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ASSESSMENT OF VALUE-ADDED SOLID WASTE DISPOSAL PERCEPTIONS IN GHANA: A CASE STUDY OF KWAMO COMMUNITY, KUMASI

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Abstract
Assessment of perception on solid waste disposal is fundamental to any proper planning of solid waste management in an area. This study assessed the value-added solid waste disposal perception in Kwamo community, Ejisu Municipality in Ghana. Two hundred and sixty (260) households were stratified into high, middle and low-class residential areas based on the type of building, access to road and income status, randomly sampled and interviewed via a structured questionnaire. This study indicated 85% of the respondents consider waste materials as potential value-added resources. Concerns on negative environmental impact of improper solid waste disposal was raised by 77.7% of the responding population, 18.5% were not aware and 3.8% not sure of the negative impacts. The awareness creation on the negative impacts of waste was effective in the following order: media (36.2%) > school (30.3%) > neighborhood (16%) > friends (12.2%). Waste segregation at source was known and practiced by 4.6% while 95.4% of the households had waste bins for storage of their wastes but do not practice segregation. About 74.6% of respondents were interested to participate in waste segregation while 71.5% had interest in adding value to waste (community-based composting). It implies that source separation of waste can be practiced as an integral part of waste management in the municipality. Waste segregation has a potential of providing cleaner materials to maximize revenue through compost preparation, recycling and land reclamation and reduce challenges with public health caused by poor management of waste.

Key Words: *Waste disposal, Compost, Value-addition, Community-based waste management, Ghana*

Introduction

Waste management poses a great challenge to many nations. Waste is defined by many authors as any unwanted material intentionally thrown away for disposal (Oresanya, 1998). Composition and volume of wastes vary from one region to the other and from one country

to another (Cointreau, 1982). Solid wastes consist of biodegradable substances, plastics, glass, metals, textiles and rubber materials. Solid waste management refers to the collection, transfer, treatment, recycling and disposal of solid waste. The various options involved in effective management of waste are prevention, source reduction and re-use, composting, recycling, waste combustion and disposal in landfills (USEPA, 1995). The primary purpose of solid waste management is to promote good health, environmental protection, aesthetic, land use and economics associated with improper solid waste management (Tchobanoglous, 2003). According to Khatit (2011), growth in population aside increasing the quantities of waste generated, has resulted in complexity of the generated wastes due to changing life styles, culture and geographic location. Gomez et al. (2009), reported of garden and food waste as contributing to 65.1% of the total waste stream in most developing countries. According to Miezah *et al*. (2015), waste generation rate of Ghana at the household level was 0.47 kg/person/day, translating into about 12,710 tons of waste per day per then population of 27,043,093. Biodegradable waste generation in Ghana was 0.318 kg/person/day, forming 61% of the solid waste stream (Miezah *et al*., 2015). This fraction has been identified as a major source of environmental pollution especially in urban areas (Fobil *et al*., 2008). The high biodegradable waste could be attributed to the high dependency on agricultural products (Duku *et al*., 2011). It is believed that waste management strategy will become more efficient if there is a concerted effort in mass mobilization to positively change the attitude of citizens in waste material handling and disposal (USEPA, 1995). It cannot be overemphasized that awareness creation and environmental education is key in achieving such a feat. Knowledge of what citizens believe and do with and about waste is the starting point to addressing this pressing issue, especially in the urban areas of developing countries. Biodegradable waste materials can be effectively treated and disposed for land applications in the fields of environmental remediation and agriculture in solid waste management (Adekunle *et al*., 2011).

This study sought to (i) investigate the level of awareness on waste management practices, attitude toward and willingness to participate in value-added waste disposal for environmental sustainability, using Kwamo community in the Ashanti Region of Ghana as a case study and (ii) determine factors that would contribute to willingness of the people to participate in value-added waste disposal.

