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Indiscriminate open space solid waste dumping behaviour of householders in the Brong-Ahafo region of Ghana: a political economy analysis

Theophilus Tweneboah Kodua* and Kwabena Asomanin Anaman

Abstract: This study assessed the factors which influenced households' choice of waste disposal methods using cross-sectional data of 547 households from seven districts in the Brong-Ahafo region of Ghana. Indiscriminate dumping of solid wastes in open spaces by households was the pivotal method of disposal of solid wastes that was analysed using economic theories related to consumption behaviour. We established that large household sizes were associated with increased likelihood of open dumping of solid wastes. Increased likelihood of open dumping of solid wastes by householders was also linked to the lack of formal education or schooling of the household head, the availability of electricity inside the premises of the house, which encouraged production activities within the household, and open defecation. Urban householders were less likely to engage in open dumping of solid wastes as compared to rural households. The other factors that reduced the likelihood of open dumping of solid wastes were generally in the area of quality of

ABOUT THE AUTHORS

Theophilus Tweneboah Kodua holds a Bachelor's degree in Development Studies (Economics & Entrepren. option) from University for Development Studies, Ghana and a Master's degree in Agricultural Economics from the University of Ghana. He is currently pursuing a PhD degree in Agricultural Economics and Policy at the College of Basic and Applied Sciences, University of Ghana. His research interests include rural and agricultural development, production, resource and environmental economics and agricultural trade and market access.

Kwabena Asomanin Anaman is a Professor at the University of Ghana, Legon, Accra, Ghana. Professor Anaman has 37-year professional work experience, which includes 19 years of research, teaching and government advisory work in the Asian-Pacific Region. His research interests are in applied economics, in the areas of political economy, resource and environmental economics, economic growth (firm, industry and macroeconomy), economics of agriculture, international trade, managerial/business economics, and economics of the family and marriage.

PUBLIC INTEREST STATEMENT

The objectives of sustainable development as enshrined in the 2030 United Nations Sustainable Development Goals, emphasize good environmental sanitation. Achieving this goal is undermined in many parts of the world by open-field dumping of solid wastes behaviours. Using cross-sectional data we assessed the factors which influenced householders' indiscriminate dumping of solid wastes in open spaces in the Brong-Ahafo region of Ghana. We established that large household sizes, lack of formal education or schooling of the household head, the availability of electricity inside the premises of the house, which encouraged production activities within the household, and open defecation were associated with increased likelihood of open dumping of solid wastes. In general, urban householders were less likely to engage in open dumping of solid wastes than rural householders. The other factors which reduced the likelihood of open dumping of solid wastes included the number of sleeping rooms available to the household and higher quality of housing services revealed through the willingness-to-pay for rents by householders.
housing services; these were the availability of water inside the household premises, the number of sleeping rooms available to the household, and higher quality of housing services revealed through the willingness-to-pay for rents by householders. Finally, Guan-headed households were less likely to engage in open dumping of solid wastes than non-Guan-headed households, especially those living in rural areas. Rural Guan-headed households had the lowest proportion of open dumping of solid wastes.

Subjects: Environmental Sciences; Environmental Management; Environment & Philosophy; Environment & Economics; Environment & Health; Conservation - Environment Studies; Political Ecology; Biodiversity & Conservation; Ecology - Environment Studies; Environmental Politics

Keywords: economic behaviour; environmental economics; environmental management; household behaviour; Ghana; open space dumping; solid wastes; waste management

1. Introduction
The objectives of sustainable development as enshrined in the 2030 United Nations Sustainable Development Goals (SDGs) emphasize good health and well-being (goal 3); clean water and sanitation (goal 6), and responsible consumption and production (goal 12). Achieving goal 6, which is related to environmental sanitation, is undermined in many parts of the world by open field dumping behaviours by households. Rapid population growth and urbanization contribute considerably to increasing waste generation rates in many countries. Usually, waste generation rate does not commensurate with the level of efforts society makes in terms of their collection and disposal. The effects of inadequate waste collection and disposal lead to air, land and water pollution with health effects. Deteriorating human health and environmental degradation have grave consequences on the productivity, efficiency, and the development of a country.

Despite the many studies on waste management challenges of countries, and their effects on human health and the environment (for example, refer to works such as Ayotamuno and Gobo (2004), Anaman and Nyadzi (2015), Amoah and Kosoe (2014), Boadi and Kuutinen (2005), Chaplin (1999); Dladla et al. (2016), Katusiimeh (2012), Kwetey et al. (2014), Miller (1988), Puupiel (2010), Sule (1981), Ziraba et al. (2016), and Saleh (2019)) people continue to adopt environmentally unfriendly methods of dumping solid wastes onto open public spaces such as gutters, streets, rivers and the sea. Such behaviour adversely affects society by imposing negative externalities. For example, the aesthetic nature of the environment is destroyed; people are exposed to bacteria and viruses which result in outbreak of diseases such as bilharzia, cholera, diarrhoea, eye infections, guinea worm infections, malaria and typhoid. Malaria is the most common source of deaths among people, especially children under five years of age, in Africa including Ghana.

In Ghana, diseases linked to poor environmental sanitation are responsible for about 70% of out-patient-department (OPD) cases. The costs of these environmental diseases threaten the viability of the national health insurance system. Improper disposal of wastes in Ghana combined with the drainage infrastructure deficits, poor architectural designs, and weak regulatory and institutional arrangements have partly contributed to the perennial flooding events during rainy seasons, especially in Accra, the capital city of Ghana. While the country makes large investments in dredging rivers and choked gutters, indiscriminate dumping of wastes including solid wastes in open spaces such as gutters and rivers render these investments ineffective in improving the overall socio-economic development of Ghana.

