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Application of theory of planned behaviour to households' source separation behaviour in Ghana

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Abstract

Purpose – The purpose of this paper is to examine the factors that encourage households' source separation behaviour in Accra and Tamale Metropolises in Ghana.
Design/methodology/approach – Using a cross-sectional design, 855 households of Ghana were interviewed based on the theoretical framework of the theory of planned behaviour (TPB). The ordered probit regression model was employed to examine the factors that influence households' source separation intention.
Findings – The results indicated that educational attainment of head of household, total income of household, occupation type of household head, information, past experience with source separation, inconvenience in terms of time, space and availability of formal source separation scheme, attitude, subjective norm and the location of the respondents significantly predicted households' solid waste separation intentions.
Research limitations/implications – The cross-sectional design does not determine causality but an association. Thus, future studies should examine actual household waste separation behaviour by using the experimental design to test the TPB model.
Practical implications – To promote solid waste separation at source, the public should be educated and provided with solid waste separation schemes that are efficient and compatible with households' preference.
Originality/value – This study was partly motivated by the fact that despite the benefits associated with source separation, little attention has been given to formal source separation in Ghana. Moreover, there are limited studies on source separation behaviour in Ghana using the TPB as the theoretical framework.

Keywords Ghana, Ordered probit regression, Solid waste, Source separation

Paper type Research paper

1. Introduction

Solid waste management (SWM) has become one of the major developmental challenges facing countries all over the world today. Generally, cities in many developed countries to a large extent have succeeded in solving this crisis by adopting an integrated and sustainable (solid) waste management. This is a system where solid waste is segregated at its source to prevent contamination and to preserve its value for recycling and recovery (Oteng-Ababio, 2014; United Nations Environment Programme (UNEP), 2015). The practice reduces the cost of SWM, decrease environmental pollution, conserve natural resources and improve public participation (Scheinberg *et al.*, 2010; UNEP, 2015).

Despite the benefits of source separation, most developing countries including Ghana have not formally adopted the practice. In addition, most cities in Ghana have largely failed

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in providing adequate solid waste collection and disposal services, which had resulted in indiscriminate dumping of solid waste into open spaces, roadsides and beaches. While several factors have been identified for the solid waste crisis in the country, central to these are the poor SWM practices and inadequate financial resources (Post, 1999; Awortwi, 2003; Oteng-Ababio, 2010; Oduro-Kwarteng, 2011). The existing SWM practice in Ghana where solid waste is collected and disposed of without any incentive to recycle (i.e. "end-of-pipe approach") has been unsustainable, because it has led to unsightly accumulation of waste, indiscriminate dumping, increase in the management cost and reduction in life-span of existing dump site or landfill (Oteng-Ababio, 2014; Owusu *et al.*, 2012). In Accra for instance, 2,200 tonnes of solid waste is produced daily as at 2000 out of which about 70 -80 per cent were collected (Oteng-Ababio, 2010; Houber, 2010). The remaining 20-30 per cent were either burned, buried or dumped on the side of roads or into drainage channels (Ministry of Local Government and Rural Development, 2010); contributing to public health problems, perennial flooding events, methane generation and leachate formation which are sources of environmental pollutants (Oteng-Ababio, 2010; Othman *et al.*, 2013). As at 2008, the Accra Metropolitan Assembly's (AMA) indebtedness to private waste contractors was 75 billion Ghana cedis (Oteng-Ababio, 2013). With such huge unpaid debt coupled with other institutional weaknesses, the contractor cannot provide reliable and quality service, hence the poor environmental conditions experienced in the city.

This disturbing situation has prompted the government to adopt several policies and programme. In an attempt to achieve cost efficiency and better service provision, the public-private partnership (PPP) policy was instituted in early 1990s. Traditionally, the Waste Management Departments (WMD) of district assemblies are mandated by the Local Government Act (Act 462), to provide SWM services (Ministry of Local Government and Rural Development, 1999). However, due to inadequate solid waste collection and low cost recovery by WMD, the PPP concept was conceived (Oduro-Kwarteng, 2011). It was envisaged that the adoption of PPP would improve revenue mobilisation, quality of service and also extend the coverage of SWM services (Post, 1999; Oteng-Ababio, 2010; Oduro-Kwarteng, 2011). Although its implementation saw an increase in solid waste collection coverage, it failed to improve environmental quality, especially in low-income areas (Oteng-Ababio, 2010).

Apart from the PPP policy, city authorities have engaged in a number of projects and programme to divert the high organic content of solid waste (about 67 per cent) generated (Oteng-Ababio, 2011) from landfill for recycling and composting. One such attempt was the Teshie-Nungua Compost plant and the Accra Composting and Recycling Plant established in 1974 and 2010, respectively. Another such intervention is the National Source Waste Segregation Programme which was launched in November 2013, by the Ministry of Environment, Science, Technology and Innovation, in collaboration with Environmental Protection Agency, Zoomlion and Jekora Ventures, (Ghana News Agency, 2013), but was not successful because of low participation (EPA/BED, 2015).

In spite of the various efforts by successive governments and its developmental partners in arresting the environmental sanitation problem, the country is still ranked among the dirtiest places in Africa (Blacksmith Institute, 2013). Also, although government's expenditure on SWM is rising, environmental sanitation has taken a nosedive (Oteng-Ababio, 2012), creating a conundrum. Experiences in the country point to the fact that there is an urgent need to move away from the conventional practice of collection-transportation-disposal to a more sustainable system of SWM that integrates source separation, reuse, recycling and recovery. Such a system is more sustainable, economically prudent and environmentally acceptable (UNEP, 2015) for a developing country like Ghana, where sanitary landfill sites are scarce and final solid waste disposal poses a daunting challenge (Owusu *et al.*, 2012).

