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Possibility of improving solid waste management in senior high schools in the Ashanti region of Ghana

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Little attention has been given to solid waste management in Senior High Schools meanwhile their population and consumption pattern keeps on increasing. The study was conducted in senior high schools within the Ashanti Region to determine the composition and generation rate of solid waste in the selected senior high schools. An extensive field investigation was used for quantification and analysis of the composition of solid waste in fifteen senior high schools in the Ashanti Region of Ghana. Averagely, waste generated were organic (70.91%), rubbers and plastics (11.24%), metals (5.64%), textiles (4.67%), other waste (2.77%), glass/ceramics (2.64%) and papers (2.13%). The per capita per day generation rate ranged from 0.02 to 0.13 kg/cap/day with an average of 0.056 kg/cap/day. The population of the schools and generation rate per capita per day of the schools had a negative correlation coefficient (-0.05). More than 90% of the waste generated in the schools could be dealt with through waste reduction, recycling, and composting. It was recognized that a greater percentage of the waste generated in the selected senior high schools was organic and therefore composting should be encouraged as a way of effectively managing such components of the waste stream and whipping up the students' knowledge in waste as a resource.

Key words: Waste generation, solid waste, waste characterization, source sorting, composting.

INTRODUCTION

Solid waste management has become a critical issue in developing countries and the most crucial aspect in managing the solid waste generated is to ascertain the characteristics or composition of the said solid waste (Miezah et al., 2015). Solid Waste Management policies, plans, and systems cannot be successful without considering the characteristics or composition of the solid waste (Bolaane and Ali, 2004). Chung and Poon (2006) stated that data from waste characterization are essential for the selection of solid waste management systems and waste management policy formulation. Though data on solid waste composition are crucial in waste management, these data are lacking in most developing countries including Ghana (Miezah et al., 2015) and this affects the management of solid waste in these countries. Solid waste treatment and final disposal option such as reusing, recycling, landfilling and incineration is influenced by knowledge on waste characterization (Al-Jarallah and Aleisa, 2014). An effective and efficient integrated solid waste management system can only be successfully initiated with knowledge on characteristics and generation rate of the solid waste (Hettiarachchi et

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al., 2018).

Educational institutions in developing countries including Ghana are not left out in the problems of solid waste management and the first step in finding a remedy to this problem is to know the characteristics, generation rate, and per capita generation rate of the solid waste generated in these institutions. Meanwhile, studies conducted by Lehmann et al. (2009) and Zilahy and Husingh (2009) have revealed that educational institutions can play a significant role in promoting sustainable programmes in society. It should be noted that the population of these educational institutions especially Senior High Schools in Ghana is increasing rapidly due to introduction of free Senior High School education by the Government of Ghana (Tarlue, 2020). Besides, the quantity of waste generated and population are correlated and the main disposal methods of the waste generated in these institutions include crude dumping and open burning (Bundhoo, 2018). In Ghana, treatment facilities for waste generated are lacking and few landfill site available in some communities are not properly managed and as a result of that most people resort to clude dumping and open buring (Yoada et al., 2014). The senior high schools with their increasing poplations in Ghana are not left out of these practices. However, little or no study has been conducted to find out the types and quantities of waste generated in these schools. To address the waste management practices among the increasing student population in these schools call for a detailed study and analysis of the situation. This study, therefore, focused on the characterization and generation rate of solid waste in selected Senior High Schools within the Ashanti Region of Ghana to determine the potential approach for effective waste management systems for sustainable development. This study took into consideration both the characteristics and quantity of the generated waste using a direct waste sampling and analysis approach.

MATERIALS AND METHODS

All the schools were selected from the Ashanti Region of Ghana, which is located South of Ghana (Figure 1). It is the largest of 16 administrative regions currently operating in Ghana. It occupies a total land surface of 24,389 km² (10.2%) of the total land area of Ghana (Ghana Statistical Service, 2014). Kumasi is the capital of the region. In terms of population, however, it is the most populous region with a population of 4,780,380 accounting for 19.4% of Ghana's total population (Ghana Statistical Service (GSS), 2014). The region experiences double maxima rainfall in a year with an average annual rainfall of 1270 mm and ranges between 1100 and 1800 mm. Much of the region is situated between 150 and 300 m above sea level. Humidity is high during the wet months of the year and low during the dry months. The average humidity in the southern districts is about 85 and 65% in the northern part of the region (GSS, 2014).