Based on information from the 2010 population and housing census (Ghana Statistical Service (GSS), 2013; refer to Table 1), dumping of solid wastes into public containers is the commonest
| Method of rubbish disposal | All regions (2010) | Urban | Rural | Western | Central | Eastern | Greater Accra | Volta | Brong-Ahafo | Northern | Upper East | Upper West | Total |
|----------------------------|-------------------|-------|-------|--------|---------|---------|-------------|-------|-------------|----------|-----------|----------|-------|
| Collected                  | 14.4              | 4.6   | 8.2   | 4.6    | 6.1     | 4.1     | 2.9         | 9.1   | 11.1        | 6.2      | 11.1      | 6.2      | 11.1 |
| Burned by household        | 10.7              | 10.2  | 11.4  | 5.8    | 13.4    | 13.0    | 15.9        | 16.2  | 25.0        | 10.9     | 25.0      | 10.9     | 25.0 |
| Public dump (containers)   | 23.8              | 38.7  | 21.1  | 18.7   | 25.7    | 16.6    | 22.8        | 21.8  | 14.8        | 14.8     | 17.9      | 14.8     | 17.9 |
| Public dump (open space)   | 37.7              | 22.7  | 56.6  | 50.6   | 53.8    | 84.3    | 41.3        | 41.3  | 38.7        | 38.7     | 31.2      | 38.7     | 31.2 |
| Dumped indiscriminately    | 9.1               | 3.1   | 16.7  | 9.7    | 54.6    | 84      | 41.3        | 41.3  | 38.7        | 38.7     | 31.2      | 38.7     | 31.2 |
| Burned by household        | 3.3               | 2.3   | 4.6   | 3.5    | 3.4     | 1.4     | 5.2         | 5.2   | 2.7         | 5.2      | 2.7       | 5.2      | 2.7  |
| Buried by household        | 1.0               | 0.8   | 1.2   | 0.9    | 1.5     | 0.9     | 1.2         | 1.2   | 0.7         | 0.7      | 0.8       | 0.8      | 0.8  |
| Other                      | 1.0               | 1.0   | 1.0   | 1.0    | 1.0     | 1.0     | 1.0         | 1.0   | 1.0         | 1.0      | 1.0       | 1.0      | 1.0  |
| Total                      | 100               | 100   | 100   | 100    | 100     | 100     | 100         | 100   | 100         | 100      | 100       | 100      | 100  |

Source: Ghana Statistical Service (GSS) (2013)
form of household waste disposal in Ghana; this is followed by dumping of solid wastes in designated public dumps. The third popular method of solid wastes disposal in Ghana is burning. Indiscriminate dumping of solid wastes into open spaces is the fourth most popular method nationally. However, for rural areas, indiscriminate dumping is the second most popular form of disposal of solid wastes with dumping of wastes in designated public dumps the most popular. The 2010 census data also clearly showed the rural/urban difference in indiscriminate dumping of wastes (16.7% of rural households versus 3.1% of urban households). In simple terms, about one in six rural households dumped their solid wastes indiscriminately compared to about one in 30 households for rural areas. Diadla et al. (2016) also found that indiscriminate dumping is the main waste disposal method used in African countries especially, followed by landfill, open burning and recycling respectively.

Building on earlier studies including those cited above, this study sets out to identify factors that are associated with the increased likelihood of householders dumping solid wastes onto open land/open fields, rivers, gutters and other open public spaces. This paper attempts to find answers to the following questions; who are those dumping onto the open environment and what factors influence this open dumping behaviour? The main objective of the study is to identify the determinants of open dumping of solid wastes in the Brong Ahafo region of Ghana.

2. Political economy analysis of consumer behaviour and choices

2.1. Introduction to markets, community and the state

No individual human being is an island on his or her own. Each individual belongs to a Community, and is governed by the laws of the Nation-State that he/she lives in. So why do people openly dump refuse into the environment despite all of the obvious negative health consequences on human lives? Economists argue that such human behaviour is explained with the concept of market failure. Market failure refers to the actions of individuals which lead to excessive production of goods and services not required by society. Markets deal with the exchange of goods and services among producers and consumers. Individuals involved in such exchanges are assumed to act based on their rational self-interest (McConnell et al., 2016).

The production and consumption of goods and services result in waste generation. The inadequacy of waste disposal services and/or high user-fees charged to consumers by waste collection companies may lead to improper disposal of solid wastes by households. This behaviour is an example of market failure. The analysis and correction of market failures involve the understanding of the linkages among the Market, Community and State institutions. All countries are mixed economies having various features of the Market, Community and the State (Clarke, 2009; Ostrom, 2005; Otsuka & Kalirajan, 2010; Piketty, 2017; Saros, 2019).

The Community consists of non-State actors such as non-governmental organizations, religious groups and semi-voluntary structures related through blood ties such as the extended family systems and traditional chieftaincy institutions (Anaman & Nyadzi, 2015). Communities have in-built mechanisms for dealing with market failures which are substantial and pervasive in rural societies around the world (Otsuka & Kalirajan, 2010). For instance, in Ghana, Traditional Councils impose rules and regulations to bar people from dumping refuse into open fields indiscriminately and can organize communal labour for cleaning of the environment. Non-governmental organizations and religious groups may also use their platforms to educate individuals and the community at large on the grave consequences of open field dumping or even organize environmental clean-up campaigns/exercises. An Environmental Care Campaign rolled out by The Church of Pentecost in Ghana clearly exemplifies this.