In view of the increasing cost of SWM and the scarcity of disposal sites, there is a need to divert solid waste from landfills. Unfortunately, the system of household solid waste collection in Ghana does not encourage source separation of solid waste. However, for source separation to be successful, it requires the active participation of householders who generate most of the solid waste in the country. Thus, this study examined the factors that influence households' formal source separation behaviour in Accra and Tamale Metropolises in Ghana. Identification of the factors that encourage households' source separation behaviour would enable local authorities design source separation schemes that are convenient and meets the local conditions, as well as educational campaigns that would change households' attitude towards source separation. Finally, the outcome of the study will support the achievement of the sustainable development goal (SDG6) on universal access to safe water and adequate sanitation. It will also help assess the achievement of Ghana's Water Sector Strategic Development Plan 2012-2025 and other policies and plans developed to improve environmental sanitation and reduce urban poverty.

The structure of the paper is as follows: Section 2 presents a review of past studies on households' source separation and recycling behaviour and the research gap; Section 3 focuses on the methodology which includes the study area, sampling technique, data collection and estimation techniques; Section 4 presents the empirical results and discussions; and Section 5 concludes with policy implications.

2. Literature review

Determinants of households' recycling and waste separation behaviour have been extensively studied. Recent studies by Echegaray and Hansstein (2016), Pakpour *et al.* (2014), Karim Ghani *et al.* (2013), Davis *et al.* (2006) and Barr *et al.* (2005) employed the theory of planned behaviour (TPB) developed by Ajzen (1991) to understand households' source separation and recycling behaviour. The TPB hypothesised that an individual's behaviour is directly influenced by his/her intention. Intention, in turn, is influenced by individual attitude towards the behaviour, subjective norm and perceived behaviour control. Attitude reflects a person's positive or negative evaluation of a particular behaviour, whiles subjective norms refer to perceived social pressure to engage in a specific behaviour. Perceived behavioural control reflects people's perception of the ease or difficulty of performing the behaviour of interest.

On the effect of attitude on recycling behaviour, Nigbur *et al.* (2010) found a positive relationship between attitude and recycling behaviour in the UK. Pakpour *et al.* (2014) also found attitude to be a significant predictor of household waste recycling behaviour in Iran. Davis *et al.* (2006) studied recycling behaviour in West Oxfordshire, and contrary to the theoretical expectation they found attitude to be insignificant. Past empirical studies have reported mixed findings about the role of subjective norms on individual's recycling behaviour. Barr *et al.* (2001) and Knussen and Yule (2008) indicated that subjective norm has effect on households' recycling behaviour, in contrast, other scholars including Knussen *et al.* (2004), Tonglet *et al.* (2004) and Hage *et al.* (2009) did not find social influence to be significant in explaining recycling behaviour. Perceived behaviour control has also been reported to influence recycling behaviour. Mahmud and Osman (2010) found perceived behavioural control to be the strongest predictor of intentional behaviour. A study on household waste recycling behaviour among Iranians by Pakpour *et al.* (2014) revealed that perceived behaviour control significantly influenced waste recycling behaviour.

Despite the extensive used of the TPB model in analysing recycling behaviour, it has been criticised for its rationality assumption and the exclusion of emotions on behaviour (Sheeran *et al.*, 2013; Conner *et al.*, 2013). The TPB model has also failed to recognise the collective-action nature of waste recycling behaviour (Yau, 2010). Furthermore, a systematic review of 24 studies that conducted experimental tests on TPB by Hardeman *et al.* (2002)

could not confirmed the usefulness of the theory. Other scholars have criticised the limited validity of the TPB model. They argued that most of the variations in observed behaviour is not explained by measures of the TPB model and recommended the addition of more variables to improve the predictive validity of the model (see Boldero, 1995; Davies *et al.*, 2002; Tonglet *et al.*, 2004).

Based on this argument, several factors have been used to examine households' recycling and source separation behaviour and are classified into socio-economic characteristics (i.e. education, income, age, sex, family size) and situational factors such as information and the inconvenience of source separation in terms of time and space. The role of information in source separation and recycling behaviour has been acknowledged by Vining and Ebreo (1992), Gamba and Oskamp, (1994) and Hornik *et al.* (1995) among others. Hornik *et al.* (1995) reported that information on recycling issues increase households' awareness which motivate them to adopt recycling. On sex, Vicente and Reis (2008) argued that women in Portugal bore a greater burden of recycling tasks than men in a household, while Ekere *et al.* (2009) reported that women in Uganda are usually associated with waste segregation tasks because they traditionally play a greater role in domestic tasks. Saphores *et al.* (2006) found women to be more willing to recycle electronic waste at drop-off centres in the state of California. However, other studies by do Valle *et al.* (2004), Hage *et al.* (2009) and Knussen and Yule (2008) found no link between sex and recycling. Scholars including Barr *et al.* (2003), Saphores *et al.* (2006) and Hage and Soderholm (2008) observed statistically significant relationship between waste recycling behaviour and educational attainment. They argued that well-educated people are more aware of recycling issues than the less-educated. Saphores *et al.* (2006) revealed that higher education increases the willingness to recycle in California, but Meneses and Palacio (2005) reported that education has no significant effect on recycling. Some studies found age to be a significant factor influencing recycling involvement. Martin *et al.* (2006) and Saphores *et al.* (2006) indicated that older people are more willing to recycle because they have more leisure time.

