

Article

Assessment of Belief Constructs to Support an Intervention in Municipal Solid Waste Separation at the Source in Low–Middle-Income Countries: Observations from the Greater Accra Region of Ghana

Kwaku Oduro-Appiah ^{1,*}, Abraham Afful ² and Henrietta Osei-Tutu ³

¹ Department of Water and Sanitation, School of Physical Sciences, University of Cape Coast, Cape Coast P.O. Box DL 1206, Ghana

² Waste Management Consultant, Accra P.O. Box KIA 9818, Ghana; abrahamafful@rocketmail.com

³ Ministry of Sanitation and Water Resources, Accra PMB 60, Ghana; s-waste@garid-accra.com

* Correspondence: koduro-appiah@ucc.edu.gh; Tel.: +233-209-333-876

Abstract: This article uses a modified model of the theory of planned behaviour to assess salient beliefs of household heads towards the separation of municipal solid waste at its source in the Greater Accra Region of Ghana. Structural equation modelling was used to analyse the responses of 598 household heads to a questionnaire in a cross-sectional design. Whilst the default model produced an acceptable fit to the data and explained 37% of the variance in households' intention to separate waste at its source, the modified model with moral norms as an additional construct fitted the data excellently, explaining 52% of the variance in intention. Moral norms and perceived behavioural control were the predominant latent constructs to influence intentions. Control beliefs related to the availability of waste receptacles, provision of regular waste collection services, and access to knowledge of the separation process had the greatest tendency to facilitate households' intentions. Pro-environmental interventions designed in a participatory manner to promote moral correctness, responsibility, respect for the environment, and positive affect may empower households to separate waste at its source. This research contributes to the development of a municipal solid waste strategy in the region, and may further support research in waste diversion and the circular economy in other jurisdictions.

Keywords: source separation; municipal solid waste; theory of planned behaviour; behavioural intention; moral norms; perceived behavioural control; control beliefs; Greater Accra Region; Ghana; developing countries



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1. Introduction

Separation of municipal solid waste (MSW) at its source before collection is crucial to integrated and sustainable waste management [1]; it supports the recovery of clean recyclable materials, and mitigates the climate change burden of MSW through the diversion of biodegradable waste from landfills [2]. These, in addition to the concerns of resource scarcity, the demands of the Sustainable Development Goals (SDGs), and the circular economy, have made MSW separation at the source a common practice in the municipal solid waste management (MSWM) systems of developed countries [3–5]. What prevails in most developing countries—especially in sub-Saharan Africa—is different; MSW separation at the source is not a formal practice [6–8]. Most developing countries' metropolises, such as the Greater Accra Metropolitan Area (GAMA) of Ghana, collect commingled MSW and dispose of it into semi-controlled landfills and dumpsites [9,10]. Nearly all MSW separation and recovery of recyclables occurs at disposal sites through the effort of informal waste pickers [11,12], albeit at a cost to their wellbeing [13,14] and a loss in the value of the recovered materials.

Nevertheless, the rising rate of urbanisation and scarcity in urban land space, coupled with rising MSW generation rates and increasing biodegradable and recyclable waste streams [15–17], are triggering a new and growing interest amongst researchers, policymakers, and funding institutions to work together towards the attainment of functional solid waste management (SWM) systems in developing countries [18], with a particular emphasis on waste diversion from landfills. Those charged with MSWM have a new impetus to divert decision making towards the separation of MSW at the source for environmentally friendly valorisation and recycling purposes [8,19,20].

Implementing such a strategy calls for careful planning with regards to infrastructural investments [21], along with an understanding of the significant mix of social determinants that may influence the behavioural intentions of households [22,23], who may never have formally separated MSW at its source in their lifetime [24]. Pro-environmental behaviours such as MSW separation at the point of generation are dependent on active public participation, and require a conscious effort from households to reduce the negative impacts of their activities on the environment [25,26].

There is a plethora of scholarly literature on the determinants of pro-environmental behavioural intentions related to MSW separation at the source and recycling. Notable examples include studies in China [26,27], Cuba [28], India [29], Iran [30,31], Malaysia [23,32,33], South Africa [34,35], Thailand [36], the United Kingdom [37], and Vietnam [38], to name but a few. However, the varying outcomes of these studies even within the same country show that intention with regards to such behaviours—and especially recycling behaviours—is region-dependent [22,26].

In Ghana, eight studies relating to MSW separation behaviour at the source were identified in the scholarly literature: Two of them assessed the efficiency of small-sample-size pilot source separation schemes in two metropolises [39,40]. One assessed the effect of incentives on the willingness of urban households to participate in household-level source separation in one metropolis [41]. The other five were on behavioural intentions to separate MSW at the source in a municipality [19,42–44], with only one of them based on a socio-cognitive model of behaviour [24]—the theory of planned behaviour (TPB). All eight studies were analysed by means of descriptive, logit, and probit regression statistics. Remarkably, none of the studies in Ghana conducted formative research of the belief constructs to behavioural intentions—a critical ingredient in the development of social behaviour change interventions [45,46], and also a major requirement of the TPB [47,48]. Researchers and behaviour change interventionists use formative research to understand what people in the target audience value most [48], and also to gain insights into the opportunities, barriers, and drivers that surround human social behaviour change theories [49].

This article constitutes the first study in Ghana to adopt a modified model of the TPB and use structural equation modelling (SEM) to identify elicited salient beliefs and behavioural constructs that may influence the behavioural intentions of household heads towards MSW separation at the source in 17 municipalities of the region. The objective was to support the development and implementation of a strategy for MSW separation at the source within the municipalities, which are themselves the target of an ongoing project of the government of Ghana to improve MSW collection and divert biodegradable and recyclable waste from landfills. We chose the TPB for this study because of its unique ability—for more than three decades—to support research that seeks to identify the determinants of human social behavioural intentions and use them to develop evidence-based behaviour change interventions [48,50]. Furthermore, the flexibility of the TPB in allowing for modification through the incorporation of additional constructs improves the predictability of intentions and supports the development of socially appropriate interventions [51]. SEM combines factor analysis and multivariate regression to comprehensively analyse the relationships between belief constructs and latent variables, which is not possible using descriptive and normal multivariate regression analysis [52,53]. By using a modified TPB and SEM, this research seeks to determine the complex mix of relevant beliefs and their relationships to household intentions to support the development

of evidence-based and theory-driven interventions towards MSW source separation and sustainable MSWM practices in Ghana.

Belief constructs relating to moral norms—namely, moral obligation, sense of responsibility, respect for the environment, and better feeling or otherwise [54–56]—were used as the latent variable to extend the original TPB in this study. The scholarly literature recommends the use of a measure of moral norms and/or personal norms to improve the predictability of intentions to engage in behaviours with clear moral dimensions, such as source separation and recycling [48,55,57,58].

Moral norms relate to an individual's personal beliefs about the moral correctness or incorrectness of performing a specific behaviour [37]. Moral obligation refers to a person's perception of whether it is morally right or wrong to participate in a behaviour [48]. Sense of responsibility refers to an individual's participation in a given behaviour due to their awareness of and willingness to accept and live by societal obligations. Feeling better or feelings of guilt are considered to be emotional states evoked in an individual as a result of performing or not performing a behaviour [35,59]. Feeling better is considered to be a positive emotion, whilst feeling guilty is considered to be a negative emotion. Both emotions are known to be positive predictors of moral norms and pro-environmental behavioural intentions [60–63].

In the case of this study, moral norms refer to the household heads' beliefs concerning the moral correctness of separating MSW at the point of generation. Moral obligation refers to household heads' perception of whether it is morally right or wrong to separate MSW at the source. Sense of responsibility refers to household heads' willingness to participate in MSW sorting at the source because of their obligation to society, whilst feeling better and feelings of guilt refer to household heads' emotional states after deciding to separate or not to separate MSW at the point of generation.