The government or the State equally enacts laws for the purposes of maintaining environmental quality and hygienic sanitation at all times. It has various law enforcement agencies to see to it
that these laws are adhered to. However, in contemporary Ghana, there is widespread government failure in environmental sanitation as exemplified by the very poor environmental sanitation of Ghana revealed by several international ranking agencies such as World Health Organization & United Nations International Children’s Emergency Fund (WHO & UNICEF) (2017) and the Yale University Environmental Performance Index (Yale University, 2018). Yujirō Hayami, the Japanese political economist, suggested in two papers published in 1989 and 2009, several mechanisms for the correction of market failures by the Community and/or the State, and the conditions under which these two components of society are useful in the correction of market failures, especially in rural-based societies. Hayami emphasized the conditions under which each of the three components of society (Market, Community and the State) fails which then require corrections. Just like market failures, both Community and State failures are common. Further, some market failures cannot be corrected either by the Community or the State.

A major factor involved with both Community and State failures is transaction costs. The concept of transaction costs was first introduced by the British-American political economist, Ronald Harry Coase in 1937 to explain the economic rationale for the existence of firms, and later in 1960 to explain the transaction costs involved in market exchange between individuals, that involve externalities. Transaction costs are composed of three parts: (1) search and information costs, (2) bargaining costs among the parties involved with the transaction costs, and (3) enforcement and policing costs. Community and State failures in Ghana for sanitation projects are often due to the high transaction costs dealing with finding suitable areas of land for public waste dumps and land for the construction of community facilities.

2.2. Neoclassical economics theoretical formulation of the open dumping problem

Neoclassical economic analysis of open waste dumping behaviour of individuals and households starts with household consumption of goods and services as the major waste-generating activities in Ghana. The consumption of goods either from household’s own production or purchase from the commodity market such as farmers’ market centres and modern malls and supermarkets generate solid wastes. We assume that householders obtain utility from the disposal of solid wastes from their households as household cleanliness by itself provides utility. We assume that each household consumes varying quantities of k commodities available within the society and disposes its solid wastes using two methods which are (1) open dumping ($W_2$) and (2) non-open dumping methods ($W_3$).

The general consumption problem for the ith household is to maximize the consumption of k commodities, plus the use of the two waste collection services for which the household obtains utility or satisfaction for their consumption as shown by Anaman and Jair (2000). This consumption is subject to the budget constraint of the household. The demand functions derived are the Marshallian demand functions named after the British economist, Alfred Marshall who first advocated the supply and demand functions concepts for the allocation and valuation of goods and services (market prices) by integrating the utility-based demand concept with the supply-based labour theory of value, into a unified (neoclassical) theory in 1890 (Marshall, 1890).

For this study, we adopt the total expenditure theoretical approach to analyse the problem of open dumping of solid wastes. The economically-rational household’s consumption problem is then to minimize the total expenditures involved in the consumption of k commodities and two waste disposal services subject to the achievement of a minimum total utility level. This problem is denoted in Equations (1) and (2) for household i as follows:

\[
\begin{align*}
\text{Minimize} & \quad \sum_{j=1}^{k} P_j X_{ij} + R_1 W_{3ij} + R_2 W_{2ij} \\
\text{Subject to the constraint denoted in Equation (2)}
\end{align*}
\]
\[ U_i(X_{ij}, \ldots, X_{ik}; W_{1i}, W_{2i}) = \bar{U}_i \]  

(2)

where \( X_{ij} \) is the quantity of the \( j \)th good consumed by the \( i \)th household based on the price \( P_j \) for good \( j \). This household produces \( W_1 \) plus \( W_2 \) quantities of solid wastes which are disposed off, using the open dumping and non-open dumping methods at the costs of \( R_1 \) and \( R_2 \) respectively; \( U_i \) is the utility derived from consuming \( k + 2 \) bundle of commodities made up of \( k \) commodities and the two waste disposal services, with \( \bar{U}_i \) being the total utility level required by the household.

This total utility level is achieved by the consumption of the various goods and services including the two waste disposal services. The use of this total utility level is applicable to Ghanaian households who often base their livelihood decisions on certain minimum levels of consumption of food and non-food products. The waste disposal cost, \( R_1 \) is often zero as the household does not make an effort in terms of time and/or money to dispose of the solid wastes but rather dump the wastes anywhere (this behaviour fits the definition of open or indiscriminate dumping). The other non-dumping solid wastes disposal methods involve some costs (\( R_2 \)) which include time travel costs, other time costs and money. Based on Equations (1) and (2), the Lagrangian-constrained minimization function for the \( i \)th household is given as:

\[ L = \sum_{j=1}^{k} P_j X_{ij} + R_1 W_{1i} + R_2 W_{2i} - \gamma (\bar{U}_i - U(X_{ij}, \ldots, X_{ik}; W_{1i}, W_{2i})) \]

First order conditions yield the following results:

\[ L_{X_{ij}} = P_j + \gamma U'_{X_{ij}} = 0 \]

\[ L_{W_{1i}} = R_1 + \gamma U'_{W_{1i}} = 0 \]

\[ L_{W_{2i}} = R_2 + \gamma U'_{W_{2i}} = 0 \]

\[ L_{\bar{U}_i} = U(X_{ij}, \ldots, X_{ik}; W_{1i}, W_{2i}) - 0 \]

