UNIVERSITY OF CAPE COAST

SUSTAINABLE ELECTRONIC WASTE MANAGEMENT AMONG HOUSEHOLDS IN THE GREATER ACCRA REGION: PRACTICES, DRIVERS AND BARRIERS

DANIEL OFORI

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BY

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Thesis submitted to the Department of Management of the School of Business, College of Humanities and Legal Studies, University of Cape Coast, in partial fulfillment of the requirements for the award of Doctor of Philosophy degree in Business Administration

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate Signature ………………….. Date: …………………………..

Name: Daniel Ofori

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature …………………….. Date: ………………..

Name: Prof. (Mrs.) Abigail Opoku Mensah

Co-Supervisor's Signature ………………………….... Date: ………………

Name: Dr. Alex Yaw Adom

ABSTRACT

The study examines sustainable electronic waste management among households in the Greater Accra Region. Based on a quantitative survey, a cross-sectional study of households was conducted. Data from 652 respondents were collected using questionnaires and analysed with frequencies, chi-square and partial least squares structural equation modelling (PLS-SEM). Results from the descriptive analysis show that households mostly adopt a mix of circular and linear-economy based practices towards e-waste management. Also, Environmental values and social norms mainly influenced pro-environmental intentions, while sustainable e-waste management behaviour was influenced by facilitating conditions, perceived producer responsibility, and perceived behavioural control. It was also found that pro-environmental intentions did not directly influence sustainable e-waste management, but was mediated by perceived behavioural control. Finally, multi-group analysis provided further insight into how socio-demographic factors moderated pro-environmental intentions and sustainable e-waste management path relationships. Consequently, it is recommended that government and producers must collectively implement regulations, incentivised collection programmes and invest in e-waste facilities to promote the continuance adoption of sustainable e-waste management practices among households.

KEY WORDS

Circular economy

Environmental norms

Households

Pro-environmental intentions

Sustainable electronic waste management

Waste management hierarchy

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DEDICATION

To all loved ones and the late Dr. Alex Yaw Adom.

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LIST OF ACRONYMS

AVE	Average Variance Extracted
KMO	Kaiser-Meyer-Olkin Measure of Sampling Adequacy
PLS	Partial Least Squares
PLS-SEM	Partial Least Squares-Structural Equations Modelling
SEM	Structural Equations Modeling
VIF	Variance Inflator Factor
EPA	Environmental Protection Agency
MESTI	Ministry of Environment, Science, Technology and Innovation
TPB	Theory of Planned Behaviour
NAM	Norm Activation Model

CHAPTER ONE

INTRODUCTION

Households are described as the highest generators of both solid waste. Among these waste categories, the management of electronic waste, although forms about 6% of the solid waste generated (Keesman, 2019), does not only have environmental implications, but health, social, economic and sustainability implications (Ismail & Hanafiah, 2020). Yet, the recovery of valuable fractions is very low as a result of the indiscriminate disposal and other unsustainable management practices. Such unsustainable methods, at the backdrop of rising demand for new electronic and electrical equipment, have worsened the conservation of natural resources such as rear earth elements that form critical part in the production of electronic and electrical equipment. This has prompted the need to consider sustainable e-waste management among the consuming public.

Accordingly, this study, through the lens of circular economy theory, the theory of planned behaviour (Ajzen, 1991; 2011b), the norm activation and psychological ownership theories, examines the current electronic waste management practices, analyses the drivers and the barriers to sustainable e-waste management among households in the Greater Accra Region. The introductory chapter provides the general context for the study, the problem and gap analysis which form the basis of the research objectives. The chapter also presents the significance of the study, limitations, delimitations and how the entire thesis has been organised.

Background to the Study

The consumption of electronic and electrical products contributes to societal progress in areas of health, education, entertainment, among others (Kaur & Bawa, 2018). These growing social needs have fuelled innovation to develop electronic and electrical equipment to help humanity perform these roles. Meanwhile, studies such as Islam and Huda (2018) indicates that planned obsolescence and the symbolic devaluation of consumer products appear to be acute in the electronics and electrical equipment sector, contributing to the rising volume of electronic waste generated. Waste describes the 'end of life' of objects after their primary use. A common characteristic of the waste management practice in developing economies, is open dumping in the bush, gutters, curb sides and landfilling of unseparated waste (Tweneboah-Kodua, Adams & Nyarku, 2020; Ismail & Hanafiah, 2020).

Electronic waste generated and, subsequently, abandoned, dumped, buried or landfilled has severe local as well as global environmental impacts. The local environmental impacts include air pollution, surface and groundwater pollution from leaching of hazardous substances, and land and marine contamination (Kaplan, Henn, Park, & Kurman, 2019). Besides, solid waste management accounted for around 3% of global greenhouse gas emissions, with most of that attributable to methane emissions from landfill sites (Zhang, 2019). Meanwhile, a study by Forti, Baldé, Kuehr and Bel (2020) shows that waste from electronic and electrical equipment stands as the fastest growing waste stream (Figure 1) across the globe.

Figure 1: Global E-waste generated and recycled

Source: Baldé, et al. (2020).

From 9.2 million metric tonnes of e-waste in 2014, the global generation in 2019 stands at 53.6 million metric tonnes, and less than 20% was recycled through appropriate channels (Forti, Baldé, Kuehr & Bel, 2020). Figure 1 shows the rising volumes of e-waste generated in metric tonnes compared to the percentage properly recycled. E-waste accounts for about 6% of municipal solid waste with global generation currently at 48.9 million tonnes/year and increasing by 3-5% annually (Menikpura, Santo & Hotta, 2014). Once waste generation is an inevitable aspect of life, it requires relentless efforts towards sustainable management to avoid pollution of our ecosystem, preserve good health, while promoting sustainability of critical earth resources.

In the sustainability literature, there are conflicting views on how natural capital should be developed and managed (Wilson & Wu, 2017). The strong sustainability paradigm assumes that the substitutability of natural capital by man-made or manufactured capital is severely limited. Consequently, this paradigm advocates for conservation of natural resources through circular economy practices along the production and consumption value chains (De Groot et al., 2003; Brand, 2009). On the other hand, weak sustainability proponents assume that manufactured capital of equal value can replace natural capital (Ekins et al., 2003; Neumayer, 2003, 2012). Waste management behaviours considerably affect the quality of natural capital. Consequently, the strong sustainability view provides the philosophical context to examine electronic waste management practices among households and the factors influencing such practices.

Research by Kumi, Hemkhaus and Bauer (2019) shows that, in Ghana, individual households are the largest generators of electronic waste (Figure 2, in millions of tonnes).

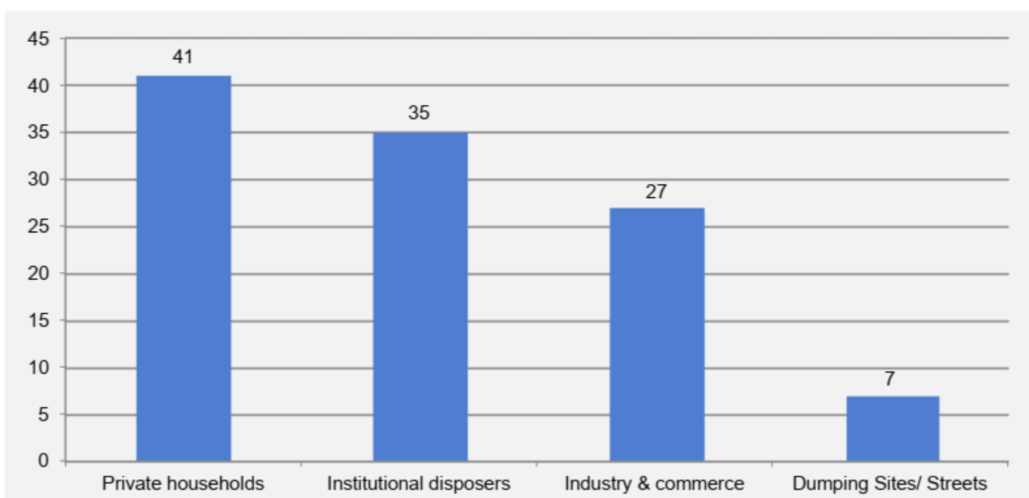

Figure 2: Source of Electronic waste

Source: Kumi, Hemkhaus and Bauer (2019)

Urban areas including the capital city generates about 0.75–1 kg per capita per day of solid waste (Keesman, 2019). The country spends about $300 million due to poor sanitation and waste management (Abalo et al., 2018). Between 2012 and 2015, the country generated 20 million tonnes of e-waste out which about 0.9% was recovered through both formal and informal e-waste channels (Keesman, 2019). Increasing importation of second-hand electronic, most of which are waste on arrival is compounding the situation.

Therefore, an opportunity exists for promoting sustainable electronic waste management practices. Research by Yao, Wang, Liu, Yao and Wu (2019); Forti, Baldé and Kuehr (2018), and Kumar and Samadder (2017) show the possible benefits of promoting sustainable electronic waste management among households. These include industrial uses of resources recovered from electronic waste, reduction in environmental pollution and global emissions, an efficient collection mechanism for recovering still-usable items for reuse (Barr, et al. 2013). Besides, sustainable electronic waste management ensures useful materials retain their aesthetic value for recycling and reuse (Oteng-Ababio, 2014), while reducing negative environmental and health impact (Akortia, Olukunle, Daso, & Okonkwo, 2017; Fujimori et al., 2016; Kyere, Greve, & Atiemo, 2016).

Recognising these benefits, there is increasing research into the various aspects of sustainable electronic waste management in the sustainability literature. This is confirmed by a number of reviews and bibliometric publications on sustainable electronic waste management. These studies include those by Pérez-Belis, Bovea and Ibáñez-Forés, (2015); Gao et al., (2019); Zhang, Lai, Wang and Wang (2019) and Ismail and Hanafiah, (2020). However, an analysis of these systematic reviews on electronic waste management reveals a skewed attention towards how production systems can adopt innovative business processes to conserve resources and closed-loop systems for e-waste. However, although these solutions are required to inspire radical changes and provide business case to drive circular economy, Islam and Huda (2018) describe the neglect of the consumer who makes consumption and disposal decisions as a significant barrier towards circular economy.

Sustainable electronic waste management (SEWM) is a considerable challenge facing most developing countries (Ismail & Hanafiah, 2020; Oteng-ababio, Owusu-sekyere, & Amoah, 2017). This is because households (consumers), who play an important role in the development of effective collection systems (Abdulhasan et al., 2019), most often have shown little desire to participate. A research report titled "E-waste statistics: Guidelines on Classification, Reporting and Indicators," authored by Forti, Baldé and Kuehr (2018), shows that the highest collection rate was only 35% in Europe, whereas the lowest collection rate of e-waste was 0.1% in Africa. In the wake of global ecological crises, resource sustainability and health-related risks, sustainable electronic waste management is of dire importance to individuals, society, firms and governments.

The theory of planned behaviour (TPB) proposed by Ajzen (1991) is a psychological theory that links individual beliefs to their behaviour. The theory assumes that individual actions occur as a result of one's free will to behave in a certain way, and by forces outside one's domain. The individual has free will, but such a will is limited to psychological and personality factors, such as attitude, values and norms. The theory of planned behaviour has been applied to understand and examine the determinants of consumers' intentions to engage in environmentally friendly behaviours and disposal practices (Wang, Ren, Dong, Zhang, & Wang, 2019; Echegaray & Valeria, 2016; Wang, Guo, & Wang, 2016).

Further, individuals who share altruistic values show selfless concern for the well-being of others, to the extent that the former is aware of the consequences of adopting proper waste management practices. Norm activation theory (Schwartz, 1973, 1977) is a social–psychological model of altruistic behaviour that explains individuals' willingness to engage in specific pro-environmental behaviours such as engaging in electronic waste recycling. According to Schwartz (1973, 1977), environmental norms activate altruistic behaviours among individuals who believe that particular conditions pose threats to others, and that individual actions can be initiated to reduce the threats. Substantial evidence supporting the theory's applicability to a range of environmental behaviours is evidenced in the literature (e.g., Black, 1978; Black et al., 1985; Stern, Dietz & Guagnano, 1995; Schultz & Zelezny, 1999; Widegren, 1998).

In Ghana, the management of electronic waste has been largely handled by the informal sectors, popularly called "condemn" or "scrap dealers." The Greater Accra Region has been a major hub of urban mining by informal recyclers, who migrate from all walks of life to engage in such business. The same region, according to Alhassan, Kwakwa and Owusu-Sekyere (2020), has also benefited from several electronic waste management interventions with the support of major development partners. The Greater Accra Region harbours both the capital city, Accra, and the industrial hub of the country. The region remains the most economically vibrant in terms of business activities, has the highest population of households with electronic equipment such as desktop and laptop computers (Table 5), and has a diverse population with characteristics such as high income and low-income clusters (Ghana Statistical Service, 2010). With increasing rural-urban migration, the impact of the activities of informal e-waste recyclers, such as unregulated and unsound recovery practices, is seen all over the capital city.

In a study by Tansel (2017) and Ovchinnikov, (2011), the authors shared similar view on the need to ensure as much e-waste recovery as possible because a sustainable electronic waste management requires flows of waste from the generating points to guarantee the quality and quantity of reusable electronic appliances and secondary raw materials. Thus, Islam et al. (2021) findings also confirm the role of end users in the circular economy. In effect, household perception towards waste management practices and their pro-environmental intentions to engage in sustainable waste management practices have considerable influence on the sustainability of any waste management system. Accordingly, in line with the assumptions of the circular economy approach to resource management and the waste management hierarchy (WMH) by Lansink (1979), the study examines the current electronic waste management practices, the factors influencing pro-environmental intentions towards e-waste management and sustainable e-waste management practices among households in the Greater Accra Region.

Statement of the Problem

Different categories of solid waste are generated from our homes. They include papers, food, plastics and electronic waste. Out of these categories, biodegradable constitutes 61%, Plastic 14%, Paper 5%, and electronic waste is 6% (Oduro-Appiah, Scheinberg & Mensah, 2019). The nature of the various constituents, their composition and resource potential differ from one waste stream to another. For example, while waste from plastics may not be reusable most often, it is not the same with electronic waste. Studies such as Kumi, Hemkhaus and Bauer (2019) have shown that in 2015, the sector contributed GHS513 million to Ghana's GDP. Again, Tansel (2017), waste from electronic products contains several hazardous materials such as lead, mercury, polybrominated biphenyl and diphenyl, dangerous for individual and environmental health if not properly treated. Similar results were found by Kyere, Greve, and Atiemo, (2016) who showed that contamination due to heavy metal concentrations were significantly higher in the working areas where burning, dismantling and other indiscriminate disposal activities take place.

By this, one can say that electronic waste streams pose the greatest threat to the attainment of Sustainable Development Goal (SDG) 3, 6, 11 and 12, which are: good health and well-being; clean water and sanitation; sustainable cities and communities; and responsible consumption and production, respectively even though it forms 6% of total municipal solid waste. With the rising importation of electronic appliances and shorter product lifetimes (Cole, Cooper, & Gnanapragasam, 2016), more of such electronic waste is being generated daily. With many households unaware of the value of electronic waste, they store, burn, bury or sell both functional and in-need-of-repair electronic items to informal collectors (Kumi, Hemkhaus & Bauer 2019; Owusu-Sekyere, Peprah, & Demuyakor, 2018).

The current system of solid waste management in Ghana leaves much to be desired. Besides the devasting effect on soil quality, Oduro-Appiah, Scheinberg and Mensah (2019), Alhassan, Asante, Oteng-ababio and Bawakyillenuo (2017); and Alhassan, Kwakwa and Owusu-Sekyere (2020), in their various studies have shown that the indiscriminate e-waste disposal have resulted in air pollution from the burning activities of informal recyclers (popularly called "condemn"), surface and groundwater pollution from leaching of hazardous substances and loss of precious metals among others, respectively. Besides, air quality in the country's urban centers shows worsening conditions as the annual mean concentration of PM2.5 is 35 µg/m3 exceeds the recommended maximum of 10 µg/m3 by the World Health Organisation, and one of the major contributory factors is waste management (WHO, 2021).

Addressing electronic waste management has become necessary to ensure the attainment of SDG 3, 6, 11 and12, which impresses upon economies to promote cleaner cities, good sanitation, and sustainable consumption and production. By extension, countries must promote green behaviours among stakeholders at both industrial and community levels. Currently, Ghana has one of the largest urban mining yards, located at old Fadama, Agbogbloshie in the Greater Accra Region, where about 95% of electronic waste generated are informally processed under unsound environmental conditions, and households have been cited as the greatest contributors (Kumi, Hemkhaus & Bauer, 2019). Besides, close to this dumpsite is the home of one of the largest food markets in the Greater Accra Region, a health risk to the food supply chain (Kyere, Greve & Atiemo, 2016). As noted by Akortia, Olukunle, Daso and Okonkwo (2017); Fujimori et al. (2016); Srigboh et al. (2016), SDG 3: good health and wellbeing; SDG 6: clean water and sanitation; and SDG 11: sustainable cities and communities, are undermined when the current system of waste management is maintained.

Again, studies by Dutta et al. (2016), and Tansel (2017) show that the production of new electronic appliances places a high demand for rare earth elements (REE), which are risk of sustainability. Meanwhile, Currently, about 8million tonnes of electronic waste are landfilled annually. This culminates in the loss of precious metals worth 5 million dollars annually (Keesman, 2019). Rare-earth elements (REE) are necessary components for the production of electronic and electrical equipment (Balaram, 2019). The current electronic waste management practices such as burying, dumping, abandoning and other disposal practices by households is a threat to the reuse potential of metals that could be recovered to serve as secondary raw materials into production lifecycles, thus ensuring sustainable consumption and production (SDG 12).

Pérez-Belis, Bovea and Simó (2015) also emphasise that consumer behaviour is one of the important elements that cannot be ignored in the successful implementation of any waste management system. In addition, to develop appropriate policy actions towards sustainable electronic waste management practices, it is necessary to understand individual characteristics, values and attitude, and external triggers that shape individuals' waste management behaviours. Accordingly, the theory of planned behaviour demonstrates how individual beliefs together with positive environmental triggers influences their motivation to engage in desirable social and environmental behaviours. Similarly, the norm activation theory assumes people in general value environmental quality and accept the responsibility to care for it, when they know the consequences of their actions towards the environment.

The theory of planned behaviour explains that intentions are a product of subjective or social norms, attitude towards behaviour and perceived behavioural control over the behaviour, and these intentions together with control beliefs influence actual behaviour. What people perceive as a normative belief is influential in determining their participation pro-environmental intentions towards collective waste management in their communities (Sorkun, 2018). Similarly, an individual's attitude towards waste and how it affects his or her immediate environment influences one's pro-environmental intentions. Meanwhile, personal norms towards the environment, according to the norm activation theory influence an individuals' general attitude towards waste management. Personal norms occur in response to the belief that particular conditions pose threats to others, and that one can initiate certain actions to reduce such threats. Based on these assumptions, individuals who are aware of the nature of harm their disposal-related activities cause to the environment are highly inclined to engage in sustainable waste management behaviours.

In light of Ghana's waste management challenges, literature on solid waste management is growing. Related studies such as those by Alhassan, Asante, Oteng-ababio and Bawakyillenuo (2017); Oteng-Ababio, Owusu-sekyere and Amoah (2017); Boateng et al (2019); Sarfo-Mensah et al. (2019); Adzawla, Tahidu, Mustapha and Azumah, (2019); and Tweneboah-Kodua et al. (2020) shed light on the solid waste management situation in Ghana. In Tweneboah-Kodua et al. (2020) the authors examine households' attitude, norms and beliefs towards waste management. Similar findings were found by Alhassan, Asante, Oteng-ababio and Bawakyillenuo (2017) through the application of the theory of planned behaviour. One limitation in previous studies which the current study leverages is the examination of waste disposal behaviours with respect to general solid waste. The implication of this approach is that, specific policies required for each category of solid waste will be handicapped.

In Keesman (2019) study on market survey for waste and circular economy in Ghana, the author proposed focused policies for various categories of waste. In support of his argument, Kumi, Hemkhaus and Bauer, (2019) in their value chain assessment of e-waste in Ghana indicates that much attention on e-waste management is critical because of its contribution to GDP, job creation and helping industry access secondary raw materials. Again, much attention on recycling as the only sustainable approach. Examination of Alhassan Asante, Asante and Bawakyillenuo (2017), Sarfo-Mensah et al. (2019); and Tweneboah-Kodua, Adams and Nyarku (2020) show that the focus of studies has been recycling. Waste reduction and methods that promote reuse behaviours have been ignored, yet they are also described as sustainable waste management strategies proposed in the waste management hierarchy (WMH) (Lansink, 1979).

Another limitation in previous studies is the lack of theoretical acknowledgement of human-object relationship nuances that characterise electronic waste management practices. Electronic waste disposal goes beyond just physical separation to emotional and separation from a part of the self (Young & Wallendorf, 1989, p. 33, cited in Cherrier, 2009; Haws et al, 2012). Consumers associate memories and emotion with their possessions, which contributes to the complexity of the disposal decision (Lastovicka & Fernandez, 2005). In this light, theories explaining electronic waste managemeng in consumer behaviour must examine the physical detachment, as well as emotional separation, from the meanings and events attached to the object. Unlike other types of waste such as plastic, food, electronic waste may possess sentimental and instrumental properties (Kwok, Grisham & Norberg, 2018). Parting with possession with certain characteristic sometimes constitute a great loss. Perceived value influences the tendency to demand compensation for parting with a cherished electronic item or keep it.

Much literature on the adoption of the Theory of Planned Behavior (TPB) to examine individuals' attitude towards waste management, however, TPB assumes the principle of sufficiency. According to Ajzen (2015) although other variables may be important to predict intentions, their effect is mediated by attitude, social norms and perceived behavioural control. Trafimow (2015) describes the sufficiency assumption as questionable especially when one seeks to maximise variance in the target construct. The assumption of sufficiency can be problematic when examining issues such as waste management. Environmental values play an important role according to the norm activation theory (NAT) (Steg & Nordlund, 2019). Also, there is evidence of the positive influence of extended producer responsibility strategies on nurturing socially desirable behaviours such as green and ethical consumption. Further, environmental protection paradigm proposes collective approach: government, firms and consumers because waste management is a shared responsibility.

In addition, the TPB and the NAT have recorded evidence of predicting intentions with high accuracy, and that a person's intention is the immediate predictor of his or her behaviour. However, when it comes to predicting actual behaviour, evidence shows weak relationship which is noted in the pro-environmental behaviour and ethical consumption literature as 'intention-behaviour gap' (Carrington, Neville & Whitwell, 2010). To the best of my knowledge, studies examining the intention-behaviour gap focused on ethical consumption. Since, waste disposal is the immediate consequence of consumption, it is only appropriate that the debate is extended to examine sustainable waste management. Further knowledge is required in understanding factors that will propel households to conveniently perform intended actions with respect to electronic waste management.

Finally, previous studies acknowledged the role of demographic factors on waste management but hardly showed differences in perception on waste management. In Agbefe, Lawson, Yirenya-Tawiah (2019), income, work experience and marital status were found to influence willingness to separate waste at source. Again Adzawla, Tahidu, Mustapha and Azumah, (2019) found that educational background of respondents, characteristics and location of households has influence on waste disposal behaviour. Although, the aforementioned studies show that socio-economic factors are significant predictors of waste management behaviours, the logistics regression technique adopted by the authors relies on assumptions which are rarely achieved in real world situation (Sarstedt, Henseler

& Ringle, 2011). Moreover, the statistical methods employed by previous authors does not provide differences in assessment of waste management practices and the factors predicting them. On this note, the current study fills these gaps in the literature by employing circular economy theoretical perspectives together with planned behaviour, norm activation to examine the current electronic waste management practices, analyse the drivers and the barriers to sustainable e-waste management among households in the Greater Accra Region.

Purpose of the Study

The purpose of the study was to examine the current electronic waste management practices, analyse the drivers and the barriers to sustainable e-waste management among households in the Greater Accra Region.

Research Objectives

The specific objectives of the study were to:

1. examine the practices prevalent in e-waste management in Ghana,
2. analyse the effect of environmental values, social norms, perceived behavioural control and pro-environmental intentions,
3. investigate the effect of pro-environmental intentions, facilitating conditions, perceived producer responsibility and sustainable e-waste management behaviour;
4. explore whether the factors influencing pro-environmental intentions and sustainable e-waste management practices differ by age, sex, income level and type of settlement; and

5. examine the interacting role of behavioural control factors on the relationship between pro-environmental intentions and sustainable electronic waste management practices.

Research Hypotheses

In relation to objectives 2 to 5, the following hypotheses were formulated and tested.

Hypothesis 1

$H1_0$: Environmental values do not influence pro-environmental intentions.

$H1_1$: Environmental values affect pro-environmental intentions.

Hypothesis 2

$H2_0$: Social norms do not influence pro-environmental intentions.

$H2_1$: Social norms influence pro-environmental intentions

Hypothesis 3

$H3_0$: Perceived control over electronic waste recycling does not influence pro-environmental intentions and sustainable e-waste management

$H3_1$: Perceived control over electronic waste recycling influence pro-environmental intentions and sustainable e-waste management

Hypothesis 4

$H4_0$: The presence of facilitating conditions does not affect sustainable electronic waste management behaviour.

$H4_1$: The presence of facilitating conditions affect sustainable electronic waste management behaviour.

Hypothesis 5

$H5_0$: Perceived producer responsibility does not affect sustainable electronic waste management behaviour.

$H5_1$: Perceived producer responsibility affects sustainable electronic waste management behaviour

Hypothesis 6

$H6_0$: Pro-environmental intentions do not influence sustainable electronic waste management among households.

$H6_1$: Pro-environmental intentions influence sustainable electronic waste management among households.

Hypothesis 7

$H7_0$: Behavioural control factors do not moderate/mediate the intention-behaviour relationship

$H7_1$: Behavioural control factors moderate/mediate the intention-behaviour Relationship.

Hypothesis 8

$H8_0$: The strength of the influence of the determinants of pro-environmental intentions and sustainable electronic waste management behaviours does not differ by age, sex, income and type of settlement.

$H8_1$: The strength of the influence of the determinants of pro-environmental intentions and sustainable electronic waste management behaviours differs by age, sex, income and type of settlement

Significance of the Study

In light of the increasing acquisition and consumption of electronic products, and its implication for the environment, recovery of end-of-life (EOL) electronic product from their point of consumption plays a significant role in ensuring sustainable resource management and maintaining a healthy environment (Cole et al., 2018). Consumers who make consumption and disposal decisions in the circular economy are ignored from policy frameworks (Repo, 2017) and practice (Islam & Huda, 2019a). As policy makers take keen interest in circular economy, household consumers are effectively a 'supplier' in this system and can influence volume, collection efficiency and condition of used goods.

A limitation in previous studies, however, which the current study explores, is the examination of waste disposal behaviours with respect to solid waste. The implication of this approach is that, specific policies required for each category of solid waste stream will be handicapped. Again, much attention on recycling as the only sustainable approach. In the circular economy approach to resource conservation, reduce and reuse behaviours is gaining much attention. Another limitation in previous studies is the lack of theoretical acknowledgement of human-object relationship that characterise electronic waste management practices. As this study specifically looks at electronic waste management, recommendations that considers these object-human relationships will facilitate the design and implementation of policies and programmes specific to e-waste management.

Also, in the pro-environmental behavior literature, the theory of planned behavior has been used extensively to examine individual intentions and behavior. As the theory operates within boundary of assumptions, one of which is the sufficiency, it may be necessary to explore other factors that may significantly explain intentions and behavior. Besides, waste disposal is both a social and an environmental problem. Trafimow (2015) describes the sufficiency assumption as questionable especially when one seeks to maximise variance in the target construct.

Environmental values play an important role according to the Norm Activation Theory (NAT) (Steg & Nordlund, 2019). Also, there is evidence of the positive influence of extended producer responsibility strategies on nurturing socially desirable behaviours such as green and ethical consumption. Further, environmental protection paradigm proposes collective approach: government, firms and consumers because waste management is a shared responsibility. The implication of this view is that consumers are more inclined to take necessary actions to properly manage their electronic waste to the extent that government and firms regulate and incentivize the process. Accordingly, the role of environmental values, producer responsibility and facilitating conditions such as policies and incentives is examined.

Also, empirical evidence on the intention behaviour gap in pro-environmental behaviours is lacking. Echegaray and Hansstein, (2017) found that less than 2% of aimed at explaining the gap between intentions and behaviour. The current study will add to the debate on the intention-behaviour gap, by examining the interaction role behavioural control factors. The outcome can better provide directions for managerial and policy implications. Finally, as analytical techniques continue to grow. To the best of my knowledge no study in Ghana explores the differences in perception and opinions with respect to these socio-economic characteristics. Differences in opinion, according to Patel, Modi and Paul (2017) can also help in targeted policies and effective marketing strategies.

In addition, the results of the study contribute to theory development by proposing a modified waste value chain and how households' characteristics influence each stage in the value chain. Again, the literature on e-waste management from developing country perspective is sparse. This calls for more research, taking cognisance of developmental, cultural and behavioural differences, and approach to end of life and end of use electronic and electrical equipment. Finally, the results of the study also contributed to the social marketing literature by unveiling the major social and personal factors that should form the basis for designing social marketing programmes.

Delimitations

The study is within the supply chain setting. In a typical supply chain, there are producers, transporters, distributors, retailers, wholesalers and final consumers. The study focused on households as individual consumers in the supply chain. The study is bounded by the downstream electronic and electrical supply chain. The end-users in the supply chain include households and corporate bodies. The study will survey households in Accra on their disposal practices. Again, the study focuses on voluntary disposal behaviour. Involuntary behaviours are outside the focus of the study. The Greater Accra Region was chosen because of the size of the populations and heavy dumping of electronic waste. Again, in terms of methodology, the study adopted a quantitative study with data collection undertaken through questionnaires.

Limitations of the Study

The limitations of the study relate to the scope and methods. In terms of scope, the study was limited to three metropolitan areas in the Greater Accra Region. In terms of methodology, the quantitative approach does not lend itself to obtaining qualitative experiences of households on their waste management practices. Second, the measurement of sustainable e-waste management behaviour through self-reported behaviour, no matter how one tries to exact true responses, still carry a bias. Consequently, some studies measure behaviour through independent observation of respondents. Observation as a data collection method has been implemented in some pro-environmental studies, such as littering and waste sorting. It is effective in situations where the aim is to compare what people say and do. However, this is only possible when smaller sample sizes are involved.

Another limitation was the use of field assistants to interpret some questions to respondents. This was necessary to overcome language barriers. Steps were taken to ensure the administration of the questionnaires by field assistants did not influence the outcome of the study. Also, the study adopted semi-structured questionnaire which limited the amount of information respondents could provide. In addition, the inability to control the environment because of the use of questionnaires could affect the study's findings. The is because conditions of respondents as well as the time the questionnaire is being administered to them also affects their responses. As a result, their responses may be influenced by their current situation, which could eventually affect the study's findings. Finally, data for pro-environmental intentions and sustainable e-waste management were collected, using a single instrument. This approach has been cited as a source of social desirability. Nevertheless, the study followed the TACT (time, action, context and target) principle to ensure intentions and behaviour are well captured.

Definition of Key Terms

Several variables and terms were employed in the study. This section presents the operational definition of variables in the context of this study. It also indicates how the variables have been measured. Below are the key variables:

1. *Electronic Waste* or e-waste, refers to all electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without any intent of re-use. This implies that items for which the same owner intends to repair and reuse cannot be described as waste. (Step Initiative, 2014).
2. *Electronic waste recycling:* it was operationalised as an approach to waste management that provides economic well-being for actors in the sector, reduces negative environmental impact and promotes societal well-being. Former recycling is backed by all applicable laws and conforms to environmental protection requirements as enshrined in the Hazardous and Electronic Waste Control and Management Act, 2016, Act 917.
3. *Pro-environmental intention:* willingness to engage in disposal practices that provide economic incentive reduces environmental impact and promotes societal well-being.
4. *Attitude towards sustainable waste management behaviour*: refers to how one feels performing an action or behaviour, his expectations and evaluations, whether favourable or unfavourable of the behaviour.

5. *Perceived behavioural control over sustainable e-waste management:* individual's perception of ability or belief in his or her ability to perform a behaviour as well as the prediction of what will happen when that action is performed.
6. *Subjective norms on sustainable disposal behaviour:* it represents the perceived social pressure from close relations. Close relations may include: family, friends
7. *Awareness:* is defined as the level of one's awareness of the state of their environment and the global ecology. Environmental awareness is defined as the attitude regarding the environmental consequences of human behaviour. It is a predisposition to react to environmental issues in a certain way or manner
8. *Facilitating conditions:* they refer to the perceived availability of convenient points for electronic waste recycling. It includes the knowledge of appropriate channels for recycling.
9. *Supply chain:* it refers to the value-adding activities carried out by independent, yet interdepend organisations to deliver value to the final consumer.
10. *Reverse logistics:* it refers to the reverse flow of resources and related materials from the point of consumption to the point of origin to recapture value and ensure proper disposal.
11. *Environmental values:* refers to moral principles that shape our attitude towards the natural environment.

12. *Social marketing:* the application of marketing principles to promote responsible social and environmental behaviours whiles satisfying the core objectives of firms
13. *Circular economy:* the application of biological lifecycles to the management of resources by keeping resources in use for as long as possible so that maximum value can be extracted.

Chapter Summary

The chapter began with as introduction that presented the problem under study, the significance of the study, how the study related to previous work and the theoretical underpinning of the study. The chapter followed with a background to the study, where the writer showed the relevance of the study. The chapter continued with the statement of the problem and identified gaps in the existing literature. Subsequently, the purpose of the study was declared, and four objectives were set to guide the study direction. Based on the stated research objectives, hypotheses were formulated. The significance of the study was later presented, followed by delimitations, limitations of the study.

Organisation of the Study

The presentation of the study was organised around nine chapters, including chapter one, which discusses the background and provides the context within which the study is undertaken. Chapter two consists of literature on electronic and electrical equipment supply chain and its landscape in Ghana. Chapter three is devoted to the review of related theories and concepts whereas chapter four comprises empirical literature review, lessons learnt from the entire literature review and presentation of the conceptual framework of the study. Rubrics of the research methodology are presented in chapter five.

In chapters six to seven looks at the presentation and discussion of research findings on the determinants of intention to participate in sustainable electronic waste management. Chapter eight comprises findings and discussions on the interaction effect of age, sex, type of housing unit and income level, while chapter nine consists of the summary and conclusions of the study, contributions to knowledge, limitations of the study and suggestions for further research. Figure 5 provides a pictorial representation of the structure of the study.

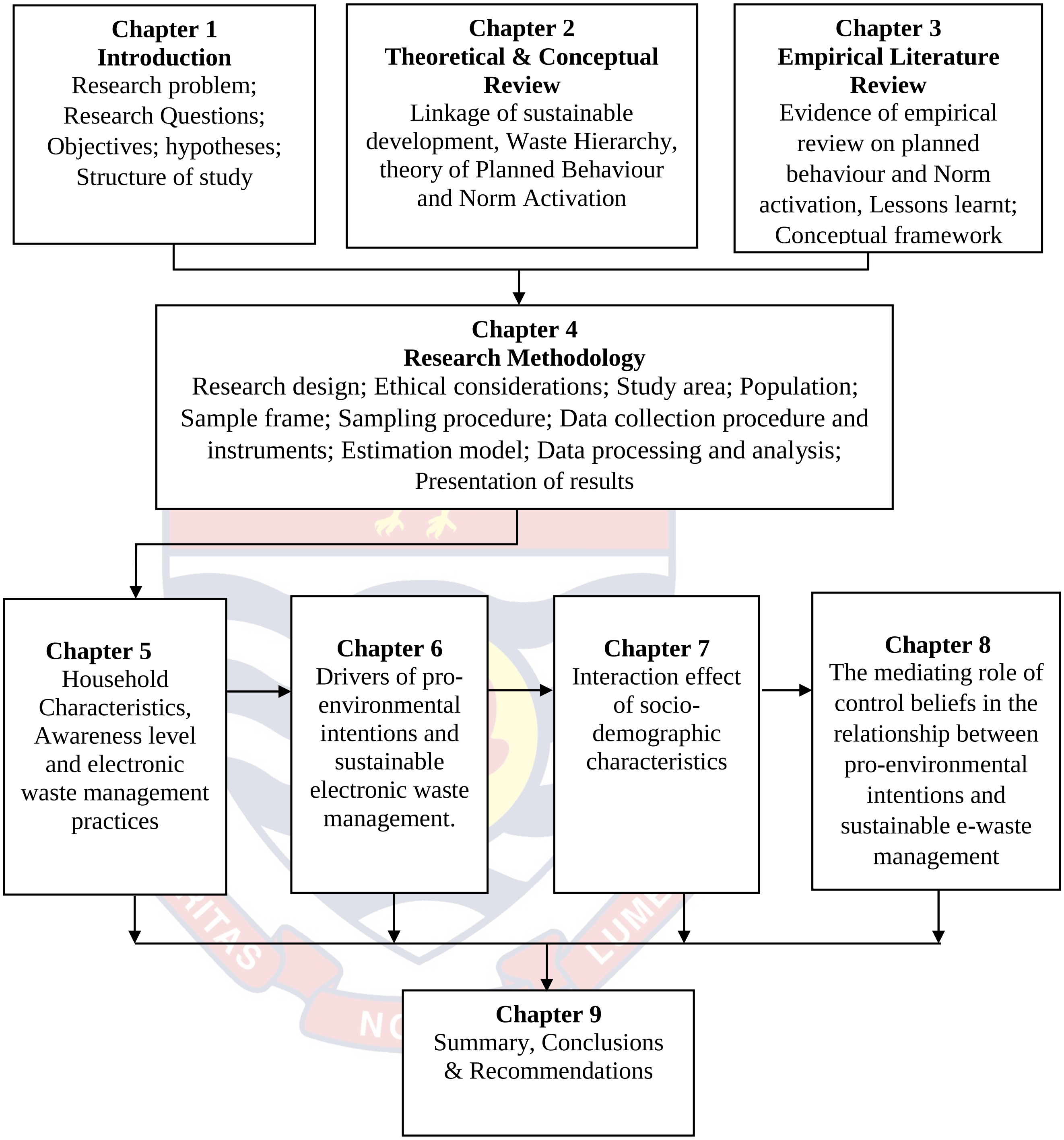

Figure 3: Structure of the Study

Source: Author's construct (Ofori, 2020)

CHAPTER TWO

THEORETICAL AND CONCEPTUAL REVIEW

Introduction

Chapter one described the general context, the justification and overall purpose of the study, which was to analyse the determinants of sustainable electronic waste management among households. This chapter presents a review of the theoretical context within which the study was undertaken. Literature reviews, according to Siddaway, Wood and Hedges (2019), bring together, synthesize, and critique existing literature to provide evidence about a particular research question, highlighting gaps and helping in the formulation and refining of research problems. The literature review further identifies areas of consensus and significant debates on relevant issues, helping to avoid the replication of methodological limitations while better articulating the knowledge gap (Cano, 2013).

The purpose of the review was to gain prior knowledge and understanding within the area of research (Karlsson 2007, cited in Owusu, 2013). Accordingly, this chapter of the study reviewed the theoretical arguments concerning environmental behaviour, and in particular waste management behaviour. The chapter also presented key concepts of these theories and how they relate to the research objectives and key assumptions of this study. The chapter begins by examining the theoretical arguments from sustainable development and circular economy. It also reviews normative, attitude-behaviour theories of human behaviour as a critical component to sustainable development.

Theoretical Review

Developing and promoting behavioural change towards proper waste management is critical to sustainable development. Accordingly, the Theory of sustainable development (SD), the Circular Economy (CE) (Stahel & Redey, 1976, Stahel, 2006; McDonough & Braungart, 2002, 2007), and the waste hierarchy (Lansink, 1979) are presented to set the context and underlying philosophy of the study. The application of social marketing to the recycling of waste is also examined in the light of planned behaviour (Ajzen, 1991) and the norm activation and extended producer responsibility theories. The study also refers to psychological ownership theory to understand consumers' perception and attitude towards their objects of possession. Finally, examination of the intention-behaviour gap supported by Carrington intention-behaviour hypothesis and the transtheoretical model of behaviour change are also presented.

Sustainable Development and the Circular Economy (CE)

Stahel (2016) defines linear economy is economic system characterized by take, make, waste and dispose. Since the beginning of the third industrial revolution, according to the Ellen MacArthur Foundation (2013), producers have adopted business models that make extensive use of materials to meet growing consumer needs. Since, every business exists to achieve economic and social goals, it is rational that it operates as efficiently as possible in the quest to meet these goals. The consequences, however, is the mass neglect of recycling, reusing and the increasing generation of waste. While the linear economy has been successful in creating economic development, Jørgensen and Pedersen (2018) describe such approach as the prime cause of rising resource depletion, climate change and other environmental externalities. Subsequently, authors such as Robert (1989); Hawken, Lovins and Lovins, (2013) and Perhay (2005) have championed the course of sustainable development as the alternative to the traditional model of economic development.

Environmental problems are well documented in almost every discussion on sustainable development. Global warming and ozone depletion are among the topical environmental problems, the consequence of which have a social and economic impact. The effects of global warming, for example, are diverse – flooding, storms and droughts. The contributory factors to the same phenomena are linked to human activities, such as driving, construction, cultivation, waste disposal among others that produce greenhouse gases (Daly, 1990). So why pursue development that seeks to promote economic growth while creating environmental and social problems for humanity?

The term sustainable development was first mentioned in a book during the 1972 UN Conference on Environment in Stockholm. One key milestone, after the first meeting, was the development of a report titled "Our Common Future" often referred to as the Brundtland Commission Report, from which the first definition of sustainable development was presented as:

"*Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generation to meet their own needs*" (World Commission on Environment and Development, 1987, p. 43).

This definition has been examined in a different context and the literature on sustainable development has grown over the years. Among these contributors are John Elkington (1985), whose study dwelt on the "Cannibals with fork: the triple bottom line", "Natural Step – principles of a sustainable society" by Karl-Henrik Robert (1989) and Hawken, Lovins and Lovins, (2013) on Natural Capitalism. "Our Common Future" identified a series of social and ecological challenges including unsustainable patterns of economic development that were strongly correlated with resource depletion.

One main assumption underlying the theory of sustainable development is the approach towards the management of resources or capital stock. The Capital concept distinguishes among four main types of resources or capital: natural capital, human capital, human-made or manufactured capital and social capital (Pearce & Atkinson, 2017). Waste management behaviours affect the quality of natural capital, which is made up of natural resources, ecosystem and the biophysical environment. In the sustainability literature, there are conflicting views on how natural capital should be developed and managed (Wilson & Wu, 2017). The strong sustainability paradigm assumes that the existing stock of natural capital must be maintained and enhanced because the function it performs cannot be duplicated and replaced by manufactured capital (De Groot. Van der Perk, Chiesura & van Vliet 2003; Brand, 2009). On the other hand, weak sustainability proponents assume that manufactured capital of equal value can replace natural capital (Ekins et al., 2003; Neumayer, 2003; 2012).

While the strong sustainability view supports the sustainable use of natural resources, sustainable waste management, and conservation through minimisation, reuse and recovery practices, the weak sustainability paradigm advocates for a free-market approach to resource use in production and consumption (Wilson & Wu, 2017). According to the weak paradigm, enough man-made capital will be manufactured to compensate for the loss of natural capital. Recognising that nature is entirely distinct in diverse ways and, therefore, the innovative prowess of humanity cannot replace it, strong sustainability argument presents considerable justification and motivation for understanding human-environmental behaviour such as resource and environmental conservation and circular economy values (Stahel, 2006; McDonough & Braungart, 2002, 2007)

Hawken, Lovins and Lovins (2013) propose four strategies to promote natural capitalism: 1) radical resource productivity - using resources more efficiently, 2) biomimicry – eliminating waste through biological cycles (circular economy); 3) service-based economy – a shift from ownership to usage; and 4) investment in natural capital. These authors, described as strong sustainability proponents, support the idea that to preserve natural capital, efforts should be made towards promoting the circular flow of resources during consumption, production and disposal activities. Circular economy (shown in Figure 7) is a mimicry of the biological process that can be applied to waste management, because it ensures efficiency of resources by eliminating waste through closed cycles. Figure 7 shows a contrast between a linear economy and a circular or closed-loop economy.