Both moral and personal norms have been used in diverse ways as additional constructs to improve the predictive viability of the TPB with regard to pro-environmental behavioural intentions. Examples include the use of personal and moral norms with the TPB to improve the predictability of intentions related to households' greywater treatment and reuse [56], and residents' waste separation at source [27,32], respectively.

Following this Introduction, the remainder of this paper has six additional parts: The theoretical framework and the justification for modifying it in this study are discussed in Section 2. In Section 3, a brief background and the status of MSWM within the study area are briefly discussed. Section 4 describes the methods used in gathering and analysing data. Section 5 presents the results of the analysis and discusses their implications for the introduction of MSW separation at the source in the region. The limitations of the study are addressed in Section 6, and the conclusions of the study constitute Section 7.

2. The Theoretical Framework: The Theory of Planned Behaviour

The theory of planned behaviour (TPB) was used as the theoretical framework for this research work. The TPB—the most widely used social psychological theory over the last four decades—is an integrative framework for the prediction and changing of human social behaviour [48,51]. The implicit claim of the TPB is that an individual's behaviour is best predicted by their intentions (Figure 1) which, in turn, are influenced by the individual's attitudes, subjective norms, and perceived behavioural control [48].

Intention is defined by the TPB as one's cognitive preparedness to perform a behaviour [48,56]. Attitude is defined by the theory as an individual's positive or negative evaluation of performing a behaviour. Subjective norms refer to the social pressure that people perceive from important referents to participate or not to participate in a behaviour, while perceived behavioural control refers to the individual's perception of control over the behaviour to be performed.

All three of the constructs that influence intention are elicited from individual beliefs. Attitude is elicited from behavioural beliefs, which are individual beliefs about the likely consequence(s) of performing a behaviour. Subjective norms are based on normative beliefs, which are based on individuals’ beliefs of what other important people expect them to do. Finally, perceived behavioural control is based on control beliefs, which are individual beliefs of factors that may facilitate or impede them from performing the behaviour [47]. According to the TPB, positive evaluations of the behaviour, positive perceived social pressure from important referents, and positive perceptions of control over the behaviour to be performed all lead to positive intentions.

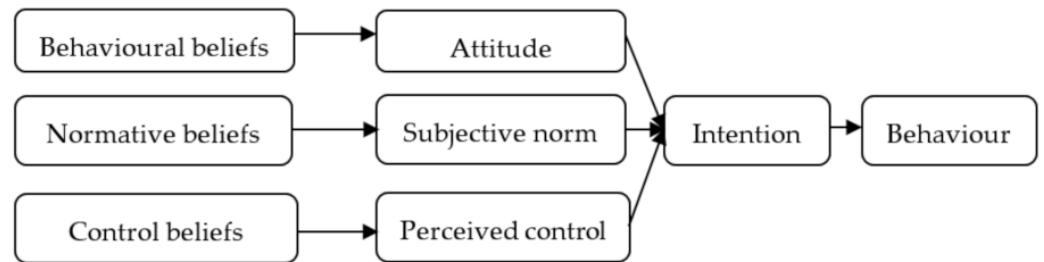


Figure 1. The default TPB conceptual framework.

In relation to the above definitions, the attitude of a household is defined as the extent to which the household’s head expects good or bad outcomes from participating in a household source separation system. If household heads believe there will be positive outcomes, they will have a favourable attitude towards the process. Subjective norms are defined as the perceived social pressure from important referents such as family members and neighbours to compel household heads to separate MSW at the source, while perceived behavioural control is defined as the household head’s perceived ability to separate MSW at the point of generation. Thus, according to the TPB, households should have a strong intention to separate MSW at its source when they perceive that there will be good outcomes from the process, that important referents expect them to participate in the process, and that they have control over the process. The moral norm construct (Figure 2) was added in order to explore its potential for increasing the predictive viability of household heads’ intentions, and also to inform the development of sustainable interventions towards the source separation process within the 17 municipalities.

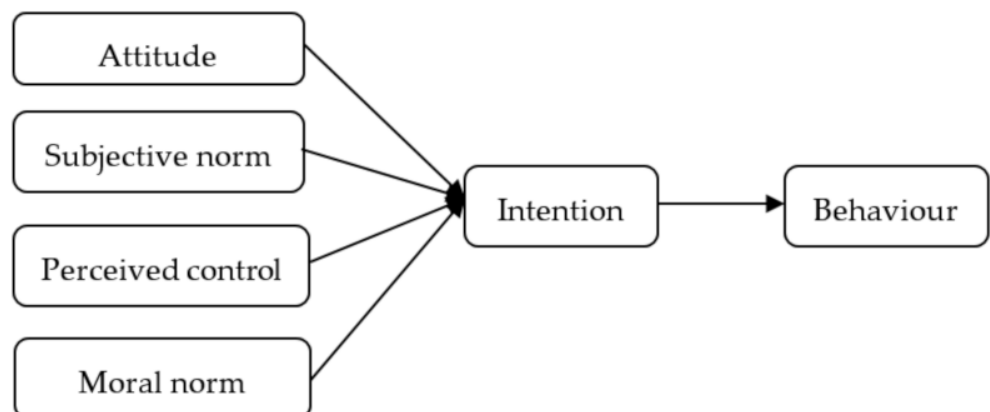


Figure 2. The modified TPB conceptual framework.

3. The Status of Municipal Solid Waste Management in the Study Area

The Odaw River Basin comprises 17 municipalities out of the 25 in the Greater Accra Region of Ghana (Figure 3). The basin drains the most densely populated area of the country, and has since 1950 become synonymous with perennial flooding, leading to loss of lives and property [64]. The basin’s 3.2 million inhabitants represent 63% of the total

inhabitants of the region [65]. The average MSW generation rate per capita per day is 0.7 kg, with a composition of 54% biodegradables, 16% plastics, 13% inert materials, 3.7% glass, 3.2% textiles, 2% paper, and 2% metals [16]. The basin was selected for the study because of the commitment of the government of Ghana to reducing its flood risk and improving its solid waste management system [66]. The average MSW collection coverage within the basin is 75%; the rest is burned, buried, and/or disposed of in drains and on vacant plots [67]. Formal service providers, who hold the franchise to collect MSW within the basin, contribute to 49% of collection, with their informal counterparts contributing to 50%. Municipalities together contribute to only 1% of collection. More than 95% of collected MSW within the basin is disposed of on uncontrolled or semi-controlled landfills. The recycling rate is estimated to be 10%, which is solely the effort of informal recycling value chain actors. Despite the significant socioeconomic contribution of the informal waste actors, they are yet to be recognised and integrated into the MSWM system [41,68]. The MSWM system of the basin, like that of cities in low–middle-income countries, is not financially sustainable [68–70]. The institutions managing the system have since 2017 seen improvement, but human resource capacities remain inadequate [67].

