equivalent to 11.579 MWh of electricity and 9.535 Mwh of heat. However, 63% of this waste is not sorted nor treated before dumping (Abiti et al. 2017), reducing the potential for value recovery.

In 1999, Ghana issued the Environmental Sanitation Policy, a detailed and continuously updated plan for the development of better sanitation in the country, including a stronger SWM system. In 2010, the update pinpoints capacity development, education of communities and adaptation of services to all population groups. These goals should be met through stronger legislations, a sustainable financing level that includes cost recovery, and a monitoring and evaluation plan (Government of Ghana 2010). Ghana holds a monthly National Sanitation Day, a nation-wide clean-up involving citizens. Ranking 9/52 in the SSA SDG index (SDG Center for Africa and Sustainable Development Solutions Network 2019), Ghana keeps struggling to establish a sustainable SWM system, facing many of the region's common challenges.

Based on the brief literature review in section 2, it is plausible to claim that WM is a complex system and there is not a single factor triggering its in-/effectiveness. Hence, in this paper, I aim to analyse the perceptions and potential of households as key stakeholders, since they contribute with a large share of the waste generated and are directly affected by its negative consequences. For public policy purposes, without a comprehensive understanding of the current situation, it is not possible to design an effective plan to achieve a sustainable SWM in the country, and, therefore, contribute to increase welfare of local populations.

3.2. Study setting

¹Human Development Index goes beyond economic growth when assessing the development of a country, extending the criteria to people and their capabilities. (United Nations Development Programme) 10

This research focuses on Bawjiase, one of the five Area Councils of Awutu Senya district (Figure 1), located in the Central Region (Appendix 1, Figure A1), in Ghana. Recent data from 2010, positions Bawjiase as the second largest town in Awutu Senya, with a population of 15,976 people (Ghana Statistical Service 2014). Ghana's population has increased 25.5% in the past 10 years (The World Bank 2019), hence Bawjiase's current population is expected to be around 20,000 people.

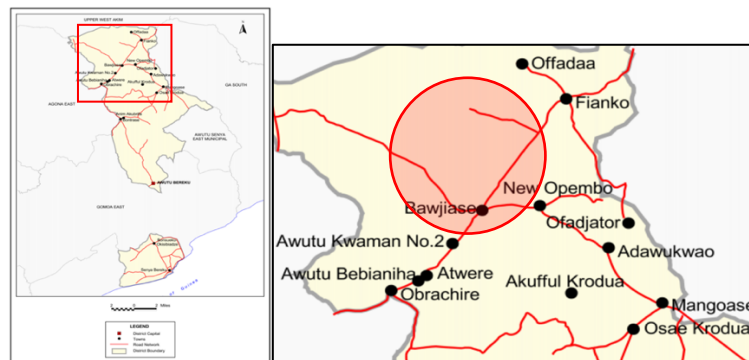


Figure 1. Bawjiase mapped out in Awutu Senya District.

Bawjiase was selected for this research due to its regional reputation associated to its popular market and good elementary and high schools, which attract people in the area, leading to its rapid population growth and urbanisation. Bawjiase, such as other urban centres in Ghana, has a large open dump where the community dumps its waste, animals search for food leftovers and children play. Based on 2010 data, the average household size in the district is 4.1, less than the regional average, 4.2, and the national average, 4.5. The majority of houses, 64.5%, are made of cement blocks/concrete, and 32.1% are made of mud brick. In regard to sanitation, there are three widely used bathing facilities in the district: open bathing cubicle (35.1%), shared separate bathroom in the same house (23.7%), mainly in urban areas, and, finally, own bathroom for exclusive use (13.5%), more common in rural areas (Ghana Statistical Service 2013 & 2014). Like other urban centres smaller than metropolitan cities, such as Accra or Kumasi, Bawjiase does not benefit from detailed planning by authorities, so houses are built without planning approval (Cobbinah et al. 2017). This leads to poor municipal waste management planning, creating high levels of indiscriminate dumping. In fact, according to

Ghana Statistical Service (2013), 68% of households in the district dispose their solid waste (SW) at open dumps. Bawjiase's strategic location positions it as a strong urban centre between two regions with significant economic relevance, Central and Greater Accra. Nevertheless, while the latter benefits from superior planning and processes, Bawjiase faces a significantly different reality, with lower levels of development. Concluding, Bawjiase serves as an illustrative example for the many medium to large towns across Ghana, which increases the potential relevance of the results for Ghanaian policies.

3.3. Research methodology

In what concerns the methodology followed in this study, a literature review was undertaken, focusing on the topic and the region. Additionally, government documents were reviewed, nation- and area-wide, in order to set the case for selecting the study's target municipality. One of the conclusions drawn from this background research is that an extended view of stakeholders is not normally considered in the management of SW, namely, by excluding households. Hence, in this study, households from Bawjiase were surveyed, focusing on three issues: understand the current state of SWM in the area, including households' relationship with SWM; underline some of the factors that may influence the current state; and, finally, draw a roadmap to help improving SWM in Bawjiase.

The survey conducted was inspired on Ibáñez-Forés et al. (2019), Cobbinah et al. (2017), Nkwo (2019), and Okayama et al. (2010). In order to understand Bawjiase's current state of SWM, the relevant questions were scored from 1 to 3, 1 being the worst SWM practices and 3 the best. The data obtained was used to create a spider chart to set priorities for the planning design of SWM. Then, statistical analysis was performed to elicit households' perceptions on determinants and priority actions, in order to assess their attitudes towards SWM. Building on this, an action plan that may serve as a roadmap to implement a new management policy towards waste management was developed.

4. RESULTS AND DISCUSSION

4.1. Characteristics of Respondents

The online survey was targeted at households from Bawjiase (n=103). The survey reveals that, while 72.09% of women engage in some form of employment, only 52.63% of men are employed, contradicting the traditional idea of women taking care of the household as the current reality in Ghana. As presented in Table 1, the most common forms of employment are agriculture, and trading and sales. However, since 33.98% of respondents answered “Other”, it is difficult to clearly understand their economic activity. 32.04% of the respondents have no formal educational, though prevailing within those over 40 years old (44.44%). Of those with at least a secondary education level, 65.45% are male, 70.91% are below 40 years old, and 61.82% are unmarried. Of the 14.56% with a university degree, the majority is below 40 years old and unmarried. Additionally, as expected, the most significant economic activity within this educational group is services, contrary to the majority of respondents. This indicates that younger and unmarried people are more likely to take formal education, hence engaging in less traditional economic activities (e.g. agriculture and sales).

