UNIVERSITY OF EDUCATION, WINNEBA

INVESTIGATION INTO THE EFFECT OF SCRAP METAL USAGE ON LOCALLY MANUFACTURED DOMESTIC MACHINES IN THE CAPE COAST METROPOLIS

ENOCH SESIMEH ADJABENG

7141220002

AUGUST (2016)

UNIVERSITY OF EDUCATION, WINNEBA

INVESTIGATION INTO THE EFFECT OF SCRAP METAL USAGE ON LOCALLY MANUFACTURED DOMESTIC MACHINES IN THE CAPE COAST METROPOLIS

ENOCH SESIMEH ADJABENG

7141220002

A Dissertation presented to the Department of Mechanical Technology, Faculty of Technical and Vocational Education, submitted to the school of Research and Graduate Studies, University of Education, Winneba, in partial fulfilment of the requirement for the award of Master of Mechanical Technology (MTECH) Degree

AUGUST (2016)

DECLARATION

STUDENTS DECLARATION

I **ENOCH SESIMEH ADJABENG** hereby declare that this dissertation is my own work towards the **Master of Mechanical Technology (MTECH)** and that to the best of my knowledge it contains no material which has been accepted for the award of any other degree of the University except where due acknowledgement has been made in the text.

……..…… ……..……

ENOCH SESIMEH ADJABENG (DATE)

(Student)

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this research report was supervised in accordance with the guidelines and supervision of the project work laid down by the University of Education, Winneba.

……..……..…… ……..……

DR. ANTHONY AGYEI-AGYEMANG (DATE)

(Supervisor)

ACKNOWLEDGEMENT

I am grateful to Almighty God for His guidance and protection. Secondly, to my supervisor, Dr Anthony Agyei-Agyemang for his patience, attention, direction and taking his time to effect all the corrections in this dissertation. God bless you beyond human understanding and imagination.

DEDICATION

I dedicate this dissertation to my loving and caring wife Mrs Hawa Adjabeng and my three children namely Chenielle Gyanwaah Adjabeng, Jerell Kojo Adjabeng and Elias Kwesi Adjabeng for standing solidly behind me through thick and thin.

ABSTRACT

The main objective of the study was to investigate into the effect of scrap metal usage on locally manufactured domestic machines in the Cape Coast Metropolis. This study adopted the case study strategy. Both qualitative and quantitative research approaches were used for the study. The population for the study was four hundred and fifty-seven (457), consisting of scrap dealers and locally manufactured domestic machines manufacturers in the Cape Coast Metropolis. Purposive and random sampling methods were used to select a sample size of two hundred and ten (210) respondents for the study (100 domestic machine manufacturers and 110 scrap dealers). Questionnaires were the main instrument used to collect primary data for the study. Primary data was collected through a field survey of domestic machine manufacturers and scrap metal dealers in the Cape Coast metropolis. Data was collected through the use of a designed questionnaire administered to participants in their workshops. The SPSS version 18 was used to analyse data. The study findings concluded that the domestic machines manufacturers fabricated flour mill, cassava grater, vegetable mill and corn mill. Moreover, the respondents used new and scrapped materials in fabricating domestic machines. Also, the respondents used pillar drilling machines, lathe machines, arc welding machines, gas welding machines, pedestal grinder and milling machines to manufacture domestic machines. The study results concluded that the main difficulties preventing people engaged in metal scrap collection and recycling of scraps is non availability of recycling plants. The study recommended that the government and stakeholders must provide adequate long and medium scale recycling plants to recycle scrap waste to minimize the high cost of locally manufactured machines. The availability of the machine tools will improve productivity of domestic machines manufacturing.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

In a study conducted by Zerboc (2003), in a developing country like Ghana, the problems associated with solid waste management are more acute than in a developed country. Lack of financial resources and infrastructure to manage waste creates a vicious cycle; lack of resources leads to low quality of service provision which leads to fewer people willing to pay for said services, which in turn further erodes the resource base and so on (Kuniyal et al. 1998). The problem is further complicated by rapid growth in population and urbanization, which adds greatly to the volume of waste being generated and to the demand for waste retrieval service in metropolitan cities. However, more often than not, an increase in population is not matched with an equal increase in revenue for the local municipalities for waste management (Zerboc 2003). Besides this, rapid urbanization means rapid growth of shanty dwelling units that are largely unplanned for, and add to the waste, health, and hygiene problems. Another significant factor that contributes to the problem of wastes management in a developing country scenario is the lack of recycling plants.

The environmental benefits of scrap metal recycling can be based on a number of issues. Within the context of scrap metal recycling, the beneficial issues discussed here are resource conservation and efficiency of resources use, solid waste management strategy, energy conservation and pollution prevention of soil and groundwater bodies. The recycling of scrap metals for the production of new metals conserves virgin ores (Langenhoven et al, 2007) which is known to be finite and non-renewable (Gordon et al., 2006). Apart from the environmental damage and the pollution of soil and groundwater bodies caused by mining activities of virgin ores, the recycling of scrap metal also

prevents the depletion of the finite ores (Kaseva & Gupta, 1996) and ensures efficiency in the maximum utilization of non-renewable resources. According to Kaseva and Gupta (1996) in "Citation of Environmental Sanitation Review of 1984", the production process of steel from scrap steel recycling is realized to use 40% less water than the production process from virgin ores.

According to Kaseva & Gupta, (1996), scrap metal collection from landfills and the surrounding environment for recycling can be realized as a more sustainable approach to the Cape Coast Metropolis solid waste management. This is due to the fact that scrap metals can be bulky and will occupy very large areas of landfills. The collection of the scraps therefore reduces the amount of waste in landfills thereby reducing the amount of land required for waste disposal. The retrieval of scrap metals from landfills also prevents the pollution of soil and groundwater bodies from the decomposition of the metals in the soil.

According to Johnson et al. (2008), the production of stainless steel from the recycling of scrap stainless steel is realized to save 67% of energy usage and 70% reduction in CO_2 emission if all materials used in the production process were all scrap stainless steel rather than virgin ores. Waste reduction, composting and recycling efforts continue to expand throughout the Cape Coast Metropolis. Approximately 45 percent of what was once considered waste is now being diverted from disposal in landfills. These results have been accomplished through the collaborative efforts of the public, private and not-for-profit communities. Because of these efforts, less waste is going to our landfills. But in addition, significant amounts of energy and natural resources are conserved. Recycling also reduces, and in many cases eliminates, the pollution associated with virgin material extraction and processing.