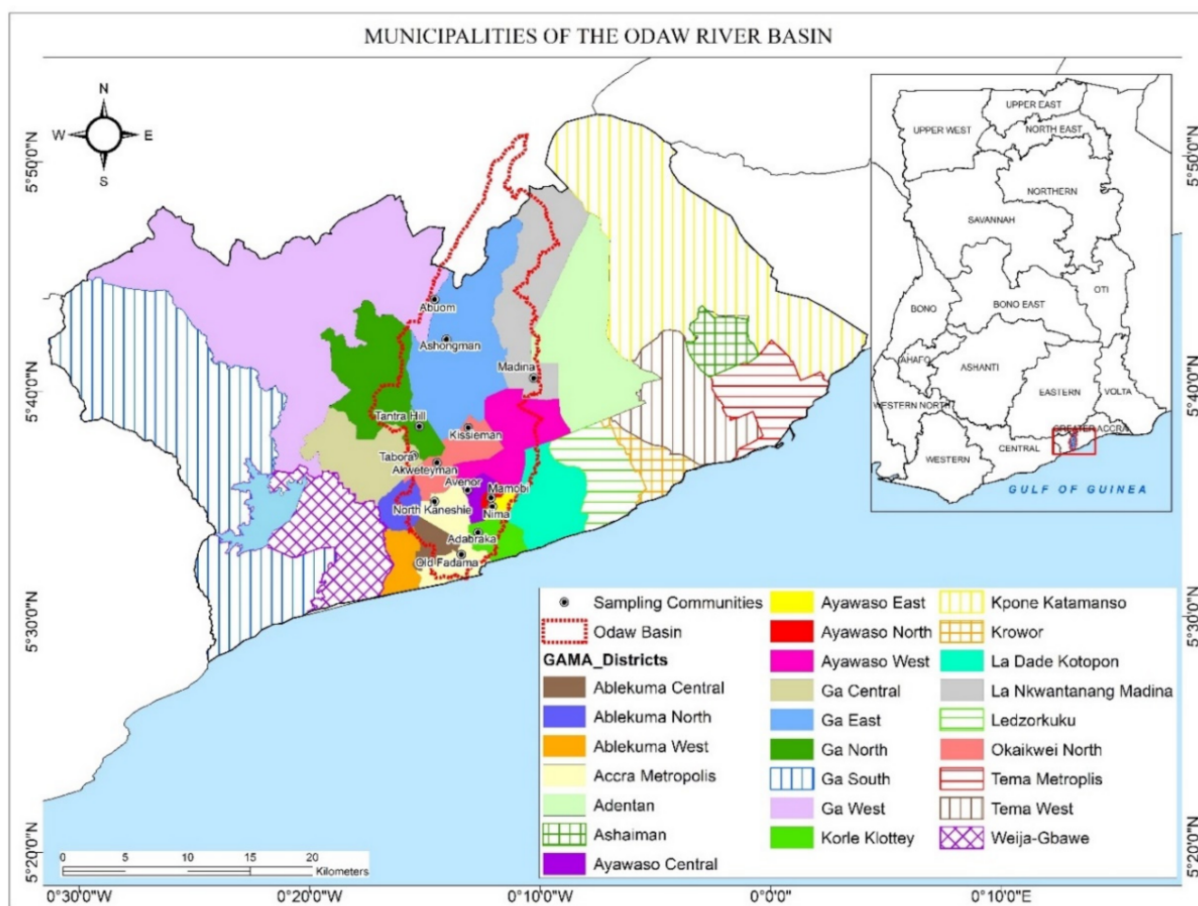


Figure 3. The communities and municipalities (solid shadings) of study within the Odaw River Basin of Ghana. Source: The authors.

4. Methodology

4.1. Elicitation Study

The researchers conducted an elicitation study among 60 randomly selected household heads within 6 communities to identify readily accessible beliefs on MSW separation at the source. The objective was to develop the questionnaire of the main study with salient beliefs within the target population as compared against predetermined beliefs of the researchers [48]. The communities were carefully selected to be representative of the

various socioeconomic divides within the country. For this study, female heads (elderly women and mothers) within the households were given preference as participants to male household heads. Most adult females in Ghana consider it an obligation to handle and manage MSW at the household level [19,71]. Open-ended questions—categorised under behavioural beliefs, normative beliefs and control beliefs—were used. To elicit behavioural beliefs, participants were asked to write down a list of at least five perceived advantages and disadvantages of separating MSW at its source within their municipalities. For normative beliefs, participants were asked to separately list the individuals or groups of important referents who would approve or disapprove of them separating MSW at its source in the near future; they were further asked to list the individuals or groups of important referents who they perceived would separate and would not separate MSW at its source in the near future. The questions on the control factors asked participants to list factors that would make it easy or difficult for them to separate MSW at its source when introduced as part of the MSWM system. All questions were asked after the researchers had explained the concept of MSW separation at the source to the participants. A content analysis was performed on the outcomes of the study, using Microsoft Excel to determine the most readily accessible beliefs within the targeted population. The identified salient beliefs were used to prepare the questionnaires for the main study.

4.2. Main Study

The researchers and 12 trained investigators administered questionnaires continuously for 10 days in 12 randomly selected communities (Figure 3), using a mobile data collection app. The communities were carefully selected to be representative of all known socioeconomic divides within the country. Questionnaires were used to assess the beliefs of 648 household heads towards the adoption of the pro-environmental behaviour of MSW separation at the source within the 17 municipalities. The questionnaires were in three parts: the first was on socio-demographics and the second on the TPB constructs; gender, age, level of education, marital status, and household size constituted the demographics; with the exception of intentions and moral norms, all other TPB constructs were assessed indirectly, with belief strengths and their corresponding outcome evaluations (Table 1). Each belief item was measured on a seven-point Likert scale. All indirect belief strength items were measured from “highly unlikely” to “highly likely”. Indirect outcome evaluations were measured with differing scale items, such as “extremely bad” to “extremely good”, “definitely not” to “yes definitely”, and “highly harmful” to “highly beneficial” (see Supplementary Table S1). Attitudes were assessed with three salient belief items, subjective norms were assessed with five salient belief items, and perceived behavioural control was assessed with four salient belief items. Moral norms were assessed with five direct belief items, while the dependent measure—intention—was assessed with two direct belief items. The third set of questions were on situational factors (availability of time and space towards the performance of the behaviour), households’ knowledge of the MSW components, and current practices on MSW separation at the source. These were intended to provide enough information to support decision making during the design of interventions. The questionnaires were administered only after the instruments had been pre-tested to improve upon the internal consistency and the validity. The questionnaires were in English, but the questions were asked in six different languages to meet the needs of the participants.

Table 1. Questionnaire items related to the TPB.

Latent Construct	Outcome Evaluation	Belief Strength
Attitude	For my household to support employment creation will be:	My household will separate solid waste at its source to support employment creation.
	For my household to contribute to making this city clean will be:	My household will separate solid waste at its source to contribute to make this city clean.
	For my household to earn some money will be:	My household will separate solid waste at its source to make some money.
Subjective Norm	For issues relating to solid waste management, what my family members think we should do is most important to me:	Our family members will expect one another to separate solid waste at its source for recycling purposes.
	As far as solid waste management is concerned, my household will do what community leaders think we should do:	Community leaders will expect us to separate solid waste at its source for recycling purposes.
	For matters relating to solid waste management, my household will do what religious leaders think we should do:	Religious leaders will expect us to separate solid waste at its source for recycling purposes.
	When it comes to solid waste management, my household will do what our neighbours think we should do:	Our neighbours will expect us to separate solid waste at its source for recycling purposes.
	Pertaining to solid waste management, my household will do what our close friends think we should do:	Our close friends will expect us to separate solid waste at its source for recycling purposes.
Perceived Behavioural Control	Having the necessary receptacles will enable my household to separate MSW at its source:	My household will separate solid waste at its source if we get the necessary receptacles.
	Experiencing regular solid waste collection services will enable me to separate MSW at its source:	My household will separate solid waste at its source if we experience regular solid waste collection services.
	Getting knowledge of the different components in the solid waste stream will enable my household to separate solid waste at its source for recycling purposes:	My household will separate solid waste at its source if we have knowledge of the different components within our waste stream.
	Receiving some incentives will encourage my household to separate solid waste at its source for recycling purposes:	My household will separate solid waste at its source for recycling purposes if we receive some form of incentive for doing so.
Latent Construct	Belief Item	
Moral Norm	My household will consider that we are doing something morally right if we separate solid waste at its source for recycling purposes.	
	We consider it to be our responsibility to separate solid waste at its source.	
	We will separate solid waste at its source as a show of respect for the environment.	
	In my household, we will feel guilty if we do not separate solid waste at its source in order to promote recycling.	
Intention	In my household, we will feel better if we separate solid waste at its source.	
	My household plans to separate solid waste at its source for recycling purposes.	
	My household will separate solid waste at its source for recycling purposes.	