Materials and Methods

Study Area

The study was conducted in the Ejisu Municipality of the Ashanti Region, Ghana. The Ejisu Municipality lies in the central part of the Ashanti Region occupying a large area of 365 km^2 with Ejisu as its municipal capital. It is located within latitude 1.15°N and 1.45°N north and longitude 6.15°W – 7.00°W (Figure 1). The municipality shares boundaries with six districts in the region, Sekyere East and Afigya Kwabre district to the north-east and north-west, Juaben to the north-east, Bosomtwe district to the south-west, Asante Akim South to the east and Oforikrom to the west. The distance between the district capital, Ejisu and the regional capital, Kumasi is approximately 17 km.

The municipality has a bi-modal rainfall pattern. The major rainfall periods begin from March to July. The average annual rainfall for the major season is between 1200 mm-1500 mm per year. The minor rainfall period begins in September and ends in November with annual rainfall range of 900 mm – 1120 mm. Mean annuals temperatures in the municipal area are lowest in August, around 25^{o}C and at highest (32^{o}C) in March (Ejisu Municipal Assembly, 2021). The 2021 Population and Housing Census showed that, the population in the Ejisu municipality was 180,723 comprising of 87, 836 (48.6%) males and 92,887 (51.4%) females with annual growth rate of 2.3% (Ejisu Municipal Assembly, 2021). The projected population of the current Ejisu municipality for 2022 is 184,879, this reduction in population was as a result of the creation of Juaben Municipality out of the Ejisu-Juaben Municipal Assembly. Agriculture is the main occupation in the municipality employing about 47% of the total households (Ejisu Municipal Assembly, 2021).

Fig. 1: Map of Ejisu municipality

Data Collection Methods

Data Types and Sources

Data used for the research work were from both primary and secondary sources. Primary data were collected through field survey, face-to-face interviews and questionnaire survey. Secondary data were collected from past research works, books, journals and articles were the source of valuable inputs in the preparation of the questionnaire for the study.

Population and Sample Size Determination

Stratified random sampling was adopted to select 260 households under three strata, namely, high socioeconomic area, middle and low socioeconomic areas (Bernache-perez *et al*., 2001). The community was stratified based on type of building, access to road, type of road and layout of the area (Anon, 2012b). Further variables considered before including a household into a particular socioeconomic group were their occupation and income. In literature, there is no specific method used for specifying the number of samples for solid waste analysis study. According to Al-khatib *et al.* (2010), a minimum of thirty (30) samples are adequate for house waste characterization. However, Nordtest (1995) recommended households numbers between 50 and 250 as representatives while Israel (1992) recommended a minimum of 200 samples for a population size between 5000 and 10000 at 95% confidence level. Therefore, the 260 samples used in this study fit in all the recommendations on solid waste assessment surveys. The sample size from high medium and low socioeconomic areas were 111, 60 and 89 households, respectively. This selection of the numbers was based on availability of waste collection point to a household in each of the residential areas.

Households Education and Questionnaire Administration

The randomly selected households were educated on the questionnaire to be administered. The importance of the survey was explained to the respondents to encourage their full participation.

The designed questionnaire was administered to the selected households. Data obtained were on socio-demographic and economic characteristics, awareness and participation in general waste management, willingness to participate in community base composting, financial implication of waste management to respondents, among others.

Survey Data Analysis

Primary data collected from the 260 respondents were coded according to the variables and cross-checked for quality assurance purposes before analysis. Frequencies were computed to obtain counts on variables' values, which were translated to percentage values. Results were then presented as bar-charts, pie-charts and Tables.

Results

Socio-demographic Characteristics of Respondents

Results on the socio-demographic characteristics of the 260 respondents are presented in Table 1. It showed that 6.9% of the respondents were below 20 years, 72.3% fell within 20 to 50 years of age and 20.8% were above 50 years. The relatively higher male respondents, 61.5% in the survey area could be attributed to males being predominantly heads of the families in the area. Majority (63.5%) of the respondents are married people while singles were 28.5%. On education, 13.5%

had no formal education and 86.5% who were educated was at the secondary school level (36.9%). Household sizes varied between 1 and 10 people. Majority (36.5%) of the respondents had household size of 4 to 6 persons, 24.6% had household size of 7 to 9 persons, 23.1% had household size of 1 to 3 persons and 15.8% had more than 10 persons constituting the households.