Another important environmental benefit of recycling programs, which is often overlooked, is the significant reductions in greenhouse gases. These greenhouse gas reductions results because recycling decreases the energy needs of product development, reduces emissions from incinerators and landfills and lastly, recycling programs save trees which act as a carbon sink for carbon dioxide in the lower atmosphere. Therefore, continuing growth of waste reduction and recycling activities will, also, increase the environmental benefits in the future. Therefore, the study seeks to investigate into the effect of scrap metal usage on locally manufactured domestic machines in the Cape Coast Metropolis.

1.2 Statement of the Problem

Human nature is such that waste generation cannot be avoided. The management of solid waste continues to be a major challenge in urban areas throughout the world particularly in the rapidly growing cities of the developing world (Foo, 1997). A high rate of population growth in our various cities are increasing in generation of enormous volumes of solid waste which are very difficult to deal with and possess serious threats to environmental quality and human health (Snidha, 2003). Today, the importation of metal products, aluminium can drink and food is the primary packaging container used in the soft drink industries and food industries in Ghana is increasing. The import rate of both industries and manufacturers has rapidly increased in the market of our cities and communities. Customer demands according to investigation by the retailers and wholesalers have become the most lucrative business to do in the country.

The problem here is how to dispose the cans and metal scraps after consumption. These metal scraps or cans occupy space at landfills. Even when the metal scraps or cans are burnt, they do not burn completely and very difficult to decay. These metal scraps or

cans contain left over and when it rains, water stays in the scraps and breed mosquitoes. The female anopheles mosquitoes evade the whole area with malaria which is the number one killer diseases in Ghana. These concerns are quite legitimate but how can we minimize our waste products especially metal scraps or can foods and drinks. It has become very necessary owing to the fact that the world is increasingly conscious of the environmental sustainability thereby precipitating innovations and strategies such material recovery in waste management (Dodo, 2012). The study therefore seeks to investigate into the effect of scrap metal usage on locally manufactured domestic machines in the Cape Coast Metropolis.

1.3 Purpose of the Study

The main objective of the study is to investigate into scrap metal usage on locally manufactured domestic machines in the Cape Coast Metropolis. However, specific objectives include to:

1. Investigate into scrap metal usage on locally manufactured domestic machines in the Cape Coast Metropolis.
2. Investigate the quantity of current waste generation and metal scrap usage in the Cape Coast Metropolis.
3. Assess the importance of recycling metal scraps in the Cape Coast metropolis.
4. Identify the main difficulties currently preventing people engaged in scrap metal collection and improve the current recycling system in order to increase the recycling rate, and at the same time reduce scrap metals dumped into landfills.

1.4 Research questions

The research is guided by the following questions:

1. What is the effect of scrap metal usage on locally manufactured domestic machines in the Cape Coast Metropolis?
2. What is the quantity and quality of current waste generation and metal scrap usage in the Cape Coast Metropolis?
3. What is the importance of recycling metal scraps in the Cape Coast metropolis?
4. What are the main difficulties currently preventing people engaged in metal scrap collection and improve the current recycling system in order to increase the recycling rate, and at the same time reduce the biodegradable waste going into landfills?

1.5 Significance of the Study

The study will provide useful information for the waste management or environmental protection agencies e.g. NGOs and metal scrap dealers in the Cape Coast Metropolis to help them assess the current trends regarding their business and how to protect the environment and improve environmental safety and protection. The study will also help locally manufactured domestic machines manufacturers in the Cape Coast Metropolis. It will also provide useful information for policy makers in the waste management and scrap dealers business.

1.6 Limitations of the Study

A study like this requires the researcher using many cities in Ghana as possible. However in this study only Cape Coast Metropolis was selected and used as a case study. Financial and time constraints were a limitation. Despite these limitations, the reliability of the study was not compromised.

1.7 Scope of the Study

The study covered the activities of metal scrap dealers and impacts of recycling metal waste in the Cape Coast Metropolis. The study also focused on scrap metal usage on locally manufactured domestic machines. However, it is assumed that Cape Coast Metropolis can provide information that can be used to generalize all big cities in Ghana. The study therefore is geographically limited in scope to the Cape Coast Metropolis in the Central Region of Ghana. The study is conceptually, empirically and theoretically limited in scope to the effects of scrap metal usage on locally manufactured machines.

1.8 Organization of the Study

This thesis consists of five Chapters. Chapter one deals with the background of the study, statement of the problem, purpose of the study and research questions. It also deals with the significance of the study, delimitation, limitations and organization of the study. Chapter two focuses on the review of related literature, whiles chapter three deals with the research methodology used in the study. Other aspects of chapter three describe the research design, the population sample and sample procedures, data gathering instruments and data collection procedures of the study and methods of data analysis. Chapter four describes the research findings and the discussion of the main findings and chapter five presents the summary of the findings, conclusions and recommendations and suggestions for further research.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

2.1 The quantity and quality of current waste generation and metal scrap usage

2.1.1 Theoretical framework of the study

The research has its bases on the theories of human development within the context of sustainable development, sustainable livelihoods and human development. The justifications for suitability of the research within these theoretical frameworks are separately analyzed in the following sub-sections: The Behavior Analysis Approach to Saving the Environment, the Behavior Analysis Approach to Recycling, and Human Development within the Context of Sustainable Development. According to Glasser, (2007) "Our fate and future is and always has been intertwined with nature, despite the widespread failure of most humans to act in a manner that reflects a deep understanding of this relationship." This failure is referred to as the "gap" between the possession of environmental knowledge and environmental awareness, and the display of pro-environmental behavior (Kollmuss et al, 2002; Glasser, 2007). Exploration of the gap is central to innumerable theoretical and experimental analyses attempting to account for the persistent and seemingly senseless destruction of the environment resulting from human behavior. Because of its emphasis on the contextual controlling variables that contribute to the emergence of behavior, the field of behavior analysis is uniquely aligned to contribute to this body of work. Although behavior analysis has historically focused on single-subject interventions, a strong line of environmentally focused group-design research has emerged.

2.1.2 The Behavior Analysis Approach to Saving the Environment

Behavior analysts began confronting the challenges of group contingencies in the context of environmentally relevant behaviors as early as the 1980s. According to Geller et al, (1982) the emergence of applied behavior analysis research focusing on a range of environmental issues including litter and waste reduction, energy conservation, transportation, and water conservation. A decade later, Dwyer et al, (1993) documented the frequency of the publication of articles that took intervention approaches to environmentally relevant behaviors from 1970 to 1990 and offered a review of articles published after 1980. Their analysis depicted a steady increase in articles published after 1970, peaking at 14 in 1977 and steadily declining to two or less per year by 1990. They attributed this decline in research interest to lack of support and challenges faced in creating the necessary changes within large systems and institutions including public policies and deeply ingrained cultural practices. The new millennium brought a renewed interest in environmental research among psychologists. In the May, 2000 issue of American Psychologist, a series of commentaries called for the continued involvement of psychologists.

