

T.C.
ANTALYA BILIM UNIVERSITY
INSTITUTE OF POSTGRADUATE EDUCATION

MASTER THESIS'S PROGRAM OF BUSINESS ADMINISTRATION

MASTER'S THESIS

**PLASTIC WASTE AND E-WASTE MANAGEMENT, POLLUTION, AND
RECYCLING IN MALI**

Mariam SOUMARE

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DECLARATION

MSc Thesis of this study named “Plastic and E-waste Management, Pollution, and Recycling in Mali”, which I presented, I declare that scientific moral principles were followed in the preparation of this study, in case of benefiting from the works of others, reference is made in accordance with scientific norms, no falsification has been made in the data used, and that any part of this study is not presented as another academic study.

11/ 12 / 2022

Mariam SOUMARE

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ABSTRACT

PLASTIC WASTE AND E-WASTE MANAGEMENT, POLLUTION, AND RECYCLING IN MALI

Mariam SOUMARE

MSc Thesis in Business Administration

Supervisor: Doç. Dr. A. Mohammed ABUBAKAR

December 2022; 70 pages

This thesis contributes to the existent literature which has limited documentation on understanding household knowledge, awareness, attitude, disposal practice, and willingness to pay (WTP) about plastic, electrical and electrical waste management (WEEE) related in the context of Mali, with a special interest on the level of awareness, knowledge on plastic and electrical and electronic waste equipment, the main reason behind discarding, special choice, and disposal practice. To this end, the goal of this investigation is to stipulate analytical knowledge principles for facilitating a policy agenda by evaluating the actual plastic and e-waste management tendency among households. Study data has been gathered by handing out survey forms randomly through fillable papers or face-to-face and online through Google Forms. Therefore, 455 participants were surveyed. The present investigation discovered a very considerable amount of knowledge on plastic and e-waste among respondents (e.g., 89,45%). Environmental factors consideration while purchasing are very limited. For instance, energy efficiency (25.69%), and (14.27%) for CO₂ emission. With the presence of the unofficial sector in waste controlling namely collection and recycling, this investigation found that 14.95% (e-waste) and 10.11% (PW) of the household were selling items to scrap collectors for economic benefits. Around 34,5% and 20.22% respectively for e-waste and PW of households throw their items with household waste. 67.91% of households were eager to pay an extra fee for developing a sustainable waste management system. As a recommendation, a particular legal framework on e-waste devices and plastic products should carefully be developed to bolster and assist actors to take part in plastic and e-waste management. On the other hand, despite the level of awareness and knowledge, the WM situation is still worsening in Mali. Furthermore, the education system should include an intensive program to deeper warn households about the matter for true, clear, and precise ecological awareness enhancement. Municipal authorities should also play an important role in the awareness-building program in Mali.

KEYWORDS: E-waste, waste impact, waste management, Plastic waste, waste recycling.

COMMITTEE: Doç. Dr. A. Mohammed ABUBAKAR (Supervisor)
Dr. Öğr. Üyesi Festus Victor BEKUN (Co-Supervisor)
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ÖZET

PLASTIC WASTE AND E-WASTE MANAGEMENT, POLLUTION, AND RECYCLING IN MALI

Mariam SOUMARE

MSc Thesis in Business Administration

Supervisor: Doç. Dr. A. Mohammed ABUBAKAR

December 2022; 70 pages

Bu tez, Mali bağlamında plastik, elektrikli ve elektrikli atık yönetimi (AEEE) hakkında hane halkı bilgisi, farkındalık, tutum, elden çıkarma uygulaması ve ödeme istekliliği (WTP) hakkında sınırlı dokümantasyona sahip mevcut literatüre katkıda bulunmaktadır. farkındalık düzeyine özel ilgi, plastik ve elektrikli ve elektronik atık ekipman bilgisi, atılmasının ana nedeni, özel seçim ve bertaraf uygulaması. Bu amaçla, bu araştırmanın amacı, haneler arasındaki mevcut plastik ve e-atık yönetimi eğilimini değerlendirerek bir politika gündemini kolaylaştırmak için analitik bilgi ilkelerini ortaya koymaktır. Çalışma verileri, anket formlarını dosyalanabilir kağıtlar aracılığıyla rastgele dağıtarak veya Google formu aracılığıyla yüz yüze ve çevrimiçi olarak toplanmıştır. Bu nedenle, 455 katılımcıya anket uygulandı. Mevcut araştırma, yanıt verenler arasında plastik ve e-atık hakkında çok önemli miktarda bilgi keşfetti (ör. %89,45). Satın alırken çevresel faktörlerin dikkate alınması çok sınırlıdır. Örneğin, CO2 emisyonu için enerji verimliliği (%25.69) ve (%14.27). Toplama ve geri dönüşüm gibi atık kontrolünde resmi olmayan sektörün varlığı ile bu araştırma, hane halkının %14,95'inin (e-atık) ve %10,11'inin (PW) ekonomik faydalar için hurda toplayıcılara ürün sattığını ortaya çıkardı. E-atık için sırasıyla %34,5 ve %20,22 civarında hanelerin PW'si eşyalarını evsel atıklarla birlikte atmaktadır. Hanelerin %67,91'i sürdürülebilir bir atık yönetim sistemi geliştirmek için ekstra bir ücret ödemeye istekliydi. Öneri olarak, aktörlerin plastik ve e-atık yönetiminde yer almalarını desteklemek ve onlara yardımcı olmak için e-atık cihazları ve plastik ürünlerle ilgili özel bir yasal çerçeve dikkatle geliştirilmelidir. Öte yandan, farkındalık ve bilgi düzeyine rağmen, Mali'deki WM durumu hala kötüleşiyor. Ayrıca, eğitim sistemi, gerçek, açık ve kesin ekolojik farkındalık geliştirme için haneleri konu hakkında daha derinden uyarmak için yoğun bir program içermelidir. Mali'deki bilinçlendirme programında belediye yetkilileri de önemli bir rol oynamalıdır.

ANAHTAR KELİMELER: atık etkisi, E-atık, Plastik atık, , atık geri dönüşümü, atık yönetimi.

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SYMBOLS AND ABBREVIATIONS

Symbols

Bko	: Bamako
EEE	: Electrical and Electronic Equipment
E-waste	: Electrical Waste
EoL	: End-of-Life
EM	: Environment
EPR	: Extended Producer Responsibility
GIE	: Groupements D'Intérêts Economiques
IT	: Information Technology
ICT	: Information, and Telecommunications Technology
POP	: Persistent Organic Pollutants
PWM	: Plastic Waste Management
SN	: Subjective Norms
H	: The Hypothesis
Ho	: The Null Hypothesis
BC	: The Perceived Behavioral Control
TPB	: The Theory of Planned Behavior
TCLP	: Toxicity Characteristic Leaching Procedure
WEEE	: Waste Electrical and Electronic Equipment
WM	: Waste Management
WTP	: Willingness to Pay

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PREFACE

Essentially, my sincere thanks to my dear respected advisor, Dr. Mohammed ABUBAKAR, for the patience, know-how, availability, and professionalism that he has demonstrated during my thesis period. His guidance and assistance aided me, during the whole process of my research. I do not have enough words to thank you as I wish. I could not have thought of having a superior advisor for my thesis.

Aside from my main advisor, I would like to address a special thanks to my co-advisor Dr. Festus Victor BEKUN for his encouragement, good instructions, and knowledge. Thank you, a bunch.

My sincere thanks go to my parents Oumarou Soumare and Nana B Touré, who have always been here for their children and continue to teach us Incredible values. And I particularly thank my father who has given everything to take me where I am today. I owe you everything and I will forever be grateful to you.

Finally, I would not end my acknowledgment without expressing my thankfulness to the overall of my relatives and my folks who encouraged me with emotional and rational assistance throughout my thesis research. To all the jury members, I offer my thanks, respect, and gratitude.

1. INTRODUCTION

1.1 Background of the Study

Today, imagining a world without e-waste and plastics is nearly impossible. Plastic and electrical and electronic equipment (EEE) are gradually used throughout the economy, serving as a determinant factor in fields as diverse as construction, healthcare, electronics, packaging, and transportation (Magazzino et al., 2021). Plastics have brought enormous economic benefits to these previously highlighted sectors, thanks to their composites of versatility, sustainability, high strength-to-weight ratio, and low cost. In addition, computer internet networking, and information and telecommunication technology (ICT) have penetrated practically every aspect of modern life and are favorably impacting human life even in the most remote areas of developing countries. The rapid growth of ICT has increased the capacity of computers and capacity concomitantly diminishes the product's lifetime as a result we progressively noticed an increased quantity of electrical and electronic equipment (e-waste) generation yearly. ICT accessibility in most developing countries, especially in Africa, mostly relies on secondhand or refurbished EEES most of which are introduced without confirmatory testing for functionality. Consequently, massive volumes of e-waste in these nations are generated. The constraints affecting the developing countries through e-waste management consist of an absence of framework for end-of-life (EoL) product take-back or implementation of extended producer responsibility (EPR) which supports the crucial approach of 3rs (reduce, reuse, and recycle), lack of appropriate infrastructure for adequate waste management, and absence of legislation dealing particularly with e-waste. Therefore, this thesis analyses these issues as they are relying on waste disposal practices in developing countries with priority on the prevailing situation of Mali.

Plastic and e-waste use has become worldwide and remains interplanetary dangerous and non-degradable which emanates soil infertility, dirtiness, and related diseases in multiple cases. Alongside, regarding West African countries especially in the case of Mali, the dissemination of plastic and e-waste remains alarming. In Mali, people repeatedly utilize plastic shopping bags to hold a set of domestic products from market to domicile. Furthermore, majority of women daily frequent market to buy food and any other needs from the market. That will significantly increase the proliferation of plastic waste around the city and curbside. However, the spreading of plastic waste in the environment poses countless disadvantages namely malaria, soil sealed, blocking drains, and causing floods; in the terrestrial aspect we can consider animals extinction, causing health issues on livestock for those animals which ingest littered plastic in the street and may die as a result namely cattle, sheep and so on. When it comes to Malaria, Mali is the third country in Africa suffering in terms of death from that disease after Burkina Faso with 90.74 percent cases and Sierra Leone with 72.49 percent/cases, and then Mali with 61.16 percent, according to World Health Organization (2018). To a large extent, malaria is a serious and generally mortal disease due to parasite that usually contaminates a certain kind of mosquito which feeds on humans. People who have malaria pathogen are extremely sick with high temperature, trembling, and flu-like illness (Margaret et al., 2017).

As malaria is mostly caused by preach of mosquitoes which come from dirtiness, Mali is the quintessential place, especially in its northern regions and then others such as Bamako, Sikasso, Koulikoro, Kayes, Mopti, etc. where ditches are full of wastewater,

plastic waste so forth, that stuck water and is where mosquitoes are generally located (Severe Malaria Observatory, 2018). Considering all these negative factors, the present study will be mainly focused on how to turn plastic waste into valuable things for Malian interest protection.

1.2 Problem Statement

Mali is situated in the Sahel Region in West Africa and has an annual population growth of 3.6% and is also considered as one of the dirtiest countries in the world with tremendous, related diseases besides. Beforehand, substantial research has been done in West Africa to analyze the state of plastic and e-waste management purposively to identify what kind of matter West African countries (namely Mali) are facing regarding plastics and e-waste issues. As a result, findings were countless and we noticed that waste management has been kept aside in most countries because they are suffering from a lot of issues which are primarily based on poverty, lack of infrastructure, education problems, allocation inequality of natural resources issues. Therefore, they rather prefer to keep the focus on primary problems.

For this, the exploration target focuses on how developing countries, especially Mali could tackle waste mismanagement by studying household knowledge and awareness, etc. in the demographic characteristic aspect and finally propose a better solution to deal with the issue. In another word, turning waste into valuable items also creates employment and economic gain around the country, while keeping the environmental ecosystem safe.

1.3 Research Objective

To accomplish the crucial objectives, the following theoretical assumptions have been set and will be evaluated. In all, questionnaires have been set in this order:

- To identify the main key factor of plastic and EEE uses in West Africa and particularly in Mali and then explain its effects.
- To help us investigate the knowledge of the population on plastic and e-waste. In other terms, impact on the environment, humans, and animals.
- To analyze the environmental awareness of the households during their purchase of new products.
- To delve disposal practice of plastic and e-waste equipment by household and their willingness to pay if the government decides to launch a sustainable waste management system in Mali.
- To analyze the role of print and electronic media on waste management and relevant environmental issues in Mali.

And finally, to establish a couple of approaches to face challenges that are faced by Malians in the plastic and e-waste recycling sector to diminish waste mismanagement.

1.4 Relevance of the Investigation

The study aspires to be exceedingly worthwhile to various sectors in academia, environment conservationists and citizens, businessmen and women, an investor in the recycling area, financial service suppliers, marketers, and government.

Primarily, the exploration will be of paramount importance to the body of literature serving as a concern and guideline scrip since that area is in lack in Mali. Additionally, this study will assist local plastic and e-waste recyclers and normal population users to identify their challenges in waste management and then provide them with strategies to improve that issue.

1.5 The Structure of the Study

The present study is organized based on five (5) chapters with each section focusing on a critical principle and information to contribute to the overarching completion of the specified objectives. The primary chapter consists of the background of the study, problem statement to underline trends of events that needed the investigation, study goals and questions as well as the essence of the study. The second section is related to the literature review which diagnoses tremendous concepts, theories, and studies accomplished in the alike area. The third chapter focuses on the methodology, approaches, instruments, and tools employed to carry out the study. The fourth section highlights the presentation and discussion of the results and findings of the study. The last chapter is related to the summary of the findings, conclusions, limitations and suggestions of future research.

2. LITERATURE REVIEW

The literature review chapter explores tremendous literature and principles focused on the impact of waste on the environment and ecosystem and will concern all the objectives and elements mentioned in the study. Correspondingly, the chapter is categorized into two (2) parts such as the theoretical literature review and the empirical literature review. The theoretical literature review copes with numerous definitions, compositions, concepts, impacts, theories, and beliefs linked to the topic area. In contrast, the empirical literature review is related to hypotheses and highlights alike studies accomplished by other researchers to throw more light on the situation.

2.1 Theoretical Review

To start, e-waste is identified as electrical and electronic equipment waste that has been dumped without the intention of reuse notably all segments or sub-assemblies that are mostly broken, not-working, outdated, old, and at end-of-life (Needhidasan et al., 2014, p. 1-9). The expression touches any appliances that no longer fulfill its initial purpose. For instance, refrigerators, televisions, radios, computers, washing machines, microwaves, etc. that have already reached the end of their life. However, plastic waste management is a baseline to oversee the quantity of plastic waste discarded into the environment by adopting a circular economy and environmental-friendly disposal solutions (Magazzino et al., 2021).

On the other hand, composites are usually categorized by the pattern of equipment used for the matrix. The four principles groups are polymer matrix composites (PMCs), carbon matrix composites (CMCs), ceramic matrix composites (CMCs), and metal matrix composites (MMCs). Carbon-carbon composites (CCCs) are the most important subclass of CAMCs. At this time, PMCs are by far the most widely used type of composites.