4.3. Data Analysis

The Statistical Package for the Social Sciences (SPSS) version 26 and analysis of moment structures (AMOS) version 24 were used for the analysis. The data collected were first imported from the mobile data app to Microsoft Excel, and later to SPSS. The researchers deleted four questionnaire responses that had missing data after screening, leaving 644 responses for the analysis. For ease of analysis of the multiplicative combination of subjective probabilities and values [72], the unipolar seven-point Likert scale (1–7) of all belief strengths was recoded to a bipolar scale of (−3 to +3), replacing 1 with −3, 4 with 0, and 7 with +3 (see Supplementary Table S3). Mahalanobis distance, degree of freedom, and probability values (*p*-value) were used to identify multivariate outliers. All *p*-values below 0.001 were classified as outliers and were deleted from the analysis. This further resulted in

the exclusion of 46 responses from the analysis, leaving 598 responses. Structural equation modelling was used to fit the data first to the original TPB model, and thereafter to the modified TPB model [47]. Confirmatory analysis using maximum likelihood estimation was performed on the data, while the reliability of the scale measuring the latent constructs was measured before running the model. The behavioural belief item “earn some money” and the control belief item “incentive” had low loading factors, and were subsequently deleted to improve the reliability of the scale measuring the latent constructs.

4.4. Analysis of Variables

Due to the assumption of multivariate normality and the sensitivity of the chi-squared test statistic to sample size, the original and modified TPB models were assessed using three independent fit indices, namely, the root-mean-square error of approximation (RMSEA), the Tucker–Lewis index (TLI), and the comparative fit index (CFI) [47,73,74]. The literature considers TLI and CFI values greater than 0.95 and RMSEA less than 0.06 to be excellent model fits [56,73]. RMSEA values between 0.06 and 0.08 and TLI and CFI values between 0.90 and 0.95 are considered to be acceptable model fits.

5. Results and Discussion

5.1. Descriptive Statistics

The total number of participants was 648, with 85% being females. The average age of participants was 44 years (maximum 85 and minimum 18)—a justification that all participants were sufficiently mature to hold onto their beliefs. Most participants (82%) had acquired some form of primary, secondary, and tertiary education—a possible indication of their comprehension of the questions. Almost 55% of participants were married, with 14% widowed and 23% being single. Only 44% of participants knew the differences between the components of their waste streams, pointing to the need to educate households through demonstration projects to support efficient future source separation processes [39]. Nevertheless, more than 80% of participants knew the benefits of source separation processes to employment creation and cleaner cities—a very good observation to influence households’ attitudes towards the behaviour. Around one-third (34%) of participants claimed to segregate plastic bottles from their waste streams, either for free or for sale to itinerant buyers. Whilst the researchers were unable to verify these claims, there is evidence of the practice in major cities in Ghana, where some households within middle- and low-income neighbourhoods separate metals and plastics to support their livelihoods [12,70]. Almost equal numbers of participants (~43%) preferred either a three-category (biodegradables, plastics, and metals) or a two-category (biodegradables; all other recyclable MSW) separation at the source process, which is consistent with the literature and practices elsewhere, where decision makers are advised to start with a two-category or three-category separation process to allow for learning before scaling up to more complex separation categories [44,75].

Participants reported strong intentions ($M = 6.05, SD = 0.30$), positive attitudes ($M = 14.96, SD = 0.88$), moderately high social pressure ($M = 8.35, SD = 1.92$), moderately high controllability ($M = 8.87, SD = 1.98$), and moderately high moral norms ($M = 5.77, SD = 0.23$) with regard to the separation of MSW at its source (Table 2). Apart from attitudes, all other latent constructs were significantly associated with intention.

Table 2. Cronbach’s alpha, means, standard deviations, and correlations between latent constructs.

Construct	Cronbach’s Alpha	Mean	SD	1	2	3	4	5
1. Attitude ^a	0.69	14.96	0.88	1				
2. Subjective Norm ^a	0.86	8.35	1.92	0.60 **	1			
3. Perceived Control ^a	0.66	8.87	1.98	0.59 **	0.63 **	1		
4. Moral Norm ^b	0.86	5.77	0.23	0.63 **	0.57 **	0.56 **	1	
5. Intention ^b	0.89	6.05	0.30	0.09	−0.02 **	0.20 **	0.54 **	1

** $p < 0.05$; theoretical range (−21–21) ^a, (1–7) ^b.

5.2. Assessment of the Default Structural Equation Model

The hypothesised default model appeared to provide an acceptable fit to the data ($X^2 = 197.96$, $df = 45$, $X^2/df = 4.39$, $p < 0.001$ RMSEA = 0.075 TLI = 0.93, CFI = 0.95), and was able to explain 37% of the variance in the intentions of household heads to separate solid waste at its source (Figure 4). Whilst perceived behavioural control ($\beta = 0.32$, $p < 0.001$) and attitudes ($\beta = 0.30$, $p = 0.03$) appear to be strong predictors of household heads' intentions to separate solid waste at its source, subjective norms ($\beta = 0.09$, $p = 0.10$) had no statistically significant effect on intentions. This result is supported by a similar finding in Malaysia [23].

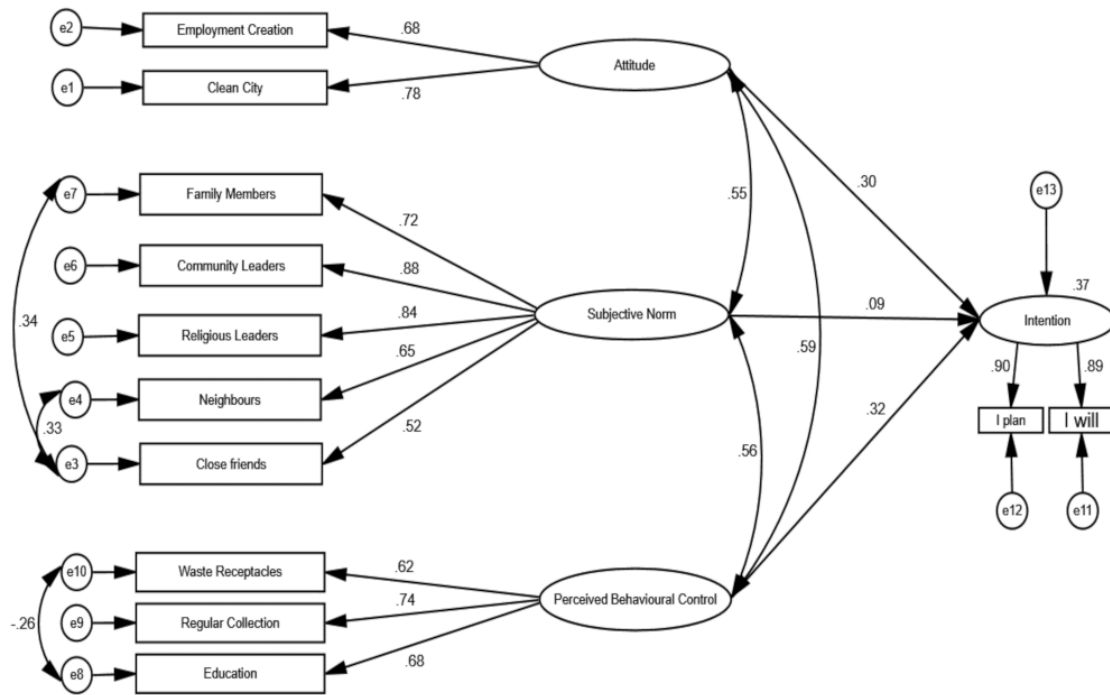


Figure 4. The default structural equation model.