Assuming sufficient second order conditions exist, then the constrained minimization problem yields two Hicksian demand functions for waste disposal services for open dumping (\( W_{1i} \)) and non-open dumping (\( W_{2i} \)) for the \( i \)th household. The Hicksian demand function is named after the British economist, John Richard Hicks who initially developed the concept in 1939. The two solid wastes Hicksian demand functions are noted in Equations (3) and (4).

\[ W_{1i} = f(\bar{U}_i, P_1, \ldots, P_k, R_1, R_2) \]  

(3)

\[ W_{2i} = f(\bar{U}_i, P_1, \ldots, P_k, R_1, R_2) \]  

(4)

The estimation of Hicksian demand functions, using cross-sectional data, as is done in this study, requires some further assumptions. We assume that the prices of the \( k \) goods and the two waste disposal services (\( P_1, \ldots, P_k, R_1, R_2 \)) are constant during a period of time, such as the period that the survey was undertaken in the Brong Ahafo region. It is also assumed that individual households are too small to affect market prices. In other words householders are price-takers. Therefore, Equations (5) and (6) could be proxies for Equations (3) and (4) respectively.

\[ W_{1i} = f(\bar{U}_i, K_1) \]  

(5)

\[ W_{2i} = f(\bar{U}_i, K_2) \]  

(6)

where \( K_1 \) and \( K_2 \) are constants for all households.

The empirical estimation of the Hicksian demand functions for \( W_{1i} \) and \( W_{2i} \) depends on \( \bar{U}_i \), the required total consumption level of the household \( i \). As noted by Thian (2018, p. 133), and Varian
(2014), the Hicksian demand functions are not directly observable. However, given that \( W_{\text{t}} \) and \( W_{\text{n}} \) are observed as dichotomous variables represented by either use of the particular waste disposal service or not (0, 1), we argue that the Hicksian demand functions for the two waste disposal methods can be estimated by using a proxy vector of socioeconomic variables for the household \( i \), to represent the unknown variable, \( \bar{U} \).

In our cross-sectional study, the vector of socioeconomic variables used to represent \( \bar{U} \) are as follows: (1) household size, (2) formal educational attainment level of household head, (3) type of toilet facilities used by the household, (4) the availability of water for general use inside the household living premises, (5) the availability of electricity inside the household within the living premises, (6) the number of sleeping rooms available to the household, and (7) the economic value of housing rental services used by the household.

2.3. Upgrading the open dumping problem analysis from neoclassical economic analysis to political economy analysis

The discussion in the previous section analyses the open dumping of solid wastes problem purely from the characteristics of the individual household by using these characteristics as a proxy for the total household consumption level. This approach neglects group effects which can influence individual choices. The individual lives within a community and belongs to various voluntary groups and other groups related to his/her blood ties. Political economy analysis enhances the neoclassical economics analysis by the incorporation of additional variables related to groups which may influence the behaviour of an individual, and others related to political power structures. For example, as indicated by Kiely (2006), Sackrey et al. (2016), and Soros (2019), structuralism theories assert that dominant groups determine and/or shape the socio-economic outcomes in a nation state. It is therefore useful to incorporate variables in grouped forms that could possibly affect individual behaviour.

From this perspective, open dumping behaviour could be influenced by interactions of the individuals with members of groups that he/she belongs. Further, political economy analysis also incorporates geographical location and demographic factors as these may affect consumption behaviour of individuals such as the use of specific waste collection services. In this study, based on the available data, we extended the simple neoclassical model discussed earlier with additional variables. These variables were the age group, ethnic group, marital status, religious affiliation, and sex of the household head and rural/urban geographical location of the household. The analytic models used for the study are discussed in the next section.

3. Methodology

3.1. Data

The study uses data collected by the Monitoring Evaluation and Technical Support Services (METSS) in the Savannah Accelerated Development Authority (SADA) regions: Upper East, Upper West, Northern, Brong Ahafo and Northern Volta under the United States Agency for International Development (USAID) Feed the Future Initiative. The Feed the Future Initiative aims to help developing countries address root causes of hunger and poverty specific to their individual and unique circumstances through the transformation of agricultural production and improvement in health and nutrition (United States Agency for International Development, 2020). The data were collected on eleven modules including household demographic information, household hunger scale, cultivation of key crops, access to productive capital, access to credit, consumption of food items, non-food consumption expenditure, group membership, dwelling characteristics, women’s dietary diversity, and women’s anthropometry. In all, 4,410 households were sampled and interviewed over the period, 2014 to 2015.

For the purposes of this study 554 households were drawn from the Brong-Ahafo region from the Jaman North, Tain, Wenchi, Sene, Pru, Kintampo South and Kintampo North districts. But seven households were dropped due to incomplete information. In effect 547 households were used
comprising of 370 rural households (67.6%) and 177 urban households (32.4%). The focus was on the dwelling characteristics combined with the consumption and household demographic characteristics from which households’ waste management/disposal behaviours were assessed. The Brong Ahafo region, the region of this study, was created by An Act of Parliament in 1958. Based on a referendum held in December 2018, the region was further divided into three separate regions namely: Bono (Bono West), Bono East and Ahafo regions. These three new regions became operational in January 2019.