2.2.1 Understanding Waste Disseminations

The annual growth rate of world e-waste is three-time quicker than the normal municipal solid waste (Davis & Herat, 2008, p. 1031-1039). 500 million PCs reached end-of-life between only (1994-2003) which could have an unbelievable quantity of lead, cadmium, and mercury (Widmer, et al., 2005, p. 436-458). Developing Economies have demonstrated the quickest annual expansion rates in electronics use. For example, e-waste from dumped mobile phones in 2020 in India and China was foreseen to reach 7 and 8 times than the 2007 level (Widmer, et al., 2005, p. 436-458). The speculation of universal production of complete electronic waste mirrors an upswing from 33.8 million tons in 2010 to 49.8 million tons in 2018 (Wang, 2019, p. 18-26). The remarkable key determinants attached to those facts are the elevated obsolescence rate, brief innovation cycle, increasing consumer demand, and small recycling rates that trigger the purchase of electronic devices. For instance, new cell phone models develop regularly including the accessories namely chargers with frequent changes (Perkins et al., 2014, 286-295). Designed obsolescence is a preponderant strength as the rising emphasis on gradual products emanates shorter durables replacement and disposal spirals with environmental disadvantages (Hossain, 2010). On the other hand, plastics occupy a worthwhile part of our daily lives and activities. For example, biomedical, engineering, transportation, leisure, aerospace food, construction, packaging, electronics, etc. due to their low

production costs. The long chains of polymers pertain thousands of monomers, repeating units, which enable plastics to be long-lasting. Plastic manufacturing has augmented drastically over the last centuries with an average annual growth rate of 8.7% from 1950 to 2012, rising from 1.5 million metric tons (MMT) in 1950 to nearly 335 (MMT) and 359 (MMT) in 2016, and 2018, respectively. The total production of plastics speculated could be tripled by 2050. The waste generated by plastic is frightening because of its large-scale manufacturing.

2.2.2 Effects on the Environment and Human Health

Human populations are directly or indirectly linked to the distribution of plastic waste and e-waste in several ways. Additives of plastic and electronic devices (heavy metals, plasticizers, harmful colorant moieties, and stabilizers) come from indiscriminate disposal and leach and ultimately percolate into numerous aspects of the environment, resulting in contamination of water and soil (Rahman & Brazel, 2004, p. 1223-1248). According to the report, synthetic polymer fibers and microplastics are evident five years after being applied to soil and sewage sludge (Rahman & Brazel, 2004, p. 1223-1248). Plastics in the seas are also hard enough to break down and take almost a year to do so, but still not entirely (Barnes, 2002, p. 808-809). Since microplastics are found in benthic and pelagic ecosystems and are tiny, they are bioavailable to a wide range of marine life (Barboza & Gimenez, 2015, p. 5-12). Almost 260 marine animals, including mammals, fish, seabirds, invertebrates, and turtles either accidentally consume plastic waste or get entangled thereby resulting in problems like lacerations, ulcers, decreased movement, and reproductive output, feeding, and death (Sigler, 2014, p. 1-9). Plastics containing chlorine also leach toxic chemicals into the soil, which can then percolate into groundwater or the nearby water body, causing ecosystem pollution. When landfilled plastic waste decomposes and methane (CH₄) and carbon dioxide (CO₂) are emitted into the atmosphere which is another threat to the entire environment. When plastic waste is burned openly, contaminants including furans, polychlorinated biphenyls (PCBs), dioxins, and heavy metals are released into the air, posing health effects, particularly respiratory problems. When humans come into contact with toxins used in plastic, they may become infected through skin absorption as well (Chandegara et al., 2015, p. 404-415).

2.2.3 Theoretical Framework

The topic has been discussed in a lot of articles and among them, an integrated analysis has been done to certify how important occupying the consciousness regarding plastic and e-waste management is. Extendedly, First, it contributes to e-waste recycling research by supplying a tenacious theoretical framework that associates belief, perception, and point of view, with behavior, which counts for the behavioral factors of e-waste recycling. In addition, Qingbin et al. (2016, p.635 – 643) confirmed that “recycling habit plays the most significant role in e-waste recycling behavior and should be considered as an indispensable task for long-term construction of e-waste management”. In the same way, Otto et al. (2018, p. 30-40) believed that social theories (e.g., ecological attendance, habits, policy, and ambition) have the propensity to be more predominant than institutional theories in decreasing e-waste recycling costs. In addition, consumers participate considerably in the extension of the e-waste issue as front-runners in the intake, production, and administration operations. However, their attitudes and

behavior have been considerably neglected in ecological research (Farhana et al., 2019). The theory of planned behavior (TPB) has been approved for its illustrative force regarding human's willingness to accomplish some behavior that interferes with three antecedents (Ajzen, 1991 p. 179-211). These antecedents implicate the individual's attitude that indicates his or her, estimation of the intended behavior as favorable or unfavorable; subjective norms (SN) that describe the opinion of family members, folks, and other social reference groups about whether the individual should accomplish the intended behavior; and finally, the perceived behavioral control (BC) which depict a person's opinion of the intended behavior as being facile or uneasy to be accomplished (Kumar, 2019, p. 378-389). The TPB pattern (Fig. 2) will be significantly employed to analyze a person's determination to achieve pro-environmental behaviors such as utilizing green-book (Hsu, et al., 2017, p. 161-170) and adopting green behaviors IT (Li & Gong, 2013; Yarimoglu & Gunay, 2020). Mancha and Yoder (2015, p. 145-154) applied the TPB to foresee green behavior determination using survey data of 144 respondents. To go further, they diagnose the influence of character and self-construal on behavioral intentions, they denoted that the way we specify ourselves has a considerable impact on our intention to save the environment. Li and Gong (2013, p. 923-926) adopted the TPB to apprehend the environmental boycott behavior of Chinese consumers. The findings demonstrated that consumers' sense of environmental safety, subjective norms, and perceived behavioral control significantly influence green purchase decisions and taking boycott behavior intention into action. An analysis mainstay of waste separation among Malaysian households according to Razali et al. (2020) have guaranteed that subjective norms, attitudes, and perceived behavior oversee positively and affect the households' engagement in waste separation activities.

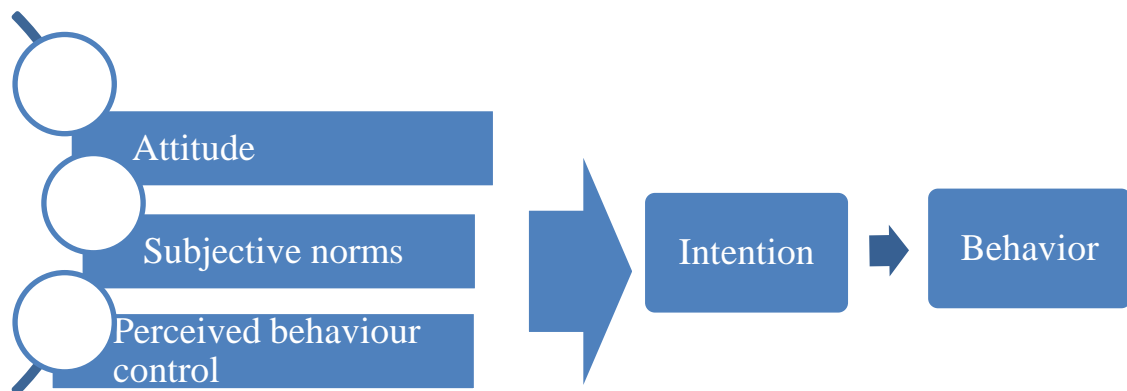


Figure 1. Theory of planned behavior (TPB) model

Source. (Ajzen, 1991 p. 179-211)

2.2.4 Attitude towards Waste Recycling

As a psychological tendency, attitude indicates an assessment answer to a particular matter as either favor or non-preferred. It is usually a pre-arranged emotional state regarding a special issue, entity, or object, (Perloff, 2016, p. 49-62). Based on the TPB, the attitude toward certain behavior favorably encourages the intention to adopt appropriate behavior (Davis et al., 1989, p. 982-1003; Ajzen, 1991, p. 179-211). Attitudes have also been asserted as strong indicators of pro-environmental behavior because of

their capability to ensure incertitude and dicey traits that stem the adoption of the decision (Liu et al., 2019).

2.2.5 Subjective Norms of Waste Recycling

The SN idea interferes with an individual's feelings of collective pressure concerning whether to adopt a special behavior (Ajzen, 1991 p. 179-211); it is the procedure by which a person's opinion, emotion, view, and judgments are impacted by the prospect of reference category or regime, namely relatives, folks, peers, and communities in most of the time. Above all, Swinerd and McNaught (n.d) delineated that these SN occupy a predominant predictive duty all along the recent adoption aspect of novel or new regimes. Anterior research has shown the preponderant effect of SN on pro-environmental intentions. By the same token Khan et al. (2019, p. 49-58) examined behavioral intention to refurbish plastic waste in an emerging term using the TPB models. The findings' testified SN is a major indicator of households' return motivation.

2.2.6 Perceived Behavioral Control of E-Waste Recycling

Behavioral control (BC) is related to "individual's conception about their capacity to carry out a special behavior (Ajzen, 1991, p. 179-211). It denotes human assurance and control over some behavior which alternately strengthens their motivation to endorse that behavior. The result from the anterior investigation has denoted that BC deeply impacts human intention to elaborate a pro-ecological behavior namely food waste recycling (Russell et al., 2017). All in all, awareness and knowledge are very important for waste management.

Alternatively, public awareness and active attendances are the prerequisites victory of plastic and electrical and electronic equipment waste management baseline. There is small comprehension of the manner of how the awareness level challenges the discharge behavior and durable administration of e-waste in a particular country or nation. It is important to detect household e-waste disposal behavior in a particular nation to discern efficient vulnerabilities present in the regime which eases establishing administration solutions and awareness-raising campaigns (Pérez-Belis et al., 2015, p. 277-288).

2.2.7 Waste Management in Mali

In Mali, the principal waste discarders are significantly based on small outskirts associations and business groups. The main association is known as Groupements D'Intérêts Economiques (GIE) which is directed by an organization named 'Collectif des Groupements Intervenant dans l'Assainissement au Mali (COGIAM)' (Bardy, 2013). Since early, they were integrated into part of the waste management regime in Bko and are responsible for door-to-door waste gathering and transferring to the depot's site. Regarding teams generally constitute five (5) to thirty (30) participants and operate for a cost of 2.56 Dollars' that was directly paid by households. These associations have been an important source of recruitment, especially for young adults 8 to 82 years old. It is important to recognize how hard workers was that association, so to speak discarded the public dump of 11000 m³ of waste every day and employed about 667 people (Bardy, 2013). Over years in 2015, the Moroccan company Ozone is engaged in outside cleaning,

dump gathering, and disposal services, which was declared as a “**big clean-up**” of the city that would be the end of the region’s long-lasting dump matters. As part of the eight-year engagement with the district and national government, **Ozone** took over a prerequisite number of opportunities that were used to manage waste in a decentralized way by GIEs. Moreover, after several years of the clean-up announcement, the region’s dump issues have simply aggravated further because Ozone in 2019 itself gathered around 30 percent of waste (Interview with a Local Waste Picker). GIE restarted again to retrieve its littlest customers and to also ameliorate its offer of services. However, Bamako’s waste gathering is roughly related to an absence of an appropriate depot site. Over some decades, a lot of cities’ wastes ended up at the Doumanzana dumpsite, an area of 10 hectares located in the north of the first Commune of Bko, in an abandoned quarry where waste has never been designed to receive dumps, its spacious cavity was considerably filled with dump. In 2012, the site was formally opened as a landfill and, with the help of NGOs, secured and equipped with toilet facilities. That area receives every year 250.000 m³ of waste and is the principal landfill in Bamako (Malijet, 2011).

Doumanzana is frequented by hundreds of waste collectors which are mostly women and children who resided from what they could find in the rubbish again they also gathered every sort of recyclable dump that might be able to be sold, namely clothes, metals, bottles, and electronics appliances. Young adults, for instance, reported: “We collected iron pieces that we sell to blacksmiths and people who come here to buy and export them” (Malijet, 2011).

Additionally, in 1991, some co-operatives named Sema, Sanya contracted in Mali for the same purpose of GIE which was waste collection, and they can also be found in almost every region of Mali, and they are over sixty similar entities in Bamako itself today (Keita et al., 2002, p. 241-258). Besides that, several micros and small-business progress in the plastic and electronic waste are also known as a circular economy to refurbish them into numeral things such as composting, plastic sinks, and latrines. Furthermore, ‘R-last opened services in March 2020 aiming to readdress the problem of what they called ‘end-of plastic life dumped into the environment. The project calls for a focus on refurbishing methods for plastic bottles that can be implemented in Mali. “Plastic bottles of water and juice have multiple lives in Mali. In addition to their initial life, the bottles are used three or four times for water, oil, and fuel and end up in the short or medium-term in gutters, garbage cans, and unfortunately, also in the river,” said Beatrice Roby, the project director (Boris, 2020).

Regarding the population expectation, manifestations were increasing since 2011 by populations to notify the government of the reek and fire that come from the main landfill of Doumanzana, a neighborhood in Bamako, to change the landfill site. From the following collected pictures, the message is noticeable in the pictures alone.



Figure 2. The whole composition of how landfills look across the figures by drawing attention to plastics and e-waste

Source. (Fulblog.blogspot, 2014)

On the government side, since Malians are producing over seventeen thousand tons of waste, in 2013 the Malian government promulgated a law banning the import, manufacture, marketing, and single use of plastic bags (Boris, 2019). However, the existence of that anti-plastic law and its application is still on the table not forward advancement about that subject for the moment because the official statistics still demonstrated the same data of waste produced on the ground which was around seventeen thousand tons per year (Boris, 2019).

2.2 Role of Awareness and Knowledge of Plastic and E-Waste Management

Consumers and government play an important role in Item which contains plastic and have the power in changing the trend to a better and more profitable situation, but the question is “are they aware of the impact of plastic and e-waste on the environment and its residents?” If yes, what do they wait for to react? Environmentalists and scientists have shown in several articles how plastic and e-waste impacts are negatively increasing on health and the environment around the world. To go deep into the topic, it is worthwhile to define the degree of harmfulness of electronic and electronic equipment of waste. First, the speedy extension of e-waste is impacted by rapid technological advancement and modernization and accelerates alterations in information and communication technologies (ICT), economic growth, and EEE starting to be the main element of our daily life, augmenting the versatility of electronic device and the on the bottom trend in prices (Ylä-Mella et al., 2015, p. 374-384). For example, around 5.6 billion mobile phones win use-use in the world in 2012 with the power for transferring growth in the close-by future (Russell et al., 2017). In addition, the fast advancement in technology, consumer attitude/demand, and solid encouragement for intake brings a drastic lifespan reduction and encourage replacement rates for electronic devices, the disadvantage of which is the rising amount of e-waste (Wang et al., 2019, p. 18-26). It constitutes 1–3% of global

municipal waste production of 1636 million tons per year with a potential to increase by 3–5% every year (Mallawarachchi & Karunasena, 2012, p. 44-53).