Table 1

Household characteristics of respondents (n=103).

Source: Field Survey, October 2020

Background characteristics	Frequency	Percentage (%)
Gender		
Female	43	41.75%
Male	57	55.34%
No response	3	2.91%
Total		
Age		
<25	28	27.18%
25-39	39	37.86%
40-55	26	25.24%
>55	10	9.71%
Total		
Marital Status		
Married	24	23.30%
Unmarried	50	48.54%
Other	29	28.16%
Total		
Years of residence in Bawjiase		
Less than 1	11	10.68%
1-3	25	24.27%

4-6	35	33.98%
6 or more	32	31.07%
Total		
Region		
Central	18	17.48%
North	18	17.48%
South	21	20.39%
East	22	21.36%
West	24	23.30%
Total		
Household Members		
1	14	13.59%
2	16	15.53%
3-5	50	48.54%
6 or more	23	22.33%
Total		
Number of Dependents (kids or elders)		
None	37	35.92%
Up to 3	41	39.81%
Above 3	25	24.27%
Total		
House Characteristics		
Have bathroom	92	89.32%
Have sanitation	44	42.72%
Have running water	33	32.04%
Have electricity	66	64.08%
None	5	4.85%
Total		
Employment Status		
Self-employed	48	46.60%
Employee	14	13.59%
Unemployed	36	34.95%
Retired	5	4.85%
Total		
Economic Activity		
Agriculture (farming and fishing)	25	24.27%
Services	12	11.65%
Trading and Sales	22	21.36%
Carpentry, arts and crafts	0	0.00%
Other	35	33.98%
Not applicable	9	8.74%
Total		
Education Level		
No education	33	32.04%
Primary school/JSS	15	14.56%
Secondary	29	28.16%
Post-secondary (non-degree)	11	10.68%
Degree (in progress/finished)	15	14.56%
Total		

For the purpose of discriminating across distinct groups of respondents, and since only a small number of responses on respondents' average income levels were obtained, the reported available house facilities were considered instead. Bawjiase was divided in low-, middle- and

high-class areas. While the high class covers the locations where the majority of respondents have more facilities, i.e. three or more; middle-class covers those with an average number of facilities, i.e. two; and low-class covers the areas where the majority of the respondents have few facilities, i.e. one or none. Therefore, West Bawjiase was considered high-class; East and Central, middle-class; and South and North, low-class.

4.2. Current state of SWM in Bawjiase: analysis

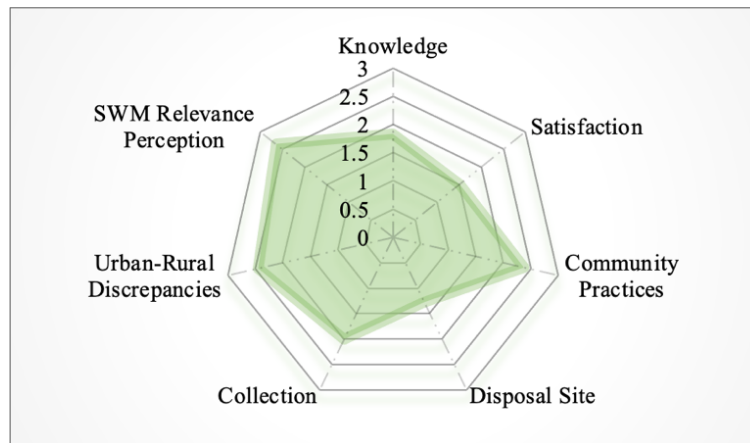


Figure 2. Spider chart of relevant aspects to evaluate the current state of SWM in Bawjiase.

The spider chart (Figure 2) provides a visual understanding of Bawjiase's SWM current state, positioning the best performance indicators close to the edges and the low performance ones close to the centre. The following analysis is based on the best performance ones.

SWM Relevance perception: 82.5% of respondents agree that SWM should be of high importance, and a priority in government's agenda. Besides, the results suggest the potential of an inclusive and engaging role of community members in SWM planning and processes.

Urban-Rural Discrepancies: This question deems nation-wide discrepancies. The high score portrays minor discrepancies. Though, 24.30% respondents mention larger urban centres with better systems, namely Kasoa, Accra and Kumasi. This may be explained by their higher urbanisation control, leading to higher rates of collected waste (Louikil and Rouached 2019).

Community practices: 82.52% of respondents dump waste in communal containers (Figure 3). This is mostly the case within those living in high- and middle-class areas, having house-to-house collection or separating waste at home. However, within these 82.52%, 44.66%

hold the habit of throwing waste in nature or the streets, which is prevalent in low-class areas. Contributing to this is the limited availability of containers, a problem mentioned by 81.55% of respondents. 22.33% perceive communal containers as a “foreign idea” which does not fit Ghanaian culture, but only 10.68% do not see any benefits in communal containers.



Figure 3. Communal containers and open dump in Bawjiase

Next, an analysis is carried out based on the indicators with the worst performance.

Satisfaction: Respondents’ satisfaction with the current system averages 1.5/3.0. However, it is worth noting that the mode falls on 1.0, low satisfaction. The worse responses come from older people (above 40 years old), those living for longer in the community (above 4 years) and those with low levels of education (below secondary). The reason may be that younger and more educated people have a broader perception of the actual WM situation in the country and, hence, have developed a more positive perspective on Bawjiase’s situation. In contrast, older people and those having lived in the area for longer, may have been discouraged by the town’s uncleanness and, thus, developed a negative perception over the years. The levels of satisfaction were lower for people with two or less facilities in their houses. This can be a consequence of being exposed to poor conditions, having less access to cleanliness.