Stuart Oskamp's "A Sustainable Future for Humanity? How can Psychology Help?" provided a detailed overview of the impacts of human behavior on the environment and made a powerful case for psychologists to join environmentalists in the "war against the common enemy of an uninhabitable Earth (2000)."The Fall 2010 issue of The Behavior Analyst contained commentary in the form of a special section titled "The Human Response to Climate Change: Ideas from Behavior Analysis". Multiple intervention-based research studies were presented along with opinion pieces suggesting future directions for behavioral environmental research. It was later criticized for failing to address the issue of consumerism as a main target of change (Grant, 2011).

In an update of the Dwyer et al, (2013) review, Lehman et al, (2004) noted a decline in the number of articles evaluating behavioral interventions and an increase in research attempting to correlate traits such as attitudes, affluence, income, and demographics of individuals to pro-environmental behavior. They reported that these articles outnumbered the intervention-based articles by seven to one. Trait-based analysis of pro-environmental behavior has indeed enjoyed a long and prolific history, dating back to the 1970s and continuing today (Maloney et al, (2005); Lounsbury et al,(2007). Although this form of research may prove beneficial in the development of incentive programs and other intervention-based research, Lehman and Geller point out that trait-focused research has no direct potential to result in interventions that incite behavior change.

In an attempt to reorient the focus of environmental research toward a more behavior analytic approach, Lehman et al, (2004) outlined six main areas where human behavior impacts the environment and reviewed research that has made attempts to create behavioral change in these areas. The areas include: 1) air pollution, 2) climate change, 3) water pollution and depletion, 4) solid waste, 5) soil erosion and contamination, and 6) loss of green space and species diversity. The various interventions and settings discussed included litter control in theatres, increasing the rate and efficiency of recycling, decreasing energy used in buildings, altering transportation related behavior, and altering consumers' purchasing behavior.

Lehman et al, (2004) divided intervention strategies into two categories, antecedent strategies and consequence strategies. The antecedent interventions included information and education, prompting, modelling, commitment, and environmental design. The consequence based strategies included rewards and feedback. Geller and Lehman also addressed the issues of choosing behavioral targets, maintaining pro-

environmental behavior, the differences between curtailment and efficiency behaviors, response maintenance, permanent interventions, and the challenge of dissemination.

Lehman et al, (2004) also pointed out that behavior analysts have focused their research on only three main targets, 1) increasing recycling-related behavior, 2) decreasing residential energy use, and 3) reducing environmental litter. They opined that these targets provide convenient research topics because they provide easy to measure outcomes. This is especially true of recycling research studies, where the product of the target behavior is tangible and can be weighed or counted. Lehman et al, (2004) challenged behavior analysts to test interventions that have the potential to make a greater impact. Increasing recycling is a worthy target, but more attention should be paid to the consumption and reuse aspects of consumerism versus the disposal of items at the end of the waste stream.

2.1.3 The Behavior Analysis Approach to Recycling metal scraps

According to the United States Environmental Protection Agency [U.S. EPA], 2010), given this powerful argument, one might wonder why yet another behavioral analytic recycling research project is necessary when there are obviously much larger issues at hand. The issue is that the book is not closed on research related to recycling behavior. The current recycling and material recovery rates in the United States leave significant room for improvement. In 2010, only 8.2% of plastics generated were recovered for recycling followed by 27.1% of glass, 35.1% of metals, and 62.5% of paper (United States Environmental Protection Agency [U.S. EPA], 2010). Additionally, every community, event, residence, and building is different and presents its own unique situational challenges, most of which are unaccounted for by the current research.

Until a comprehensive guide providing solutions tailored to as many conceivable settings as possible is complete and recovery rates for all recyclable material reach 100%, our work is not done. Given the relative ease with which this form of research can be conducted, it is surprising that such attempts have not yet been made.

Porter et al, (2005), published the only known review of behavioral research designed exclusively to increase recycling. They discussed research studies, 21 of which used antecedent interventions, 10 that used consequence based interventions, and one that used both. The antecedent interventions included written and oral prompts, commitment strategies, environmental alterations, goal setting, and both prompts and environmental alteration. Of these, goal setting was deemed to be the most promising technique for increasing recycling. Consequence based interventions included feedback, rewards, and penalty for failure to recycle. Of these, reward-based consequences proved to be the most effective interventions. It can be difficult to compare recycling research across settings for many reasons. Curbside recycling programs capitalize on a captive audience because participants do not generally vary from day to day. Because of this, public posting, feedback, commitment, goal-setting and individualized consequence-based contingencies are made more feasible. For the purposes of this recycling study, a more narrow review of literature is necessary. The following review outlines the relevant research studies that have been performed in settings similar to a college campus or academic building. Some of the research was included in the Porter et al, (2005) review and some was published afterward.

In 1980, Geller et al studied the effects of aesthetically pleasing bird shaped trash receptacles when compared to typical unobtrusive trashcans on litter rates in an indoor mall setting. Two of the typical trashcans were replaced with bird shaped receptacles. They found that litter rates decreased substantially in the areas surrounding the bird

receptacles and that much more litter was placed in the bird receptacles compared to the typical trash cans, concluding that aesthetic bins are more effective.

Jacobs et al, (1984) studied participation in curbside recycling programs when residents were presented with varying collection programs. The programs included various forms of media prompts and coinciding the trash and recycling collection days. The most effective intervention noted was the distribution of specialized containers to help residents easily sort recyclables, along with frequent prompting. Even though the curbside setting of this research study differs greatly from a college campus setting, the findings have interesting applications. Beyond providing prompts and educational materials, presenting residents with specialized containers had the most substantial and longest lasting effects on participation in the recycling program.