3.2. Statistical and econometric analysis

The study applies simple descriptive statistical analysis using means, percentages and standard deviations to variables of interest (i.e. sociocultural and demographic characteristics of households). The results of this analysis are presented in Tables 2 and 3. The ability to predict discrete outcomes is important in many applications involving with the modelling of human behaviour (Hill et al., 2018). The probit regression model analysis was used to estimate the factors that influence households’ choice of method of solid waste disposal. The choice of method of waste disposal by households is modelled as a binary variable within a probit framework because the dependent variable is dichotomous in nature.

As discussed in the empirical analysis literature review, the choice of solid waste disposal method used by households is related to their characteristics. The relevant waste disposal method chosen for this study is open dumping of solid wastes into natural environments such as open fields, rivers, lakes and seas. The general probit regression model of household open dumping behaviour is specified below in Equation (7) as follows:

\[ \text{OPENDUMPING} = f(\text{LARGEHHSIZE}, \text{NOSCHOOLING}, \text{OPENDEFECATION}, \text{WATERINSIDETHEHOUSE}, \text{ELECTRICITYINSIDETHEHOUSE}, \text{SLEEPINGROOM}, \text{HOUSINGCOSTS}, \text{URBANRURAL}, \text{GUAN}, \text{GUAN} = \text{URBANRURAL}) \]

where OPENDUMPING is the choice measure with a value of 1 if the household was engaged in open dumping of solid wastes as at the time of the survey and zero otherwise.

LARGEHHSIZE is a dummy variable representing large household sizes with the value of 1 denoting the number of people living within the household being greater than 4 (5 to 13 in the survey area), and zero for household size four or lower.

NOSCHOOLING is a dummy variable with a value of 1 if the household head had no formal schooling qualifications and zero if he/she had formal schooling qualifications.

OPENDEFECATION is a dummy variable with a value of 1 if the household was engaged in open defecation as its toilet facility and zero otherwise.

WATERINSIDETHEHOUSE is a dummy variable if the household had water inside the household premises for which its members could use and a value of zero otherwise.

ELECTRICITYINSIDETHEHOUSE is a dummy variable if the household had national grid electricity connection inside the house and a value of zero otherwise.

SLEEPINGROOMS is the number of rooms reserved for sleeping in the household.

HOUSINGCOSTS is the declared willingness-to-pay for housing in Ghana cedis per month based on information obtained from the household head indicating that the amount of money that he/she would be prepared to pay for accommodation of its current living premises. Home owners also offered answers while those renting properties indicated their actual rents paid.
URBANRURAL is a geographical location measure of the household with 1 for households located in urban areas and zero for households located in the rural areas.

GUAN is a dummy variable if the household head was from the Guan broad ethnic group and zero of the household head was not from the Guan broad ethnic group. The Guans are considered the First Ghanaians having settled and lived in Ghana, including Brong Ahafo region, since the First Millennium of the Common Era, and several centuries before the arrival of the other members of the eight broad ethnic groups into Ghana (Ghana Statistical Service (GSS), 2013; Anaman & Bukari, 2019, pp. 194–195).

GUAN*URBANRURAL is the interaction term derived as GUAN multiplied by URBANRURAL. This variable allows for the open dumping behaviour of Guans resident in urban areas to be compared to Guans living in rural areas (also refer to Table 6).

Because of its strong statistical significance in influencing the dependent variable, the Guan variable was the only ethnicity variable used in the analysis. The other eight broad ethnic groups, when used as separate independent variables, did not improve upon the statistical power of the models. Further, the parameters of the other political economy “structural” variables such as sex of the household head (female/male), age group of the household head, currently married status (married/not currently married), religious affiliation (Christian/Muslim/Traditionalist), when used as independent variables in the model, were all not significant, and hence were dropped from the model, without committing any specification error. The specific probit model used for the study is shown in Equation (8) as follows:

\[
\text{OPEN DUMPING}_{i} = \beta_{0} + \beta_{1}\text{LARGE HH SIZE}_{i} + \beta_{2}\text{NOSCHOOLING}_{i} + \beta_{3}\text{OPEN DEFECATION}_{i} + \beta_{4}\text{WATER INSIDE HOUSE}_{i} + \beta_{5}\text{ELECTRICITY INSIDE HOUSE}_{i} + \beta_{6}\text{LSLEEPING ROOMS}_{i} + \beta_{7}\text{LHOUSINGCOSTS}_{i} + \beta_{8}\text{URBANRURAL}_{i} + \beta_{9}\text{GUAN}_{i} + \beta_{10}\text{GUAN*URBANRURAL}_{i} + \epsilon_{i}
\]

where LSLEEPINGROOMS and LHOUSINGCOSTS and are the natural logarithms of SLEEPINGROOMS and HOUSINGCOSTS, respectively. Bi (i = 0, 2 ... 10) are the parameters to be estimated with the sample and the Ui is the error term of the regression equation.

4. Results of analysis

4.1. Socio-economic characteristics of the sampled households

Table 2 provides summary information on the socio-economic characteristics of the survey respondents presented in a frequency-type format and for specific groups. About five out of eight responding household heads were males. A similar proportion of the respondents were currently married at the time of the survey with about 13% of these respondents being single and never married. The majority of the respondents had never attended school (63.25%). However, slightly over one quarter of the responding household heads had completed the equivalent of junior secondary school (nine or ten years of formal schooling).

In Ghana, there are nine broad ethnic groups and 89 individual social/ethnic or sub-ethnic groups or tribes (Ghana Statistical Service (GSS), 2013). For this study, the data on responding household heads were compiled based on the composition of the nine broad ethnic groups.