Disposal Site: the disposal site relies mostly on open dumping (Figure 3) and burning (87.38%), which are the most common practices in SSA, and Ghana specifically (Ferronato and Torretta 2019). Other responses, weighting similar percentages (16.5%), include landfilling, giving leftover food to pets, and recycling and composting. These responses do not exclude burning, as participants could choose up to two methods. The majority of responses

are from high-class residents. As Alhassan et al. (2020) point, this class with better facilities in their household, are more likely to have a place in their houses where they burn their waste. Furthermore, high-class being located in a wide peri urban area, as in Bawjiase's case, also influences their proneness to openly burn waste (Cobbinah et al. 2017). Besides, Bawjiase's major open dump is located near the high-class area, creating easier accessibility conditions for residents to dump their waste. Regarding landfilling, recycling and composting, the majority of responses are from the middle-class area. This area is near Kasoa, a big urban centre, which might influence residents' accessibility to better facilities and services provided by their neighbouring municipality. Waste composition includes plastic (41.75%), organic (24.27%), paper and card (15.53%), ceramics and glass (10.68%), and tins and metals (7.77%). In the near future, it is expected that plastic covers the majority of waste, substituting what used to be dominated by organics. This is explained by rising imports, industrialisation and consumerism in developing nations (Kaza et al. 2018, Louikil, and Rouached 2019). The collection system, despite ranking average, partially relies on informal workers (41.75%). This potentially contributes to the high levels of open dumping and burning: informal workers do not have the knowledge and tools to ensure proper waste disposal and treatment (Louikil and Rouached 2019). Hence, they use the cheapest and most straightforward options in the short-term (Couth and Trois 2012). Despite the lack of knowledge and tools, informal workers are key stakeholders in the system (Wilson et al. 2013, Andrianisa et al. 2016), and contribute positively for the development of communities (Oduro-Appiah et al. 2019). With such a significant number of responses, regulating the informal sector should be a priority. As in the evaluation of households' satisfaction with the system, those having lived in Bawjiase for longer, perceive the collection of waste more negatively. The reason should be similar: they are discouraged by minor improvements in the system over the years. Unlike results from Adzawla et al. (2018), no other socioeconomic factors present significant influences on

respondents' attitudes towards collection. This may be because when appropriate facilities are lacking – which individuals depend on – better practices are not enough to improve the overall system, regardless of individuals' characteristics. Zoomlion Ltd. is indicated as the company responsible for collecting waste in Bawjiase. However, respondents recall that “the fees were very expensive, so households and authorities ceased their payment”. Hence, the company ceased its services in the town. Interestingly, a similar explanation is given by Cobbinah et al. (2017). It is worth noting that this past service might have influenced responses creating an unrealistic positive perception of the system and, hence, jeopardising the results.

SWM Knowledge: Despite an average value, the mode is low (1.0). The respondents less confident on their SWM knowledge hold the lowest education levels. Besides, they are less satisfied with the system than those confident on their knowledge. This suggests that low education on the topic might create a more negative perception of the system than it is in reality.

4.3. Households' attitudes towards SWM

For the purpose of this study, determinants and priority actions were investigated based on the sample in order to clearly understand citizens potential roles. This step is important in the study, particularly since the majority of respondents agreed that SWM should be a priority.

Participants point out the large blames for poor SWM, ranking them as follows: urbanisation and growing population, lack of education of the community, and public apathy. The last two might be related to the community's low confidence on their knowledge about SWM. Regardless of ranking, lack of education of the community was the most common choice. Other responses include institutional limitations, non-involvement of households and local authorities, and no consideration of NGOs and business groups' opinions. All of these are in line with previous studies (Breukelman et al. 2019). Despite the lack of involvement of key stakeholders, 49.50% respondents position waste as everyone's responsibility. However, 26.20% attribute full responsibility to authorities, which follows the results of Kubanza (2020)

where a community poorly educated on WM blames local authorities for the inefficiencies across the SWM system. This result can negatively impact the outcomes of the system if the community becomes apathetic to the problem or expects a reward in order to take action. Other responses assign responsibility to NGOs and business groups, and to the community in general.

Due to the interest in being involved, participants were asked about their preferred potential roles in SWM, presented in Figure 4. The most common first choice is supervision, while the second is paying a fee for the services. This may be due to the current practice of some community members regularly supervising others' best practices on waste disposal to ensure a clean environment. In Figure 5, the influence of certain sociodemographic factors in role preferences is presented (regardless of ranking). The results show that those living in lower classes are more willing to take different roles, including supervising, paying a fee, engaging in clean-up exercises or education. On the other hand, higher classes have a more specific set of preferences, contrary to Cobbinah et al. (2017), where extreme sides of classes converge to a particular preferred role. Age also influenced choices, such that elders prefer authoritarian roles (e.g. supervising), and are more willing to pay a fee than younger respondents. The latter prefer to directly intervene, through monitoring, clean-ups or education. Interestingly, education decreases the willingness to pay a fee, but motivates direct involvement. This could be due to this group, having more insights on the topic, finding taking direct intervention more important for implementing a better system, or due to a lack of confidence on institutions. Those with more dependents are less willing to pay a fee, as the expenses for taking care of more people place a heavier burden. Hence, they prefer to be directly involved compared to those with less or no dependents. This result follows Adzawla et al. (2018) findings, stating that unstable incomes (e.g. younger or people with more dependents) motivate direct intervention rather than paying a fee. However, the same was not verified in the low-class, who normally suffers higher instability. This could be because they are not aware of the magnitude

of influence that paying a fee would have on the available income left for other expenses, since the amount is not discussed.

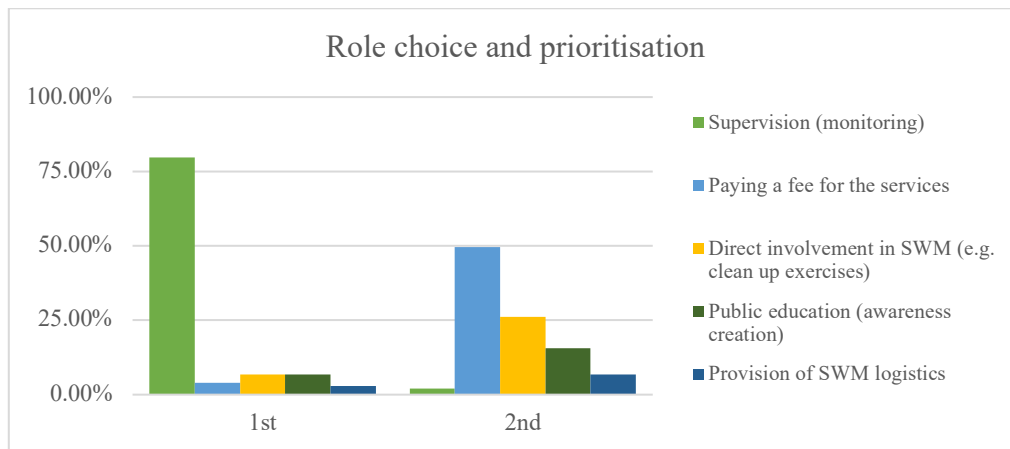


Figure 4. Perceived households' role in SWM: ranking by preference.