This suggests that creating an easy system for sorting recycling from trash may lead to increased recycling rates in an academic setting. Austin et al, (2003) explored the effects of the proximity of signage along with the proximity of recycling receptacles to waste receptacles on the percentage of items recycled in two separate academic departments. During baseline, in Department A, a waste bin and a recycling bin were positioned next to each other. In Department B, the waste and recycling bins were 4 m apart. All receptacles had small stickers affixed to them describing proper items for each. In a proximal prompt condition in Department A, large signs detailing what items were appropriate for each receptacle were positioned above the receptacles. In Department B, a prompt condition was initiated where signs were also posted above the receptacles, but the signs and receptacles remained 4 m apart. After several sessions, the receptacles and signs in Department B were moved next to each other to replicate the proximal prompt condition in Department A. In Department A, an increase from 51% in baseline to 84% during the proximal prompt condition was found. Department B also showed a rate of

51% during baseline increasing to 60% during the prompt condition and 66% during the proximal prompt condition. These findings suggest that positioning waste and recycling receptacles in close proximity and positioning signage directly above receptacles results in an increased rate of recycling.

Werner et al, (2008) studied effects of signage on the amount and cleanliness of polystyrene containers recycled in a school cafeteria setting. The cafeteria in this study had switched from washable dishware to polystyrene dishware and made many failed attempts at encouraging all students to recycle the new polystyrene containers. Problems included lack of recycled items placed into bins, as well as contamination of the bins by placement of food items, cans, and other non-polystyrene items. The original signage consisted of printed 8.5 x 11 inch signs placed about three feet above recycling bins. The signs bore messages simply encouraging students to recycle. By taking into account the participants' expectations about their physical environment and events, the authors created new signs that were noticeable, clearly written, and memorable. The new signs focused on three concepts: recycle, polystyrene, and how. Large signs were placed at eye level above each bin and were readable from across the room. Samples of used polystyrene items that had been sufficiently cleaned (food items scrapped off) were attached to the signs demonstrating what could be placed in the bins and how clean they should be. As a final prompt, the words "STOP. DO NOT CONTAMINATE" were placed around the rims of the recycling bins. The authors note that their intervention was not designed to convince people to recycle, only to give instructions on how to recycle. The dependent variable established in this study was the estimated amount of recycling in bins. After a four day baseline period, each of the four bins was approximately one quarter full of polystyrene. This small amount of polystyrene was contaminated and not

recyclable. During the intervention, however, 3.5 bins were full after every day. The polystyrene was scrapped and uncontaminated, all of it was recyclable.

Duffy et al, (2009) examined the effects of the presence of specialized waste receptacle lids on recycling compliance in public settings. They compared the number and accuracy of items deposited in waste stations with lidless bins to the items deposited in bins with specialized lids that reflected the shape of items meant to be deposited. The trash lid consisted of a traditional flap lid, the aluminium, glass, and plastic lid had a circular hole in it for bottles and cans, and the paper lid had 2-inch wide slits. Each station included three bins: trash, paper recycling, and aluminium/glass/plastic recycling. All were located in a 5-storey academic building. They found that the presence of the lids increased recycling compliance, measured by the number of items recycled rather than thrown in the trash bin, by 34%. Additionally, in the lidless condition, a majority of the recycling bins contained trash items that contaminated the recycling stream. The lid present condition only had one bin containing a trash item, meaning that accuracy of items recycled was increased by 95%.

Brothers et al, (2004), studied the effects of the placement of recycling receptacles on the amount of paper recycled in an office setting. Using an AB design, they first collected data on the percentage of paper recycled with the presence of a central recycling bin. During treatment, they provided desktop recycling bins. During the baseline condition, 28% of paper was recycled compared to 85% – 94% during treatment. Follow up assessments 1, 2, 3, and 7 months later showed a maintained rate of 84% - 98% paper recycled.

Ludwig et al, (2008) also studied the effects of the receptacle location on the number of recycling items placed in the receptacles. They used a multiple baseline ABA design in two different academic buildings. During baseline conditions, receptacles were

placed in a central location of the building. During the intervention, a receptacle was placed in each classroom. The researchers collected cans from both the recycling receptacles and all trash bins in the building. The dependent variable was calculated by dividing the number of cans in a recycling or trash bin divided by the total number of cans collected that day. In Building A, 40% of cans were placed in recycling receptacles during baseline, 63% during intervention, and 40% during withdrawal. In Building B, 35% of cans were placed in recycling receptacles during baseline, 65% of cans during treatment, and 29% of cans during withdrawal.

O'Conner et al, (2010) pointed out that the success of Ludwig et al, (1998) could have been due to the increase in recycling receptacles from the baseline to treatment condition rather than simply the placement of the recycling receptacles. In order to test this theory, they performed a replication with an added condition. Before recycling receptacles were placed in classrooms, they were first placed outside of each classroom in the hallway. The increased number of receptacles had no effect on the rate of recycling and the findings of Ludwig et al. (2008) were replicated – classroom placement is indeed the critical factor.

The research suggests a framework for the creation of effective recycling programs that consists of at least 5 components. First, aesthetically pleasing, specialized containers that make sorting simple resulted in a statistically significant improvement in recycling rates over baseline measures (Geller et al, 1980). Second, adding lids to all receptacles with openings that reflect the predicted shapes of intended waste streams resulted in a 30-54% improvement (Duffy et al, 2009). Third, the addition of signage that is simple, directional and avoids the use of general pro-recycling statements increased recycling rates significantly (Werner et al, 2008).

Fourth, placing both signage and all receptacles in close proximity resulted in a 47-71% improvement (Austin et al, 1993). Lastly, placement of recycling receptacles in all areas of consumption increased recycling rates by 20-40% (Brothers et al, 1994; Ludwig et al, 1998; O'Conner et al, 2010). This research project seeks to measure the effect of these elements when combined and implemented as a treatment package.

2.1.4 Human development within the context of sustainable development

According to Bell et al, (2003), sustainable development (SD) or sustainability has its significance embedded in intergenerational human development. The concept was borne from the notion of ensuring human development, while maintaining the planetary life support systems by the United Nations World Commission on Environment and Development (UNWCED) in 1987. The report of the commission titled our "common future" highlighted the significance of improving the living conditions of societies through the use of natural resources and ensuring that future generations will have similar opportunities to utilize these resources and enjoy the same benefits. The concept however professes upholding the three fundamental pillars (economic, environmental and social) regarding the issues of continuity and equity among current and future generations.

Considering the need for the south to catch up with developments already achieved by the north, SD served as a framework of strategies on which to base developmental policies for the achievement of such developments. The developments intended within this study are not only focused on the growth of the economies of nations of the south, but developments that will reflect improved living conditions of the people of the countries of the south. In order to achieve sustainable human development

aspirations as enshrined in SD and get African countries from the bottom of the UNHDI, the growth of African economies should be targeted towards improving the standards of living of its people. The exploration contained in this study is conceived to be within the notion of human development through improved livelihoods. The study aims to provide information that will be useful for the enhancement of policies that will improve opportunities for the people to earn better incomes for their livelihoods and eventually improve their standards of living (UNWCED, 1987).