Table 1: Demographic characteristics of respondents

Variables	Number of respondents	Percentage	Variables	Number of respondents	Percentage
Gender			Age (Year)		
Male	160	61.5	Below 20	18	6.9
Female	100	38.5	20 - 30	41	15.8
Marital status			31 - 40	65	25
Married	165	63.5	41 - 50	82	31.5
Single	74	28.5	Above 50	54	20.8
Divorced	16	6.2			
Widowed	5	1.9	Education level		
Household size			None	35	13.5
1 – 3	60	23.1	Primary	68	26.2
4 – 6	95	36.5	Secondary	96	36.9
7 – 9	64	24.6	Tertiary	49	18.8
Above 10	41	15.8	Other	12	4.6

Socio-economic Characteristics of Respondents

Socio-economic characteristics of the respondents are expressed on employment status, housing tenure, housing type and period of tenement (Figure 2, Table 2). More than half (58.1%) of the participants were gainfully employed by either the government or private sector while 28.8% were self-employed. Regarding housing regiment (Table 2), 67.3% of the respondents were tenants, living in rented apartments and 32.7% lived in their own houses. Majority, 70.8% lived in residential areas, 29.2% dwelt in non-residential (5.4% for institutional and 23.8% for commercial). Period of tenement for houses varied between 1 to 5 years for 44% of the people, less than 1 year for 6.9%, between 6 to 10 years for (33.1%) and above 10 years for 16% of the participants.

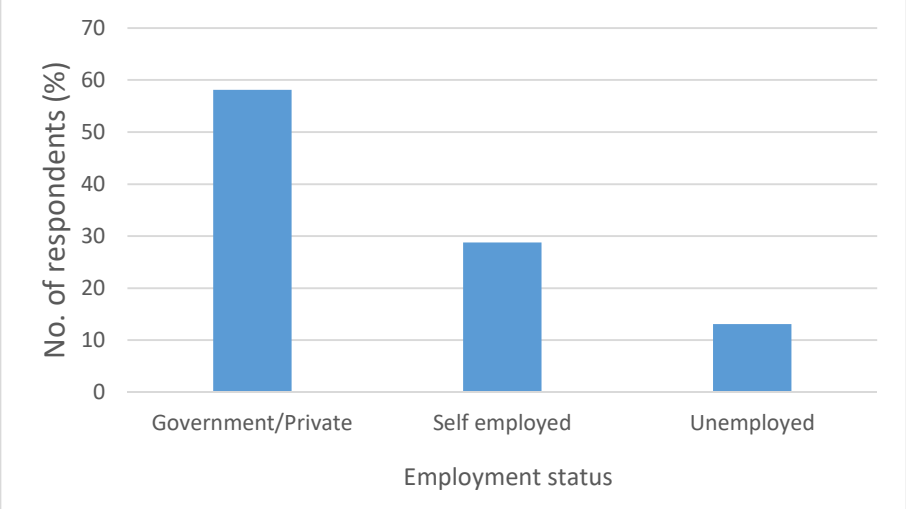

Fig. 2: Employment status of respondents

Table 2: Information on housing regiment of respondents showing housing tenure, type and period of tenement

Variables	Number of respondents	Percentage
Housing tenure		
Owner	85	32.7
Tenant	175	67.3
Type of housing		
Residential	184	70.8
Institutional	14	5.4
Commercial	62	23.8
Period of tenement (Year)		
Below 1	12	6.9
1 – 5	77	44
6 - 10	58	33.1
Above 10	28	16

Awareness and Participation in General Waste Management

The awareness and participation in general solid waste management are presented under the following concepts; (i) knowledge and awareness on waste management, (ii) sources of waste management information, (iii) waste material handling (iv) type of waste sorting: into recyclables, non-recyclables and biodegradables (v) type of waste collection systems, (vi) time of waste collection and (vii) frequency of collection. Data showed that 77.7% of the respondents were very much aware of the impact of improper waste disposal (Figure 3). About general waste management, 72.3% had knowledge on the theoretical concepts while 5.4% were not sure of the theoretical concept of general solid waste management (Figure 4). Major sources of information identified were media, 36.2%, school, 30.3%, neighbourhood, 16% and friends12.2% .