5.3. Assessment of the Modified Structural Equation Model

The hypothesised modified model with moral norms as an additional predictor of intentions provided an excellent fit to the data ($X^2 = 287.19$, $df = 104$, $X^2/df = 2.76$, $p < 0.001$, RMSEA = 0.054, TLI = 0.95, CFI = 0.96), and explained 52% of the variance in the intentions of household heads to separate solid waste at its source (Figure 5). In this model, moral norms ($\beta = 0.54$, $p < 0.001$) and perceived behavioural control ($\beta = 0.20$, $p < 0.001$) had strong effects on household heads' intentions to separate solid waste at its source. Subjective norms ($\beta = -0.02$, $p = 0.74$) proved again to be a poor predictor of intentions, with attitudes ($\beta = 0.09$, $p = 0.18$) having no statistically significant effect on intentions. The results show that the modified structural equation model (with moral norms as an additional latent construct) provided an improvement in the prediction of household heads' intentions compared to the default TPB model, both in the explained variance in intentions to separate MSW at its source, and in the fit indices.

5.4. Assessment of the Effect of Composite Beliefs

The assessment points to moral norms and perceived behavioural control as the most significant predictors of household heads' intentions to separate MSW at its source in the region. In the default model (Figure 4), households perceive regular MSW collection services ($\lambda = 0.74$), education on MSW separation ($\lambda = 0.68$), and availability of MSW receptacles ($\lambda = 0.62$) as the most important composite control beliefs to enable them to separate MSW at its source. In the modified model (Figure 5), it was observed that the influence of beliefs from moral norms—namely, moral obligation ($\lambda = 0.81$), sense of

responsibility ($\lambda = 0.80$), showing of respect to the environment ($\lambda = 0.73$), feeling better ($\lambda = 0.71$), and feelings of guilt ($\lambda = 0.65$)—had the greatest impact on household heads’ intentions to separate MSW at its source.

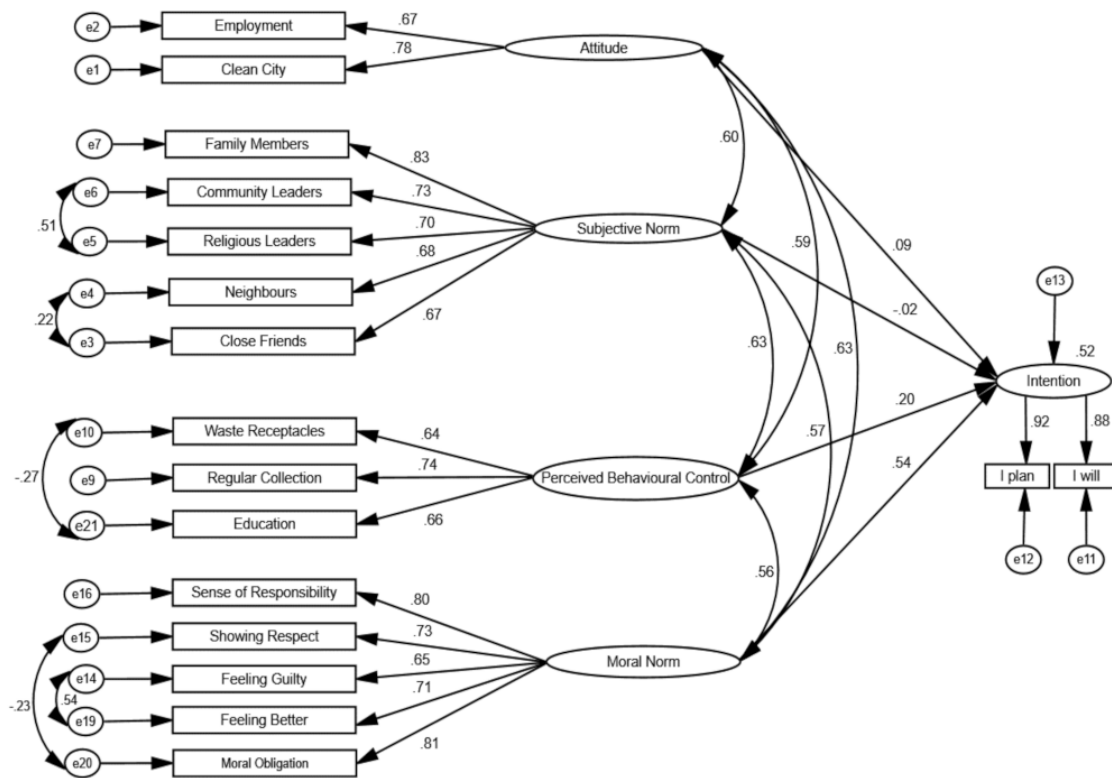


Figure 5. The modified structural equation model.

6. Discussion

In this study, the socio-cognitive theory of planned behaviour (TPB) proved successful in supporting an understanding of the underlying belief constructs that have the greatest potential to influence households’ intentions towards the separation of MSW at its source in the Greater Accra Region of Ghana. The adaptability of the TPB framework [47,51] allowed two structural equation models to be tested: first, the default model, with attitudes, subjective norms, and perceived behavioural control as the latent constructs (see Figure 4); and second, the modified model, in which moral norms were used as an additional construct for the default model (see Figure 5). The results highlight moral norms and perceived behavioural control as the two most important constructs that have the tendency to influence households’ intentions towards the separation of MSW at its source in the region—similar to findings in most developing countries [54]. Moral norms and/or personal norms have been found to be the most important constructs influencing not only households’ intentions to separate MSW at its source in most developing countries [32,76], but also their actual behaviour [77]. Whilst the default model was able to explain 37% of the variance in household heads’ intentions to separate MSW at its source, the modified model explained 52% of the variance, further confirming the predictive advantage of additional constructs to behavioural intentions [32,56]. Furthermore, the structural equation model in which moral norms were added as an additional construct fitted the data excellently, as compared to the acceptable fit of the default model. In both the default and modified models, subjective norms proved to be the weakest predictor of household heads’ intentions, confirming previously reviewed findings on the application of the TPB to intentions [78], in which the subjective norm construct was generally found to be a weak predictor of intentions. Attitudes proved to be an equally good predictor of intentions in the default model, but were weak in predicting intentions in the modified model, similar to findings in

China and Ghana [19,26,27]. The weakness of attitudes as a predictor of intentions in the modified model may be due to the presence of the moral norm construct, which is known to influence separation behaviour indirectly through the attitudes construct [77].

Analysis of the beliefs that influence overall perceptions of moral norms amongst the participants showed moral obligation, sense of responsibility, respect for the environment, and feeling better to be the four most important factors. The addition of the two affective belief items (feeling better and feelings of guilt, as part of the moral norm construct) somehow compensated for the reported weakness of the TPB as based only on cognitive processes, overlooking the contributions of non-cognitive determinants such as emotions and habits to the prediction of intentions and behaviour [79].

The implication of the findings for policy is that MSW system handlers and policy-makers in the Greater Accra Region of Ghana—and perhaps in other, similar regions—will have to consider the availability of waste receptacles, the offer of regular MSW collection services, and education of households on separation streams as the three most important control factors to facilitate households' intentions to participate in future MSW separation-at-source programs. Improved MSW collection services and provision of knowledge on separation categories have been reported not only to positively influence households' intentions towards source separation and recycling, but also to have the tendency to support households' in overcoming MSW separation barriers related to time and space [80]. The ability of municipalities to provide households with waste receptacles (polyethylene bags or bins) at a reduced cost may be perceived as a stimulus to further support the effective implementation of the separation process [40,41,76].

Locally appropriate pro-environmental interventions designed in a participatory manner to promote moral correctness, responsibility, respect for the environment, and positive affect may have the highest potential to empower and create a sense of ownership amongst households towards a successful MSW separation-at-source program within the region [22,34,81].

Although attitudes had a weak influence on intentions in the modified model, this study was able to determine two behavioural beliefs—creation of employment, and contribution to clean cities—as the most important factors that may influence the attitudes of households towards MSW separation at its source in the region. Community leaders, religious leaders, family members, and neighbours are the most important referents likely to influence households to participate in future source separation programs. An initial three-category MSW separation at source process with biodegradables, plastics, and metals may fit well with households, with the possibility of a systematic addition to the number of categories based on lessons that may be learned.

7. Limitations of the Study

This study assessed the beliefs of household heads as a representation of the entire household, which might not always be the case, since there is the possibility that some household members may act differently from the expectations of their household heads.