The research is within the framework of SD with the justification of the need to investigate if the economic benefit of scrap metal collection is adequate to provide the social needs of improved conditions of living for poor people. Improve standards of living is considered here as the main focus of human development, which is also the central theme of SD. Therefore, activities that renders environmental benefits while at the same time ensuring human development can be evaluated as a win-win scenario for the environment and socio-economic development of people. Furthermore, the question of investigating the quality of people's lives engaged in scrap metal collection and its continuity i.e. over intergenerational time scale, which is a significant issue of SD, justifies the theoretical basis of the study within the framework of SD (UNWCED, 1987).

2.1.5 Sustainable livelihoods

The significance of the theory of sustainable livelihood and its basis for this study is borne by the desire to empower the capacity of people to earn incomes that meets their current and future economic and social needs and minimizes their vulnerability to external stresses and shocks (Ashley et al, 2009). According to Arce (2003), the theory of livelihood is not only limited to income generation but also entails the social welfare

of people. It is therefore essential to put into context the social well-being of people into the concept of sustainable livelihood. The desire to enhance the sustainability of livelihoods for poor people in developing countries has attracted the attention of many international organizations (Toner et al, 2006). But according to Toner et al' (2006) citation of Bond et al, (2009), most of the approaches employed to enhance sustainable livelihoods failed because of their top down nature (Toner et al, 2006). It is very vital for any effective intervention in the enhancement of the sustainability of livelihoods to allow the beneficiaries to make the choice of the nature of the intervention (Toner et al, 2006).

Also, according to Farrington et al, (2009), sustainable livelihood approaches should include a central focus on people and a holistic approach. The central focus on people entails pro-poor strategies that include analyzing the dynamics of livelihoods, rendering support and allowing the total participation of beneficiaries. It should also entail bringing together the various policies and institutional settings that exist with the intent being to influence and harmonize the differing arrangements in furthering a pro-poor agenda (Farrington et al., 2009). The holistic approach involves eradication of the marginalization of poor people, understanding the complexity of the relationship of their influences, recognition of various institutional stakeholders, encouragement and promotion of a diversity of livelihood strategies adopted by people (Farrington et al., 2009).

A thrilling issue specifically with regards to informal activities such as scrap metal collection is how should livelihoods from this activity be made sustainable? Several issues can be brought into the focus of livelihoods for a meaningful discussion. These issues include the economic, social and institutional concepts of sustainability, and issues of intra and inter-generational equity. The economic sustainability of livelihoods based on scrap metal collection deals with the adequacy (or inadequacy) of the economic

benefits generated from the activity required to meet improved standards of living for those engaged in it as prescribed by the ILO conditions of decent work (ILO, n.d.). The quality of decent work described by ILO is one that ensures job security, reliability and social protection, while the incomes should be capable of lifting workers from poverty (Rogers, 2007). It is apparent that the purpose of poor people's engagement in scrap metal collection is to realize economic benefit that will lift them out of poverty. The failure of the income to meet improved standards of living can be regarded as an unsustainable livelihood activity. Furthermore, the continuity of the economic benefit should be seen in the long term perspective, specifically as long as individuals are engaged in the activity.

The social sustainability of livelihood with respect to SMCs entails issues such as social security of the job, and other social services relevant for improved standards of living for SMCs.

A livelihood activity that enables an individual to afford access to the above social facilities can be regarded as sustainable. Intra generational equity issues on sustainable livelihoods concerns equality in income distribution between the various stakeholders in the trade such as collectors, agents and entrepreneurs in the scrap metal collection for recycling trade. For the sustainability of the livelihoods of SMCs, inequality in the incomes of local agencies, SMCs and entrepreneurs should be minimized so as to avoid the possibility of the exploitation of one stakeholder by the other. The intergenerational sustainability should in the same sense ensure that future generations' opportunities of earning incomes from the scrap metal collection should not be disadvantaged by current generations.

The sustainability of livelihoods of people cannot be guaranteed if institutional capacity required to design and implement policies and regulations in the interest of the

people is lacking. According to Toner et al, (2006), the formulation and implementation of policies and regulations determines the level of benefits achieved in sustaining livelihoods.

2.2 The effect of scrap metal usage on locally manufactured domestic machines

2.2.1 An assessment of the Quality of metal products

The implementation of quality management systems such as ISO 9000, and ISO 9001 in industries have been beneficial at a greater extent despite its draw-backs observed by some companies. Heras and his group presented in their survey paper a summary of the benefits and effects of implementing quality management systems such as ISO 9000. It was observed that certified companies stand higher chances of increasing their productivity, profitability, product quality and competitiveness, increasing market share as well as increasing customer satisfaction. However, the effects include long installation periods, and uncertain time to achieve return on investment (Heras et al, 2001).

In spite of these, in production and manufacturing networks where metal mill plates is a critical enabling technology, the quality of welding is highly essential and cannot rely only on quality management systems as mentioned. Even though ISO 9001 has been considered as a stand-alone quality standard, in metal industry, there is the need for more robust quality requirements. Moreover, due to increasing applications of welded products in relation to customer demands as well as health, safety and environmental issues, welded metallic products are therefore required to demonstrate quality attributes such as reliability, efficiency and consumers safety in a wide range of applications. This

is evident in applications such as offshore structures where welded metallic products are made to withstand harsh environmental conditions (Royal Dutch Shell Plc., 2011). Regardless of the product, quality must be efficiently ensured, thus meeting sound quality requirements (Martikainen, 2007). However, these attributes of a welded metallic product cannot be built only in the final stages in welding operation since the act and process of welding itself is characterized as a "special process in that the final result may not be able to be verified by testing, thus the quality of the weld is manufactured into the product, not inspected" (Finnish Standard Association -SFS, 2005). For this reason, metallic products require being quality assured through quality control and quality management systems before, during and after manufacturing operations. Most research papers about metallic quality tend to focus on ways of achieving quality with respect to manufacturing processes and parameters, welding techniques, material types, welding consumables or a combination of either of them, and or monitoring of metallic product quality. However, very few papers have made mention of the needed requirements to achieving quality in metallic products.