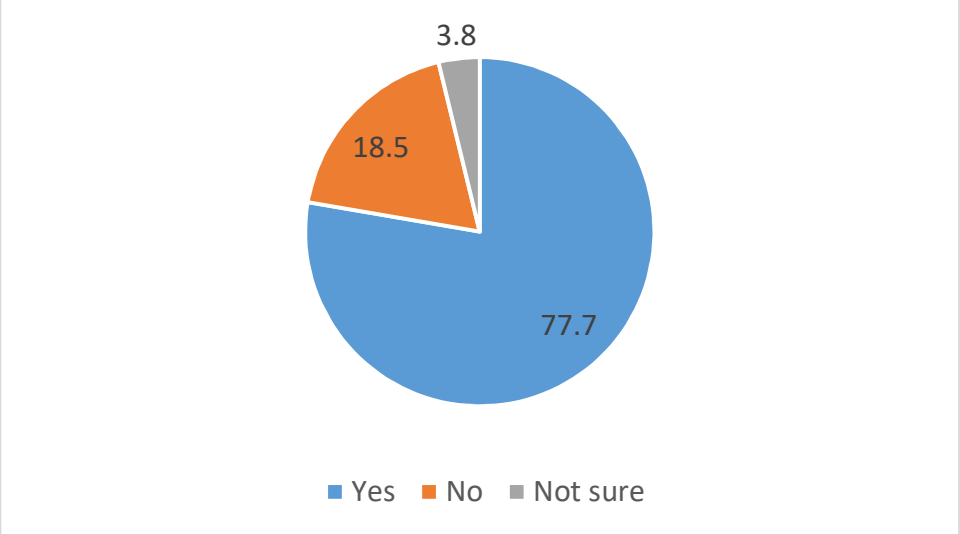

Fig. 3: Distribution of respondents regarding awareness on adverse environmental impact of improper disposal of waste materials