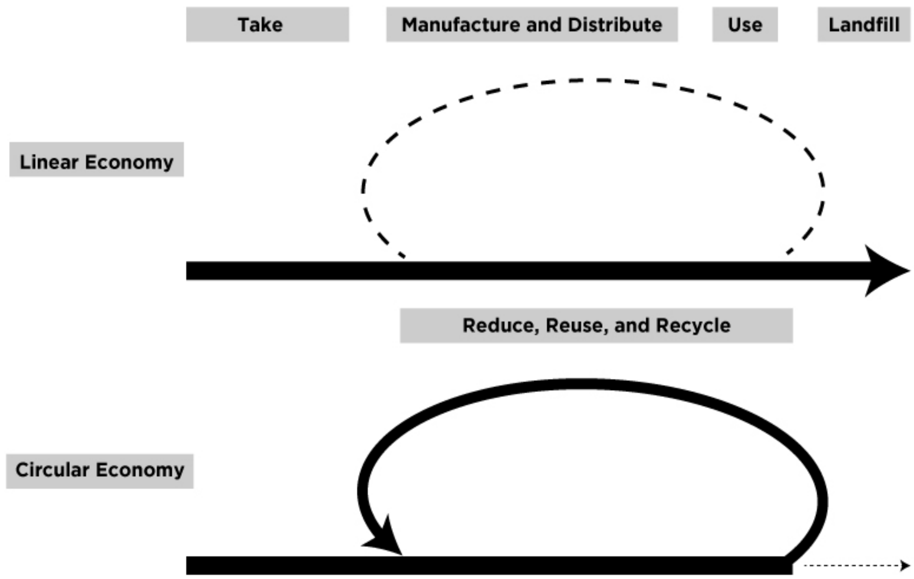

Figure 4: Circular economy contrasted with linear economy

Source: Jørgensen and Pedersen (2018)

Circular economy is a systemic approach to sustainable development designed to benefit businesses, society, and the environment. It is founded on the principle of designing out waste and pollution; keeping products and materials in use and developing regenerative natural cycles (Stahel, 2006; McDonough & Braungart, 2002, 2007). The less radical circular economy theorists believe the strict application of circular economic models underscores the importance of consumer behaviour such as consumption and disposal in the product lifecycle. As the world battles with diminishing natural capital, emphasis on waste minimization, reuse and recovery through recycling has gained attention (Hawken, Lovins & Lovins, 2013). Human behaviour towards waste management managed requires a critical view and understanding to inform policies towards sustainable solid waste management. (Kalmykova, Sadagopan, & Rosado 2018).

Circular economy requires the application of waste management strategies to encourage sustained efforts among all economic agents that produce waste in the supply chain. Accordingly, the waste management hierarchy (WMH) (Schall 1992) and the extended producer responsibility (EPR) (Lindhqvist, 2000) are waste management models that underpin the development of sustainable waste management system. The waste management hierarchy, originally developed by Lansink (1979), indicates an order of preference for action to reduce and manage waste from the most favourable option to the least. The model, also called Lansink's Ladder (Figure 8), is premised on three core principles that define sustainable waste management behaviours.

The first principle is best practicable environmental option (BPEO), which involves assessing waste management options and selecting one that has minimal or no effect on the quality of the environment, and at a manageable cost. Second, the waste management hierarchy entreats stakeholders to promote waste reduction, reuse, and recovery, while maintaining landfilling as the last option. Third, the proximity principle suggests that waste should be dealt with as near to its point of creation. By implication, since waste is generated during production and consumption, both firms and consumers should collectively take responsibility for their waste. Figure 8 shows the waste management hierarchy as proposed by Lansink (1979).

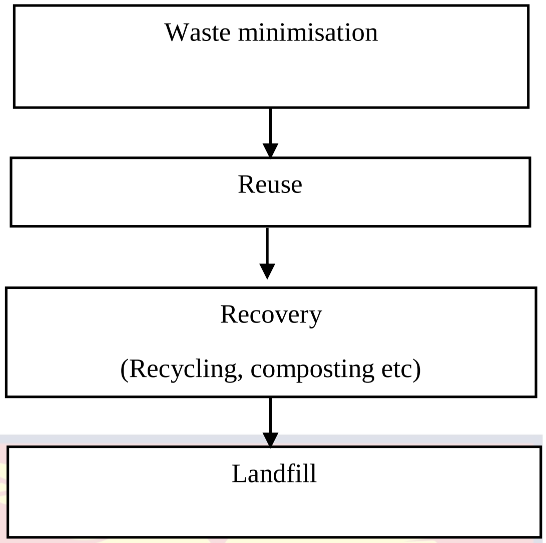

Figure 5: Waste Management Hierarchy

Source: Lansink (1979)

As a hierarchy, households are expected to "reduce" their waste generation or avoid waste where possible. Where one finds it impossible to reduce waste, the next most preferred option in the waste hierarchy is to re-use items to extend the product life. For example, many household electronic appliances that are usually discarded by owners can be cleaned or repaired to be re-used, sold, gifted to people in their social networks or donated to charities. Where items can no longer be reused, the hierarchy presents recovery as the next best option. Meadows, Meadows and Randers (1992); Parajuly and Wenzel, (2017) and Parajuly et al. (2020) describe recycling as an essential tool in achieving sustainability by recovering useful materials that can serve as secondary raw materials. Where all options have been exhausted, landfilling of waste is suggested. However, the model assumes that only unusable and dangerous substances should be landfilled.

Extended Producer Responsibility

Similar to the waste management hierarchy, extended producer responsibility (EPR) is one of the environmental protection paradigms within the broader sustainable development theory. This model was first introduced in 1990 by Thomas Lindhqvist. The model, which is based on the polluter pays principle (PPP), implies that waste management responsibilities should be shifted to the producer of the products instead of consumers and authorities responsible for waste management. The waste management hierarchy suggests that waste should be dealt with at the point of creation. Since waste is generated during materials extraction, production and consumption, it implies that all economic actors along the value chain including producers and consumers should be involved in waste management.

Whiles the waste management hierarchy assumes a proximity principle where waste is best dealt with near the point of creation, extended producer responsibility assumes producers must take responsibility for the cost of environmental damage from their products from production to consumption, thus shifting responsibility from consumers to producers (Lodhia, Martin, & 2017). The EPR aims to encourage the business community to voluntarily implement practices to reduce and manage waste from its products. Rogers (1998) also describes producer responsibility as a model that proposes industry participation in internalising the cost of waste management.

The EPR model assumes that producers have better control over their product design, product development and marketing, and can therefore leverage these capabilities to manage the end-of-life of their products. Figure 9 presents a model of extended producer responsibility showing four main areas of responsibility: liability, physical responsibility, economic responsibility and information responsibility.

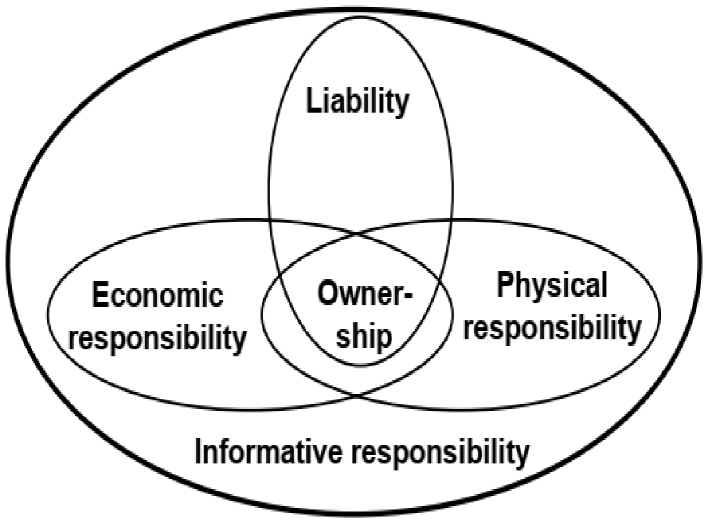

Figure 6: A Model of Extended Producer Responsibility

Source: Lindhqvist (2000)

According to Lindhqvist (2000), liability describes producers accepting responsibility for proven environmental damages caused by their product. Economic responsibility occurs when the producer absorbs all the cost for the collection, recycling or final disposal of the products. The involvement of producers in the physical management of the products and the related waste is physical responsibility. Informative responsibility signifies several different possibilities to extend responsibility for the products by requiring the producers to supply information on the environmental properties of the products they are manufacturing.

Well, as a model, its utmost critic is the assumption of the physical proximity of original equipment manufacturers (OEM). Consumers are influenced when they feel they are part of the corporate social responsibility practices of businesses. This position is confirmed by Tudor et al. (2008), where the authors established a link between producer responsibility, environmental citizenship and the management of healthcare waste. Another weakness lies in the feasibility of its application when waste management systems are solely the prerogative of governments, especially in developing economies. In economies where governments assume ownership and take full control of waste management, economic, physical and legal responsibilities automatically devolve to government. Nevertheless, manufacturers still retain significant role by providing sufficient information on the environmental and health impact of their products.

Another limitation of the model was the problem of 'orphan' products. This occurs when there is no parent manufacturer to take responsibility for the end-of-life waste from products because the manufacturer has ceased operation. The model assumes that when this occurs, the trading company takes responsibility. Also, the model expects firms to voluntarily adopt an appropriate mechanism to manage waste. Voluntary adoption of policies has been shown by Rubio, Ramos Leitão and Barbosa-Povoa, (2019) and Rogers (1999) as weak in eliciting immediate desired behaviour. Consequently, critics suggest voluntary-based policies like the EPR, together with 'command and control' policies provide an ideal framework for sustainable waste management.

Theory of Planned Behaviour

The Theory of Planned Behaviour by Ajzen (1991) is described as an extension of the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1977). TRA assumes that individuals have complete volitional control i.e an individual can decide at will to perform or not perform the behaviour, which does not always happen in real life. Ajzen (1985) in subsequent studies found that not all behaviours could be explained by the TRA, given that most depend to some extent on non-motivational factors such as availability of requisite opportunities and required resources (namely: time, money, availability of facilities, among others). These non-motivational factors represent individuals' perceived control over the behaviour. Thus, the assumption excluded people, who despite the pro-environmental intentions to perform a behaviour or act, perceive themselves to have little control over the behaviour. Figure 10 presents the Theory of Planned Behaviour model.

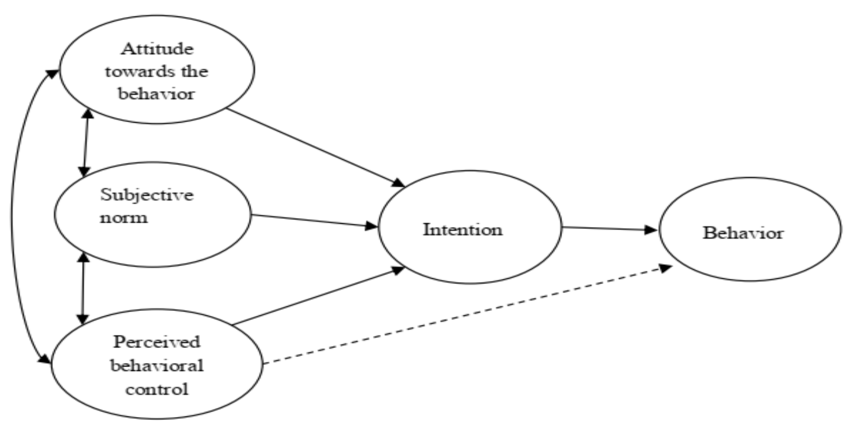

Figure 7: Theory of Planned Behaviour

Source: Ajzen (1991)

The theory of planned behaviour overcomes this limitation in explaining behaviours of which individuals have incomplete information, cannot decide or act. The theory of planned behaviour states a behaviour will most often be successfully performed when the individual has the required opportunities and resources (ability), and the motivation (pro-environmental intentions) to perform the behaviour. Pro-environmental intentions to perform certain behaviours or act in a certain way is influenced by the attitude towards the behaviour, subjective norms, and perceived behavioural control; and these pro-environmental intentions, together with perceptions of control over behaviour, causes behaviour to occur (Ajzen, 1991 p. 179). Thus, as shown in Figure 10, pro-environmental intentions would be expected to influence performance to the extent that the person has control over the behavioural, and performance should increase with behavioural control to the extent that the person is motivated to try (pro-environmental intentions).

Pro-environmental intentions are a function of perceived behavioural control, attitudes and subjective or social norms (Ajzen, 1991). Perceived behavioural control, grounded in the self-efficacy theory by Albert Bandura (Bandura, 1978), is further explained as an individual's perception or belief in his or her ability to perform a behaviour as well as the prediction of what will happen when that action is performed. Perceived behavioural control is said to be determined by specific control beliefs as well as their expected power to prevent or promote the performance of a behavioural option (Bamberg, Hunecke & Blöbaum, 2007). It is the extent to which a person feels capable and has confidence in her ability to undertake a behaviour. This includes the ability to overcome potential barriers, challenges and assess the required resources or take advantage of opportunities to perform a behaviour. Pro-environmental intentions are the motivational factors that influence behaviour; a measure of how hard people are willing to try, and how much of an effort they are planning to exert, to perform the behaviour (Ajzen, 1991, 2011b). Attitude towards the behaviour refers to how a person thinks and feels about the behaviour, his expectations and evaluations, whether favourable or unfavourable of the behaviour.

Subjective norm is also another major construct of the theory of planned behaviour. Subjective norm is the belief that an important person or group of persons such as family members, friends or significant others, will support or approve of a behaviour. In other words, subjective norms are described as what people think and do. Results from studies shows mixed effect of social norms on intentions and behaviour. Studies such as White, Smith, Terry, Greenslade and McKimmie (2009); Brekke, Kipperberg and Nyborg (2010); Özdemir and Utkun, 2016; Sorkun, (2018) specifically examined the role of social norms in predicting recycling behaviour.

For example, Özdemir and Utkun (2016) and Sorkun, (2018) recorded weaker relationships with pro-environmental intentions than attitude and perceived behavioural control. While attitude and perceived behavioural control have produced consistent results, certain authors, including Botetzagias, Dima and Malesios, (2015); Zhang, Lai, Wang and Wang (2019) Appiah-Nimo, Ofori and Arthur, (2018), revealed weaker relationships between subjective norms and pro-environmental intentions. Rivis and Sheeran (2003) describe intention to act in a certain way as a personal decision that is mostly influenced by personal factors such as attitude. Apart from the argument by Rivis and Sheeran (2003), it can also be deduced that social norms mainly depends on how close and influential the significant others are to an individual. This was evident in Passafaro, Livi and Kosic (2019), who found that the influence of norms on behavioural pro-environmental intentions varied with individuals proximity to the significant others.

Results from the application of this theory have been mixed (Kianpour, Jusoh, Mardani, & Streimikiene, 2017; Kumar, 2019; Z. Wang et al., 2016). Others have also included environmental norms and values and awareness in forming pro-environmental intentions (Kumar, 2019; Z. Wang et al., 2016). This is also in line with Ajzen, (2011), who mentioned that whether pro-environmental intentions predict behaviour depends in part on factors beyond the individual's control, i.e. the strength of the intention–behaviour relation is moderated by actual control over the behaviour. In this research, monetary incentives for recycling and the convenience with which recycling can be done is expected to moderate the relationship between pro-environmental intentions and actual behaviour.

Norm-Activation Theory

Moral theories of altruism had been used to examine the underlying factors influencing an individual's pro-environmental behaviours such as adopting environmentally friendly transport, energy conservation and waste management behaviours (Zuo et al., 2017; Sorkun, 2018). The concept of altruism was first articulated by Heberlein (1972), who presumed that because the environment is a public good, altruistic motives are necessary to contribute to its protection in a significant way. Subsequently, the concept of altruism was espoused by Schwartz (1977) in a study that sought to examine the motivation behind helping behaviours and voluntarism. Altruism has been defined by Schwartz and Howard, (1984, p.

229) as "self-sacrificial acts intended to benefit others regardless of material or social outcomes for the actor" In that study, arguments were put across as to what motivates helping behaviour.

However, Schwartz and Howard (1981) maintain that an act motivated by the concern for the welfare of others is said to be an altruistic behaviour, to the extent that individuals take actions to contribute to the fulfilment of the need. The Norm activation theory brings to fore the importance of environmental norms and altruistic behaviours to promote pro-environmental behaviours. People in general value environmental quality and accept the responsibility to care for it. The process that leads to the development of altruistic behaviour to care for the environment is based on three propositions: an obligation proposition, activation proposition and defence or acceptance proposition.

Altruistic behaviour is dependent on the intensity of moral obligation, a feeling to initiate helping behaviours or take steps to minimise risks for the benefit of others. Altruistic behaviour is described as selfless towards an individual, an object or the environment (Schwartz & Howard, 1984). Second, helping behaviours are activated in situations for which an individual acknowledges and learn of consequences others are exposed to. Third, the theory further explains that the prior acceptance or denials of responsibility may neutralise or strengthen the development of altruistic behaviours. For example, an individual who is aware of the effect of burning of waste on health, and accepts responsibility for indiscriminate burning and its consequences could initiate actions to stop others from burning.

These propositions apply to the relations of internalized norms and values to any behaviour motivated by feelings of moral obligation, not exclusively to altruistic behaviour. Altruism is involved only when the feelings of obligation and the norms and values from which they are generated pertain to behaviour that can benefit others (Schwartz, 1977, p. 227). Feelings of moral obligation is a function of conditions which affect the acceptance or denial of responsibility to perform an appropriate behaviour. These relationships have been shown in Figure 11.

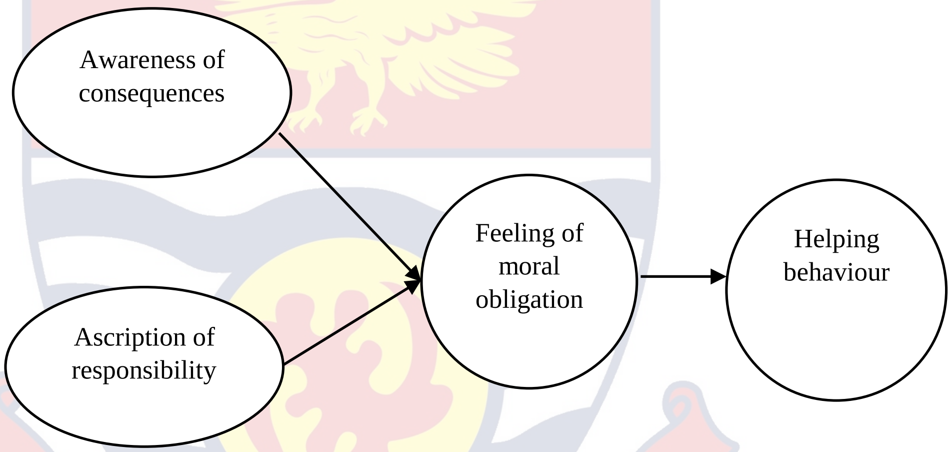

Figure 8: Norm Activation Model

Source: Schwartz (1977)

The norm activation theory assumes pro-environmental actions follow from the activation of our environmental values, which are a product of two main antecedents (Figure 11): awareness of consequences of behaviour, the ascription of responsibility. Individuals' environmental values are stronger when they are aware of the problems their behaviour have contributed to and feel personally responsible. Again, it is stronger when people believe they have what it takes to contribute to reducing environmental problems. Specifically, the activation of environmental values tends to improve environmental quality by activating pro-environmental behaviours such as waste sorting and recycling. Environmental values, as described by Steg and Nordlund (2019), is the moral obligation to engage in or refrain from certain actions. There is evidence to support the effect of environmental values on pro-environmental intentions to perform behaviours such as recycling (Zuo, Rameezdeen, Hagger, Zhou, & Ding, 2017; Sorkun, 2018).

The link between the theory of planned behaviour and norm activation is both emphasise the role of norms. While the theory of planned behaviour emphasizes subjective norms, reflecting the perceived expectations of a group of significant reference concerning how an individual should behave, Norm activation includes personal norms described as feelings of a moral obligation to perform a certain behaviour (Schwartz, 1973, 1977; Schwartz & Tessler, 1972). Thus, the central feature of personal norms is internalization. The proposed effect of personal norms on pro-environmental intentions is also in line with Ajzen's (1992) prediction that moral obligations would be expected to influence pro-environmental intentions, in parallel with attitudes, subjective (social) norms and perceptions of behavioural control.

In an environmental context, studies have shown that people who feel a moral obligation to protect the environment are also more likely to develop pro-environmental intentions towards reducing personal car use (Nordlund & Garvill, 2003), or using public transportation (Bamberg et al., 2007) or to purchase organic food products (Cheung & To, 2019) or even decide to participate in recycling waste electronic items instead of throwing away with garbage (Zuo, Rameezdeen, Hagger, Zhou, & Ding, 2017; Sorkun, 2018). These studies highlight the importance of environmental values in explaining variation in littering behaviour, the purchase of organic foods, and resource-conserving behaviours such as reuse, reduce and recycling.

Psychological Ownership Theory

Psychological ownership theory was necessary because electronic waste, unlike other type of waste may be perceived as posing sentimental and instrumental values even when they are no longer in use (Kwok, Grisham & Norberg, 2018). The purchase of electronic appliances for our homes and personal use leads to both legal and psychological ownership. Disposal of personal possession causes a break in ownership and detachment from self because, as we use objects over time, it becomes part of us. Consequently, disposal goes beyond just physical separation to emotional separation from a part of the self (Young & Wallendorf, 1989, p. 33, cited in Cherrier, 2009). Psychological Ownership Theory, describes the development of possessive feelings for targets of psychological attachment (Pierce, Kostova & Dirks, 2001; 2003). This phenomenon has been cited to cause possessive feelings towards inanimate objects and cause people to keep objects even when they longer need them.

However, Haws et al. (2012) believe that individuals who keep their objects even when they are not reusable, usually, have the desire to be economical with the consumption of resources, think about new ways of reuse, and general concern for the environment. The implication of Haws et al. (2012) argument is that so long as people become attached to their possessions, they are more likely to handle the product with care, postpone its replacement or disposal, and repair it when it breaks down (Van Nes & J. Cramer 2006, Mugge 2007, Ramirez, Ko & Ward 2010; Cole, Cooper & Gnanapragasam, 2016). Again, the tendency to store electronic waste could also be motivated by creatively reusing parts for other purposes or passing them on to others for reuse. Further, concern for the environment may cause individuals to keep waste objects awaiting an opportunity to properly discard.

The relationship between psychological ownership and reuse behaviours have been documented. Jussila et al. (2015) found that psychological ownership leads to positive evaluations about a product, which also influences the preference for continued use of a product or a brand. When consumers express psychological ownership of an object, their evaluations of that object increase (Kwok, Grisham, & Norberg, 2018; Steketee, Frost, & Kyrios, 2003). Also, preference for keeping or selling reflects the sentimental and instrumental attachment to electronic possessions.

Intention-Behaviour Gap

Good intentions may not necessarily produce good behaviours. The opposite is also true. People do not always do what they intended. The intention-behaviour gap occurs when one develops an intention towards the performance of a behaviour, but does not initiate any action to perform the intended behaviour. Notably, the TPB and the NAM have recorded evidence of predicting intentions with high accuracy. These theories share similar belief that a person's intention is the immediate predictor of his behaviour.

However, when it comes to predicting actual behaviour, evidence shows weak relationship. Empirical evidence on the intention behaviour gap in pro-environmental behaviours is lacking. Out of the 103 articles reviewed, less than 2% (Echegaray & Hansstein, 2017) aimed at explaining the gap between intentions and behaviour. Studies show that the contribution of intentions to behaviour is around

50%. In other words, when 100 people indicate high intentions to carry out a behaviour, about 50% or less are likely to act on their intentions. Thus, other factors could induce or interact with intentions to cause actual behaviour to occur.

Three main questions arise:

1. How large is the gap between intention-behaviour?
2. What factors frustrate the process from intentions to behaviour?
3. What strategies should be implemented to close the intention behaviour gap?

Widely applied psychological models of behavioural change in health studies that could provide insight into the intention-behaviour relationship in pro-environmental studies include: Health Action Process Model (Schwarzer & Luszczynska, 2008; Schwarzer, Lippke & Luszczynska 2011), Transtheoretical model (Prochaska & Velicer, 1997; Prochaska, Redding & Evers (2015); and Self-Determination Theory (Deci, Eghrari, Patrick & Leone 1994; Gagné, & Deci 2005). Health Action Process Model believes people experience a pre-intention phase where emphasis is mainly on motivational and perceived control (self-efficacy) factors, and post intention phase where sustenance of the self-efficacy is key. In the TPB, Ajzen, in similar argument, mentions that the performance of a behaviour is dependent on intentions together with actual control over behaviour (Ajzen, 1991).

Transtheoretical Model indicates six stages of change and these stages are not interchangeable. The model hypothesises that an action is likely to be achieved when self-efficacy and self-regulation are maintained. The Self-Determination Theory suggests three factors that influence behavioural change: autonomy, competence and relatedness. Autonomy and competence are also linked to perceived behavioural control, while relatedness can be described as close individuals who share and perform similar behaviour. From the theories, and other evidence provided in literature, the intention-behaviour gap could be due to experience, information deficit, lack of extrinsic motivation, amotivation and social obligation or responsibility.

Experience is about habit formation. Information deficit occurs when one does not have the requisite information, knowledge to perform the behaviour. Extrinsic motivation involves rewards and incentives that could exact required behaviours. Amotivation is the lack of interest to take steps to perform a behaviour. Social obligation or responsibility describes the perceived pressure to yield to societal expectations. In the recycling literature, policy factors, such as sanctions and incentives inherent in recycling programmes, have been found to narrow the gap and influence behaviour. Other factors include convenience and provision of appropriate infrastructure. Zhang, Lai, Wang and Wang, (2019) found that government incentives and facility accessibility directly promoted waste sorting behaviours; it nevertheless, weakened the link between intention and behaviour.

In Echegaray and Hansstein (2017) the authors suggest awareness creation connected with people's health could motivate actions towards the behaviour. Also, convenience and accessibility could reduce the barriers for actual performance. Sheeran, Godin, Conner and Germain (2017) although their study examined pro-health behaviour, found a U-shape role of habit formation in influencing the intention-behaviour gap. Adopting a longitudinal study, they found that experience both strengthens and weakens intention-behaviour relationship over time. Johnstone and Tan (2015) also finds that perceived ease or difficulty of performing a behaviour, readiness to be green and lack of support from others contributes to the gap. The intention-behaviour presents an opportunity for programmes that will yield the desired behaviours.

Review of Related Concepts

This section discusses some key concepts that emerged out of the theoretical discourse. These concepts have been hypothesised as significant predictors of pro-environmental intention and sustainable e-waste management behaviour. The concepts include: social norms, environmental values, perceived behavioural control, facilitating conditions, producer responsibility, pro-environmental intentions and how they relate to sustainable waste management behaviour is also discussed.

Sustainable E-Waste Management

According to Jacoby, Berning and Dietvorst (1987), disposal behaviour is operationalized as the action taken by a household unit when it no longer intended to use an appliance for its original purpose. Sustainable e-waste management was operationalised according to the waste management hierarchy (Lansink, 1979). Accordingly, and in line with the waste hierarchy, sustainable waste management behaviour in this context refers to the disposal actions that promote reuse, recycling and reduction of electronic waste generation (3Rs).

As a hierarchy, households are expected to reduce their waste generation or avoid waste where possible. Where one finds it impossible to reduce waste, the next most preferred option in the waste hierarchy is to re-use items to extend the product life. For example, many household electronic appliances that are usually discarded by owners can be cleaned or repaired to be re-used, sold, gifted to people in their social networks or donated to charities. Where items can no longer be reused, the hierarchy presents recovery as the next best option. Meadows, Meadows and Randers (1992); Parajuly and Wenzel (2017) and Parajuly et al. (2020) describe recycling as an essential tool in achieving sustainability by recovering useful materials that can serve as secondary raw materials. Where all options have been exhausted, landfilling of waste is suggested. However, the model assumes that only unusable and dangerous substances should be landfilled.

On the basis of the theoretical arguments presented so far, sustainable e-waste management is expected to be influenced by facilitating conditions, producer responsibility, perceived behavioural control and pro-environmental intentions, which in turn is predicted from environmental values, social norms and perceived control over behaviour (or perceived behavioural control). Collectively, these factors are described as external triggers. Empirical evidence establishing the relationship among the concepts and how it influences reduction, reuse and recycling behaviours is presented in chapter three of the thesis.

Environmental Values

Environmental values, a concept in the norm activation theory (Schwartz, 2012), reflects individuals' recognition and propensity to engage in practices that will minimize harm to the environment (Kim & Chung, 2011). Drawing from the Value theory by Schwartz, (1992, 1994) and the New Environmental Paradigm (NEP) (Dunlap, Van Liere, Mertig, & Jones, 2000), individuals exhibit a range of values, out of these, four human values namely egoistic, biospheric, altruistic and hedonic have been found to motivate individuals' consumption and disposal patterns (Stern, Dietz & Kalof, 1993). While egoistic and hedonic values are about the pursuit of one's self enhancement, biospheric and altruistic values emphasise self-transcendence (Schwartz, 1994). Self-transcendence refers to state of treating others as equal and showing concern for their welfare

One key assumption underlying NAT is altruistic values, which is expected to influence pro-environmental behaviours (Stern, Dietz, & Kalof, 1993). Altruistic value orientation was defined by Schwartz and Howard (1984, p. 229) as self-sacrificial acts intended to benefit others. This definition is reflected in the reuse and recycling behaviours in the waste management hierarchy. For example, taking steps to segregate one's waste and applying the appropriate methods such as donating or gifting benefits others. Schwartz and Howard (1981) maintain that an act that is motivated by the concern for the welfare of others is said to be an altruistic behaviour, to the extent that individuals take actions to contribute to such need. Described by Schwartz as helping value, individuals exhibit altruistic values, by donating unwanted electronic objects for the benefit of others.

In the pro-environmental discourse, however, the linkage between altruistic motives and pro-environmental behaviours an indicated by Stern, Dietz and Kalof, (1993) is limited unless biospheric values, which is directly linked with environmentally conscious motives, (Steg & Nordlund, 2019) is acknowledged. Consequently, environmental values, operationalised as concern for the welfare of others and the environment, is found to account for significant effect on pro-environmental actions (Islam et al., 2016; Kanhai et al., 2019; Wang, et al. 2018). When an individual is environmentally consciousness, he/she is more concerned about protecting the environment (Dunlap, 2008; Dunlap, Liere, Mertig, & Jones 2000; Ritter et al., 2015). According to these authors, concern for the quality of the environment influences an individual's attitude towards environmental issues. According to NAT (Schwartz, 19877), people in general, value environmental quality and accept the responsibility to care for it. The theory assumes that activation of environmental values occurs through an internalisation mechanism involving awareness of the consequences of human activities on the biophysical environment. A justification for promoting awareness is based on this assumption.

Pro-Environmental Intentions

According to the theory of planned behaviour, the immediate determinant of behaviour is one’s pro-environmental intentions to perform the behaviour, because pro-environmental intentions are underlying motivation to perform a behaviour. In turn, pro-environmental intentions to perform the behaviour is influenced by the attitude towards the behaviour, subjective norms, and perceived behavioural control; and these intentions, together with perceptions of control over behaviour, causes behaviour to occur (Ajzen, 1991 p. 179).

The rise in calls for global environmental actions towards climate reforms is an indication of the growing awareness of the problematic relationship between modern industrialized societies and the physical environments on which they depend. Human activities have been touted as one of such relationship producing more harm than good. Ajzen (1991) further explains that the motivation to perform a given behaviour is highly dependent on internally activated values (attitude), the immediate social structure and perceived environmental forces. Attitude is explained as the value one places on the performance of a behaviour. This is directly related to environmental values proposed in Schwartz’s (1977) norm activation theory.

Social Norms

The Theory of Planned Behaviour reveals the role of social norms in influencing community waste management practices and its effect on the individuals. Studies such as White, Smith, Terry, Greenslade and McKimmie (2009); Brekke, Kipperberg and Nyborg (2010); Özdemir & Utkun, 2016; Sorkun, (2018) specifically examined the role of social norms. Similarly, Schwartz (1977) clearly distinguishes between social and personal norms. He views social norms as reflecting the perceived expectations of a group of people made up of both one's close reference groups and others he/she may not be related. Development in scientific enquiry has made it necessary to distinguish between two main forms of subjective norms proposed in the Theory of Planned Behaviour: injunctive and descriptive. Injunctive norms correspond to expectations of significant others which has been the main basis of measuring subjective norms in the Theory of Planned Behaviour.

Facilitating Conditions

Although the theory of planned behaviour and the norm activation model have proven to be jointly robust in predicting pro-environmental intentions and subsequent behaviour, studies such as Wan et al. (2014) have described the critical role policy factors play to facilitate behavioural change by boosting individual's perceived control over the behaviour. These factors are subsequently termed as facilitating conditions. Facilitating condition is defined Electronic waste Management "as the degree to which an individual believes that an organisational and technical infrastructure exists to support the adoption and use of a system"

(Venkatesh et al., 2003, p. 453). Facilitating conditions are factors that seek to remove barriers to adoption, reuse and recycling practices (Venkatesh et al., 2003).

Facilitating conditions in the context of this study largely emphasize the role of government and in promoting sustainable waste management behaviours. In line with the environmental protection paradigm, the government has a role to play in pollution reduction and waste control through regulations, incentivised waste recovery schemes and infrastructure that motivates one to segregate and channel his or her e-waste appropriately. Environmental regulation has been resorted to in the wake of the need to process the rapidly growing volumes of end-of-life and end-of-use (WEEE) in a manner that is friendly to the environment and human health (Cole, Gnanapragasam, Singh, & Cooper, 2018).

In the waste management context, facilitating conditions may include supporting policies, infrastructure, public awareness programmes and incentive schemes. Wan et al. (2014) discussed the relevance of perceived policy effectiveness (PPE) on recycling behaviour. Wan et al. (2014) found perceived policies construct to be a significant predictor of recycling behaviour. Zhang, Lai, Wang and Wang (2019) found that facilities accessibility, together with intentions, significantly influenced waste-sorting behaviour. Meng et al. (2019) examined factors influencing disposal behaviours of households' solid waste. Results show support for environmental facilities and services influencing households' waste recycling. Also, Zhang, Lai, Wang and Wang (2019) find that facilities accessibility is positively related to waste-sorting behaviour

Producer Responsibility

Producer responsibility is based on the EPR model (Lindhqvist, 2000), which is widely adopted in the management of plastic and electronic waste in most developed economies. Based on the polluter-pays principle (PPP), producer responsibility implies that responsibilities which were originally assigned to consumers and authorities responsible for waste management are to be shifted to the producer of the products (Rogers and TibbenLembke, 1999). Proponents argue that producers have better control over their product design, product development and marketing, and can therefore leverage these capabilities to manage the end-of-life of their products. In developing economies, the practice of the PPP is popular in the plastics sector.

There is empirical evidence that suggests the positive impact of producer responsibility schemes on sustainable waste management. Quartey et al. (2015) describe producer responsibility as an effective tool that ensures that the environmental cost of products is absorbed along the value chain. Similarly, according to a study by Cao et al. (2016), the adoption of the waste management system based on EPR has positively impacted the waste situation in China. Also, Rubio et al. (2019) demonstrate the positive effect of EPR implementation on material usage reduction and increasing recycling activities. Similarly, Baah et al. (2021) found that sustainable logistics practices such as waste management had enormous influence on environmental reputation of firms.

Chapter Summary

The chapter presented a theoretical framework that provides key assumptions for the study. In this respect, the theory of sustainable development was reviewed. Informed by the strong sustainability paradigm, circular economy provides a model towards waste management, where the application for waste management hierarchy was examined. Understanding pro-environmental intentions and environmental behaviour were examined from the theory of planned behaviour and the norm activation theories. Finally, consumers' attitude and perception towards their objects of attachments were analysed through the lens of psychological ownership theory.

Sustainable development is a broader concept of growth, cutting across economic, social and environmental dimensions. Circular economy is an economic system where economic growth is pursued decoupled from negative environmental externalities. The waste management hierarchy is an integral paradigm of the circular economy where production and consumption cycles are closed through reuse and sustainable e-waste managements. To explain the motivation underlying the practice of sustainable waste management behaviours among households, the theory of planned behaviour, together with the norm activation theory, describes waste management behaviours as a product of pro-environmental intentions of individuals to engage in pro-environmental behaviour and other environmental factors that encourages, facilitates the practice of sustainable waste management.

CHAPTER THREE

EMPIRICAL REVIEW, EMERGING ISSUES AND CONCEPTUAL FRAMEWORK

Introduction

The previous chapter presented the general theoretical framework within which sustainable waste management practices among households have been examined. It also looked at how these theories have evolved, their assumptions and concepts. In this section, an empirical review establishing the factors influencing sustainable waste management practices have been outlined. The empirical review aimed to synthesise results from existing studies, by identifying the similarities, contradiction and gaps in such studies. The empirical review also provided the context for the study, acknowledging and examining prior knowledge on the topic and appreciating modes of presentation and discussions on research findings. The empirical review further identifies areas of methodological limitations in previous studies (Cano, 2013).

Empirical Review

This section looks at the review of articles that has employed the underlying theories to examine pro-environmental intentions and sustainable electronic waste practices. The review is presented according to the research objectives. The purpose of the study was to examine the practices, analyse the drivers and barriers to electronic waste management practices among households. The study was guided by the following research objectives, which were to:

1. examine the practices prevalent in e-waste management in Ghana,
2. analyse the effect of environmental values, social norms, perceived behavioural control and pro-environmental intentions,
3. investigate the effect of pro-environmental intentions, facilitating conditions, perceived producer responsibility and sustainable e-waste management behaviour;
4. explore whether the factors influencing pro-environmental intentions and sustainable e-waste management practices differ by age, sex, income level and type of settlement; and
5. examine the interacting role of behavioural control factors on the relationship between pro-environmental intentions and sustainable electronic waste management practices.

Empirical review on the effect of environmental values, social norms, perceived behavioural control on pro-environmental intentions towards sustainable e-waste management

Kollmus and Agyeman (2002) define pro-environmental intentions as inner drives and motivation intended to achieve an outcome beneficial for the welfare of biophysical environment. According to Ones, et al. (2015), households can contribute to sustainable environmental practices in their purchase, usage and disposal practices of food, clothing and housing. According to the norm activation theory (NAT) (Schwartz, 1977), pro-environmental behaviour can either be viewed as motivated by self-interest (e.g. to minimize one's own health risk or injury) or the obligation to act pro-socially and environmentally (e.g. concern for other people, the next generation, other species, or the biosphere). Empirically, the NAT, has been successful in predicting various environmentally friendly behaviours such as support for environmental policies, the purchase of environmentally friendly products and the participation in waste segregation and recycling campaigns (Nguyen, Lobo and Nguyen (2017). Guided by these assumptions, the following studies were reviewed: Khalil, Abdullah, Manaf, Sharaai and Nabegu (2017); Alhassan, Asante, Asante and Bawakyillenuo (2017), Echegaray and Hansstein (2017); Wang et al., (2018); and Issock, Roberts-Lombard and Mpinganjira (2020).

Khalil, Abdullah, Manaf, Sharaai and Nabegu (2017) examine the predictors of household pro-environmental intentions to recycle and conditions that facilitate their engagement in the proper management of household waste. A cross-sectional survey involving 393 households from Kano state in Nigeria were examined based on the TPB framework. Questionnaires were used to collect the data. Covariance-based structural equation modelling was used to analyse the data and the results provide support for the TPB framework.

Overall, 42% of the variance in recycling intentions was predicted by the TPB constructs. From their results, attitude and personal norms contributed significantly to recycling intentions. Respondents observed a positive evaluation of the recycling of their waste. This was followed by subjective norms. Perceived behavioural control was not a significant predictor of pro-environmental intentions. The authors also moderated the relationships with the availability of facilities and showed that attitude and personal norms fail to influence pro-environmental intentions when facilities were lacking. It was concluded that the provision of adequate facilities is important to generate high pro-environmental intentions and positive behaviours.

Alhassan, Asante, Asante and Bawakyillenuo (2017) examined the factors that encouraged waste separation intentions among households in Accra and Tema metropolis. The study was based on a survey of 855 households, conducted in 7 randomly selected low, middle and high-income residential areas in Accra Metropolitan Assembly (AMA) and Tamale Metropolitan Assembly (TaMA) in Ghana. The reason for these strata was to find out if income and residential characteristics could influence source separation behaviour. studies of these nature require large sample sizes to produce better results even where certain design and test specific assumptions are relaxed, as stipulated by the central limit theorem.

The authors employed the ordered probit regression analyses because responses were ordinal. Consequently, it renders the ordinary least squares regression technique inappropriate. The results from the estimation indicate that sex of household head, educational attainment of household head, the total income of the household, occupation type of household head, information, experience with source separation, attitude, subjective norm and inconvenience, were statistically significant variables that influence households' source separation intention. In the case of TaMA, household size, occupation type of head of household, experience with source separation, inconvenience, attitude towards source separation and subjective norm are the statistically significant variables that influence households' source separation intention. The authors concluded that attitude, subjective norms and perceived behavioural control significantly influence pro-environmental intentions, but not the actual behaviour.

Echegaray and Hansstein (2017) analysed the key determinants of households' pro-environmental intentions to participate in electronic waste recycling and actual sustainable e-waste management. Employing the theory of planned behaviour, they hypothesized that awareness level, subjective norms, attitude towards waste and perceived behavioural control would influence pro-environmental intentions, which in turn, would predict behaviour. Primary data was collected from a sample of 802 households in selected cities in Brazil. The respondents were obtained by cluster sampling approach. Pro-environmental intentions were measured with three items and included questions such as: 'I am willing to take some time to take my old electronic appliance for recycling' 'I am ready to speak to speak to friends about the appropriate modes of recycling and 'I am willing to get more information about collection and recycling sites for e-waste'

Probit and logit regression was used to analyse the determinants of pro-environmental intentions and behaviour respectively. The authors found that attitude, social norm and perceived behavioural control positively relates to recycling intentions. Social norms, however, was a significant predictor of recycling intentions. Awareness recorded a significant and positive effect on pro-environmental intentions. As part of the conclusions, the authors propose that awareness campaigns be intensified because it positively impacts societal norms which also influence waste management behaviours. Again, awareness campaigns can shape individual attitude towards adopting sustainable waste management practices at home.

Wang et al. (2018) analysed the influence of awareness creation and information publicity on the pro-environmental intentions of households to recycle their electronic waste. The survey involving 462 households took place in Shandong province, China. The study used the theory of planned behaviour (TPB) and norm activation theory (NAT). Cross-sectional surveys collect data from a large sample to make inference about a population at a point in time (Fowler Jr, 2013). Primary data was collected through the administration of questionnaires. The questionnaires had three main parts: the first part contain information about six major home appliances: refrigerators, air conditioning, washing machine, computers, Tv sets and mobile phones. The second part of the questionnaires measured residents' understanding of recycling and the final part contained information about the variables in the research model.

After reliability and validity test were conducted using principal component analysis, covariance-based structural equation modelling was used to test the hypothesized relationships. CB-SEM requires that data collected is subjected to a normality test but was not mentioned by the authors. The alternative approach is to use PLS-SEM, which does not necessarily require data to follow a normal distribution (Hair, Ringle, & Sarstedt, 2011). The results from the TPB-NAT model showed that information publicity and awareness highly influenced personal norms, which was operationalized as a moral obligation to protect the environment. Their findings were consistent with the norm activation theory. Information publicity was the main contribution of the authors to theory. Attitude towards recycling and subjective norms also influenced recycling intentions. Information publicity also positively influenced attitude and behaviour. The results from the study confirm the relevance of information on the state of electronic waste disposal.