The effect of income on recycling behaviour has been extensively studied. Williams and Kelly (2003) and Martin *et al.* (2006) observed that the rich are more likely to recycle compared to the poor. In contrast, a study of income elasticity by Hage and Soderholm (2008) revealed a negative relationship between income level and recycling behaviour. They reported that the rich are less likely to recycle because of their busy schedules. Dwelling, household size and population density have been identified to influence recycling behaviour. Hage *et al.* (2009) and Hage and Soderholm (2008) found households in private housing (single-family dwelling) to recycle more than those who live in multiple-family apartments due to space availability. Similarly, household size has been found to affect recycling behaviour positively by Ojeda-Benítez *et al.* (2008). They argued that households with higher number of family members tend to have higher recycling rates.

Some studies have reported a statistically significant relationship between recycling behaviour of householders and convenience of waste separation/recycling scheme. Domina and Koch (2002), in their study of textile recycling behaviour, reported that convenience is an important driver of recycling behaviour. Saphores *et al.* (2006) study households' willingness to recycle electronic waste at drop-off centres and observed that convenience factors such as proximity to the drop-off centre increase recycling, because residents do not need to travel longer distance to use the facility. Gonzalez-Torre *et al.* (2003) examined selective waste collection systems that are frequently used in Europe and America and concluded that a system that requires less time and effort to dispose and separate waste results in a higher recycling rate. Karim Ghani *et al.* (2013) concluded that situational factors such as easy access to facilities and the opportunity to source separate significantly influence waste separation intentions. A study by Ekere *et al.* (2009) revealed

that urban respondents in Uganda are less likely to sort waste compared with their peri-urban counterparts because of lack of space to store separated waste and inadequate time to engage in such activities. Hage *et al.* (2009) found that as population density increases, recycling decreases, resulting in low collection rates in major cities. This is because high population density cities are highly congested and thus lack space to keep extra bin for storing separated waste. Other researchers have studied the influence of households' past behaviour on recycling behaviour. Barr *et al.* (2003) found past behaviour to be very important towards current intentions, while according to Tonglet *et al.* (2004), previous experience lowers the perception of effort. In a study by Knussen *et al.* (2004) in Glascow, past behaviour was a significant predictor of both intentions to recycle and actual behaviour.

Although there exist numerous empirical studies on determinant of household recycling behaviour, comparatively little attention has been given to source separation of waste. Fundamentally, however, before households can participate in recycling activities they need to sort their waste. Apart from recycling, source separated waste can be reuse rather than buying new products, a situation known as waste minimisation. Research has revealed that household recycling behaviour is different from waste minimisation behaviour (Barr *et al.*, 2001) and by extension source separation behaviour. This is because they are likely to be driven by different factors.

Second, limited research on the subject area was found in the context of Africa in which Ghana is no exception. Recent studies on source separation behaviour in Ghana have focused on the technical aspects (see Asase, 2011; Adjei, 2013), the degree and category of source separation (see Oduro-Appiah and Aggrey, 2013) and households' willingness-to-accept economic incentives to participate in source separation (see Owusu *et al.*, 2013). In short, one can argue that though a number of studies have been done on solid waste separation in Ghana, there is hardly any detailed research using TPB to examine households' source separation behaviour in Ghana. This study aims to bridge the knowledge gap by combining the TPB variables, socio-economic and situational factors to explain and predict households' source separation behaviour in selected cities of Ghana. Understanding the determinants of households' source separation behaviour is crucial to getting people to move from zero participation to full participation.

3. Methodology

3.1 Survey procedure and administration

The study was based on a survey of 855 households, conducted in seven randomly selected low, middle and high-income residential areas in AMA and Tamale Metropolitan Assembly (TaMA) in Ghana. Accra is the largest city and also serves as the administrative, political and economic hub of Ghana. It is a wholly urbanized and highly populated city in Ghana, with a population of about 1.9 million in 2010 (Ghana Statistical Service (GSS), 2014a). Tamale is a medium-sized city and is located in one of the least developed and poorest regions in Ghana. It is the largest urban centre in the three northern regions in Ghana and among the "fastest-growing cities in Ghana with an annual growth rate of 3.3 per cent" (Gyasi *et al.*, 2014, p. 13). The population of Tamale more than double from 135,952 in 1984 to 371,351 in 2010 (Ghana Statistical Service (GSS), 2014b). Compare to Tamale, Accra offers relatively better livelihood opportunities which attract people from other regions; making it the main rural-urban migration destination centre (World Bank, 2014). The rapid population growth in these two cities has brought about a significant increase in waste generation, which has outpaced the capacities of city authorities to manage it sustainably (Kranjac-Berisavljevic and Gandaa, 2013; Oteng-Ababio, 2013).

With a target total population of 670,719 households; 450,748 in AMA and 219,971 in TaMA (GSS, 2014a, b), a minimum sample size of 384 was obtained using the

Krejchie and Morgan (1970) sample selection formula. The following assumptions were made in determining the sample size: a sampling error of 5 per cent; 95% confidence interval and a standard population proportion of 50 per cent. However, Cohen (1992) argued that a larger sample size, increase the reliability and decrease the degree of error, resulting in a truly representative sample of the population. Based on this argument, this study oversampled 855 households for the structured questionnaire survey.