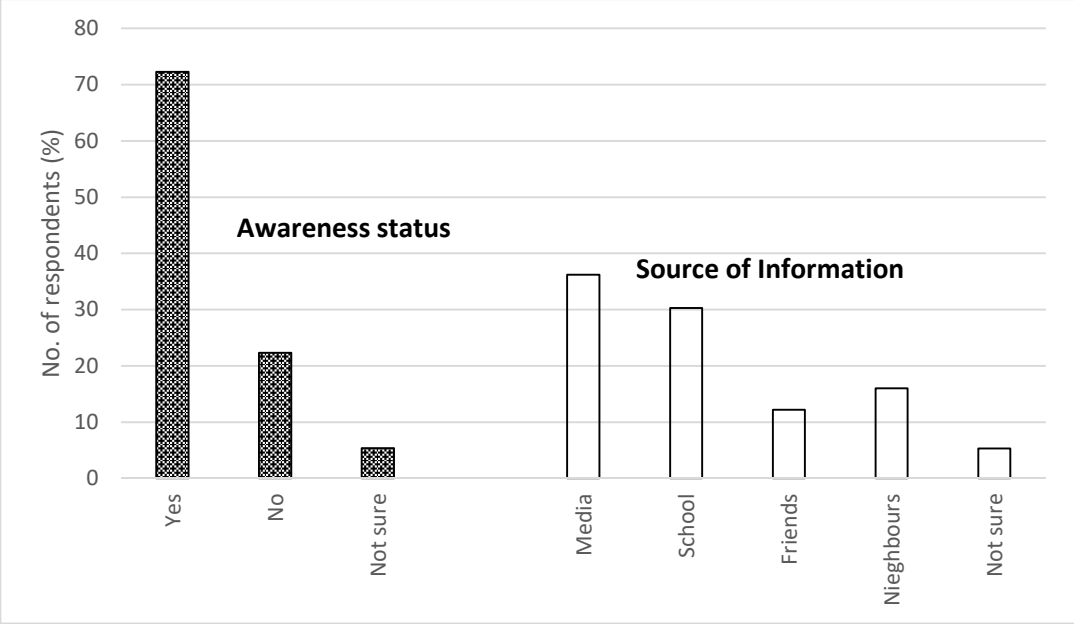

Fig. 4: Awareness status on general waste management theoretical concept and corresponding source of information

Waste management strategies practiced by the respondents are presented in Table 3. The study revealed that 4.6% of the participants separated their waste materials into recyclables and non-recyclables at source, 62.3% of the respondent confirmed that they did not practice waste separation at source and 33.1% practiced indiscriminate waste disposal. Collection of waste for disposal by the municipal authority was reported by 21.2% of the participants while waste material disposal

in open space (illegal waste dumpsite) was the practice of 11.5% and 67.3% of the participants disposed their wastes in community bins. Majority of the respondents were disposing waste on a daily basis, 46.9% followed by those who do it on weekly basis, 32.3% (Table 3).

Table 3: Information on waste disposal strategies

Waste disposal strategy	**No. of respondents**	**Percentage**
Waste separation at source	12	4.6
Waste mix at source	162	62.3
Indiscriminate waste disposal	86	33.1
Total	**260**	**100**
Waste collection technique	**No. of respondents**	**Percentage**
Collection by municipality	55	21.2
Waste disposal in open space	30	11.5
Waste disposal in community bin	75	67.3
Total	**260**	**100**
Frequency of waste disposal	**No. of respondents**	**Percentage**
Daily	122	46.9
Weekly	84	32.3
Monthly	9	3.5
Irregular	45	17.3
Total	**260**	**100**

Knowledge and awareness of composting technology as a value-added disposal technique for organic wastes

The survey on knowledge of the respondents on composting techniques (Figure 5) showed that majority (53.1%) of the respondents were aware of the technique while as high as 46.9% of the respondents were either unaware of the technique or not sure of their knowledge on composting technology. About 40% are practicing composting as waste disposal technique despite the appreciable level of awareness. The most common composting technology practiced was heap composting as acknowledged by 48.6%, against pit, on-farm composting, windrows and static in-vessel composting methods (Figure 5). Moreover, the study found that 71.5% of the respondents were willing to participate in community-based composting for environmental sustainability and 74.6% of them were willing to practice waste segregation at source to facilitate community based-composting.