2.3.1 Understanding the Meaning and the Importance of Social Media

Social media are reciprocal techno electronic channels that ease the invention and sharing of information, interests, ideas, and other forms of terms across virtual communities and networks. On the other term, social media are specified by their capacity to connect people, as this would fundamentally recommend that different technology such as television and mobile phones are also social media (From Wikipedia, the free encyclopedia). Over years in 2019, Merriam-Webster specified social media as "forms of electronic communication" (e.g., websites for social networking and microblogging) across which utilizers establish online communities to distribute private messages, ideas, information, and other contents, (such as videos). Social media are prerequisite applications of mobile marketing because the creation, exchange, and circulation of user-produced can help organizations with marketing research relationship development, etc. Hence, the real question is 'how do we engage with media rather than 'should we engage with social media?

Otherwise, like facilities, investigations have confirmed that the amplification of social networking sites is due to their function in linking people and forging social profit across social networks (Shen et al., 2016, p. 2265-2270). Social networks (for instance, solid relationships) are fundamental for social capital (Lin et al., 2018), which induces like-minded people together (Shen et al., 2016, p. 2265-2270), link and social relationships as a fruit of social networks and social bounds (Granovetter, 1973, p. 1360-1380) and supplies stand shar-out and reliance, as the benefit of social media capital, to complete individual or collective purpose (Granovetter, 1973, p. 1360-1380). Li et al. (2004) assumed that social capital mediated three components: It is a resource for a person that is related to social ties and needs an individual to invest in and continue the social ties (the network). Focused on social capital doctrine everyday social interactions are considered as an investment in social networks that help reciprocal later actions for assisting extra interactions online across social networking sites (Valenzuela et al., 2009 p. 875–901). Investigations have noted that individuals attend social networking sites to retain their social networks with existing folks and to connect with new folks (Liu et al., 2019). Thus, social networking sites enable people to keep and boost their social networks. As a result of networking with those who have reciprocal benefits, the activities of social exchange and social networks may enhance correlation.

The intention to embrace innovation is impacted by, amongst other factors, the information obtained from numerous communication channels about the innovation (Helmers & Rogers, 2010, p. 227-248). Information obtained from communication channels can increase awareness about innovation at the knowledge formation step, it can also impact the training of positive or negative attitudes towards the innovation aspect, decisions making about any kind of domain or innovation can also be influenced to reject or adopt through social networking (Shabanpour et al., 2018, p. 21-32). Conversation channels can pertain to both mass media and interpersonal networks (Helmers & Rogers, 2010, p. 227-248). Inter-personal channels indicate the exchange of information among two or more people (Granovetter, 1973, p. 1360-1380). Mass media conversation channels are preponderant throughout the early level of innovation propagation. They are

worthwhile in establishing awareness about innovation and have a considerable impact on early adopters.

For instance, based on the mechanism of nudging, approaches that emphasize social influence on household behavior can be separated into two parts. In the first part, social influence is seen as a source of information that can positively or negatively impact the likelihood of adoption. The second group of theories pertains to the signal that the decision-maker will communicate back to the social network by adopting or rejecting an innovation.

2.3.2 Social Media Impact on Plastic and E-Waste Management

Emerging countries all over the world, including Mali, have been faced to handle e-waste appropriately by establishing efficiency in gathering, refurbishing, treatment, and disposal mechanisms. Handling the exponential extension of waste is cost-intensive but truly needs to maintain the opposite effects of environmental hazards, if left unmonitored, which would lead to pollution and natural disasters. For instance, in the publicity area, the fundamental publicity route before the year 2000 was classical one-way media, namely magazines, posters, and newsletters. Today, on the internet part 2003, considerable publicity manners were spread through web pages. Social media information has been testified to establish operational value (Gallino et al., 2019). With the advancement of the Internet of Things (IoT), subscription accounts on social media platforms are being applied to household waste management innovatively (Demen-Meier et al., 2018, p.196-206) and waste electronic equipment collection with the help of WeChat, Weibo, and Sina blogs (Zuo et al., 2016).

2.3 Empirical Overview

Research related to household knowledge, awareness, purchase, disposal practice, and WTP or refurbishing behavior on plastic and electronic devices has grown into a widely utilized investigation theory for understanding the essential and possible advancement of the overall management system. Survey-based data collection and eventual data analysis with large socio-economic variables Ramzan et al. (2019, p. 20003-20013) showed young households have an insignificant level of awareness about electronic devices waste-related laws, refurbishing programs, policies, and formal sectors. Such awareness is crucial to make electronics waste management successful. The investigation of public perception and household behaviors helps specify the lifespan of plastic and EEE and the reason behind their disposal practices of waste (Zhang et al., 2019). This is crucial since tremendous findings in this domain are opposed to each other and show the household behavior toward WEEE collection and refurbishing on peculiarities of every nation (Cai et al., 2020). Detecting the explanation for disposal also helps in eluding the establishment of WEEE waste. In compliance with the waste hierarchy, where reduction is favoured over refurbishing (Dagiliūtė et al., 2019, p. 95-101). The absence of recycling opportunities and concerns for information security (also referred to as privacy concerns) were detected as reasons why most survey participants preferred hoarding their appliances, instead of reutilizing or recycling (Zhang et al., 2019). In a European investigation published as a white paper surveying 15 affairs and 55 government officials, Kirchherr et al. (2017) showed awareness to be a principal

barrier in the conversion to a circular economy; and Arain et al. (2020) in the USA, described that “consumer behaviors are critical to managing and reducing e-waste”. Research confirmed that the level of awareness in the nation is utmost crucial in accomplishing further plastic electronic device waste management systems Edumadze et al. (2013, p. 224-234) gathered findings in Ghana and reported that ‘poor public awareness is still one of the main barriers to pro-environmental behavior’. Dagiliūtė et al. (2019, p. 95-101) in Lithuania, explained that “information provision remains the primary tool for WEEE management system efficiency from the consumer side” along with appropriate infrastructure. The opposite of these results is that attitudes and habits are the fundamental factors on determinants of their WEEE refurbishing behavior while recycling, knowledge has only moderate effects (Cai et al., 2020). Yushkova and Feng (2017, p. 501-516), also showed that mobile phone devices are stockpiled even if there is a positive intention toward recycling in the absence of an established habit. They conclude that “environmental education may be a key factor that, through direct and indirect effects, would induce higher intention to engage.” Along with environmental education and raising the general awareness level in a population, other public and private measures such as infrastructure, legislation, and waste tracking were crucial for maximizing resource efficiency through recycling (Dias et al., 2020, 653-683).

2.4 Testing of Hypothesis

2.5.1 Gender Variations

Krathwoh (2002, p. 212-218) has classified knowledge into four types namely (factual, conceptual, procedural, and metacognitive). Knowledge is simply defined as a specific detail and basic element within any domain. Likewise, knowledge is considered as one of the durable competitive advantages that should be possessed by an organization. Some investigations emphasized that knowledge was capable of higher interest in subjects considered sometimes as insignificant and brings light (Arcury, 1990, p. 300-304 ; Levine & Strube, 2012, p. 308-326). Knowledge of gender on detrimental chemicals is linked with the modernizing of e-waste treatment options and end-of-life (EoL) for emerging countries and developed countries as well (Yushkova & Feng, 2017, p. 501-516). According to TPB the real knowledge of plastic and e-waste will largely influence the interest of an individual to behave. Hornik et al. (1995, p. 105-127) clarified that knowledge of the technical aspect of refurbishing can boost the intention of people to modernize. Tremendous reviews concluded that "knowledge" related to modernizing, e.g., dividing sewage and rubbish is placed, is a crucial key determinant to portray the behavior of gender to recycle. Meanwhile, a study about gender differences conducted in China, Laos, and Thailand demonstrated that females maintain a positive conception of environmental conditions and judge it to be enhancing. Although, females seem to be less knowledgeable about how to improve ecological conditions than the opposite gender in these three nations (Liang & Sharp, 2016, pp. 388–395). Hence, in conclusion, knowledge is seen to have a positive and crucial influence on the attitudes of gender toward plastic and e-waste.

To start, awareness is considered as one of the key factors of recycling behavior according to TPB. Hence, the TPB considers the practice in awareness-raising to effectively incentivize waste precaution, reuse, and reprocess behavior within the waste collection

area. Eventually, this should convert into improved performance through determinant waste production and disconnection indicators. Poor degree of people awareness on the disadvantageous nature of plastic and e-waste as well as crude and unqualified theories of e-waste administrating has adversely assisted the e-waste issues in Africa (e-Stewards, 2013). The absence of awareness and instructive information relevant and adequate management operations related to e-waste may lead to hazards to humans. From a gender comparison aspect, Andrew et al. (2020, p. 653-683) have discovered that females present higher ecological concerns than males, which indicates that they exhibit more pro-environmental activities. Moreover, Milfont and Sibley (2016, p. 85-88) also discovered females to be more environmentally aware than males.

The theory of planned behavior of Ajzen (1991, p. 179-211) has been universally used to analyze and explicate households' attitudes toward environmental activities and other corporate socially responsible actions. Another standard of the empirical research was concerned with exploring the influence of demographic and psychological variables, among others gender environmental consideration while purchasing. The integrated picture through the sample and over time, with some exemptions, has shown that under certain circumstances women are more environmental-friendly and engage in pro-environmental activities compared to their counterparts (Bagozzi & Dabholkar, 1994). For instance, in one of the cross-national studies which delved into gender differences in environmental behavior through twenty-two nations, Xiao and Hong (2010, p.88-104) classified women to be more intent on pro-environmental behavior, namely modernizing and driving less, purchasing chemical-free, etc. compared to males.

The unsuitable disposal of waste leads to eventual damage to the ecosystem. As a considerable amount of plastic and e-waste are landfilled, exposure to environmental toxins is likely to augment, resulting in increased risks of cancer and developmental and neurological disorders. Especially Denga et al. (2006, p.6945–6955) reported that the main driving element of the growing e-waste issue is the short lifespan of appliances less than two years for computers and mobile phones. Gender determinant factors in the lifespan of plastic and EEE, hence, an adequate understanding of gender in waste disposal behavior and related factors is needed, which will impact determinations to engage in green behavior. In this light, a lot of researchers have diagnosed gender intentions on and behavior toward modernization by employing the theoretical lens of the theory of planned behavior (TPB). For example, Bagozzi and Dabholkar (1994) found and categorize females to be more environmentally concerned once they are adequately enlightened about the issue of properly disposing of waste.

An essential assumption of the TPB framework is an attitude, together with SN and BC can have a causal influence on the behavioral intention, leading to the manifestation of behavior. Hence, attitude is the principal determinant that interferes with cognitive/perception of the outcome. Attitude towards willingness to pay is clarified as the level to which participants analyze their behavior towards an outcome. An evaluation of gender intention vis à vis willingness to pay has been conducted by using TPB (Bagozzi & Dabholkar, 1994). From their findings, they detected women to have a higher probability of willingness to pay than men and considered willingness to pay as sensible/responsible/pleasant' which potentially elevates the intention to perform certain actions.

H₁: Gender will vary between plastic and e-waste in terms of (a) Knowledge, (b) Awareness, (c) Purchase, (d) Disposal Practice, and (e) Willingness to Pay.

2.5.2 Age Variances

Age is connected to two parts of change that may increase the importance in later life. Firstly, age is linked with a decrease in the relevance of cognitive procedures (Salthouse & Miles, 2002, p. 548). Secondly, knowledge symbolizes the long-lasting items of processing, which are relatively well-conserved in later life as reflected in stable levels of crystallized ability (Salthouse & Miles, 2002, p. 548). In terms of waste, Botelho et al. (2016, p. 1074-1080) considered the age group to be positively related to the probability of higher concern over environmental conditions. Moreover, the necessity to address younger age group and to increase knowledge of waste and environmental conditions is highlighted (Liang and Sharp, 2016, pp. 388–395). In addition, young generations are future consumers and future recyclers. Moreover, their knowledge-raising together with other waste regime efficiency factors are of importance for the efficiency of WEEE management.

Patrick et al. (1990, p. 711-717) investigated to assess how age impacts awareness by then, he highlighted in the study that as people grow older their competencies gradually decline as well. In this light, awareness is considered the state of being conscious of something in an ongoing improvement process. Which might be uneasy for aged people. In terms of environmental awareness, Schwartz (1977, p. 423-429) stated that the younger generation's awareness is more beneficial in terms of reaction and efficiency as they are visibly more concerned. Although, when talking about plastic and e-waste younger generation plays an important role in the waste-generating aspect, this generation's awareness about environmental hazards is required.

In recent years, studies have obtained increasing attention from more and more individuals considering environmental factors while purchasing new EEE. Xu et al. (2020) demonstrated that the principal reasons why the age group especially (the older age group) pays attention to these factors are for their health. In other words, the older generation tends to be more careful than the younger generation. Also, many investigations namely Tarkiainen and Sundqvist (2005), and Yadav and Pathak (2016, p. 732-739) have demonstrated that the attitude can be positively impacted by health consciousness. Given the beneficial outcome of purchasing green furniture for households with health, consciousness is more possible to shape positive attitudes and intentions to buy green furniture.

Perceived Control relates to one's confidence in the possibility of achieving certain behavior despite external and internal constraints. Individual perception of possible effortlessness or difficulties involved in performing certain behavior can be measured by a set of traditionally perceived control variables (Tonglet et al., 2004, p. 191–214). As a way of explanation, the older generation tends to be more environmentally concerned in terms of health and conservatory aspects. For example, as they are confident about 'how what, and when to refurbish or adopt suitable disposal practices that is why they are more likely to display recycling behavior in contrast to most young who believe that they have limited control over existing or upcoming constraints.

In a study on e-waste knowledge and attitudes in India, Sivanthanu (2016, p. 413-423) indicated that the age group's awareness has a direct relationship with the willingness to recycle e-waste, which is a crucial condition for efficient e-waste management. In this context, empirical studies also have shown that age attributes were considered statistically significant factors to explain people's willingness to pay a recycling fee for electronics. Thus, different age groups were targeted in surveys of US households for their knowledge and awareness of the effectiveness of the household recycling policies (Saphores et al., 2012 p.49–63), and their preferences for disposing of e-waste (Milovantseva & Saphores, 2013 p.8–16).

H₂: Age will defer between plastic and e-waste in terms of (a) Knowledge, (b) Awareness, (c) Purchase, (d) Disposal Practice, and (e) Willingness to Pay.

2.5.3 Education Variances

The most usual technic used to bring behavioral change is education as it is also equivalent to knowledge. Adopting the conventional 'deficit model' of science conversation, the underlying belief is that if people simply knew further, they would effortlessly adopt more sustainable behaviors for suitable waste management. Indeed, sometimes environmental education alone, both conducted informal (Varela-Lovsada et al. 2017, p. 634-641) and formal (Mosher and Desrochers, 2014) settings can lead to a positive behavioral change toward the environment. But to effectively motivate students to be environmentally friendly, schools usually provide and teach factors to increase sustainable behavior (Saphores et al., 2012 p.49–63). For illustration, a recent investigation pointed out five (5) key determinants factors that enhance durability behaviors: knowledge of issues, social encouragement, knowledge of procedures, knowledge of issues, material incentives, and prompts/reminders which are mostly used by education regime (Chelliah et al., 2017, p. 42-53). While all these things are worthwhile, different factors provide and integrate different behaviors. The most largely studied of these factors is knowledge. For example, scholars consider knowledge is a determinant factor in promoting recycling because misconceptions can inhibit this behavior.