For the purpose of the study, fifteen senior high schools selected from 180 senior high schools in the Ashanti Region using simple random sampling technique. Table 1 shows the sex and total students' population of the selected schools as of the 2017/2018 academic year.

Each selected school was visited to assess the conditions and situation on the ground to ensure that everything was ready for the study, giving prior notice about the exercise such that waste generated within the day would be kept in the dustbin or storage container for the sorting and weighing exercise to be done. Field collecting students were trained on how to sort and weigh solid waste as well as safety precautions with regards to the survey. The materials which were used for the survey included; plastic bags (30 L capacity each) of which two were allocated for each of the schools to cater for sorting and taking the measurement of waste; 10 dial spring scales (20 kg capacity) for weight measurement; plastic sheet for the sorting of waste into predetermined categories (organic, plastic/rubber, glass/ceramics, metal, textile, paper and other waste); personal protective equipment (hand gloves, nose mask and overall coat) and data recording sheets. In order to obtain a realistic weight, measurement of the amount of waste produced by a particular school was performed for three different days. The generated solid waste was sorted into organic, plastic/rubber, glass/ceramics, metal, textile, paper and other waste each time. Each waste component was weighed separately and recorded.

Direct sampling and analysis was the method considered for waste characterization (Moore et al., 1994). The solid waste generated at the selected point-of-generation (kitchen, dormitory, and dining hall) was conveyed to the waste disposal site for the sorting and weighing (collection, conveying and weighing usually took a maximum of three days). The weight of each category of waste was recorded on a data sheet and was structured with the predetermined categories. The solid waste sorting and weighing were done from September 2017 to February 2018. The weight percentage for each sub-category was calculated using the following equation:

$$Percentage\ composition\ of\ waste = \frac{Weight\ of\ individual\ waste\ category}{Total\ weight\ of\ all\ waste\ categories} \times 100\%$$

To determine the waste management practices in the senior high schools in the Ashanti Region, 60 students were selected purposively from each school and structured questionnaires were administered to the selected students. Assistant headmasters/headmistresses in charge of domestics were interviewed on the waste management practices in each school.

RESULTS AND DISCUSSION

Waste management practices in the schools

Results from the study revealed that all the selected schools had waste collection bins and 93.3% of the schools stored their waste in the bin for at most 24 h before taking the waste to the final disposal site while only 6.7% of the selected schools stored its waste for almost 72 h. Waste generated had high content of organic waste and according to Malakahmad et al. (2010), long storage of organic waste in containers may producing odour, breed microbes and insects. All the schools (100%) were willing to sort the waste generated and stored the waste differently if more waste collection bins are supplied (Table 2). However, all of them

Table 1. Student population of the selected schools as of September 2017.

School	Student population		
	Males	Female	Total
Ejisu-Juaben Senior High School	1795	1702	3497
Adventist	1320	1180	2500
Ejisu Senior High/Technical School	815	441	1256
Kumasi Academy Senior High School	1600	1100	2700
KNUST Senior High School	1587	1125	2712
Konadu-Yiadom Senior High School	460	747	1207
Amaniampong SHS	1117	1363	2480
Oduko SHS	237	200	437
St. Joseph SHS	1214	877	2091
St. Monica's SHS (Girls' school)	N/A	2100	2100
Anglican Senior High School	2500	1000	3500
Ejisuman Senior High School	1623	1626	3249
Prempeh College (Boys' school)	3079	N/A	3079
Agona S.D.A. Senior High School	1417	1543	2960
Nsutaman Catholic SHS	-	-	1725

SHS means Senior High School.

Table 2. Solid waste management practices in Senior High Schools in Ashanti region.

Waste management practices	Frequency (%)
Availability of waste collection bins	15 (100)
Duration of waste storage (hours)	
24	14 (93.3)
72	1 (6.7)
Willingness to practice source sorting	15 (100)
Waste disposal option	
Communal containers	1(6.7)
Crude dumping and burning	13 (86.7)
Incineration	1 (6.7)

indicated that they had difficulty in acquiring adequate dust bins for waste collection (personal communication with heads of the schools). Majority of the schools did not have an environmentally friendly way of disposing of their waste since 1 (6.7%) dispose its waste into a communal container, 13 (86.7%) practiced crude dumping and open burning of the waste generated and only 1 (6.7%) incinerated the waste generated (Table 2). The crude dumping could produce leachates that could contaminate surface and groundwater bodies (Naveen et al., 2017), while the burning of the waste materials could also produce pollutants that could potentially cause upper respiratory diseases (Jiang et al., 2016).