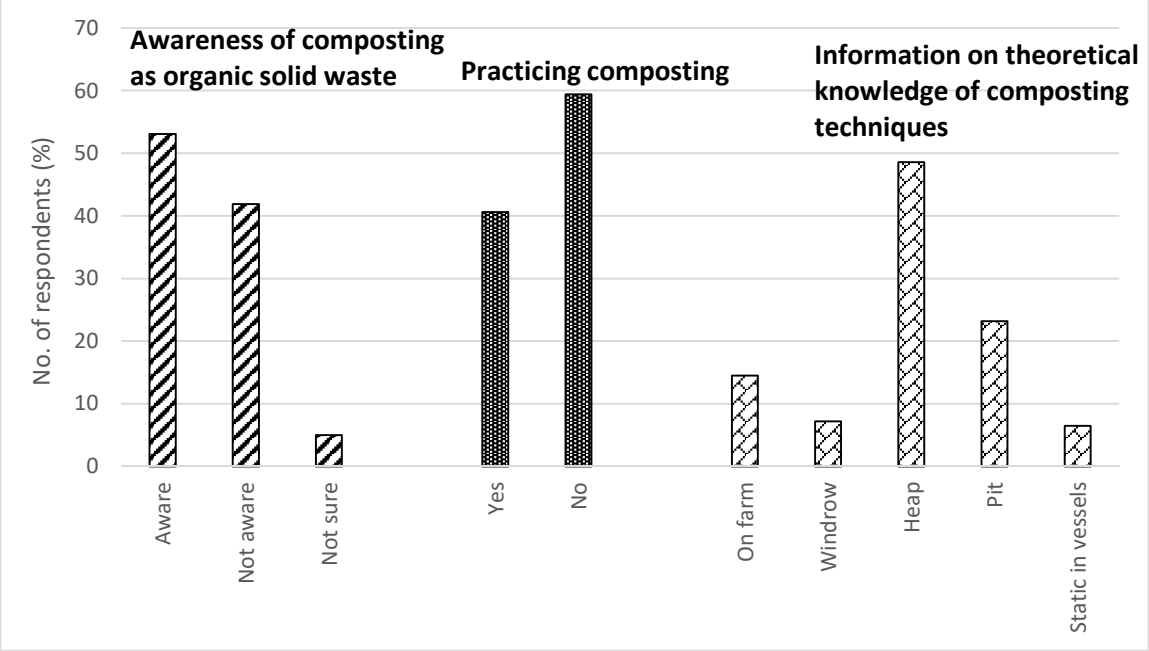

Fig. 5: Information on composting from respondents

Figure 6 presents the source of materials used by respondents for composting in the study area. The majority of respondents practicing composting used household waste plus poultry manure (32.2%) followed by household waste plus goat manure (21.4%) and the least source of materials for composting was goat manure only (1.8%). Besides household waste, poultry manure, goat manure and pig manure the other materials used by respondents for composting in the study area were cow manure and sheep manure. Majority, 62.5% of the respondents perceived that their compost matures after 3 months while the least, 3.6% allowed their compost to go beyond 4 months to mature (Figure 7).