Education is a vital key to performing with awareness, increasing community concern, promoting social development, and supporting sustainable growth. In the meantime, developing an understanding of the science backward climate change and its other environmental relatives (Uvalić-Trumbić, & Daniel, 2016, p. 65). Some searchers consider that if adolescence shows suitable education and understanding of climate change, they will potentially behave accordingly (Whitley Dietz, 2018, p. 12334-12336). Andrew et al. (2020, p. 653-683) statement towards university education positively impacts environmental aspects.

Sustainable new EEE purchasing depends on the comprehension level of waste and its related impact on the ecosystem. Recent research explained that the incorporation of personal norms in the theory of planned behavior model can improve its explanatory power in respect of understanding and considering environmental factors while purchasing (Koklic et al., 2019, p. 27-34). Therefore, the more educated a person considers himself/herself as a person who considered side effect factors while purchasing the eco-friendlier, they feel moral, and the stronger they are potentially involved in their

purchase of sustainable items. Moreover, it was stated that knowledge about environmental matters impacts attitudes, and people's buying behaviors (Scott & Vigar-Ellis, 2014, p. 642-649).

Education is a preservation and sustainable development tool. The eventual assistance of education to durably dispose of dumps will come with both personal and social change in behavior, improving ecological resilience and elevating awareness of climate change (Bangay, 2016). Affective knowledge, values, belief, awareness, and changing attitudes, education possess important power to ecologically alter harmful lifestyles and unsuitable waste disposal practices. According to Uvalić-Trumbić and Daniel (2016, p. 65), education tends to ameliorate behaviors by involving residents in many actions that promote ecosystem protection.

By having considerable awareness of the impact of e-waste and plastic, a household can pay more attention to environmental factors while purchasing their items and seek better environmental sustainability by also being ready to pay extra fees for recycling purposes. Moreover, some studies also observed environmental concerns not only affect behavior but also impact attitude, which in turn elevates their willingness to pay (Saphores et al., 2012 p.49–63). Besides, Education encourages environmental concern and helps behavior by increasing implications among people (Uvalić-Trumbić & Daniel, 2016). Few research studies from different populations across the globe conducted on electronic consumer recycling behaviors have shown that households mostly change their initial mind to a positive one and are willing to pay for sustainability aspects thanks to Socioeconomic factors, such as education and high-income level (Saphores et al., 2012 p.49–63).

H₃: Education will distinguish between plastic and e-waste in terms of (a) Knowledge, (b) Awareness, (c) Purchase, (d) Disposal Practice, and (e) Willingness to Pay.

2.5.4 Income Variances

Ecological knowledge is specified as “a general knowledge of facts, concepts, and relationships concerning the natural environment and its major ecosystems” (Fryxell & Lo, 2003, p. 45-69). Employee or Individual consumer knowledge is among the principal defiance of plastic and e-waste management, as it is insufficient to design and implement the regulatory framework with precisely clarifies the task of various stakeholders. The duty of households' awareness has been highlighted by Miner et al. (2020, p. 1047) who considered that a well-informed and aware population can appropriately make good decisions related to managing e-waste especially when it comes to the high-income holder as they are also considered waste generators somehow.

First income is defined as a certain amount of revenue received in the counterpart of service, and sometime the amount could be different from each other. Furthermore, Wang et al. (2019, p. 18-26), assessed how income groups can affect social awareness of nature. As a result, we noticed that higher-income individuals are more socially concerned about awareness. But these groups in terms of consumption might be very environmentally unfriendly even though they proclaimed themselves to be concerned about social issues, this explains interest does not necessarily convert into behavioral shifts in consumption choice. Again, Fryxell and Lo (2003, p. 45-69) ascertained those

Individual consumers with higher income levels as the general provenance of waste generation and sometimes miss awareness and an initial municipal sense city resident which poses difficulty to handling the waste.

In the same investigation has been categorized higher-income individuals as mostly the main unecological while purchasing a new product and as the main waste generator (Fryxell & Lo, 2003, p. 45-69). Thereby, the lower-income individual tends to be environmentally friendly in terms of consumption past empirical research also revealed that there is a relationship between attitude, knowledge, and awareness, which in turn influences various sustainable purchase behaviors of high-income gainers (Polonsky et al., 2012, p. 238-263). Moreover, it was revealed that knowledge of a particular environmental issue impacts attitudes, and people's buying behaviors (Scott & Vigar-Ellis, 2014, p. 642-649).

Socio-demographic determinant namely income is also likely to play an important role in recycling behaviors by drawing attention to a proper waste-discarding system by households. (Polonsky et al., 2012, p. 238-263) have shown that the most important way to appropriately managed waste is first to understand to be able to react accordingly. In that case, they also asserted that high-income gainers are mostly waste generators. Therefore, they can simultaneously assist in waste management if they are aware enough of its potential impact. Moreover, low-income individuals are mostly concerned about suitable waste disposal practices. For instance, concerning old items, lower-income individuals tend to store bags in-house to reuse them again and resell old electronic items to recycling organizations. In short lower-income individuals are more ecological.

The willingness to pay is sometimes referred to as an aspiration to pay certain fees to take advantage of sustainable aspects of the environment (Sigler, 2014, p. 1-9). This willingness to pay varies among people due to extrinsic differences which are observable key determinant factors namely education, salary, and age (Chelliah et al., 2017, p. 42-53). Regarding the factors affecting households' willingness to pay, other studies have contrasting findings regarding the influences. Among others, Elisabeth Marie Constance 2021; Ndaou and Tilley (2018, p. 54) discussed that a considerable income level has a positive and significant impact on a household's willingness to pay. This explains that people who get a profitable income and have a good understanding of the importance of a clean environment are hence more willing to pay for the removal and treatment of waste.

H4: Income will diverge for plastic and e-waste across (a) Knowledge, (b) Awareness, (c) Purchase, (d) Disposal Practice, and (e) Willingness to Pay.

2.5.5 Social Media

Since, social media development, people became significantly influenced by information through it. Social media gives everyone the capacity to discover knowledge and contacts as they exchange information and collaborate. Concerning plastic/e-waste management and considering the existence of the online environment and its influence on the waste recycling process, Wang et al. (2019, p. 18-26) explored the kind of tools people use to gather information, especially about waste management., they found that nowadays most people used at least one/two social media tools and those people found it

mostly easier to gather information through it no matter the subject. For instance, 63% of the respondents responded to knowing about waste through social media.

The literature revealed that the main factor driver of discrepancy is how information is displayed to people. Nowadays, knowledge is displayed whether through education or social media. For instance, conversating information through social media is crucial for promoting sustainable behavior when balanced with the conventional campus marketing model. From that, in that generation of knowledge and awareness, Sivanthanu (2016, p. 413-423) assumed that there is an important and huge role of media regarding waste management, as media is all around us when we watch television, read books, magazines, newspapers, listen to radios, etc. As a fact, it has been shown to take a part in and plays an interesting role in waste awareness.

Subjective norms according to TPB refer to the perception of general social/social media pressure to perform or not certain behavior (Ajzen, 1991, p. 179-211). Thus, subjective norms have been confirmed to have a specific relationship between social media and pro-environmental behavior (Ajzen & Fishbein, 1975). For instance, Yadav and Pathak (2016, p. 732-739) asserted that young generations' subjective norm/newsfeed is likely to be positively influenced toward sustainable item purchases. An early study by Si et al. (2020) also confirmed subjective norms as guideline influencing people to go for sustainable usage of EEE namely bike. Hence, the literature shows that people who have certain fame and stuff like that across social media have a powerful ability to impact others and invite them to consider environmental factors while purchasing (Xu et al., 2020).

The usual utilizers of the internet tend to have more knowledge about environmental issues which are regarded as a conductor wire to adopt proper waste disposal practices. The internet enables environmental institutions to encourage their campaigns to an active auditorium and offers an online interface to deliberate about environmental issues and mobilize actions (Zelwietro, 1998, p. 45-56). In another word, it could serve as a guideline of how useful proper waste disposal could be profitable for both eco-friendly and economic.

Media attention relates to people's tendency to voluntarily devote cognitive effort to particular types of media messages (Slater et al., 2009, p. 59). Petty and Cacioppo, (1986, p. 1-24) suggest that attention to text content is a compulsory condition for convincing effects. Hence, people's attention to media messages can influence persuasive and learning effects as a result leading people to opt for more sustainable aspects and push them to be willing to pay. Consequently, media attention has been considered a prerequisite indicator of message influence (Slater et al., 2009, p. 59). Some research revealed a positive correlation between media use and pro-environment behavior (PEBs) among other WTP. Yadav and Pathak (2016, p. 732-739) showed that viewing public affairs television content and fact-based programs such as nature documentaries generated positive effects on people's PEBs.

H₅: Social media will differ from plastic and e-waste across (a) Knowledge, (b) Awareness, (c) Purchase, (d) Disposal Practice, and (e) Willingness to Pay.

3. METHOD

The methodology of research copes with the notion of approaches employed in undertaking the study. Thus, it is not just about the apology of the choices made with concern to the ordinary design of the research but rather it incorporates the philosophical approaches and underpinning upon which your study is focused, and the involvement of these for the framework that has been used (Rojon & Saunders, 2012, p. 55-61). The methodology of this research is based on research design, demography and target population of the study, sampling method and techniques, the procedure employed for data collection, reference of data for the study, sample procedures and techniques employed, instrumentation, validity, and reliability of the instrument used, and ethical considerations used in the research to investigate, examine, diagnose the various goals.

3.1 The Context of Mali

Mali is located in West African countries without any entry to the sea and is bordered by Burkina Faso, Niger to the East, Algeria to the North, Mauritania, Ivory Coast to the South, Senegal to the west, and Guinea to the southwest.



Figure 3. The geographical position of Mali on the card of Africa

Source. (Encyclopædia Britannica, Inc.)

French is the official language but only 5 to 10% understand the language correctly. Mali is home to a lot of ethnicities and tribes with tremendous languages spoken including (Bambara, Fula, Dogon, Maraka, Songhai, Mandinka, Bobo, Bozo, etc). However, 80% of citizens spoke the national language Bambara. Most of the Malians are Muslims, 15% of Christian, and only 5% belong to other religious groups. 70% of its citizens are living in the rural area and the alphabetization rate is very insignificant according to UNICEF over two million children among 5 to 17 years old does not have access to school, and over half of the country's young generation aged from 15 to 24 are not literate.

The population of Mali is about 20,025,000, with a land superficies of 1,241,238 square kilometers, and 3% is considered to be the annual growth rate, which involves exponential extension and proliferation of plastic and e-waste. Mali is also among the poorest countries globally with a poverty rate of 50.3 percent in 2009 (20.3 percent in an urban area and 73 percent in a rural area) (World Bank, 2018). The country is separated into eight (8) regions in addition to the district of Bamako namely, Kaye, Koulikoro, Segou, Sikasso, Mopti, Gao, Kidal, and Timbuktu, and has only three climate zone the Sahara Desert in the north, the semi-desert Sahel in the center, and the Sudanese savannah in the south (Lyche et al., 2012, p.73-101).

In Mali, after gold, the economy is heavily based on agriculture with 70 percent of Mali's forced labor, cotton and livestock make up 75-80 percent per year, and fishing is generally centered in the north region of Mali. Plastics are increasingly used across the economy and are visibly advantageous, serving as a key factor for sectors as diverse as packaging, construction, transportation, healthcare, and electronics. But the side effect should also be worrisome, especially for developing countries that do not have the means to enough recycle plastic waste appropriately. Plastic bag pollution not only damages the natural environment but also leads to health and safety concerns. As Malian's principal activities are mostly based on these sectors, important considerations regarding the environment, animal, and human health should be taken. For example, the dissemination of plastic bag rubbish poses health problems to animals who ingest plastic bags littered in the streets or curbside and may die. Plastics are also washed into rivers, threatening seafood, blocking drains, and causing floods that may harm people's residences and crops. Plastic bags are used to bear rainwater and simply become a breeding space for mosquitos, which develop the risk of malaria. Because plastic bags decompose over years, their eventual long-lasting damage to the ecosystem is deep (Yvonne et al., 2015, p.11).

Otherwise, Solid waste generation, as one would forecast, differs between countries, cities, and parts of cities in Africa. Reliable data is hard to obtain, and cities' economic and political conditions are forceful over time (Achankeng, 2003 p. 22). Waste is provided by multiple sources in Mali. Waste Comes from the residential population, commercial establishments, and public and private institutions as shown below.

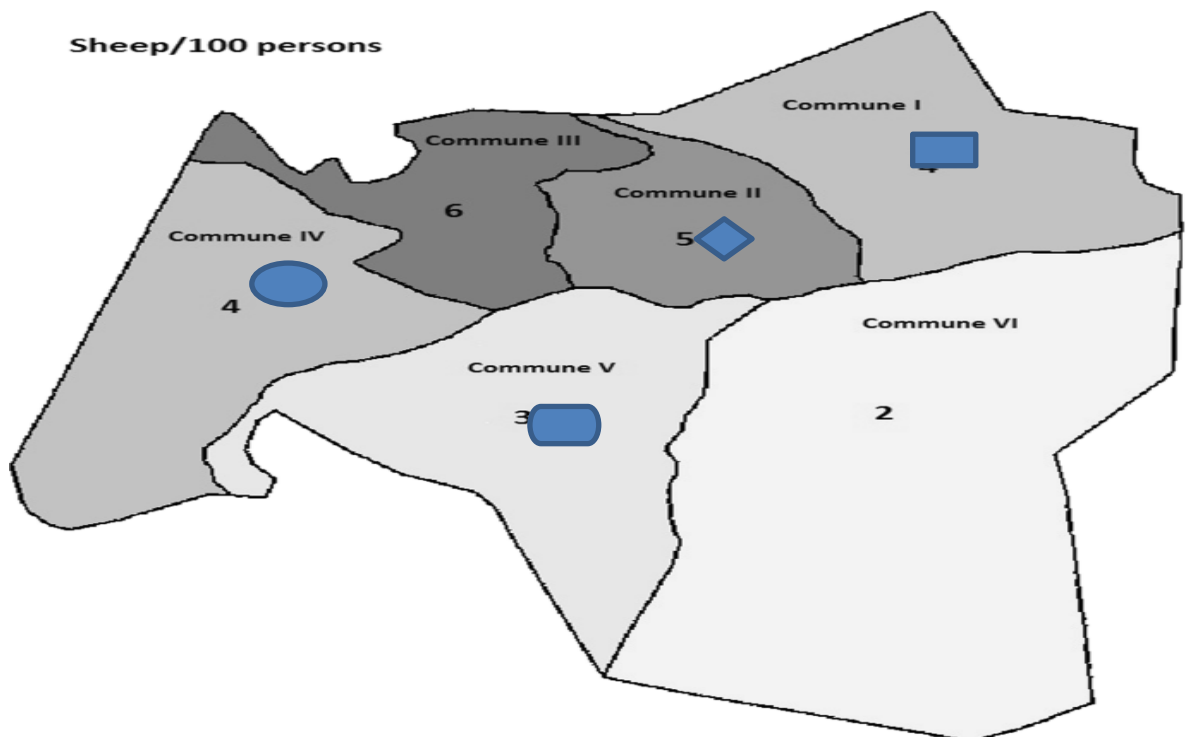


Figure 4. Location of map with the different communes of Bamako to understand where Landfills are Based

Doumazana is the principal landfill.