Knowledge and willingness to practice composting

Compost is a soil conditioner composed of organic matter that improves soil structure and can reduce the amount of chemical fertilizer required for crop production (Haight and Taylor, 2000). The survey indicated that 563 (62.6%) of the 900 respondents were aware of composting whilst 337 (37.4%) were unaware of it. Out of the 563 respondents, who were aware of composting, 3 (0.33%) thought animal feed was generated from composting, 7 (0.78%) though it was used for gas and 553 (61.4%) said it produced manure. On materials used for composting, 194(21.6%) thought any waste could be composted, 343(38%) thought food waste was the material used and 24 (2.7%) were not sure of the materials used in composting. Materials used and products generated from composting have been explained by many researchers to be organic materials and compost or manure respectively (Haight, 2006; California Air Resources Board (CARB), 2008; Smyth et al., 2010). Surprisingly, none of the students knew the processes involved in the generation

Table 3. Willingness to manage organic waste by composting.

Activity	Frequency (%)
Knowledge on composting	
Composting awareness	
Yes	563 (62.6)
No	337 (37.4)
Product obtained from composting	
Animal Feed	3 (0.33)
Gas	7 (0.78)
Manure	553 (61.4)
Material used in composting	
Any waste	194 (21.6)
Food waste	343 (38)
Undecided	24 (2.7)
Understanding of composting processes	
Yes	0 (0)
No	900 (100)
Willingness to practice composting	
Starting of composting	
Yes	523 (58.1)
No	195 (21.7)
Reasons for not starting composting	
Environmental pollution	16 (1.8)
No resources	58 (6.4)
No technical knowledge	80 (8.9)
Not interested	10 (1.1)
Number of time and space	31 (3.4)

of compost (Table 3). The youth plays an important role in executing national waste management planning and for such reason needs to be educated on resources potential of waste generated as is currently being practiced as a waste management strategy in many countries (Song et al., 2015).

Although a greater percentage (61.4%) of the respondents possessed knowledge on composting, the remaining without any idea of composting can be assisted through student education on composting (Alexander and Kennedy, 2002; Bartlett, 2011; Beben, 2015) since majority were ready to start it at home or school (Table 3). It has been initiated in Nepal, where the new curriculum was created to teach about waste with an emphasis on why people should reduce the amount of waste discarded and the benefits of composting over discarding waste (Solis, 2016). The concept was new to most of the students, however such students were ready to start learning the process and therefore were interested in composting their organic solid waste. The majority of students who were not ready to start composting their solid waste attributed to problems such as no technical knowledge, no resource, no time and space, environmental pollution whilst some said they were not interested in composting (Table 3). However, Mackenzie (2016) argued that composting is easier than one can think.

Physical composition of solid waste

The study showed that a sizeable portion of waste generated across the selected schools was organic waste, which had a percentage ranging from 43.5 to 91% (Table 4). The amount of organic waste generated in all the schools conformed to a study conducted by the World Bank, which indicated that solid waste generated in developing countries is made of 40 to 80% organic (World Bank, 2012). Organic wastes generated in the selected schools were discarded through crude dumping, but such waste could be used for composting rather than taking it to the open dumpsite due to its biodegradable nature (Malakahmad et al., 2010). Disposing waste on an open dumpsite, can attract vermins, pollute water bodies and soil. The study showed that plastic/rubbers were the next highest with a percentage between 4.8 and 19.3%. Empty water sachet and polythene bags dominated the plastics and rubber component and this might be a result

Table 4. Waste characterization and quantification in selected schools in Ashanti Region.