Issock, Roberts-Lombard and Mpinganjira (2020) examined the role of normative influences on the intention to separate household waste and the moderating role of socio-demographic characteristics and upstream social marketing interventions. The authors argued that descriptive norms, injunctive norms (Cialdini, Reno & Kallgren, 1990) and moral norms (Schwartz, 1977) influence behavioural intention to separate household waste before disposal. According to the authors, the three categories of norms involve distinct sources of motivation and so different influence on behaviour is expected.

The distinction between the three norms by the authors is in line with Schwartz (1977) and Rivis and Sheeran (2003). Manstead (2000) also adds that the distinction among the three different sources of norms, and their inclusion as predictors in the TPB model can contribute to a significant increase in the explained variance in behavioural intentions and actual behaviour. While descriptive and injunctive norms are external influences, which are found in the theory of planned behaviour and reasoned action, moral norms, otherwise called personal norms, is hypothesised as the main determinant of altruistic or sacrificial acts in the norm activation theory (Schwartz, 1977; Schwartz & Howard, 1984).

The study adopted a cross-sectional design. Closed-ended questionnaires were used to collect quantitative data from 350 households. The analytical technique was structural equation modelling. After reliability and validity were established, the results showed Injunctive and moral norms were significant influencers. Moral norms were highly influential in predicting the intention to separate household waste. This confirms the views of Özdemir and Utkun (2016), and Sorkun (2018), that moral norms better predict pro-environmental behaviours than social norms. Results of moderation analysis also show age and gender recorded a significant interaction effect on the normative influence on waste sorting behaviour. Specifically, the descriptive norm was higher among males than females. Finally, the model accounted for 33% of the variance in pro-environmental intentions to sort waste at home.

Analysis of the empirical evidence presented shows that intentions serve as the underlying factor in the pro-environmental behaviour discourse. Nevertheless, authors showed limited understanding of the assumptions of the underlying the widely adopted theories: TPB and NAT. For example, in Khalil et al. (2017), whiles the authors cited the TPB variables as significant predictors, their results show attitude together with personal norms. These two variables are conceptually the same, hence could have looked at other unique variables. Also, in terms of moderation, Khalil et al (2017) missed the real significance of introducing such interaction. According to Baron and Keney (1986) a moderator must not be a causal result of the independent variable.

Finally, Issock, Roberts-Lombard and Mpinganjira (2020) based on the weaknesses in the conceptualisation of norms, hypothesised that three types of norms: personal norms, injunctive norms and descriptive norms. While the distinction between the three norms by the authors is in line with Schwartz (1977) and Rivis and Sheeran (2003). Manstead (2000) actual implementation has always been problematic. The distinction between social norms and personal norms is clear, but that of injunctive and descriptive norms is subtle. It is no surprise that studies still refer to injunctive norms as social norms. The review shows that pro-environmental intentions do not always lead to behaviour as found in Alhassan, Asante, Asante and Bawakyillenuo (2017) and Echegaray and Hansstein (2017).

Empirical review on the effect of pro-environmental intentions, facilitating conditions, perceived producer responsibility and sustainable e-waste management behaviour.

The theory of planned behaviour (TPB) has been one of the widely used theoretical lens through which waste management behaviours of various types, including recycling, source separation and waste minimisation has been examined. TPB, one of the rational choice or cognitive theories assume that individuals behave rationally and will always adopt the best cause of action that provides maximum utility. According to the TPB, the immediate determinant of behaviour is the intentions to perform the underlying behaviour, together with perceptions of actual control over behaviour. The following studies were reviewed to provide justification for the current study: Xiao, Zhang, Zhu and Lin (2017), Alhassan, Asante, Asante and Bawakyillenuo (2017); Rosenthal (2018); Kumar (2019), Meng et al., (2019); Tweneboah-Koduah, Adams and Nyarku (2020) and Aboelmaged, (2021).

Xiao, Zhang, Zhu and Lin (2017) examined the willingness of Xiamen City residents to participate in recycling to better manage their electronic waste. The study design was a cross-sectional survey, questionnaires were administered face to face to the respondents. The questionnaires had three main sections. The first section contained questions about waste management satisfaction and waste management practices. The second section sought to evaluate the willingness of the citizens to pay for waste separation. Responses were rated on a five-point Likert-type scale. Structural equation modelling was used to analyse the data.

Covariance-based structural equation modelling (CB-SEM) and IBM AMOS was to process the data. CB-SEM usually requires that normality assumptions are satisfied because it uses maximum likelihood. The endogenous or dependent variable was the willingness to participate, while knowledge, institutions and social motivation were the exogenous factors. From the results, knowledge about waste management recorded the highest and significant positive effect on willingness to participate. This was followed by social motivation. The role of institutions in enforcing sanctions, although a significant predictor of willingness, was not effective as presumed. So, knowledge about waste infrastructure was critical in shaping the behaviour of the citizens towards waste separation.

Kumar (2019) examines electronic waste management among two culturally distinct countries: China and India. Kumar described Chinese culture as relatively masculine compared to India, mostly preferred selling their electronic waste because of the monetary value placed on them. India valued interpersonal relationship and preferred to keep or pass on to relatives, as found by Borthakur and Govind (2019). Employing the theory of planned behaviour, and norm activation model, questionnaires were administered to the two distinct samples. The respondents were post-graduate students. The data analysis technique was partial least squares structural equation modelling. The justification was that PLS-SEM was more effective for modelling both formative and reflective constructs, moderation and multi-group analysis.

After establishing validity and reliability required by the statistical technique, the bootstrapping procedure was applied to test the hypothesized relationships. Attitude, perceived behavioural control, subjective norms and individual responsibility were found to influence pro-environmental intentions, whereas convenience and awareness of consequences did not influence pro-environmental intentions. This is similar to the findings by Zhang, Lai, Wang and Wang (2019). In addition, from the multigroup analysis, the authors found cross-cultural differences between the two samples. Specifically, the effect of perceived control and subjective norms on pro-environmental intentions was stronger among the Chinese than Indian sample.

The implication was that the Chinese considered the presence of recycling facilities and social influences among peers very important. On the other hand, the effect of attitude and individual responsibility on pro-environmental intentions were stronger among Indians than Chinese. This could be the reason Indians preferred storing or donating to family members, and other close social relations than selling. The effect of attitude on pro-environmental intentions was moderated with a sense of duty. The interaction role was not significant. Although the authors did not provide any reason, one could infer based on the conceptualization of the constructs. Sense of duty was operationalised similar to attitude and so the moderation was not justifiable.

Meng et al. (2019) examined factors influencing disposal behaviours of households' solid waste. The theoretical framework that guided the study was the theory of planned behaviour and the attitude-behaviour model. The study design was a cross-sectional survey involving 709 households. Based on the theory, disposal behaviour was regressed on environmental attitude, Social norms, environmental knowledge and facilities. The environmental attitude was operationalized as the perception held by individuals. Social norms were operationalized as pressure from people in society and their influence on households' behaviours. Environmental knowledge involves the skills and information necessary for one to engage in waste segregation and recycling. Environmental facilities and services refer to resources and infrastructure that encourages sustainable waste management behaviours. Data were analyzed using covariance-based structural equation modelling (PLS-SEM).

Results show environmental facilities and services recorded the strongest effect on households' waste recycling. This was followed by environmental attitude and environmental knowledge. Availability of waste management facilities increases convenience and accessibility, so its effect on improving recycling rates has gained much support. In Zhang, Lai, Wang and Wang (2019), facilities accessibility, together with pro-environmental intentions, significantly influenced waste sorting behaviour. Social norms did not significantly influence waste disposal practices. The results are consistent with Zhang, Lai, Wang and Wang's (2019), where subjective norms did not influence behavioural intentions. Weak effects recorded in some studies were attributed to how social norms were operationalized and subsequently measured (Passafaro, Livi & Kosic 2019). Also, the strength of the effect of social norms on pro-environmental intentions is influenced by culture, as found by Kumar (2019).

From a social marketing perspective, Tweneboah-Koduah, Adams and Nyarku (2020) applied the theory of planned behaviour to examine household waste disposal behaviour. A social marketing environment ensures government institutions and corporate bodies use their marketing communication tools to promote positive behaviours while discouraging negative ones. The study was cross-sectional and the quantitative approach was adopted to guide data collection and analysis. Questionnaires were administered to some selected households in densely populated areas in the Greater Accra Region, where waste generation was perceived to be high. Convenience sampling was used because there was no sampling frame. 450 questionnaires were distributed, out of which 343 valid questionnaires were used. The data were analysed with covariance-based structural equation modelling with the help of IBM AMOS.

Attitude towards behaviour and subjective norms influenced actual waste behaviour, while perceived behavioural control did not. Following Preachers and Hayes (2004) bootstrapping procedure, the mediation role of pro-environmental intentions revealed the following: there was partial mediation recorded for attitude and waste disposal behaviour. No mediation effect recorded between subjective norms and actual behaviour. Their findings provide further insight into the role of attitude in informing desired waste management behaviour. Attitudinal change plays a critical role if proper waste management practices could be enhanced.

Aboelmaged, (2021) examines the determinants of recycling intentions among young consumers. Young consumers are touted as contributing to e-waste generation due to increasing consumption of ICT-related products. Through a quantitative survey, cross-sectional data was collected. The analytical technique was partial least squares structural equation modelling. Habit and attitude were strong predictors of intentions, whiles perceived behavioural control and subjective norms did not influence the respondents' intentions to recycle. Similar to Tweneboah-Koduah, Adams and Nyarku (2020), whiles positive attitude influenced recycling intentions, perceived behavioural control did not.

From the review, studies have proposed several factors have the potential to influence sustainable waste management behaviours such as recycling. In particular, authors have shown divergent views on the application of the theory of planned behaviour and the norm activation theory. It was reported that pro-environmental intentions do not always lead to behaviour (Echegaray & Hansstein 2017). While some authors, such as Zhang, Lai, Wang and Wang (2019) and Kumar (2019), believed some factors could moderate the relationship to increase the influence, others proposed infrastructure and incentives directly influences behaviour.

Whilst acknowledging the widespread adoption of the TPB in explaining various environmental behaviours, Lindenberg and Steg (2007) argue that TPB primarily focuses on personal gains, hence it best explains pro-environmental behaviour and behavioural choices constrained by money, time and effort. Several studies extending the TPB have therefore incorporated factors such as awareness, environmental values, and emotional factors in predicting pro-environmental behavior. Such inclusions have proven to provide a more comprehensive understanding of multiple motives relating to green consumption, which is identified as an important concern in the literature (Moisander,2007).

However, armed with the sufficiency assumption in the TPB, a more cautious approach towards extending the TPB should be exercised. This ensures needless inclusion of variables that comes at the cost of higher explained variance (R-square). On that note, the PLS-SEM technique implemented in this study overcomes such weakness by providing the avenue to assess the measurement model before establishing significance of path relationships

Empirical evidence on the interaction effect (moderation) of socio-demographic characteristics of respondents on sustainable waste management behaviours.

Pro-environmental intentions to perform a behaviour is highly dependent on behavioural, normative and control beliefs. While control beliefs have mostly been linked to external factors such as convenient waste sorting infrastructure, behavioural and normative beliefs are believed to be influenced to some extent by an individual socio-demographic characteristic such as age, sex, income level and educational background. The theory of planned behaviour, therefore, assumes that these background characteristics play a key role in influencing these beliefs which in turn affects one's pro-environmental intentions and his/her behaviour. Specifically, waste management practices are also linked to socio-demographic characteristics (Varotto & Spagnolli, 2017). These socio-demographic characteristics have been used as moderators in the models predicting pro-environmental intentions and behaviour.

This is in line with Baron and Kenny (1986), who defined moderators as characteristics of respondents or some environmental conditions that influence the strength and/or direction of a relationship. They further added that moderator variables partition a focal independent-dependent variable relationship into subgroups. On that note, the following studies were reviewed: Sánchez, López-Mosquera and Lera-López, (2016), Triguero, Álvarez-Aledo and Cuerva, (2016), Chekima, Chekima, et al., (2016), Chekima, Azizi, et al., (2016), Padilla & Trujillo (2017), Echegaray and Hansstein, (2017), Oztekin, Teksöz, Pamuk, Sahin, and

Sultan (2017), Xu, Ling, Lu and Shen, (2017), Guiot and Urien (2019), Issock et al., (2020).

Triguero, Álvarez-Aledo and Cuerva, (2016), examine the influence of individual and socio-demographic characteristics mainly age, gender, educational level and occupational status and environmental awareness on waste generation and recycling among households in 28 European countries. The authors specifically examine the willingness to accept different waste management policies. Cross-sectional design involving 24,000 households. The statistical technique was logistic regression. The justification was that the outcome variable was categorical. The respondents were presented with three choices: to pay a fixed some through taxes, to pay in proportion to waste generated and to pay for the price of the product with the cost of waste included. So, making a choice was represented with 1 and 0 if no choice among the three alternatives was made.

The results showed varying levels of influences among the socio-demographic characterises on the willingness to accept a waste management policy. Women preferred to pay as you throw scheme than men. Also, it was found that women seem to care more about their environment than men. Men were more likely to transfer waste management responsibility to companies. The authors did not record any significant differences among age groups. Their results further showed that a high educational level positively influenced the level of acceptance for waste management responsibility. The authors found that the change in the probability of being responsible for one's waste increases with the educational level. A lower level of education was positively correlated with a higher perception of government responsibility. Also, individuals in active occupation were more likely to accept responsibility than unemployed.

Sánchez, López-Mosquera and Lera-López (2016) analyse the impact of personal attitude, socio-demographic characteristics, economic and political variables in promoting pro-environmental behaviours in areas of purchasing and consumption among households. A stratified sampling technique was employed to select municipalities from which house address were randomly selected. This study is among the few studies that used simple random method to select respondents. Perhaps, it was possible to use a random sampling approach because the data was a secondary one.

The two outcome variables pro-environmental purchase behaviour and pro-environmental consumption behaviour were measured with 6 items and 11 items respectively. All items were adapted. All measurement scales were examined for reliability and validity. From the analysis, the aged, employed and respondents with higher educational background scored high on pro-environmental consumption. Besides, women, the aged, employed possessed strong pro-environmental attitude and were more likely to engage in pro-environmental purchasing. The influence of gender was also confirmed in Triguero, Álvarez-Aledo and Cuerva (2016), who concluded that women seem to care more about their environment than men.

Chekima, et al. (2016) examined the factors influencing green purchasing behaviour based on the theory of planned behaviour. Green purchasing was operationalised as the incorporation of environmental considerations in areas of ease of disposal, non-toxic purchasing and energy efficiency during the purchasing process. The variables in the study were moderated with the demographic characteristics of the respondents. The study adopted a cross-sectional survey. Questionnaires were used as data collection instrument and administered to over 600 households in Kuala Lampur, out of which 450 valid questionnaires were retrieved. The instrument was pre-tested to about 30 respondents who were conveniently selected in shopping centres.

Partial least squares-structural equation modelling was used to analyse the data. Educational background and gender were used to moderate the relationship between the independent variables: environmental attitude, eco-label and man-nature orientation and the dependent variable, green purchase intentions. After establishing reliability and validity test, it was found that the relationship between environmental attitude, eco-label and green purchase intentions was higher for those with higher educational background. Again, gender was found to interact with the relationship between man-nature relationship, eco-label and green purchase intentions. Specifically, the effect was higher among women than men.

Factors influencing household waste separation were examined by Padilla and Trujillo (2017). Waste generated in our homes has been increasing, and this trend is expected to continue due to population growth and rapid urbanisation especially among developing countries. Data were sourced from an existing socio-economic database. The survey comprised information on housing, public utilities, household composition, demography, health, income, education, use of information and communication technology and participation in environmental programmes. From the sample of households, the authors used multivariate probit model. Probit models are used when dichotomous, nominal and categorical data are involved.

From their results, it was concluded that the higher the household's socio-economic class, the greater its effort for separating solid wastes. Age and gender were also influential in influencing waste separation behaviours. The older the household head, the higher their pro-environmental attitude towards waste separation. Also, when the household head was a man, the likelihood of recycling all types of waste decreased. The findings also showed that among the lower socio-economic class, the attitudes towards solid waste separation was influenced by the use of the internet, membership of an environmentalist organisation, the level of education of the head of household and homeownership. It was concluded that improvement in educational level plays a major role in waste management because managing household solid waste relies on an awareness of the importance of environmental protection and recycling, which is facilitated by higher education levels. Waste management education improves attitude, skill and efficiency in managing waste.

Echegaray and Hansstein (2017) examine the intention-behaviour gap. The aim was to analyse the key determinants of households' pro-environmental intentions to participated in electronic waste recycling and actual sustainable e-waste management because it was a critical factor in designing appropriate policies and legislation for waste management. Again, recycling was described as a sustainable approach towards pollution reduction and depletion of natural resources, so encouraging recycling among households contributes immensely to sustainable waste management, especially in developing countries.

The study was underpinned by the theory of planned behaviour. Primary data was collected from a sample of 802 households obtained by cluster sampling approach. The effect of socio-demographic factors was analysed by one-way analysis of variance (ANOVA). Differences between groups were established by posthoc Bonferroni tests. The results indicated that females, respondents within 30 – 49 years and those within lower income bracket exhibited more positive intention to recycle. However, analysis of the actual behaviour revealed that respondents within higher income were more likely to properly dispose of their electronic waste through recycling.

Xu, Ling, Lu and Shen (2017) investigate the key determinants influencing household waste separation intentions and behaviour. The theory of planned behaviour informed measurement and hypotheses development. The study adopted a cross-sectional design, to collect data from households living in the city of Hangzhou. A total of 1,575 questionnaires were sent, out of which 1,234 questionnaires were retrieved. To ensure the validity of responses, the questionnaires were screened for non-responses. After a series of screening, the final valid questionnaires were 628.

Waste separation intention was measured by two items, while waste separation behaviour was measured by the frequency of separation. Both were scored on a five-point Likert-type scale. Five demographic characteristics gender, age, income, education and occupation were included in the model as moderators. The data analysis technique was partial least squares structural equation modelling, whiles PLS-multigroup analysis was used to examine group differences/ Contrary to the findings of Echegaray and Hansstein, (2017); Padilla and Trujillo (2017), males report a significant effect of perceived behavioural control on pro-environmental intentions and behaviour. For example, Padilla and Trujillo (2017) reported that when the household head was a man, the likelihood of recycling all types of waste decreased, suggesting that females showed a higher likelihood.

Also, the effect of subjective norms on pro-environmental intentions was higher for the middle-aged group. Perceived behavioural control was also higher among the young generation. The young and middle age group were more likely to engage in recycling than the older group. Consistent with Xu, Ling, Lu and Shen (2017) and Echegaray and Hansstein (2017), households in the middle and lower-income category shown a high level of intentions and was more likely to recycle. The implication of this study was necessary for developing demographic profiles and appropriate waste management policies.

Guiot and Urien (2019) established the effect of ageing on households sustainable e-waste management. The authors mainly looked at how factors related to ageing: generativity, available time and perceived skills influence sustainable e-waste management. The authors explain that age is only a description, but the associated physiological, psychological and sociological processes are what influences behaviour. Guiot and Urien (2019) provide an account of why for example, the young and middle age group were more likely to engage in recycling than the older group as reported by Xu, Ling, Lu and Shen (2017). Unlike gender, findings are inconsistent concerning age. The cross-sectional survey was conducted and self-administered by respondents through an online system. A sample of 600 households was involved in the study. Stratified sampling was used to select respondents for each age category: 31–45; 46–60; 61–75.

Covariance-based structural equation modelling was used to test the hypothesized relationships. The authors report a weak but positive effect of ageing on recycling frequency. Also, they confirm that age indirectly influence household recycling. Ageing has a positive effect on posterity generativity, perceived skills, available time for recycling and perceived control over behaviour. Posterity generativity is defined as an orientation towards future generation, which is linked to altruism. So, in effect, as people age, their helping intentions increase. Also, from the results, as people age, they reported more available time and skill to separate waste and recycle. It must be noted the effect of ageing on waste management is also linked to the state of development of a country in terms of economic, infrastructure and institutional structures.

Issock, Roberts-Lombard and Mpinganjira1 (2020) examined the role of normative influences on the intention to separate household waste and the moderating role of socio-demographic characteristics and upstream social marketing interventions. The moderation analysis was carried out by multigroup analysis of structural equation modelling. Results of moderation analysis also show age and gender recorded significant influences in their normative influence on waste sorting behaviour. Specifically, the relationship between descriptive norms and intentions was different among males and females. Descriptive norm was higher among males than females. This result is also confirmed by Xu, Ling, Lu and Shen, (2017), who reported that males are more likely to be influenced by social norms than women. Age moderated the relationship between injunctive, descriptive, moral norms and intentions.

The influence of socio-demographic characteristics, such as age, gender, income, education and household size, on sustainable waste management behaviours, continues to be a debate in the literature. For example, women were found to be consistently associated with pro-environmental behaviours, but the same is not reported of men. Other studies associate men with behaviours such as donation, membership of the environmental organisation and environmental protests (Oztekin et al., 2017). Recycling intentions is predominant among the high-income class and people with a high level of education. These people may have sufficient information, financial and logistical resources to overcome barriers such as carting of electronic waste appliances to collection points.

An empirical review of the interaction role of behavioural control factors in the intention-behaviour relationship.

The gap between pro-environmental intentions and actual behaviour has generated a lot of debate in the literature. On one hand, Auger and Devinney (2007) and Carrigan and Attalla (2001) believe the existence of the gap is due to methodological limitations such as social desirability associated with surveys. On the other hand, Barr (2006); and Carrington, Neville and Whitwell (2010) theorise the divergence between pro-environmental intentions and actual reported behaviour. While Barr (2006) presents a framework that shows the enablers and inhibitors of environmental actions, Carrington, Neville and Whitwell (2010) hypothesise that implementation pro-environmental intentions, actual behavioural control and situational factors could serve as inhibitors or enablers from pro-environmental intentions to actions. To understand how authors have subsequently studied the intention-behaviour gap, the following empirical results were: Grimmer and Miles (2017); Rosenthal (2018)**;** Nguyen, Nguyen and Hoang (2018); Zhang, Lai, Wang and Wang (2019), and Sultan, Tarafder, Pearson and Henryks (2020).

Grimmer and Miles (2017), based on a model by Carrington, Neville and Whitwell (2010), examined the factors that translate purchase pro-environmental intentions of environmentally friendly products into actual pro-environmental purchasing behaviour. Carrington et al. (2010) developed a model proposing implementation pro-environmental intentions (also referred to as 'plans') mediate the relationship between intention and behaviour, and facilitate the translation of intention into actual behaviour. The objective of this study was to analyse the intention-behaviour gap. According to the authors, implementations intentions such as plans create a higher tendency that a target behaviour is more likely to be performed. An initial online sampling resulted in 1019 consumers. A second stage sampling was adopted to ensure respondents were well represented in location, age and sex. A final sample of 772 consumers participated in the survey. The study design was cross-sectional and the approach was quantitative. Constructs were operationalized using items from validated scales.

The constructs were pro-environmental intentions, implementation intentions (plans), which was hypothesized to mediate, actual behavioural control and situational factors. An initial pilot survey was undertaken involving 272 undergraduate students. Data were processed using SPSS, and process macro by Hayes (2013) was used to test the hypotheses. The total effect of intentions on pro-environmental consumer behaviour recorded a value of β = 0.22, and after controlling for the mediating role of implementation intentions, the value reduced to β = 0.07. The authors concluded the significance of the mediating influence.

Thus, the likelihood of the performance of behaviour was dependent on the plans to engage in such behaviour. Although Ajzen (2011) describes a potential moderating role of actual control over behaviour, the findings of Grimmer and Miles (2017) imply that both mediating and moderating role of certain behavioural control and environmental factors are necessary to bridge the gap between pro-environmental intentions and the performance of a behaviour.

Rosenthal (2018) undertakes an analysis of behavioural control by examining how procedural steps and recycling-related information motivates the performance of the behaviour. This study was aimed at adding to the debate on the possible factors that could facilitate pro-environmental intentions into actions. Based on the implementation intentions argument indicated in Grimmer and Miles (2017), Rosenthal proposed the role of procedural information in performing the behaviour. Based on the TPB framework, procedural information was predicted to mediate, moderate and influence behavioural control. Longitudinal data were collected from 553 households**.** Data were analysed using SPSS and process macro by Preacher and Hayes (2008).

Results showed that recycling intentions positively and significantly predicted procedural information seeking, which in turn predicted sustainable e-waste management. The mediation analysis followed the bootstrap procedure with 5000 samples. Recycling intention was the independent variable, procedural information seeking was the mediator and sustainable e-waste management was the dependent variable. The indirect effect of pro-environmental intentions through procedure information seeking was significant. In addition, procedure information-seeking positively predicted behavioural control. Finally, the moderating effect of procedure information was also significant. The higher the information-seeking behaviour, the higher pro-environmental intentions predicted behaviour. Since both mediation and moderation were significant, one can conclude that indeed, pro-environmental intentions do not necessarily produce actions.

Nguyen, Nguyen and Hoang (2018) also examine the moderating role of product availability and perceived consumer effectiveness in the relationship between intention and green consumption behaviour. Product availability was operationalised as the ease and the convenience of purchasing green products and perceived consumer effectiveness was defined as the belief in one's ability to make a difference to environmental quality by purchasing and consuming environmentally friendly products. This is similar to self and outcome efficacy by Bandura. The authors believed that under high levels of these moderators, the intention-behaviour relationship will be stronger.

Data was collected from a sample of 416 consumers in the major urban areas in Vietnam. Multiple regression was applied to three regression models including the interaction effect. Availability of and accessibility to green products recorded a positive moderating effect on the relationship between green consumption intention and behaviour. Similarly, perceived consumer effectiveness also significantly moderated the relationship between pro-environmental intentions and behaviour, such that high levels of effectiveness were associated with higher positive correlations between pro-environmental intentions and behaviour.

In another related study, Zhang, Lai, Wang and Wang (2019) motivated by the discrepancy between intention to sort household waste and actions, aimed to explore the role of personal attitudes, accessibility and government stimulus on this gap. To achieve this, the authors examined the intention-behaviour gap within the assumptions of the norm activation and planned behaviour theory. Specifically, the authors examined pro-environmental intentions and household waste sorting behaviour. The study involved households in Taishan City, China, one of the 46 pilot cities for waste sorting in China. Questionnaires were administered to about 435 households, out of which 413 valid questionaries' were received. The questionnaire items consisted of a five-point Likert-type response format.

The analytical approach was partial least squares structural equation modelling. Results from the bootstrapping procedure were as follows: personal attitude significantly predicted behavioural intentions. Personal attitude is influenced by awareness of consequences and ascription of responsibility, and the latter also significantly mediated the relationship between awareness of consequences and personal attitude, thus confirming the hypothesis of the norm activation model. However, subjective norms and perceived behavioural control did not significantly influence behavioural pro-environmental intentions.

The authors included facilities accessibility in the model. Facilities accessibility, together with pro-environmental intentions significantly influenced waste sorting behaviour. Pro-environmental intentions do not always lead to actions. In a real-world situation, one will mostly find a discrepancy between pro-environmental intentions and behaviour, but how wide the gap and how to narrow it is usually the basis for studies. Zhang, Lai, Wang and Wang (2019), also examined the moderating role of access to facilities and government stimulus. The hypothesis was that the effect of intention on waste sorting behaviour is stronger when accessibility and government stimulus is present. The authors found no support for moderation. However, the direct effect of accessibility and government stimulus on waste sorting behaviour was significant.

In a related study, Sultan, Tarafder, Pearson and Henryks (2020) examine the intention-behaviour gap through a cross-sectional survey. Specifically, the study examines the moderating effect of communication, satisfaction and trust on the intention-behaviour gap and the relationship between perceived behavioural control and actual behaviour. The authors were motivated by the rising interest in the consumption of organic foods. According to the authors, consumers usually have intentions to consume organic foods for health and environmental reasons, but the presence of psychological, economic and physical barriers impedes the occurrence of the purchase and actual consumption decision.

Data were solicited through online questionnaire administration. In all, 1, 011 consumers participated in the online survey out of an estimated population of 17,615. Data were analysed using partial least squares structural equation modelling. Overall, the hypothesised moderated relationships were positive and significant. The results demonstrated that the moderators, namely, perceived communication, satisfaction and trust, significantly improve the intention and actual behaviour gap and perceived control over behaviour and actual behaviour gap.

Examining the results reported in support of the intention-behaviour dichotomy, it was clear that pro-environmental intentions better predict actions when other factors played interacting role. Empirical evidence shows that the intention-behaviour gap exists regardless of methodological concerns such as social desirability as indicated by (Hassan, Shiu & Shaw, 2016). While some of the studies examined were not related to sustainable e-waste management, the philosophical reasoning and theoretical framework for examining the intention-behaviour gap applies to most behaviours in the pro-environmental studies.

Emerging Issues from Literature Review and Lessons for the Study

The review of the literature provided useful insight into issues such as electronic waste classification system, variable operationalization, measurement, sampling procedure and data analysis. First, the review suggests that electronic waste management practices have become an emerging area of study because, although its contribution to municipal solid waste is less, it has relatively higher environmental, social, economic and health implications (Hamdan & Saidan, 2020).

In addition to operational issues, it was also observed from the review that cross-sectional study design was appropriate for a study involving waste management practices of households. Besides, most of the studies reviewed used questionnaires, while few included interviews. Also, the review suggested that the data analysis technique appropriate for testing hypothesized relationships, including mediation and moderation was structural equation modelling. SEM-Multigroup analysis was used to examine the moderating role of demographic characteristics of respondents.

It was also observed that most studies that examined the intention-behaviour gap to establish possible moderated variables were not significant. For example, Zhang, Lai, Wang and Wang (2019) moderated the intention-behaviour relationship with availability of waste management facilities. The moderation was not significant, however, facilities accessibility, together with intentions significantly influenced waste sorting behaviour. Kumar (2019) also moderated the relationship between attitude and intentions with a sense of duty (self-responsibility) The interaction role was not significant. The reason most moderation was not significant was that these studies did not follow procedures for conceptualization and measurement of interaction variables by Baron and Kenny (1986).

Baron and Kenny, (1986) define moderators as either qualitative (such as gender, race) or quantitative variable (such as level of income) that affects the direction and/or strength of the relationship between independent and dependent variable. They further added that moderator variables partition a focal independent-dependent variable relationship into subgroups. As a lesson, this study was guided by procedures for establishing moderation and mediation as indicated in literature (Baron & Keney, 1986; Hayes 2009, 2013; Zhao, Lynch, Chen, 2010). On this note, moderation was performed using the socio-demographic characteristics of the respondents.

Other lessons duly acknowledged is measurement principles suggested for using the theory of planned behaviour to underpin relationships among constructs. One of these principles was TACT which stands for target, action, context and time. The TACT principle defines the boundary within which the theory operates. Again, the requirement for the measurement of variables is that each belief-based variable should be assessed with double items to allow for better evaluation of the variable (Armitage & Conner, 2001). Also, sampling procedures were mainly non-probability techniques. Those that used probability sampling sourced that data from a secondary database. Cluster sampling technique is suggested for studies that conduct data collection through a survey (Fowler, Jr. 2013).

Conceptual Framework on the Determinants of Sustainable E-Waste Management among Households

According to the waste management hierarchy by Linsink (1979) sustainable electronic waste management was operationalised as actions taken by owners of end of life equipment that ensures useful materials are recovered for other processes and useful parts safely discarded by regulated collectors and recyclers. The relevance of recycling has been established by the strong sustainability paradigm as an important tool towards resource conservation. The proponents of this paradigm, particularly one by Hawken, Lovins and Lovins (2013) propose resource conservation through circular economic models.

Understanding human behaviour in waste minimization, reuse and recycling has gained increasing attention in the sustainability literature, as pro-environmental behaviours. Intentions to engage in pro-environmental behaviour such as patronising electronic waste collection system have been examined within the framework of the theory of planned behaviour and from the norm activation theory. Based on the reviews and analysis of the theories, a conceptual framework is presented in Figure 9.

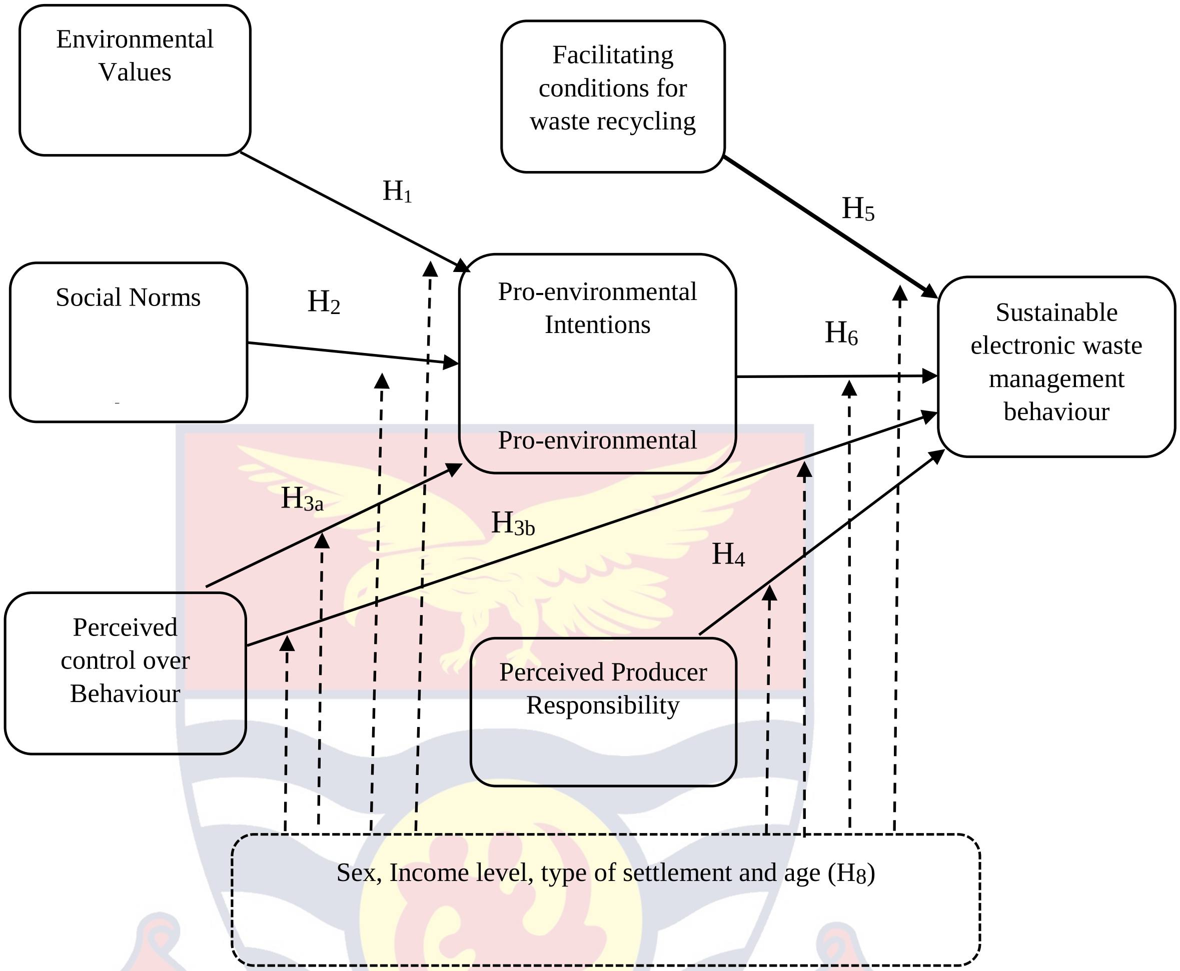

Figure 9: Conceptual framework constructed from review of related literature

Source: Author's construct (Ofori, 2020) based on literature review.

The conceptual framework shows the proposed relationships among the determinants of pro-environmental intentions, sustainable electronic waste management behaviours, the moderating role of socio-demographic characteristics. According to the planned behaviour and the norm activation theories, pro-environmental intentions are described as the motivation to adopt environmentally-friendly consumption and disposal behaviours, and this motivation is hypothesised to be influenced by environmental values (H1), social norms (H2), and perceived behavioural control (H3a). Attitude was represented on the framework as environmental values because it shares similar conceptual and operational definition. This is supported by the norm activation theory, which describes the importance of environmental values and altruistic behaviours to promote pro-environmental behaviours.

According to the theory of planned behaviour, the immediate determinant of behaviour is the underlying motivation to engage in the behaviour, together with actual control and other facilitating conditions. On that note, it was postulated that sustainable electronic waste management behaviour is influenced by pro-environmental intentions (H6), actual control over behaviour (H3b), facilitating conditions (H5), and perceived producer responsibility (H4). Perceived producer responsibility is conceptualised as how original equipment manufacturers promote environmental, health and socially valuable information through the four marketing Ps: product, price, place and product (Helmig & Thaler, 2010; Smith, 2000). The theory of planned behaviour and the circular economy postulates the presence of facilitating conditions (H4) that facilitate the performance of the desired behaviour (Varotto & Spagnolli, 2017). These conditions are described as facilitating conditions, and they include the supporting infrastructure, regulations and incentives to promote recycling.

The moderating role played by socio-demographic characteristics has been acknowledged in pro-environmental behaviour literature (Varotto & Spagnolli, 2017). The influence of socio-demographic characteristics such as age, gender, income, education and household size on sustainable waste management behaviours continues to be a debate in the literature. For example, women were found to be consistently associated with pro-environmental behaviours (Triguero, Álvarez-Aledo & Cuerva, 2016; Chekima, et al. 2016; Echegaray & Hansstein, 2017), but the same is not reported of men. The implication of the socio-demographic characteristics influences sustainable e-waste management. For example, people with high educational background and high income may have sufficient information, financial and logistical resources to overcome barriers such as carting of electronic waste appliances to collection points.

Chapter Summary

This chapter presented an empirical review on sustainable electronic waste management. It aimed to synthesise, explore and critique existing studies related to sustainable electronic waste management practices among households. The waste management hierarchy defines sustainable actions for managing waste. Specifically, the hierarchy describes waste minimisation, reuse and recycling as behaviours that are underpinned by social-demographic forces, forces within the individual, and institutional forces. This discussion was guided by planned behaviour, norm activation and psychological ownership theories. Empirical works on determinants of electronic waste recycling among households. A review of the relationship between pro-environmental intentions and sustainable behaviours was also examined. Finally, studies on the influence of socio-demographic factors on waste management behaviours were also presented.

CHAPTER FOUR

RESEARCH METHODS

Introduction

This chapter of the study discusses the research methodology adopted to achieve the purpose of the study. Research methodology involves the procedures and approaches involved in scientific enquiry. It also presents the techniques to identify, select, process and analyse data about a specific phenomenon. It guides the nature and type of data to collect, whom to collect from, how to collect and how to analyse. Further in this chapter, the study design is presented within the context of postpositivist research paradigm. This is followed by a description of the study population and sampling procedures. The data requirements, as well as instrument design, are also specified. Finally, challenge(s) of fieldwork, procedures and methods for data management and data analysis, are presented.

Research Philosophy

The approach to knowledge enquiry follows two main strands of research philosophies or world views: positivism and interpretivism. Positivism sees reality as objective, one truth. Research can be generalised and replicated following the scientific method. Interpretivism, on the other hand, perceives truth as context-specific and socially constructed. It emphasises on context-specific experiences of people. Within these philosophical thoughts lie Postpositivist, Constructivist, Transformative and Pragmatist.

A paradigm (also called worldview) has been defined as a set of basic beliefs, values, assumptions, or worldviews that are shared between scientists about how investigations should be carried out (Kuhn, 2011). Understanding the right philosophical perspectives is important because it influences how the research should be conducted, the approach and the major research implications arising from them. Creswell and Creswell (2017) notes that the philosophical assumptions guide decisions concerning the appropriate research approaches, whether quantitative, qualitative or mixed designs that should be implemented to achieve the research objectives. Guba and Lincoln (1994) ask three fundamental questions that these paradigms seek to answer.

1. What is reality? This is the ontological question
2. How should we search or look for reality? The epistemological question
3. How can the inquirer go about finding out the things that he/she believes can be known? The methodological question.

According to Creswell and Creswell (2017), four world views are most useful for informing research methods. These worldviews or paradigms and their characteristics are summarised and shown in Table 1.

Table 1: Worldviews in Scientific Research

Postpositivist	Constructivist	Transformative	Pragmatist
Determination	Understanding	Political, activist, advocacy	Consequences of actions
Reductionism	Multiple participant meanings	Empowerment, human rights, social justice-oriented	Problem centred
Empirical observation and measurements	Social and historical construction	collaborative	Pluralistic
Theory verification	Theory generation	Change, emancipatory oriented	Real-world practice-oriented

Source: Adapted from Creswell and Clark (2017)

A review of literature in this study clearly shows that most of the studies reviewed adopted a quantitative survey using questionnaires as the main data collection instrument. Households exhibit a lot of socio-demographic characteristics, which any survey have to reflect these characteristics to be able to make good judgements and policy recommendations. Based on the overall purpose of the study, the postpositivist approach to scientific enquiry was deemed suitable as a guiding philosophy because it lends itself to the development and testing of hypotheses. The study collected data from a large population to examine the factors that influence pro-environmental intentions and sustainable electronic waste management behaviours among a sample of households. The specific objectives require the collection of quantitative data so that results could be generalised to the population.

Postpositivism represents thinking after the strict assumption of the absolute truth of knowledge by the positivists was challenged (Philips & Burbules, 2000). The Postpositivist believes that reality is out there, but there are limits to our ability to capture an absolute truth. Postpositivism is an extension of the ideas in positivism. It maintains, however, that one cannot develop an absolute true picture of reality, but an approximation of the object of research. Researchers are mainly looking for cause and effect or determinism. As noted by Slife and Williams (1995), researchers who belief in this thought engage in reductionism, by narrowing, and reducing ideas into a small, discrete set of hypotheses, and focusing on interrelated variables to conclude. Postpositivist lends themselves to careful observation and measurement of objective reality by using instruments such as questionnaires and generating numeric measures of behaviour.

Constructionism is typically associated with qualitative studies, where enquiry into understanding the meaning of social phenomenon through the collection of subjective views. Transformative is focused on the need for social justice and the pursuit of human rights. Pragmatism is typically associated with mixed methods (Creswell & Clark, 2017). The pragmatist uses all available research approaches to seek reality. These worldviews or paradigm differ in terms of their philosophical assumptions: ontology, epistemology and methodology. Table 2 shows a summary of the differences between these views, based on ontology, epistemology and methodology.

Table 2: Assumptions of the World Views and their Implication for Research

Philosophical question	Post positivism	Constructivism	Transformative	Pragmatism
Ontology (what is the nature of reality)	Singular reality (e.g researchers reject or fail to reject hypothesis)	Multiple realities (e.g researchers provide quotes to illustrate different perspectives	Multifaceted and based on different social and cultural positions	Singular and multiple realities (there is a test of hypothesis and provide multiple truths)
Epistemology (what is the relationship between the researcher and what is being studied)	Researchers objectively collect data using instruments. There is distance and impartiality	Closeness and subjectivity (e.g researcher visits participants at their sites to enquire and collect data)	Collaboration (participants are involved through trust-building and honouring the opinions of participants)	Practicality (e.g researchers collect data using an approach that works to address the research question
Methodology (what process is followed)	Deductive (e.g researchers test an a priori theory)	Inductive (researchers start with participants' views, and build up, observe trends in responses and eventually develop propositions leading to theories)	Participatory (e.g researchers involve participants in all stages of the research)	Combination (e.g researchers collect both quantitative and qualitative data and mix them)

Source: Adapted from Creswell and Clark (2017)

Research Approach

Research approach refers to the overall strategy against which specific designs are implemented. Research approach is informed by the research philosophy, which has been discussed in the previous pages. From the discussions, it was realized that Ontological and epistemological beliefs eventually shape their respective approach to conducting research. The literature presents three main research approaches that inform scientific enquiry. They are qualitative, quantitative and mixed studies. Table 3 presents a summary of the features of each approach.