In terms of ethnic composition of the responding household heads, as shown in Table 2, the largest broad ethnic group was the Akans; this was followed by Gurmas (16.8%) and Guans (14.1%). The Guans are the First Ghanaians and original land owners of Ghana including the Brong Ahafo region. They arrived and settled in the land mass of Ghana forming about 30 individual kingdoms and chiefdoms during the First Millennium of the Common Era, several centuries before the arrival of the members of the eight broad ethnic groups into Ghana. The Guans comprise of about 4% of the population of Ghana (Ghana Statistical Service (GSS), 2013).
Table 2. Summary of socio-economic characteristics of respondents based on frequency analysis

| Socio-Economic Characteristic of Household Head | Percentage |
|-----------------------------------------------|------------|
| Sex of Household Head                         |            |
| Male                                          | 63.25      |
| Female                                        | 36.75      |
| Marital Status of Household Head              |            |
| Single (Never Married)                        | 13.19      |
| Currently Married (Monogamous Relationship)   | 62.82      |
| De-facto or Informal Relationships            | 7.69       |
| Separated                                     | 2.93       |
| Divorced                                      | 5.13       |
| Widowed                                       | 8.24       |
| Level of Formal Educational Attainment of Household Head |   |
| None/No Schooling                             | 63.28      |
| Completed junior secondary school or its equivalent (Middle School) | 26.10 |
| Completed senior secondary school             | 6.10       |
| Completed post-secondary colleges or institutions | 3.22 |
| Completed university                          | 1.15       |
| Others                                        | 0.23       |
| Religious Affiliation of Household Head (Percentage of Respondents) | |
| Adherents of Traditional African Religions    | 4.20       |
| Atheists or Agnostics                         | 4.94       |
| Christians (Roman Catholic)                   | 16.27      |
| Christian Protestant (Anglican, Lutheran, Methodist, Presbyterian) | 22.49 |
| Christian Pentecostal or Charismatic          | 22.30      |
| Other Christians                              | 3.11       |
| Muslims                                       | 26.32      |
| Others                                        | 0.37       |
| Ethnic Origin of Household Head (Broad Ethnic Groups) | |
| Akan                                          | 36.2       |
| Dangme/Ga                                     | 2.4        |
| Ewe                                           | 11.7       |
| Guan                                          | 14.1       |
| Grusi                                         | 3.1        |
| Gurma                                         | 16.8       |
| Male-Dagbani                                   | 7.3        |
| Mande                                         | 2.7        |
| All Other Groups Originating from Outside Ghana | 5.7      |

Table 3 indicates characteristics of the dwelling of the households using the frequency-type statistical format. Almost seven out of ten household dwellings were in moderately good to excellent condition. The dominant forms of toilet facility available to householders were open.
defecation (46.2% of households), followed by toilet facility in another house (17.7%) and public toilet facility (17.7%). Tube wells/boreholes and rivers/streams provided the dominant sources of water for general use by householders with about two-thirds of households using these sources. Only about one in 30 households had piped water available within their living premises. About 43% of the households had electricity connected to their living premises. The major sources of solid wastes disposal were dumping into public dumps and containers (46.6%) and indiscriminate dumping into open public spaces including rivers (35.1%).
In terms of religious affiliation, about 64.2% of the respondents were Christians. Muslims were the next largest group with slightly over one quarter of the responding household heads being Muslims. Atheists and agnostics (non-believers of a Supreme Deity or God) made up about 5% of the responding household heads; a figure consistent with the national proportion revealed by the 2010 Housing and Population Census (Ghana Statistical Service (GSS), 2013). Adherents of Traditional African religions, which incorporate a central belief of a Supreme Being or God, made up of 4.2% of the responding household heads.

Table 4 indicates the summary socio-economic characteristics of the responding household heads using average or mean figures and ranges. The average age of the respondents was around 45.5 years with the range from 18 to 95 years. The average household size was 4.3. In terms of the highest level of formal education level measured as years of schooling, the average was about 2.2 years with the range from 1 to 17 years. The average number of rooms available in the household was 2.86 with the range from 1 to 17. The number of sleeping rooms was slightly less averaging 2.43 with the range from zero to 15. The rental value of housing premises averaged 6.89 Ghana cedis per month with the range from zero to 200 Ghana cedis. One Ghana cedi was worth on average 3.78 Ghana cedis per one United States dollar in 2015.

4.2. Results of the regression analysis of factors influencing open dumping behaviour

The decision of households to either dump their refuse generated from production and consumption indiscriminately into open fields or use other methods of waste disposal, was modelled with a binary probit model with the variable choice. The value of 1 was assigned to open dumping and zero non-open dumping by the household. As per the theoretical arguments presented in Section 2.2, the dependent variable, choice was dichotomous and was assumed to be influenced by a number of socioeconomic variables denoted in Equation (2).