Secondly, the study was situated within the Greater Accra Region of Ghana and, thus, might not be representative of the entire country. Extending the research to other regions may help policymakers to understand the comprehensive mix of determinants to influence MSW separation at its source in the country.

Thirdly, because MSW separation at its source is not an official practice within the region, the study was not able to adopt the longitudinal research approach of assessing or predicting actual behaviour. Whilst people tend to act differently in reality from how they intend to, predicting actual behaviour after predicting intentions to perform the behaviour would possibly further support researchers and decision makers to establish a correlation between the two.

The effect of socio-demographics on intentions to engage in source separation behaviour was not assessed, since two previous studies within the region [19,24] have comprehensively addressed that.

Finally, although participants were assured anonymity in their responses, with the hope of reducing the effect of social desirability, the authors cannot guarantee that there was no overestimation of responses.

8. Conclusions

The outcome of this study contributes to an understanding of the beliefs of households towards MSW separation at its source in the Greater Accra Region of Ghana. With the exception of subjective norms, salient beliefs related to attitudes, perceived behavioural control, and moral norms were found to influence households' behavioural intentions towards MSW separation at its source in the region. However, beliefs related to moral norms and perceived behavioural control emerged as the most dominant determinants of households' intentions. In terms of attitudes, we found behavioural beliefs related to employment creation ($\lambda = 0.68$) and the contribution to a clean city ($\lambda = 0.78$) to be the most influential in encouraging households to participate in future MSW separation processes. Control beliefs that seek to make waste bins or other receptacles accessible ($\lambda = 0.62$), improve MSW collection coverage ($\lambda = 0.74$), and provide education to households ($\lambda = 0.68$) should facilitate participation in MSW separation at the point of generation. Pro-environmental educational campaign messages that reinforce moral obligation ($\lambda = 0.81$) and promote households' self-responsibility ($\lambda = 0.80$), respect for the environment ($\lambda = 0.73$), and feeling better ($\lambda = 0.71$) have a greater tendency to encourage participation. The dominant beliefs gleaned from the study can inform the design of functional MSW separation-at-source interventions as part of an MSWM strategy for implementation in the 17 municipalities of the region. Although the municipalities were engaged during the design of the research instruments and the development of interventions, we recommend that the policy institution use a participatory research approach to further create ownership of the outcomes amongst the municipalities. Ideally, participatory engagement and inclusive strategies that involve policy and research institutions, service users, and system handlers will work to situate the outcomes within the local context and empower stakeholders for purposes of implementation and sustainability. Whilst the outcomes of this study may not be the same in other regions, the methodological processes and the transdisciplinary approach to the research and the data collection provide positive examples to researchers and policymakers in cities in developing countries, in the pursuit of the replication and the design of evidence-based and theory-driven interventions in MSW separation at its source, along with the diversion of biodegradable and recyclable waste from landfills.

Supplementary Materials: The following are available online at <https://www.mdpi.com/article/10.3390/recycling7020017/s1>: Table S1: The survey questionnaire used for elicitation of households' salient beliefs on MSW separation at its source; Table S2: The questionnaire used for the main study; Table S3: The code used for analysis of the TPB part of the questionnaire.

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References

1. McDougall, F.R.; White, P.R.; Franke, M.; Hindle, P. *Integrated Solid Waste Management: A Life Cycle Inventory*; John Wiley & Sons: Hoboken, NJ, USA, 2008.
2. Scheinberg, A.; Wilson, D.C.; Rodić, L. *Solid Waste Management in the World's Cities*; UN-Habitat's State of Water and Sanitation in the World's Cities Series; Earthscan: Newcastle upon Tyne, UK, 2010.
3. Asase, M.; Yanful, E.K.; Mensah, M.; Stanford, J.; Amponsah, S. Comparison of municipal solid waste management systems in Canada and Ghana: A case study of the cities of London, Ontario, and Kumasi, Ghana. *Waste Manag.* **2009**, *29*, 2779–2786. [[CrossRef](#)] [[PubMed](#)]
4. Mmereki, D.; Baldwin, A.; Li, B. A comparative analysis of solid waste management in developed, developing and lesser developed countries. *Environ. Technol. Rev.* **2016**, *5*, 120–141. [[CrossRef](#)]
5. Marshall, R.E.; Farahbakhsh, K. Systems approaches to integrated solid waste management in developing countries. *Waste Manag.* **2013**, *33*, 988–1003. [[CrossRef](#)] [[PubMed](#)]
6. Guerrero, L.A.; Maas, G.; Hogland, W. Solid waste management challenges for cities in developing countries. *Waste Manag.* **2013**, *33*, 220–232. [[CrossRef](#)] [[PubMed](#)]
7. Godfrey, L.; Nahman, A.; Yonli, A.H.; Gebremedhin, F.G.; Katima, J.H.; Gebremedhin, K.G.; Osman, M.A.M.; Ahmed, M.T.; Amin, M.M.; Loutfy, N.M. *Africa Waste Management Outlook*; United Nations Environment Programme: Nairobi, Kenya, 2018.
8. Dickella Gamaralalage, P.J.; Ghosh, S.K.; Onogawa, K. Source separation in municipal solid waste management: Practical means to its success in Asian cities. *Waste Manag. Res.* **2021**, *40*, 0734242X211049606. [[CrossRef](#)] [[PubMed](#)]
9. Coffey, M.; Coad, A. *Collection of Municipal Solid Waste in Developing Countries*; UN-Habitat, United Nations Human Settlements Programme: Nairobi, Kenya, 2010.
10. Oduro-Appiah, K.; Scheinberg, A.; Miezah, K.; Mensah, A.; de Vries, N.K. Existing realities and sustainable pathways for solid waste management in Ghana. In *Sustainable Waste Management Challenges in developing Countries*; IGI Global: Hershey, PA, USA, 2020; pp. 115–143.
11. Wilson, D.C.; Velis, C.A.; Cheeseman, C.R. Role of informal sector recycling in waste management in developing countries. *Habitat Int.* **2006**, *30*, 797–808. [[CrossRef](#)]
12. Rockson, G.N.; Kemausuor, F.; Seassey, R.; Yanful, E. Activities of scavengers and itinerant buyers in Greater Accra, Ghana. *Habitat Int.* **2013**, *39*, 148–155. [[CrossRef](#)]
13. Asibey, M.O.; Amponsah, O.; Yeboah, V. Solid waste management in informal urban neighbourhoods. Occupational safety and health practices among tricycle operators in Kumasi, Ghana. *Int. J. Environ. Health Res.* **2019**, *29*, 702–717. [[CrossRef](#)]
14. Gutberlet, J.; Uddin, S.M.N. Household waste and health risks affecting waste pickers and the environment in low-and middle-income countries. *Int. J. Occup. Environ. Health* **2017**, *23*, 299–310. [[CrossRef](#)]
15. Kaza, S.; Yao, L.C.; Bhada-Tata, P.; Van Woerden, F. *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*; Urban Development Series; World Bank: Washington, DC, USA, 2018.
16. Oduro-Appiah, K.; Afful, A. Sustainable Pathway for Closing Solid Waste Data Gaps: Implications for Modernization Strategies and Resilient Cities in Developing Countries. In *Strategies of Sustainable Solid Waste Management*; IntechOpen: London, UK, 2020.
17. Umunnakwe, J.E.; Ekweozor, I.; Umunnakwe, B.A. Impact of lifestyle scenarios on household wastes in Port Harcourt. *Manag. Environ. Qual. Int. J.* **2019**, *30*, 864–889. [[CrossRef](#)]
18. Chammas, G.; Kayed, S.; Al Shami, A.; Kays, W.; Citton, M.; Kalot, M.; Al Marj, E.; Fakhr, M.; Yehya, N.A.; Talhouk, S.N. Transdisciplinary interventions for environmental sustainability. *Waste Manag.* **2020**, *107*, 159–171. [[CrossRef](#)] [[PubMed](#)]
19. Alhassan, H.; Kwakwa, P.A.; Owusu-Sekyere, E. Households' source separation behaviour and solid waste disposal options in Ghana's Millennium City. *J. Environ. Manag.* **2020**, *259*, 110055. [[CrossRef](#)] [[PubMed](#)]
20. Woon, K.S.; Phuang, Z.X.; Lin, Z.; Lee, C.T. A novel food waste management framework combining optical sorting system and anaerobic digestion: A case study in Malaysia. *Energy* **2021**, *232*, 121094. [[CrossRef](#)]
21. Rousta, K.; Ordoñez, I.; Bolton, K.; Dahllén, L. Support for designing waste sorting systems: A mini review. *Waste Manag. Res.* **2017**, *35*, 1099–1111. [[CrossRef](#)]
22. Knickmeyer, D. Social factors influencing household waste separation: A literature review on good practices to improve the recycling performance of urban areas. *J. Clean. Prod.* **2020**, *245*, 118605. [[CrossRef](#)]
23. Ayob, S.F.; Sheau-Ting, L.; Jalil, R.A.; Chin, H.-C. Key determinants of waste separation intention: Empirical application of TPB. *Facilities* **2017**, *35*, 696–708. [[CrossRef](#)]
24. Alhassan, H.; Asante, F.A.; Oteng-Ababio, M.; Bawakyillenuo, S. Application of theory of planned behaviour to households' source separation behaviour in Ghana. *Manag. Environ. Qual. Int. J.* **2018**, *29*, 704–721. [[CrossRef](#)]