Table 3: Summary of key features of Research Appraoches

Quantitative methods	Qualitative methods	Mixed methods
Pre-determined	Emerging methods	Pre-determined and emerging methods
Instrument-based	Open-ended questions through an interview, observation, document and audio-visual data	Both open and close-ended
close ended		Numerical and text
Numerical data		
Statistical analysis	Text and image analysis	Statistical and narrative or text analysis
Statistical interpretation	Themes, patterns interpretation	Across database interpretation

Source: Creswell (2013)

The Postpositivist approach to data collection and analysis is quantitative (Table 2). Quantitative research, according to Creswell and Creswell (2017), is an approach for testing theories by examining the interrelationships among concepts in these theories. These concepts are operationalised and measured with instruments, mostly questionnaires so that numerical data can be generated and analysed using statistical procedures. Reductionism, a key feature of the quantitative approach, helps to summarise large dataset into numbers, which helps to describe, explain or predict (Crossan, 2003). Another feature of quantitative research is that the research design is determined before commencing the research project. The advantage of the quantitative approach is the ability to study a large sample size in a cost-effective and time-saving way.

However, quantitative research may be limited by the procedure's focus on numbers, at the expense of personal experience, beliefs and practices of individuals or group of people are involved. Informed by the Postpositivist research paradigm, this study adopts a non-intervention, quantitative approach as design, data collection and analysis. Post positivist adopts empiricist epistemology in the search of objective reality. Postpositivist provides room for falsifiability by switching from positive proofs to "null" hypothesis. It is, for this reason, one does not prove hypotheses; instead, one indicates a failure to reject the hypothesis. The role of scientific theory in Post positivism is prediction and falsification. Key contributor, Karl Popper, is known for his rejection of the classical inductivist views on the scientific method in favour of empirical falsification.

Quantitative research involves the development of testable hypotheses and theories which are generalizable across populations. It is characterised by comparisons or correlations of population attributes, generalisation to populations, numerical summaries, large sample and prescribed process to establish validity and reliability of data collection and analysis. The quantitative approach to scientific enquiry involves the identification of a problem and purpose, review of relevant literature, development of hypotheses, and test of the hypotheses to conclude.

Study Design

Study designs are specific designs in qualitative, quantitative or mixed method approaches. There are several study designs that has been identified in literature. These include experimental designs, survey, comparative, case study, observational, cross-sectional, cohort, epidemiological and longitudinal. Experimental requires some interventions in a controlled environment. This study employed a cross-sectional survey design, non-interventional approach because the objective was to collect data about the awareness level, socio-demographic characteristics, attitudes and values of households about sustainable electronic waste management at a point in time.

According to Fowler Jr. (2013), characterisation of the population on social problems, such as transportation, housing, political behaviour and other social problems, are areas where cross-sectional survey research is extensively used. Surveys help to collect information about people, describe, compare or explain constructs (Crossan, 2003). Surveys help to collect verifiable information from a sample population. In quantitative research surveys usually include questions that allow respondents to select responses along a scale or other responses that results in numerical or metric data. Research objectives in survey studies may describe, compare, relate or predict (Fowler Jr., 2013).

Descriptive research questions, according to Kroll and Neri, (2009) constrain the researcher to describe what currently exists. In describing, one can examine perception, attitude or practices or describe a population by gathering data about their socio-demographic characteristics. Kroll and Neri (2009) explains that relational objective addresses or establishes a relationship between two or more variables, while causal allows for drawing a causal inference by controlling or intervening in the research environment, which is usually referred to as an experiment. In the quantitative research approach, research objectives or questions serve as the basis for developing hypotheses. These are usually developed after an extensive review of the literature. Hypotheses translate or operationalise research objectives by making them testable.

One of the main advantages of the quantitative approach, especially those implemented through surveys, is the relative ease and speed with which research is conducted. Furthermore, quantitative approach to data analysis and collection is useful when the population is very large because it can cover a wider range of situations, and where statistics are gathered from large samples, results of such studies may be of considerable relevance to policy decisions (Cooper & Schindler, 2006). The weaknesses of this approach lie in its inflexibility, artificial, and ineffective in gauging the significance people attach to actions, beliefs, nor are they helpful in generating theories (Crotty 1998).

Study Area

The chosen area for the study is the Greater Accra Region. This region was chosen because of its population density and diversity in terms of income levels, education, settlements and ethnicity (Ghana Statistical Service, 2010). Besides, most of the formal and informal recycling takes place in these regions (Oteng-ababio et al., 2017). In addition, Agbobloshie, the largest informal recycling hub in West Africa is located in the region (Keesman, 2019). It also happens that there are huge markets for used electronic and electrical equipment. The region serves as the transit point for both new and used electronic products before they are finally distributed to other regions. Greater Accra Region is made up of sixteen (16) administrative groups. Table 4 shows the administrative groupings of the Greater Accra Region.

Table 4: Administrative groupings of Greater Accra Region

Metropolitans	Municipal	Districts
Tema	Adentan	Ada East
Accra	Ashaiman	Ada West
	Ga Central	Kpone Katamanso
	Ga East	Ningo Prampram
	Ga South	Shai Osudoku
	Ga West	
	La Dade Kotopon	
	La Nkwantanang Madina	
	Ledzokuku-Krowor	

Source: Ghana Statistical Service, 2019

Out of the sixteen, there are two (2) Metropolitan, nine (9) Municipal and five (5) Districts Assemblies (Ghana Statistical Service, 2019). However, three areas including Tema Metropolis, Ga East and Adentan Municipal Assemblies were selected for the study. The choice was based on the Population and Housing Census Report in 2010, which showed that these three areas have the highest percentage of households with desktop or laptop computer. The region remains the highest in terms of usage as well as waste generation from electronic products. Table 5 shows the percentage of households with desktop/laptop computers, and Figure 10 gives a pictorial description of the study area.

Table 5: Percentage of households with desktop/laptop computers

District	Total number of Household	Household with desktop/laptop	Household with desktop/laptop (%)
Total	1,036,426	174,285	16.8
Ga South	118,846	16,125	13.6
Ga West	66,706	11,657	17.5
Ga East	66,286	15,296	23.1
Accra Metropolis	501,956	84,559	16.8
Adentan Municipal	20,478	4,256	20.8
Ledzokuku/Krowor	60,859	10,880	17.9
Ashaiman Municipal	49,936	5,631	11.3
Tema Metropolis	97,597	22,893	23.5
Dangme West	26,489	1,756	6.6
Dangme East	27,273	1,232	4.5

Source: Ghana Statistical Service (2010)

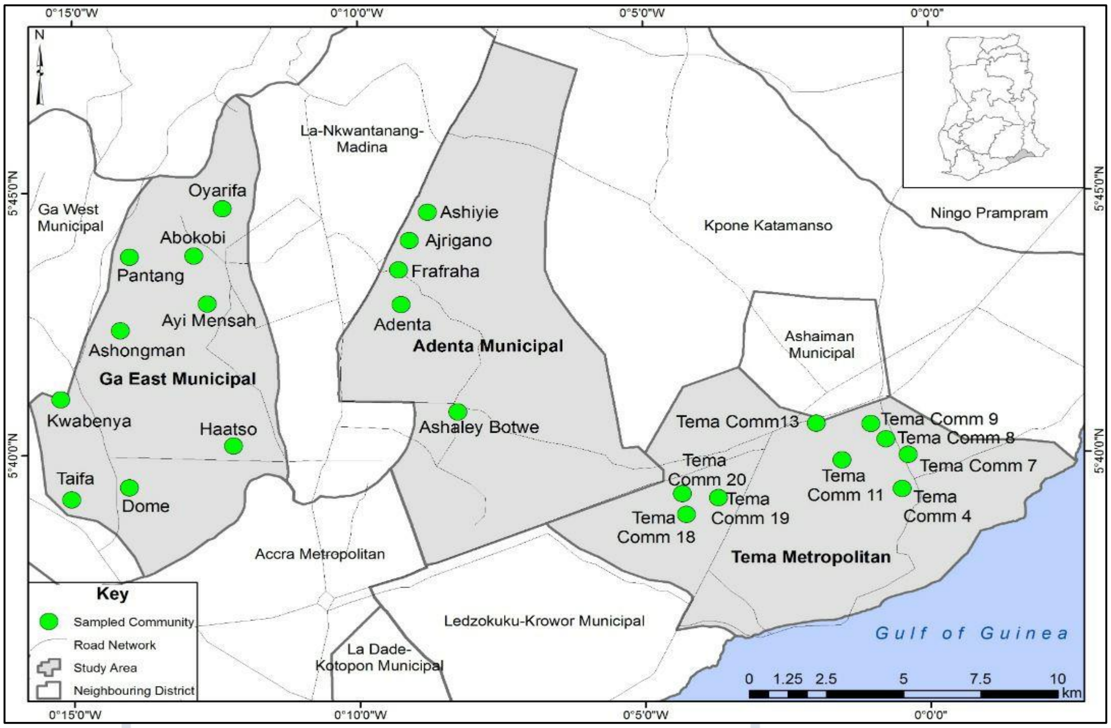

Figure 10: Map showing the study areas

Population

The target population comprised of households in the Tema Metropolis, Ga East and Adentan Municipal Assemblies in the Greater Accra Region. In the 2010 Population and Housing Census, a household was defined as “a person or a group of persons, who live together in the same house or compound, share the same house-keeping arrangements and recognize one person as the head of household” (Ghana Statistical Service, 2010: 26). A household, therefore, may consist of a man, his wife, children, distant relatives, or a housekeeper living with them. The members of the household have key decision-makers who are described as household head. The head of the household is generally the person who has an economic and social responsibility for the household. All relationships are defined with reference to the head.

Households constitute important units in planning for goods and services. In Ghana, for instance, some social intervention programmes are targeted at the household. It is worthy to note that there can be two or more families forming a household. But in this study, a household was equated to a family unit, based on the definition of household given by the Ghana Statistical Service. Besides, social intervention programmes such as livelihood empowerment, health and social welfare-related issues are targeted at households. There is increasing attention being given to the family as the unit of analysis in consumer behaviour. Such emphasis stresses the importance of assessing the characteristics of families that affect waste management.

Households were chosen as the unit of analysis because collective family decisions and the characteristics of the family affects acquisition, consumption and disposition. From the 2010 Population and Housing Census, there were 5,467,136 households in the country with 55.8 per cent of the households in the urban areas. Greater Accra Region has 1,036,426 households. According to Bartlett, Kotrlik and Higgins (2001), such population size is considered as an infinite population. The regional distribution of households is presented in Table 6.

Table 6: Regional distribution of households

Region	Number of households			Percentage
	Urban	Rural	Regional Total	
Greater Accra	**950,391**	**86,035**	**1, 036, 426**	19.0
Western	248,919	304,716	552,635	10.1
Central	255, 365	271,399	526, 764	9.6
Volta	178,817	316,786	495, 603	9.1
Eastern	293,549	338,499	632,048	11.6
Ashanti	715,470	410,746	1, 126216	20.6
Brong Ahafo	236,287	254,232	490, 519	9.0
Northern	106,071	212,048	318, 119	5.8
Upper east	41,941	135,690	177, 631	3.2
Upper west	22, 628	87,547	110, 175	2.0
Total	**3, 049,438**	**2,417,698**	**5, 467, 136**	**100.0**

Source: 2010 Housing and Population Census National Analytical Report

The data were collected from three administrative clusters: Tema Metropolis, Ga East and Adentan Municipal Assemblies. The Tema Metropolis is clustered into twenty-six communities. The popular communities are 1,2 4,7 8, 9, 13, 18, 19 and 20. Tema Metropolis is described as an industrial enclave of Ghana because it houses the Tema Harbour and other major infrastructure, such as energy, making it an ideal location for both light and heavy industrial settlements. The metropolis also boasts of a diverse population because of its cosmopolitan nature.

Ga East Municipal is bordered on the North by Akuapim District, to the west by Ga West and the south by Accra Metropolis and in the East by Tema Metropolis. Major towns in the Municipality include Abokobi, the capital, Dome, and Taifa. Other smaller towns include Ashognman, Ayi Mensah, Bansa, Haasto, Kwabenya, Oyarifa and Pantang. Adentan Municipalities shares boundaries with Ashaiman Municipal Assembly and Kpong Akatamanso District Assembly in the east and north, La Nkwantanang Municipal Assembly in the West and south, in the north. The municipality serves as a dormitory town for most people who have migrated to seek employment in the service sector, industries and government institutions within the Tema. The average household size is 3.7 persons per household.

Sampling Procedure

The primary sampling unit is households located in the Greater Accra Region. The study involves the collection of quantitative data. Determining the optimal sample size is important, and as a result, such an exercise must be guided and proper procedures followed. The convenience sampling technique was adopted because it was not possible to draw a random sample. However, according to Anderson et al. (2020, p. 325), one can still achieve random sample from an infinite population if the samples selected meets the following conditions:

a. Each element selected comes from the same population; and
b. Each element is selected independently.

Again, according to Fowler Jr. (2014), the technique is appropriate when a large population dispersed over a large area. The technique helps to generate a representative sample size even when a large population is involved. Also, it is deemed a cost-effective way to select respondents when large population sizes are involved. Again, one does not need a sampling frame listing all elements. Instead, clusters can be chosen from pre-determined or existing groups.

Out of the ten, three clusters were chosen. The choice of the cluster was based on the administrative area with the high percentage of households with desktop, laptop computers and access to ICT facilities, namely internet and mobile phones (see Table 5). On that note, Tema Metropolis (23.5%), Ga East (23.1%) and Adentan Municipal (20.8%) were selected. Accordingly, the number of questionnaires administered was in proportion to these percentages. In all, a total of 850 questionnaires were administered. Based on proportions, 298, 289 and 263 questionnaires were administered respectively. Within each cluster, because the population of households was described as infinite,

Data Collection Instruments

Questionnaires were used to collect data from the respondents. This was deemed appropriate, considering the study design and the research approach adopted for the study. A questionnaire is a data collection instrument, usually made up of closed and open-ended items, distributed to research participants to solicit their objective views about a subject matter (Cooper & Schindler 2011). According to Fowler Jr (2014), a questionnaire has definite, concrete and predetermined questions requiring respondents to rate along a scale. This aids in collecting uniform and objective views from respondents.

Questionnaires are the appropriate choice for surveys involving the collection of quantitative data from a larger population. In the realm of objectivity, questionnaires can produce valid and reliable responses where generalisation of results to a study population is required (Fowler Jr., 2014). However, it does not allow investigators the freedom to ask supplementary probing questions. In some instances, open-ended questions had been used to collect additional information. Respondents in this instance, apart from the objective scores provided, are expected to write additional responses in the form of text.

Two sets of questionnaires were developed for the study. The first set (Appendix B) was to identify the most frequently generated electronic waste in our homes. Respondents were presented with a predetermined list, consisting of six categories of electronic and electrical equipment. This categorisation was informed by the United Nations University UNU (Wang et al., 2012). This classification is referred to as the UNU-KEYS. The second questionnaire (Appendix C) comprised of 98 items grouped under three sections: A, B, and C. Section A sought socio-demographic characteristics of respondents. Section B contained questions on the awareness, nature of electronic waste generated and disposal practices among households. Section C solicited information on the determinants of sustainable electronic waste management behaviour. Section C was based on the concepts in the planned behaviour and the norm activation theories and were measured using unipolar scales (+1 to +7) (Newton, Ewing, Burney & Hay, 2012).

Operationalisation of Variables and Measurement

The conceptualisation of a study creates abstract phenomena that require operationalisation so that hypotheses can be developed and tested. Variable operationalisation helps to apply measurement theory to define concepts to a more empirical level (Hair et al, 2018). The study was based on sustainable development, planned behaviour and norm activation theories, which also guided the generation of the research objectives and development of research hypotheses. Based on the review of the literature and emerging lessons, the key concepts were sustainable electronic waste management, which was the endogenous variable, pro-environmental intentions, perceived producer responsibility, facilitating conditions, perceived control over behaviour, social norms and environmental values.

Sustainable electronic waste management was a key concept of the study. The operationalisation of the concept was guided by the waste management hierarchy by Lansink (1975). In that model, sustainable electronic waste management was defined as waste reduction, reuse, recycling and maintaining landfilling as the last option. So sustainable electronic waste management among households involves the adoption of behaviours that ensure waste reduction, reuse, recycling and resorting to landfilling as the last option. Sustainable electronic waste management was measured through self-reported behaviour. Specifically, electronic waste management practices were measured using items adapted from Bamberg (2002) and the pro-environmental behaviour scale by Markle (2013). Participants reported the extent to which they engaged in practices that reduced waste, contributes to reuse and promote recycling during the past year.

Based on the conceptualisation provided by Barr (2007), Maki and Rothman (2017), pro-environmental intentions in this context was operationalised as the underlying motivation to engage in sustainable electronic waste management. The items measuring pro-environmental intentions were adapted from Azjen and Fishbein (1977), Ajzen (1991) and Rothman (2017). Measures of the concept included "I intend to engage in sustainable electronic waste recycling", "I plan to engage in sustainable electronic waste recycling", I will try to engage in sustainable electronic waste recycling", and "I am willing to tell people about sustainable electronic waste management".

Perceived producer responsibility was operationalised into four main dimensions. They are physical or product responsibility, informative responsibility, economic responsibility and liability or legal responsibility. This categorisation was based on the extended producer responsibility model by Lindhqvist (2000). Households are directly influenced by the extent of producers' involvement in the physical management of their product such as setting up designated points for recalls or take-backs. Also, information responsibility is the supply of information on the environmental properties of a product. This is usually observed through stickers and labels that come with products and their packages. Consequently, perceived producer responsibility was measured with items reflecting information and physical responsibility. The items were adapted from Lindhqvist, (2000) and Tojo, (2004).

Facilitating conditions include the supporting infrastructure, policy factors, regulations and incentives that promote sustainable electronic waste management. Facilitating conditions was a necessary factor because producer responsibility was inadequate in addressing waste management because it was mainly a voluntary approach where firms are encouraged to take responsibility for managing end-of-life products and other related waste. Rogers (1998) described such voluntary approaches as useful but requires the support of ‘command and control’ forces. Facilitating conditions was measured with items adapted from Wan, Shen and Yu 2014) and Zhang, Lai, Wang and Wang (2019). Collectively, these items solicited information on the availability of sanctions, incentives and infrastructure to promote sustainable electronic waste management.

Environmental values reflect individuals' an individual’s general propensity to engage in practices that will minimize harm to the environment (Kim & Chung, 2011). De Groot and Steg (2007) describe these values as biospheric values. When an individual has a strong environmental consciousness, he/she is more concerned about protecting the environment (Dunlap, 2008; Dunlap, Liere, Mertig, & Jones 2000; Ritter et al., 2015). According to these authors, concern for the quality of the environment influences an individual's attitude towards environmental issues. Items measuring environmental values were adapted from De Groot and Steg (2007) and the new environmental paradigm scale by Dunlap (2008). The new environmental paradigm scale has a set of 16 items measuring environmental attitude of individuals.

Operationalisation and measurement of attitude, social norms, and perceived control over behaviour, were adapted from Ajzen (1991; Azjen & Fishbein, 1977; Ajzen, 2002, 2011a); and suggestions from other studies such as Rivis and Sheeran (2003); and Passafaro, Livi and Kosic (2019). Also, Tobergte and Curtis, (2013) propose that measurement of planned behaviour constructs must follow three principles: specificity, enactment or avoidance and observation. As a guide for studies, Ajzen and Fishbein (1980) indicated four elements that must be addressed to ensure specificity. These elements have been codified in a framework called TACT principle which include target, action, context and time.

The first element 'action' refers to the specific nature of the behaviour being investigated. Ajzen and Fishbein (1980) distinguished between two behavioural categories: behaviour and a behavioural outcome. Sustainable waste management is described as behaviour and not an outcome. The second condition in the TACT principle refers to the 'target' at which a behaviour or action is directed. In this study, the target is electronic waste. The third element of context refers to 'where' and for 'what' purpose people enact the behaviour. The context in this study was the households engaging in electronic waste minimisation through reuse and recycling. The final element of time refers to the time frame within which the behaviour is observed.

The inclusion of all four elements makes the behaviour more specific, however for some behaviours, action, context and time may be sufficient. Tobergte and Curtis (2013) show that the minimum required is action and context, and to improve the validity and reliability of the instrument, questions should be formulated following the behaviour being measured. The next consideration according to Tobergte and Curtis, (2013) is the nature of behaviour whether it involves the enactment of or avoidance of a behaviour. The final issue concerns whether the behaviour is to be measured by self-report or by observation. In some instances, the choice is made by the nature of the behaviour itself or the research design. The study design required that data were collected from a large population and so using self-reports was appropriate, faster and easy to implement that than observation (Armitage & Conner, 2001).

Further, according to Ajzen (1991, 2011b), the measures for attitude, social norms and perceived control over behaviour should be defined by an expectancy-value model, where belief strength is multiplied by outcome evaluation, and the products are subsequently summed across all the constructs. Hence, in measuring behavioural beliefs, both belief strength and outcome evaluation was captured (Appendix C). In the same way, normative beliefs was measured by assessing normative belief strength and motivation to comply while control beliefs were measured by assessing control belief strength and control belief power (Gagné & Godin, 2000). Given these measurement directions, each belief-based variable was assessed with double items. Accordingly, attitude towards the behaviour was measured using 3-items as posited by the theory of planned behaviour.

Social norms, which referred to perceived social pressure from significant people in an individual's social network, were also measured with seven items. Social norms were further classified into descriptive norms and injunctive norms. Injunctive norms were measured with four items, while descriptive norms were measured with three items. However, some modification to the questions were necessary. Perceived behavioural control was measured with three items, which include "I have enough knowledge on proper waste management practices, I have been implementing the knowledge and will continue to do". The items relating to attitude, social norms and perceived control over behaviour were adapted from Ajzen (1991, 2002, 2011a); Rivis and Sheeran (2003); and Passafaro, Livi and Kosic (2019).

In the context of structural equation modelling, these operationalised concepts are referred to as latent variables. Constructs are not directly observed but are inferred from manifest variables that are observed or directly measurable. Manifest variables are also referred to as items or indicators, which were the questions administered to the respondents. These indicators are viewed as a representative sample of all the possible items available in the conceptual domain of the construct when the construct is reflectively measured (Hair Jr, Sarstedt, Ringle & Gudergan, 2017). All the latent variables were reflectively measured because the items are considered to manifest indicators reflective of the underlying constructs. Again, Diamantopoulos and Siguaw (2006) mention that the choice of formative or reflective should be informed by content, parsimony and criterion validity. Accordingly, several indicators were drawn from scales in literature. According to Hair et al (2017), using several indicators to measure concepts is more likely to represent all the different aspects of the concepts, which helps in reducing measurement errors (Hair et al., 2011).

Dealing with Non-Response

Non-response affects studies, especially when probability sampling is used. One way to deal with non-response is to oversample (Fowler Jr., 2014). A review of literature reports response rates for online surveys at 40-55% whiles that of face to face is between 60 to 75%. In social science research, Barbie and Kidder et al (2017) regarded 50% as an acceptable response rate. One of the methods of estimating the non-response rate is using results from pilot studies (Bartlett, Kotrlik & Higgins 2001). Accordingly, the response rate for the main study was estimated from the pilot studies. The strategy for reducing the non-response rate differ from the type of survey being conducted. Thus, the techniques for mail surveys are different from telephone and face to face. According to Fowler Jr (2014), the following are some measures to reduce non-response which were implemented in this study:

1. Effective communication and presenting accurately the purpose of the research project.
2. Ensuring flexible appointments and using weekends as most people are usually at homes.
3. Training of interviewers.
4. Interviewers being present at data collection sites to answer queries from respondents.

Common Method Bias and Social Desirability

Common method bias also referred to as common method variance (CMV) has been defined by Campbell and Fiske (1959) cited in (Malhotra, Schaller, & Patil, 2017) as the potential alterations to true correlations among observed variables in a study, because the data for these variables are being collected from respondents using a single survey instrument and at the same time. According to Podsakoff et al. (2003), some examples of common rater effects include social desirability, acquiescence bias, leniency effect and consistency motive. The effect of these is that respondents may be lenient in their responses. For example, people tend to over-report good behaviours and under-report negative behaviours, and this is highly associated with studies that elicit responses of socially desirable behaviours such as waste management, values and ethics (Onwezen, Antonides, & Bartels, 2013).

The second category is called item characteristic effects, where common item formats and common item content are used to operationalize multiple variables on a questionnaire. Although this practice helps to reduce respondent fatigue, some authors are of the view that it encourages a phenomenon termed as "global ticking". Respondents paying less attention to subsequent questions because they have become familiar with the response format. One of the measures taken to reduce the effect of common item format was the inclusion of statements relating to that construct at the beginning before respondents answer the questions. Also, the response format was modified where necessary to agree with the questions. For example, some questions required a "not important to extremely important" format, while others required a "least agreement to strong agreement".

The third category of bias emanates from perceived relationships among measurement items in the questionnaire. That is the positioning of the items with each other. Some authors recommend mixing measurement items of various constructs so it becomes difficult for respondents to relate a new question from a previously answered one. An approach recommended by Meade and Craig (2011) was applied in this study. One way was to include "attention tracking" questions. They were introduced into the questionnaire to check if respondents read and understood the questions. The final group of the source of CMV is measurement context effects, which occurs when the same instrument is used to collect data on both the predictors and criterion variables. For example, some less-motivated participants tend to give average responses or agree (or disagree) with most of the items in long or cumbersome self-report surveys (Baumgartner & Steenkamp 2001). Some authors argue that such an approach introduces a common bias among both the predictors and criterion variables.

Some approaches to deal with and minimise the effect of common method bias have been proposed in the literature. Jaccard and Blanton (2005), proposed that respondents could be motivated to tell the truth by assuring them of their confidentiality and anonymity. Since motivation may sometimes be difficult to provide, and may not even guarantee respondents will be honest in responses, procedural and statistical approaches have been recommended in literature to control CMV (Podsakoff, Mackenzie, Lee, & Podsakoff, 2003). The procedural measures are undertaken before or during the data collection exercise whereas the statistical approaches usually described as ex-post measures are undertaken after the data is collected.

Procedural measures involve separating the data collection exercise on the predictor and outcome variables. It also includes shuffling the order of questions in an instrument. Other techniques include: mixing both negatively and positively worded items, reducing ambiguities in scale items by pre-testing instruments, and eliminating common scale effects by using different response options. Although these measures, to a large extent help, minimise the potential of CMV, Rindfleisch et al. (2008) caution that such remedies should be considered only if they will not produce lower response rates, respondent fatigue and confusion. Some of these measures were considered in the construction of the instrument. Different response forms were used and instruments were pre-tested to ensure the wording of items are free from ambiguities. Counterbalancing of items and separating predictor and criterion measurement, along with anonymity, are also suggested by Podsakoff et al. (2003) as procedural remedies to control for common method bias

Malhotra et al. (2017) present some commonly used statistical procedures. They are Harman's single-factor test and Multitrait-Multimethod analysis. According to Yeap, Jasmine and Ramayah (2016), Harman's single-factor test involves determining the extent of bias in a given data set when the results are entered into an exploratory factor analysis. If only a single factor emerges from the unrotated factor solution or where there is more than one factor and the first factor accounts for the majority of the variance (Podsakoff et al., 2003), CMV is likely to be present. Harman's single-factor, although criticized for its inability to produce a quantitative measure for the extent of the CMV, is the common approach found in the literature.

Also, other approaches, such as full collinearity assessment (FCA), have been proposed for studies that used partial least squares structural equation modelling as the analytical technique. In PLS-SEM, the occurrence of a VIF greater than 3.3 is proposed as an indication of pathological collinearity, and also an indication that a model may be contaminated by common methods bias. Therefore, if all (factors level) VIFs resulting from a full collinearity test are equal to or lower than 3.3, the model can be considered to be free from common methods bias (Kock, 2015).

Ethical Considerations

First, ethical clearance was sought from the Institutional Review Board of the University of Cape Coast on 25th September, 2019. The ethical clearance was obtained from the board on 26th November, 2019 (Appendix A). Anonymity and confidentiality of the respondents were assured by including a statement at the introductory section of the questionnaire to that effect. The procedure for the collection of the data for the study was explained to the respondents. Since the respondents were required to provide information relating to educational background, income levels, occupation, household size, residential type, they were assured that such information would be used solely for the study and that no information collected from them will be used for other purposes without their prior knowledge and consent. Possible benefits of the study to the respondents were also explained to them. Further, it was indicated to the respondents that no monetary compensation would be available to them for participation in the study and that they were free to withdraw from the study when they wanted to.

Pilot Study

A pilot study, according to Fowler Jr. (2014), is a small-scale or mini version of the full-scale study, that collects data from respondents similar to those to be used in the full study, as well as specific pre-testing of research instruments. Zailinawati, Schattner and Mazza (2006) also define a pilot study as a small-scale study to test research protocols, data collection instruments and sampling strategies in preparation for a larger or main study. The activities involved in pilot studies make such an exercise an important exercise. Conducting a pilot study does not guarantee success in the main study, however, it provides the necessary directions and guides to increase the likelihood of success (van Teijlingen & Hundley, 2002).

Pilot studies go beyond the pre-testing, where validity and reliability of the instruments and suitable research design, in general, are confirmed. Prior to the pilot study, the face and content validity of the questionnaire was assessed through initial pre-testing. According to Bowden, Fox-rushby, Nyandieka, and Wanjau, (2002), pre-testing provides the avenue to gauge the meaning that respondents will attribute to survey questions before the collection of data that may not provide the needed responses to meet the objectives of the study. The instruments were given to experienced researchers and consultants knowledgeable in electronic waste management. Specifically, the team assessed the accuracy of measures as well as the extent to which items truthfully represented and measured the respective constructs.

Pilot study procedures outlined by Peat, Mellis, Williams and Xuan (2002) were followed to improve the internal validity of the instruments. The results from the pilot study also helped in further review of the research instruments and also provided an estimate of the response rate. The following were undertaken as part of the pilot studies.

1. The data collection instruments were administered to pilot subjects in the same way as it would be administered in the main study.
2. Respondents were asked for their feedback to identify ambiguities and difficult questions.
3. Through the pilot study, the actual time it took for a respondent to complete a questionnaire was estimated.
4. All difficult and double-barrelled questions were deleted or modified.
5. An assessment of whether respondents exhibited understanding of the questions.

The pilot study took place in the Cape Coast Metropolitan Area. The choice of this area was to afford field assistants the opportunity to familiarise themselves with data collection rubrics involving households. In addition, research conditions in these two metropolises are not expected to deviate so much from the main data collection areas in the Greater Accra Region. The recommended sample size for pilot studies has been estimated at ten per cent of the expected sample size for the main study (Charan & Biswas, 2013). On that note, about 120 usable questionnaires were collected, although a total number of 300 questionnaires were distributed.

Data Collection Procedures and Field Challenges

The source of data for this study was primary. It involved collecting responses with a questionnaire from households in selected locations in the Greater Accra Region. Five research assistants were recruited to help in administering the questionnaires. Drawing from some lessons in the pilot survey, such as reducing missing data and boosting response rates, some respondents had to be assisted. The assistance was in the form of helping to make questions clearer where necessary. This meant that the research assistants are trained in the focus of the research, the nature and characteristics of the respondents, ethical principles, timelines, strategies for effective follow up and retrieval and managing the retrieved data.

The data collection exercise started from February 2020 to July 2020. The data collection exercise was prolonged because of the outbreak of COVID-19, which resulted in the Government announcing restrictions on movement in some parts of the country. So, from March 2020, the exercise was halted and resumed after restrictions had eased. Fortunately, about 70% of the questionnaires have been collected. Because of the partial lockdown that halted the exercise, more questionnaires had to be printed because some of them could not be retrieved by the research assistants. Also, the research assistants had to be given extra training on data collection, while observing all protocols recommended by the health authorities.

Data Preparation and Management

Data preparation and management involves all the procedures adopted to ensure data collected are devoid of basic errors due to data entry and meets all the requirements for subsequent analysis. The study collected quantitative data, using a questionnaire with both open- and close-ended questions. Initially, retrieved questionnaires were screened for errors. The questionnaires were counted and each assigned with a unique number. Assigning the numbers helped to retrieve questionnaires with errors such as non-responses and skewed response patterns. A codebook (Appendix D) was developed for the data entry. IBM SPSS version 25 was used for coding and managing the data. As part of the data cleaning techniques, basic descriptive statistics such as minimum and maximum values were produced to check for correct entry of codes. The questionnaire did not contain any negatively worded item.

The questionnaire was structured into three main sections – A, B and C. Section A contained information on the socio-demographic characteristics of respondents. This included the size of the household, type of housing unit, age, sex, educational background and income level. With exception of the size of the household and age, they were all measured, using a categorical scale. Section B sought information on disposal practices and awareness of the health and environmental impact of electronic waste management. There were eighteen questions out of which three were open-ended. The opened questions required respondents to list as many as they could remember, some of the electronic waste they have generated over the past 1 year and the disposal method they used. Section C contained variables measuring pro-environmental intentions and sustainable electronic waste management behaviour respectively.

Missing data were managed according to the procedure outlined in the data processing software. Allison (2001); and Barladi and Enders (2010) provide some approaches to dealing with missing data: mean replacement, pairwise deletion and casewise deletion. These approaches have been implemented in the most widely used multivariate data analysis tools such as IBM SPSS and SmartPLS. The first option is to do mean replacement. This approach replaces missing values with the mean value of the remaining data points. This option maintains the sample size; however, it can alter the estimated path coefficients. It requires that missing values should be strictly random. It is usually used where the percentage of missing values to the total sample size is below 5% (Hair Jr. et al, 2017).

The second strategy is case deletion or listwise deletion, which deletes the entire row or case with the missing data. Nevertheless, it can reduce sample size, so it is usually recommended where the sample size is sufficiently large such that deleting cases with missing data will not affect the power of the statistical technique. Pairwise deletion, on the other hand, only deletes the observations with missing value and not the entire case. It is appropriate for surveys limited by sample size. Where missing data is random, it can lead to different sample sizes being used for calculating model estimates.

The processed data was stored in cloud storage (dropbox,) and backed up on an external hard disk drive. Prior to the data entry, questioners were screened for non-responses and poorly answered questionnaires. Also, questionnaires with suspected response patterns were taken out according to procedures laid down by Peat, Mellis, Williams and Xuan (2002), and Baker-Prewitt and Miller (2009). Minimum and maximum values were also generated to confirm correct codes have been entered during the data entry process. Where it was found that a code outside the scale has been entered, the questionnaire was retrieved and the correct code entered.

Data Processing and Analysis

Data processing and analysis involves reducing a large set of data collected into useful information and reports that subsequently provides useful input into decision making and policy formulation. The process of reducing this data set was achieved through descriptive and inferential statistics. The descriptive statistics provide tools that help in organising and summarising data based on the characteristics of the respondents. Inferential statistics help to make inferences about the population based on sample estimates. Descriptive statistics were generated, using IBM SPSS version 25, while SmartPLS 3 by Ringle, Wende and Jan-Michael, (2015) was used for the inferential analysis.

Descriptive Analysis

Descriptive statistics are statistical techniques used to describe and summarise information about the sample. Examples of descriptive statistics include the mean, median, mode and standard deviation. Descriptive statistics are usually the preferred means of analysing and presenting data collected using a categorical scale. The study was guided by four objectives. The first objective sought to assess the awareness level of households on the nature of electronic waste and how it is currently managed. To achieve this objective, questions concerning the respondent's general knowledge of what constitutes electronic waste, conditions that necessitated replacement decisions, the source of information about electronic waste, knowledge of the dangers of the waste and how they manage their waste were solicited. The nature of the scale used required the generation of frequencies, graphs and chi-square as the analytical techniques. The data collected on the volumes of e-waste generated was also analysed using frequencies.

Inferential Analysis

Inferential statistics involved using sample data to estimate sample parameters that can be generalised across the population under study. There are several classes of inferential statistics. Pallant (2000) categorises them into two broad categories: those that help to compare groups and those that help to test relationships. The choice of statistical technique is influenced by research objectives and measurement philosophy. In the context of the social sciences, concepts are rarely directly measurable, hence existing multivariate approaches were limited when unobservable variables needed to be measured indirectly by indicators. A widely used approach that helps to minimise limitations due to concept measurement is structural equation modelling (SEM). Wong (2013) and Hair Jr et al (2014) describe structural equation modelling (SEM) as a more robust statistical technique that helps to incorporate unobservable or latent variables, which are measured indirectly by some indicators.

There are two main approaches to structural equation modelling: Covariance-based Structural Equation Modelling (CB-SEM) (Jöreskog 1973, 1978) and variance-based or Partial Least Square Structural Equation Modelling

(PLS-SEM) (Wold 1982, 1985). CB-SEM is a parametric procedure primarily used to confirm or reject theories. CB-SEM makes assumptions about data distribution, minimum sample size, model complexity, reflective constructs and strong theoretical knowledge about the model being tested (Hair et al., 2011). Although both SEM approaches have their strengths and weaknesses, the assumption underlying PLS-SEM makes it an ideal statistical technique for the study.

PLS-SEM is a non-parametric approach to examining the relationship among constructs including mediation and moderated relationships. As a non-parametric technique, the strict assumption about data distribution and sampling procedure is not critical to the techniques approach. PLS-SEM, unlike CB-SEM, is used if the research objective is to predict and develop theories by maximising explained variance in the dependent variables (Hair Jr, Sarstedt, Hopkins & Kuppelwieser, 2014). PLS-SEM does not assume data distributions, so it relies on a resampling procedure called bootstrapping. Mooney, Mooney, Mooney, Duval and Duvall (1993) describe bootstrapping as an intensive computational algorithm that involves resampling the data with replacement many, many times to generate an empirical estimate of the entire sampling distribution of a statistic. The results of such a procedure are minimising measurement errors and also producing estimates that provide a better representation of the population (Mooney et al., 1993).

Nevertheless, the authors suggest that highly skewed data can still reduce the statistical power of the analysis (Hair Jr, et. al., 2014). So, steps were taken to ensure the data was free from extreme values and outliers. Besides, one must be equally critical with small sample sizes, as it has the potential to occasion a type II error, which occurs when a poorly specified model can still falsely achieve adequate model fit (Wong, 2013). PLS-SEM, as the name implies, operates much like multiple regression that minimizes the residual variances of the endogenous constructs (Hair et al., 2011). Compared to CB-SEM, it is more robust and works with both smaller as well as much larger samples.

Unlike CB-SEM, PLS-SEM readily and easily works with both formative as well as reflective constructs. This unique feature makes it a suitable data analysis technique for exploratory and descriptive studies (Hair Jr, et. al., 2014). Also because of its prediction orientation, PLS-SEM is the preferred method when the research objective is theory development and prediction. This is useful in situations where theory is less developed. Moreover, PLS-SEM avoids the problem of indeterminacy: difficulty with estimating stable factor scores and develops more precise estimates of factor scores because the PLS algorithm calculates latent variable scores as exact linear combinations of the observed indicator variables (Lowry & Gaskin, 2014).

It must be noted however that the advantages offered by PLS-SEM are constrained by some disadvantages as well. First, PLS-SEM's focus is on maximizing partial model structures. Specifically, the PLS-SEM algorithm first optimizes the measurement model parameters and then, in a second step, estimates the path coefficients in the structural model. Thus, researchers applying PLS-SEM first have to examine the measurement models' characteristics by assessing the reliability and validity of the indicators and eliminate those that may fall out of the acceptable threshold. Another issue that restricts the use of PLS-SEM for theory testing and confirmation is that there is no adequate global measure of goodness of model fit (Hair Jr et al., 2014).

Partial Least Squares-Multi Group Analysis (PLS-MGA)

Characteristics of the population in urban centres are diverse. Individual behaviour is influenced in some circumstances by their socio-demographic characteristics such as income level, type of housing, sex and educational background (Patel, Modi, Paul & Paul, 2017). The Greater Accra Region, where the data were collected, houses most businesses in the country, and its economic vibrancy draws people from all over the country in search of job opportunities and better living conditions. The region has a very diverse population, different ethnic background, income levels, housing types and occupation. These characteristics bring about heterogeneity in the population. It was, therefore, important to identify, assess and treat heterogeneity in data.

Most importantly, waste management practices are highly linked to socio-demographic characteristics such as age, sex, income level etc. In path modelling, interaction variables can be playing a mediating or moderating role in path relationships. There are rules of thumb for identifying a mediator from a moderator: mediators must be a causal result of the exogenous construct and a causal antecedent of the outcome variable, whereas, a moderator must not be the causal result of the exogenous. Moderators are mostly variables that are characteristics of the respondents or the context of the study (Baron & Kenny, 1986).

On that note, objective four was to assess the interaction effect (moderation) of socio-demographic characteristics of respondents on the various relationships in the path model. To achieve this objective, Partial Least Squares-Multi Group

Analysis (PLS-MGA) was used. The technique tests whether differences can be traced to observable characteristics such as age, income level, type of settlement, size of household and occupation. Multigroup analysis is used when there are group-specific differences that relate to respondents' background characteristics such as sex, income level etc. can influence the relationships in the PLS path model.

Multi-Group Analysis Procedure in PLS-SEM

To test for group-specific differences in path relationships, some diagnostic statistics must be tested. This diagnostic is called measurement invariance or measurement equivalence. Establishing measurement invariance is important because it shows that group differences do not result from how specific groups interpreted questions administered, rather than the true differences in structural relationships (Hair et al., 2018). To assess measurement invariance in PLS-SEM, Hair et al. (2018) present three steps. These steps are collectively called measurement invariance of the composite models (MICOM) procedure. Failing to achieve measurement invariance may contribute to measurement error, which could reduce the statistical power of the test (Hult et al., 2008).

The MICOM procedure begins with examining configural invariance. Configural invariance involves ensuring there are identical indicators, data treatment and algorithm settings across the groups being compared (Hair, Jr. et al., 2018). Each group must also have the minimum recommended sample size, which is usually guided by Cohen (1988) table for determining the adequacy of sample size. Once configural invariance is achieved, the next step involves compositional invariance. This stage involves comparing original correlations (c) with 5% quantile value of the distributions (C_u). If the original correlation is equal to or greater than 5% quantile, compositional invariance is attained. The procedure tests the null hypothesis that $c = 1$, which must not be rejected. The final diagnostics involves testing for equality of composite mean values and variance across the selected groups. Where composite mean values and variance falls between 2.5% and 97.5% confidence interval, full invariance is reached. If only some conditions are met, partial invariance and where none is achieved, no invariance.

Chapter Summary

The chapter presented the research methods that were implemented to collect data and guide the analysis and discussion of results. The chapter began with a discussion of philosophies in research and their characteristics. Based on the characteristics, the postpositivist view was adopted. This view largely believes in an objective approach to scientific enquiry. On that note, the quantitive research approach, and the cross-sectional study design were suitable for meeting the objectives of the study. In addition, the study area and population were discussed. The choice of the selected areas in the Greater Accra Region was provided. A pilot study was undertaken in the Cape Coast Metropolis to test the instrument and made necessary modifications. Data management and data analysis techniques were also examined. Since the study design was quantitative, data was mainly self-reported which is subject to social desirability bias. Accordingly, steps outlined by MacKenzie and Podsakoff (2012) were followed to reduce these biases.

CHAPTER FIVE

HOUSEHOLD CHARACTERISTICS, AWARENESS LEVEL AND WASTE MANAGEMENT PRACTICES OF HOUSEHOLDS

Introduction

Previous chapters have looked at the background and the research problem, followed by a review of literature, which comprised a theoretical, conceptual and empirical review of related studies. Also, the research methods implemented to achieve the objectives of the study have been presented. This chapter presents the discussion of the socio-demographic characteristics of the respondents and the presentation of results and the discussion of objective one.

The nature of electronic waste generated, provision of adequate information and knowledge about sound electronic waste (e-waste) management contributes to good policies that ensure the protection of environmental and human health. Borthakur and Govind (2018), in their review, described awareness as central to the sustainable management of electronic waste. Against this background, the first objective sought to examine electronic waste management practices, and assess the awareness level of households on the state of electronic waste management in Ghana. Subsequently, the demographic characteristics of the respondents are first presented.