Selected schools	Waste composition (kg) (%)							
	Organic	Plastics /rubber	Glass /ceramic	Metal	Textile	Paper	Others	Total
Ejisu-Juaben Senior High School	317.9(62)	59.8(11.7)	27.2(5.3)	18.8(3.7)	30.9(6)	13(2.5)	45.1(8.8)	512.7(100)
Ejisu Senior High Technical School	59.9(61.2)	5.5(5.6)	5.6(5.7)	9.5(9.7)	8.4(8.6)	0(0)	9(9.2)	97.9(100)
Adventist Senior High School	273.9(83.9)	16.75(5.1)	0.76(0.2)	25.49(7.8)	3.08(0.9)	4.08(1.3)	2.3(0.7)	326.4(100)
Prempeh College	479.7(83.3)	51.09(8.9)	0(0)	37.8(6.6)	0.53(0.1)	4.09(0.7)	2.3(0.4)	575.5(100)
Kumasi Academy Senior High School	275(51.0)	104(19.3)	39(7.2)	60(11.1)	61(11.3)	0(0)	0(0)	539(100)
KNUST Senior High	176.3(58.1)	30.6(10.1)	3.6(1.2)	58.9(19.4)	7.8(2.6)	0(0)	26.5(8.7)	303.7(100)
Agona SDA Senior High School	816.5(87.8)	44.2(4.8)	38(4.1)	0.8(0.1)	6.7(0.7)	21.3(2.3)	2.5(0.3)	930.6(100)
Amaniampong Senior High School	245.4(67.9)	40.5(11.2)	3(0.8)	23.5(6.5)	43.5(12)	5.6(1.55)	-	361.5(100)
Oduko Boatemaa Senior High School	100.5(57.6)	40(22.9)	5.5(3.2)	11(6.3)	9.5(5.4)	6.1(3.5)	1.9(1.09)	174.5(100)
St. Joseph Senior High School	206.4(71)	35(12)	2(0.7)	3.5(1.2)	30(10.3)	10.2(3.5)	3.4(1.2)	290.5(100)
St. Monica's Senior High School	232.6(67.7)	54.5(15.9)	2(0.6)	13.5(3.9)	32(9.3)	4.8(1.4)	4.1(1.2)	343.5(100)
Konadu-Yiadom Senior High School	413.6(91)	11.2(2.5)	0.1(0.02)	1.6(0.4)	9.8(2.2)	17.9(3.9)	0.4(0.9)	454.6(100)
Anglican Senior High School	170(43.5)	105(26.9)	9(2.3)	45.5(11.6)	12(3.1)	13(3.3)	36(9.2)	391(100)
Ejisuman Senior High School	260.3(73.7)	23.9(6.7)	8.1(2.3)	16(4.5)	10.3(2.9)	15.2(4.3)	19.2(5.4)	353(100)
Nsutaman Catholic Senior High School	180.8(64.3)	45(16)	11.3(4)	9(3.20)	11.8(4.2)	11.3(4)	11.9(4.2)	281.1(100)
Mean	**280.59**	**44.47**	**10.34**	**22.33**	**18.49**	**8.44**	**10.97**	**395.70**

of the water consumption pattern of students and the use of polythene bags to wrap food and other items bought by students.

All the selected schools did not practice source sorting and this could affect organic components that could be used for composting and also affect the willingness to practice composting. The schools could generate revenue from the rubbers and plastics if source separation and waste recycling practices were adopted (Armijo de Vega et al., 2008; Smyth et al., 2010).

Currently, many recycling companies do purchase empty sachet containers and other plastics for recycling in Ghana. The third highest component in terms of generation was metals with the percentage ranging from 0.1 to 19.4%, followed by textiles, 0.1 to 12%, other waste, 0 to 9.2%, glass/ceramics, 0 to 7.2% and papers 0 to 4.3% (Table 4). The practice of source sorting could separate the metals which could be sold to steel processing companies. Recycling of metals for processing is being practiced in Ghana and other countries.

Waste generation rate

The per capita per day generation rate of the selected schools ranged from 0.02 kg/cap/day to 0.13 kg/cap/day with an average of 0.056 kg/cap/day. The highest rate (0.13 kg/cap/day) generated by Oduko Boatemaa Senior High School and Konadu-Yiadom Senior High School with a student population of 437 and 1207 respectively. With the student population of 2712, KNUST Senior High School generated 0.02 kg/cap/day, which was the least generation rate among all the schools. The rates of waste generation of all the selected schools were far below the national generation rate of 0.47 kg/cap/day for Ghana (Miezah et al., 2015). It might be a result of the involvement of day students in the schools who normally eat from the home. The study also focused on waste generated at the dormitories, kitchen and dining halls without taking into account of what was generated at other parts of the schools. Their foods were cooked in bulk at the kitchen, which could minimize the amount of waste generated from cooking and most of the students do not purchase food from outside. Though the

Table 5. Solid waste generation per capita per day.