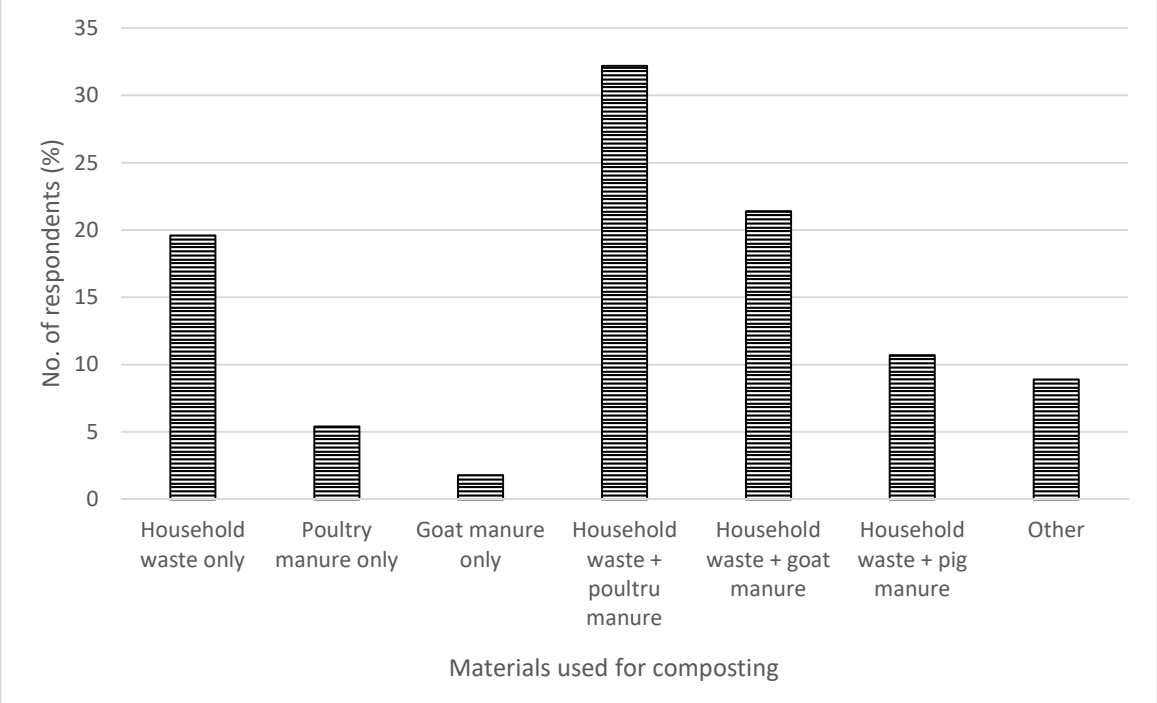

Fig. 6: Information on materials used by respondents for composting

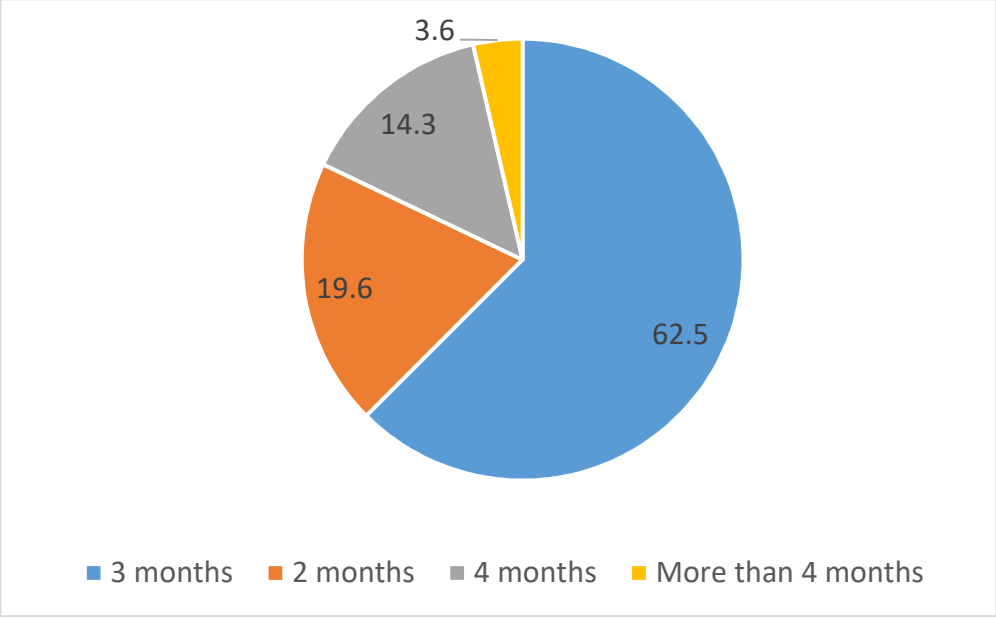

Fig. 7: Perceived composting period to maturity

Financial Implication of Waste Management

The response of participants on financial implication of waste management is presented in Table 5. About 85% of the respondent considered waste materials as potential raw materials, while 7.3 % had actually derived

monetary benefits from waste materials. For effective waste disposal, 39.2 % of the respondents pay money for waste collection by the waste management servicing companies, and 81.9% of the respondents would be motivated to manage their wastes better if they could derive some degree of financial benefit from their waste. Furthermore, 67.3% would still be motivated even if they are asked to pay some specific amount of money to achieve effective disposal of their waste (Table 4).