Demographic Characteristics of Respondents

Four socio-demographic characteristics of respondents were examined. They were the type of housing unit, sex, age, and income level. Out of the 652 valid questionnaires, total responses for sex were 617, 642 for the type of housing unit, 620 for income category and 621 for age. Table 7 shows the Socio-demographic characteristics of the respondents.

Table 7: Socio-demographic characteristics

Characteristic	Category	Frequency	Percentage
Sex	Male	339	52.0
	Female	278	42.6
	Missing	35	5.4
	Total	652	100.0
Housing unit	Compound house	254	39.0
	Detached/separate house	178	27.3
	Semi-detached / Shared apartment	210	32.2
	Missing	10	1.53
	Total	652	100.0
Income level	Up to 3,456	122	18.7
	Over 3,456 up to 4,656	80	12.3
	Over 4,656 up to 6,336	85	13.0
	Over 6,336 up to 42,336	230	35.3
	Over 42,336 up to 240,000	80	12.3
	Above 240,000	23	3.5
	Missing	32	4.9
	Total	652	100.0
Age	22 – 30	173	26.5
	31 – 40	325	49.8
	41 – 48	96	14.7
	49 - 57	21	3.2
	58+	6	0.9
	Missing	31	4.8
	Total	652	100.0

Source: Field survey, Ofori (2020)

The majority (52%) of the respondents were males, while the remaining were females (42.6%). Also, there were more occupants of compound housing units (39%), followed by semi-detached and flat units (32.2%) and the rest were occupants of detached housing (27.3%). For income level, the distribution shows a considerable number (35.3%) of respondents in the middle-income bracket. The age distribution shows a quite high number in the middle-aged categories (49.8%), followed by a young adult (26.5%). This is reflective of Ghana's population structure, which is described as youthful.

Household Characteristics and the E-Waste Value Chain

Historically, the production of consumer durables was made under the assumption of long-term utility and ownership. Over time, the emphasis on marketing orientation uncovered several strategies to attract consumers and push more products into their consumption basket. Advancement in manufacturing processes made planned obsolescence possible by shortening product life (Tansel, 2017). In developed countries, product usage lifetimes have reduced, which means products join the waste stream at a faster rate (Cole et al., 2016). Generally, e-waste is sourced from institutions such as schools, hospitals, banks, industries etc. However, one average, each household possess electronic and electrical equipment making this segment the highest generator of electronic waste.

E-waste inventory survey by Kumi, Hemkhaus, and Bauer (2019) shows that about 85% of the e-waste collected were from households; including those picked from streets, drainage and roadside. Noufal, Yuanyuan, Maalla and Adipah (2020) describe household solid waste as highly heterogeneous, reflecting the socio-economic characteristics, values and environmental beliefs. In developing economies, where waste infrastructure is less efficient, solid waste generated from households is typically a mixture of plastics, food leftovers, biodegradables, paper, clothing and metals. Since waste generation is an inevitable aspect of life, it becomes a matter of urgency to observe the process from generation to disposal to determine the areas of critical concern.

Solid Waste Management (SWM) is defined as the control, generation, storage, collection, transportation, processing and disposal of solid waste consistent with best practices of public health, economic and financial, administrative, legal and environmental considerations (Othman, 2002). The value chain from the perspective of the consumer begins with the consumption of electronic products. Other activities in the value chain involve the collection of e-waste from various generation points, dismantling recovery, and end processing of recovered metals into a semi-finished or finished product.

The value chain begins with the consumption phase, where households are described as the highest consumers. These consumption patterns are influenced by e-literacy, rising income level among others. The next phase in the value chain is waste generation, and this has been mainly exacerbated by shorter product lifecycles, planned obsolescence etc. During waste collection, owners of appliances have to extinguish their interests in their electronic products. Concerns have been raised at this stage where electronic appliances may also contain private information about the user. Disposal involves not only physical detachment but psychological, and that makes the process complex than other types of waste. Also, households may require incentives to sort their waste at home. At the recovery and recycling stages, it has been possible for people to recreate other objects from their waste, although such activity mostly requires technical expertise. Also, households' willingness to use products created from recycled materials can boost recovery and recycling activities. That is why the arrow is bi-directional. Finally, end processing and disposals activities have implications on human health and the natural environment. At this stage, the arrow is in one direction because the assumption is that end processing and disposal activities must be undertaken in a controlled environment devoid of any human interaction. The role of households as actors in the e-waste value chain is informed by psychological factors, environmental value system, institutional factors, economic, demographic, and socio-cultural factors. Figure 6 presents an electronic waste value chain.

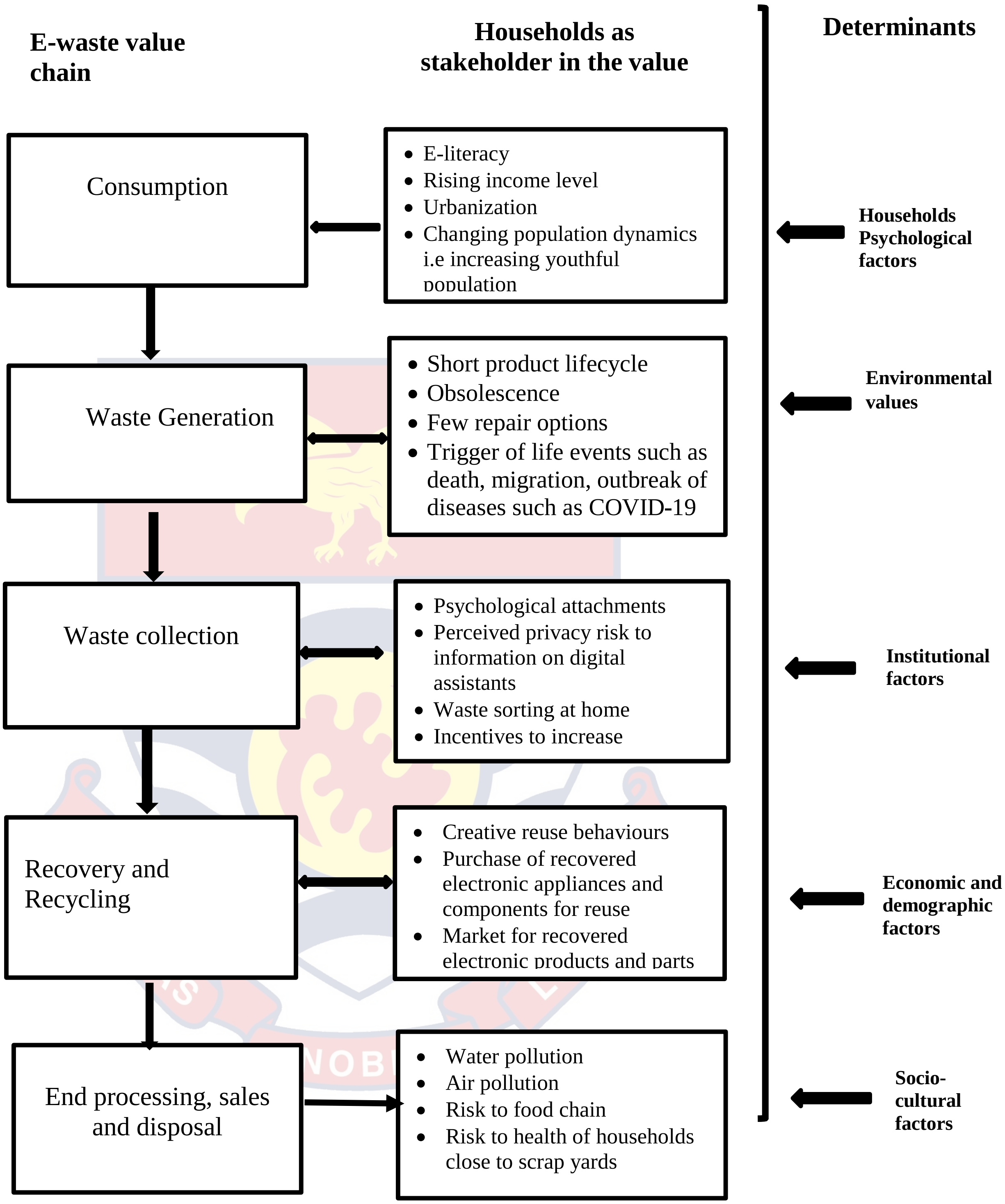

Figure 11: Consumer E-waste Value chain

Source: Author’s construct (Ofori, 2020) based on review of literature.

Demographic characteristics and awareness level of households

Households' access to adequate information and knowledge about sustainable electronic waste management contributes to good policies and effective implementation that ensure the protection of environmental and human health. Against this background, the first objective sought to assess the nature of electronic waste generated, disposal methods, information on electronic waste and the awareness level of households. Table 8 shows the level of e-waste awareness among households.

Table 8: Awareness of E-waste

Question	Responses	Frequency (N)	Percent (%)
Have you heard about electronic waste?	Yes	318	48.8
	No	308	47.2
	No response	26	4.0

Source: Field survey, Ofori (2020)

From Table 8, a considerable number (48.8%) have heard about electronic waste. The level of awareness is remarkable, given that in most developing countries, solid waste has been limited to plastic and food waste. Generally, with the increasing consumption of electronic products, consumers are becoming aware of the high levels of waste some of which are being stored at home. For example, a considerable number of respondents indicated storage of ICT related waste at home. This management practice has been found in surveys such as Borthakur and Govind (2019), who stated that inventory assessment of households in India showed, on average, individuals possessed at least two mobile phones. Also, in Islam et al.,(2016), the authors reported increasing consumption of personal computer and mobile phones. To provide further insight, a cross-tabulation that presents level of awareness by sex, income level, housing unit and age is also presented. Table 9 displays information on sex of respondents and their awareness of e-waste.

Table 9: Sex and Awareness of E-waste

Responses	Male (%)	Female (%)	Total (%)
Yes	168 (54.9)	138 (45.1)	287 (100.0)
No	155 (54.0)	132 (46.0)	306 (100.0)
Total	323 (54.5)	270 (45.5)	593 (100.0)

Pearson Chi-Square ($\chi 2$) = 0.048, p = 0.827
Yates continuity correction = 0.019, p = 0.892 (For 2x2 Table)
Source: Field survey, Ofori (2020)

Table 9 shows the distribution of respondents who indicated "yes" or "no" by sex. The assumption on minimum expected cell frequency was met for all other cross-tabulations (Appendice E). The proportion of males who reported knowledge of electronic waste did not differ from females who also responded "yes" χ_2 (1, N = 593) = 0.048, p > .05. This implies that the sex of respondents did not influence their awareness of e-waste. Table 10 displays information on the type of housing unit and their awareness of e-waste.

Table 10: Housing unit and Awareness of E-waste

Responses	Compound Housing (%)	Detached / Separate (%)	Semi- detached /Flat (%)	Total (%)
Yes	109 (34.9)	94 (30.1)	109 (34.9)	312 (100.0)
No	134 (43.8)	77 (25.2)	95 (31.0)	306 (100.0)
Total	243 (54.5)	171 (27.7)	204 (33.0)	618 (100.0)

Pearson Chi-Square ($\chi 2$) = 5.165, p = 0.076

Source: field survey, Ofori (2020)

The distribution of respondents according to housing type was also examined for differences in awareness. There is no association between housing type and awareness $\chi 2$ (2, N = 618) = 5.165, $p > 0.05$. This implies that information about electronic waste was well disseminated among all types of a residential system. Table 11 presents information on income level of respondents and their awareness of e-waste.

Table 11: Income and Awareness of E-waste

Responses	Lower income (%)	Middle income (%)	High income (%)	Total (%)
Yes	125 (41.3)	168 (55.4)	10 (3.3)	303 (100.0)
No	150 (50.8)	132 (46.0)	13 (4.4)	295 (100.0)
Total	323 (54.5)	270 (45.5)	593 (100.0)	598 (100.0)

Pearson Chi-Square ($\chi 2$) = 6.878, p = 0.032

Source: field survey, Ofori (2020)

Cross-tabulation of awareness of e-waste by income category revealed that awareness among respondents in middle income was high. The proportion of respondents who reported knowledge of electronic waste did differ by income. A test of association between income level and awareness was significant $\chi 2$ (2, N = 598) = 6.878, $p < 0.05$. Increasing income levels is cited as one of the major reasons for the high consumption of electronic products and willingness to pay for waste management (Islam et al., 2016). By implication, increasing income level is associated with increasing electronic waste generation and hence higher awareness. Table 12 highlights information on age of respondents and their awareness of e-waste.

Table 12: Age and Awareness of E-waste

Responses	Young Adults (%)	Middle-Aged (%)	Old Adults (%)	Total (%)
Yes	110 (36.3)	171 (56.4)	22 (7.3)	297 (100.0)
No	164 (55.2)	109 (36.7)	24 (8.1)	303 (100.0)
Total	274 (54.5)	280 (45.5)	46 (7.7)	600 (100.0)

Pearson Chi-Square ($\chi 2$) = 24.400, p = 0.000
Source: field survey, Ofori (2020)

The Pearson chi-square $\chi 2$ [(2, N = 600) = 24.400, $p < 0.05$] of the cross-tabulation of the age of respondents by awareness also indicated a significant association between age and awareness level of respondents. The results show that knowledge of electronic waste and awareness was high among the middle-aged category. This supports Patel, Modi, Paul and Paul (2017) who found that consumers in middle aged-category, due to their high level of environmental awareness, have a higher propensity to engage in pro-environmental behaviours than young adults and old adults.

Nature of Information and Households' Perception of Electronic waste

The kind of information about electronic waste available to the population shapes their perception and general attitude towards the management of electronic waste. Agbefe, Lawson and Yirenya-Tawia (2019) describe information and perception as important factors that inform households willingness to pay for waste management. In this sub-section, the perception of electronic waste was examined, followed by the medium through which information about electronic waste was received. The content of information disseminated is also presented. Table 13 describes what respondents perceive to constitute e-waste.

Table 13: Perception of what constitutes e-waste

Question	Responses	Frequency (N)*	Percent (%)
What is electronic waste in your opinion?	Outmoded electronic appliances	78	11.6
	Broken electronic appliances	57	8.5
	Discarded electronic appliances	353	52.7
	Appliances not in use	172	25.4
	An old electronic appliance	5	0.7

Source: field survey, Ofori (2020)
*Multiple responses

Table 13 shows the respondents' perception of what constitutes electronic waste. Respondents expressed varying opinion on what constitutes electronic waste. The majority (52.7%) described electronic waste as a discarded electronic appliance. Also, 25.4% indicated electronic waste refers to appliances "not" in use.

Respondents felt an old electronic appliance is not necessarily waste. This reflects the belief that old appliances were made more durable. Besides, as a developing economy, the country still relies on the import of used electronic appliances mostly from Europe (Quaye et al., 2019; Keesman, 2019). However, according to Forti, Baldé, Kuehr, and Bel (2020), most of these second-hand imports are usually waste on arrival. Table 14 presents the medium through which respondents receives information about e-waste.

Table 14: Medium of information dissemination

Question	Responses	Frequency (N)*	Percent (%)
Where do you get information on electronic waste in the country?	TV	220	33.7
	Radio	136	20.9
	Internet	167	26.6
	Conference/Workshops	24	3.7
	Magazine	23	3.6
	Information Centre	39	6.2
	Others (i.e friends, colleagues, etc)	21	3.2

Source: Field survey, Ofori (2020)
*Multiple responses

This question was aimed at assessing the most effective means through which respondents receive regular information about electronic waste. Out of the six media of information dissemination, 33.7% indicated television, while 26.6% indicated the internet, radio was 20.9% and the fourth was information centre (6%). Education and information dissemination among the public about waste management is of prime concern for achieving a circular or zero-waste economy. Effective social marketing is based on how one can appeal to consumers' psychology and subsequently influence their behaviour towards pro-environmental actions (Rivers, Shenstone-Harris, & Young, 2017; Winterich, Nenkov & Gonzales, 2019; Zhang & Wang, 2020).

The results show that television as a medium of communication is effective in transmitting audio-visual messages about waste management to the general public. This is followed by the internet (26.6%), an indication of the penetration rate of information and communication technology as most people use social media as a source of information (Stieglitz & Dang-Xuan, 2012). Table 15 provides further insights into the nature of information transmitted through the medium identified in Table 14. Table 15 presents describes the content of the information disseminated to respondents.

Table 15: Content of information dissemination

Question	Response	Frequency (N)	Percentage (%)
Nature of information/	Importance of waste separation	136	33.3
	Health and environmental impact of improper electronic waste disposal	448	68.7
	Institutional directives on electronic products (i.e energy commission, environmental protection agency)	10	1.6
	Non-response	68	10.4

Source: Field survey, Ofori (2020)

The results show that the most common information on electronic waste is on the health and environmental impact of improper electronic waste management (68.7%). Findings from Quaye et al. (2019) reveal that continuous awareness creation is lacking, given that Agbobloshie, located at old Fadama has been cited by the media from the international community as the largest dumpsite in West Africa, where about 95% of electronic waste generated are informally processed under unsound environmental conditions. The authors further emphasize the importance of education and awareness creation on segregation of electronic waste, health and environmental impacts through all forms of information dissemination methods. A study by Cao et al. (2016) in China showed that a lot of information on electronic waste were also made available in various forms for ease of comprehension by the public irrespective of educational background or age.

Awareness of Environmental, Health and Safety Hazards of Electronic Waste Management

The dangers produced from electronic waste during consumption and disposal usually come from direct contact with harmful materials and heavy metals such as lead, cadmium, chromium and mercury. According to Kyere et al. (2016), the environmental, health and safety risk also arises from the inhalation of toxic fumes, and the leaching of toxic materials into the soil, and their accumulation in soil, water and food. Lead is found in the screen of mobile phones, TVs and other monitors. Households awareness of the environmental, health and safety hazards of electronic waste management improves attitude towards sustainable electronic waste management. This position is established by the norm activation theory, which predicts higher pro-environmental intentions when people are aware of the negative consequences their consumption and disposal behaviours is creating for the environment, health and safety. On this note, awareness of health hazards from electronic waste and the perception of hazard on disposal is examined and presented in Tables 16 and 17, respectively.

Table 16: Awareness of health hazards from discarded electronics

Question	Response	Frequency (N)	Percentage (%)
In your opinion, how will you rate the environmental and health hazards from discarded electronics	Low	143	21.9
	Medium	230	35.3
	High	248	38.1
	Non-Response	31	4.7

Source: Field survey, Ofori (2020)

In Table 16, respondents expressed their opinion on the amount of environmental and health hazards from discarded electronic devices. 21.9% of the respondents think that discarded electronic devices possess minimal danger to human health and the environment, while 38.1% believes it is highly dangerous to human health and the environment. The response shows that there is an increasing knowledge of the dangers associated with the management of discarded electronic devices. However, whether this knowledge translates into behaviour was examined and presented in Table 17.

Table 17: Hazardous influence on disposal

Question	Response	Frequency (N)	Percentage (%)
To what extent does your knowledge of environmental and health hazards of discarded electronics and related components influence the type of disposal methods used?	Not at all	122	18.7
	A little	208	31.9
	Somehow	160	24.5
	Large	116	17.8
	Non-Response	45	6.9

Source: Field survey, Ofori (2020)

From Table 17, 18.7% revealed the hazardous nature does not influence their disposal methods. 31.9% indicated little influence, 24.5% revealed some level of influence, while 17.8% shows the hazardous content influenced their disposal decisions. A critical examination of the results shows that although a considerable number of the respondents (38.1%) were aware of the dangers, as shown in Table 16, it did not have much influence on how they dispose of their electronic waste. Although some 35.9% knew the growing volume of e-waste, they could not tell the potential risk it possesses to health and the environment. 39% expressed knowledge of growing volumes of e-waste and the potential health and environmental hazard.

Circularity of E-waste

Whiles the purchase of new devices provides a lot of benefits, we have to take into consideration what happens to old devices when they are replaced with new ones. The practice of throwing away old devices versus consciously putting otherwise discarded items into a reusable state, even when one can afford a new one, has several benefits including reducing the amount of electronic waste at landfills, increasing product lifespan and consequently minimising emission throughout the product life-cycle (Cole, Cooper & Gnanapragasam, 2016). The results in Tables 18 and 19 present household perception and management approach towards the electronic waste that may have reusable properties.

Table 18: E-waste recovery

Question	Response	Frequency (N)	Percentage (%)
Do you usually retain useful electrical /electronic equipment or related component yourself before permanently discarding	Yes	286	43.9
	No	334	51.2
	Non-response	32	4.9

Source: Field survey, Ofori (2020)

Table 18 presents responses on efforts made to recover useful parts from waste electronic appliances before permanently discarding them. In particular, the questions in Tables 18 and 19 sought to find out the creative reuse behaviours of respondents. The majority (51.2%) of the respondents do not make effort to recover. Haws, Naylor, Coulter and Bearden (2012) describe creative consumers as those that think about new ways of using products, break apart objects that are no longer functioning to create something new either by themselves or at their directions.

Table 19: Use of Recovered Electronic and Electrical equipment

Question	Response	Frequency (N)	Percentage (%)
For what purpose do your discarded electronic devices if you decide to keep them?	I keep for reuse by myself or others	206	31.6
	I keep to remind of certain events and people	59	9.0
	I sell as scrap	209	32.1
	No response	178	27.3

Source: Field survey, Ofori (2020)

The responses in Table 19 show how people perceive and the management approaches for their electronic waste. The psychological ownership theory explains how enduring emotional bonds causes consumers to protect their possessions against damage and become anxious when they are physically separated from their possessions. Further, Kwok, Grisham and Norberg (2018) offer two main tendencies as the cause of such emotional attachments. Generally, consumers perceived their waste to possess sentimental and instrumental values. This usually results in households keeping items for further use or giving them out to others (31.6%). Again, where items are perceived to be valuable, so the willingness to accept monetary compensation in exchange for the electronic waste is usually the practice of households who prefer selling electronic waste as scrap (32.1%) (Kwok, Grisham & Norberg, 2018; Haws et. al., 2012).

Also, according to Evers, Gruner, Sneddon and Lee (2018), consumers who are described as frugal are those that were likely to keep or find other uses for their end-of-life products. Frugal consumers do not easily abandon products simply because they have developed a fault or it is technologically obsolete, but take steps to maintain products to ensure maximum use. Gatersleben, Murtagh, Cherry and Watkins (2019) suggest that although frugality is associated with waste reduction behaviours, consumers maintain different traits and identities to meet different consumption situations, and so policies aimed at promoting environmental behaviours must incorporate all consumer traits.

Electronic waste generation: common waste stream and quantities

Respondents were asked to identify some examples of commonly generated electronic and electrical waste (e-waste). Table 20 shows the nature and volume of e-waste generated in the study areas. The e-waste classification system is based on the E-waste Statistics Guidelines on Classification and Reporting Indicators – Second Edition by Forti, Baldé and Kuehr (2018) that groups electronic and electrical equipment into 54 different product-centric categories. The 54 electronic and electrical equipment product categories are subsequently re-grouped into six general categories based on each products waste management characteristics: by similar function, comparable material composition (in terms of hazardous substances and valuable materials) and related end-of-life attributes.

These major classifications are temperature exchange equipment, large equipment, screens and monitors, small equipment, lamps and lighting equipment and small ICT equipment. For this study, the classification system was modified for simplicity, and ease of understanding by respondents. For example, under the 'small equipment category', 'other small household equipment' was merged with 'small consumer electronics' because they shared similar characteristics. Also, under the 'temperature exchange category', freezers and fridges were merged as refrigerator and freezers. Table 20 presents the classifications and corresponding frequencies.

Table 20: Nature of electronic waste generated among households

EEE category under EU-6	Description of products	Yes	No*
Large Equipment	Central Heating (household installed)	50 (7.7)	602 (92.3)
	Professional Heating & Ventilation (excl. cooling equipment)	79 (12.1)	247 (37.9)
	Dishwashers	105 (16.1)	547(83.9)
	Other Kitchen equipment for food preparation (e.g. large furnaces, ovens, cooking equipment)	101 (15.5)	551(84.5)
	Washing machines, incl. combined dyers.	210(32.2)	442(67.8)
	Wash dryers, centrifuges	60(9.2)	592(90.8)
	Household room heating + ventilation, excl. small table ventilators, hoods	70(10.6)	582(89.4)
	Photovoltaic Panels (incl. inverters)	10(1.6)	640(98.2)
	Professional IT equipment (e.g. servers, routers, data storage, copiers	160(24.5)	492((75.5)
	Professional Tools and equipment (e.g. for welding, soldering, milling, sewing)	129(19.8)	523(80.2)

Table 20, continued

EEE category under EU-6	Description of products	Yes	No*
	Leisure equipment (e.g. sports equipment, electric bikes, juke boxes)	107(16.5)	544(83.5)
	Professional medical equipment (e.g. hospital, dentist, diagnostics)	43(6.6)	609(93.4)
	Professional Monitoring & Control equipment (e.g. laboratory, control panels	14(14.7)	638(97.8)
	Non- cooled Dispensers (e.g. for vending, hot drinks, tickets, money) Cooled	96(21.2)	556(78.8)
Temperature exchange	Refrigerators and Freezers for food, ice, etc.	537(82.4)	115(17.6)
	Air conditioners	210(32.2)	442(67.8)
	Other cooling equipment (e.g. dehumidifiers, heat pump dryers	33(5.1)	619(94.9)
	Professional cooling equipment (e.g. large air conditioners, cooling displays)	57(8.8)	595(91.2)
	Cooled Dispensers (e.g. for vending, cold drinks)	96(21.2)	514(78.8)
Small Equipment	Microwaves (incl. combined, excl. grills)	447(68.5)	205(31.5)
	Other small household and consumer equipment (e.g. small ventilators, irons, clocks, adapters, chargers, extension boards, remote controls)	612 (93.80)	40(6.20)

Table 20, continued

EEE category under EU-6	Description of products	Yes	No*
	Small household equipment for hot water preparation (e.g. coffee, tea, kettles,)	507(77.7)	145(22.30)
	Vacuum Cleaners (excl. professional)	100(15.4)	552(84.60)
	Personal care equipment (e.g, hair dryers, trimmers, razors)	187(91.20)	465(8.80)
	Portable Audio & Video (e.g. MP3, iPod,)	404(61.90)	248(38.10)
	Music Instruments, Radio, Speakers, Hi-Fi (incl. audio sets)	515(79.10)	136(20.90)
	Video (e.g. Video recorders, DVD, Blue Ray, decoders) and projectors	361(55.30)	291(44.70)
	Cameras (e.g. camcorders, photo & digital still cameras)	203(31.10)	449(68.90)
	Toys (e.g. car racing sets, electric trains, music toys, sex toys, drones)	256(39.20)	396(60.80)
	Household Tools (e.g. drills, saws, hand sewing machines, high pressure cleaners, lawn mowers)	230(35.20)	422(64.80)
	Household medical equipment (e.g. thermometers, blood pressure meters	181(27.80)	471(72.20)
	Household Monitoring & Control equipment (fire alarm, motion sensors, smoke detectors, excl. screens)	91(13.90)	561(86.10)

Table 20, continued

EEE category under EU-6	Description of products	Yes	No*
Small ICT equipment	Small IT equipment (e.g. routers, mouse, keyboards, external drives & accessories)	422(64.8)	230(35.2)
	Desktop PCs (excl. monitors, accessories)	356(54.6)	296(45.4)
	Printers (e.g. scanners, multi -functionals, faxes	130(20.1)	520(79.9)
	Telecommunication equipment (e.g. cordless phones, answering machines)	229(35.2)	422(64.8)
	Mobile Phones (incl. smartphones, pager	573(87.9)	78(12.1)
	Game Consoles e.g play stations	191(29.3)	460(70.7)
Screens and Monitors	Laptops (incl. tablets	521(79.9)	131(20.1)
	Cathode Ray Tube (CRT) Televisions	213(32.6)	131(67.4)
	Cathode Ray Tube (CRT) Monitors	97(15)	439(85)
	Flat Display Panel Televisions (LCD, LED)	406(62.3)	246(37.7)
	Flat Display Panel Monitors (LCD, LED)	165(25.3)	246(74.7)

Table 20, continued

EEE category under EU-6	Description of products	Yes	No*
Lamps and Lighting equipment	Compact Fluorescent Lamps (incl. retrofit & non-retrofit)	215 (30)	437(67)
	Special Lamps (e.g. professional mercury, high- & low-pressure sodium)	74 (11.4)	578 (88.6)
	Straight Tube Fluorescent Lamps	523 (80.2)	129 (19.8)
	LED Lamps (incl. retrofit LED lamps)	341(52.3)	487 (74.7)
	Small lighting equipment (excl. LED & incandescent)	179 (27.5)	473 (72.5)
	Household Luminaires (incl. household incandescent fittings & household LED luminaires such as bedside lamps, decorating lamps)	108 (16.5)	544 (83.5)
	Professional Luminaires (offices, public space, industry)	46 (7)	606 (93)

Source: Field survey, Ofori (2020)

*No: non-response was included in the No category

Table 20 shows the 54 electronic product categories, together with the six major re-classification. The response form was "Yes" when one has generated any waste corresponding to any of the appliances and "No" when one has not or not sure. Non-response was also considered as "No". In addition, for purpose of simplicity, only products that are frequently used and commonly disposed of by respondents is subsequently discussed. Accordingly, temperature exchange equipment category was represented with refrigerator (n = 537), large equipment category was represented by washing machine (n= 210), screens and monitor category was represented by cathode ray tube (CRT) (n = 213), flat panel display TV (n=406) and laptop (n=521); small equipment category was represented by microwave (n= 447), small kitchen equipment such as blender (n=507), small household electronic equipment such as electric iron, clocks (612) and music instrument such as radio (n = 515). Bulbs (n=523) and mobile phone (n=573) were used to represent lighting and small ICT equipment categories respectively (Ylä-mella et al., 2015).

Some appliances were mostly expected because of the purpose it serves in our homes. For example, refrigerator and small electronic items such as iron, clocks etc. Results also show, despite the obsolete technology and energy-consuming nature of CRT monitors/TV, there was a considerable number still in use. Tansel (2017); Ackah, (2017) and Forti, et al. (2020) confirmed that large quantities of CRT monitors and televisions are transported from some developed countries to developing countries for reuse or donations to less privileged institutions such as basic and second cycle schools. Meanwhile, it is noted in Wang et al. (2012); and Tansel, (2017), that CRT monitors/TVs are considered difficult to recycle electronic waste, so, developed countries consider donations to less privilege in developing economies as a cheaper alternative to disposing of them. A practice that is forbidden under the Basel Convention (Tansel, 2017). As most of these CRTs have entered the waste stream, because of advancement in technology, and the decline in the market for recycled CRT glass, there is an urgent need for an efficient management system for their safe disposal (Tansel, 2017). Table 21 shows the most common reasons why households replace their electronic items.

Table 21: Replacement Reasons

Reason	Frequency*	Percent
Physical damage	372	57.1
Need for greater functionality	214	32.8
Energy efficiency	159	24.4
Lost/stolen	99	15.2
Malfunction	355	54.4
Desire for newest technology	199	30.5

Source: Field survey, Ofori (2020)

*Multiple Response

In Table 21 respondents were asked to indicate the reasons for replacing their electronic appliance. The most cited reason for replacement was physical damage (372) and malfunction (355). This finding is in line with Li et al (2012) and Cao et al (2016) who found that consumers discarded appliances that were mostly defective, accounting for 52% of electronic waste. The next replacement reason was the need for greater functionality (214) and the desire for newer technology (199). Reduced functionality and improvement in technology make an appliance obsolete. Thiebaud, Hilty, Schluep, and Widmer (2017) and Liu, Bai, Zhang, Jing, and Xu (2019) found obsolescence to be high among ICT equipment such as mobile phones. Obsolete products such as mobile phones had mostly been traded in for newer versions.

The pursuit of fashion and the urge to stay up to date with new technological advancements, especially among the youthful population, according to Kumar (2019) has considerably reduced the average life expectancy of most smart ICT devices such as mobile phones from 2.9 years in 2011 to 2.21 years in 2018. Energy efficiency is also becoming one of the factors considered in the purchase of high energy-consuming electronic appliances such as air conditioner, refrigerator, water heater etc. In Ghana, the Energy Commission has engaged in several activities aimed at promoting energy conservation. An example is the Eco-labelling of high consuming appliances. Also, the rising cost of energy is making consumers conscious of energy consumption and hence the consideration of energy efficiency. Consequently, producers are leveraging their expertise to innovate and modify their products to meet the increasing demand for greener products.

Electronic Waste Disposal Methods

Parajuly et al. (2020) and Ismail and Hanafiah (2020) indicated that differences in developed and developing country context, culture and socio-demographic chara20teristics brings about differences in electronic waste management practices. For example, member countries in the European Union must strongly adhere to the Basel Convention and Waste Electrical and Electronic Equipment Directive (Parajuly et al., 2020; Cole, Cooper and Gnanapragasam 2016). On the other hand, developing economies usually have weak regulations and a lack of enforcement fuels the growth of informal sector waste management activities (Davis, Akese, & Garb, 2018; Subramanian, 2014) and unsustainable disposal practices (Kanhai et al., 2019). Effective regulatory environment influences how consumers dispose of their electronic waste for onward collection.

Figure 14 shows the frequently generate e-waste (in Table 20) and the various disposal methods based on Jacoby, Berning and Dietvost (1977). According to Jacoby, Berning and Dietvorst (1987), disposal behaviour is operationalized as the action taken by a household unit when it no longer intended to use an appliance for its original purpose. According to the authors, disposal options available to consumers after the end of life or when they have no intention to reuse appliances include: discarding or throwing away, selling, donating, gifting, trading for a newer model and storing or keeping. According to the authors, the relationship between a consumer and their possessions significantly influences a consumer's disposal choices as to how and when they dispose of a used good. This will impact the volume, timing and condition of goods entering the e-waste value chain. Figure 14 shows the most common ways households dispose their electronic waste.

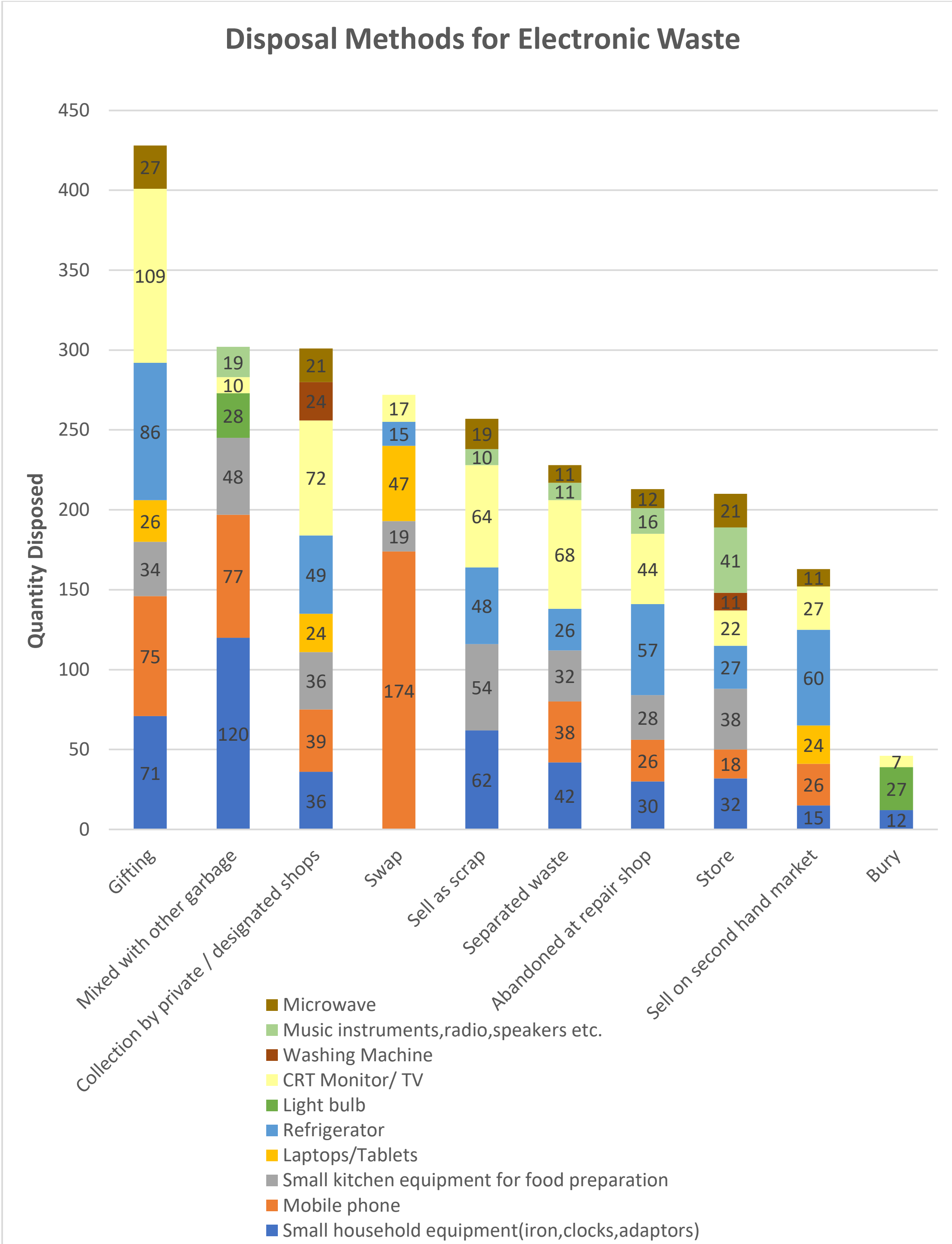

Figure 12: Disposal methods

Source: Field survey (Ofori, 2020).

Frequently generated e-waste among Households

The type of Electronic waste generated differ from one households to another. In the same way, the common electronic waste generated in Ghana differs from those generated in Europe and Asia. The differences is highly linked to differences in technology development and the level of adoption among households. This sub section aimed at examining the most frequently generated electronic waste among households in Ghana and the most common method adopted to manage such waste. Examination of the results reveals fridge, CRT monitors, mobile phones, electric bulbs, electronic equipment for food preparation, washing machine, among others, were commonly found among households.

Fridge: Safe disposal of waste refrigerator is usually complex because of the presence of highly dangerous gas; Chlorofluorocarbons (CFC), that must be safely discharged (Ruan & Xu, 2011). However, according to Foelster et al. (2016), an environmentally sound recycling system for waste refrigerators, especially, has the potential to reduce C_O2 emission and energy consumption. The survey revealed that out of 537 households (Table 20) who responded to have generated waste refrigerator, 86(16%) of them used gifting as a method of disposal, 60(11.2%) sold as second hand to others for reuse, 57(11%) abandoned at a repair shop, 49 (9.1%) used collection centres, 48(8.9%) sold as scrap, 27(5 %) stored their old fridge, 15(2.8%) swapped for newer fridge models with older versions and the rest 169(31.4%) did not respond.

Because refrigerators by their nature take up space, individuals would prefer to give them out or gift to others to clear space for other equally important things. Others send their refrigerators to the workshop with the intension of getting them repaired. Just like CRT TVs, improvement in refrigeration technology easily renders existing ones obsolete. So, owners do not see the reason to incur the high cost of repair when more advance energy-efficient options are available. This explains why a lot of refrigerator repairers have quantities of deteriorating refrigerators at their workshop usually left at the mercy of all-weather conditions.

Cathode ray tube (CRT) monitors and television*:* Improvement in technology has resulted in the replacement of CRT display monitors and television (TVs) with flat display panel TVs. Flat display panel TVs are energy efficient, light in weight, compatible with most digital signals and the ability to hang on walls make them appealing (Harbers, Timmers & Sillevis-Smitt, 2002). Due to this abrupt change, a lot of waste CRT TVs have been generated globally (Gusukuma & Kahhat, 2018). Of all the electronic waste components, Singh, Li, and Zeng (2016) describe waste from CRT TVs as the most polluting.

Therefore, sound disposal of CRT TVs is necessary for human health and environmental quality (Nnorom, Osibanjo & Ogwuegbu, 2011). From the study, out of the 619 Households responding yes, to discarding television over the past year. 109 (30.7%) households indicated gifting their waste TV, mostly CRTs. It is assumed that donated equipment most often perceived to be in good condition by the recipient. Reuse helps to extend the average life of equipment by at least 30% (Tieband et al, 2017; Cole, Gnanapragasam & Cooper, 2017). Reuse also helps to keep resources in circulation, which promotes a circular economy principle of elimination of waste (Cole, Gnanapragasam & Cooper, 2017). However, in promoting reuse, the environmental impact of reusable electronic products should be considered.

About 11.6% of respondents had supplied their waste TVs to designated collection points. This is usually the case when manufacturers or agents specifically directs consumers to supply old appliances. This finding is in line with that of Tieband et al (2017) who found that the collection rate for CRT TVs was higher. 64(10.3%) sold as scrap, 44(7.1%) abandoned at repair shops. This is particularly true of the CRT TVs which had become obsolete and therefore owners did not see the reason to incur the high cost of repair when more advance energy-efficient options are available. This was evident in various repair shops where CRT TVs have flooded the workshop (see Figure 3). 27 respondents (4.4%) sold on the second-hand market.

Mobile phone: Mobile phones were the predominant appliances that were discarded using swap as the means of disposal. Out of 573 households (Table 20) that agreed to have generated waste from mobile phones, 174(30.4%) adopted swapping as a means of disposal, 77(13.4%) dropped broken or spoilt phones in ordinary house garbage, 75 respondents (13.1%) donated their used or older phones, 39 respondents (6.8%) sent older mobile phones to collections points or centres as a means of disposal, 26(4.5%) abandoned at repair shops and 26(4.5%) sold on the second-hand market as well, 18(3.1%) kept or stored their waste generated from mobile phones and 100(17.5%) did not respond to the questions. Apart from swapping, storing of mobile phones and giving away to family and close acquaintances is predominat in collective societies. Ananno et al. (2021) cite reasons such as low income levels and cultural collectivesim.

Small electronic and electrical equipment like mobile phones has been found to have shorter product lifetimes. Thiebaud, Hilty, Schluep and Widmer

(2017) found that the average service lifetime varies from 3.3 years for mobile phones. Further, Liu, et al. (2019) stated that for conspicuous reasons, the pursuit of fashion and the urge to stay updated with new technology, especially among young adults, has drastically reduced the average life expectancy of mobile phones from 2.9 years in 2011 to 2.21 years in 2018. At the same time, mobile phones usually serve as storage points for sensitive information. In Liu et al. (2019) information leakage posed the greatest obstacle to mobile phone recycling in China for example. Unlike developing nations, Milovantseva and Saphores (2013) and Cole, Gnanapragasam and Cooper (2017) indicated that there are some options available for conveniently recycling mobile phones for reuse; in addition, to drop of bins at retail stores, a lot of organisations offer prepaid envelopes so people can mail out their old phones and, in some cases, get paid for it.

Bulbs*:* Light bulbs such as straight tube fluorescent bulbs, lamps and led bulbs are the most common types found in the Ghanaian market. Studies, such as Aucott, McLinden and Winka (2012), have shown that fluorescent bulbs contain mercury and this substance is released into the environment anytime bulbs get broken when they are being disposed of. According to Aucott, McLinden and Winka (2012), about 17% to 40% of mercury in broken bulbs is released into the air, and this release rate is higher in higher temperature regions. Out of 523 households who indicated they have generated waste from electric bulbs, 28 respondents (5.4%) disposed of bulbs by mixing with ordinary garbage, 27(5.1%) of the respondents adopted burying as a method of disposal, and the rest of about 468 respondents (89.5%) did not respond. Burying waste bulbs in backyards and around the house prevents cuts and the risk of children coming into contact with these electronic wastes. Waste from electrical bulbs is normally disposed of by mixing with ordinary garbage. Engaging in proper recycling of CFLs and other fluorescent bulbs, where a system for recycling is available, allows the reuse of the glass, metals and other materials that make up fluorescent lights.