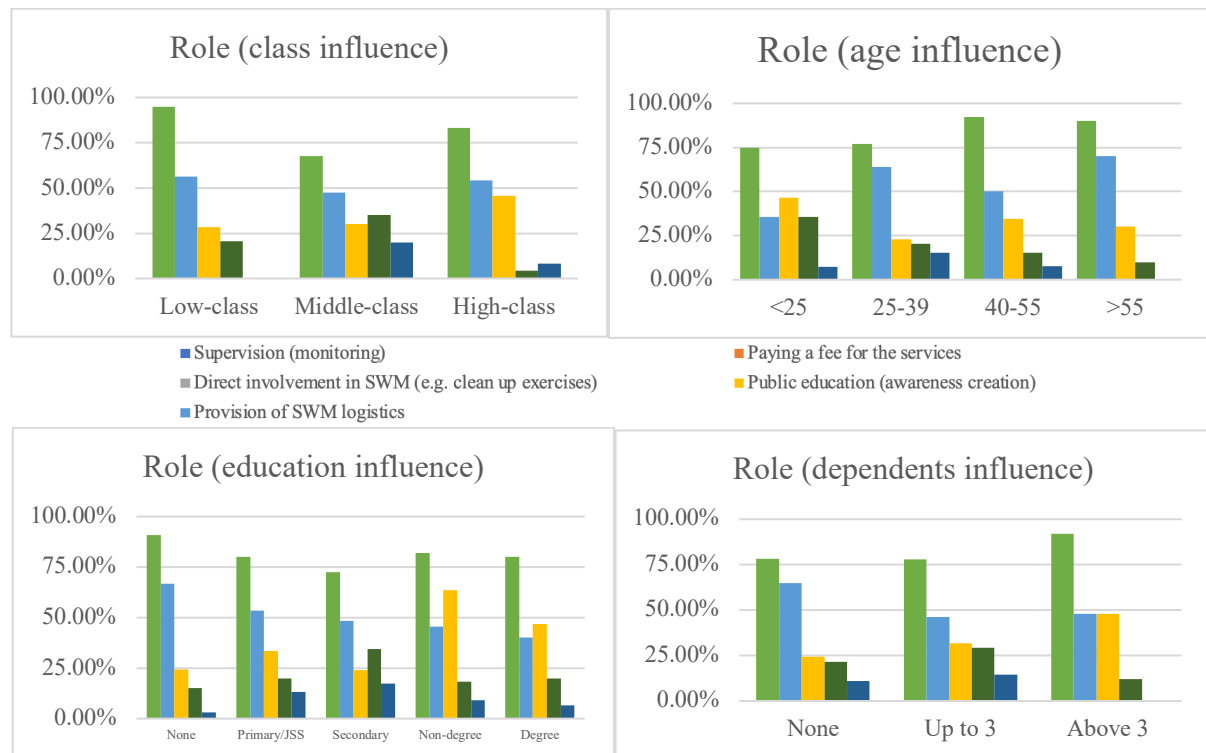


Figure 5. Perceived households' roles in SWM in Bawjiase: sociodemographic influence.

When asked about specific steps the public and NGOs can take (Figure 6), the majority of participants (80.58%) highlight the importance of each person reducing their waste consumption and changing disposal habits. This includes extending the lifetime of goods, which is in line with the 4 Rs (i.e. reduce, reuse, recycle and recover). Other common choices include collaborating with NGOs, businesses and governments, and participating in volunteer work to clean the environments or educate the community. Those with higher education place

more value on cooperation, volunteer work and providing education (or studying more about the topic). On the other hand, those with less education prioritise changing one's habits. Interestingly, studies show that less developed SWM systems are missing out on economically valuable opportunities due to lacking knowledge about the topic (Kaza et al. 2018, Ayeleru et al. 2020). Another study points out that institutions have little research capacity for designing effective SWM processes (Idowu et al. 2019), contributing to degradation of the overall situation. Hence, education plays a major role on implementing a better SWM system.