Using a three-staged sampling design, low, middle and high-income residential areas were randomly selected in AMA and TaMA, following earlier work of Owusu and Agyei-Mensah (2011). However, in AMA, two low-income residential areas were randomly selected, giving the total number of residential areas selected in the two cities to be seven. This was the first stage. In the second stage, using the lists of Enumeration Areas (EAs) as the sampling frame, a total of 57 EAs were randomly selected in the two cities by employing the probability proportion by size sampling procedure (see Table I for details). To allow for intra-city analysis EAs were over-sampled in Tamale. With the lists of households in the selected EAs, 15 households were systematically selected with a random start and interval separately in each EA, to give a total of 855 households from the seven residential areas in the two cities (see Table I). Within each selected household, the head was interviewed because household waste separation decision largely depends on the heads of household. In addition, wife of male-headed households was interviewed since traditionally women in Ghana are responsible for domestic SWM (Oteng-Ababio, 2007).

The study used household structured questionnaire survey to collect data because it allows data to be elicited from large number of respondents for easy quantification of results. Data captured from the structured questionnaire included information on household's SWM practices, source separation behaviour and preferences, question on TPB constructs and household socio-economic characteristics, and assets. The TPB questions were largely based on the questions used by Karim Ghani *et al.* (2013) and a five-point Likert scale, from strongly disagree (1) to strongly agree (5) were used to measure the components of TPB (attitude, subjective norms and perceived behavioural control), waste separation behaviour, intentions and the variable inconvenience.

3.2 Method of analysis

In this study, the determinants of households' source separation intention were estimated by following two main steps. In the first step, factor selection with principal component

Metropolis	Community	SES community	No. of households	Proportionate sample (%)	No. of selected EAs	Actual sample allocation to households
Accra	Airport residential area	High income	1,391	4	2	30
	Dansoman	Middle income	14,300	38	11	165
	Glefe	Indigenous low income	2,368	6	4	60
	Nima	Migrant low income	19,196	52	18	270
Sub total			37,255	100	35	525
Tamale	Russia Bungalow	High income	482	10	3	45
	Zogbeli	Middle income	2,327	49	11	165
	Aboabo	Low income	1,951	41	8	120
Sub total			4,760	100	22	330
Grand total					57	855

Table I. Selected communities and sample allocation

analysis (PCA) was applied to the TPB constructs items, and inconvenience factor items with the aim of summarizing large sets of data into meaningful groups. In order to extract the components from the statements, Kaiser's criterion (KMO) (Kaiser, 1958), Bartlett's test (Bartlett, 1947), and scree test were used as suggested by Pallant (2005). The KMO measure was used to check the sampling adequacy whilst the Bartlett test was used to check the strength of the relationship among the statements in order to examine the factorability of the statements. The KMO statistic is a ratio that ranges from 0 to 1 and should be at least 0.7 for PCA to be acceptable. The Bartlett test examines if the correlation matrix among the variables is significantly different from the identity matrix. The scree plot, which was drawn using the eigenvalues, was then used to determine the number of components that could be retained. Subsequently, Cronbach's α test was applied to evaluate the reliability of the Likert-type scale questions with the aim of ensuring each question under a variable are all measuring the same underlying attributes.

In the second analytical step, ordered probit regression analysis was used to analyse the determinants of households' source separation intention. This is because responses for source separation intention in this study are not continuous but ordinal. Consequently, it renders the ordinary least squares regression technique inappropriate. This is because it can produce spurious probabilities and negative variance estimates (Greene, 2003). As a result of this, the ordered probit model was used for estimating the determinants of source separation intention.

Following Greene (2003), the ordered probit model is presented as:

$$y_i^* = x_i'\beta + \varepsilon_i \tag{1}$$

where y_i^* is a latent variable representing the source separation intention associated with household i, x_i is a vector of independent variables and β is the vector of regression coefficients to be estimated and ε is the random error term assumed to be standard normally distributed. Because y_i^* is latent, the observe discrete responses of the variable.

y_i is presented as below:

$$y_i = 1 \quad \text{if} \quad y_i^* \leqslant \theta_1, \tag{2}$$

$$y_i = 2 \quad \text{if} \quad \theta_1 < y_i^* \leqslant \theta_2, \tag{3}$$

$$y_i = 3 \quad \text{if} \quad \theta_2 \leqslant y_i^* \tag{4}$$

The θ_j are the unknown threshold parameters to be estimated simultaneously with the other coefficients β. The probability that the ordered dependent variable y takes different possible value is:

$$\Pr(y_i = 1|x) = 1 - \omega[\beta' x_i - \theta_1] \tag{5}$$

$$\Pr(y_i = 2|x) = \omega[\beta' x_i - \theta_1] - \omega[\beta' x_i - \theta_2] \tag{6}$$

$$\Pr(y_i = 3|x) = \omega[\beta' x_i - \theta_2] \tag{7}$$

where ω indicates a cumulative normal distribution and the cut-points, θ_j, divide the categories of the dependent variable. The parameter of the ordered probit model is estimated by the maximum likelihood method. However, since we are not only concerned about the direction of the impact of the independent variables but also the magnitudes of their effects,

the marginal effects are also estimated:

$$\frac{\partial \Pr(y_i = 1|x)}{\partial x} = -\omega\ (\beta' x_i - \theta_1)\beta \tag{8}$$

$$\frac{\partial \Pr(y_i = 2|x)}{\partial x} = [\omega\ (\beta' x_i - \theta_1) - \omega\ (\beta' x_i - \theta_2)]\beta \tag{9}$$

$$\frac{\partial \Pr(y_i = 3|x)}{\partial x} = \omega\ (\beta' x_i - \theta_2)\beta \tag{10}$$