Kitchen equipment for food preparation: like an oven, electric burner, electric whisker, graters and other cooking equipment a total of 551 households generated waste from kitchen equipment for food preparation. 54 (9.8%) indicated waste generated was sold as scrap, 38 (6.8%) households responded to have kept or stored the waste from kitchen equipment, 36(6.5%) household supplied their kitchen equipment waste to designated collection points, 34(6.1%) households donated their fairly used kitchen equipment for food preparation to family, friends and sometimes repairers, 28(5%) abandoned their kitchen equipment for food preparation at repair shops. Kitchen equipment and related appliances mostly contain precious metals like aluminium fractions normally suitable for further processing, hence the preferred choice among other disposal options.

Other small household equipment: The total number of responses to have shown yes to generating other small household equipment waste like small ventilators, iron, clocks, chargers, adaptors and extension boards etc., were 578 households. However, when respondents were asked to indicate the method of disposal, results showed that 120 (20.8%) discarded mixing with ordinary garbage, 71(12.3%) households donated other small household equipment to friends and family, 62(10.7%) households sold other small household equipment as scrap to scrap dealers, 42 respondents (7.7%) separated other small household equipment and appliances waste from other wastes generated, 36 of the respondents (6.2%)

sent or supplied waste to various collection points, 32(5.5%) households responded to have kept or stored the waste generated from other small household equipment, 30(5.2%) abandoned at the repair shop, 15(2.6%) household sold other small household equipment on the second-hand market, 12(2.1%) adopted burying as a disposal method and the rest of 158 (27.3%) were unaccounted for.

In a study conducted by Afroz et al (2013), in Malaysia, 40% of electronic waste were mixed with other household waste due to the low level of awareness on waste separation and the environmental and health impact of electronic waste. Unlike larger equipment like fridges, television set, etc., which easily take up space, waste from small household equipment are mostly dropped in mixed garbage, without any thought of segregation. For example, a broken charger will just be dropped in the trash can in the house, unlike a spoilt TV which would have to be kept for some time and later donated or sent to a collection site.

Musical instruments, radio, speakers and audio set*;* The survey revealed 515 households had generated waste from musical instruments like radios, speakers, audio sets etc. 41(8%) households decided to keep these electronics, 19(3.7%) household disposed of music instruments by mixing with ordinary garbage, 16 (3.1%) abandoned waste at repair shops, 11(2.1%) separated music instruments waste from other waste, 10 (2.0%) households revealed they sold waste generated as scrap, and the rest 418 (81.2%) did not respond. One reason for the storage os music instruments was found in Casey, Lichrou and Fitzpatrick (2019). According to the authors, people develop emotional bonds with certain music instruments from which favourites tracks were played. In addition, music instruments are linked to culture, and so old musical instruments are kept to remind people of the history of certain kinds of music.

The small size and lightweight of electronics like the music box and mobile phones make stockpiling an easy option and create obstacles for 'take-back' and other more formal ways of reuse or recycling hence keeping or stockpiling. (Speake & Yangke,2015). According to, Siby, Singh and Singh (2018), keeping e-waste has been one of the most predominant methods opted by households in both developed and developing nations. The storage of discarded e-waste has been found as a barrier to promoting a circular economy (Nowakowski, 2019).

Laptops/tablets: ICT equipment such as laptops, tablets and mobile phone usage is predominant among the young adult population in developing countries. The youth represent the new generation that contributes significantly to ICT related product consumption and growth in ICT waste (Aboelmaged, 2021). Disposal behaviour of the youth is characterized by obsolescence in terms of technology (Kumar, 2019) and hence ICT waste are mostly functioning which makes it desirable to swap, donate, sell as second hand to others or sent to a collection point. The results of this study confirm this position. Out of 521 households that responded yes to have generated waste from laptops and Tablets, 47 respondents (9%) swapped their older laptops for newer or latest versions, 26 respondents (5%) donated mostly to family and friends, 24 (4.6%) supplied obsolete laptops and tablets to various collection points, 24(4.6%) sold on second-hand markets and the rest 400(76.8%) did not respond to the question.

Washing machine: Although it is usually considered a luxury in developing economies, it is gradually becoming a common appliance especially among large family-sized households (Pakula & Stmminger, 2010). This is because it helps to save time, to attend to other equally important activities. It was not surprising that 210 households showed “yes for generating electronic waste from washing machines. However, when respondents were asked to indicate the method of disposal, results showed that 24 of the respondents (11.4%) discarded by sending to appropriate collection points, 11(5.2%) decided to keep or store for reuse, refurbishment or for no reason at all and the rest 175(83.3%) did not respond to the question. Washing machine is one of the electronic appliances heavy, in addition to its size making mobility difficult. Scrap metal workers are most interested in the waste because of its rich content in aluminium copper, and some plastics (Tansel, 2017).

Microwave: Microwave is another kitchen equipment found among middle and higher-income households (Dindarian, Gibson & Quariguasi-frota-neto, 2012) From the study, out of the 447 Households responding yes, to discarding microwave over the past year 27(6%) donated microwaves to their family and friends and sometimes to repairers, 21(4.7%) supplied to appropriate collection centres, 21(4.7%) keep their microwaves, 19(4.3%) sold as scrap to scrap dealers, 12(2.7%) abandoned at repair shops, 11(2.5%), 11(2.5%) sold on the second-hand market and the rest, 325 (72.7%) did not respond to the question.

In contrast to the finding by Dindarian, Gibson and Quariguasi-frota-neto (2012), where discarding of microwave oven was driven by the desire for new technology in the UK, it is not usually the case in developing countries like Ghana where microwaves are not necessarily discarded because of obsolete technology and that is why people will not swapping microwaves for upgraded ones and hence respondents did not indicate swap as a means of disposal.

Chapter Summary

In summary, continuous use of electronic applinces activates the process of depreciation whiles improvement in technology creates obsolescence. In either case, there are triggers of waste disposal. Although some type of e-waste such as small electronic appliances generated in our homes is easy to manage, others present a significant challenge. From the survey the common methods of disposal include mixing with ordinary garbage, separating them for further processing, sending them to collection points or being collected by designated e-waste processors, swapping, donation, storing at homes, abandoning at repair shops, selling as scrap, burying and selling on the second-hand market. Donation or gifting was the predominant method for disposing of unwanted electronic appliances. This confirms a study by Cruz-Cárdenas, González, & del Val Núñez (2016).

The practice of giving to family, friends and other acquaintance is a characteristic of the collectivist culture that emphasizes values such as, benevolence, friendship, love and religiosity (Cruz-Cárdenas et al., 2016). From the results, the reasons cited for replacing the electronic appliance were physical damage and malfunction of an appliance, this was followed by consumers desire for newer technology and greater functionality. From a developing economy perspective, Liu et al. (2019) and Cao et al. (2016) found that malfunction and physical damage accounted for 52% of disposals in China.

In contrast, the desire for newer technology and greater functionality, according to studies by Cao et al (2016) and Cole, Cooper and Gnanapragasam

(2016), characterises the disposal of electronic waste in high-income economies. Li et al. (2012) noted that e-waste is most often sold to peddlers or hawkers from where electronic waste flow into the second-hand market after refurbishing and then re-sold. Again, another characteristic of electronic waste management in developed economies such as Europe is the strict enforcement and adherence to certain laid down regulations relating to the use, consumption and disposal of electronic products, and the availability of infrastructure. On the other hand, in some developing nations in Asia and Africa, electronic waste management is dominated by urban mining to meet daily livelihood (Cao et al., 2016).

CHAPTER SIX

DRIVERS OF PRO-ENVIRONMENTAL INTENTIONS AND SUSTAINABLE ELECTRONIC WASTE MANAGEMENT AMONG HOUSEHOLDS

Introduction

This chapter presents results for objective two and three. The previous chapter has dealt with the waste management practices and the awareness level of households. On this note, this chapter of the study addresses the second and third objectives, which sought to analyse the effect of environmental values, social norms, perceived behavioural control and pro-environmental intentions, and investigate the effect of pro-environmental intentions, facilitating conditions, perceived producer responsibility and sustainable e-waste management behaviour.

To achieve this objective, the quantitative approach and cross-sectional design were adopted. The PLS-SEM visually displays the hypotheses and variable relationships in a path model. The model consists of two elements: the inner model (structural model) and the outer model (measurement model). The structural model represents the relationship among the constructs, while the measurement model shows the relationship between constructs and their indicators.

The PLS-SEM approach estimates its path models by combining principal component analysis and ordinary least square regression. (Mateos-Aparicio, 2011). Accordingly, the presentation of results follows a procedure outlined by Hair et al. (2018), who states that measurement model should be first assessed for validity and reliability, and when they meet required criteria, before examining the structural model. All constructs were reflectively measured because indicators were adapted from validated instruments, indicators were manifestations of the underlying constructs, and direction of causality was from indicators to construct (Hair Jr, Hult, Ringle & Sarstedt, 2011). As part of the initial data diagnostics procedures, the distribution of data including mean, standard deviation, skewness and excess kurtosis is presented. This is followed by reliability, validity and common method assessment.

Data Characteristics

The analytical procedure is highly robust, works relatively well with non-normal data because its algorithms include a bootstrapping procedure that is purely non-parametric. Nevertheless, it is important data is assessed for missing values, skewness and kurtosis. The percentage of missing values was determined by dividing the total number by the total number of responses (652). The minimum number of missing values was 3 and the highest was 18. According to Hair, Jr. et al. (2017), to maintain statistical power of PLS-SEM, missing values should be below 5%. The results showed missing data was between 0.8% - 3%. SmartPLS presents three approaches for treating missing values: mean replacement, case deletion and pairwise deletion. Case deletion was chosen because the cases with missing data were minimal and so deleting did not affect the model estimates.

Secondly, although normally distributed data are not required for PLS-SEM analysis, one must also ensure data possess acceptable characteristics, such as the absence of extreme outliers and collinearity (Hair et al., 2010). PLS-SEM, generally, does not assume random data distribution. However, according to Hair et al. (2018), bootstrapping with nonnormal data can produce peaked and skewed bootstrap distributions. So, the distribution of data was considered before inferential statistics was applied. Assessing normality has been traditionally conducted using Kolmogorov-Smirnov and Shapiro-Wilk tests (Sarstedt & Mooi, 2014).

Also, an examination of two measures of distribution—skewness and kurtosis—provides the extent to which data deviates from normality. SmartPLS automatically generates mean, standard deviation, excess kurtosis and skewness once data is imported into the software. Table 22 shows the mean (M), standard deviation (SD), excess kurtosis (EK) and skewness (SK). The skewness of normally distributed data is 0 and kurtosis equal to 3. Excess kurtosis is determined by deducting 3 from the kurtosis. So essentially, excess kurtosis of normally distributed data should also be 0. The data did not deviate so much from a normal distribution, which is usually the case with most primary-data based surveys in social sciences (Zhao, Lynch & Chen, 2010). Table 22 shows results of the mean (M), standard deviation (SD), excess kurtosis (EK) and skewness (SK).

Table 22: Scale Items and Distribution

Code	Items	M	SD	EK	SK
	Sustainable e-waste management				
RB1	In the course of the past year, I often made efforts to repair faulty electronic appliance if it is possible before thinking about replacement.	3.308	1.830	-0.799	0.536
RB2	In the past year, I have often engaged in proper recycling	3.535	1.849	-0.984	0.450

Table 22, continued

Code	Items	M	SD	EK	SK
RB3	I usually patronise formal collection services for my electronic waste in the past year.	3.637	1.869	-0.896	0.509
	Pro-environmental Intentions				
INT1	I intend to participate in formal electronic waste recycling system when available	4.513	1.940	-1.120	-0.257
INT2	I will try to participate in formal electronic waste recycling when available	4.767	1.762	-0.780	-0.385
INT3	I plan to participate in formal electronic waste collection system when available	4.784	1.865	-0.811	-0.456
	Attitude				
ATT1	Engaging in proper electronic waste management will be too much of a bother; I am not prepared for such a bother	3.669	1.908	-1.076	0.148
ATT2	Engaging in proper electronic waste management will enable me to be environmentally responsible; being environmentally responsible is important for me	5.313	1.469	-0.025	-0.702
ATT3	Engaging in proper electronic waste management will protect me and others from contracting harmful ailments; being safe from harmful ailments is very important	5.629	1.422	1.094	-1.174

Table 22, continued

Code	Items	M	SD	EK	SK
	Environmental Values				
EV1	I feel morally responsible to do my part to promote a sound environment	5.191	1.723	-0.238	-0.759
EV2	I try only to buy products that can be easily recycled	4.574	1.807	-0.69	-0.439
EV3	I do not buy household products that harm the environment	4.777	1.854	-0.69	-0.534
EV4	I feel a moral obligation to protect the environment	5.428	1.556	0.403	-0.941
EV5	I feel it is important that people, in general, protect the environment	5.557	1.621	0.609	-1.147
EV6	Because of my values/principles, I feel an obligation to behave in an environmentally-friendly way	5.474	1.615	0.553	-1.082
EV7	If I engage in environmentally inappropriate behaviour, I will feel terrible whether or not anyone knows about it	5.197	1.709	-0.103	-0.848
EV8	I feel it as a moral responsibility to spend money to protect the environment	5.123	1.67	0.174	-0.904
EV9	I feel it as a moral responsibility to spend efforts to protect the environment	5.394	1.667	0.473	-1.089
	Perceived Behavioural Control				
PBC1	I have enough knowledge on proper waste management practices, I have been implementing the knowledge and will continue to do that	3.882	1.725	-0.963	0.098

Table 22, continued

Code	Items	M	SD	EK	SK
PBC2	I have adequate skills to engage in proper waste management practices	3.934	1.658	-0.837	-0.028
	I have been using the skills and will continue to do that				
PBC3	There are many challenges if I try to engage in proper electronic waste recycling, I do not want to go through such challenges	4.207	1.701	-0.902	-0.148
	Facilitating conditions				
FC1	There are convenient and officially designated collection centres where I can properly dispose my electronic waste, having a designated collection centre is very important for me to adopt proper waste management practices	3.949	1.51	-0.45	-0.013
FC2	There are rules and regulations on electronic waste disposal, I have been complying or will comply with the rules and regulations (when available)	4.302	1.536	-0.466	-0.268
FC3	I am aware of sanctions/penalties from city authorities for improper disposal of electronic waste, I have been complying or will comply with the sanctions (if available)	4.287	1.604	-0.579	-0.274
FC4	I am ready to pay for the disposal of my e-waste, paying for waste disposal contributes to the effective management of electronic waste in the country.	4.764	1.707	-0.562	-0.512

Table 22, continued

Code	Items	M	SD	EK	SK
	Injunctive Norms				
SNJ1	The leadership of my community expects that I adopt proper waste management practices; I am always ready to comply with good directives from leadership	4.643	1.529	-0.463	-0.381
SNJ2	My neighbours expect that I use proper waste management practices; I am always ready to comply with good directives from my neighbours	4.866	1.547	-0.188	-0.585
SNJ3	My family members who stay with me expect that I practice proper waste management; I am always ready to comply with good directives from my family members	5.096	1.538	-0.103	-0.747
SNJ4	My close friends think I should properly dispose of my electronic waste; I am always ready to comply with good directives from my close friends	5.060	1.515	-0.202	-0.636
	Descriptive Norms				
SND1	How often do you think that the leadership in your community engage in proper recycling of their household electronic waste?	3.380	1.929	-0.982	0.391
SND2	How often do you think that your neighbours engage in proper recycling of their household electronic waste	3.642	1.840	-0.913	0.262

Table 22, continued

Code	Items	M	SD	EK	SK
SND3	How often do you think that your family members in your home engage in proper recycling of their household electronic waste	3.924	1.864	-1.029	0.026
SND4	How often do you think that your close friends engage in proper recycling of their household electronic waste	3.964	1.857	-0.996	-0.041
SND5	When I see leaders, my neighbours, family members and close friends engage in proper waste management, I feel I should do as well	4.817	1.834	-0.764	-0.460
	Awareness				
AOC1	Pollution generated from dumpsites harm people all over the country	5.082	1.904	-0.325	-0.851
AOC2	The effects of pollution on public health is worse than we realize	5.381	1.686	-0.006	-0.951
AOC3	Human activities are endangering the environment	5.471	1.665	0.173	-1.018
AOC4	Electronic waste is a serious problem both locally and globally	5.359	1.664	-0.319	-0.810
AOC5	My welfare is affected by problems like waste disposal	5.073	1.761	-0.442	-0.682
AOC6	Economic activities are affected by poor waste management practices	5.406	1.677	0.241	-1.013

Table 22, continued

Code	Items	M	SD	EK	SK
	Perceived Producer Responsibility				
PPR1	I see how to recycle on product labels	4.536	1.844	-0.727	-0.455
PPR2	Product labels direct and warns users of the dangers of improper recycling	4.796	1.692	-0.410	-0.567
PPR3	Adverts by producers/retailers encourages proper waste disposal	4.618	1.815	-0.790	-0.478
PPR4	Product manuals have procedures for recycling an item when it becomes waste.	4.690	1.785	-0.667	-0.526
PPR5	Product labels contain clear guidelines on how to safely dispose of the waste.	4.726	1.753	-0.631	-0.528
PPR6	Some retailers make known areas where items can be recycled at the point of purchase	4.376	1.948	-1.100	-0.308
PPR7	I am assured of take-back when I find a challenge with a product	4.458	1.899	-1.022	-0.328
PPR8	The content of some promotional messages encourages one to engage in proper waste recycling	4.555	1.982	-1.011	-0.457

Source: Field survey, Ofori (2020).

All the items were adapted from exiting validated scales and were reflectively measured. Diamantopoulos and Siguaw (2006) mention that the choice of formative or reflective measurement theory should be grounded on content, parsimony and criterion validity. For these reasons, it was ensured that the scales adapted were validated and used in similar studies. Also, the content of each scale primarily reflects te underlying construct, and the items adequately covered the conceptual domain of the construct such that deletion does not cause changes in the underlying construct. Finally, after conducting a reliability and validity test, some constructs and indicators were not included in further analysis.

PLS-SEM approach conducts exploratory factor analysis on the measurement model as part of ensuring reliability and validity of measures and their constructs. Consequently, items measuring attitude ATT2 and ATT3 loaded strongly on environmental values, other than on attitude itself so the entire construct was deleted because there were only three items. Trafimow (2015) explains that the conceptualisation of environmental norms in the NAM model is similar to attitude because they all measure individuals perceived evaluation of undertaking a behaviour. The environmental values scale had EV2, EV3, EV4, EV6 and EV9 deleted. Besides, RB1, PBC3, PPR1, PPR2 and PPR7 were deleted. The rest of the indicator's loadings, reliability and AVE is shown in Table 24.

Test for Common Method and Social Desirability

It is reported that self-reported bias may be present in surveys that solely employed questionnaires or self-reports as data collection instrument leading to common method bias (CMB) (Ahari et al., 2018; Craighead, Ketchen, Dunn, & Hult, 2011; Malhotra et al., 2017; Podsakoff et al., 2003). Both procedural and statistical approaches have been recommended. Procedural remedies, in line with a recommendation by Malhotra et al., (2017) and Podsakoff et al. (2003), were implemented before the data collection exercise commenced. Also, the most common statistical approach for testing CMV, Harman's single-factor was conducted (Malhotra et al., 2017). According to this test, the unrotated first factor from factor analysis should be less than 50% (Podsakoff & Organ, 1986).

The test was conducted using SPSS and Bartlett's test of sphericity ($p<.05$) (Bartlett 1954), and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (0 to 1) (Kaiser 1970, 1974) were generated as measures to check factorability of data. Bartlett's test of sphericity was significant ($p < .05$) and the KMO index was 0.906, which was greater than the minimum of 0.6, so the factor analysis was considered appropriate. The result of the unrotated solution shows factor analysis produced 58 distinct factors, and the largest factor accounted for 25.122% of the variance of the model. This suggested that the data did not suffer from common methods bias.

In addition to Harman's single-factor approach, the collinearity test, which involves a critical examination of the variance inflation factors (VIFs) for all the latent variables, were also presented (Table 15). In PLS-SEM, the occurrence of a VIF greater than 3.3 is proposed as an indication of pathological collinearity, and also an indication that a model may be contaminated by self-reported bias. Therefore, if all (factors level) VIFs resulting from a full collinearity test are equal to or lower than 3.3, the model can be considered to be free from common methods bias (Kock, 2015).

Assessment of Reliability and Validity Test

Reliability and validity test are important diagnostics for studies that mainly relies on self-reported questionnaires. While reliability measures the consistency of items, validity examines the accuracy and the degree to which concepts are well captured by items (Ahari et al., 2018). Within the domain of structural equation modelling, some authors have proposed rules of thumb that serve as guidelines to assess and interpret the results from PLS-SEM (Chin, 2010; Roldán & Sánchez-Franco, 2012). Table 23 provides a snapshot of these thresholds.

Table 23: Measurement Criteria Thresholds

Measurement criteria	Recommended	Reference
Indicator loading	≥ 0.708	Hair et al., (2013)
Composite reliability	≥ 0.60	Hair et al., (2018)
Average Variance Extracted (AVE)	> 0.50	Henseler et al., (2016)
rho_A	≥ 0.70	Dijkstra & Henseler (2015)
HTMT Ratio	< 0.90	Henseler, Ringle & Sarstedt (2014)
Cronbach's Alpha	≥ 0.70	Henseler Ringle & Sarstedt (2014)
Variance inflation factors	≤ 3.3	Kock (2015)

Source: Adapted from Hair et al. (2013)

The measurement model was reflective so the first step was to examine the indicator loadings. Although the minimum value of 0.708 is recommended, loadings below 0.708 are acceptable in studies that explore underlying relationships to add to theory (Hair et al., 2018). Loading of 0.708 and a corresponding AVE of 0.50 means that the construct explains more than 50 per cent of the variance of the indicator. In reflective measurement, the indicators are dependent on the construct. Examination of all indicator loadings in Table 24 shows acceptable item reliability because the corresponding AVEs were above 0.50. The second step was to examine the internal consistency reliability, which was based on composite reliability (Jöreskog, 1971). According to Hair et al. (2018), Cronbach alpha produces a less precise measure of reliability because it does not consider the number of items. In contrast, composite reliability is weighted-based and was considered appropriate. Table 24 shows the reliability and the validity results.

Table 24: Reliability and Validity Results

Variables	Indicator Loadings	rho_A	Composite Reliability	AVE
Sustainable e-waste management				
RB2	0.878	0.869	0.867	0.685
RB3	0.818			
RB4	0.784			
Intentions				
INT1	0.640	0.708	0.700	0.533
INT3	0.810			
Environmental Values				
ATT2	0.753	0.837	0.834	0.502
EV6	0.657			
EV7	0.671			
EV8	0.708			
EV9	0.757			
Control over behaviour				
PBC1	0.876	0.857	0.857	0.750
PBC2	0.856			
Facilitating Conditions				
FC2	0.813	0.814	0.810	0.587
FC3	0.694			
FC4	0.786			

Table 24, continued

Variables	Indicator Loadings	rho_A	Composite Reliability	AVE
Injunctive Norms				
SNJ1	0.740	0.880	0.878	0.642
SNJ2	0.827			
SNJ3	0.796			
SNJ4	0.839			
Descriptive Norms				
SND2	0.704	0.847	0.845	0.578
SND3	0.759			
SND4	0.769			
SND5	0.806			
Perceived Producer Responsibility				
PPR3	0.782	0.883	0.881	0.597
PPR4	0.809			
PPR5	0.796			
PPR6	0.700			
PPR8	0.773			

Source: Field survey, Ofori (2020)

From Table 24, composite reliability values range from 0.700 to 0.881. Values between 0.70 and 0.90 are described as “satisfactory to good.” But values of 0.95 and higher could indicate that some items are redundant, thereby reducing construct validity (Diamantopoulos et al., 2012; Drolet & Morrison, 2001). Dijkstra and Henseler (2015) also proposed another measure of internal consistency reliability represented as rho_A. This measure is seen as a balance between the more conserved Cronbach’s alpha and more flexible composite reliability (Hair et al., 2018). All rho_A values for all constructs were above the threshold value of 0.7. The third step was to assess the convergent validity of the indicators of each construct. Convergent validity is gauged with average variance extracted (AVE), which should yield a minimum value of 0.50 or higher, an indication that a construct explains at least 50% of the variance in the underlying indicators. An examination of all AVEs in Table 24 shows that all constructs explained at least 50% variation in their indicators, so convergent validity was achieved.

The fourth step in the assessment process of the reflective measurement is discriminant validity. While convergent validity examines the extent to which indicators measure or capture a common construct, discriminant validity indicates the extent to which two scales measure distinct construct in a structural model (Henseler, Ringle & Sarstedt, 2014). There are about three criteria for assessing discriminant validity. Fornell and Larcker (1981) suggested that to establish discriminant validity, the square root of the AVE of a construct should be greater than the correlation between the same construct and all other reflectively measured constructs. The results of this procedure is shown in Table 25. However, some authors, such as Henseler, Ringle and Sarstedt (2015), have shown that this criterion is not suitable, especially when indicator loadings differ slightly.

Accordingly, Henseler, Ringle and Sarstedt (2014) proposed a more robust technique called Heterotrait-Monotrait Ratio (HTMT) as an alternative (Table 26). According to this new criterion, discriminant validity is not achieved when HTMT values are above 0.85. Table 26 shows that all values are below the threshold point, an indication of discriminant validity. A more manual approach involved an examination of the cross-loadings of all indicators against their underlying constructs and other constructs. However, the cross-loadings (Appendix F) only provide additional insight into the magnitude of the loadings unto the other constructs. Results from cross-loadings are attached in Appendix F. Table 25 and 26 shows the results of the discriminant validity.

Table 25: Fornell-Larcker Criteria

Constructs	DN	EV	FC	IN	PPR	PC	RB	Int
DN	**0.760**							
EV	0.456	**0.707**						
FC	0.545	0.519	**0.766**					
IN	0.503	0.622	0.478	**0.802**				
PPR	0.405	0.318	0.503	0.348	**0.773**			
CB	0.496	0.327	0.465	0.318	0.312	**0.866**		
RB	0.238	0.067	0.333	0.196	0.408	0.284	**0.828**	
Int	0.268	0.479	0.342	0.469	0.176	0.176	0.040	**0.730**

Note: Numbers in bold are squared root of AVEs
DN means Descriptive norms, EV means Environmental Values, FC means Facilitating Conditions, IN means Injunctive Norms, PPR means Perceived Producer Responsibility, CB means Control over Behaviour, RB means Sust. E-waste mgt., Int means Pro-env Intentions.

Source: Field survey, Ofori (2020)

Table 26: Heterotrait-Monotrait Ratio (HTMT)

Constructs	DN	EV	FC	IN	PPR	CB	RB
DN							
EV	0.449						
FC	0.540	0.513					
IN	0.500	0.617	0.478				
PPR	0.406	0.313	0.501	0.344			
CB	0.496	0.326	0.465	0.317	0.310		
RB	0.239	0.066	0.333	0.192	0.412	0.283	
Int	0.268	0.488	0.329	0.477	0.171	0.178	0.130

Source: Field survey, Ofori (2020)

Note: DN means Descriptive norms, EV means Environmental Values, FC means Facilitating Conditions, IN means Injunctive Norms, PPR means Perceived Producer Responsibility, CB means Control over Behaviour, RB means Sust. E-waste mgt., Int means Pro-env Intentions

Assessment of Structural Model

When all criteria to assess the measurement, model has been satisfied and results meeting the required thresholds, the next step is to evaluate the structural model. The structural model shows the hypothesized relationship between constructs. Before the significance of the structural relationships is assessed, some fit indices were first examined. According to Hair et al. (2018), the structural model was assessed for collinearity issues. This was followed by an examination of the predictive power of the model through the coefficient of determination, R^2, the effect size (f^2) and the predictive relevance (Q^2). All endogenous constructs were assessed for collinearity in the structural model. Table 27 shows the results of the collinearity.

Table 27: Collinearity

	Environmental Values	Perceived Control	Sust. E-waste Mgt	Pro-env Intentions
Descriptive Norms				1.649
Environmental Values				1.724
Facilitating Conditions			1.683	
Injunctive Norms				1.810
Perceived Producer Responsibility			1.353	
Perceived Control over Behaviour			1.290	1.351
Sustainable e-waste Mgt				
Pro-env Intentions		1.000	1.133	

Source: Field survey, Ofori (2020)

The collinearity procedure involves examining the variance inflation factors to be sure that it does not bias the regression estimates. It tests whether correlations among constructs is not substantial. Latent variable scores of the endogenous variables are used to calculate variance inflated factors (VIF) values. Based on the thresholds in Table 23, all VIFs in Table 27 are below 3.3, suggesting collinearity is not present in the model. This was also confirmed by the correlations in Table

25, which showed all values were below a recommended 0.7 threshold (Pallant 2020). The structural model (in Figure 11) depicts the relationships among the latent constructs based on the theoretical framework.

The latent variable estimates are linear aggregates of their observed indicators, whose loadings are obtained via the bootstrapping procedure (Awang, Wan Afthanorhan, & Asri, 2015). As a measure of the goodness of fit of the structural equation, a coefficient of determination, (R^2), the effect size (f^2), the predictive relevance (Q^2) is produced as part of the results and shown in Table 28. R-square measures the percentage of the variance of the dependent variable that is caused by the independent variables, while effect size is a measure of the magnitude of contribution an independent variable makes to the variance in a dependent variable. Table 28 presents the results of the model fit measures.

Table 28: R-square, F-square and Q-square

	Pro-environmental Intentions	Sustainable e-waste Management
Descriptive Norms	0.014	
Environmental Values	0.078	
Facilitating Conditions		0.016
Injunctive Norms	0.062	
Perceived Producer Responsibility		0.089
Perceived Control over Behaviour		0.018
Sustainable e-waste management		
Recycling Intentions		0.009
R Square	0.280	0.222
R Square Adjusted	0.276 **	0.217 **
Stone-Geissers' Q² (=1-SSE/SSO)	0.135	0.134

Dependent variables: Pro-environmental Intentions and Sust. E-waste mgt.
*significant at 5% **significant at 1%
Source: Field survey, Ofori (2020)

The coefficient of determination (R^2) measures the amount of variance in the endogenous variable that is explained by a set of exogenous variables in a model. In Table 28, the total variance explained by the predictors of intentions (R^2) was 0.276. This implies that environmental values, descriptive norms, injunctive norms and perceived control over behaviour collectively explained 27.6 per cent of the variation in pro-environmental intentions, reaching a statistical significance of

0.01. Also, 21.7 per cent of the variation in sustainable e-waste management behaviour was explained by facilitating conditions, perceived producer responsibility, pro-environmental intentions and perceived control over behaviour, with perceived producer responsibility making a significant contribution ($\beta = 0.309$, $p = 0.000$).

The effect size (f^2) of each exogenous construct to the endogenous constructs is shown in Table 28. Cohen (1988) proposes a guide to the interpretation of effect sizes. As a rule of thumb, values greater than 0.02, 0.15, and 0.35 are considered small, medium and large effect respectively. From Table 28, environmental values, descriptive norms and injunctive norms recorded a small effect, although environmental values were the highest among them. Also, facilitating conditions, perceived producer responsibility, intentions and perceived control over recycling achieved small effects. Further, Geisser (1974) and Stone (1974) propose Q^2 values show the predictive accuracy of the PLS model. This measure is obtained from a blindfolding procedure. Since the values of Q^2 are all above zero, there is predictive relevance (Hair et al., 2018).

The structural model in figure 15 shows the factors influencing pro-environmental intentions and sustainable e-waste management behaviour and are represented through path relationships. Each of these paths was hypothesised based on a review of related literature. The results of the hypotheses tests are shown in Table 29. The bootstrapping procedure recommended by Preacher and Hayes (2008) was used to establish the significance of the path coefficients. Generally, the path coefficients describe the effect of each exogenous construct on the endogenous construct. According to Awang, Wan Afthanorhan and Asri (2015), PLS-SEM, which is variance-based, completely relies on the bootstrapping procedure or known as resampling with replacement in obtaining the estimates for path coefficients and their respective standard errors. Figure 15 shows the factors influencing pro-environmental intentions and sustainable e-waste management behaviour.

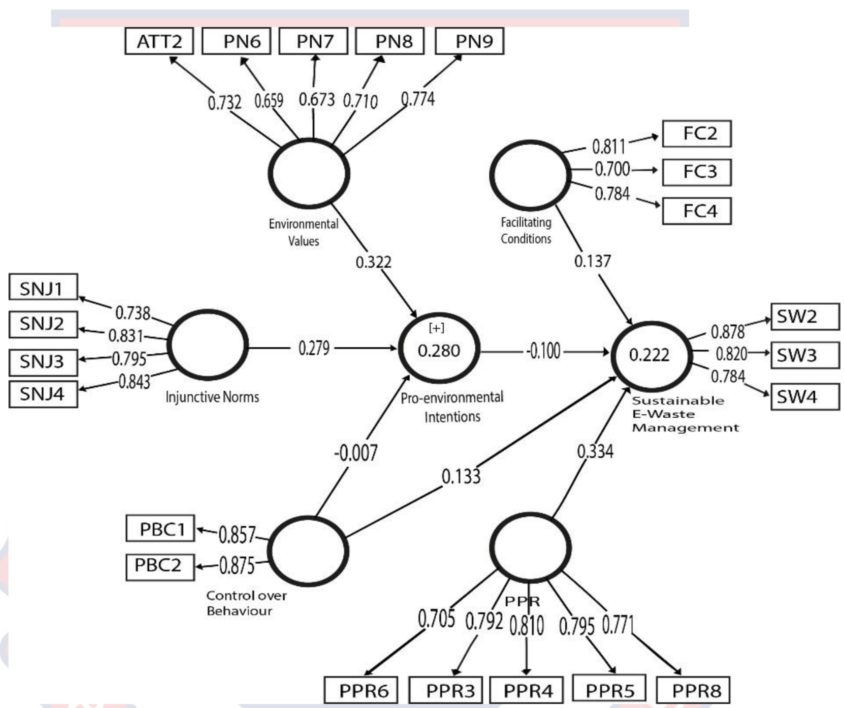

Figure 15: Structural Model

Source: Field survey, Ofori (2020)

Assessment of Path Relationships

Objective two and three were guided by seven hypotheses, which were subsequently analysed. The dependent variables were pro-environmental intentions and sustainable e-waste management. The results of the hypotheses test were further discussed in the light of the theory of sustainable development, planned behaviour and norm activation. The results are presented in Table 29.

Table 29: Results from hypotheses test

Structural relationships (Hypotheses)	Path Coefficient (O)	STDEV	T Statistics (|O/STDEV|)	P Values
Environmental Values -> Pro-environmental Intentions (H1)	0.322	0.079	4.081	0.000
Social Norms -> Pro-environmental Intentions (H2)	0.279	0.083	3.357	0.001
Perceived Control over Behaviour -> Pro-environmental Intentions (H3a)	-0.007	0.062	0.113	0.911
Perceived Control over Behaviour -> Sustainable e-waste management (H3b)	0.133	0.047	2.830	0.005
PPR -> Sustainable e-waste management (H4)	0.334	0.050	6.680	0.000
Facilitating Conditions -> Sustainable e-waste management (H5)	0.137	0.064	2.127	0.034
Pro-environmental Intentions -> Sustainable e-waste management (H6)	-0.100	0.051	1.960	0.084

Dependent variables: Pro-environmental intentions and Sustainable e-waste mgt.
Significance level: 5%
Source: Field survey, Ofori (2020)

An examination of the path coefficients in Table 29 shows that the hypothesised relationship between environmental values and intentions, and injunctive norms and intentions were not rejected at 5% significance level.

Environmental values recorded the highest effect on pro-environmental intentions (H1) ($\beta = 0.322$, p = 0. 0.000), followed by social norms (H2) ($\beta = 0.279$, $p = 0.001$) with environmental values explaining about 32.1 per cent of the variance in pro-environmental intentions. However, perceived control over behaviour (H4a) ($\beta = -0.007$, $p = 0.911$) recorded insignificant effect on pro-environmental intentions. Environmental values and injunctive norms made significant contribution to the variance in pro-environmental intentions.

Environmental values represent internalised moral obligation towards the natural environment and how its resources should be managed. It has been found to play a significant role in the pro-environmental behaviour of consumers. How people form opinions, their readiness to engage in environmental actions and give out resources in support of environmental campaigns is highly influenced by ones' environmental value system (Kaplan et al., 2019; Yang & Weber, 2019). Schwartz (1977) proposed the model of altruistic behaviour which is explained by personal norms, social norms, awareness of consequences. Environmental knowledge, which reflects people's knowledge of the consequences of their behaviours on the environment, is commonly recognized as the first important step in generating internal desires and preparing people to sustainably solve environmental problems (Fu, et al., 2019). Schwartz (2012) defines environmental values as values that account for environmentally significant behaviours and they include biospheric, egoistic, social-altruistic and hedonic values.

The environmental value system has been described by Onwezen, Antonides and Bartels (2013) as providing a self-regulatory role in the activation of pro-environmental intentions towards the environment. Findings from Wang, Guo, Wang, Zhang and Wang (2018) and Zhang, Lai, Wang and Wang (2019) confirm the contribution of environmental values to sustainable e-waste management. Findings from these studies show that environmental values made the highest contribution towards recycling because environmental values define one's attitude. This confirms the views of Özdemir and Utkun (2016) and Sorkun (2018) that moral norms better predict pro-environmental behaviours than social norms.

Zhang, Liu and Zhao (2018) also confirmed the role of environmental value system in influencing environmental complaint behaviours of citizens using the norm activation model. According to the authors, the immediate predictor of environmental complaints was individuals' environmental values and norms. Similar to Wang, Zhao and Yang (2019), it was revealed that environmental values was the highest determinant of pro-environmental binning behaviour. However, in the view of Esfandiar et al. (2020), although environmental knowledge is a necessary pre-condition for environmental change, for the consumer, recycling is not just a question of knowledge, but also the availability of infrastructure that makes waste segregation and recycling convenient and easy to accomplish.

Social norm was the second-highest predictor ($\beta = 0.279$, $p = 0.001$) of pro-environmental intentions, explaining about 28 per cent of the variance in pro-environmental intentions. This finding is consistent with Issock, Roberts-Lombard and Mpinganjiral (2020), who examined the role of normative influences on the intention to separate household waste. Significant effect of injunctive norms on waste separation. From a theoretical perspective, whether social norms do influence intentions depends on the context of the study. The effect of social norms from family, friends, co-workers etc, on individual behaviour, depends on the extent to which one is exposed to these influences (Passafaro, Livi & Kosic, 2019).

The effect of perceived control over behaviour on pro-environmental intentions was not significant (β = -0.007, p = 0.911). The role of perceived behavioural control was the additional variable that distinguished reasoned action from planned behaviour and empirical evidence shows its significant contribution to forming intentions. According to Ajzen, (2011) individuals may not always have total control over the performance of behaviour because they may face incomplete information or may lack the ability to decide or act. Authors, such as Alhassan, Asante, Asante and Bawakyillenuo (2017), and Liu et al. (2019) found that perceived behavioural control influenced households' intentions to separate waste at home, while Khalil et al. (2017); Echegaray and Hansstein (2017), Zhang, Lai, Wang and Wang (2019), Tweneboah-Koduah, Adams and Nyarku (2020) and Aboelmaged (2021) found no support for perceived behavioural control's influence on waste separation and recycling intentions.

Examining the context of the diverging results, it was realised that the influence of perceived behavioural control was significant when certain contextual factors were present. Perceived behavioural control is about the ability to direct the right efforts, knowledge, skills and availability of the infrastructure required to perform a task with ease. In emerging economies, when awareness creation about waste separation and recycling was intensive, residents reported influence on their pro-environmental intentions. Also, measurement and operationalisation contributed to the diverging results. For example, Liu et al. (2019) operationalise perceived behavioural control as convenience and self-ability. Echegaray and

Hansstein (2017) found low average values for perceived behavioural control. In the case of the latter, perceived behavioural control was operationalised as the provision of adequate waste separation and recycling facilities.

Sustainable e-waste management behaviour was predicted from four main determinants: pro-environmental intentions perceived control over behaviour, perceived producer responsibility and facilitating conditions. Except for pro-environmental intentions, the remaining factors were significant at 5 per cent. Besides, perceived control over behaviour, perceived producer responsibility and facilitating conditions showed a positive effect on sustainable e-waste management. Intentions, however, recorded an insignificant effect on sustainable e-waste management. The theory of planned behaviour states a behaviour will most often be successfully performed when the individual has the required opportunities and resources (ability), and the continuous motivation (intentions) to perform the behaviour. Intentions, however, was not significant in predicting behaviour. Perceived producer responsibility (H5) was the highest determinant of sustainable e-waste management ($\beta = 0.334$, $p = 0.000$), followed by facilitating conditions (H6) ($\beta = 0.\ 137$, $p = 0.034$), then perceived control over behaviour (H4b) ($\beta = 0.133$, $p = 0.005$).

Perceived producer responsibility explained 33.4 per cent of sustainable e-waste management behaviour. Perceived producer responsibility was operationalised as the efforts made by original equipment manufacturers to promote sustainable waste management behaviours through their marketing communication efforts (Xu, Ling, Lu, & Shen, 2017). Perceived producer responsibility is based on the concept of extended producer responsibility (EPR), where firms, are held accountable for the environmental cost of the end-of-life of their products. From the review, authors have reported that information publicity by firms does influence households' waste separation and sustainable e-waste managements.

Kitila, and Woldemikael (2021), in their analysis of EPR adoptions in other jurisdiction such as the EU concluded that the purpose of EPR is to promote social responsibility by encouraging manufacturers to consider end-of- life management during the product design phase. Results from the current study shows that producer responsibility practices also have effect on the willingness of households to adopt sustainable e-waste management practices. In Wang et al. (2018), information publicity influenced waste separation and sustainable e-waste management. In other studies, awareness creation campaigns influenced environmental attitudes. In Echegaray and Hansstein (2017) the authors propose that awareness campaigns be intensified because it positively impacts societal norms, which also influence waste management behaviours. The significance of waste management information was also found by Xiao et. al. (2017) to have a significant positive effect on willingness to participate in recycling.

Perceived producer responsibility requires manufacturers to take responsibility for the environmental impact of their product throughout the product lifecycle (Gordon & Gurrieri, 2014). The rising consumption patterns for newer electronic products and diminishing natural resources has forced firms to relook at their marketing strategies. Gradually, intensive commercial marketing is giving way to social marketing. Social marketing means that firms are not only interested in meeting only the core objectives of their business, but voluntarily initiate moves to manage the end-of-life of its products and influencing consumers' behaviour towards pro-environmental actions (Hodgkins, Rundle-thiele, Knox & Kim, 2019).

Facilitating conditions also explained 13.7 per cent variance in sustainable e-waste management behaviour. Facilitating conditions include the supporting infrastructure, regulations and incentives that promote recycling, reduction and reuse of electronic waste. Sharing similar findings, Xiao, Zhang, Zhu and Lin (2017) found that knowledge about waste infrastructure was critical in shaping the behaviour of the citizens towards waste separation. Zhang, Lai, Wang, and Wang (2019) describe accessibility to facilities as a key influencer of waste sorting behaviour. Meng et al. (2019) also reported similar findings and support for environmental facilities and services as a major influencer of waste sorting behaviour. Despite the plethora of evidence suggesting the significance of facilitating conditions in encouraging sustainable e-waste management among households, other studies found little or no influence of adequate waste management infrastructure on sustainable e-waste managements. Studies by Islam et al. (2016) and Cao, et al. (2016) suggest that, perhaps, even with infrastructure, consumers also consider economic value from their electronic waste.

Islam et al. (2016) found that most people (53.72%) preferred to sell their electronic waste than to pay for recycling. This finding was also confirmed by Cao et al (2016), where respondents indicated their key consideration to patronize collection is economic benefit. The authors cite low-income levels in these countries as one of the reasons. The survey by Islam took place in the capital of Bangladesh, while Cao et al. (2016) examined electronic waste generation and management in the Chinese province of Zhejiang. The findings of Islam et al.