Medina Coura.

Lafiabougou.

Daoudabougou

Source. (Achankeng, 2003 p. 22)

3.2 Study Regions

More than two million people are dwelling in Bamako as known as the capital of Mali, as many large African cities, it has fought to manage its waste. There are at least 40 unauthorized dumps where garbage is clogged and polluting the air, water, and soil. In 2008, Forbes classified Bamako as the 16th dirtiest city in the world (In Mali's capital, illegally dumped trash is clogging waterways, 2018). As solid household waste pertains to an important percentage of organic material, farmers in Bamako and other surrounding areas of Mali repeatedly make an informal, illegal, arrangement with drivers of the municipal waste lorries to have solid waste dumped near their fields. Although, the Direction des services urbains de voirie et d'assainissement (DSUVA), the city department for waste management, does not currently aim to restrict it. For this, trash is clogging waterways, particularly along the banks of the River Niger, the riverside is covered with decomposing organic material, plastics, and scrap (Hilhorst, 2003, p. 12).

The research study will be purposively conducted in Bamako due to its high population and saturation with dumps or plastic waste around the city.

3.3 Research Design

Grove, Burns, and Gray (2012) revealed that research design is a concept deployed to delve into and allows greater oversee over the factors that possibly involve the reality of results. Concerning the model of information needed for research, people probably be interviewed, questionnaires distributed, and visual or audio records taken (Williman, 2011, p. 58-63). Thereby, the quantitative method is a method in which the searcher implicates numerical methods of data gathering and analysis in a study. This model of research allows a policy researcher to demystify arduous phenomena in a probability manner across numbers, charts, and basic statistical analyses (Cresswell, 1999, p.455-472). The quantitative method has been useful for tremendous reasons. First, its capacity to provide statistical data while using a non-purposive sampling method, and its ability to allow researchers full unit samples based on their professional competencies judgment as noted by (Bougie, 2010, p.13). Secondly, it is possible to get a full understanding of the topic by gathering important detailed data stated (Rojon & Saunders, 2012, p. 55-61). Afterward, the first unit sampling method was chosen, to investigate a useful questionnaire survey through the non-purposive sampling method to determine not only thoughts feeling, and opinions but also being able to put a quantity on a specific onset theory by confirming or disconfirming a particular theory at the end of the survey. Data has been collected from online links explicitly through Google Forms approach and papers-based were also distributed to different locals in Mali such as education areas, markets, and some workplaces. This method allows participants to fill out online questionnaires easily, properly, and efficiently. That method has been used to know how people envisioned arranging plastic and e-waste management while making it profitable economically and environmentally and to also identify challenges they are facing by assessing people's level of awareness, knowledge, and willingness to turn waste into economic benefit.

3.4 The Study Approaches

First, the present study will be driven across the triangulation approach which is an exploration in which individuals used multiple reference points to locate an object's exact point to advance one reason for conducting a mixed-method study. By triangulation, Jick (1979, p. 602-611) meant that different methods, each administered independently could "uncover some unique variance which otherwise may have been overlooked by a single". In his study of the effect of a merger on employees, Jick illustrated triangulation by collecting data through a survey, semi-structured interview, unobtrusive and non-participant observation, and archival materials. His approach was to corroborate or converge the result from these alternative quantitative approaches and systematically attempt to reduce the potential bias inherent in any one method of data collection. In light of this, it is needless to mention how the triangulation approach would be useful to help us collect data without ambivalence in the overarching goal while enabling us to compile, disassemble, and reassemble data for conclusion and interpretation purposes.

3.5 Sampling Procedure and Technique

As described by Ngechu (2004), a population is a well-specified group of people, categories, elements, things, or households that are being investigated. Bougie (2010, p.13) also highlights the population as an entire group of individuals, objects, or events

having observable characteristics. In this regard, the present study population focused on the normal population, or households and some enterprises. Nevertheless, Punch (2003) stated that one cannot study everyone in a population hence a set of decisions is needed to decide on persons to administer questionnaires and processes to engage them. A target population is a set of elements different from the population and to which the researcher would generalize his or her findings. Accordingly, a survey has been conducted in Bko (through google forms, and some were physically filled by students and workers) due to its highly concentrated number of people and activities which are relative to our subject of concern.

According to Polit and Beck (2006, p. 489-497) sampling is the practice of selecting a part that covers the overall study population. The sampling procedure presents the sample size for the study and the sampling technique that will be used in drawing the sample size. The research employed non-purposive sampling in the selection of the capital of Mali "Bamako". All the participants in the survey were aged around 20 or less, to 40 years old or above. In this study, 480 samples were collected with a 96% response rate to maintain the required responses of the survey with 14 questions.

Research Samples are Itemized as Follows in 14 Interrogations

Similar studies with similar questionnaires are conducted in Bangladesh by Islam et al. in 2016 and in Australia as well by Islam et al. in 2020. Hence, the actual questionnaires are as followed :

- 1) Did you hear anything about e-waste and plastic waste?
- 2) Do you know that e-waste contains heavy metals and harmful plastic materials that can harm your health if it is not recycled or processed appropriately?
- 3) Are you aware of how harmful is plastic waste to your health, animals, and environment?
- 4) Which of the following factor you consider during your purchase of new electrical and electronic equipment items?
- 5) When comes to plastic, what do you consider in the buying phase?
- 6) How do you dispose of your e-waste items?
- 7) How do you get rid of plastic waste items?
- 8) If the government of Mali wants to develop sustainable e-waste and plastic waste management infrastructure and recycling facilities, are you willing to pay?
- 9) How many plastics bag do you use per day?
- 10) Did you hear anything about e-waste and plastic waste on social media, newspapers, TV, and the internet?
- 11) What is your gender?
- 12) What is your age?
- 13) What is your education level ?
- 14) What about your income level ?

3.6 Data Analysis and Presentation

Probability techniques were used in the data analysis and presentation. The SPSS program has been used in delving into the demographic characteristics of the pre-encoded data from excel then data has been transferred in the SPSS program to get them ready for analyzing the hypothesis. Statistical analysis will purposefully be established to find a correlation between the independent (socio-demographic) variables such as age, gender, level of education, and income level of the respondents, and dependent variables such as

the number of items in use, the reason for disposal, and average possession time and others.

4. FINDINGS AND DISCUSSIONS

In this chapter will be presented and discussed the data collected from Google forms and face-to-face handouts filled that were primarily analyzed through SPSS which is a data analysis tool. In this regard, the basic or demographic data of the respondents is analyzed first. This is followed by the general research objectives analysis which is categorized under respective headings and presented in tables for easy understanding and interpretation.

4.1 Demographic Information

The demographic characteristics are shown downward in Table 1 for in-depth information. The survey had 480 respondents of which 25 findings represented missing data. So, to have perfect data results, we removed them. In total, 455 responses were left, which showed that 295 were male and 158 were female and 2 participants did not want to specify their gender. A considerable number of participants were from the age group of 20-30 (56.70%) which attune with the most post-graduate student ready to get a job. The main educational qualification of prerequisite participants was certificate holders (221). Otherwise, the standard income of respondents was roughly above \$251 per month counted (107). Fundamentally, the highest group of participants was in the not-working section namely counted 250 participants.

Table 1. Socioeconomic information for the surveyed households

Basic information	Group(years)	N(numbers)	The proportion of the total (%)
Age	< 20	54	12
	20-30	258	56.7
	30-40	99	21.76
	> 40	44	9.67
Gender	Male	295	64.84
	Female	158	34.73
	Other	2	0.44
Level of Education	High school or less	25	5.49
	Diploma	34	7.47
	Bachelor's degree	119	26.15
	Post graduated	244	53.63
	higher	33	7.25
Income of households	67-100\$	42	9.23
	100-167\$	8	1.76
	167-251\$	41	9.01
	> 251\$	114	31.65
	I do not work	250	54.95

Source. Retrieved from the analyzed data

4.2 Contingency and Chi-square Test

That part aimed to understand everything related to chi-square

4.3.1 Definition of Chi-Square Test

The logic of hypothesis testing was first invented by Karl Pearson (1857-1936); Victorian London in 1900 (Sofiane et al., 2022 p. 639). Pearson's Chi-square distribution and the Chi-square test are known as goodness-of-fit and the test of independence is his most important contribution to the modern theory of statistics. The importance of Pearson's Chi-square distribution was that the statisticians could use statistical methods that did not depend on the normal distribution to interpret the findings. He invented the Chi-square distribution mainly catering to the needs of biologists, economists, and psychologists. His paper in 1900 published in Philosophical magazine elaboration is the invention of Chi-square distribution and the goodness of fit test (Mushtaha et al., 2022, p. 1-21).

A **chi-squared test** (also **chi-square** or χ^2 test) is a statistical hypothesis test that is valid to perform when the statistical test is chi-squared distributed under the null hypothesis, specifically Pearson's chi-squared test and variants thereof. Pearson's chi-squared test is used to determine whether there is a statistically significant difference between the expected frequencies and the observed frequencies in one or more categories of a contingency table.

Formula:

$$X^2 = \sum_i \frac{(O_i - E_i)^2}{E} \quad (4.1)$$

Thereby:

O_i = Observed value.

E_i = Expected value.

X^2 = Chi-square.

4.3.2 The Importance of the Chi-Square Test

The Chi-square test of independence (also known as the Pearson Chi-square test, or simply the Chi-square) is one of the most useful statistics for testing hypotheses when the variables are nominal and ordinal. Unlike most statistics, the Chi-square (χ^2) can provide information not only on the significance of any observed differences but also provides detailed information on exactly which categories account for any differences found. Thus, the amount and detail of information this statistic can provide render it one of the most useful tools in the researcher's array of available analysis tools. As with any statistic, there are requirements for its appropriate use, which are called "assumptions" of the statistic. Additionally, the χ^2 is a significance test, and should always be coupled with an appropriate test of strength (McHugh, 2013, p. 143-149). The Chi-square test is statistically important because it is used to compare observed and expected results which extendedly help to determine the relationship between categorical variables. Adversely,

if there is no association between variables the H_0 is maintained to prove that variables are statically not significant.

4.3.3 Conditions to Adopt the Chi-Square Test

The Chi-square test is a nonparametric test used for two specific purposes: (a) To test the hypothesis if there is/or no association between two or more groups, populations, or criteria (e.g., to check independence between two attributes); (b) and to test how likely the observed distribution of data fits with the distribution that is expected (i.e., to test the goodness-of-fit). It is used to analyze categorical data (e.g., male, or female patients, smokers, non-smokers, etc.), but it is not meant to analyze parametric or continuous data (e.g., height measured in centimeters or weight measured in kg, etc.).

4.3 Descriptive Statistic of Hypothesis

First, it is important to summarize the research objectives and hypothesis to have a good understanding of the following interpretation sections: above all, the research objectives aimed to assess the relationship between demographic characteristics (gender, age, level of education, income, and social media) and key factors to sustainably behave toward the environment (knowledge, awareness, purchase, disposal practice, and WTP) by drawing attention to plastic and e-waste.

4.4 Public Knowledge and Environmental Consciousness about Plastic and E-Waste

Regarding the stage of knowledge about plastic and e-waste, we can notice from the cross-tabulation output, that most citizens eventually (89.23%) respondents have heard about plastic and e-waste in Bamako. In addition, (83.52%) of the households were aware that plastic and e-waste pertain heavy materials and hurt humans-health, animals, and the environment if not properly recycled or appropriately processed (figure 3). Despite the level of knowledge, people continue to inappropriately dispose of waste in areas, since 54.73% of the household admitted throwing plastic and electrical equipment waste to landfills explicitly (with household waste) instead of valuably converting them.

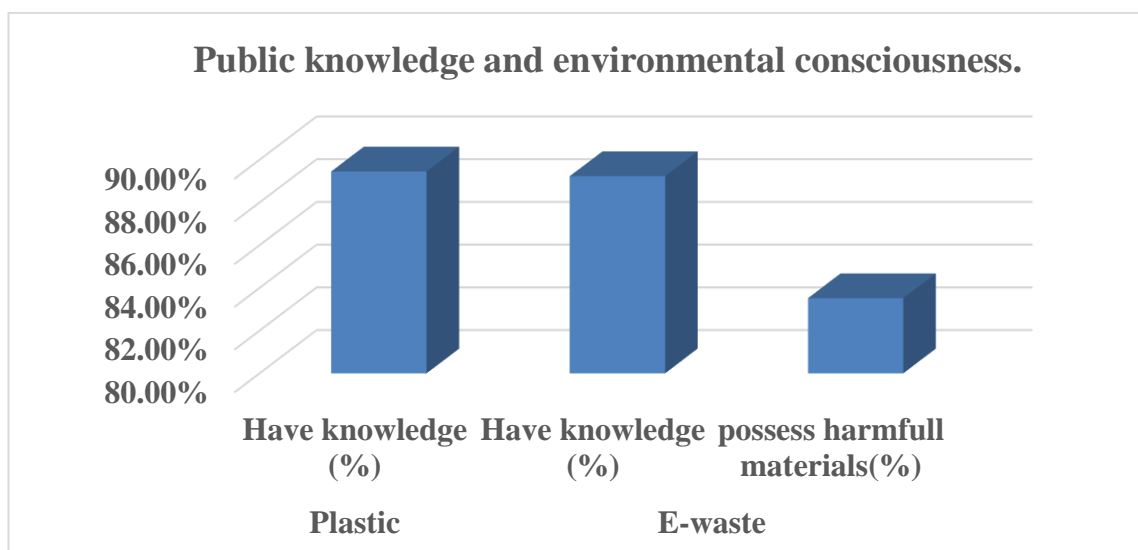


Figure 5. Household Knowledge and Environmental Awareness about Plastic and E-Waste

Source. Retrieved from the analyzed data

Concerning the environmental factor, respondents were asked whether they look at environmental factors such as CO₂ emission, energy efficiency, noise, warranty, brand, and cost during their purchase of new EEE products or not. Figure 5-9 shows the environmental factors considered by the demographic characteristics namely gender, age, level of education, and income. This investigation, regarding environmental awareness of gender, revealed that males occupy the most important part of the whole share with 18.46% by drawing their attention to energy efficiency as an environmental factor while purchasing EEE, and only 9% of males considered CO₂ emission. Whereas females usually give much less importance to such aspects since energy efficiency counted for 7.69% versus 5.27% for CO₂ emission. On the other hand, the present investigation showed that age categories strongly play a role in environmental issues and accounted for 15.16% of energy efficiency of the age category between 20-30. At the level of education, post-graduate registered 12.31% (energy efficiency) and 8.57% (CO₂ emission) which tangibly witnessed very less priority on environmental sustainability. And lastly in the income categories, the unemployed or jobless tend to be very careful about environmental factors, especially in energy efficiency with 14.29%, 7.91% (CO₂), and lastly, the employee with a wage of \$251 or above occupy the third place with only 7.25 (energy efficiency). In conclusion, we observed throughout the figures that households drew less attention and priority on environmental factors while EEE purchasing, even if environmental factors took the higher percentages than buying factors which are cost, warranty, and brand, it's still not enough to brief Malian household environmental conservationist.