The empirical model is expressed as:

$$\begin{aligned} WS_{int} = {} & \beta_0 + \beta_1 \text{attitude} + \beta_2 \text{subjective norm} + \beta_3 \text{perceived behavioural} \\ & + \beta_4 \text{income} + \beta_5 \text{education} + \beta_6 \text{sex} + \beta_7 \text{marital status} + \beta_8 \text{tenancy} \\ & + \beta_9 \text{occupation} + \beta_{10} \text{householdsize} + \beta_{11} \text{age} + \beta_{12} \text{past expereince} \\ & + \beta_{13} \text{information} + \beta_{14} \text{inconvenience} + \beta_{15} \text{Location} + \varepsilon_i \end{aligned} \tag{11}$$

where WS_{int} is the source separation intention and ε the error term.

Based on previous studies and information collected from participants, the variables used to determine households' source separation intention are presented in Table II.

Independent variables	Measurement	Expected sign
Socio-economic factors		
Age of household head	Number of years	−
Marital status of household head	Married = 1; Otherwise = 0	+
Sex of household head	Male = 1; Female = 0	−
Educational attainment of household head	Number of years in schooling	+
Occupation	Sector of employment (Formal sector = 1; Otherwise = 0)	+
Household income	Monthly household expenditure used as a proxy for household income (in Ghana cedis)	+
Household size	Number of persons in respondent's household	+
Situational factors		
Information	Household's knowledge or awareness on solid waste separation (1 = Yes; 0 = No)	+
Inconvenience	Household's perception about the condition that makes waste separation difficult to adopt (mean value of a five-point Likert scale)	−
Past experience	Whether household source separate solid waste or not (Yes = 1; Otherwise = 0)	+
Location	Metropolitan dummy (AMA = 1; 0 = TaMA)	−
Socio-psychological factors		
Attitude	Household attitude towards waste separation (mean value of a five-point Likert scale)	+
Subjective norm	Perception of the respondent's social pressure to separate waste (mean value of a five-point Likert scale)	+
Perceived behavioural control	Perception of the respondent's ability to perform the behaviour of waste separation at home (mean value of a five-point Likert scale)	+

Table II. Description of independent variables for ordered probit model

4. Results and discussion

4.1 Socio-economic characteristics of respondents

Table III presents a summary statistics of the socio-economic characteristics of the respondents. About 63.9 per cent of the respondents in the entire study area were male and the mean household size was approximately 5. The mean age of the sampled respondents was 43.4 years and most of the respondents (71.3 per cent) were married. However, respondents in TaMA have larger household size and were slightly older than those in AMA. The mean household total expenditure use as a proxy for household income was GH₵1,239.6, while the mean years of schooling was 10.2 years for the entire study area. On average respondents in AMA had more years of schooling and income compared to those in TaMA.

4.2 TPB variables, inconvenience and information

Based on the mean score of the TPB variables, the respondents in the entire study area strongly agree ($M = 4.93$, SD = 0.36) that they reuse leftover food rather than throwing it away. They also agree to both the statements of reuse of empty bottles ($M = 3.51$, SD = 0.98) and reuse of food waste to feed livestock ($M = 3.69$, SD = 1.09). The respondents in entire study area agree to participate in solid waste separation if it is made mandatory ($M = 3.64$, SD = 0.97), when local authorities enforce public participation ($M = 3.67$, SD = 0.98), if service providers provide satisfactory waste separation services ($M = 4.40$, SD = 1.05) and if they are convinced of the benefits of solid waste separation at source ($M = 3.58$, SD = 1.18). They also agree that solid waste separation is a good activity ($M = 3.74$, SD = 1.21), interesting task ($M = 3.79$, SD = 1.00), useful to practice at home ($M = 3.54$, SD = 1.09), should be formalized ($M = 4.19$, SD = 0.97) and promoted ($M = 3.67$, SD = 1.14) in Ghana.

The mean scores also indicate that the respondents in the entire study area agree that their neighbours ($M = 3.56$, SD = 0.89) expect them to source separate and they will source separate if they see community members ($M = 4.42$, SD = 1.16) doing the same. Others show indifference on the statements on whether their family ($M = 3.45$, SD = 1.01) and colleagues ($M = 3.48$, SD = 0.83) thinks they should separate waste at home. An equally important observation is that even though respondents agree waste separation is an easy task ($M = 4.13$, SD = 0.83) and that they have control over the activity ($M = 3.62$, SD = 1.17), they at the same time agree that lack of space ($M = 4.06$, SD = 0.84), limited time ($M = 4.27$, SD = 0.77), poor knowledge on waste separation ($M = 4.15$, SD = 0.74), lack of waste separation collection centres ($M = 3.38$, SD = 0.94) and service provider not collecting separated waste ($M = 3.36$, SD = 1.16) would discourage them from practicing waste separation at source.

Table IV shows the factor analysis and their corresponding reliability coefficients which was measured using Cronbach's α test. The result indicated that all the variables have a coefficient reliability values above 0.70, suggesting that all the variables measured were reliable.