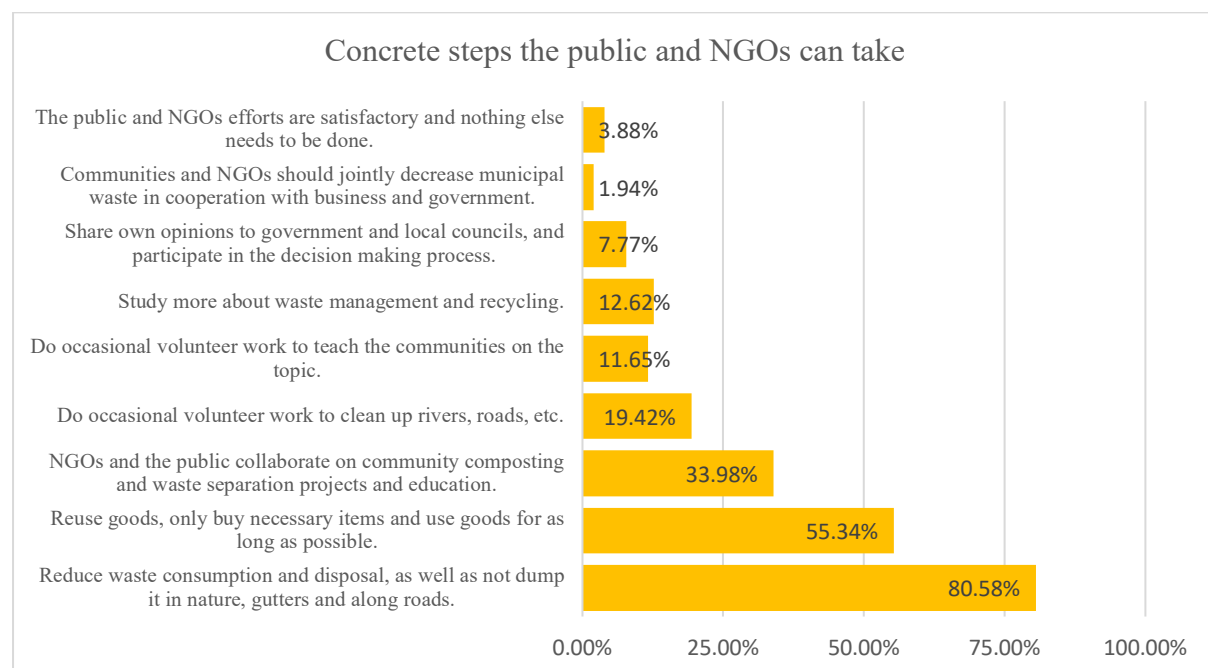


Figure 6. Households' perception of steps the public and NGOs can take to tackle SWM challenges

Lastly, participants were asked about potential incentives and discouraging factors influencing their attitude towards SWM (Figure 7). The results present respondents' particular interest in public recognition of community members who keep their environments clean and in providing education about the topic to citizens. Once again, education differentiated responses. Despite the ideal situation to be that high education levels dominate, that is a long-term goal. Hence, this result enhances the fact that, in the short-term, different strategies should target different groups of people. More educated people place higher value on providing facilities such as waste bags and bins, providing reminders (phone notifications, word of mouth

or announcements in gatherings – which are common in Ghana), and educating the community. A platform or the use of media to communicate with citizens and optimise waste collection routes, for example, is a strategy that has been used in Senegal. This has not only improved SWM, but also created jobs to young professionals (Kaza et al. 2018). On the other hand, respondents with lower education levels place higher value on public recognition and rewards, and also find penalties more effective. Contrary to the paper by Agyeiwaah (2020), social pressure does not play a major role in incentivising the community.

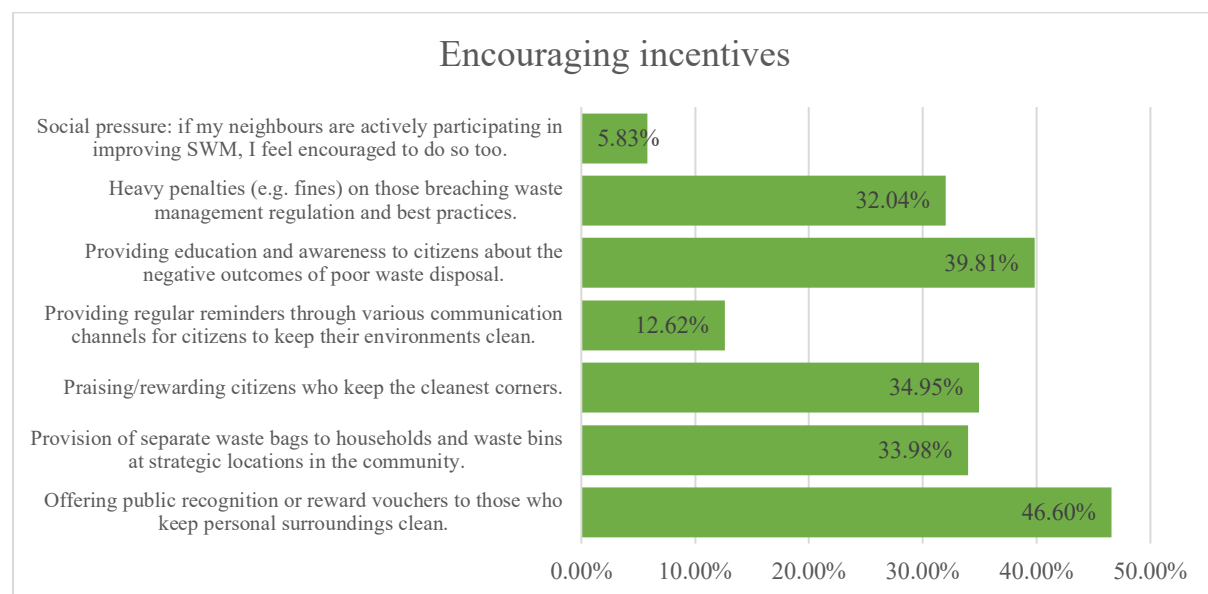


Figure 7. Households' perception of incentives to take active participation on SWM.

When assessing factors that discourage active engagement in SWM, corruption and improper allocation of resources are households' first choice (Figure 8). These are portrayed to households as a lack of transparency, a common problem of SWM contracts (Yeboah-Assiamah et al. 2017, Fobil et al. 2008). Corruption can impose a high burden on decision-making, making the community feel that regardless of their degree of involvement, the outcome will not be achieved. The second choice, and the most prevalent regardless of ranking (94.17%), is local authorities not recognising the importance of households' involvement for SWM improvements. As a matter of fact, the findings on this paper show that households are actually willing to pay a fee for SWM services. However, low stakeholder engagement might discourage this behaviour. This may have contributed to the community ceasing to pay for

Zoomlion services. Additionally, studies have shown that citizens, even in slum areas, are normally willing to pay for services, particularly if they have been involved in the process, and if the system is transparent and adapted to local prices and situation (Wilson et al. 2013). The lack of transparency and non-involvement of all key stakeholders (i.e. users and potential users, providers and external agents, Appendix 2 Figure A3), may be contributing to increased public apathy and lack of engagement towards SWM. In fact, in another municipality in Ghana, households became more apathetic to WM as the government let them down by not actively engaging them in the system (Cobbinah et al. 2017). Other studies highlight the importance of broader stakeholder engagement (Oduro-Appiah et al. 2017, Fobil et al. 2008), and provide examples where it led to improvements in SWM in developing countries (Kaza et al. 2018, Wilson et al. 2013). The third leading choice (and second most chosen option overall) is the limited education that households have on SWM, which is in line with the previously mentioned importance placed on education. The least mentioned external factor is the availability of financial resources to afford the services. Again, the low importance placed on this contributes to the finding that citizens are normally willing to pay for the services.