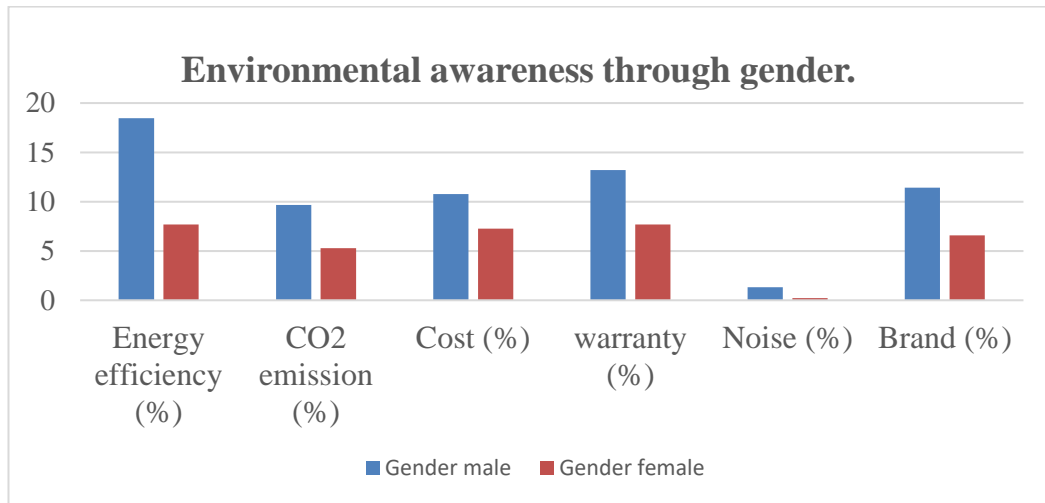


Figure 6. Gender Environmental Factors Consideration during Purchasing

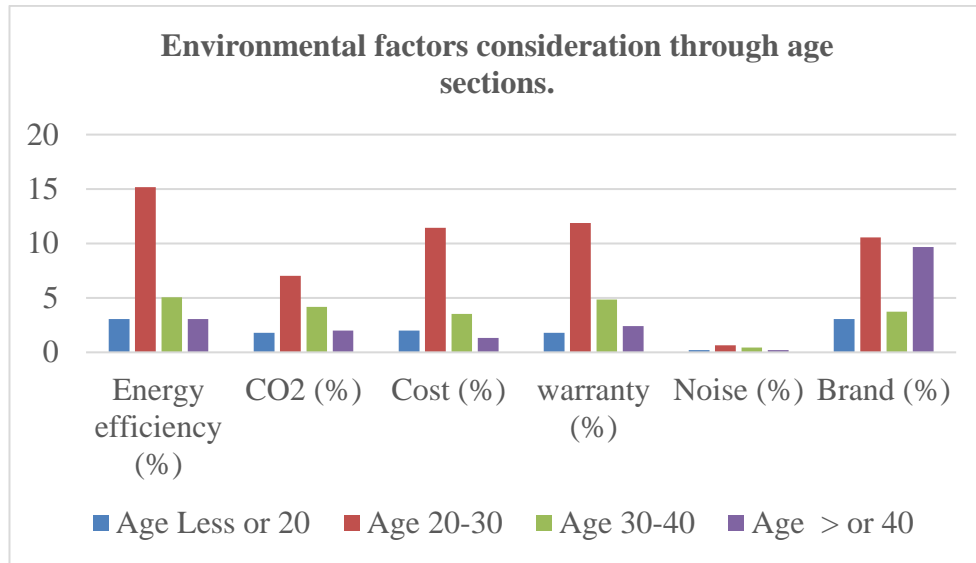


Figure 7. Age Environmental Factors consideration during Purchasing

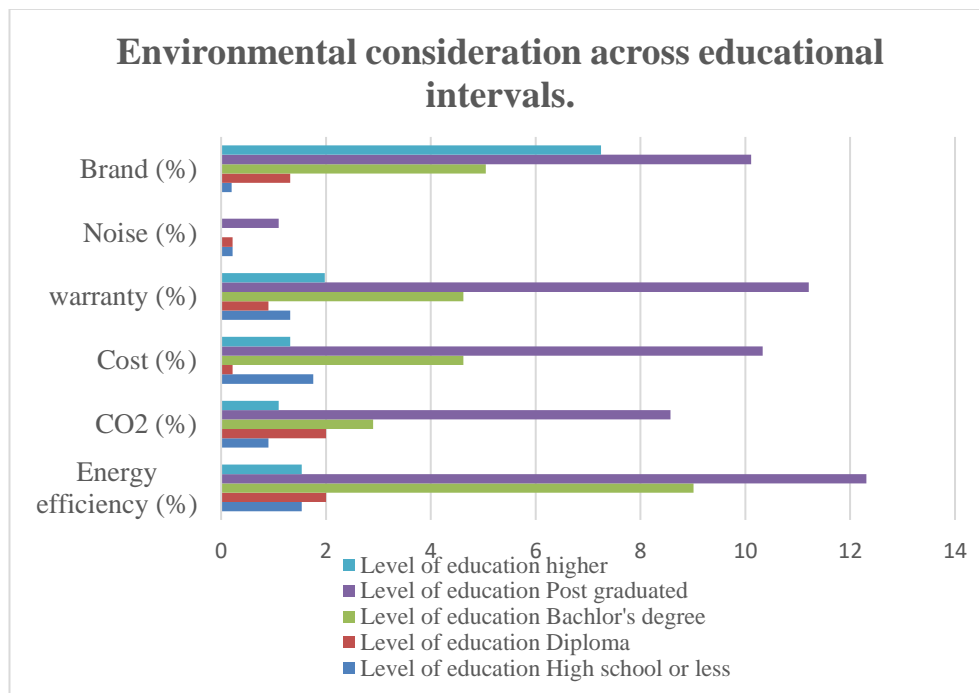


Figure 8. Level of Education Concerns during EEE Purchase

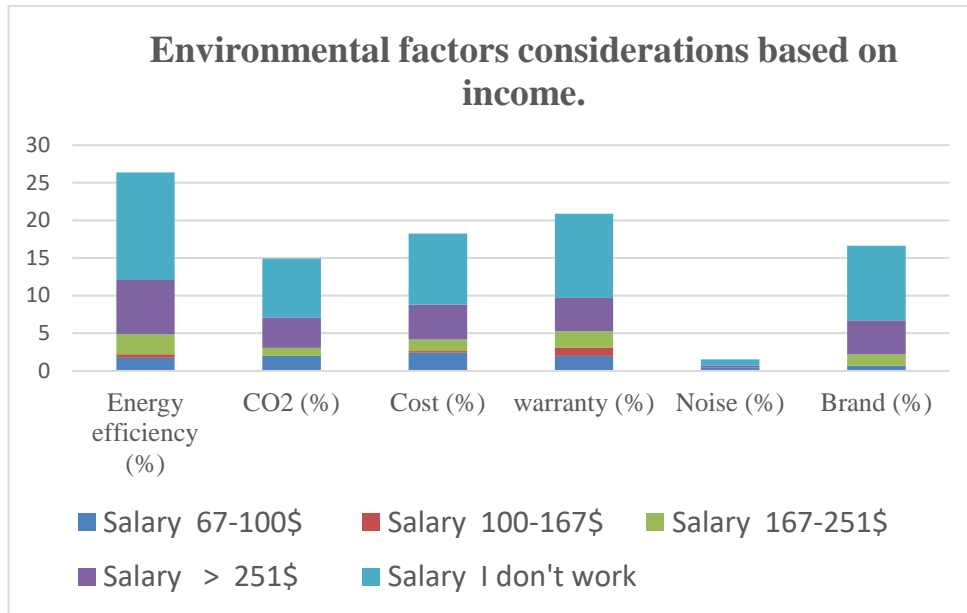


Figure 9. The Measurement of Employees' Concerns while EEE Purchases

Source Figure(6-9). Retrieved from the analyzed data

4.5 Disposal Method of Plastic and E-Waste Items

Figure 8 shows the disposal method practiced by households for plastic and e-waste. The results of this investigation show that 27.91% of the households were selling the waste EEE items to local small electrical material scrap dealers to get economic benefits and 60.88% of households selling plastic waste namely bottles, tires, even bags, etc. to local scrap plastic dealers. The presence of the informal sector in WEEE recycling in developing countries is dominant, and customers get paid by selling their WEEE items to local informal sector scrap dealers (Chi et al., 2011, p. 731-742). 34.51% (e-waste) and 20.22% (plastic waste) of the respondents asserted that they throw their items with household waste because the product became outdated. Although, the following percentages of 15.16% and 6.81% respectively for e-waste and plastic of households kept their unused items at home. In addition, 14.95% (e-waste) and 10.11% (plastic waste) mostly returned their items to manufacturers for discarding purposes. In the meantime, plastic waste (2%) and e-waste (7.47%) of households mentioned not having any idea of how they discard their waste.

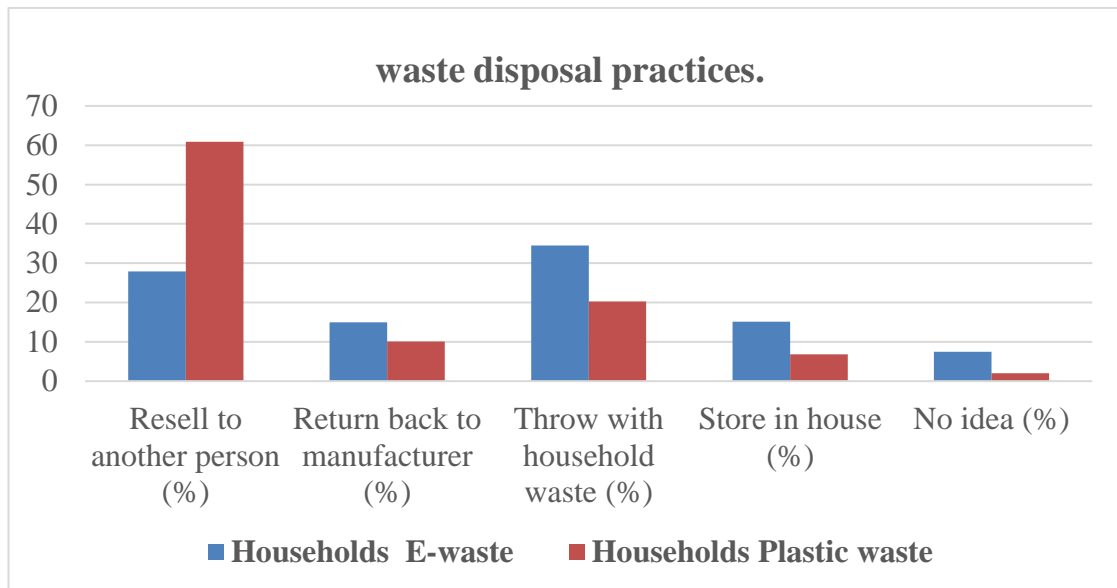


Figure 10. Plastic and E-Waste Disposal Practices

Source. Retrieved from the analyzed data

4.6 Willingness to Pay (WTP) of the Households for a Sustainable Waste Management System

In this study, the households were asked if they would like to pay a certain amount of fees for a formal recyclable waste collection and recycling system if it is built by the government. The result of this study found that around 67.91% of the households were willing to pay. Supposedly, those who were not willing to pay would prefer to sell their product and obtain economic benefits rather than pay for the treatment of waste management or would simply consider the sustainable matter as the government's responsibility. However, 28.13% of households pledged to not having any idea of what they will do in that situation.

4.7 Gender Variations

Gender and Knowledge

Findings from the survey regarding general knowledge of plastic and e-waste, gender showed that 64.84% of male and 34.73 % of female respondents were knowledgeable about plastic and e-waste, which is following the literature. Liang and Sharp (2016, pp. 388–395) conducted a study in China, Laos, and Thailand and found that 30.2% of males and 38.9% of females already knew about waste in Laos. Conversely (89.3%) of male and (89.6%) female of respondents from Thailand had the highest percentage of answering 'no'. Due to Thailand's inadequate education in raising public knowledge. Therefore, in the present study, chi-square present and judge the outputs for both plastic and e-waste as insignificant since the p-values are over the critical value of 5% ($\chi^2=5.325$, $df=4$, $p=0.256$ for plastic/e-waste). In another word, we can briefly conclude that gender differences are not important in terms of knowledge regarding the existence and management of plastic and e-waste in Mali, and at the same time hypothesis, 1a has been rejected because of the lack of distinctive outputs.

Gender and Awareness

The study pointed out similar percentages to the previous outcome namely for both males and females. Turning back to comparable literature. Liang and Sharp, (2016, pp. 388–395) stated that in Laos male respondents seem to be aware because (67.2%) of ‘yes’ to the question. And on the other hand, Chinese male respondents provided a very considerable percentage namely (52.1%) answered ‘no’ to the same question. This indicates in the study conducted in Laos that, male respondents had the best awareness of how to improve environmental conditions as opposed to Chinese respondents, who had the least knowledge about it. As a result of the present study, chi-square strongly opposed the original assertion with an output of ($\chi^2=3.801$, $df=4$, $p=0.434$ for e-waste; $\chi^2=6.132$, $df=6$, $p=0.409$ for plastic) which visibly means that hypothesis 1a is rejected. In short, despite the high percentage of gender awareness about waste, there is not enough statistical significance to conclude an association between variables. In another term, the findings show the percentage of participants that were male, and female did not differ by awareness.

Gender and Purchase

The analysis revealed that 28.13% of males take into consideration environmental factors while purchasing new electronic equipment and only 12.96% of females consider environmental factors. In addition, Liang and Sharp (2016, pp. 388–395) demonstrated that both male (97.3%) and female (98%) Laos respondents provided an important percentage of ‘yes’ indicating that Laos respondents are very concerned over environmental conditions. Besides, both male (43.7%) and female (49.7%) Thai respondents provided a certain percentage of ‘yes’ answers, indicating that Thai respondents considered that the environmental conditions in Thailand were improving. Conversely, Chinese respondents, male (80.4%) and female (79.0%), provided the highest percentage of ‘no’ indicating that Chinese respondents considered that the environmental conditions were not improving, but even deteriorating in China (Liang & Sharp 2016, pp. 388–395). Correspondingly, the current result deeply supports the initial assumption with a high significance ($\chi^2=17.827$; $df=6$; $p=0.007$) for plastic waste. This means, there is a high significance between gender and the purchase of plastic. However, the contrary has been noticed in the e-waste area which counted ($\chi^2=6.825$; $df=10$; $p=0.742$). As a way of explanation, the hypothesis of 1c varied from plastic and e-waste across purchases.