The results of the probit regression analysis are presented in Table 5. At the 10% level of significance, the parameters of all ten independent variables and the constant term incorporated in the model, were statistically significant, with the exception of the WATERTHUSEHOUSE variable. The four independent variables which positively influenced the likelihood of open dumping of solid wastes by households were LARGEHSHIZE, NOSCHOOLING, OPENDEFECATION and ELECTRICITYINSIDE THE HOUSE. As expected, households with large sizes, specifically five or more members, would generate more solid wastes than those with smaller sizes. The increased waste generation might encourage household disposal based on dumping in open spaces. Households headed by formally-educated individuals would be probably more incentivised to avoid open dumping of solid wastes based on improved knowledge on good hygiene and its effects. Open defecation behaviour increased the likelihood of open dumping of solid wastes; these two activities could be seen as complementary. Electricity inside the premises of the household could generate increased household production activities such as the sale of sachet water and other items using plastic material for packing and storage; the increased waste generation from the use of electricity could be dumped indiscriminately.

| Item                                      | Mean  | Range |
|-------------------------------------------|-------|-------|
| Age of the Household Head (Years)         | 45.47 | 18 to 95 |
| Household Size                            | 4.29  | 1 to 13  |
| Highest Level of Formal Educational Level Attained of the Household Head (Years of Schooling) | 2.19  | 1 to 17  |
| Number of Rooms Available in the Household | 2.86  | 1 to 15  |
| Number of Sleeping Rooms Used by Household | 2.43  | 0 to 15  |
| Housing Rents Paid (Ghana Cedis Per Month) | 6.89  | 0 to 200 |
The URBANRURAL variable had a negative estimated parameter value implying that urban households were less likely to engage in open dumping of solid wastes as compared to rural households. This conclusion is also supported by figures in Table 6 which indicate that only 22.03% of urban households as compared to 41.35% of rural households were engaged in open dumping of solid wastes.
of solid wastes. Similar findings have been reported by Crofts et al. (2010) and Laundra (2011) as cited in Dladla et al. (2016) in rural America where indiscriminate dumping of municipal solid waste is a common challenge. The other independent variables which negatively influenced open dumping of solid wastes by households were SLEEPINGROOMS, HOUSINGCOSTS and GUAN. The number of sleeping rooms and the rental value paid for the use of premises by households reflected the quality of these premises. Householders willing to have improved quality of housing services would be less likely to engage in open dumping of solid wastes and might be more inclined to use household waste collection services provided by municipal authorities and the private sector.

The GUAN ethnic group variable was strongly statistically significant in influencing the likelihood of open dumping of solid wastes in the negative direction. This variable could not be dropped from the model as it would have caused a mis-specification bias. For example, the dropping of the Guan variable from the model led to a decrease of the $R^2$ from 0.196 to 0.179. Overall, Guan-headed households were less likely to engage in open dumping of solid wastes than non-Guan-headed households. Based on the actual figures reported in Table 6, only 24.68% of Guan-headed households as against 36.81% of non-Guan-headed were engaged in open dumping of solid wastes. Comparing the figures for rural households, only 20.79% of rural households headed by Guans, as compared to 45.45% of rural households headed by non-Guans, were involved with open dumping of solid wastes. However, among Guan-headed households, 40.00% of urban households as compared to 20.79% of rural households were engaged in open dumping of solid wastes. This factor explains the significant positive parameter sign for the interaction variable, GUAN*URBANRURAL (refer to Table 5).

The significant difference between the open dumping behaviour of Guan-headed rural households and Guan-headed urban households, shown in both Tables 5 and 6, could be explained by the dominant role of the Guan Traditional Councils in enforcing the traditional cultural bans and restrictions on open dumping of solid wastes especially near rivers and water bodies. Many Ghanaian traditional states (represented by traditional councils) have taboos and restrictions against the dumping of solid wastes into open spaces. Probably, the community corrections instituted by Guan Traditional Councils in the Brong Ahafo region were more effective in reducing the market failures of individual rural Guan household heads, for whom the Guan Traditional Councils would have more persuasive effects, in modifying their behaviour than other bodies such as State agencies charged with the enforcement of laws dealing with open dumping of solid wastes.

Hayami (1989) argued that traditional institutions could be more effective than State institutions in the correction of certain types of market failures. The effectiveness of traditional institutions, such as the Guan Traditional Councils, often lies in their lower transactions costs compared to those costs incurred by State agencies, especially in the enforcement of State environmental sanitation rules. These State sanitation rules are often similar to those enshrined in traditional culture, religions and laws but are more enforceable by the Traditional Councils for people with strong ties to these Councils such as rural dwellers.

5. Conclusions and recommendations

5.1. Conclusions
We analysed the factors which influenced households’ choice of waste disposal methods using cross-sectional data of 547 households from seven districts in the Brong-Ahafo region of Ghana with emphasis on dumping of solid wastes in open spaces by households. We showed that large household sizes were associated with the increased likelihood of open dumping of solid wastes. The other factors that increased the likelihood of open dumping of solid wastes were the lack of formal education or schooling, the availability of electricity inside the premises of the house and open defecation; the latter could be considered a complementary activity with open dumping of solid wastes. On the other hand, urban households were less likely to engage in open dumping of
solid wastes. The other factors that reduced the likelihood of open dumping of solid wastes were in the area of quality of housing services and were the availability of water in the household premises, the number of sleeping rooms available, and higher quality of housing services revealed through the willingness-to-pay for rents by household heads. We established that Guan-headed households were less likely to engage in open dumping of solid wastes than non-Guan-headed households, especially those living in rural areas. Guan-headed rural households had the lowest proportion of open dumping of solid wastes.

5.2. Discussion of policy recommendations

The findings of our study are useful in contributing some answers to the Ghanaian paradox of very poor national environmental sanitation quality, in the more recent modern era, especially over the last three decades. This apparent paradox nominally appears to defy explanation based on development economics theories which suggest improvement in national environmental sanitation quality with increasing economic growth. Since, the Fourth Republican era starting in January 1993, the country has achieved an average economic growth rate of around six percent per year based on annual increases in the gross domestic product (GDP) of the country. This economic growth fuelled by large external debts cancellations, huge foreign loan inflows, remittances from about two million foreign-based Ghanaians, and exports of moderate quantities of crude oil starting in December 2010, led the country to regain its lower middle-income status in 2009. This lower-middle-income status has been maintained over the period, 2010 to 2019. Ghana was for brief periods, in 1961 and 1973 classified as a lower middle-income country, based on average capita GDP of over 1,000 dollars (Anaman, 2018c).