Table 4: Cost of waste management

	Frequency (%)			
Inquiry	**Yes**	**No**	**Not sure**	**Total**
Ever considered waste materials as raw materials?	221 (85.0)	31 (11.9)	8 (3.1)	260 (100)
Ever received money for your waste materials?	10 (7.3)	237 (91.2)	4 (1.5)	260 (100)
Ever paid to municipality for waste material disposal?	102 (39.2)	145 (55.8)	13 (5.0)	260 (100)
Will you be motivated if paid some token for effective disposal of your own waste materials?	213 (81.9)	37 (14.2)	10 (3.8)	260 (100)
Will you still be motivated if asked to pay some token for effective disposal of your own waste materials?	175 (67.3)	83 (31.9)	2 (0.8)	260 (100)

Discussion

This study revealed that 85% of the respondents considered solid waste as potential raw material with financial benefit indicating that they could be assisted to begin waste projects at household levels to add value to waste with financial benefits from their waste materials disposal by 7.3% of the respondents. Some of them are already involved in practices such as trading in plastic bottles, metals and glass bottles to generate income. Enhancing these activities among households with better market opportunities and training could help them make the most from their waste. Some environmentalists are of the opinion that improper waste handling in developing countries is compounded by the vicious cycle of poverty, population explosion and decreasing standard of living (Zerock, 2003; Al-Khahb *et al*., 2007; Ogwueleka, 2009). Waste segregation at source was4.6%, the reason being that lack of market for the segregated waste materials, lack of training on how to segregate their waste, lack of availability of receptacles for segregating their waste materials, poverty and population explosion could be really the foundational causative factors to unsafe waste material disposal and management. The study revealed that majority of respondent had interest to participate in waste segregation, 74.6% and value-added waste management especially community-based composting, 71.5%. It then confirms that positive attitudinal change in the citizens towards best solid waste management practices will be achieved with proper education and mobilization of the population (Tikka *et al*., 2010). This is an indication that they consider source segregation as a positive step in waste management for environmental sustainability, therefore there is a need for leadership drive to attain this foremost step in waste

valorization. It then follows that if properly informed, mobilized and conditions made favorable, the citizens will actively participate in effective waste disposal and value-added solid waste management such as segregation at source and community-based composting scheme, for a cleaner and healthier environment.

Regarding information dissemination on awareness of waste disposal and management, there was a decreasing order as follows: media (36.2%) > school (30.3%) > neighborhood (16%) > friends (12.2%). How different it would be if the percentage impact from school on information dissemination was very much higher (on the average of 70%). This is an avenue where the citizens could be captured young and proper waste handling becomes part and parcel of their daily activities. Introduction of environmental education in the basic and high schools could change the paradigm of waste disposal and management in the country. The study further revealed that 67.3% households have wastes bins for storage of waste they generate for collection by the service providers. An enhanced benefit could be achieved if source-separation which involves systematic separation of the waste at the source of generation is employed. This may reduce the incidence of contamination resulting from comingling of the different kinds of waste. The relatively high proportion, 86.5 % of respondents with formal education shows the high level of formal education of the respondent in Kwamo community. This high level of education could help in dissemination of education on waste management and the use of available waste management technologies. Amfo-Otu *et al*. (2012) and Aggrey and Douglason (2010) reported that educational level is an important aspect for adoption of technologies because educated people may be more appreciative of the benefits of new technology.

Conclusion

This study investigated the level of awareness on waste management practices, attitude towards waste management and willingness to participate in value-added waste disposal option for environmental sustainability, using Kwamo community in the Ashanti Region of Ghana as a case study. Currently, source separation of waste is practiced by majority of the respondents in the study area. However, a higher percentage of them are willing to participate in waste segregation at source and adopt composting at home as value-addition to waste for proper disposal of waste in their community. This would enable the waste to be effectively managed since the benefits of the various practices (including compost formation and recycling) could be maximized when they participate. It would minimize the improper handling of solid waste and enhance the economic value derived from compost and recyclable solid wastes in the municipality to promote better public health. The start to participation should begin on pilot scale trials on waste segregation at source using selected communities within the municipality. Community-based composting schemes aimed at formulating composts suitable for land applications and bioremediation should be demonstrated with the help of identified groups such as non-governmental organizations (NGOs), community-based organizations (CBOs),

Municipal authority, waste management companies, among others.

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