Table III. Socio-economic characteristics of respondents

Variables	AMA Mean (SD)	TaMA Mean (SD)	Entire study area Mean (SD)
Sex (% male)	61.1 (48.8)	68.2 (46.6)	63.9 (48.1)
Age (years)	42.9 (10.3)	44.13 (10.1)	43.4 (10.2)
Education (years)	11.3 (4.2)	8.4 (6.4)	10.2 (5.4)
Household size	4.3 (1.9)	5.8 (2.8)	4.9 (2.4)
Marital status (% married)	68.4 (46.5)	76.1 (42.7)	71.3 (45.2)
Income	1,441.0 (1608.2)	919.0 (542.6)	1,239.6 (1,328.5)

Factor	Question	Reliability coefficient AMA	TaMA	Entire study area
Attitude	1. In my opinion, source separation of solid waste is a good activity	0.8160	0.8404	0.8589
	2. I think that solid waste separation at home is interesting task			
	3. For me, solid waste separation at home is useful			
	4. Solid waste separation should be formalized in Ghana			
	5. Solid waste separation should be promoted in Ghana			
Subjective norms	1. My family thinks I should separate solid waste at home	0.7996	0.7885	0.7591
	2. My neighbours expect me to participate in source separation of solid waste			
	3. My friends think I should be involved in source separation of solid waste			
	4. If my neighbours separate their solid waste, I will too			
	5. I will separate my solid waste if I see my community doing the same			
Perceived behavioural control	1. The decision to separate solid waste is completely up to me	0.7786	0.7023	0.8101
	2. Separating solid waste at home would be an easy task			
	3. I have complete control in deciding whether or not to separate solid waste at home			
	4. If I wanted to, I could separate solid waste at home			
	5. I do not need anyone approval to separate solid waste at home			
Inconvenience	1. Not having enough space would make it difficult to separate solid waste at home	0.7718	0.9733	0.7454
	2. Not having enough time would make it difficult to separate solid waste at home			
	3. Not having proper knowledge on waste separation would make it difficult to separate solid waste			
	4. Not having collection centres will discourage me from practicing source separation			
	5. No having service provider collecting separated waste would discourage me from practicing source separation			

Table IV.
Factor analysis and corresponding reliability coefficients

4.3 Determinants of households' source separation intention

Table V shows the results from the ordered probit regression for respondents in AMA, TaMA and the entire study area. Based on the results, the LR χ^2 value for AMA is 184.87, TaMA is 203.65 and the entire study area is 550.80 and is statistically significant 1 per cent. The significance of the LR χ^2 value shows that all the variables jointly determined the dependent variable.

From the results, the determinants of households' source separation intention in the entire study area are educational attainment of household head, total income of household, occupation type of household head, information, past experience with source separation, inconvenience in terms of time, space and availability of formal source separation scheme, attitude, subjective norm and the location of the respondents. Regarding households in AMA, the results from the estimation indicate that sex of household head, educational attainment of household head, total income of household, occupation type of household head, information, past experience with source separation, attitude, subjective norm and inconvenience, are the statistically significant variables that influence households' source separation intention. In the case of TaMA, household size, occupation type of head of household, past experience with source separation, inconvenience, attitude towards source

Independent variable	AMA Coefficient	TaMA Coefficient	Entire study area Coefficient
Sex of head of household	−0.3095** (0.1245)	−0.1977 (0.2367)	−0.0113 (0.1024)
Age of head of household	0.0088 (0.0066)	−0.0124 (0.0101)	0.0033 (0.0049)
Household size	0.0144 (0.0313)	0.0433** (0.0211)	−0.0028 (0.0221)
Marital status	0.1719 (0.1561)	0.2298 (0.2503)	0.1008 (0.1099)
Educational attainment of head of household	0.0456** (0.0197)	0.0038 (0.0213)	0.0025** (0.0012)
Total household income	−0.6614*** (0.2657)	0.2777 (0.5374)	−0.0373** (0.0180)
Occupation type	−0.4425*** (0.1351)	−0.2998* (0.1759)	−0.1944* (0.1186)
Tenancy status	−0.1221 (0.1233)	−0.0502 (0.2384)	−0.0715 (0.0933)
Information	0.0418*** (0.0123)	0.0705 (0.1557)	0.1117*** (0.0388)
Past experience with source separation	0.2588** (0.1334)	0.6797*** (0.1959)	0.5554*** (0.1051)
Attitude	0.5574*** (0.1094)	0.7481*** (0.1118)	0.7101*** (0.0653)
Subjective norm	0.3653*** (01232)	0.2426** (0.1073)	0.4133*** (0.0706)
Perceived behavioural control	−0.0719 (0.1122)	0.0391 (0.1342)	−0.0816 (0.2820)
Inconvenience	0.1477** (0.0671)	0.3016*** (0.0928)	−0.3118*** (0.0854)
Location (1 = AMA)	n/a	n/a	−0.2505** (0.1043)
Observations	525	330	855
LR χ^2	184.87***	203.65***	550.80***
Log likelihood	−505.7307	−213.792	−758.26616

Table V.
Ordered probit regression estimations

Notes: Standard error in parenthesis; Dependent variable is household source separation intention, ranging from strongly disagree and disagree (1), neutral (2) and agree and strongly agree (3). *,**,***Significant at 10, 5 and 1 per cent levels, respectively

separation and subjective norm are the statistically significant variables that influence households' source separation intention.

Although Table V presents the regression coefficients, these are of little relevance in ordered probit analysis, as they do not provide any insight into the strength of the individual independent variables (Greene, 2003). The marginal effects of the independent variables at their respective means provide this information as it measures small changes in the independent variable on the outcome variable. The marginal effects for respondents in AMA, TaMA and the entire study area are presented in Table VI.