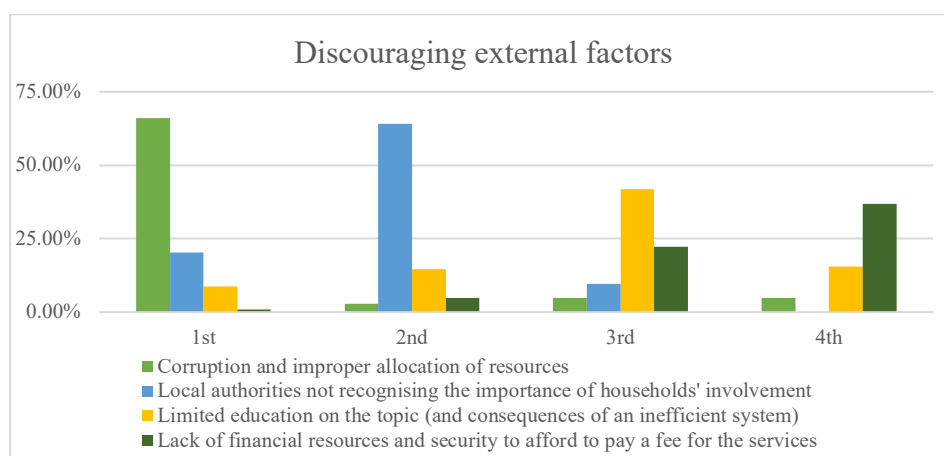


Figure 8. Households' perception of external factors discouraging active participation: in order of relevance.

Facing the current pandemic, participants were asked whether COVID-19 affected their perspective on environmental health. The responses are in line with the previous discussion. Of those saying “Yes”, 64.71% agree that people staying at home leads to higher levels of

waste. This is due to either an overflow of communal containers and dump sites, or the fear of the virus and the social distancing requirements which impede the regular clean-up exercises, making surroundings dirtier. 23.52% argue that COVID-19 brought higher levels of sanitation and hygiene to households, which is likely to positively affect households' responsibility and involvement on SWM. The last 11.76% put the pandemic as eye-opening for the health risks of unclean environments, again enhancing the role of education.

5. CONCLUSIONS & RECOMMENDATIONS

5.1. Action Plan

Based on previous research, an Action Plan was drawn, aiming to be a roadmap to enhance broader stakeholder engagement. The Plan (Table 2) is designed focusing on households' perspective, since they were at the centre of this study. Nevertheless, it targets authorities, namely local, to take action, giving a clear understanding on how they should engage all key stakeholders in SWM's planning and processes. The Action Plan sets six priority strategies: Involvement in decision-making; Education & Research; Provision of incentives; Collection facilities; Waste Collection and Treatment; Monitoring & Evaluation.

Table 2

Action Plan.

Note: The Ministry of the Environment is represented under the form of "Central Government".

Issue						
Lack of engagement of community members in SWM is leading to a poor SWM system						
Desired Outcome						
Full involvement of the community in solid waste management decision-making and processes						
Action Plan Sponsor						
Local Authorities						
Strategic Action	Resources Required	Stakeholders Appendix 2 Table A1	Constraints	Metric	Due Date	Outcome(s)
Involvement in decision-making	Know-how; database.	Local & central governments; NGOs; education & research institutions; WM business groups; citizens; opinion leaders.	Social stigma; corruption.	>50% household satisfaction with SWM; stakeholders' engagement (e.g. % of stakeholders feeling relevant in decision-making).	Ongoing.	Increased transparency and trust in authorities; locally targeted actions.

Elect household/NGOs/business/central government/opinion leaders (i.e. religious) representatives, that work together on establishing policies towards a positive SWM (e.g. organise local survey on WTP for waste collection and treatment fee, waste collection facilities preference for future investment, key challenges to address).						
Education & Research on SWM practices, issues and consequences	Know-how; technology tools (e.g. teaching/campaign); marketing materials.	Local & central governments; NGOs; education & research institutions; media; WM business groups; citizens; opinion leaders.	Low municipality budgets.	Confidence level on SWM (increase % of households highly confident).	Achieve 9/10 households by 2030.	Higher proactivity from different community groups; best practices shared and applied.
Partnerships with schools and universities at the local area to educate students on best practices regarding SWM through practical exercises (e.g. create a collective composting spot on campus, gather daily waste and separate it in an in class exercise); Work with NGOs and education institutions to create clean-up exercises, teaching communities on the topic, research on the topic; Fund and promote awareness campaigns organised by community members/NGOs/businesses working in the utilities sector; Promote practices namely the 4 Rs: reduce, reuse, recycle and recover.						
Provision of incentives	Database; marketing and technology tools.	Local & central governments; NGOs; education & research institutions; investors; media; WM business groups; citizens; opinion leaders.	Social stigma.	Praise/publicly recognise one person per month.	Ongoing.	Stronger care and pride for the SWM system; cleaner surroundings.
Allow for incentives to households to “do their part”, with a stronger focus on positive incentives (rather than fines, although necessary): public recognition/praise or reward vouchers, separate bags and bins to each household, reminders, or even through encouraging education.						
Collection facilities	Financial investment; supplies; transportation infrastructure.	Local & central governments; NGOs; private WM company; WM business groups.	Low municipality budgets).	Provide one container per 50 people.	Ongoing.	Higher percentage of waste collection; community’s satisfaction with waste facilities.
Provide appropriate facilities for waste collection, namely enough communal containers and recycling bins; Accelerate infrastructure development for a more effective collection.						
Waste Collection and Treatment	Know-how from businesses; waste collection services; land; labour; transportation infrastructure.	Local & central governments; research institutions; employees; private WM company; WM business groups; citizens.	Low municipality budgets; fee affordability by households.	100% SW formally collected and treated monthly; reuse of waste recaptured value in businesses; reduce informal sector by 1% (previous year baseline)	Ongoing.	Wider data availability; local economy boost; higher recovery value from waste.
Partnerships with local businesses that can cover waste collection and treatment – and gather data in order to evaluate the SWM system in the area and plan future policies/actions; Partnerships with local businesses/social enterprises/NGOs that can reuse waste recovered value; Regulate the informal sector.						
Monitoring & Evaluation	Labour; know-how from businesses; database; technology (i.e. data	Local & central governments; research institutions; waste exporters and importers;	Current data unavailability; highly manual tasks due to low	Reduce the informal sector by 1% (previous year baseline); create accurate publicly	Ongoing.	Improve data collection and availability to better inform future public

	management and security tools)	employees; private WM company; WM business groups.	technology investments.	available data on a yearly basis		policies; job creation.
Assign roles to monitor and gather data in order to evaluate the SWM system in the area and plan future policies/actions; Assign household representatives willing to supervise the community's best practices in regard to SWM; Regulate the informal sector.						