Ratnayake presented five "Ps" of metallic manufacturing quality in his paper as suggested by Lincoln Electric Company. It was so that, in order to achieving quality in metallic products, requirement such as: process selection, preparation, procedure, pretesting and personnel must be considered (Ratnayake, 2013). Contributes made by other authors suggest that metallic product quality could be obtained if the design of the joint, electrode, technique, and the skill of the manufacturer are acknowledged (Cary et al, 2005). However, achieving the required quality in a metallic product cannot be fully obtained by following general hypothesis or emulating only quality management system guidelines or standards such as ISO 9000:2005. As manufactured metallic products are

bound to compete on both local and international markets, quality must be built in them right from the onset. It is therefore required that companies which operations chiefly depend on manufacturing of metallic products should comply with international quality standards in order to meet the expected quality in their metallic products.

2.2.2 The International Quality Standards of metallic products

The provision of metallic quality standards is to assure quality in metallic product as well as standardizing manufacturing operations globally to streamline international trade barriers. A metallic product can therefore be considered as "quality" if the product has been manufactured according to quality standard requirements laid down by technical experts such as the international organization for standardization technical committee (ISO/TC 44) (Finnish Standard Association -SFS, 2005).

The approved quality standard which outlines the quality requirements for fusion welding of metallic materials is the ISO 3834 and it consists of six parts such as:

Part 1: Criteria for the selection of the appropriate level of quality requirements

Part 2: Comprehensive quality requirements

Part 3: Standard quality requirements

Part 4: Elementary quality requirements

Part 5: Normative references to fulfil the requirement of ISO 3834-2, ISO 3834-3 or ISO 3834-4

Part 6: Guideline on implementing ISO 3834 As a result of the different levels in variations. In design, materials and fabrication processes in any product group, a specific part of ISO 3834 cannot be designated to particular types of products. Therefore, compliance with a higher level of quality requirement from the above parts of ISO 3834 accords a manufacturer the compliance at a lower level (ISO 3834-1). It is advantageous

to select a higher level of quality requirement from the list of ISO 3834 parts since it gives the opportunity to apply that quality requirement on a broader range of products. For example, complying with ISO 3834-2 (i.e. comprehensive quality requirement) for fusion welding of metallic materials both in workshops and at field installation sites gives an edge to demonstrate quality requirement for products which require compliance with ISO 3834-3 and ISO 3834-4 respectively (Finnish Standard Association -SFS, 2005).

The benefits of implementing ISO 3834 or in addition to ISO 9000 or ISO 9001 could be enormous and thus surpass the contributions quality standards such as ISO 9000 or ISO 9001 have brought to welding industries.

2.3 Empirical framework of the study

2.3.1 The importance of recycling metal scraps

According to United Nations Department of Economic and Social Affairs (UNDESA) (2005), at the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil in 1992, 178 governments agreed that more sustainable solid waste management was needed in both developed and developing nations. Chapter 21 of Agenda 21, the Rio Declaration on Environment and Development, outlines the environmentally sound management of solid wastes through the following hierarchy of program areas: 1) minimizing wastes; 2) maximizing environmentally sound waste reuse and recycling; 3) promoting environmentally sound waste disposal and treatment; and 4) extending waste service coverage (UNDESA, 2005).

According to Michelcic et al, (2003) “Sustainability is defined here as the design of human and industrial systems to ensure that humankind’s use of natural resources and cycles do not lead to diminished quality of life due either to losses in future economic

opportunities or to adverse impacts on social conditions, human health and the environment."

Eight years later, though not as specifically addressed in Agenda 21, sustainable management of solid waste is still a global concern, as exemplified by the United Nations Millennium Development Goals (MDG) that 191 member states support. The seventh MDG indirectly advocates for solid waste management (SWM) by aiming to ensure environmental sustainability into countries' policies and programs and reverse negative environmental impact. Proper SWM will likely result in relieving poverty, reducing child mortality, improving maternal health, and preventing disease, which are MDG goals one, four, five, and six, respectively (UNMDG, 2005). An organized and effective SWM plan will provide jobs that are clearly defined and necessary. Collecting, transporting, and treating garbage in an environmentally-sound manner will remove the very substance present in inhabitants' living and working spaces causing health problems and protect the soil and water resources people need for food production and drinking water.

A review of several international government organizations (IGOs) and one professional society demonstrates the effort put toward sustainable SWM at the global level. Many of these organizations have a primary mission of relieving poverty, improving drinking water sources, or dissolving corrupt governments, and have recognized the direct relation of these greater issues to SWM. Every organization researched embraces the importance of SWM planning through a major publication, whether it is in the form of a guidebook or training manual. The following paragraphs highlight each organization's involvement with respect to SWM and recycling.

United Nations Educational, Scientific, Cultural Organization (UNESCO), an IGO working "to contribute to peace and security by promoting collaboration among

nations through education, science and culture," documents a UNESCO also conducted an international meeting focused on creating new synergies for recycling information technology equipment. Lastly, it is noted that UNESCO advocates that MSW may be a useful, sustainable energy source for small-island, developing countries (UNESCO, 2005).

United Nations Environment Programme (UNEP) "promotes environmental understanding and increases public knowledge about environmental factors and problems of future generations." Through its International Environmental Technology Centre (IETC), the 3R Platform has been launched to provide the direction and tools necessary for developing countries in the Asia-Pacific Region to implement sustainable production and consumption (SPC) activities (UNEP-IETC, 2005). Two SPC projects already taking place incorporate ideas of the life-cycle approach and eco-towns, respectively, with both projects emphasizing material reuse and recycle. UNEP also collaborated with the International Solid Waste Association (ISWA) to produce a SWM planning booklet called (UNEP and ISWA, 2004).

The ISWA is an international, non-profit organization with a mission "to promote and develop professional solid waste management world-wide." Aside from the SWM planning booklet jointly produced with UNEP, ISWA also publishes two well-respected journals Waste Management World and Waste Management and Research. ISWA also cooperates with the World Health Organization (WHO) and UNEP to create and promote training, seminar, and workshop material on health care wastes and landfills, recycling, and hazardous wastes, respectively. ISWA has several 'working groups' that consist of experts striving to study in-depth specific MSW issues (e.g.; in 2004, such a group reported on various collection schemes utilized in nine different countries). Specifically

of interest to this research are the ISWA position papers on the Prevention and Recycling of Wastes and the Definitions of Waste Recycling and Recovery (ISWA, 2005).