(2016); and Yeung and Chung (2018) show willingness to pay was high in developed countries than in developing countries. This is because developed countries, particularly in Europe, have effective waste management regulations, better infrastructure and high environmental literacy among consumers than developing and emerging economies.

Perceived control over behaviour, although was not a significant determinant of pro-environmental intention, was found to influence sustainable e-waste management behaviour. Perceived control over recycling (H3b) recorded 13.6 per cent contribution to sustainable e-waste management. This finding is consistent with Echegaray and Hansstein (2017), and Zhang, Lai, Wang and Wang (2019). Both studies did not find any effect of perceived control over recycling on intentions to recycle, however, its effect on sustainable e-waste management was not rejected. Control belief as presented in the social-psychology literature is predicted to influence health and environmental behaviours. An individual who believes they have control over the management of their waste, for instance, are more likely to engage in proper waste management behaviours.

Chapter Summary

Electronic waste disposal practices among households considerably affect the sustainable management of natural resources. The determinants of pro-environmental intentions and sustainable e-waste management behaviour were analysed within the theories of sustainable development, planned behaviour and norm activation. Environmental values and injunctive norms mainly influenced pro-environmental intentions, while sustainable e-waste management behaviour was informed by facilitating conditions, perceived producer responsibility and perceived behavioural control. It was also found that intentions did not directly influence sustainable e-waste management.

CHAPTER SEVEN

INTERACTION EFFECT OF SOCIO-DEMOGRAPHIC CHARACTERISTICS

Introduction

This chapter discusses the interaction effects of socio-demographic characteristics of the respondents. Intentions to perform a behaviour and the performance of a behaviour is dependent on behavioural, normative and control beliefs (Ajzen, 2011). While control beliefs have mostly been linked to external factors such as convenient waste sorting infrastructure, access to information etc, behavioural and normative beliefs are believed to be influenced to some extent by an individual socio-demographic characteristic such as age, sex, income level and educational background.

The theory of planned behaviour, therefore, assumes that these background characteristics play a key role in influencing behavioural beliefs which in turn affects one's intentions and his/her behaviour. A review by Fredriks, Stenner and Hobman (2015) established the effect of socio-demographic characteristics on waste management practices. These socio-demographic characteristics have been used as moderators in models predicting intentions and behaviour (Varotto & Spagnolli, 2017).

Moderating Role of Age, Sex, Income Level and Type of Housing

Characteristics of the population in urban centres are diverse. Individual behaviour will differ along with some socio-demographic characteristics. Besides, the Greater Accra Region houses most businesses in the country, and its economic vibrancy draws people from all over the country in search of jobs and good living standards. The region has a very diverse population, different ethnic background, income levels, housing types and occupation. These characteristics bring about heterogeneity in the population. It is, therefore, important to identify, assess and if present treat heterogeneity in data. Again, these heterogeneities informed the cross-sectional study design.

On that note, objective four was to assess the interaction effect (or moderating role) of socio-demographic characteristics of respondents on the various path relationships in the research model. More specifically, the path relationships were examined for group differences based on income level, type of housing unit and sex. To achieve this objective, PLS multigroup analysis (MGA) (Henseler, Ringle, & Sinkovics, 2009) was used. The technique tests whether differences in sustainable e-waste management can be traced to observable characteristics such as age, income level, type of settlement and occupation. PLS-MGA is used when there are categorical variables that can influence the relationships in the PLS path model (Sarstedt, Henseler, & Ringle, 2011). MGA tests the null hypothesis (H_o) that the path coefficients between two groups are not significantly different.

Before group differences were explored, measurement invariance of composite models (MICOM) which serves as a diagnostic test before differences between groups can be assessed was examined (Henseler, Ringle, & Sarstedt ,2014). Failing to achieve measurement invariance may contribute to measurement error (Hult et al., 2008), and could reduce the statistical power of the test by producing misleading estimates. MICOM involves three steps: 1) configural invariance. (2) composite invariance, and (3) equality of composite mean values and variances. The MICOM procedure was performed for income level, type of settlement, age and sex. Results for the MICOM procedure for sex, type of housing unit, age and income level are presented in Appendices G, H, I and J, respectivley.

Multi-Group Analysis based on Sex of Respondents

Sex was operationalised as male and female. The effectiveness of waste disposal initiatives can be improved through the incorporation of an understanding of gender differences and perception of waste management (Utami, & Godjali, 2020). In the most cultural setting in developing economies, men and women play unique roles in managing their homes. For example, women are primarily responsible for childcare, cleaning, food preparation, and other domestic household chores etc. Consequently, they have different perceptions of how waste should be managed and who should be primarily responsible. Vaughter (2019) states that since women hold the primary responsibility for parenting and are mostly with children, they have substantial influence on the development of the child's environmental attitudes and behaviours.

It was, therefore, hypothesised that sex moderates the relationship between environmental values, injunctive norms, descriptive norms, perceived behavioural control, and pro-environmental intentions. Similarly, it was also hypothesised that sex moderates the relationship between intentions, facilitating conditions, perceived producer responsibility, perceived behavioural control and sustainable e-waste management. Table 31 presents the results of the multi-group analysis.

Table 30: Results of Multi-Group Analysis (MGA) between Female and Male

Structural Path	Path coefficient (Male)	Path coefficient (Female)	Path coefficient (difference)	P-value
Injunctive norms × sex -> Pro-environmental Intentions	0.397	0.160	0.237	0.179
Control over Behaviour × sex -> pro-environmental intentions	-0.090	0.092	-0.182	0.161
Descriptive Norms × sex -> pro-environmental intentions	0.047	-0.114	0.161	0.288
Environmental Values × sex ->Pro-environmental intentions	0.218	0.410	-0.192	0.229
Facilitating Conditions × sex -> Sustainable e-waste management	0.250	-0.038	0.287	0.035*
PPR × sex -> Sustainable e-waste management	0.280	0.370	-0.090	0.387
Control over Behaviour × sex -> Sustainable e-waste management	0.062	0.240	-0.178	0.075
Recycling Intentions × sex -> Sustainable e-waste management	-0.080	-0.083	0.002	0.982

*Significant at 5 %

Source: Field survey, Ofori (2020)

Results in Table 30 show separate path coefficient for the male and female model. The significance of the difference is displayed in the p values. From the table, differences exist in the path coefficient of injunctive norms (male = 0.397, female = 0.160). Males perceived a higher effect of injunctive norms on their pro-environmental intentions than females. Xu, Ling, Lu and Shen (2017) reported that sustainable e-waste management behaviour of males was more influenced by their social network than women. Issock, Robert-Lombad and Mpingangra (2020) also reported that perceived normative pressure to sort waste at home was higher for men than women. Another difference, although not significant, was the perception of environmental values. Females exhibited higher environmental values than men (male = 218, female = 410). Evidence from Triguero, Álvarez-Aledo and Cuerva (2016), and Sánchez, López-Mosquera and Lera-López (2016) suggest that women showed care for their environment than men.

In a study by Zhang, Liu, Wen, and Chen (2017), more females classified themselves as "binners" and separated more at source whiles males were found to be "litters". The effect of facilitating conditions on sustainable e-waste management was higher for men than women and the difference was significant at 5% ($p = 0.035$). Facilitating conditions are described as the perceived availability of convenient points for electronic waste recycling. The business of recycling is mainly dominated by males. By implication, men place a priority on collection points to recycle, whiles women think producers of these electronic products should show responsibility for their end product.

Multi-group Analysis based on Type of Housing Unit

The housing unit was operationalised as the type of housing system or residential accommodation respondents lived. According to the Ghana Statistical Service, Regional Analytical Report (2010), a housing unit is defined as a "structurally separate and independent place of abode such that a person or group of persons can isolate themselves from the hazards of climate such as storms and the sun." A distinction was made between compound housing units, detached housing units and semi-detached or flat housing units. Detached housing usually is not joined to other houses. From the literature review, the effect of type of housing unit on disposal behaviour, to the best of my knowledge, has not been looked at. Table 31 shows the differences in environmental values, normative beliefs, control factors and disposal behaviour.

Table 31: Results of multi-group analysis (MGA) between Compound and Detached Housing type

Structural Path	Path coefficient (Detached Housing)	Path coefficient (Compound Housing)	Path coefficient (difference)	P-value
Control over Behaviour × Housing type -> Sustainable e-waste management	0.246	0.147	0.099	0.313
Control over Behaviour × Housing type -> Pro-environmental intentions	-0.036	0.007	-0.043	0.677
Descriptive Norms × Housing type -> Pro-environmental intentions	0.066	-0.047	0.113	0.307
Environmental Values × Housing type -> Pro-environmental intentions	0.403	0.128	0.275	0.015*
Facilitating Conditions × Housing type -> Sustainable e-waste management	0.218	0.080	0.138	0.195
Injunctive Norms × Housing type -> Pro-environmental intentions	0.138	0.352	-0.214	0.126
PPR × Housing type -> Sustainable e-waste management	0.171	0.304	-0.133	0.166
Recycling Intentions × Housing type -> Sustainable e-waste management	-0.122	-0.034	-0.088	0.391

*Significant at 5 %

Source: Field survey, Ofori (2020)

In Table 31, occupants of detached housing units exhibited higher environmental values than households in compound housing (Detached = 0.403, Compound = 0.128). Occupants of detached housing enjoy the serenity that comes with residential housing. They have much control over their immediate environment than occupants of compound houses, where several families may have to share a bathroom, kitchen and immediate environment. Differences in the effect of injunctive norms on recycling intentions were higher for occupants in compound housing. Since compound houses have a lot of families sharing facilities, such as kitchen, bathrooms, influences from friends, neighbours, etc. are higher than in detached accommodation separated by walls, and where occupants are mostly single-family units.

Multi-group Analysis based on Age of respondents

Age was considered another demographic characteristic that influences attitude towards waste disposal and pro-environmental behaviour. Particularly, it has been recorded in green marketing literature as a segmentation tool for green consumers (Elhaffar, Durif, & Dubé, 2020; Wei, Ang, & Jancenelle, 2018). The age of the respondents was classified into three: young adults (18-30), Middle-aged adults (31-44), and Old adults (45+) (Bhat & Patil, 2016). Comparison between young adults and old adults showed considerable differences in attitude and pro-environmental values (Patel et al., 2017). Table 32 presents the results from the test of differences related to the predetermined age categories.

Table 32: Results of multi-group analysis (MGA) for Young adults and Old adults

Structural Path	Path coefficient Young adults (18-28)	Path coefficient Old adults (45 +)	Path coefficient (difference)	P-value
Control over Behaviour × Age -> Sustainable e-waste management	0.106	0.223	-0.117	0.311
Control over Behaviour × Age -> Pro-environmental intentions	-0.038	-0.031	-0.008	0.965
Descriptive Norms × Age -> Pro-environmental intentions	0.085	0.034	0.051	0.721
Environmental Values × Age -> Pro-environmental intentions	0.270	0.334	-0.064	0.661
Facilitating Conditions × Age -> Sustainable e-waste management	0.082	0.227	-0.145	0.271
Injunctive Norms × Age -> Pro-environmental intentions	0.214	0.183	0.031	0.855
PPR × Age -> Sustainable e-waste management	0.142	0.393	-0.251	0.036*
Recycling Intentions × Age -> Sustainable e-waste management	-0.099	0.069	-0.168	0.222

*Significant at 5 %

Source: Field survey, Ofori (2020)

Table 32 displays differences in path coefficients between respondents aged 18 – 28 and those above 45 years. Padilla and Trujillo (2017) found that the older the head of the household, the higher their pro-environmental attitude towards waste separation. From the results, the environmental value was higher for older adults (b = 0.334) compared to young adults (b = 0.270), confirming Padilla and Trujillo (2017). Similarly, Sánchez, López-Mosquera and Lera-López (2016) describe that aged as more pro-environmental. However, the difference was not significant. The influence of injunctive norms was slightly higher among young adults (b = 0.214) than old adults (b = 0.183).

Facilitating conditions, such as knowledge of appropriate channels for recycling, was also higher for old adults (b = 0.227) than young adults (b = 0.082) The only significant difference was the relationship between perceived producer responsibility and intentions to sustainable e-waste management. Older adults sustainable e-waste management is more influenced by perceived producer responsibility than young adults. Also, Guiot and Urien (2019) confirm that age indirectly influence household recycling. Ageing has a positive effect on posterity generativity, perceived skills, available time for recycling and perceived control over behaviour. Posterity generativity is defined as an orientation towards future generation, which is linked to altruism. So, in effect, as people age, their altruistic values increase.

Multi-group Analysis based on Income level of Respondents

The effect of income on sustainable e-waste management has been established in the literature. However, whether high-income influences higher sustainable e-waste managements or vice versa is still inconclusive (Alhassan et al., 2017). Income level is also linked to type of settlement because as people's income level improves, they are likely to seek better housing. An increase in income levels has also been linked to increase consumption of electronic products, and consequently waste generation. Table 33 shows the multi-group analysis (MGA) between higher and lower-income brackets.

Table 33: Results of multi-group analysis (MGA) between higher and lower-income brackets

Structural Path	Path coefficient (Higher)	Path coefficient (Lower)	Path coefficient (difference)	P-value
Control over Behaviour × Income level -> Sustainable e-waste management	0.210	0.193	0.017	0.890
Control over Behaviour × Income level -> Pro-environmental intentions	-0.065	0.017	-0.081	0.576
Descriptive Norms × Income level -> Pro-environmental intentions	0.098	0.060	0.039	0.772
Environmental Values × Income level -> Pro-environmental intentions	0.369	0.219	0.150	0.362
Facilitating Conditions × Income level -> Sustainable e-waste management	0.225	0.009	0.216	0.170

Table 33, continued

Structural Path	Path coefficient (Higher)	Path coefficient (Lower)	Path coefficient (difference)	P-value
Injunctive Norms × Income level -> Pro-environmental intentions	0.097	0.256	-0.158	0.370
PPR × Income level -> Sustainable e-waste management	0.084	0.451	-0.366	0.006*
Recycling Intentions × Income level -> Sustainable e-waste management	-0.037	-0.014	-0.023	0.851

*Significant at 5 %, Perceived producer responsibility (PPR)

Source: Field survey, Ofori (2020)

Respondents in the high-income group perceived that facilitating conditions influenced their sustainable e-waste management. Thus, their knowledge of existing recycling channels and appropriate information was considerably higher (b = 0.225) than in lower-income groups (b = 0.009). Lower income group also perceived a higher propensity to recycle when producers or their agents encouraged recycling through their marketing channels (PPR), than those in high-income brackets. This is confirmed by the significant difference (diff = -0.366, p = 0.006) in the effect of perceived producer responsibility (PPR) on sustainable e-waste management. This is confirmed by Cao et al. (2016). According to Cao, in some developing nations in Asia and Africa, recycling is about getting monetary compensation or a rebate for turning in electronic waste through proper channels.

Chapter Summary

In summary, intentions to perform a behaviour is highly dependent on behavioural, normative and control beliefs. While control beliefs have mostly been linked to external factors such as convenient waste sorting infrastructure, behavioural and normative beliefs are believed to be influenced, to some extent, by an individual's socio-demographic characteristic, such as age, sex, income level and educational background. The theory of planned behaviour, therefore, assumes that these background characteristics play a key role in influencing these beliefs which in turn affects one's intentions and his/her behaviour. Accordingly, through the multi-group analysis technique in PLS-SEM, group differences were established for age, sex, type of housing and income level. On the determinants of pro-environmental intentions, occupants of detached housing recorded higher environmental values than occupants of compound housing units. Also, the effect of facilitating conditions and perceived producer responsibility on sustainable e-waste management behaviour was moderated by sex, age and income level.

CHAPTER EIGHT

THE MEDIATING ROLE OF CONTROL BELIEFS IN THE RELATIONSHIP BETWEEN PRO-ENVIRONMENTAL INTENTIONS AND SUSTAINABLE E-WASTE MANAGEMENT

Introduction

This chapter seeks to provide further insight into the role other contextual factors play in translating intentions into actions. The gap between intention to actions serve as a barrier preventing behaviour from occurring. The works of Fishbein and Ajzen has provided a lot of insight into psychological factors that influence behaviour by introducing the mediating role of intentions. By this paradigm, intentions were the immediate predictor of behaviour (Fishbein & Azjen, 1975). Although behaviour may be triggered by some environmental cues, the formation of intentions is a motivational force ensures the maintenance and sustainability of a behaviour. However, evidence from Rosenthal (2018) suggest intentions alone may not be sufficient to cause and sustain a behaviour.

The theory of reasoned action assumes that individuals have complete volitional control to perform behaviour. Ajzen's (1991) theory of planned behaviour extended the theory of reasoned action by accounting for non-motivational factors such as availability of requisite opportunities and required resources which helps individuals to perform a behaviour successfully. On this note, intentions are predicted to influence behaviour when certain factors are present. The mediating role of control beliefs is examined in this chapter.

Mediating Role of Control Beliefs

Subsequent empirical evidence and meta-analysis, such as those by Armitage and Conner (2001); Sheeran (2002); Rivis and Sheeran (2003); Sheeran, Trafimow, and Armitage (2003); and Trafimow (2015), have shown that intentions together with perceived behavioural control accounted for variance in behaviour. Drawing lessons from the literature, most consumer behaviour theories such as the theory of planned behaviour, assumes a cognitive progression, where beliefs determine attitudes, attitudes determine intentions, and intentions ultimately informs behaviour.

However, studies, such as those by Fukukawa, (2003) and Carrington, Neville and Whitwell (2010), have shown that during the transition between intentions and actual buying behaviour, the individual interacts with a physical, cultural and social environment. This interaction with environmental factors influences their decision making. Subsequently, the focus has shifted towards narrowing the intention-behaviour gap (Sheeran & Webb, 2016; Hassan, Shiu, & Shaw, 2016).

There are other arguments that if one desire a behaviour change, manipulating intentions alone may not result in the desired change in behaviour. In this situation, a discrepancy exists between intentions and behaviour. The gap between intentions and actual behaviour has generated a lot of debate in the literature. On one hand, Auger and Devinney (2007) and Carrigan and Attalla (2001) believe that the existence of the gap is due to methodological limitations, such as social desirability that produces inflated intention factors. On the other hand, Barr (2006); and Carrington, Neville and Whitwell's (2010) theories show that the divergence between stated intentions to exhibit positive environmental actions and actual reported behaviour is far from social desirability.

Waste management is a social, economic and environmental challenge that confront our communities, the nation and the world at large and require the development of new ways of thinking and behavioural change. Developing and promoting behavioural change towards proper waste management requires that consumers find it easy and convenient to perform the required behaviour. The perceived ease or difficulty to perform the intended action is described as perceived behavioural control. Empirical evidence shows that the availability of waste management infrastructure, supportive policies, incentives and awareness creation influences control over the intended behaviour (Khalil, et al. 2017; Meng et al., 2019**;** Zhang, Lai, Wang, & Wang, 2019)**.**

Perceived control over behaviour is about confidence and how easily one can sort household waste and engage in appropriate sustainable e-waste managements. A critical analysis of the conditions surrounding the insignificant influence of perceived control over behaviour on intentions was confirmed by Carrigan and Attalla (2001), Auger and Devinney (2007), Carrington, Neville and Whitwell, (2010). Carrigan and Attalla (2001), and Auger and Devinney (2007) are of the view that individuals may want to appear as environmentally friendly and socially desirable, which influence high intentions to engage in a behaviour, but may not eventually perform the desired behaviour.

According to Podsakoff, Mackenzie and Podsakoff (2012), social desirability is witnessed in environmental studies, and so whiles a lot of people may indicate their intentions to engage in a behaviour, few will eventually carry out the behaviour. Carrington, Neville and Whitwell (2010) are of the view that the argument offered by Auger and Devinney (2007) and Carrigan and Attalla (2001) on the possibility of social desirability is only a partial explanation to the phenomenon. According to Carrington, Neville and Whitwell (2010), where intentions do not translate into behaviour, it is an indication of internal and external constraints to performing the behaviour.

Findings from this study find support from Carrington, Neville and Whitwell's (2010) argument on the intention-behaviour gap. Intentions were not a significant predictor of sustainable e-waste management. Intentions to perform behaviour represents one's motivation or readiness to engage in such behaviour. Studies, including Grimmer and Miles (2017) and Opoku et al.'s (2020), have shown that intentions do not always result in actions. People do not always do what they intend because human behaviour is complex to predict. In a study by Kor and Mullan (2011), the authors found that barely 20% of studies reported a significant effect of intentions on behaviour. Zhang, Lai, Wang and Wang (2019) found that intentions did not influence households waste sorting behaviour. However, when accessibility to waste sorting facilities was included, facilities together with intentions significantly influenced waste sorting behaviour.

So, in Zhang, Lai, Wang and Wang (2019), the authors examined the moderating role of recycling knowledge and facilities accessibility on intentions and waste sorting behaviour found no support. Also, both moderating and mediation analysis of procedural information seeking was undertaken by Rosenthal (2018). It was confirmed that procedural information-seeking both moderated and mediated the relationship between intentions and sustainable e-waste management.

Empirical evidence shows that weather factors moderated or mediated depends on the underlying theory and conceptualization of these variables. For example, while the availability of facilities plays a moderating role, access to information and knowledge on appropriate recycling channels showed significant moderation and mediation effects.

Path Analysis and Discussion of Results

The findings from this study show the significance of one's control beliefs to perform the desired behaviour after intentions are developed. Perceived behavioural control (control beliefs) was used as a proxy for actual control over behaviour. The structural model in Figure 16 and the corresponding results in Table 30 shows a mediating role of actual control between pro-environmental intentions and sustainable e-waste management behaviour. Grimmer and Miles (2017) examined the factors that translate the purchase intentions of environmentally friendly products into actual pro-environmental purchasing behaviour. The authors concluded that both mediating and moderating role of certain behavioural control and environmental factors are necessary to bridge the gap between intentions and the performance of a behaviour. It can, therefore, be concluded that mediating influence of internal and external environmental factors are important in managing household waste, even when intentions are formed.

Table 34: Mediating Role of Perceived Control Over Sustainable E-waste Management

Indirect effect	Path coeff.	STDEV	T values	LLCI, ULCI	Sig (p<0.05)?
Pro-environmental Intentions -> Perceived control -> Sustainable e-waste management	0.024	0.012	2.071	[0.007, 0.053]	Yes

LLCI: Lower limit confidence interval
ULCI: Upper limit confidence interval

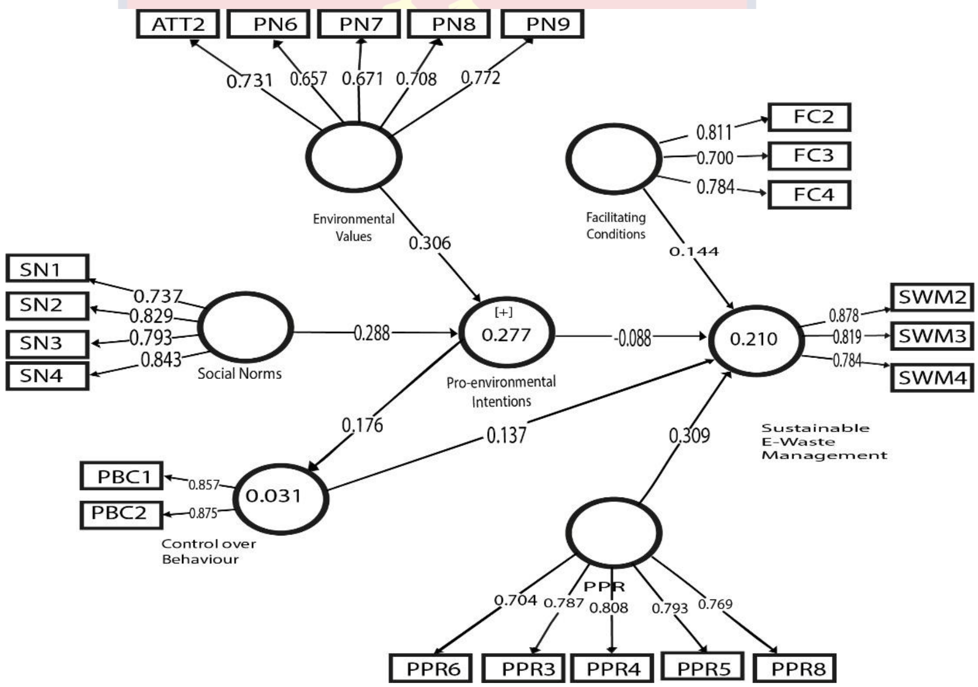

Figure 16: Structural model showing mediating role of control beliefs

Source: Field survey, Ofori (2020)

Results (Table 29) from the study shows that the direct effect of intention on sustainable e-waste management was not significant (β = -0. 100, p = 0.084).

However, when the same relationship was mediated by actual control over behaviour, the mediated relationship was significant (CI: 0.007, 0.053) as evidenced from 95 per cent bias-corrected bootstrap confidence intervals (CI) from 5000 bootstrap samples (Hayes, 2013). Mediation is found to be statistically significant when the CI does not include zero. This finding confirms Grimmer and Miles (2017) intention-behaviour model. Full mediation was recorded based on the results in Table 29 and Table 34. This implies that intentions only influence behaviour through actual control over behaviour.

Behavioural control is about self-efficacy (Bandura, 1978) and controllability. A theoretical explanation for the mediating role of control beliefs in pro-environmental intention and sustainable e-waste management relationship was based on the transtheoretical model (Prochaska & Velicer, 1997; Prochaska, Redding & Evers, 2015). The transtheoretical model of behavioural change explains the intention-behaviour gap by showing that people go through five stages of change: pre-contemplation, contemplation, preparation, action and maintenance.

The first stage is pre-contemplation when individuals are not ready for change. In the context of waste management, this occurs when people do not see the need to properly manage their waste or stop littering and will defend their lifestyle. The contemplation stage shows intentions to engage in the desired behaviour. At this stage, the individual shows readiness to engage in the behaviour. According to Prochaska and Velicer (1997), although individual exhibits positive outcomes of performing the behaviour, may still avoid the act. This is what has been termed the intention-behaviour gap (Sheeran, 2002).

The contemplation stage can be linked to implementation intention (Carrington, Neville & Whitwell, 2010). Individuals begin to find out where they can send their waste electronic equipment for proper waste management. This stage is followed by preparation, which involves garnering the steps, skills and knowledge to perform the behaviour. The acquisition of necessary skills and knowledge and the perceived ease of performing the behaviour represents one's actual control over the behaviour (Ajzen, 1991). The fourth stage is where actual action is performed and maintenance is the final stage in the model. At these stages, self-efficacy is important to maintain the behaviour.

The significance of the mediation is in line with the 'preparation' stage in the Transtheoretical Model (Prochaska & Velicer, 1997; Prochaska, Redding & Evers, 2015). The model predicts that an action is likely to be achieved when self-efficacy and self-regulation are maintained. In the recycling literature, policy factors, such as sanctions and incentives inherent in recycling programmes, have been found to narrow the gap and influence behaviour. Other factors include convenience and provision of appropriate infrastructure. Zhang, Lai, Wang and Wang (2019) found that government incentives and facility accessibility directly promoted waste sorting behaviours; it nevertheless, weakened the link between intention and behaviour.

In Echegaray and Hansstein (2017), the authors suggest awareness creation connected with people's health could motivate actions towards the behaviour. Also, convenience and accessibility could reduce the barriers to actual performance. Although their study examined pro-health behaviour, Sheeran, Godin, Conner and Germain (2017) found a U-shape role of habit formation in influencing the intention-behaviour gap. Adopting a longitudinal study, they found that experience both strengthens and weakens the intention-behaviour relationship over time. Johnstone and Tan (2015) also find that perceived ease or difficulty of performing a behaviour, readiness to be green and lack of support from others contributes to the gap.

Chapter Summary

In summary, the determinants of intentions and sustainable e-waste management were analysed within the theories of sustainable development, social marketing, planned behaviour and norm activation. Environmental values and injunctive norms mainly influenced recycling intentions, while actual behaviour was informed by facilitating conditions, perceived producer responsibility and perceived behavioural control. It was also found that intentions did not directly influence sustainable e-waste management. Nevertheless, it was fully mediated by actual control over recycling. The intention-behaviour presents an opportunity for programmes that will yield the desired behaviours. There is a need for future research in pro-environmental behaviours to examine the intention-behaviour gap from these perspectives so better outcome for managerial and policy implications can be proposed.

CHAPTER NINE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter of the study consists of the presentation of key findings, conclusions and some recommendations made based on the conclusions drawn from the study. This section of the study also discusses contributions of study brings to theory, methods and practice. Based on the limitations and the findings of the study, several suggestions are made for future studies. Integral to these conclusions and related recommendation is the recognition that sustainable e-waste management among households is predicted from multiple theoretical perspectives suggesting a 'three-party' approach towards the development of sustainable e-waste management.

General Summary

The purpose of the study was to analyse the determinants of sustainable e-waste management among households. The study was prompted by the need to promote sustainable management of electronic waste. Increasing concerns about the environmental impact of human activities in the areas of consumption and disposal has prompted the need to consider sustainable consumption and disposal patterns in the quest to meet the needs of humanity, while preserving natural and human capital. In this perspective, the practice of sustainable principles will only be effective as long as it is capable of promoting changes in the consumption and disposal patterns of households.

Sustainable electronic waste management requires flows of waste from the generating points to guarantee the quality and quantity of reusable components and other resources. Household perception towards waste management practices and their intentions to engage in sustainable waste management practices have considerable influence on the sustainability of any waste management system. Through the lens of sustainable development, waste management hierarchy, extended producer responsibility, norm activation, planned behaviour and psychological ownership theories, the purpose of the study was to examine the practices, analyse the drivers and barriers to electronic waste management practices among households. The study was guided by the following research objectives, which were to:

1. examine the practices prevalent in e-waste management in Ghana,
2. analyse the effect of environmental values, social norms, perceived behavioural control and pro-environmental intentions,
3. investigate the effect of pro-environmental intentions, facilitating conditions, perceived producer responsibility and sustainable e-waste management behaviour;
4. explore whether the factors influencing pro-environmental intentions and sustainable e-waste management practices differ by age, sex, income level and type of settlement; and
5. examine the interacting role of behavioural control factors on the relationship between pro-environmental intentions and sustainable electronic waste management practices.

The study adopted a quantitative study approach, specifically, a cross-sectional study design. The target population comprised of households in the Greater Accra Region. The region currently has sixteen administrative clusters. The data were collected from three administrative clusters: Tema Metropolis, Ga East and Adentan Municipal Assemblies. The justification for the choice was based on the clusters with a higher number of households possessing desktop or laptop computer. The presence of this electronic equipment was a proxy for gauging ICT development according to the 2010 Population and Housing Census Report. On that note, Tema Metropolis (23.5%), Ga East (23.1%) and Adentan Municipal (20.8%) were selected. Subsequently, the number of questionnaires administered was in proportion to these percentages. In all, a total of 850 questionnaires were administered. Based on proportions, 298, 289 and 263 questionnaires were administered respectively.

A combination of self- and researcher-administered questionnaire administration strategy was used due to differences in educational levels. A pilot study was undertaken in Cape Coast Metropolis before the main data collection exercise. Data collection spanned a period of eight months, from January 2020 to August 2020. The exercise was halted due to a COVID-19 outbreak that necessitated a lockdown in the data collection areas by health authorities. Fortunately, about 60% of the questionnaires had been retrieved. Extra questionnaires were subsequently administered to complete the data collection exercise when restrictions were eased. Data was processed with IBM SPSS and SmartPLS 3. The data analysis techniques were descriptive statistics and partial least squares structural equation modelling. Descriptive statistics mainly frequencies and Chi-square test were used to analyse objective one. Objectives two and three were achieved through partial least squares structural equation modelling, while objective four was analysed with partial least squares multi-group analysis. All quantitative variables were measured on a scale of 1 to 7, where 1 represents the least score, and 7, represents the highest score.

Summary of Key Findings

In respect of the first objective which was to examine the practices prevalent in e-waste management in Ghana, the following were the key findings from the study:

1. First, it was established that a considerable number of households (48.8%) are aware of the increasing levels of waste, although the percentage shows less than half of the respondents.
2. While considerable number of households are aware of the increasing levels of e-waste, there is limited knowledge of health hazard.
3. Households adopted a mix of circular and linear-based management practices towards their electronic waste. Among the linear-based management practice is unsegregated waste where significant number of respondents indicated to have used as a means to dispose-off mobile phone.
4. Further, insight into the relationship between respondents' socio-demographic characteristics: sex, income level, type of housing, and age, on one hand, and awareness, on the other hand, revealed that while sex of respondents and housing type had no association with awareness, income recorded significant effect on the awareness level of households.
5. Generally, consumers perceived their waste to possess sentimental and instrumental values. This was reflected in two main behaviours that were

common among respondents. 31.6 per cent of the respondents usually keep items for further use or gave them out to others to be reused. Again, where items are perceived to be valuable, monetary compensation in exchange for electronic waste.

6. ICT equipment such as laptops, tablets and mobile phone usage is increasing among households. Specifically, its usage is predominant among the youth, who contribute significantly to ICT consumption and waste generation. Replacement reasons and disposal behaviour of the youth is characterized by obsolescence; getting access to newer technology, and the latest features. Consequently, ICT related waste is mostly functioning making it desirable to swap, donate, sell as second hand to others or sent to collection points.

The determinants of pro-environmental intentions and sustainable e-waste management were examined as the second and third objective of the study respectively. The key findings are presented as follows:

1. The key factors influencing pro-environmental intentions were environmental values and social norms. Thus, internal motivation was mainly driven by one's normative beliefs about his or her environment and the perceived pressure from significant others. An indication of the interplay of the individual and his social structure
2. Perceived producer responsibility was the highest determinant of sustainable e-waste management explaining about 34 per cent of the variance in sustainable e-waste management among households, followed by facilitating conditions, then perceived control over behaviour. An

implication that the actual determinant of behaviour lies in external triggers Facilitating conditions include the supporting infrastructure, regulations and incentives that promote recycling of electronic waste.

The fourth objective was to investigate whether the strength of the relationship among the factors influencing intentions and sustainable e-waste management differ by respondents' age, sex, income level and type of settlement. The following were the findings:

1. Even with the appropriate infrastructure and other motivating conditions, females are less likely to engage in reuse, reduce and recycling behaviours.
2. Respondents in improved housing facilities are more inclined to show better orientation towards their environment
3. Older generation (45+) are described as frugal in the use of resources and more likely to observe environmental and safety directives from producers than the younger generation (18-28) who are notability e-waste generators than recyclers.
4. The barriers to engage in sustainable e-waste management is higher for respondents in higher income group than lower income.

The fifth objective involved an assessment of the possible role of intervening or interacting variables that facilitate intentions into behaviour. The key findings are as follows:

1. Pro-environmental intentions influence sustainable e-waste management practices through perceived control over behavior.

2. The findings from this study show the significance of one's actual control to perform the desired behaviour after intentions are developed. In other words, intentions cause one to seek procedures, appropriate information and the required skill to engage in the desired behaviour.

Conclusions

The perception and sustainable electronic waste management practices of households during the end-of-life stages of their electronic possessions have implications for the success of electronic waste recovery and recycling programmes. Electronic waste is perceived as largely unwanted and discarded electronic and electrical equipment, which are usually abandoned, consciously stored, buried, donated or sold as scrap or for reuse.

Households are becoming aware of the negative environmental and health implications of the increasing consumption of electronic products, although the increasing awareness and the hazardous nature of the waste generated did not influence how they managed the waste. Income and age recorded a significant effect on the awareness level of households. Increasing income is associated with higher consumption of electronic and electrical equipment, and consequently higher electronic waste generated. Also, increasing income propels people to seek out knowledge and ways to minimise one's environmental impact of waste generation. Again, age was also influential in informing awareness of e-waste. Although one expects that young adults, due to higher participation in social media, will show higher awareness, yet households in the middle-age category showed higher awareness of e-waste probably because most of the people in this category are described as working-class or economically active population.

Also, the psychological ownership perspective was brought to bear in the findings. Most studies had ignored the psychological aspect of the human-object relationship and mainly focused on household perception and management practices of their electronic waste. Preference for keeping or selling reflects the sentimental and instrumental attachment to electronic possessions. Enduring emotional bonds causes consumers to protect their possessions against damage, theft, and become anxious when physically separated from one's possessions. Also, most respondents preferred selling their electronic waste as scrap. This is an indication that households generally will not pay for their electronic waste to be recycled. Further, the findings suggest that electronic waste management policies should consider a reusable electronic products buyback scheme.

The pro-environmental intentions of households to engage in proper waste recycling was higher than actual sustainable e-waste management. Thus, a clear gap between intention and actual behaviour exists. The determinants of pro-environmental intentions were environmental values and injunctive norms. Perceived behavioural control and descriptive norms were not significant determinants. Comparatively, environmental values recorded the highest effect on pro-environmental intentions. While pro-environmental intentions was not significant predictor of sustainable e-waste management behaviour, perceived control over recycling, perceived producer responsibility and facilitating conditions were the major influencers of sustainable e-waste management behaviour.

Perceived producer responsibility was the highest determinant of sustainable e-waste management behaviour, explaining about 33.4 per cent of the variance.

Analysis of the intention-behaviour gap shows that the effect of pro-environmental intentions on sustainable e-waste management was significant when the relationship was transmitted through actual control over behaviour. In other words, intentions cause one to seek procedures, appropriate information and the required skill to engage in the desired behaviour. Control over behaviour is described as the ease with which one can sort its household waste, reduce where necessary and engage in appropriate sustainable e-waste managements. Since intentions did not directly influence sustainable e-waste management in this context, the finding contradicts the assumption of the theory of planned behaviour. The finding supported the argument that the transition from intentions to actual behaviour interacts with an individuals' control beliefs and environmental factors. The transtheoretical model is relevant for understanding the intention-behaviour relationship.

The strength of the relationship among the factors influencing pro-environmental intentions and sustainable e-waste management differed by respondents' age, sex, income level and type of settlement. The effect of injunctive norms on recycling intentions was higher among males than females. Specifically, males perceived a higher effect of injunctive norms on their intentions than females. Females, on the other hand, exhibited higher environmental values than men. Facilitating conditions, such as the availability of convenient recycling channels, was higher among males than females. This difference was significant. Again, the type of housing unit interacted with the relationship between environmental values and recycling intentions. Intentions of households in detached housing units to recycle were influenced significantly by their environmental values than households in compound housing.

Differences in the effect of injunctive norms on pro-environmental intentions were also observed, although not significant. Injunctive norms were higher for occupants in compound housing than detached units. The effect of perceived producer responsibility on sustainable e-waste management was also higher among occupants in compound housing than detached units. Older adults sustainable e-waste management is more influenced by perceived producer responsibility than young adults, and finally, households in the lower-income group are more inclined to engage in sustainable e-waste management when producers or their trading agents encouraged recycling through their marketing channels, than those in high-income brackets.

Overall, this study contributes to the understanding of the role of households in the e-waste value chain and electronic waste management in Ghana. Efforts towards the development of a sustainable solid waste management system require a better understanding of management practices, perception and factors that will motivate households to improve upon the current system of managing their electronic waste. Finally, based on the findings, the study reveals the key actors in sustainable waste management to include consumers, society, firms and government. Environmental values and perceived control over behaviour are individual characteristics. Descriptive and injunctive norms are social factors. The role of firms was measured through perceived producer responsibility and facilitating conditions described the role of policy and infrastructure.

Recommendations for Policy

This study shows that the current system of electronic waste management is characterised by unsustainable processing techniques, open, dumping and unregulated landfilling. Waste management behaviours have a considerable impact on natural and human capital. Consequently, it requires the development of new ways of thinking and behavioural change along the E-waste value chain. Emphasis on households as key stakeholders suggests that any sustainable e-waste management must give priority to their needs, expectations and interests. Based on the key outcomes of the study, the following recommendations are made:

1. Awareness creation events about electronic waste management should be intensified and championed especially by the Environmental Protection Agency (EPA) and Ministry of Environment, Science, Technology and Innovation (MESTI). Waste management practice improves when people are aware of the health and environmental risks associated with electronic waste. Adoption of multiple channels for information dissemination, with emphasis on the dangers of indiscriminate e-waste management.
2. In designing and implementation of awareness-raising event, the income level and age of the target audience should be considered. This is because income influences educational attainment, and consequently exposure to environmental education. Age, on the other hand, can guide the design and content of awareness creation messages. Messages should emphasize the dangers to human health and the environment.
3. To encourage households to undertake source separation, the government must enact policies that regulates and incentivise such behaviour

4. To boost electronic waste recovery programmes, especially for reusable products (either by the state government or manufacturers), adequate incentives can boost disposal of products that are attractive for reuse. Again, like in developed economies, a system for the collection of unwanted electronic products especially those that are reusable, so that individuals willing to donate or resell can conveniently make such goods available at minimum or no cost.
5. A collection system that mainly focus on mobile phones, could be developed in collaboration with private individuals engaged in sales and repairs of mobile phones by serving as collection points.
6. Advocacy programmes centred on circular economy gains can influence behaviours toward environmental protection.
7. Through environmental communication, people should be nudged on the dangers of environmental damage.
8. Educational curriculum should emphasise societal values that promote concern for the environment and participation in environmental care programmes.
9. OEMs can use marketing tools to share instructional tips to create some awareness, drive public knowledge and skills in e-waste management.
10. Government institutions and producers must collectively implement regulations and incentivised programmes that will drive e-waste management among households.

11. Improvement in spatial planning and housing can improve people's orientation towards the environment.
12. Stakeholders such as MESTI can implement Circular economy activities to entice the youth to engage in e-waste management programmes
13. The development of take back systems and collection mechanism should be tailored and made more convenient for those in higher income group to recycle or to reduce their e-waste generation.
14. Finally, the gap between intentions and behaviours provides opportunity for businesses and government to initiate actions that could reduce the barriers to desirable behaviours. In the review, experience, awareness creation campaigns are some of the key factors to minimize the gap between intentions and behaviour.

Contribution of the Study

The study contributes to theory, policy and methods. First, the study extends the TPB application in waste management by exploring the significance of PPR, FC and Environmental values. The findings also support "implementation intention" hypothesis in the Carrington (2010) intention-behaviour model, suggesting the model's suitability to waste management practices. As a contribution to policy, the results of the study highlight key areas that should be major focus for policies towards circular economy. The study highlights to policy makers the need to consider: regulation, incentives and accessibility (convenience). The study explores the multi-group analysis technique in PLS-SEM to examine the observed heterogeneity due to cross-sectional data.

Specifically, as a contribution to literature, the study established a link between sustainable development, circular economy, the waste hierarchy, extended producer responsibility and develops a new e-waste value chain that examines how households' characteristics influence each stage; from consumption to end-processing. In addition, based on the planned behaviour and norm activation theories, the study established the relevance of social norms, environmental values, perceived producer responsibility, perceived control over behaviour and facilitating conditions as important factors for consideration in policy formulation.

Further, while the theory of planned behaviour provides a major framework to examine intentions, waste management behaviour is multi-faceted, described as pro-environmental behaviour. Accordingly, the theoretical discourse draws support from human environmental values as assumed by the norm activation theory. The study also adds to the body of research on the intention-behaviour gap by exploring an assumption of the Transtheoretical model towards implementation intentions, and provides insight into the relationship between intentions and behaviour.

The results of this study support a fully-mediated relationship between pro-environmental intentions and sustainable e-waste management behaviour. Behavioural control fully mediated the relationship between pro-environmental intentions and sustainable e-waste management behaviour. In other words, the effect of pro-environmental intentions on sustainable e-waste management behaviour is transmitted through the acquisition of the required skills, information and the perceived ease of performing appropriate waste management behaviours.

Lastly, the study has demonstrated the usefulness of partial least squares structural equation modelling in two ways: first, the application of structural equation modelling techniques enhances measurement and analyses of structural relationships among unobservable concepts. Second, the multi-group analysis further gives relevance to the role of socio-demographic characterises and the analytical technique makes it easier to assess the influence of these characteristics on the predictors of intentions and behaviour.