25. Kollmuss, A.; Agyeman, J. Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environ. Educ. Res.* **2002**, *8*, 239–260. [[CrossRef](#)]
26. Ma, J.; Hipel, K.W.; Hanson, M.L.; Cai, X.; Liu, Y. An analysis of influencing factors on municipal solid waste source-separated collection behavior in Guilin, China by Using the Theory of Planned Behavior. *Sustain. Cities Soc.* **2018**, *37*, 336–343. [[CrossRef](#)]
27. Zhang, D.; Huang, G.; Yin, X.; Gong, Q. Residents' Waste Separation Behaviors at the Source: Using SEM with the Theory of Planned Behavior in Guangzhou, China. *Int. J. Env. Res Public Health* **2015**, *12*, 9475–9491. [[CrossRef](#)]
28. Tamas, A.; Mosler, H.-J.; Tobias, R.; Rodríguez, T.C.; Miranda, O.G. Factors determining the intentions to reuse, separate and compost household waste in the city of Santiago De Cuba. *Waste Soc. Context* **2005**, *1*, 736–744.
29. Rathore, P.; Sarmah, S. Investigation of factors influencing source separation intention towards municipal solid waste among urban residents of India. *Resour. Conserv. Recycl.* **2021**, *164*, 105164. [[CrossRef](#)]
30. Pakpour, A.H.; Zeidi, I.M.; Emamjomeh, M.M.; Asefzadeh, S.; Pearson, H. Household waste behaviours among a community sample in Iran: An application of the theory of planned behaviour. *Waste Manag.* **2014**, *34*, 980–986. [[CrossRef](#)] [[PubMed](#)]
31. Heidari, A.; Kolahi, M.; Behraves, N.; Ghorbanyon, M.; Ehsanmansh, F.; Hashemolhosini, N.; Zanganeh, F. Youth and sustainable waste management: A SEM approach and extended theory of planned behavior. *J. Mater. Cycles Waste Manag.* **2018**, *20*, 2041–2053. [[CrossRef](#)]
32. Razali, F.; Daud, D.; Weng-Wai, C.; Jiram, W.R.A. Waste separation at source behaviour among Malaysian households: The Theory of Planned Behaviour with moral norm. *J. Clean. Prod.* **2020**, *271*, 122025. [[CrossRef](#)]
33. Ghani, W.A.W.A.K.; Rusli, I.F.; Biak, D.R.A.; Idris, A. An application of the theory of planned behaviour to study the influencing factors of participation in source separation of food waste. *Waste Manag.* **2013**, *33*, 1276–1281. [[CrossRef](#)]
34. Strydom, W. Applying the Theory of Planned Behavior to Recycling Behavior in South Africa. *Recycling* **2018**, *3*, 43. [[CrossRef](#)]
35. Issock, P.B.I.; Roberts-Lombard, M.; Mpiganjira, M. Understanding household waste separation in South Africa: An empirical study based on an extended theory of interpersonal behaviour. *Manag. Environ. Qual. Int. J.* **2020**, *31*, 530–547. [[CrossRef](#)]
36. Vassanadumrongdee, S.; Kittipongvises, S. Factors influencing source separation intention and willingness to pay for improving waste management in Bangkok, Thailand. *Sustain. Environ. Res.* **2018**, *28*, 90–99. [[CrossRef](#)]
37. Tonglet, M.; Phillips, P.S.; Read, A.D. Using the Theory of Planned Behaviour to investigate the determinants of recycling behaviour: A case study from Brixworth, UK. *Resour. Conserv. Recycl.* **2004**, *41*, 191–214. [[CrossRef](#)]
38. Nomura, H.; Takahashi, Y.; Yabe, M. Psychological driving forces behind households' behaviors toward municipal organic waste separation at source in Vietnam: A structural equation modeling approach. *J. Mater. Cycles Waste Manag.* **2017**, *19*, 1052–1060.
39. Oduro-Kwarteng, S.; Anarfi, K.; Essandoh, H. Source separation and recycling potential of municipal solid waste in Ghana. *Manag. Environ. Qual. Int. J.* **2016**, *27*, 210–226. [[CrossRef](#)]
40. Asare, W.; Oduro-Kwarteng, S.; Donkor, E.A.; Rockson, M.A. Incentives for improving municipal solid waste source separation behaviour: The case of Tamale Metropolis, Ghana. *SN Soc. Sci.* **2021**, *1*, 132. [[CrossRef](#)]
41. Owusu, V.; Adjei-Addo, E.; Sundberg, C. Do economic incentives affect attitudes to solid waste source separation? Evidence from Ghana. *Resour. Conserv. Recycl.* **2013**, *78*, 115–123. [[CrossRef](#)]
42. Agbefe, L.E.; Lawson, E.T.; Yirenya-Tawiah, D. Awareness on waste segregation at source and willingness to pay for collection service in selected markets in Ga West Municipality, Accra, Ghana. *J. Mater. Cycles Waste Manag.* **2019**, *21*, 905–914. [[CrossRef](#)]
43. Gyimah, P.; Mariwah, S.; Antwi, K.B.; Ansah-Mensah, K. Households' solid waste separation practices in the Cape Coast Metropolitan area, Ghana. *GeoJournal* **2019**, *86*, 567–583. [[CrossRef](#)]
44. Oduro-Appiah, K.; Aggrey, B.E. Determinants of source separation of municipal solid waste in developing countries: The case of Ghana. *J. Sustain. Dev. Afr.* **2013**, *15*, 47–60.
45. Downs, D.S.; Hausenblas, H.A. Elicitation studies and the theory of planned behavior: A systematic review of exercise beliefs. *Psychol. Sport Exerc.* **2005**, *6*, 1–31. [[CrossRef](#)]
46. Frick, T.; Reigeluth, C. Formative research: A methodology for creating and improving design theories. *Instr.-Des. Theor. Models New Paradig. Instr. Theory* **1999**, *2*, 633–652.
47. de Leeuw, A.; Valois, P.; Ajzen, I.; Schmidt, P. Using the theory of planned behavior to identify key beliefs underlying pro-environmental behavior in high-school students: Implications for educational interventions. *J. Environ. Psychol.* **2015**, *42*, 128–138. [[CrossRef](#)]
48. Fishbein, M.; Ajzen, I. *Predicting and Changing Behavior: The Reasoned Action Approach*; Psychology Press: Hove, UK, 2011.
49. Spotswood, F. *Beyond Behaviour Change: Key Issues, Interdisciplinary Approaches and Future Directions*; Policy Press: Bristol, UK, 2016.
50. Yuriev, A.; Dahmen, M.; Paillé, P.; Boiral, O.; Guillaumie, L. Pro-environmental behaviors through the lens of the theory of planned behavior: A scoping review. *Resour. Conserv. Recycl.* **2020**, *155*, 104660. [[CrossRef](#)]
51. Miller, Z.D. The Enduring Use of the Theory of Planned Behavior. *Hum. Dimens. Wildl.* **2017**, *22*, 583–590. [[CrossRef](#)]
52. Tabachnick, B.G.; Fidell, L.S. *Using Multivariate Statistics*, 7th ed.; Pearson: Boston, MA, USA, 2019; Volume 7.
53. Mueller, R.O. Structural equation modeling: Back to basics. *Struct. Equ. Modeling: A Multidiscip. J.* **1997**, *4*, 353–369. [[CrossRef](#)]
54. Rousta, K.; Zisen, L.; Hellwig, C. Household Waste Sorting Participation in Developing Countries—A Meta-Analysis. *Recycling* **2020**, *5*, 6. [[CrossRef](#)]
55. Ravis, A.; Sheeran, P.; Armitage, C.J. Expanding the affective and normative components of the theory of planned behavior: A meta-analysis of anticipated affect and moral norms. *J. Appl. Soc. Psychol.* **2009**, *39*, 2985–3019. [[CrossRef](#)]