The marginal effects for each outcome (as presented in Table VI) largely confirm the results in Table V. Concentrating on outcome 3 (i.e. agree to strongly agree) for AMA, TaMA and the entire study area, the effect of sex on source separation intention indicates that male-headed household decreases the probability of household source separation intention by 7.5 per cent in AMA. This is expected because traditionally women are responsible for domestic waste management and are thus more likely to adopt source separation (Oteng-Ababio, 2007). This result confirms the finding of Vicente and Reis (2008) and Ekere *et al.* (2009) who reported a negative relationship between sex and recycling behaviour.

An increase in household size increases the probability of household source separation intention by 1.3 per cent in TaMA. TaMA is one of the poorest urban areas in Ghana with Dagombas as majority who are largely Muslims. Traditionally, they have larger family size and engaged in livestock rearing to supplement their income. Consequently, the role of source separation of solid waste such as cassava, plantain and yam peels used to feed livestock would not rely on one person, but every member of the family making it less burdensome. The study also observes that a year increase in head of household's education increases the probability of source separation intention by 0.54 per cent in AMA and 0.08 per cent in the entire study area. This observation is attributed to the fact that well-educated people generally are more enlighten; have easy access to information and tend to appreciate the social, economic and environmental benefits of proper SWM than the less educated. The positive effect of education on source separation intention confirm the

Independent variable	AMA			TaMA			Combine (entire study area)		
	Strongly disagree to disagree Outcome = 1	Neutral Outcome = 2	Agree to strongly agree Outcome = 3	Strongly disagree to disagree Outcome = 1	Neutral Outcome = 2	Agree to strongly agree Outcome = 3	Strongly disagree to disagree Outcome = 1	Neutral Outcome = 2	Agree to strongly agree Outcome = 3
Sex of head of household	0.0406**	0.0344**	−0.075**	0.0218	0.0299	0.0517	−0.0037	−0.0065	0.0102
Age of head of household	−0.0008	−0.0007	0.0015	0.0014	0.0019	−0.0032	0.0002	0.0004	−0.0007
Household size	0.0039	0.0033	−0.0072	−0.0048**	−0.0066**	0.0113**	0.0003	0.0006	−0.0009
Marital status	−0.0610	−0.0518	0.1128	−0.0253	−0.0348	0.0602	−0.0049	−0.0087	0.0136
Educational attainment of head of household	−0.0029**	−0.0025**	0.0054**	−0.0004	−0.0006	0.0010	−0.0003**	0.0005**	0.0008**
Total household income	0.0312***	0.0264***	−0.0576***	−0.0307	−0.0420	0.0727	0.0161**	0.0278**	−0.0439**
Occupation type	0.0267***	−0.0264***	−0.0494***	0.0055*	0.0076*	−0.0131*	0.0118*	0.0205*	−0.0323*
Tenancy status	0.0037	0.0032	−0.0069	0.0331	0.0454	−0.0785	0.0127	0.0220	0.0347
Information	−0.0281***	0.0238***	0.0519***	−0.0078	−0.0106	0.0184	−0.0099***	−0.0172***	0.0270***
Past experience with source separation	−0.0614**	−0.0521**	0.1135**	−0.0750***	−0.1028***	0.1779***	−0.0490***	−0.0851***	0.1342***
Attitude	−0.1394***	−0.1182***	0.2576***	−0.0826***	−0.1132***	0.1958***	−0.0504***	−0.0875***	0.1379***
Subjective norm	−0.1239***	−0.1051***	0.2291***	−0.0267**	−0.0367**	0.0635**	−0.0415***	−0.0719***	0.1135***
Perceived behavioural control	0.0077	0.0065	−0.0142	−0.0043	−0.0059	0.0102	0.0037	0.0063	−0.0099
Inconvenience	0.0260***	0.0221***	−0.0481***	0.0333***	0.0456***	−0.0789***	0.0405***	0.0703***	−0.1107***
Location							0.0092***	0.0160***	−0.0252***

Notes: Dependent variable is household source separation intention, ranging from strongly disagree and disagree (1), neutral (2) and agree and strongly agree (3).
*, **, ***Significant at 10, 5 and 1 per cent levels, respectively

Table VI.
Marginal effects of ordered probit model

observation of Saphores *et al.* (2006), that educated people are associated with stronger recycling behaviour. On the contrary, Meneses and Palacio (2005) found no significant association between recycling behaviour and education.

The study also reveals that a unit increase in household total income decreases the probability of source separation intention by 5.8 per cent in AMA and 4.4 per cent in the entire study area. The result suggests that affluent households are less likely to participate in source separation compared to poorer households. This is reasonable because affluent households are more likely to attach a high opportunity cost to time spent on separating waste at source, and thus will be less likely to adopt the practice. The negative effect of income on source separation intention compares favourably with previous study by Hage and Soderholm (2008). However, contradict the evidences by Martin *et al.* (2006) and Berglund (2006) who found a positive effect of income on recycling behaviour.