While the WHO's goal is "the attainment by all peoples of the highest possible level of health," WHO specifically recognizes poor MSW management as a health problem. WHO has created eight informational booklets on waste topics such as solid waste and health, waste incineration and landfill, waste minimization, and hazardous waste (WHO, 2005). It is evident that WHO accounts for waste created by its efforts from its published book Safe Management of Waste from Health Care Activities with a chapter detailing minimization, recycling, and reuse of health care wastes (Prüss et al., 1999), and the investigation and support of recycling the plastic portion of syringes (WHO, 2005). The WHO also advocates tracking data about waste generation and fate (i.e., recycling, disposal, etc.), as well as how to perform a waste characterization study in its document Information Management for Municipal Solid Waste Management Services (WHO, 2005).

The European Commission holds responsibility for proposing legislation to Parliament and the Council, administering and implementing Community policies, enforcing Community law (jointly with the Court of Justice), and negotiating international agreements. European Union (EU) legislation requires SWM planning, and accordingly, the Commission has created a guidance booklet called preparing a Waste Management Plan: A methodological guidance note. In 1999, the Commission hosted the first EU conference on SWM planning with the aim to exchange the necessary information to encourage greater coverage of SWM plans throughout the EU. Five years later, an Integrated Waste Management & Life Cycle Assessment Workshop and Conference furthered more sustainable uses of resources, waste prevention and

recycling, which inadvertently minimizes environmental impacts associated with waste generation and resource use, while promoting economic growth and improved quality of life (Europa, 2005).

United Nations Human Settlements Programme (UN-HABITAT) has been "mandated by the UN General Assembly to promote socially and environmentally sustainable towns and cities with the goal of providing adequate shelter for all." Several case studies of UN-HABITAT projects illustrate such effort with respect to SWM specifically. One project in Sri Lanka utilizes micro-enterprises to promote solid waste management; the waste collection centre generates income with a percentage of profits from the resale of recyclable items funding community development projects (UNHABITAT, 2005a). In Afghanistan, a UN-HABITAT project aims to initiate a solid waste collection strategy, health and hygiene education, and a recycling and composting program (UN-HABITAT, 2005b). These project examples and others utilize the UNHABITAT's which considers the political/institutional, social/cultural, financial/economic, and technical aspects (Schübeler, 2006).

World Health Organization (WHO, 2005c) "In most developing countries, solid waste is disposed in open dumpsites with waste pickers. These inadequate solid waste management systems cause environmental and public health problems. Since the mid-1980s, WHO has been supporting countries to strengthen their national capacity in solid waste management."

The World Bank Group's mission is "to fight poverty and improve the living standards of people in the developing world" by providing loans, policy advice, technical assistance, and knowledge sharing services to low and middle income countries. An inter-agency solid waste collaborative working group formed in the 1990s to further strategic SWM planning (World Bank, 2005), and in 2003, was published which

supports this effort (Kobus, 2003). The Bank prefers to fund projects that include elements of strategic planning, social assessment, and public participation in SWM. The World Bank also promotes financially assessing the different SWM options through its "Waste Collection Planning Tool: Cost Analysis of Collection Options" (World Bank, 2005).

Although the aforementioned organizations are making incredible strides toward improving SWM, several account that their efforts are not enough. The European Commission comments that "today, almost 25 years after the adoption of the Framework Directive, the situation within the EU regarding waste management continues to be unsatisfactory" (Europa, 2005), which may largely be due to other, more immediate issues taking priority over SWM. Also, many of the organizations discussed above focus their efforts on developing countries, because it is in these countries where SWM requires the most attention. Developed countries are gaining proficiency at SWM at a much higher rate than developing countries due to the availability of financial and technological resources.

According to the United Nations Environment Programme (UNEP, 2001), Further investigation of SWM in developing countries is needed to ensure health and safety of all global citizens and to protect the environment from which all humans seek resources. Therefore, the overall goal of this research is to study recycling as one possible solution to the solid waste management problem of the developing world while embracing the ideal of sustainability. Known information on SWM in developing countries will be synthesized, and knowledge on the sustainability of SWM in developing countries will be further developed. The following four specific objectives are pursued in order to accomplish this goal:

1) Compile and present solid waste generation and recovery rates globally, including the composition of the waste stream.
2) Summarize previous recycling research both in the first and third world.
3) Analyze case studies on developing countries to identify barriers against or incentives toward recycling, which will justify the creation of key factors that influence sustainable SWM.
4) Relate the factors created in objective three to understand the collaborative nature required of sustainable SWM, and align the factors to social, environmental, and economic dimensions, which will make apparent any correlations between stakeholder involvement and sustainability.

"Solid waste is an inevitable by-product of human activities. In the past, this was not a major problem because almost everything was reused or recycled and whatever remained was taken care of by nature." -United Nations Environment Programme (UNEP, 2001).

2.3.2 Review of Recycling Research in Developed Countries

Aside from the analysis of individual and groups of countries' solid waste generation and recovery rates, an extensive amount of research about the underlying reasons contributing to such waste production and treatment has been performed by others. Efforts made in engineering, mathematics, social sciences, economics, and other fields contribute to behaviors that influence solid waste management as a whole by creating tools and models, analyzing policy, and understanding human tendencies, to name a few. The creation of analysis tools offers a more tangible method to understanding and predicting solid waste generation and recovery. Daskalopoulos et al. (2008) created a model that accurately estimates future solid waste (SW) generation using a correlation to gross domestic product; the model was tested with European Union

and United States of America SW data (Daskalopoulos et al, 2008). A more practical approach to solid waste management was introduced by Barlishen et al, (1995) through a prototype decision support system, as opposed to mathematical models, which combines knowledge-based systems with spreadsheet models to better support decision-making and planning of recycling and composting programs and facilities (Barlishen et al, 2005).

Much research aims to understand how policy can act as a catalyst to decrease waste generation and increase material recovery. In a study on policy that aims to minimize solid waste and divert it from landfills in the US, Taylor (2000) concluded the three main influential policy types are command-and-control, social psychological incentives, and economic incentives, and that the latter two function best at shaping positive attitudes and behavior about waste generation and disposal (Taylor, 2000). Shinkuma (2003) investigated the following three policies affecting the economics of material recycling in more developed countries: unit pricing with an advance disposal fee, a deposit-refund system, and a producer take-back requirement (Shinkuma, 2003).

Many efforts are put forth in the social sciences to understand waste recycling behavior with the utilization of Aizen's well-accepted theory of planned behavior which includes an assessment of attitudes, social norms, and behavioral control. McCarty et al, (1994) discussed how environmental values have no direct relationship with recycling behaviors, but that values have an influence on attitudes which then have a direct correlation to the behavior (McCarty et al, 1994). Following a national study of environmentalism among Americans, Steel (1996) found a correlation between attitude and self-reported behavior with respect to recycling, as well as females behaving more environmentally-responsible than males, especially among the elderly (Steel, 1996).