5.2. Limitations of the study

The current study has several drawbacks. Due to the pandemic, it was not possible to interview all respondents in person, and rather the data was collected from an online survey, which limited the scope of the study. Besides, the sample is not representative of the population as this was impossible to obtain given the present circumstances. In particular, this has prevented eliciting households' willingness to pay for the services and, therefore, to estimate the influence of households' attributes towards SWM (e.g. sociodemographic factors, political instability). Hence, this study should serve as a first step for future research on the topic.

5.3. Future Research

In the future, it would be important to analyse the authorities and business groups' (including non-profits) perspective on SWM, by implementing a participatory public method to the different stakeholders. This will provide important information about key stakeholders, which, in turn, will allow for better targeted and effective policy recommendations to be drawn. Nevertheless, it is also relevant to assess other municipalities' situations within SSA, in order to be able to create a more compelling case and attain broader achievements. Concluding, the results obtained call upon authorities to consider and apply the results presented and strategies designed in the Action Plan for better informed decision-making. This should be undertaken at the decentralised level, searching for the most cost-effective way, in order to achieve a sustainable SWM system, and improve welfare of populations.

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APPENDIX 1

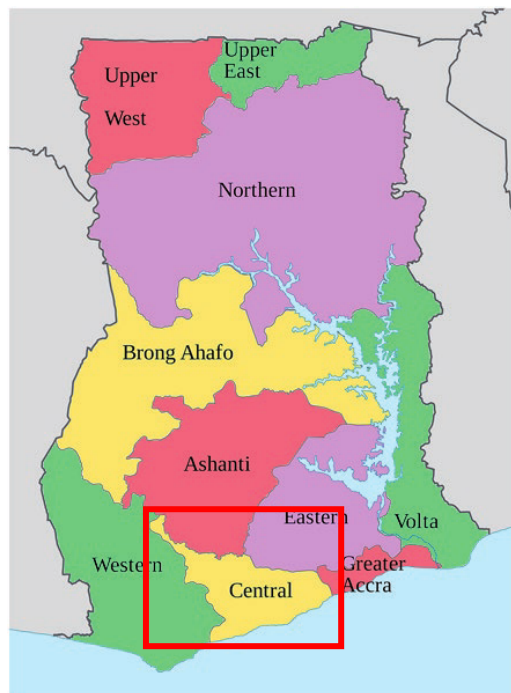


Figure A1. Mapping out the Central Region, Ghana.