Working in the formal sector, decreases the probability of household's source separation intention by 4.9 per cent in AMA, 1.3 per cent in TaMA and 3.3 per cent at the entire study area. This suggests that heads of household who are in formal employment are less likely to adopt source separation compare to those in the informal sector. This is reasonable because those in the formal employment tend to have busy schedules and attach a higher opportunity cost to time spent on source separation activities. However, those in the informal sector, who earn daily or weekly wage, may engage in source separation to supplement their income. In the case of TaMA, generally households, who are employed in the formal sector, are less likely to engaged in livestock rearing at home which demands that they source separate cassava, plantain and yam peels (which is the common source separation activities in TaMA as stated by the participants during focus group discussions) to feed their livestock. Information on source separation issues increases the probability of households' source separation intention by 5.2 per cent in AMA and 2.7 per cent in the entire study area. This could be due to the fact that access to information on issues regarding source separation improves household awareness of source separation which then translates into higher source separation intention. In previous study, Hornik *et al.* (1995) observed a positive relation between information and recycling behaviour.

Having past experience with source separation increases the probability of household source separation intention by 11.4 per cent in AMA, 17.8 per cent in TaMA and 13.4 per cent in the entire study area. This is plausible because people who have previous experience with source separation in AMA undertake the activity to supplement their income. In TaMA cassava, plantain and yam peels are predominantly separated to feed livestock. Thus, with previous experience which is largely motivated by the resource value of solid waste, household would have stronger intention about performing the activity. Scholars including Barr *et al.* (2003) and Tonglet *et al.* (2004) found past behaviour to be an important determinant of recycling behaviour and intention.

Positive attitude towards source separation increases the probability of source separation intention by 25.8 per cent in AMA, 19.6 per cent in TaMA and 13.8 per cent in the entire study area. This is reasonable because households, who have positive attitude towards source separation, tend to appreciate the social, economic and environmental benefits of source separation. Compared with previous works, Barr *et al.* (2003), Tonglet *et al.* (2004) and Nigbur *et al.* (2010) found a positive relation with attitude and recycling behaviour. In contrast Davis *et al.* (2006) established no significant effect for attitude. As expected, subjective norm increases the probability of households' source separation intention by 22.9 per cent in AMA, 6.4 per cent in TaMA and 11.4 per cent in the entire study area. Compound house is the most prevalent housing system in AMA, and is associated with the sharing of facilities such as waste bins. This promotes strong interaction among residents and creates strong social cohesion and bonding which impacts positively on their source separation behaviour. The homogenous population in TaMA also promotes strong

communal living and social cohesion which impact positively on their source separation behaviour. Hence the higher source separation intention associated with subjective norm. Scholars including Barr *et al.* (2001) and Knussen and Yule (2008) have observed that subjective norm affect households' recycling behaviour.

Having the perception that lack of time, space and formal source separation arrangement is a constraint, decreases the probability of household source separation intention by 4.8 per cent in AMA, 7.9 per cent in TaMA and 11.1 per cent in the entire study area. This suggests that households who perceive time, space and lack of formal source separation arrangement as a barrier are less likely to participate in source separation activities. Currently, Ghana has no formal arrangement for collection of separated solid waste and this discourage households from adopting source separation because only mixed wastes are collected. The result of this study is in tandem with the observation of Domina and Koch (2002) and Saphores *et al.* (2006). Finally, the negative sign of the location variable suggests that being a resident at AMA decrease the probability of source separation intention by 2.5 per cent. This is reasonable because compare to TaMA, AMA is a wholly urbanized area with high population density and heavily congested. In addition, residents in AMA tend to have busy schedules than those in TaMA. These conditions impact negatively on their source separation behaviour. Previous study by Ekere *et al.* (2009) reported that households in crowded urban areas find space a constraint in separation of garbage in cases where storage is necessary.

5. Conclusion and policy implications

The study was partly motivated by the fact that despite the benefits associated with source separation, little attention has been given to formal source separation in Ghana. Moreover, there are limited studies on source separation behaviour in Ghana using the TPB as the theoretical framework. Based on this premise, this study examined the factors that encourage households' source separation intentions in AMA and TaMA in Ghana. The estimation results from the ordered probit regression models revealed that socio-economic, socio-psychological and situational factors play significant roles in households' source separation intention in AMA and TaMA. For instance, educational attainment of head of household, total income of household, occupation type of head of household, information, past experience with source separation, inconvenience in terms of time, space and availability of formal source separation scheme, attitude towards source separation, subjective norm and the location of the respondents were the major determinants of source separation intention in the entire study area.

For successfully implementation of solid waste separation schemes, there is the need to organise frequent educational programme to redirect the perceptions and attitudes of people towards a new level of appreciating that solid waste can be a resource if separated from other waste. Second, providing source separation schemes and making the system as convenient as possible; and adapt it according to the needs and dwellings of the local population would promote source separation of solid waste. Recycling drop-off centres at convenient locations within the community and additional waste bins should be provided for easy separation. It was also concluded that social pressure from family, friends, opinion leaders among others, is critical for households' source separation intentions. Local authorities should take advantage of this by involving opinion leaders, women's groups such as Christian Mothers and other social associations to promote source separation of solid waste.

Although this study examined household waste separation intention and derived several policy implications, it is not without limitations. The findings of the study reveal that the TPB constructs significantly influence household waste separation intention, not actual behaviour. In addition, the cross-sectional design does not determine causality

but an association. Thus, future studies should examine actual household waste separation behaviour by using the experimental design to test the TPB model. Also, a sample size of 855 urban households is relatively small to represent the study area and the findings of the research are limited to urban communities (i.e. Accra and Tamale metropolises). This may limit it generalisability to rural areas in Ghana. Hence future application of the TPB model to Ghanaian population should use larger sample size that includes both urban and rural areas. Lastly, the present study did not include monetary incentive and moral obligation as predictors of household waste separation intention. Future studies should include these variables into the TPB model to examine their impact on household waste separation behaviour in Ghana.

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