Suggestions for Further Research

On the basis of the outcomes of the study and its limitations, the following were suggested. First, the use of a mixed methods approach could provide deeper insights into the determinants of sustainable e-waste management practices in a specific cultural context. Also due to the quantitative nature of the study, sustainable e-waste management was based on self-reports. Future studies may adopt other data collection methods to validate self-reported behaviours. Also, future studies may explore the role of religious values in influencing pro-environmental behaviour. Finally, where possible, a minimum period should be allowed between the measurement of pro-environmental intentions and actual behaviour.

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APPENDICES

APPENDIX A: ETHICAL CLEARANCE

UNIVERSITY OF CAPE COAST

INSTITUTIONAL REVIEW BOARD SECRETARIAT

TEL: 0558093143 / 0508878309/ 0244207814
E-MAIL: irb@ucc.edu.gh
C/O Directorate of Research, Innovation and Consultancy

OUR REF: UCC/IRB/A/2016/562
YOUR REF:
OMB NO: 0990-0279
IORG #: IORG0009096

26TH NOVEMBER, 2019

Mr. Daniel Ofori
Department of Management
School of Business
University of Cape Coast

Dear Mr. Ofori,

ETHICAL CLEARANCE – ID (UCCIRB/CHLS/2019/34)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted **Provisional Approval** for the implementation of your research protocol titled **Factors Influencing Disposal Behaviour of Households in the Electronic Equipment Supply Chain: Evidence from Greater Accra Region**. This approval is valid from 26th November, 2019 to 25th November, 2020. You may apply for a renewal subject to submission of all the required documents that will be prescribed by the UCCIRB.

Please note that any modification to the project must be submitted to the UCCIRB for review and approval before its implementation. You are required to submit periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithfully,

Samuel Asiedu Owusu, PhD
UCCIRB Administrator

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST

APPENDIX B: INVENTORY QUESTIONNAIRE

UNIVERSITY OF CAPE COAST
COLLEGE OF HUMANITIES AND LEGAL STUDIES
SCHOOL OF BUSINESS

Dear Respondent,

This survey is on "***Inventory Assessment of Electronic and Electrical Equipment (EEE) among Households***" It will take about 10 minutes to complete this survey. The exercise is for academic purpose and responses are strictly anonymous. Participation is voluntary. It is expected that the findings of this study would provide data on electronic products in our homes to inform policies for the management of electronic waste in the country.

Below is a classification system that categorise EEE by similar function, comparable material composition (in terms of hazardous substances and valuable materials) and related end-of-life attributes. **Please indicate, as many as possible, the electronic equipment you have in your home by ticking [√] the appropriate box**.

Electrical and Electronic Equipment classification

EEE category under EU-6	**Description of products**	**Please tick [√] as many as applicable**
Large Equipment	Central Heating (household installed)	
	Professional Heating & Ventilation (excl. cooling equipment)	
	Dishwashers	
	Kitchen equipment (e.g. large furnaces, ovens, cooking equipment)	
	Washing machines, incl. combined dyers.	
	Wash dryers, centrifuges	
	Household room heating + ventilation, excl. small table ventilators, hoods	
	Photovoltaic Panels (incl. inverters)	
	Professional IT equipment (e.g. servers, routers, data storage, copiers	

	Professional Tools and equipment (e.g. for welding, soldering, milling, sewing)	
	Leisure equipment (e.g. sports equipment, electric bikes, juke boxes)	
	Professional medical equipment (e.g. hospital, dentist, diagnostics)	
	Professional Monitoring & Control equipment (e.g. laboratory, control panels	
	Non- cooled Dispensers (e.g. for vending, hot drinks, tickets, money) Cooled	
Temperature exchange	Freezers for food, ice, etc.	
	Fridges (incl. combi-fridges)	
	Air conditioners	
	Other cooling equipment (e.g. dehumidifiers, heat pump dryers	
	Professional cooling equipment (e.g. large air conditioners, cooling displays)	
	Cooled Dispensers (e.g. for vending, cold drinks)	
Small Equipment	Microwaves (incl. combined, excl. grills)	
	Other small household equipment (e.g. small ventilators, irons, clocks, adapters, chargers, extension boards)	
	Equipment for food preparation (e.g. toaster, grills, food processors, frying pans)	
	Small household equipment for hot water preparation (e.g. coffee, tea, kettles,)	
	Vacuum Cleaners (excl. professional)	
	Personal care equipment (e.g tooth brush, hair dryers, trimmers, razors)	
	Small Consumer Electronics (e.g. headphones, remote controls	
	Portable Audio & Video (e.g. MP3, iPod,)	
	Music Instruments, Radio, Speakers, Hi-Fi (incl. audio sets)	
	Video (e.g. Video recorders, DVD, Blue Ray, decoders) and projectors	

	Cameras (e.g. camcorders, photo & digital still cameras)	
	Toys (e.g. car racing sets, electric trains, music toys, sex toys, drones)	
	Household Tools (e.g. drills, saws, hand sewing machines, high pressure cleaners, lawn mowers)	
	Household medical equipment (e.g. thermometers, blood pressure meters	
	Household Monitoring & Control equipment (fire alarm, motion sensors, smoke detectors, excl. screens)	
Small ICT equipment	Small IT equipment (e.g. routers, mouse, keyboards, external drives & accessories)	
	Desktop PCs (excl. monitors, accessories)	
	Printers (e.g. scanners, multi -functionals, faxes	
	Telecommunication equipment (e.g. cordless phones, answering machines)	
	Mobile Phones (incl. smartphones, pagers	
	Game Consoles e.g play stations	
Screens and Monitors	Laptops (incl. tablets	
	Cathode Ray Tube (CRT) Televisions	
	Cathode Ray Tube (CRT) Monitors	
	Flat Display Panel Televisions (LCD, LED)	
	Flat Display Panel Monitors (LCD, LED)	
Lamps and Lighting equipment	Compact Fluorescent Lamps (incl. retrofit & non-retrofit)	
	Special Lamps (e.g. professional mercury, high- & low-pressure sodium)	
	Straight Tube Fluorescent Lamps	
	LED Lamps (incl. retrofit LED lamps)	
	Small lighting equipment (excl. LED & incandescent)	
	Household Luminaires (incl. household incandescent fittings & household LED luminaires such as bed side lamps, decorating lamps)	

	Professional Luminaires (offices, public space, industry)	
Others, (please specify)		

1. Area of residence: ……………………Town/City……………………….
2. Which one of the following best describes your household?
   Individual [ ] Couple or 2 adults [ ] Couple and Children [ ]Extended family [ ] Single parent [ ] Others, please specify [ ] …………………….
3. Which of the following annual income brackets (in GH¢) does your family fall into?
   Up to 3,456 [ ] over 3,456 up to 4,656 [ ] over 4,656 up to 6,336 [ ] over 6,336 up to 42,336 [ ] over 42,336 up to 240,000 [ ]
   above 240,000 [ ]

APPENDIX C: MAIN QUESTIONNAIRE

UNIVERSITY OF CAPE COAST
COLLEGE OF HUMANITIES AND LEGAL STUDIES
SCHOOL OF BUSINESS
Questionnaire

Dear Respondent,

I invite you to share your views on the topic "***Analysis of the determinants of sustainable electronic waste management among households***" Answering this questionnaire will take about 15 minutes of your time. You will be contributing immensely towards the success of this research and knowledge if you answer these questions as frankly as possible. Your responses are strictly anonymous. Participation is voluntary. In the event that anything is published from this research, no information supplied will be identifiable to you since only aggregated data will be reported in this study.

It is expected that the findings of this study will have implications for the management of electronic waste in the country, the design of takeback systems by importers and retailers of electronic products and also contribute to the design of effective social marketing strategies of manufacturers and distributors of electronic and electrical equipment. I would be very grateful if I could get the completed questionnaire within a week. If you need any further clarification on this questionnaire, its purpose, or you wish to be informed of the results of the study, do not hesitate to contact me via 0276087861 or email: kwabendan@yahoo.com. Thank you for your valuable time and inputs.

SECTION A: DEMOGRAPHIC INFORMATION.

This section asks for information about you and your family. Please answer all of the following questions.

1. Place of residence: ………………………
2. Number of people living in your home:…………..
3. Which one of the following best describes your household?

Individual [ ] Couple or 2 adults [ ] Couple and Children [ ]

Extended family [ ] Single parent [ ] Others, [ ] please specify……

4. Type of dwelling.

Compound house [ ] Detached/Separate House [ ] Semi-detached [ ]

Shared Apartment [ ] Others [ ] Please specify……………………

5. Sex of respondent: Male [ ] Female [ ]

6. Educational Status of respondent:
No formal education [ ] Primary [ ] Middle/JHS [ ]
Voc / Comm. /Tech [ ] Senior High School [ ] Tertiary education [ ]
Others (specify): ………………………………………………………

7. Age……………………….

8. Which of the following annual income (GH¢) brackets does your family fall into?

Up to 3,456 [ ] over 3,456 up to 4,656 [ ] over 4,656 up to 6,336 [ ]

over 6,336 up to 42,336 [ ] over 42,336 up to 240,000 [ ]

above 240,000 [ ]

9. What is your current occupation?

a) Legislator/manager i.e legislators, senior government officials, corporate managers. [ ]

b) Professionals i.e accountant, lawyers, health workers, teachers, lecturers, etc . [ ]

c) Technician / Associate professionals i.e engineers [ ]

d) Clerical Support worker i.e secretariat, customer service [ ]

e) Service/sales worker i.e hairdressers, security, cook, child care, street and market sales persons. [ ]

f) Skilled Agricultural, forestry and Fishery workers i.e. farmers, fishermen, livestock farmers, forestry workers [ ]

g) Craft and related trades worker i.e carpenters, metal and electrical, welders, mining, construction, food processors [ ]

h) Elementary occupation i.e labourers, cleaners, refuse workers, house help etc. [ ]

i) Plat and machine operators and assemblers i.e commercial drivers, construction drivers and operators [ ]

j) Others, please specify……………………………………..................[ ]

SECTION B: ELECTRONIC WASTE AWARENESS LEVEL AND DISPOSAL PRACTICES OF HOUSEHOLDS: ***Please tick the box*** [ ] ***close to a question where applicable***

1. Among the household electronics appliance in your home, list those that have been replaced in the past 3 years?

   ----

2. What was your reason for purchasing or replacing? [**tick as many as applicable**]
   Physical damage [ ] Loss of function [ ]
   Need for greater functionality [ ] Desire for newest technology [ ]
   Energy efficiency [ ] Lost/stolen [ ] Others, please specify___________

3. Of the electronics you have purchased in the past 3 years, how many do you still own and use?

   ----

4. Have you heard about waste electronic and electrical equipment (WEEE) popularly called e-waste?
   Yes [ ] No [ ]

5. If yes, where did you first hear of e-waste? [**tick as many as applicable**]
   Television [ ] Radio [ ] Internet [ ]
   Conferences/workshops [ ] Magazine [ ] Information Centre [ ]
   Others, please specify ______________________

6. Where do you get information on electronic waste issues in the country? [**tick as many as applicable**]
   Television [ ] Radio [ ] Internet [ ] Conferences/workshops [ ]
   Magazine [ ] Information Centre [ ]
   Others, please specify___________________________________

7. Are you aware that electronic devices in your home, like phones, computers, tablets, TV sets, kitchen appliances, are made of hundreds of components with hazardous materials and chemicals?
   Not at all [ ] A little [ ] Somewhat [ ] Very much [ ]

8. To what extent does your knowledge of environmental and health hazards of e-waste influence the type of disposal methods used for the e-waste?
   Not at all [ ] A little [ ] Somewhat [ ] Very much [ ]

9. Have you ever received any information/lesson/sensitization regarding handling and use of electronic appliances and the waste? Yes [ ] No [ ]

10. If yes to Q9, what was the content of the information **(tick as many as applicable)?**
    The impact of solid of waste on environment [ ]
    The importance of appropriate solid waste separation [ ]
    Health and environmental effect of inappropriate solid waste disposal [ ]
    The way to separate solid waste effectively [ ]
    Others (specify): …………………………………………………………………

11. How do you dispose of electronics appliances that you no longer use?

Method of households' electronic waste disposal	**Provide examples of electronic items usually disposed through this medium. List items that immediately come to mind**
Dispose with ordinary garbage	
Dispose along with separated waste	
Dispose it in a specific collection point designated for electronic-waste (Private waste collection)	

Take it to a specific collection point as indicated by the retailer	
Return to the store where I purchased it	
Swap it with newer model	
Donate to a charity organisation	
Pass over to people who could use it or fix it for themselves	
Keep it / store at home	
Take it for repairs	
Sell as scrap	
Burry them	
Give away as scrap	
Sell on secondary market ("second hand")	
Others, please specify	

12. Do you consider some of the waste unused electronics to be reusable or used for another purpose?
    Yes [ ] No [ ]

13. Do you recover any of the electrical/electronic equipment or components from waste?
    Yes [ ] No [ ]

14. What do you do with the recovered equipment/components? [**Tick the most applicable reason**]
    I keep so that I might fix them someday or be able to use the parts from them [ ]
    I keep as an artefact to remember some people or certain events [ ]
    I sell as scraps [ ]
    I sell to repair shops [ ]
    I use to create other gadgets to serve other purposes [ ]

15. Please name any waste collection service who collects your waste electronics for recycling? (**If any**)

----

16. How will you describe the collection service provider?
    Informal collectors or scrap dealers [ ] Formal recycling services [ ]

17. Do you perceive any hazards or risks in the growing amount of electronic waste in Ghana?
    No [ ]
    Yes, but no knowledge of threat [ ]
    Yes, hazardous to health and environment [ ]

18. Do you know of any electronic waste management policies currently implemented in Ghana?
    I don't Know [ ] I am not sure [ ] No policy present [ ]
    No knowledge of policy or governing body [ ]
    I am aware of related electronic waste policy or governing body [ ]

SECTION C: DETERMINANTS OF PRO-ENVIRONMENTAL INTENTIONS TO PARTICIPATE IN SUSTAINABLE ELECTRONIC WASTE MANAGEMENT

Intention to adopt formal electronic waste recycling system To what extent do you agree with the following statements, ***in relation to the next two years***? ***Scale**:1= **Least agreement (LA); 7= Strong Agreement (SA)***	LA						SA
I *intend to* participate in formal electronic waste recycling system when available	1	2	3	4	5	6	7
I *will try to* participate in formal electronic waste recycling system when available	1	2	3	4	5	6	7
I *plan to* participate in formal electronic waste collection system when available	1	2	3	4	5	6	7
Attitude *With a **Scale**:1= **Least agreement (LA); 7= Strong Agreement (SA)***	LA						SA

Engaging in proper electronic waste management will……………………….							
be too much of a bother	1	2	3	4	5	6	7
I am not prepared for such a bother	1	2	3	4	5	6	7
enable me to be environmentally responsible	1	2	3	4	5	6	7
being environmentally responsible is important for me	1	2	3	4	5	6	7
protect me and others from contracting harmful ailments	1	2	3	4	5	6	7
being safe from harmful ailments is very important	1	2	3	4	5	6	7
Social Norms (Injunctive) ***Scale**:1= **Least agreement (LA); 7= Strong Agreement (SA)***	LA						SA
The *leadership* of my community expects that I adopt proper waste management practices	1	2	3	4	5	6	7
I am always ready to comply with good directives from leadership	1	2	3	4	5	6	7
My *neighbours* expect that I use proper waste management practices	1	2	3	4	5	6	7
I am always ready to comply with good directives from my neighbours	1	2	3	4	5	6	7
My *family members* who stay with me expect that I practice proper waste management	1	2	3	4	5	6	7
I am always ready to comply with good directives from my family members	1	2	3	4	5	6	7
My *close friends* think I should properly dispose of my electronic waste	1	2	3	4	5	6	7
I am always ready to comply with good directives from my close friends	1	2	3	4	5	6	7
Social Norms (Descriptive) **Using the scale: *1 = Never, 7= Very often*, how often do you think that……?**	Never						Very often
the *leadership* in your community engage in proper recycling of their household electronic waste	1	2	3	4	5	6	7
your *neighbours* engage in proper recycling of their household electronic waste	1	2	3	4	5	6	7

your *family members in your home* engage in proper recycling of their household electronic waste	1	2	3	4	5	6	7
your close friends engage in proper recycling of their household electronic waste	1	2	3	4	5	6	7
When I see leaders, my neighbours, family members and close friends engage in proper waste management, I feel I should do as well	1	2	3	4	5	6	7
Environmental values *From a scale of* ***1 = Not Important (NI)****,* to ***7= Extremely Important (EI)***, indicate the extent to which *the following values describe you*	NI						EI
I feel morally responsible to do my part to promote a sound environment	1	2	3	4	5	6	7
I try only to buy products that can be easily recycled	1	2	3	4	5	6	7
I do not buy household products that harm the environment	1	2	3	4	5	6	7
I feel a moral obligation to protect the environment	1	2	3	4	5	6	7
I feel it is important that people in general protect the environment	1	2	3	4	5	6	7
Because of my own values/principles, I feel an obligation to behave in an environmentally-friendly way	1	2	3	4	5	6	7
If I engage in a behaviour that is environmentally inappropriate, I will feel terrible whether or not anyone knows about it	1	2	3	4	5	6	7
I feel it as a moral responsibility to spend money to protect the environment	1	2	3	4	5	6	7
I feel it as a moral responsibility to spend efforts to protect the environment	1	2	3	4	5	6	7

Perceived Behavioural Control ***Scale****:1=* ***Least Agreement (LA); 7= Strong Agreement (SA)***	LA						SA
I have enough knowledge on proper waste management practices	1	2	3	4	5	6	7
I have been implementing the knowledge and will continue to do that	1	2	3	4	5	6	7

I have adequate skills to engage in proper waste management practices	1	2	3	4	5	6	7
I have been using the skills and will continue to do that	1	2	3	4	5	6	7
There are many challenges if I try to engage in proper electronic waste recycling	1	2	3	4	5	6	7
I do not want to go through such challenges	1	2	3	4	5	6	7
Policy factors ***Scale**:1= **Least Agreement (LA); 7= Strong Agreement (SA)***	LA						SA
There are convenient and officially designated collection centres where I can properly dispose my electronic waste	1	2	3	4	5	6	7
Having a designated collection centre is very important for me to adopt proper waste management practices	1	2	3	4	5	6	7
There are rules and regulations on electronic waste disposal	1	2	3	4	5	6	7
I have been complying or will comply with the rules and regulations (when available)	1	2	3	4	5	6	7
I am aware of sanctions/penalties from city authorities for improper disposal of electronic waste	1	2	3	4	5	6	7
I have been complying or will comply with the sanctions (if available)	1	2	3	4	5	6	7
I am ready to pay for the disposal of my e-waste	1	2	3	4	5	6	7
Paying for waste disposal contributes to the effective management of electronic waste in the country.	1	2	3	4	5	6	7
Outcome Expectancy ***Scale**:1= **Least Agreement (LA); 7= Strong Agreement (SA)*** *Engaging in Sustainable electronic waste recycling will….*	LA						SA
a. reduce health related risk for everyone	1	2	3	4	5	6	7

b. reduce the use of landfills and protect our environment	1	2	3	4	5	6	7
c. conserve natural resources	1	2	3	4	5	6	7
d. improve the quality of the environment for everyone	1	2	3	4	5	6	7
e. improve economic livelihoods of workers in the electronic waste business.	1	2	3	4	5	6	7

Ascription of responsibility ***Scale**:1= **Least Agreement (LA); 7= Strong Agreement (SA)***	LA						SA
a. Every individual must take responsibility for the environmental problems	1	2	3	4	5	6	7
b. Authorities rather than citizens are responsible for managing environmental problems	1	2	3	4	5	6	7
c. Businesses rather than citizens are responsible for managing environmental problems	1	2	3	4	5	6	7
d. I feel partly responsible for the environmental problems on our planet	1	2	3	4	5	6	7

Awareness of consequences of poor waste management practices ***Scale**:1= **Least Agreement (LA); 7= Strong Agreement (SA)***	LA						SA
a. Pollution generated from dump sites harm people all over the country	1	2	3	4	5	6	7
b. The effects of pollution on public health is worse than we realize	1	2	3	4	5	6	7
c. Human activities are endangering the environment	1	2	3	4	5	6	7
d. Electronic waste is a serious problem both locally and globally	1	2	3	4	5	6	7
e. My personal welfare is affected by problems like waste disposal	1	2	3	4	5	6	7

f. Economic activities are affected by poor waste management practices	1	2	3	4	5	6	7
Producer Responsibility ***Scale**:1= **Least Agreement (LA); 7= Strong Agreement (SA)***	LA						SA
a. I see how to recycle on product labels	1	2	3	4	5	6	7
b. Product labels directs and warn users of dangers of improper recycling	1	2	3	4	5	6	7
c. Adverts by producers/retailers encourages proper waste disposal	1	2	3	4	5	6	7
d. Product manuals have procedures for recycling an item when it becomes waste.	1	2	3	4	5	6	7
e. Product labels contain clear guidelines on how to safely dispose of the waste.	1	2	3	4	5	6	7
f. Some retailers make known areas where items can be recycled at the point of purchase	1	2	3	4	5	6	7
g. I am assured of take back when I find a challenge with a product	1	2	3	4	5	6	7
h. The content of some promotional messages encourages one to engage in proper waste recycling	1	2	3	4	5	6	7

Sustainable e-waste management **Using the scale: *1 = Never; to 7= Very often***	Never						Very often
a. In the course of the past year, I often made efforts to repair faulty electronic appliance if its possible before thinking about replacement.	1	2	3	4	5	6	7
b. In the past year, I have often engaged in proper recycling.	1	2	3	4	5	6	7
c. I usually patronise formal collection services for my electronic waste in the past year.	1	2	3	4	5	6	7
d. In the past year, I have tried to repair before replacement decision	1	2	3	4	5	6	7

APPENDIX D: CODE BOOK

	Variable Values		
	Value		Label
SECTION A: DEMOGRAPHIC INFORMATION	A1		
	A2		
	A3	1	Individual
		2	Couple or 2 adults
		3	Couple and Children
		4	Extended Family
		5	Single Parent
		6	Others
	A4	1	Compound house
		2	Detached/Separate House
		3	Semi-detached
		4	Shared Apartment
		5	Others
	A5	1	Male
		2	Female
	A6	0	No formal education
		1	Primary
		2	Middle/JHS
		3	Voc / Comm. /Tech
		4	Voc / Comm. /Tech
		5	Tertiary education
		6	Other
	A7		
	A8	1	Up to 3,456
		2	Over 3,456 up to 4,656
		3	Over 4,656 up to 6,336
		4	Over 6,336 up to 42,336
		5	Over 42,336 up to 240,000
		6	Above 240,000
	A9	1	Legislator/manager i.e legislators, senior government officials, corporate managers
		2	Professionals i.e accountant, lawyers, health workers, teachers, lecturers, etc
		3	Technician / Associate professionals i.e engineers

		4	Clerical Support worker i.e secretariat, customer service
		5	Service/sales worker i.e hairdressers, security, cook, child care, street and market sales persons
		6	Skilled Agricultural, forestry and Fishery workers i.e farmers, fishermen, livestock farmers, forestry workers
		7	Craft and related trades worker i.e carpenters, metal and electrical, welders, mining, construction, food processors
		8	Elementary occupation i.e labourers, cleaners, refuse workers, house help etc
		9	Plat and machine operators and assemblers i.e commercial drivers, construction drivers and operators
		10	Other
SECTION B: ELECTRONIC WASTE AWARENESS LEVEL AND DISPOSAL PRACTICES OF HOUSEHOLDS	B1		
	B2a	1	Physical damage
	B2b	1	Need for greater functionality
	B2c	1	Energy efficiency
	B2d	1	Lost/stolen
	B2e	1	Loss of function
	B2f	1	Desire for newest technology
	B3		
	B4	1	Yes
		2	No
	B5a	1	Television
	B5b	1	Radio
	B5c	1	Internet
	B5d	1	Conferences/Workshops
	B5e	1	Magazine
	B5f	1	Information Centre
	B6a	1	Television
	B6b	1	Radio
	B6c	1	Internet
	B6d	1	Conferences/Workshops
	B6e	1	Magazine
	B6f	1	Information Centre

	B7	1	Not at all
		2	A little
		3	Somewhat
		4	Very much
	B8	1	Not at all
		2	A little
		3	Somewhat
		4	Very much
	B9	1	Yes
		2	No
	B10a	1	The impact solid of waste on environment
	B10b	1	The importance of appropriate solid waste separation
	B10c	1	Health and environmental effect of inappropriate solid waste disposal
	B10d	1	The way to separate solid waste effectively
	B11		
	B12	1	Yes
		2	No
	B13	1	Yes
		2	No
	B14a	1	I keep so that I might fix them someday or be able to use the parts from them
	B14b	1	I keep as an artefact to remember some people or certain events
	B14c	1	I sell as scraps
	B14d	1	I sell to repair shops
	B14e	1	I use to create other gadgets to serve other purposes
	B15		
	B16	1	Informal collectors
		2	Formal recycling services
	B17	1	No
		2	Yes, but no knowledge of threat
		3	Yes, hazardous to health and environment
	B18	1	I don’t Know
		2	I am not sure
		3	No policy present
		4	No knowledge of policy or governing body

		5	I am aware of related electronic waste policy or governing body
Intention to adopt former electronic waste recycling system	INT1 - INT3	1	Least Agreement
		2	Disagree
		3	Somewhat Disagree
		4	Neutral
		5	Somewhat Agree
		6	Agree
		7	Strong Agreement
Attitude	ATT1 - ATT6	1	Least Agreement
		2	Disagree
		3	Somewhat Disagree
		4	Neutral
		5	Somewhat Agree
		6	Agree
		7	Strong Agreement
Social Norms (Injunctive)	SNI1 - SNI8	1	Least Agreement
		2	Disagree
		3	Somewhat Disagree
		4	Neutral
		5	Somewhat Agree
		6	Agree
		7	Strong Agreement
Social Norms (Descriptive)	SND1 - SND5	1	Not Important
		2	Low Importance
		3	Slightly Important
		4	Neutral
		5	Moderately Important
		6	Important
		7	Extremely Important
Personal Norms	PN1 - PN9	1	Least Agreement
		2	Disagree
		3	Somewhat Disagree
		4	Neutral
		5	Somewhat Agree
		6	Agree
		7	Strong Agreement
	PBC1 – PBC6	1	Least Agreement
		2	Disagree

Perceived Behavioural Control		3	Somewhat Disagree
		4	Neutral
		5	Somewhat Agree
		6	Agree
		7	Strong Agreement
Policy factors	PF1 - PF8	1	Least Agreement
		2	Disagree
		3	Somewhat Disagree
		4	Neutral
		5	Somewhat Agree
		6	Agree
		7	Strong Agreement
	OE1 – OE5	1	Least Agreement
		2	Disagree
		3	Somewhat Disagree
		4	Neutral
		5	Somewhat Agree
		6	Agree
		7	Strong Agreement
Ascription of responsibility	AOR1 - AOR4	1	Least Agreement
		2	Disagree
		3	Somewhat Disagree
		4	Neutral
		5	Somewhat Agree
		6	Agree
		7	Strong Agreement
Awareness of consequences of poor waste management practices	AOC1 - AOC6	1	Least Agreement
		2	Disagree
		3	Somewhat Disagree
		4	Neutral
		5	Somewhat Agree
		6	Agree
		7	Strong Agreement
Manufacturer/ Producer incentives	MPI1 – MPI8	1	Least Agreement
		2	Disagree
		3	Somewhat Disagree
		4	Neutral
		5	Somewhat Agree
		6	Agree

		7	Strong Agreement
Sustainable e-waste management	RB1 - RB4	1	Never
		2	Disagree
		3	Occasionally
		4	Neutral
		5	Somewhat Often
		6	Often
		7	Very Often

APPENDIX E: FULL RESULTS OF CHI-SQUARE TEST

Chi-Square Tests: Sex of respondents and Awareness level

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.048[a]	1	.827		
Continuity Correction[b]	.019	1	.892		
Likelihood Ratio	.048	1	.827		
Fisher's Exact Test				.869	.446
Linear-by-Linear Association	.048	1	.827		
N of Valid Cases	593				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 130.67.
b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	-.009	.827
	Cramer's V	.009	.827
N of Valid Cases		593	

Chi-Square Tests: Type of Housing Unit and Awareness Level

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.165[a]	2	.076
Likelihood Ratio	5.173	2	.075
Linear-by-Linear Association	3.483	1	.062
N of Valid Cases	618		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 84.67.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	.091	.076	.076
	618		
N of Valid Cases			

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.878[a]	2	.032
Likelihood Ratio	6.892	2	.032
Linear-by-Linear Association	3.351	1	.067
N of Valid Cases	598		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.35.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.107	.032
	Cramer's V	.107	.032
N of Valid Cases		598	

Chi-Square Tests: Income level and Awareness Level

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.878[a]	2	.032
Likelihood Ratio	6.892	2	.032
Linear-by-Linear Association	3.351	1	.067
N of Valid Cases	598		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.35.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.107	.032
	Cramer's V	.107	.032
N of Valid Cases		598	

Chi-Square Tests: Age and Awareness Level

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.068[a]	3	.011
Likelihood Ratio	11.151	3	.011
Linear-by-Linear Association	7.437	1	.006
N of Valid Cases	600		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.44.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.136	.011
	Cramer's V	.136	.011
N of Valid Cases		600	

APPENDIX F: CROSS LOADINGS

	Descriptive Norms	Env. Values	Facilitating Conditions	Injunctive Norms	PPR	Perceived Control over Behaviour	Sustainable e-waste mgt	Pro-environmental intentions
ATT2	0.273	0.753	0.383	0.542	0.219	0.159	0.066	0.442
FC2	0.478	0.396	0.813	0.371	0.405	0.361	0.296	0.294
FC3	0.383	0.329	0.694	0.350	0.360	0.338	0.270	0.215
FC4	0.388	0.463	0.786	0.379	0.391	0.371	0.202	0.272
INT1	0.183	0.372	0.135	0.310	0.070	0.117	-0.075	0.640
INT3	0.207	0.336	0.343	0.373	0.177	0.139	0.112	0.810
PBC1	0.434	0.339	0.388	0.309	0.269	0.876	0.200	0.140
PBC2	0.425	0.227	0.418	0.241	0.271	0.856	0.293	0.165
EV6	0.286	0.653	0.322	0.407	0.224	0.227	0.017	0.328
EV7	0.306	0.669	0.349	0.417	0.169	0.222	0.014	0.308
EV8	0.383	0.697	0.371	0.379	0.239	0.259	0.053	0.270
EV9	0.366	0.757	0.405	0.446	0.270	0.292	0.080	0.339
PP	0.323	0.240	0.374	0.260	0.7	0.280	0.342	0.119

R3					82			
PPR4	0.322	0.280	0.418	0.290	0.809	0.258	0.292	0.144
PPR5	0.323	0.288	0.390	0.289	0.796	0.236	0.286	0.197
PPR6	0.296	0.141	0.353	0.205	0.700	0.189	0.397	0.127
PPR8	0.302	0.270	0.408	0.295	0.773	0.237	0.273	0.091
RB2	0.204	0.083	0.303	0.191	0.318	0.278	0.878	0.080
RB3	0.184	0.052	0.254	0.151	0.376	0.212	0.818	0.006
RB4	0.204	0.029	0.269	0.142	0.322	0.212	0.784	0.009
SND2	0.704	0.233	0.391	0.327	0.338	0.377	0.206	0.144
SND3	0.759	0.341	0.394	0.374	0.302	0.403	0.183	0.197
SND4	0.769	0.324	0.396	0.363	0.360	0.407	0.207	0.177
SND5	0.806	0.476	0.474	0.459	0.239	0.326	0.134	0.288
SNJ1	0.384	0.436	0.351	0.740	0.191	0.231	0.059	0.442
SNJ2	0.405	0.523	0.387	0.827	0.317	0.277	0.174	0.368

SNJ3	0.415	0.502	0.381	0.796	0.267	0.223	0.182	0.360
SNJ4	0.407	0.529	0.413	0.839	0.333	0.285	0.203	0.342

APPENDIX G: MICOM RESULTS (MALE-FEMALE)

Results from Measurement Invariance of Composite Models

Summary of MICOM Results (Male-Female)

MICOM Step 1: Configural variance established? Yes				
MICOM Step 2: Compositional Invariance				
Composite	Correlation *c*	5% quantile of the empirical distribution of C_u	P-value	Compositional Invariance established
Control over Behaviour	0.999	0.996	0.515	Yes
Descriptive Norms	0.995	0.960	0.573	Yes
Environmental Values	0.995	0.989	0.294	Yes
Facilitating Conditions	0.995	0.990	0.227	Yes
Injunctive Norms	0.999	0.995	0.705	Yes
PPR	1.000	0.997	0.806	Yes
Sustainable e-waste management	1.000	0.998	0.701	Yes
Recycling Intentions	0.998	0.991	0.383	Yes
MICOM Step 3a: Assessing equality of composite mean values				
Composite	Difference of the composite's mean value (= 0)	95% confidence interval	P value	Equal mean values
Control over Behaviour	0.015	[-0.160; 0.157]	0.864	Yes
Descriptive Norms	-0.077	[-0.158; 0.155]	0.314	Yes
Environmental Values	0.002	[-0.165; 0.150]	0.983	Yes
Facilitating Conditions	0.029	[-0.153; 0.147]	0.721	Yes

Injunctive Norms	0.186	[-0.153; 0.166]	0.022	Yes
PPR	0.049	[-0.150; 0.154]	0.55	Yes
Sustainable e-waste management	0.12	[-0.154; 0.162]	0.146	Yes
Recycling Intentions	0.086	[-0.157; 0.160]	0.271	Yes
MICOM Step 3b: Assessment equality of composite variances				
Composite	Logarithm of the composite's variances ratio (=0)	95% confidence interval	P value	Equal variances
Control over Behaviour	-0.130	[-0.165; 0.174]	0.147	Yes
Descriptive Norms	-0.216	[-0.184; 0.191]	0.023	No
Environmental Values	-0.142	[-0.246; 0.261]	0.285	Yes
Facilitating Conditions	-0.028	[-0.200; 0.196]	0.785	Yes
Injunctive Norms	-0.243	[-0.240; 0.237]	0.041	No
PPR	-0.089	[-0.178; 0.205]	0.367	Yes
Sustainable e-waste management	-0.039	[-0.145; 0.155]	0.610	Yes
Recycling Intentions	-0.237	[-0.209; 0.213]	0.025	NO

APPENDIX H: MICOM RESULTS FOR TYPE OF HOUSING UNIT

Summary of MICOM Results (Compound and Detached Housing Units)

MICOM Step 1: Configural variance established? Yes				
MICOM Step 2: Compositional Invariance				
Composite	Correlation *c*	5% quantile of the empirical distribution of C_u	P-value	Compositional Invariance established
Control over Behaviour	0.999	0.995	0.490	Yes
Descriptive Norms	0.990	0.934	0.485	Yes
Environmental Values	0.997	0.985	0.662	Yes
Facilitating Conditions	0.992	0.984	0.196	Yes
Injunctive Norms	0.998	0.995	0.256	Yes
PPR	0.995	0.994	0.095	Yes
Sustainable e-waste management	0.999	0.997	0.319	Yes
Recycling Intentions	0.999	0.992	0.480	Yes
MICOM Step 3a: Assessing equality of composite mean values				
Composite	Difference of the composite's mean value (= 0)	95% confidence interval	P value	Equal mean values
Control over Behaviour	-0.219	[-0.192; 0.184]	0.021	No
Descriptive Norms	-0.192	[-0.193; 0.180]	0.039	No
Environmental Values	-0.213	[-0.193; 0.201]	0.029	No
Facilitating Conditions	0.208	[-0.187; 0.185]	0.034	No

Injunctive Norms	-0.059	[-0.176; 0.197]	0.553	Yes
PPR	0.155	[-0.186; 0.175]	0.111	Yes
Sustainable e-waste management	0.156	[-0.187; 0.189]	0.119	Yes
Recycling Intentions	-0.104	[-0.194; 0.198]	0.294	Yes
MICOM Step 3b: Assessment equality of composite variances				
Composite	Logarithm of the composite's variances ratio (=0)	95% confidence interval	P value	Equal variances
Control over Behaviour	-0.047	[-0.206; 0.227]	0.684	Yes
Descriptive Norms	-0.098	[-0.229; 0.237]	0.420	Yes
Environmental Values	0.051	[-0.306; 0.338]	0.762	Yes
Facilitating Conditions	-0.129	[-0.232; 0.263]	0.293	Yes
Injunctive Norms	-0.086	[-0.275; 0.273]	0.554	Yes
PPR	-0.086	[-0.207; 0.239]	0.439	Yes
Sustainable e-waste management	0.022	[-0.164; 0.174]	0.808	Yes
Recycling Intentions	-0.163	[-0.250; 0.247]	0.192	Yes

APPENDIX I: MICOM RESULTS FOR AGE

Summary of MICOM Results (Selected age groups 17-27 and 40+)

MICOM Step 1: Configural variance established? Yes				
MICOM Step 2: Compositional Invariance				
Composite	Correlation *c*	5% quantile of the empirical distribution of C_u	P-value	Compositional Invariance established
Control over Behaviour	0.997	0.977	0.391	Yes
Descriptive Norms	0.990	0.939	0.362	Yes
Environmental Values	0.996	0.989	0.505	Yes
Facilitating Conditions	0.944	0.822	0.118	Yes
Injunctive Norms	0.990	0.991	0.035	No
PPR	0.995	0.951	0.674	Yes
Sustainable e-waste management	0.998	0.980	0.725	Yes
Recycling Intentions	1.000	0.985	1.000	Yes
MICOM Step 3a: Assessing equality of composite mean values				
Composite	Difference of the composite's mean value (= 0)	95% confidence interval	P value	Equal mean values
Control over Behaviour	0.360	[-0.251; 0.231]	0.005	No
Descriptive Norms	0.000	[-0.254; 0.246]	0.996	Yes
Environmental Values	-0.365	[-0.241; 0.233]	0.001	No
Facilitating Conditions	-0.258	[-0.240; 0.236]	0.031	No

Injunctive Norms	-0.279	[-0.249; 0.237]	0.025	No
PPR	0.307	[-0.234; 0.227]	0.006	No
Sustainable e-waste management	-0.094	[-0.239; 0.237]	0.450	Yes
Recycling Intentions	-0.288	[-0.244; 0.242]	0.016	No
MICOM Step 3b: Assessment equality of composite variances				
Composite	Logarithm of the composite's variances ratio (=0)	95% confidence interval	P value	Equal variances
Control over Behaviour	0.135	[-0.262; 0.306]	0.338	Yes
Descriptive Norms	0.091	[-0.277; 0.268]	0.497	Yes
Environmental Values	0.459	[-0.353; 0.373]	0.014	No
Facilitating Conditions	0.018	[-0.283; 0.334]	0.908	Yes
Injunctive Norms	0.094	[-0.329; 0.352]	0.579	No
PPR	-0.059	[-0.283; 0.309]	0.701	Yes
Sustainable e-waste management	-0.005	[-0.242; 0.280]	0.969	Yes
Recycling Intentions	0.520	[-0.263; 0.312]	0.001	NO

APPENDIX J: MICOM RESULTS FOR INCOME LEVEL

Summary of MICOM Results (High versus Lower income bracket)

MICOM Step 1: Configural variance established? Yes				
MICOM Step 2: Compositional Invariance				
Composite	Correlation *c*	5% quantile of the empirical distribution of C_u	P-value	Compositional Invariance established
Control over Behaviour	1.000	0.996	0.593	Yes
Descriptive Norms	0.999	0.966	0.960	Yes
Environmental Values	0.980	0.984	0.024	No
Facilitating Conditions	0.995	0.986	0.317	Yes
Injunctive Norms	0.999	0.994	0.574	Yes
PPR	0.972	0.993	0.000	No
Sustainable e-waste management	1.000	0.997	0.706	Yes
Recycling Intentions	0.999	0.981	0.602	Yes
MICOM Step 3a: Assessing equality of composite mean values				
Composite	Difference of the composite's mean value (= 0)	95% confidence interval	P value	Equal mean values
Control over Behaviour	0.350	[-0.243; 0.225]	0.003	No
Descriptive Norms	0.336	[-0.247; 0.241]	0.005	No
Environmental Values	0.295	[-0.241; 0.240]	0.013	No
Facilitating Conditions	0.197	[-0.236; 0.240]	0.097	Yes
Injunctive Norms	0.302	[-0.238; 0.238]	0.010	No
PPR	0.018	[-0.238; 0.227]	0.870	Yes

Sustainable e-waste management	-0.151	[-0.246; 0.233]	0.242	Yes
Recycling Intentions	0.351	[-0.249; 0.232]	0.002	No
MICOM Step 3b: Assessment equality of composite variances				
Composite	Logarithm of the composite's variances ratio (=0)	95% confidence interval	P value	Equal variances
Control over Behaviour	-0.261	[-0.280; 0.261]	0.056	Yes
Descriptive Norms	-0.241	[-0.279; 0.253]	0.077	Yes
Environmental Values	-0.211	[-0.344; 0.315]	0.222	Yes
Facilitating Conditions	-0.054	[-0.281; 0.260]	0.687	Yes
Injunctive Norms	-0.27	[-0.339 ; 0.300]	0.102	Yes
PPR	-0.383	[-0.292; 0.263]	0.011	Yes
Sustainable e-waste management	0.085	[-0.246; 0.197]	0.434	Yes
Recycling Intentions	-0.074	[-0.311; 0.266]	0.608	Yes

APPENDIX K: CONFERENCE PROCEEDINGS

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Personal Values and Electronic Waste Disposal Among Households in Cape Coast Metropolis

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Abstract

The study examined social values that accounted for electronic waste recycling and reuse behaviours. Via a cross-community survey of 193 of households in the Cape Coast Metropolis, a correlational design was employed in the study. Partial Least Squares-Structural equation modelling was used to analyse the data. Results from the analysis showed the influence of altruistic values ($\beta = 0.275$, $p < 0.05$) on reuse behaviour. Similarly, environmental awareness ($\beta = 0.213$, $p<0.05$) also showed significant influence on participation in recycling, whereas psychological ownership significantly influenced both reuse ($\beta = 0.319$, $p < 0.05$), and participation in recycling ($\beta = 0.339$, $p < 0.05$), The joint significance of altruistic values, environmental awareness and psychological ownership to explaining recycling participation was 21.3% ($R2 = 0.213$, $p < 0.05$) and that of reuse was 24.6% ($R2 = 0.246$, $p < 0.05$). The results of the study showed that individuals who are knowledgeable about the state of their environment were more likely to participate in recycling. On the other hand, individuals with altruistic values preferred giving unwanted electronic equipment to others for reuse. Altruistic values are particularly true of collectivist cultural orientation. Psychological ownership was significant in predicting both behaviours, however, the effect size on reuse was moderate. Psychological ownership due to waste aversion and frugality lead consumers to keep, and subsequently give to close relatives in their social network. It was recommended that individuals should be encouraged to patronize formal recycling services. as a way to show concern for the well-being of others by reducing pollution due to improper waste treatment. Again, like in developed economies, second-hand collection systems for unwanted electronic products can be developed, and made convenient for individuals with reusable items, who may be willing to donate or even resell.

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Sustainable Waste Management among Households: the role of Producer Responsibility and Facilitating Conditions

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Abstract
Households are described as the highest generators of both solid and liquid waste. Among these waste categories, the management of electronic waste, although forms about 6% of the solid waste generated, does not only have environmental implications but health, social, economic and sustainability. This has prompted the need to consider sustainable consumption and disposal patterns in the quest to meet the needs of humanity while preserving the natural environment. Yet, current production models are mainly fashioned around consumption and less on disposal. The purpose of the study was to examine the influencers of pro-environmental intentions and sustainable electronic waste management among households. Adopting a cross-sectional study design, a survey of households was conducted. Data from 652 respondents was collected using questionnaires and analysed with partial least squares structural equation modelling (PLS-SEM). Among the findings, environmental values were the