Gender and Disposal Practice

According to the contingency calculations, 40% of males and 20.66% of females tend to resell old items to another person. Regarding the likelihood of throwing items with household waste, 13.85% of males and 6.15% of females tend to do that. Concerning storing items in the house 3.96% of males and only 2.86% of females keep items in the house. According to Saphores et al. (2009) women usually discard appropriately waste more than men because they are directly related to household management. From the following Table 2, chi-square demonstrated that there is no statistical significance between gender and disposal practice for both plastic and e-waste. As the calculated p-value exceeded the critical one, which is 5%, to illustrate, ($\chi^2= 3.941$; $df= 8$; $p=0.862$ for plastic, and $\chi^2=8.377$, $df=8$, $p=0.397$ for e-waste). In conclusion, the Disposal practice is uncorrelated to gender differences which literally rejects hypothesis 1d and keeps the H_0 .

Gender and Willingness to Pay

The delve identifies (64.83%) of males as the key factor to be willing to pay an extra fee to take advantage of a sustainable waste management system and only 34.73% of females were about to accept. Moreover, in the study of Liang and Sharp (2016, pp. 388–395), both male (92.2%) and female 93.7% of Thai respondents provided a considerable percentage of ‘yes’ while Chinese respondents provided the highest percentage of ‘no’. This indicates that Thai respondents are willing to participate, as opposed to Chinese respondents who had the least willingness, to comply with e-waste-related laws. As a result, this investigation declines the hypothesis as the percentage was unique for both plastic and e-waste and the critical value was also $< 5\%$ ($\chi^2=15.57$; $df=6$; $p=0.016$) which manifestly means gender and willingness to pay are statistically associated. As a way of explanation, gender is a deciding factor in willingness to pay as it can also contribute to addressing the waste management system. In short, the analysis was statistically significant, but the hypothesis is supported.

Table 2. The chi-square test of gender variations

Valuables	Gender		
	χ^2	DF	P-Value
Knowledge/plastic and e-waste.	5.325	4	0.256
Awareness about e-waste	3.801	4	0.434
Awareness about plastic waste	6.132	6	0.409
Environmental awareness during EE purchase	6.825	10	0.742
Environmental awareness during the plastic purchase	17.827	6	0.007
Household plastic disposal practice	3.941	8	0.862
Household e-waste disposal practice	8.377	8	0.397
Willingness to pay for plastic/e-waste	15.57	6	0.016

Source. Retrieved from the analyzed data

4.8 Age Variations

Age and Knowledge

Based on the contingency table, age and knowledge witnessed disparate aftermaths. To illustrate, 50.11% of (20-30), 10.11% of (<20), 19.8% of (30-40), and 9.45% of (>40) age group admitted knowing the subject. And elsewhere, only 9.02% of participants responded ‘no’ to the question. Ling et al. (2016) have shown positive correlations between age and knowledge. Likely, Saphores and Milovantseva (2013); Saphores et al. (2012, p. 49–63) also found that positive correlations were consistent with the age of US households and their knowledge of environmental conditions, and their willingness to participate in the recycling of household appliances in the US. Accordingly, the actual result opposes and rejects the initial statement as the percentages that were four age groups did not differ from plastic and e-waste across knowledge, ($\chi^2=5.257$, $df=6$, $p=0.511$). Based on that, variables are uncorrelated to each other. Hence, hypothesis 2a is rejected because the chi-square did not differ between plastic and e-waste by knowledge.

Age and Awareness

From the analysis, we noticed different results for all the age groups. For instance, 46.37% of awareness for the 20-30 age group, 18.9% for the 30-40 age group, and 9.45% for the >40 age group. Contrarily, only 14.07% of respondents were not aware of waste. Following a similar investigation, Owojori et al. (2022, p. 1310) conducted a study in South Africa and showed that 88% of the respondents were not aware of waste-related effects among the age group. Consequently, this high percentage of respondents is an indication of the need for awareness in order to properly manage waste. And Their ages also varied from 20 to more than 30 years. Moreover, the actual result profoundly denies the initial affirmation which drew attention to the distinctive output of plastic and e-waste ($\chi^2=14.939$, $df=6$, $p=0.021$ for e-waste; $\chi^2=26.275$, $df=9$, $p=0.002$). Accordingly, we would say awareness about waste can be positively impacted by age differences since Pearson witnessed correlations between the overall variables. Based on that hypothesis 2b is rejected.

Age and Purchase

Based on the cross-tabulation, 22.19% related to (20-30), 9.23% for (30-40), 5.05% from (>40), and only 4.8% (<20) of the age group considers environmental factors while purchasing new items. Two environmental factors were specified to respondents namely energy efficiency and CO₂ emission. Whereas the remaining amount of hundred percent is divided by some other key factors such as (brand, cost, warranty, etc.). Besides, the result revealed that there is no relationship between variables for both plastic and e-waste, as the Pearson value exceeded 5%, ($\chi^2=12.419$, $df=15$, $p=0.647$ for e-waste; $\chi^2=11.071$, $df=9$, $p=0.139$). From this, we conclude that environmental factor consideration while buying new items is not impacted by age differences for both plastic and e-waste and likewise, hypothesis 2c is undeniably rejected since variables did not differ by purchase.

Age and Disposal Practice

The analysis showed that 34.51% of households in the > 40 age group usually throw their waste with household waste and 15.16% in the same group store item in the house. Although, 19.12% of the 20-30 age group also throw items with household waste, and 18.46 of the same group sell items to another person and so on. Thus, Songa et al. (2012) explained that recycling appropriate waste disposal is associated with respondents' age. The age groups of (18 - 20), (21 - 30), and (41 - 50) years old were proved to be significant factors for suitable waste disposal practices and tended to have positive intentions toward the environment due to their knowledge and awareness. Conversely, the analysis reported that there was no statistical significance between the e-waste variable since the output found was ($\chi^2=17.284$, $df=12$, $p=0.139$ for e-waste) > 5%. In contrast, plastics present a very low correlation between variables to illustrate, ($\chi^2=40.487$, $df=12$, $p=0.001$ for plastic). In other terms, according to the output, a relevant disposal practice does not depend on the age group of households for only (e-waste), so based on the output, hypothesis 2d is supported.

Age and WTP

The output observed a high attitude of willingness to pay from the 20-30 age group with 56.70% of respondents answering yes to the question and the 30-40 age group is followed by 20.76% and finally, we observed a very limited interest of <20 and >40 age group which counted respectively 11.87% and 9.67%. Thereby, Saphores et al. (2012 p. 49–63) agreed that age groups appear to play a minor role except for respondents who are less than very willing to recycle waste. They conjectured that age differences are an ineffective proxy for specific knowledge about the public health/environmental consequences of improperly disposing of e-waste. Likewise, the analysis observed a very limited relationship between age differences and WTP for further facilities because the chi-square found is ($\chi^2=3.944$, $df=9$, $p=0.915$) which represents the same value for both plastic and e-waste. In conclusion, the result did not vary by WTP, so hypothesis 1e is rejected.

Table 3. Age Variables

Valuables	Age		
	χ^2	DF	P-Value
Knowledge plastic/e-waste	5.257	6	0.511
Awareness about e-waste	14.939	6	0.021
Awareness about plastic waste	26.275	9	0.002
Environmental awareness during EE purchase	12.419	15	0.647
Environmental awareness during the plastic purchase	11.071	9	0.271
Household e-waste disposal practice	17.284	12	0.139
Household plastic disposal practice	40.487	12	0.001
Willingness to pay for plastic/e-waste	3.944	9	0.915

Source. Retrieved from the analyzed data

4.9 Education Variations

Education and Knowledge

We noticed from the data a preponderant level of knowledge among students. To illustrate, 53.63% of jobless knew about waste, and 26.15% of respondents were bachelor's degree students, etc. Moreover, the educational aspect is used to positively impact waste mismanagement and to significantly help reduce 'side effects. Hopper and Nielsen (1991, p. 195-220) also conducted a study and suggested that specific knowledge about the potential danger of plastic and e-waste does matter. Interestingly, mandatory recycling at work or school has a positive spillover on e-waste recycling. In addition, a similar study has been implemented in Maseru (Masoabi, 2020, p. 1-73) likewise highlighted that knowledge of waste by households was very limited with 93.8% of respondents not having knowledge about waste. However, the actual result showed and witnessed the contrary effect for both plastic and e-waste. For instance, we found these percentages ($\chi^2=14.547$, $df=8$, $p=0.06$ for both plastic/e-waste) which denote that the level of education is not a significant factor to be knowledgeable about the actual matter. Consequently, hypothesis 3a did not correspond with the statistical result of plastic and e-waste thus again is rejected.

Education and Awareness

The data suggested that 53.63% of jobless were aware of waste, and 26.15% of respondents from bachelor's degree students. Whereas 5.49% and 7.47% respectively for high school and diploma. On the other hand, Sidra et al. (2019, p. 541) discovered that 61% of the students were aware of e-waste in India. Hence, knowledge about the related influence of waste is one of the critical factors for the success of suitable waste governance. In this study, it is found that there is no significance between variables since chi-square exceeded the standard reference of 5% ($\chi^2=7.339$, $df=8$, $p=0.5$ for e-waste; $\chi^2=14.616$, $df=12$, $p=0.263$). However, in a similar study, it is quite the contrary. For example, Ongondo et al. (2011, p.714-730) found that 69% of the students in the UK were aware of waste while Ramzan et al. (2019, p. 20003-20013) mentioned that 81% of the respondents were familiar with it. Therefore, it can be concluded that in terms of a general understanding of waste, students or educated people have a considerable level of awareness of waste but do not justify the waste management system in Mali. Accordingly, the result does not align with the initial statement, so hypothesis 3b is rejected.

Education and Purchase

The above percentages remain the same for every category for each educational group. In detail, the study highlighted a considerable percentage by gradually following the level of education. Several studies have correlated education with environmentally sustainable behavior. Li et al. (2012), for instance, argued that a high educational level appears to be the most significant aspect in raising the potential of a household's willingness to buy sustainable items. Returning to the principal case, the result shows different results for plastic and e-waste. First, there is no significant relationship between education and e-waste, which indicates a failure to refute the null hypothesis. Explicitly, the level of education does not affect the household's intention to sustainably purchase new EEE. On another hand, chi-square indicates the contrary for plastic by emanating an ($\chi^2=50.874$, $df=12$, $p=0.001$) which implies an important relationship between values and reject H_0 . To conclude, we noticed different outputs from plastic and e-waste by purchase and based on that hypothesis 3c is supported.

Education and Disposal Practice

According to the cross-tabulation, we observed diverse outcomes between levels of education. Firstly, postgraduates counted the highest percentage of participants. For instance, 18.9% of respondents reported throwing items with household waste and 13.19% of participants admitted reselling items to another person, 10.77% of participants stored old items in the house. Secondly, from the diploma category, we noticed a very low amount of disposal practices. For example, 2.86% of respondents resell the items to another person, 1.32% throw items with household waste, and so forth. As a result, Pearson strongly opposes the initial statement by resulting a similar percentage for both plastic and e-waste ($\chi^2=31.933$, $df=16$, $p=0.01$ for e-waste; $\chi^2=21.479$, $df=16$, $p=0.01$ for plastic). By the way of explanation, education is an accompanying factor of relevant disposal practice for household, as education also enables people to be aware of waste influences. In conclusion, hypothesis 3d is refuted.

Education and WTP

From the percentage table, postgraduates seem to have a higher interest in the environment because 53.63% of participants responded yes to the question which increasingly shows how a high level of education might be ecologically profitable. Besides, a gradual decrease has been constated while rank is decreasing. For example, a bachelor's degree counted 26,15% and 5.49% for high school or less. In another part, Saphores et al. (2012, p. 49-63) considered education level to play a minor role except for respondents who are less than very willing to recycle e-waste. Accordingly, they concluded that educational attainment is an ineffective proxy for specific knowledge about the public health/environmental consequences of improperly disposing of e-waste. As a result, the research finding does not align with the initial hypothesis. This indicated that their willingness to pay for or recycle plastic and e-waste does not depend on their level of education but on prior factors among others their economic situation, so hypothesis 3e is denied.

Table 4. Education Variables

Valuables	Level of Education		
	χ^2	DF	P-Value
Knowledge of e-waste/plastic	14.547	8	0.069
Awareness about e-waste	7.339	8	0.5
Awareness about plastic waste	14.616	12	0.263
Environmental awareness during EE purchase	25.382	20	0.187
Environmental awareness during the plastic purchase	50.874	12	0.001
Household e-waste disposal practice	31.933	16	0.01
Household plastic disposal practice	21.479	16	0.161
Willingness to pay for plastic/e-waste	13.618	12	0.326

Source. Retrieved from the analyzed data

4.10 Income Variables

Income and Knowledge

The investigation revealed the same amount of awareness for both plastic and e-waste. Therefore, we noticed a high level of unemployment counted lonely 47.03% of respondents that are aware of the topic. And elsewhere, around 23.08% of (> 251) income group responded 'yes' to the question. The remaining group observed very few amounts which are 6.8%, 1.1%, and 7.9% respectively (67-100\$; 100-167\$; 167-251\$) responded 'yes'. However, a total cumulated of each group counted only 12.75% of respondents responded 'no' to the question. In similar studies, Borthakur and Govind (2018) observed that 59.3% of the respondents in Bangalore (mostly belonging to the high- and middle-income group) keep their obsolete computer and mobile phone waste stored due to the lack of knowledge about its management. Below is Table 5 the approximation is quite satisfactory for only e-waste and unsatisfactory for plastic regarding income since ($\chi^2=11.528$, $df=8$, $p=0.174$ for both plastic/e-waste). Based on this result, we noticed an uncorrelation between valuables and income groups that did not differ between plastic and e-waste through knowledge, thus, hypothesis 4a is rejected.

Income and Awareness

In short, most respondents similarly answered the same responses for both knowledge and awareness 'questions. So, we kept the same data for both. In addition, Li et al. (2012) have shown the influence of annual income and education on awareness and knowledge about E-waste issues. They revealed that at 93.7%, willingness to repair their EEE is the maximum in the low-income group and this group is more aware of the presence of recycling centers in Bangalore city as compared to its higher-income counterparts. In another term, they briefly explained how the level of awareness plays an important role in waste management. Regarding the actual analysis ($\chi^2=17.11$, $df=8$, $p=0.029$ for e-waste; $\chi^2=19.925$, $df=12$, $p=0.069$), e-waste and income appear to not have any association with each other. This means income differences do not necessarily define the level of awareness of e-waste mismanagement in Mali. Consequently, high statistical significance is noticed between plastic and income. Accordingly, hypothesis 4b is supported.

Income and Purchase

The present delve reported different amounts for each income group. Therefore, 11.21% for the highest income group namely > 251\$, 22.21% for the unemployment group, and very insignificant share for the rest. For instance, we observed 3.74 for the interval 167-251\$ group, etc. As a result, the study opposes the research statement in the hypothesis, which assumed variables to be linked to each other somehow and also expected outcomes to differ from each other. In a comparable study accomplished in Nigeria by Miner et al. (2020, p. 1047), 67.5% of participants do not pay attention to ecological conditions while buying new items. Concerning findings, chi-square judge the overall findings as uncorrelated to each other because ($\chi^2=22.216$, $df=20$, $p=0.329$ for e-waste; $\chi^2=15.703$, $df=12$, $p=0.205$ for plastic). Hence, there is no statistical significance since the standard value (5%) was not respected, we failed to confirm the initial hypothesis and at the same time, hypothesis 4c is rejected as well.