APPENDIX 2

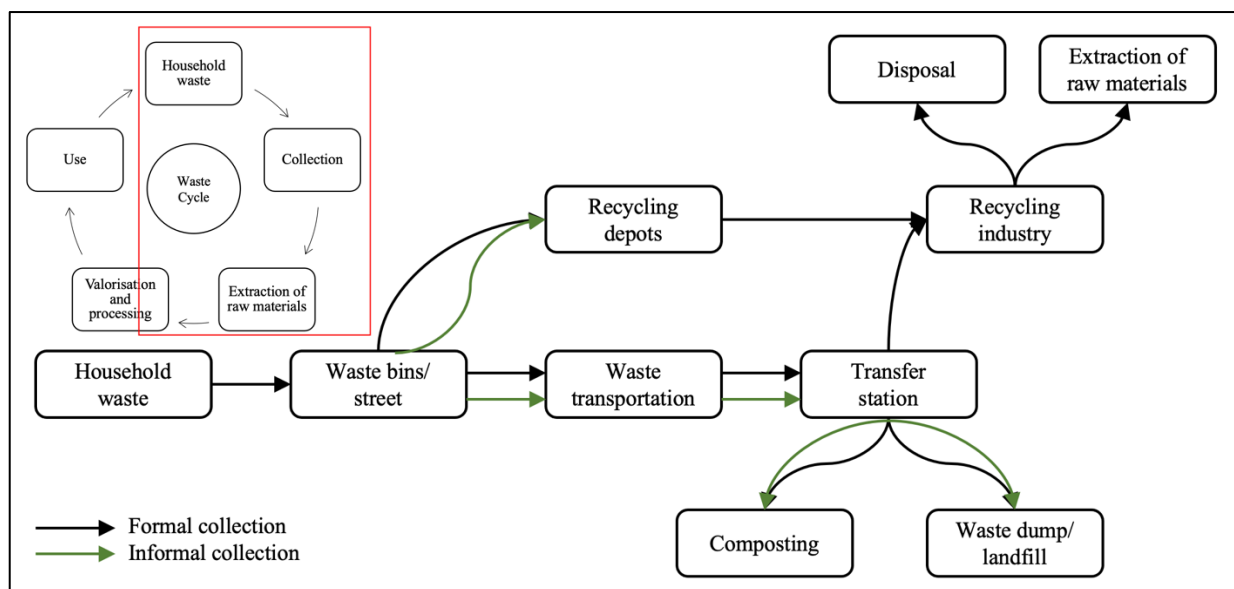


Figure A2. Waste Collection Map In-depth

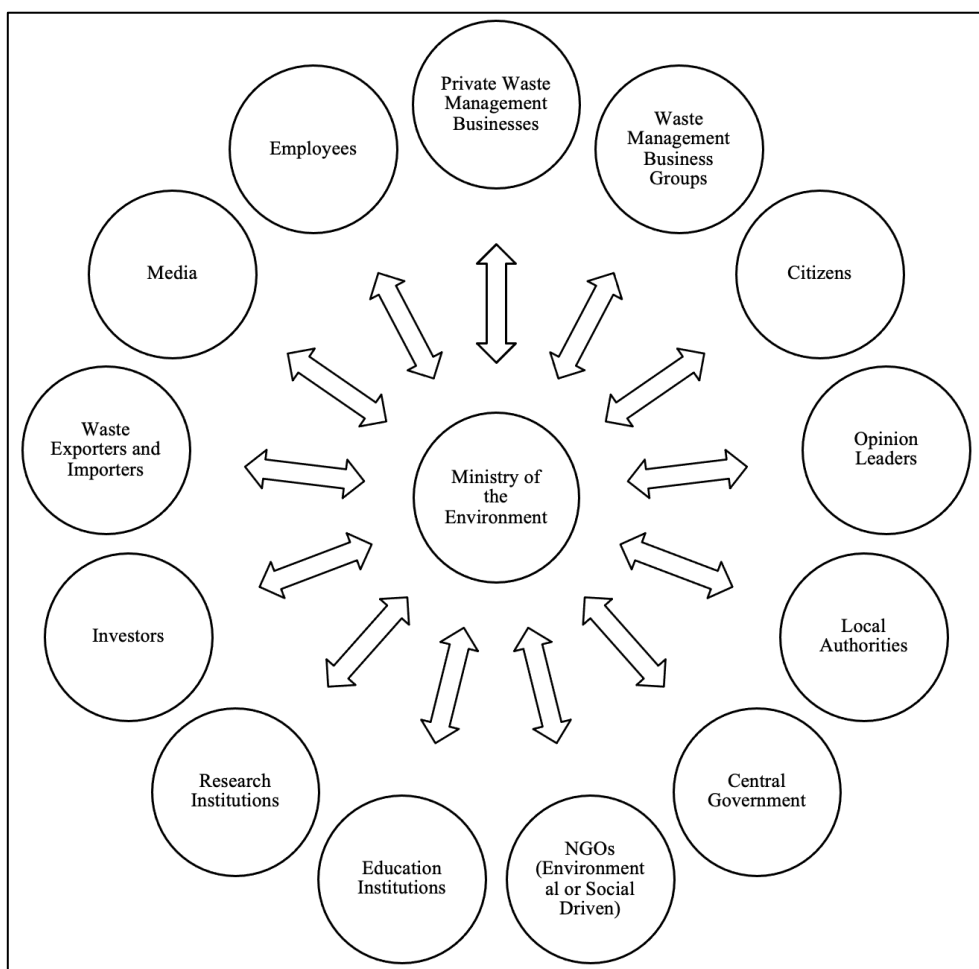


Figure A3. Solid Waste Management Stakeholder Map

Action Plan: Stakeholder Roles	
Stakeholder	Role
Involvement in decision-making	
Local & central governments	Plan decision-making & meetings; involve other key stakeholders.
NGOs	Participate in decision-making from the perspective of environmental and social development.
Education & Research Institutions	Participate in decision-making from the perspective of education and research (current and future needs).
WM business groups	Participate in decision-making from the perspective of the sector needs.
Citizens	Participate in decision-making from the perspective of households.
Opinion leaders	Participate in decision-making from the perspective of households and community.
Education & Research on SWM practices, issues and consequences	

Local & central governments	Invest and promote education nation- and area-wide; establish education plans (current and future needs); invest in research on the topic.
NGOs	Invest and promote education and awareness campaigns area-wide; partner with businesses and institutions (i.e. governments, educational) to promote SWM best practices.
Education & research institutions	Educate students on the topic of SWM; research about the topic.
Media	Invest and promote education through media channels.
WM business groups	Invest in awareness campaigns; partner with governments and institutions to promote education.
Citizens	Promote education on the topic and best practices within the community; participate in awareness campaigns.
Opinion leaders	Promote education on the topic and best (e.g. at religious community gatherings),
Provision of incentives	
Local & central governments	Provide incentives for citizens to incur in SWM best practices (examples were provided in the paper). Partner with institutions and business groups to plan incentives.
NGOs	Promote best practices and public recognition to incentivise citizens.
Education & research institutions	Incentive students through education institutions and research on the most effective methods to incentivise citizens.
Investors	Invest on initiatives (e.g. disruptive social enterprises) on the sector as to promote SWM best practices.
Media	Promote best practices as to incentivise citizens.
WM business groups	Provide incentives for citizens to incur in SWM best practices (examples were provided in the paper).
Citizens	Incentivise the community to practice appropriate SWM.
Opinion leaders	Incentivise the community to practice appropriate SWM.
Collection facilities	
Local & central governments	Provide collection facilities nation-wide to facilitate and increase coverage.
NGOs	Partner with governments and business groups to provide facilities that encourage and allow for appropriate SWM.
Private WM company	Provide collection facilities area-wide to facilitate and increase coverage; partner with governments on the initiative.
WM business groups	Provide collection facilities nation-wide to facilitate and increase coverage; partner with governments on the initiative.
Waste Collection and Treatment	
Local & central governments	Establish detailed plans for collection and treatment of waste; partner with businesses and business groups; invest on education on the topic and effective SWM technologies; invest on infrastructure that encourages higher coverage; regulate informal sector; establish and finance affordable fee schemes.

Research institutions	Research on effective methods for sustainable SWM collection and treatment.
Employees	Actively collect and treat waste.
Private WM company	Actively collect and treat waste; seek to collect data on waste collected and treatment.
WM business groups	Invest in WM companies; promote and provide resources for data collection; partner with government to establish detailed SWM plans.
Citizens	Participate in services fee decision-making; pay for the services.
Monitoring & Evaluation	
Local & central governments	Monitor collected, treated, exported and imported waste. Invest in evaluation and subsequent planning research.
Research institutions	Analyse data in order to evaluate the evolution of SWM nation-wide and research on most effective methods for current and future needs.
Waste exporters and importers	Report data on waste exported and imported; establish effective and sustainable plans for this waste.
Employees	Monitor waste collected and treated (including overseas'); evaluate results.
Private WM company	Monitor waste collected and treated (including overseas'); evaluate results by partnering with institutions.
WM business groups	Promote monitoring and evaluation; report data publicly to increase transparency and the efficacy of SWM plans.
Citizens	representatives that supervise the community's best practices.

Table A1. Action Plan: Stakeholder Roles