56. Oteng-Peprah, M.; de Vries, N.; Acheampong, M.A. Households' willingness to adopt greywater treatment technologies in a developing country—Exploring a modified theory of planned behaviour (TPB) model including personal norm. *J. Environ. Manag.* **2020**, *254*, 109807. [[CrossRef](#)]
57. Klöckner, C.A. A comprehensive model of the psychology of environmental behaviour—A meta-analysis. *Glob. Environ. Change* **2013**, *23*, 1028–1038. [[CrossRef](#)]
58. Godin, G.; Conner, M.; Sheeran, P. Bridging the intention–behaviour gap: The role of moral norm. *Br. J. Soc. Psychol.* **2005**, *44*, 497–512. [[CrossRef](#)]
59. Antonetti, P.; Maklan, S. Feelings that make a difference: How guilt and pride convince consumers of the effectiveness of sustainable consumption choices. *J. Bus. Ethics* **2014**, *124*, 117–134. [[CrossRef](#)]
60. Bamberg, S.; Möser, G. Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *J. Environ. Psychol.* **2007**, *27*, 14–25. [[CrossRef](#)]
61. Grob, A. A structural model of environmental attitudes and behaviour. *J. Environ. Psychol.* **1995**, *15*, 209–220. [[CrossRef](#)]
62. Webb, D.; Soutar, G.N.; Mazzarol, T.; Saldaris, P. Self-determination theory and consumer behavioural change: Evidence from a household energy-saving behaviour study. *J. Environ. Psychol.* **2013**, *35*, 59–66. [[CrossRef](#)]
63. Conner, M.; Armitage, C.J. Extending the theory of planned behavior: A review and avenues for further research. *J. Appl. Soc. Psychol.* **1998**, *28*, 1429–1464. [[CrossRef](#)]
64. Government of Ghana. *Enhancing Urban Resilience in the Greater Accra Metropolitan Area*; World Bank Group: Washington, DC, USA, 2017; p. 122.
65. Ghana Statistical Services. *Ghana Population and Housing Census: Projection, Districts, 2015–2020*. Available online: www.statsghana.gov.gh/ (accessed on 19 July 2021).
66. World Bank. *Project Appraisal Document, Greater Accra Resilient and Integrated Project*; PAD2667; The World Bank: Washington, DC, USA, 2019; p. 105.
67. Oduro-Appiah, K.; Scheinberg, A.; Mensah, A.; Afful, A.; Boadu, H.K.; de Vries, N. Assessment of the municipal solid waste management system in Accra, Ghana: A 'Wasteaware' benchmark indicator approach. *Waste Manag. Res.* **2017**, *35*, 1149–1158. [[CrossRef](#)] [[PubMed](#)]
68. Owusu-Sekyere, E. Creative individuals, "Kaya Bola" exceptionalism and sustainable development in twenty-first century Ghana. *J. Glob. Entrep. Res.* **2019**, *9*, 54. [[CrossRef](#)]
69. Breukelman, H.; Krikke, H.; Löhr, A. Root causes of underperforming urban waste services in developing countries: Designing a diagnostic tool, based on literature review and qualitative system dynamics. *Waste Manag. Res.* **2022**, *40*, 0734242X221074189. [[CrossRef](#)]
70. Oduro-Appiah, K.; Scheinberg, A.; Afful, A.; de Vries, N. The contribution of participatory engagement strategies to reliable data gathering and inclusive policies in developing countries: Municipal solid waste management data in the Greater Accra Metropolitan Area of Ghana. *Afr. J. Sci. Technol. Innov. Dev.* **2021**, *13*, 735–746. [[CrossRef](#)]
71. Asomani-Boateng, R. Closing the loop: Community-based organic solid waste recycling, urban gardening, and land use planning in Ghana, West Africa. *J. Plan. Educ. Res.* **2007**, *27*, 132–145. [[CrossRef](#)]
72. Ajzen, I.; Fishbein, M. Scaling and testing multiplicative combinations in the expectancy–value model of attitudes. *J. Appl. Soc. Psychol.* **2008**, *38*, 2222–2247. [[CrossRef](#)]
73. Schreiber, J.B.; Nora, A.; Stage, F.K.; Barlow, E.A.; King, J. Reporting Structural Equation Modeling and Confirmatory Factor Analysis Results: A Review. *J. Educ. Res.* **2010**, *99*, 323–338. [[CrossRef](#)]
74. Cangur, S.; Ercan, I. Comparison of model fit indices used in structural equation modeling under multivariate normality. *J. Mod. Appl. Stat. Methods* **2015**, *14*, 14. [[CrossRef](#)]
75. Chen, H.; Yang, Y.; Jiang, W.; Song, M.; Wang, Y.; Xiang, T. Source separation of municipal solid waste: The effects of different separation methods and citizens' inclination—Case study of Changsha, China. *J. Air Waste Manag. Assoc.* **2017**, *67*, 182–195. [[CrossRef](#)]
76. Zhang, B.; Lai, K.H.; Wang, B.; Wang, Z. From intention to action: How do personal attitudes, facilities accessibility, and government stimulus matter for household waste sorting? *J. Environ. Manag.* **2019**, *233*, 447–458. [[CrossRef](#)] [[PubMed](#)]
77. Yuan, Y.; Nomura, H.; Takahashi, Y.; Yabe, M. Model of Chinese household kitchen waste separation behavior: A case study in Beijing city. *Sustainability* **2016**, *8*, 1083. [[CrossRef](#)]
78. Armitage, C.J.; Conner, M. Efficacy of the theory of planned behaviour: A meta-analytic review. *Br. J. Soc. Psychol.* **2001**, *40*, 471–499. [[CrossRef](#)] [[PubMed](#)]
79. Russell, S.V.; Young, C.W.; Unsworth, K.L.; Robinson, C. Bringing habits and emotions into food waste behaviour. *Resour. Conserv. Recycl.* **2017**, *125*, 107–114. [[CrossRef](#)]
80. Strydom, W. Barriers to Household Waste Recycling: Empirical Evidence from South Africa. *Recycling* **2018**, *3*, 41. [[CrossRef](#)]
81. Wang, Y.; Long, X.; Li, L.; Wang, Q.; Ding, X.; Cai, S. Extending theory of planned behavior in household waste sorting in China: The moderating effect of knowledge, personal involvement, and moral responsibility. *Environ. Dev. Sustain.* **2021**, *23*, 7230–7250. [[CrossRef](#)]