School	Population	Per capita waste generated (kg/cap/day)	P-value
Oduko Boatemaa SHS	437	0.13[a]	
Konadu-Yiadom SHS	1207	0.13[a]	
Agona S.D.A. Senior High School	2960	0.10[b]	0.015
Kumasi Academy SHS	2700	0.07[c]	
Prempeh College	3079	0.06[c]	0.655
Nsutaman Catholic SHS	1725	0.05[d]	
St. Monica's SHS	2100	0.05[d]	
Ejisu-Juaben SHS	3497	0.05[d]	
Amaniampong SHS	2480	0.05[d]	
St. Joseph SHS	2091	0.05[d]	0.433
Adventist SHS	2500	0.04[e]	
Anglican Senior High School	3500	0.04[e]	
Ejisuman Senior High School	3249	0.04[e]	0.083
Ejisu Senior High/Technical School	1256	0.03[f]	
KNUST SHS	2712	0.02[g]	0.04

Numbers of the same superscript within columns are not significantly different and vice versa; Level of significance was estimated at a 5% confidence level.

generation rates of selected schools were lower than what was estimated by the World Bank (2012) it conforms to the observation made by Kaza et al. (2018), which specified that population size has an undeviating bearing on waste generation rate per capita per day.

The study also revealed that schools with large populations generated less as compared to schools with less population. Oduko Boatemaa Senior High School had a population of 437 and its generation rate was among the highest recorded by the study. This might also be due to the hostel system used by the school. Students are allowed to cook their food under this system. Anglican Senior High School had the largest population (3500 students) and its generation rate of 0.04 kg/cap/day was nearly one-third of that of Oduko Boatemaa Senior High School. The generation rates of all selected schools were below the daily generation rate of 0.1412 kg/cap/day in educational institutions reported in Bangladesh (Hossain et al., 2013). The estimated average daily generation by weight of the schools was 131.69 kg/day. The generation rate of Oduko Boatemaa Senior High School was significantly different from Agona S.D.A. Senior High School ($p<0.05$) and that of Ejisu Senior High Technical School was different from that of KNUST and Ejisuman Senior High Schools. The generation rates of schools with the same parenthesis were not different but those with different superscripts were significantly different (Table 5).

The population and waste generation rate per capita per day of the selected schools showed a correlation coefficient of -0.05, which indicated that the larger the population, the less waste generated per person per day and vice versa. An ANOVA of the waste components showed that the components were significantly different from each other at 5% significant level (Table 6).

Determining the recycling potential of the solid wastes

Waste generation and composition affect the factors that determine the selection of waste management options and knowledge on this will not only succor managing the waste but will also improve public health (Hossain et al., 2013). Source separation of solid waste as an approach of waste management has been accentuated by numerous studies (Maklawe et al., 2016; Liao and Li, 2019; Kasavan et al., 2020). Waste segregation at source increases the reuse and recycling potential of waste components. Analysis of the overall total amount of waste generated by all the selected schools indicated that compostable organic waste had the highest amount (71.2%). However, none of the schools had started composting its waste. The survey showed that most students had heard of composting but did not know the processes involved. The second-largest portion of the waste stream was plastics and rubbers (11.26%) and the third was metals (5.65%). The percentage share of textiles, others, glass and papers were 4.68, 2.78, 2.48 and 2.14 respectively (Figure 2). Out of the 5926.27 kg of wastes generated by all the schools, 5761.67 kg were recyclable materials of which 4208.8 kg were compostable materials and 164.6 were non-recyclables. More than 90% of the waste generated in the selected schools in the Ashanti Region could be dealt with through waste reduction, recycling and composting activities

Table 6. Comparisons of the differences between the average waste components generated each day in the randomly selected schools.