Income and Disposal

Different outputs have been observed regarding disposal practices across income levels. Among others, 13.85% from the highest income group (>251) tend to resell old items to another person, and only 5.27% from the lowest income group, and 4.84% of households from the highest income group throw old items with household waste. From a similar study, on waste disposal practices, Borthakur and Govind (2018, p. 1053-1066) pointed out that while the low-income group tries to maximize the life of their EEE because of economic disparity and everyday struggles, the higher-income groups do not give much attention to adequately dispose their waste or think of locating a recycling or repair center within the city because they can conveniently afford to purchase newer products at regular intervals. Findings judged variables as uncorrelated for both plastic and e-waste, ($\chi^2=19.055$, $df=16$, $p=0.066$ for e-waste, $\chi^2=21.284$, $df=16$, $p=0.168$). All in all, hypothesis 4d is again rejected.

Income and Willingness to Pay

As explained previously, the unemployment group counted the highest willingness amount namely 36.7% and followed by the highest income group >251 with

16.92% of respondents and the remaining groups counted 0.9% for 100-167% and 6.15% for the lowest income group. On the other hand, the category 'no idea' totaled 28,3% of the respondent that do not have any idea about their willingness to pay. And finally, the 'no' list detected a very insignificant amount namely 3.74 for the whole income group. Besides, Fryxell and Lo (2003, p. 45-69) ascertained those Individual consumers with high-income levels are generally the sources of E-waste generation, and sometimes lack awareness, basic civic sense-related issues, and appropriate waste management. Thus, Consumer knowledge plays a major role to route plastic and E-waste for safe disposal practices. Under circumstances, SPSS shows that there is not enough evidence to conclude that variables are associated. To go further, fail to reject the null hypothesis as ($\chi^2=10.124$, $df=12$, $p=0.605$), and likewise, hypothesis 4e does not align with the results.

Table 5. X² Test of Salary

Valuables	Salary		
	x ²	DF	P-Value
Knowledge for plastic/e-waste	11.528	8	0.174
Awareness about e-waste	17.11	8	0.029
Awareness about plastic waste	19.925	12	0.069
Environmental awareness during EE purchase	22.216	20	0.329
Environmental awareness during the plastic purchase	15.703	12	0.205
Household e-waste disposal practice	19.055	16	0.266
Household plastic disposal practice	21.284	16	0.168
Willingness to pay	10.124	12	0.605

Source. Retrieved from the analyzed data

4.11 Social Media, News, and TV Exposure Variation

Social Media and Knowledge

Based on the present study, we detected that most of the respondents knew about plastic and e-waste through social media indeed 89.45% have been accounted and the remaining amount knew about it elsewhere. Besides, Solomon and Tausch (2021, p. 233-244) investigated social media and knowledge to define the different sources of knowledge regarding e-waste at the household level in the province of South Africa. They approved that, most of the knowledge information about waste as cited by 34% of the respondents, got information from the workplace/office. Television and radio sources accounted for 20%. Waste source of information from schools accounted for 32%. Other sources of knowledge about plastic and e-waste as shown by the respondents indicates that newspapers/magazines account for 12%, and social media for 15%. The present finding data align with the research hypothesis because ($\chi^2=91,175$, $df=8$, $p=0.001$ for plastic/e-waste) which means there is a relationship between variables. Based on the mentioned percentages, which did not differ from plastic and e-waste, hypothesis 5a is supported.

Social Media and Awareness

From the contingency data, we discerned that most of the respondents were aware of plastic and e-waste through social media explicitly 83.96% of respondents ascertained to be aware through social media. Additionally, Solomon and Tausch (2021, p.233-244) again confirmed in the same investigation as previous that social media is also a paramount factor to display awareness about plastic and e-waste issues. Accordingly, the percentage we found percentages of ($\chi^2=41.418$, $df=8$, $p=0.001$ for e-waste, $\chi^2=41.087$, $df=12$, $p=0.001$). By the same token, the chi-square shows a relationship between variables for both plastic and e-waste. This is to say, households' awareness is affirmatively impacted by social media as the p-value is under the critical value of 5%. In conclusion hypothesis 5b is again rejected due to a lack of output differences considering plastic and e-waste.

Social Media and Purchase

From the findings, we noticed tremendous reasons that household takes into consideration while buying new electrical items. Firstly, 35.17% of participants responded to considering environmental factors while buying new items namely energy efficiency and CO₂ emissions. Secondly, we detected that most of the participants are interested in warranty which accounted for 18,68% and 16.6% of respondents are influenced by cost and so forth. Masoabi (2020, p. 1-73) explained that social media are mostly used to expose brands and new trends related to electrical equipment whether than its environmental-related side-effect aspect. Moreover, the social media and purchase (e-waste) section precisely witnessed the same pattern as the previous one, which presents the relationship between social media and purchase ($\chi^2=44.580$, $df=20$, $p=0.001$). That implies social media's likelihood to boast households to consider ecosystem factors while purchasing new electrical equipment. However, a different result has been noticed ($\chi^2=18.052$, $df=12$, $p=0.114$) which shows no associations between variables. According to that, the percentages differ from plastic and e-waste, hence, hypothesis 5c is supported.

Social Media and Disposal Practice

To explain the findings of social media and disposal, we will principally start with the highest amount. Therefore, 28.13% of respondents affirmed throwing items with the household, and 24.39% of respondents resell their old items to another person, 12,65% stored them in the house. Again Masoabi (2020, p. 1-73) demonstrated in their study that social media could be very helpful and beneficial for proper waste management since it is considered to be an important tool of knowledge displayer about waste-related side-effects on the environment and human health. The result revealed no relevant correlation between variables, as ($\chi^2=16.409$, $df=16$, $p=0.425$ for e-waste, $\chi^2=22.652$, $df=16$, $p=0.123$ for plastic) which visibly exceeds 5%. Therefore, Pearson concludes that an adequate waste disposal practice for a household is not to rely on social media. In addition, hypothesis 5d is rejected because social media did not differ from plastic and e-waste by disposal practice.

Social Media and Willingness to Pay

From the analysis, we found out that most of the participants were willing to pay. Among others, 67.91% responded yes to the question, 3.74 opted for 'no', and 28.13%

admitted to not having any idea. Moreover, Masoabi (2020, p. 1-73) again evaluated how social media could impact households' willingness to pay for waste management and found out that 85% of respondents were about to participate and revealed that most of them are aware and knew about it through social media. On other hand, we failed to confirm the initial hypothesis, as a result, we do not have enough evidence to suggest an association between the independent valuable and willingness to pay. This is to consider that, hypothesis 5e is again rejected.

Table 6. Social Media Variables

Valuables	Social		
	x ²	DF	P-Value
Knowledge/awareness about e-waste	41.418	8	0.001
Knowledge/awareness about plastic waste	41.087	12	0.001
Environmental awareness during EE purchase	44.580	20	0.001
Environmental awareness during the plastic purchase	18.052	12	0.114
Household e-waste disposal practice	16.409	16	0.425
Household plastic disposal practice	22.652	16	0.123
Willingness to pay	12.516	12	0.405

Source. Retrieved from the analyzed data

4.12 Discussion Summary

The results from the analysis and discussions above show many interconnections and appealing factors which are driving the adoption to engage in pro-environmental behaviors. The discussion revealed that most of the respondents have a basic understanding and knowledge about the impact of plastic and e-waste on humans and the environment in Mali. The findings equally revealed that most of the respondents carelessly dispose plastics with household waste and mostly return e-waste to the seller. This obviously shows a lack of personal ambition to engage in recycling and modernizing plastics and e-waste. Concomitantly, the findings showed most of the participants in Mali will be delighted or/are willing to engage or to pay and integrate if the government launch waste recycling activities. The interesting factors identified to be the key factors impacting individual decision-making to recycle waste take part into the potential high cost of technological appliances and recycling equipment to modernize waste, and/or inadequate waste recycling education, on top of that Malians' incomes are very low. In comparison with the similar study conducted in Australia beforementioned, a very limited knowledge and awareness were observed which highly contributed to the amount of disposing waste by the participants into the environment, and which equally showed those who have a higher income level owning a considerable number of devices that they carelessly dispose with their household. However, the study established in Bangladesh, testified 90% of the households were unaware of the expression WEEE and plastic waste. In other words, public knowledge and environmental awareness about the matter were very low.

The key factors mentioned are largely external factors that mostly directly or indirectly influence the entire desire to modernize waste in Mali. In other words, which will contribute to the ongoing proliferation of waste in the country. In this regard, these

factors are more likely to impact the population well-being which includes their health. For instance, Mali is the third country in Africa suffering in terms of death from malaria after Burkina Faso with 90.74 percent cases and Sierra Leone with 72.49 percent/cases, and then Mali with 61.16 percent, according to World Health Organization (2018). Because malaria is mostly caused by preach of mosquitoes which come from dirtiness.

Regardless, the results revealed how respondents are open to engaging in social benefit activities if the government gives them the opportunity to effectively integrate in a new recycling system with the required technology and infrastructure to appropriately manage waste in Mali.

5. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusions According to the Approaches

In conclusion, the first approach was established to investigate correlations between gender and what we call sustainable factor determinants namely (Knowledge, Awareness, Purchase, Disposal Practice, and WTP), and to also evaluate the results differences through plastic and e-waste. And the analysis was accomplished through statistical analysis. Based on that, the result only found evidence of a significant association between purchase, knowledge, WTP, and gender. That indicates gender to have contribution possibility to environmental factors considered while purchasing and willingness to pay. However, a limited effect of gender differences has been found on awareness and disposal practices. Therefore, according to that delve, they are not related to each other. In addition, by reference to the initial assumption, gender did not differ between plastic and e-waste for almost all the variables except purchase. Saphores et al. (2012, 49-63) deduced that for participants in the United States, results on the efficiency of socio-demographic variables were established to be statistically significant, but the interpretive potentiality attributed appears to be small.

The second hypothesis expected output to vary between plastic and e-waste, and likewise aimed to also answer questions about interactions between age and durable key factors such as knowledge, awareness, purchase, disposal, and WTP. In light of that, we detected affiliation among awareness, disposal practice (only for plastic), and age. For further understanding, this denotes the age group to be a key determinant for disposal practice and awareness. As the goal was to draw a relationship between age and socio-demographics while maintaining distinctive output between plastic and e-waste by sustainable factors, as a result, the age group only varied from plastic and e-waste by disposal practice and however, remained the same results for the rest of the variables.

With the present study, income groups were assessed to understand its power on knowledge, awareness, purchase, disposal practice, and WTP regarding plastic and e-waste, and to likewise analyze how variables results could differ from plastic and e-waste. Results revealed familiarity among income and awareness (for only plastic). Conversely, income showed an opposite effect on knowledge for both (plastic/e-waste), awareness (e-waste), purchase, disposal practice, and WTP which highlighted income to have a limited impact on waste management by drawing attention to the mentioned elements somehow. Although, in a matter of basic assumptions, the delve found distinctive results from plastic and e-waste across a) awareness. In contrast, did not differ from c) purchase, d) disposal practice and WTP.

The fourth hypothesis was first, scrutinized to provide a valuable relationship between education and knowledge, awareness, purchase, disposal practice, and WTP. And was secondly performed to account for different outputs between plastic and e-waste as well. As a result, the research assumption aligns with purchase and disposal practices for only (plastic) and education. That is to say, a level of education can be used to bring a positive contribution to waste management of plastic across the purchase and disposal of plastic. Nevertheless, definitive gaps were detected among education and knowledge, awareness, purchase(e-waste), disposal practice (e-waste), and WTP. Nevertheless, regarding the initial hypothesis, the output did not differ from plastic and e-waste by a) knowledge, b) awareness, d) disposal practice, e) WTP expect for c) purchase.

The final part is about social media involvement in waste management through sustainable factors among other knowledge, awareness, purchase, disposal practice, and WTP. We found the result of this hypothesis much more satisfactory when compared to others. In detail, we discovered social media as a paramount concern to waste management across knowledge, awareness, and purchase for both plastic and e-waste. In contrast, disposal practice and WTP are not associated with the social media aspect. On the other part, social media differed from plastic and e-waste by c) purchase only and did not vary from plastic and e-waste through a) knowledge, b) awareness, d) disposal practice and e) WTP.

5.2 Implications for Practice

These are a few possibilities of how this explicit focus can be manifested in instruction. To start, the present study is currently the first conducted on plastic and e-waste management in Mali, to assess different aspects through demographic characteristics in Mali with a sample size of 455 out of 25 missing data. Hence, due to the lack of data in the field, this paper can be useful academically, in the investigations area, and finally, encourage investigators in decision making. Besides, the investigation pointed out, how basically participants were knowledgeable and aware of the topic but still have some unclear side on waste effects which keep the matter worsening. In another word, households need an intensive information program. Moreover, that delve also showed how much the level of the recycling sector is not very formal and needs more implications for improvement purposes by highlighting the readiness of households to pay for benefiting better conditions. Throughout that mentioned information, future investors will know which part they need to address or what kind of strategy they should apply to have an appropriate added value.

5.3 Implications for Theory

Some positive outcomes of the study confirm the strength of the TPB model used to assist demographic characteristic behavior on waste management regarding plastic and e-waste. In any manner, the theory of planned behavior model can be seen as a comprehensive or absolute theory, as recognized by its initiator (Ajzen et al., 2011), however, new understanding can be obtained by supplying the model if the set of intended applications is precisely specified and empirically adopted as proved by the results of the study. Furthermore, the data of this has contributed to creating a suitable understanding of the demographic characteristic behavior in waste management.

5.4 Limitations, and Future Research Recommendations

The mathematical analysis undertaken on the approaches of this paper presented findings and sources that partly fail to reject to support the initial assumptions in the hypothesis even if it is sometimes a prerequisite head of attribute that should normally have an incredible impact on waste management. This could be because the sampling range is not very huge and probably does not portray the entire population for this research. In concern to the above statement, we would like to incentivize future researchers to utilize a huge sampling size and representative sampling model to perform a wonderful assessment.

5.5 Recommendations

According to the investigation of the present questionnaires, the succeeding conclusions are suggested:

Due to the absence of a rigorous role in Mali regarding plastic and e-waste, a special legal framework on WEEE items and the plastic product should carefully be developed to bolster and assist actors to take part in plastic and e-waste management. Equally the informal field is a huge factor in the plastic and e-waste circular economy, and the supply chain should be implemented. Otherwise, households will permanently maintain selling their devices to nearby scrap collectors, which engendered hazardous refurbishing and oppose environmental effects. The rule should appeal to perform plastic and e-waste data handling systems to maintain all associated records of products from the collection to sorting, structured consistent with the source. Hence, studies should be performed to evaluate the practicability of a regime namely a deposit-refund system as part of the legislative initiative.

A recommendation about knowledge and awareness, the education system should include an intensive program to deeper warning households about the matter for true, clear, and precise environmental awareness enhancement. And Based on the present result, future researchers should also provide their research questionnaire by drawing their intention on multiple questions (instead of yes/no questions) so that respondents can pick the right answers to deeply study the level of awareness and knowledge of WM. Municipal authorities should also play an important role in the awareness-building program in Mali. Doing and handling these issues will bring to light the full potential of waste management in Mali and will reduce the environmental issue.

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