Yet the available environmental sanitation indicators, using local and international sources, indicate lack of improvement in the overall national environmental sanitation quality and even worsening of several quality indicators over the last three decades. The local sources include the Ghana Living Standards Survey (GLSS) Rounds 3, 4, 5, 6 and 7 completed in 1992, 1999, 2006, 2013 and 2017. The international sources include the World Health Organization & United Nations International Children’s Emergency Fund (WHO & UNICEF) (2017) and the Yale University (2018). Our following discussion features several points.

First, we showed in this study that open and indiscriminate dumping of solid wastes by householders was significantly related to the general quality of housing services that they enjoyed with those enjoying higher quality of housing services less likely to engage in open dumping of wastes. The quality of housing services would be related to the total incomes of household incomes. Given the widening income inequality that was observed in Ghana over the 25-year period from 1992 to 2017, based on the data from GLSS3, GLSS4, GSS5, GLSS6 and GLSS7, the rapid growth in income inequality, considered to be among the fastest in Africa, would lead to increases in open dumping of solid wastes, for a population that is growing at the rate of 2.5% per year, and doubling in size every 28 years.

The very high population growth rate of the country has not been at the centre of national policy discourse over the last two decades. This is contrast to the extensive national population control and family planning policy discourse in the 1960 s to 1980 s. This national policy discourse on population control and family planning needs to be revisited soon.

Second, our study showed the apparent Community correction of market failures related to open dumping of solid wastes based on the substantial evidence of reduced likelihood of indiscriminate waste dumping by rural Guans, thought to be more influenced in their behaviour by their Traditional Councils. The unique role of Traditional Councils in mobilizing rural labour in the 1950 s and 1960 s in the cleaning of public streets and properties and the enforcement of traditional laws against open dumping of solid wastes and open defecation is well known. This role has in the more recent past been substantially reduced and we recommend that it is something that must be revisited.
As observed by Anaman (2018b, p. 10), the political polarization efforts of the two main national parties in a traditional area, without a substantive Paramount Chief delayed the implementation of several environmental sanitation initiatives that were funded by local and foreign non-governmental organizations, over the 22-year period from 1995 to 2017. This was a case of Community failure related to the imposition of substantial transaction costs related to the coordination of projects, especially dealing with the release of land for the siting of sanitation facilities. Coordination of local environmental sanitation community projects involve large transactions costs. These transactions costs increase with divisions within the Traditional Council caused by national political party polarization making coordination of community sanitation projects risk-inefficient ventures for individuals. This observation is in contrast to evidence by Hayami (1989) that Community failure a village in the Philippines, was due to the exceeding of the carrying capacity of the resource base of the area. Environmental sanitation services are essentially local public goods that are ideally produced by District Councils headed by democratically-elected local leaders.

Third, the poor national environmental sanitation quality, in the recent past, is partly due to the diminishing investment by the national government in infrastructures especially sanitation and waste management facilities. Capital expenditures as a proportion of GDP has been steadily declining in Ghana during the Fourth Republican era. From a peak of 14.0% in 1996, the total capital expenditure-GDP ratio declined steadily to 5.9% in 2002. This ratio picked up till it reached 10.1% in 2004. From 2004 to 2019, there was a steady decline reaching an average of 5.1% during the 2013-2016 period (Boakye, 2017; Institute of Fiscal Studies (IFS), 2018). The government capital expenditure to GDP ratio continued to fall for the 2017 to 2019 period; it reached an all-time low of 1.8% in 2019. Government total expenditures were about 19.6% of GDP in 2019 (Bank of Ghana, 2020). The 2019 annual capital expenditure to GDP ratio is lower than the average ratio recorded during the period of the near-economic collapse of the economy from 1979 to 1983, which was 2.5% as documented by Anaman (2006). Without a substantial increase in the government capital expenditures-to-GDP ratio, the necessary public investment in environmental sanitation infrastructure would not be built and maintained to eliminate and/or substantially reduce the widespread indiscriminate and open dumping of solid wastes and associated open defecation and open urination in Ghana.

Finally, a recent government initiative in parts of Ghana, especially during 2019, have involved the distribution and siting of medium-sized waste collection points in vantage points in towns. This programme has had countervailing negative impacts due to large amounts of solid wastes dumped in the areas around these waste bins as filled bins are not regularly emptied. This is not a unique problem to Ghana. As pointed out by Anaman and Jair (2000), this phenomenon was common in Brunei Darussalam until the government changed its environmental strategy to manned community-based government-operated roadside waste collection centres. These centres manned by employed people are charged with maintaining properly the waste bins and containers and the neatness of the surrounding areas of the waste collection centres. A similar initiative in Ghana could expand government waste collection centres that would employ many young people and encourage the recycling of household solid wastes and the development of modern sanitation facilities linked to these waste collection centres.

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Author details
Theophilus Tweneboah Kodua
E-mail: theophiluskodua@gmail.com
ORCID ID: http://orcid.org/0000-0002-9908-0906

Kwabena Asomanin Anaman
1 Doctoral Student, Department of Agricultural Economics and Agribusiness, College of Basic and Applied Sciences, University of Ghana, Legon, Accra, Ghana.

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