Waste component	Days	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Total	Average significance
Organics	Day 1	34.7	35.6	6.7	28.5	24	41.8	26.5	10.2	31	28.3	17.7	62.1	33.6	80.4	33.63	494.7	0.000007
	Day 2	28.1	36.7	6.2	33.8	16.9	49.8	28.7	22.5	18.3	20.3	20.3	62.5	27.5	96.1	27.47	495.2	0.000049
	Day 3	29.2	19	7.1	29.3	17.9	46.3	28.5	11	24	31.8	23.2	35.3	28.1	95.6	28.1	454.4	0.000051
	Total	**92**	**91.3**	**20**	**91.6**	**58.8**	**137.9**	**83.7**	**43.7**	**73.3**	**80.4**	**61.2**	**159.9**	**89.2**	**272.1**	**89.2**	**1444.3**	
Plastics	Day 1	6.1	1.2	0.6	20.5	2.6	1.9	4	5	3.2	4	12.3	8.4	3.1	2.4	3.1	78.4	0.002
	Day 2	6.4	0.7	0.7	8.2	5	0.6	5.3	4.2	3.3	5.3	10.8	3.3	3.4	6.4	3.4	67	0.000026
	Day 3	7.4	3.7	0.6	6	2.6	1.2	4.3	5.2	5.2	6	11.8	5.3	1.5	3.8	1.47	66.1	0.000038
	Total	**19.9**	**5.6**	**1.9**	**34.7**	**10.2**	**3.7**	**13.6**	**14.4**	**11.7**	**15.3**	**34.9**	**17.3**	**8**	**12.6**	**7.97**	**211.8**	
Glass and ceramics	Day 1	0.3	0	0.7	9.3	0.4	0	0.2	1	0	0	1	0	0.3	0.23	0.33	13.8	0.152
	Day 2	0.7	0.02	0.6	2.3	0.3	0	0.8	0.8	0.3	0	2	0	0.7	0	0.73	9.3	0.004
	Day 3	1.63	0.2	0.6	1.3	0.6	0.03	0	0	0.3	0.7	0	0	1.6	0.03	1.63	8.6	0.004
	Total	**2.63**	**0.22**	**1.9**	**12.9**	**1.3**	**0.03**	**1**	**1.8**	**0.6**	**0.7**	**3**	**0**	**2.6**	**0.26**	**2.7**	**31.6**	
Textiles	Day 1	0.6	0.63	1	15	0.9	1.5	5.2	1.2	3.3	4.5	1	0.02	0.6	2.8	0.57	38.8	.019
	Day 2	1	0.01	0.4	2.3	1.1	0.3	5.2	2	3.2	3.3	1.5	0.02	1.03	1.2	1.03	23.6	.001
	Day 3	1.8	0.4	1.5	3	0.6	1.5	4.2	2	3.5	2.8	1.5	0.13	1.8	3.1	1.83	29.7	.000012
	Total	**3.4**	**1.04**	**2.9**	**20.3**	**2.6**	**3.3**	**14.6**	**5.2**	**10**	**10.6**	**4**	**0.18**	**3.43**	**7.1**	**3.43**	**92.1**	
Metals	Day 1	2.2	0.3	1.2	11	12.1	0.5	2	1.3	0	1.2	6.3	12.3	2.2	1.3	2.23	56.1	0.005
	Day 2	0.6	4.8	0.7	4.3	11.2	0	2.3	1.7	1	1.8	4.8	0.3	0.6	0.3	0.63	35	0.009
	Day 3	2.5	3.4	1.2	4.7	3.8	0.1	3.5	0.7	0.2	1.5	4	0.02	2.5	0.8	2.47	31.4	0.000137
	Total	**5.3**	**8.5**	**3.1**	**20**	**27.1**	**0.6**	**7.8**	**3.7**	**1.2**	**4.5**	**15.1**	**12.6**	**5.3**	**2.4**	**5.33**	**122.5**	
Papers	Day 1	0	0.59	0	0	0	1.9	0.83	0	0	0	0	0.6	1.03	4.8	1.03	10.8	0.045
	Day 2	0	0.67	0	0	0	2.6	0.43	0	0	0	0	0.03	0.7	6.1	0.67	11.2	0.098
	Day 3	0	0.1	0	0	0	1.4	0.6	0	0	0	0	0.7	1.1	3.9	1.07	8.9	0.045
	Total	**0**	**1.36**	**0**	**0**	**0**	**5.9**	**1.87**	**0**	**0**	**0**	**0**	**1.4**	**2.83**	**14.8**	**2.77**	**30.9**	
Others	Day 1	2	0.1	0.4	4.8	3.8	0.1	0	0	0	0	3.8	0.3	2	0.4	1.97	19.7	0.008
	Day 2	2	0.1	1.5	4.7	2.2	0.1	0	0	0	0	5	0.4	2	0.4	1.97	20.4	0.007
	Day 3	2.5	0.6	1.1	3.2	2.9	0	0	0	0	0	3.2	0.1	2.5	0.07	2.47	18.7	0.003
	Total	**6.5**	**0.8**	**3**	**12.7**	**8.9**	**0.2**	**0**	**0**	**0**	**0**	**57**	**0.8**	**6.5**	**0.87**	**6.4**	**103.7**	

*All units are in kg/day; **Significance level estimated at 0.05; A=Ejisu-Juaben SHS; B=Adventis SHS; C-Ejisu Senior High Technical School; D=Kuamsi Academy SHS; E=KNUST SHS;F=Konadu Yiadom SHS; G=Amaniampong SHS; H=Oduko Boatemaa SHS; I=St. Joseph SHS; J=St. Monica's SHS; K=Anglican SHS; L=Prempeh College; M= Nsutaman Catholic SHS; N=Agona SDA Senior High School**;** O=Ejisuman SHS.

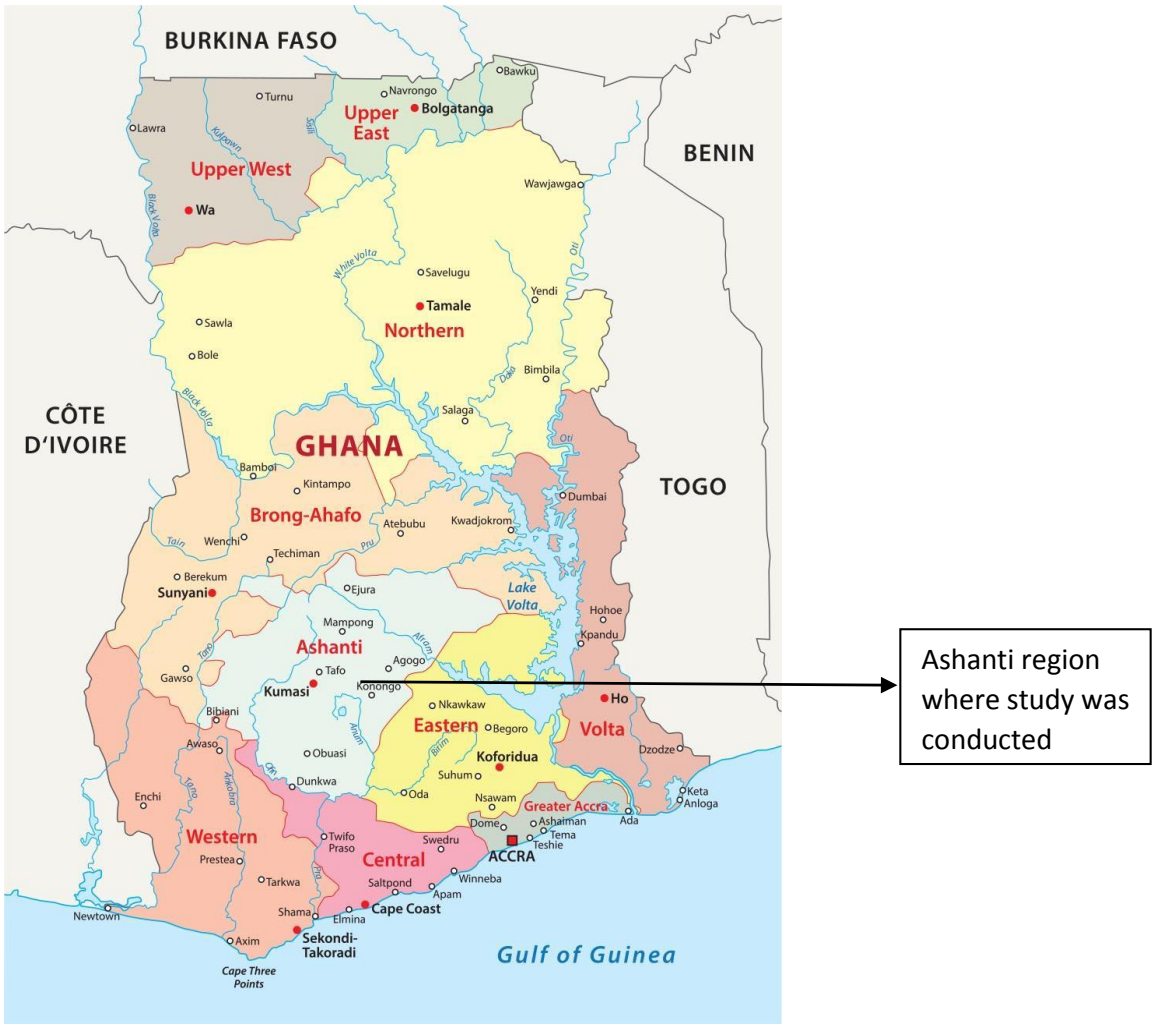

Figure 1. Map of Ghana showing Ashanti Region (Sampling area).
Source: Maps Ghana (www.mapsghanaa.com).

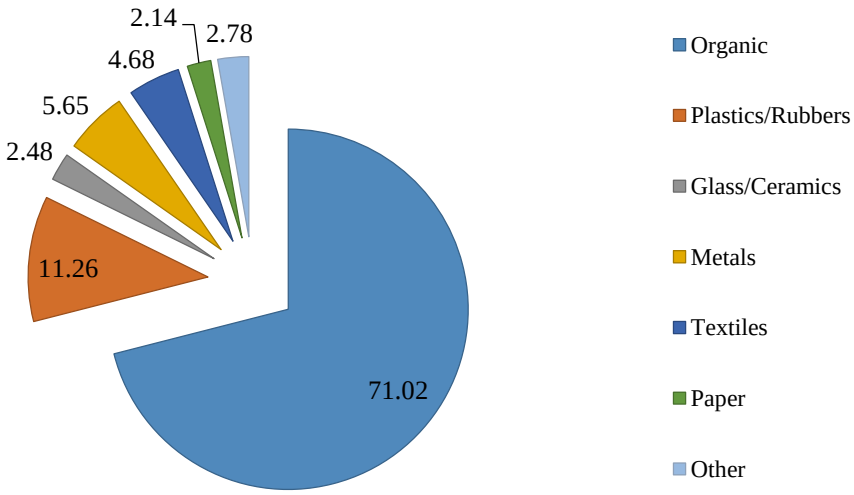

Figure 2. Overall composition of waste generated by the selected schools.

(Rada et al., 2020).

Conclusion

The percentage of organic waste was the highest in the waste streams across the selected schools and ranged from 43.5 to 91%. The organic composition varied among the various schools but these differences were not significant ($p > 0.05$). About 90% of the solid waste generated in the schools could be managed through waste reduction, recycling, and composting activities. Apart from papers, other waste, and organic wastes, there was a significant difference between the generations of the other components ($p < 0.05$). Rubbers and plastic waste was the second-highest fraction in the waste stream. Daily generation rate per capita of all the schools was far below the national generation rate of 0.47 kg/cap/day and less populated schools generated more waste than schools with large populations. Most of the senior high schools disposed of solid waste by crude dumping or open burning. Results obtained from the study suggested an immediate implementation of an integrated solid waste management system option as a way of preventing the unfavorable environmental effects resulting from the crude dumping and open burning of solid waste in senior high schools. Over 50% of students at the senior high schools have knowledge of materials used and products obtained from composting but lacked knowledge of the processes involved in it.

RECOMMENDATIONS

1. It was recognized that a greater percentage of the waste generated in the selected senior high schools was organic waste and therefore composting should be encouraged as a way of managing such components of the waste stream.
2. Source sorting at the point of generation should be encouraged by providing a specific type of dustbin for storing specified components of waste. Enough facilities/strategies should be provided to promote source separation exercise in the schools.
3. Recycling and reuse should be given priority to reduce waste generation volume and lessen the amount of waste that goes to the dumpsite, which will also reduce treatment, disposal cost, and pollution of the environment as practiced by most of the schools.
4. Crude dumping and burning of waste should be discouraged in the schools since they increase the amount of carbon dioxide in the atmosphere and pollution of water bodies.
5. Awareness of solid waste issues is very poor in senior high schools and need to be improved. Awareness can be improved through the introduction of WASH clubs or integration of Environmental Sanitation Education into the senior high school curricula.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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