Chan (1998) concluded that more publicity messages promoting recycling should be utilized to influence behavior in a study of voluntary waste recycling in Hong Kong (a

developed part of China) to predict behavioral intention and actual behavior (Chan, 1998). Again, Werner et al, (1998) link attitudes with behavior by explaining how people persist at a perceived boring, mundane task like recycling by cognitively transforming the behavior as satisfactory and pleasurable (Werner et al, 1998). It may be easier to manage the linkages between attitudes and behavior with a small, homogenous population, and therefore, much research utilizes campus communities as sample populations. Kelly et al. (2005) examined the attitudes and behavior of campus members toward recycling at a New Zealand university, and noted a strong relationship between self-reported behavior and the following three attributes: attitudes toward recycling, campus occupation, and location of work on campus. Also offered with this study is an extensive overview of work by others on recycling attitudes and behavior of campus communities (Kelly et al., 2005). With the use of a structural equation model, Hartig et al. (2001) tested if restorative experiences in nature, such as hiking or camping, influence environmentally-responsible behavior, and found that for twenty-three percent of participants in a university student survey, this is true (Hartig et al., 2001). At Pennsylvania State University, Thapa (1999) challenged the connection between environmentalist attitudes and behavior as his study resulted in undergraduate students expressing sympathy for the state of the environment, but rarely acting on these concerns through environmentally responsible behavior aside from recycling (Thapa, 1999).

A research niche beyond understanding attitudes and behaviors towards recycling and municipal solid waste generation is that of finding relationships to factors influencing such behavior. Kishino et al. (1998) compared environmentally-responsible consumption and recycling behavior in Germany and Japan. German households are required to pay for waste collection and have higher recycling rates in general than Japanese households, (Kishino et al., 1999).As an elaboration of Kishino's research just

mentioned, Hanyu et al. (2000) link recycling behavior and consumption in a toilet paper case study in Japan. Two of the four major findings were 1) recycling behavior was not directly related to consumption patterns of recycled paper, but rather knowledge of the waste collection and payment system, and 2) most people do not realize that consuming recycled products is a major component of any material recycling (Hanyu et al., 2000).

Johnson et al. (2004) investigated the differences in environmental belief and behavior among various ethnicities. In the United States, African-Americans and foreign-born Latinos held fewer environmental beliefs than Caucasians, and the environmentalism of Asian-American and domestic-born Latinos were most similar to Caucasians, whereas African-Americans were least similar. Also, females, younger persons, and persons with liberal political orientation were consistently identified as predictors of environmental concern and behavior (Johnson et al., 2004).

In investigating self-reported recycling and waste reduction behavior, Ebreo et al, (2004) found that one's concern for the future directly related to recycling behavior, and that no correlation existed between one's behavior of recycling waste versus minimizing waste (Ebreo et al, 2004). Hornik et al. (1995) concluded that the following facilitators and incentives act as predictors for recycling: consumer knowledge, commitment to recycling, monetary rewards, social influence, and frequency of collection (Hornik et al., 1995). While investigating factors that influence solid waste generation in the south-eastern United States, Hockett et al. (1995) found that the per capita retail sales of eating establishments had the greatest effect on waste generation (Hockett et al., 1995). Meaning, the more citizens spent on eating out at restaurants, a greater amount of waste was generated, which most is likely due to people not eating all the food provided in a restaurant meal and the establishment having to throw away these leftovers. Medina (1997) found that the relationship between municipal solid waste generation and income

varies with respect to the developmental stage of a nation (Medina, 1997). As a country develops, its waste generation rate increases; whereas, a weak correlation exists between income and waste generation for middle and upper-income countries, and a decrease in waste generation is seen for the wealthiest countries (Medina, 1997).

In developed countries, curbside recycling programs are very prevalent, which offers yet another research niche for identifying factors that affect recycling. Owens et al. (2000) conducted a small-scale case study to correlate recycling efficiency (RE) of residents participating in a curbside recycling program in Georgia, United States. It was noted that residents either did not recycle at all (0% RE) or heavily recycled (75-100% RE), and that strong correlations were seen between RE and annual household income, home-ownership status, and level of education attained by the lead recycler (Owens et al., 2000). Also, access to curbside recycling programs showed nearly 50% participation rate as opposed to the 25% participation in community recycling center drop-off of material, and factors such as access, shopping behaviors, age, family size, and income acted as predictors of recycling behavior (Domina et al, 2002).

Noehammer et al, (1997) examined design variables of curbside recycling programs to assess the effects on participation rate, and found that no single set of design variables result in the ideal program, but rather a variety of combinations are successful and that costs, needs, and goals of the community should be factors highly considered (Noehammer et al, 1997). As demonstrated by the previous section, a large amount of research has been focused on developed countries' solid waste generation and recovery, as well as the linkages to behavior affecting these two parameters. With nearly 80% of the nations on the globe classified as 'developing' (CIA, 2004), similar investigations of the third world should heighten understanding of the SWM issues and point to solutions that embrace a more sustainable approach to SWM.

2.4 Factors Influencing Recycling Of Metal Scraps

2.4.1 Technological and Human Resources

Availability and effective use of technology or human workforce and the safety considerations of each were recurrent barriers and incentives to recycling to warrant Technological and Human Resources to be a factor influencing sustainable SWM. In many cases in developing countries, adequate funds are not available to implement technology that is reliable and appropriate. Even when a capital investment can be made for a piece of technical equipment, many times labourers are unskilled or funds are undependable to operate and maintain the equipment properly. Both instances pose health and safety hazards, and both were seen as barriers to recycling in China (Wang and Nie, 2001), Guyana (Závodská, 2003), Jamaica (Pendley, 2005), Sri Lanka (UNEP, 2001), and Vietnam (UNEP, 2001).

Many case studies advocate for the use of manual labour in place of technical machinery in developing countries, such as China, Guyana, Jamaica, Lebanon, and Turkey, whereas others simply wanted better technology, namely India, Indonesia, and the Philippines. The Laos and Mexico case studies demonstrated content with the mix of used collection vehicles and manual SW collection, respectively. In any case, with or without technological inputs, institutions must be in place to safeguard the health of the technicians and manual labourers.

2.4.2 Land Availability

Land attributes such as terrain, ownership, and development often times dictate the SWM options available to developing countries' and SWM administrators. This factor was seen as an incentive to recycling in every case where it acted as an influence to SWM. Poor terrain, widespread development (population density), and extensive

private ownership were cited as hindrances to landfill management of waste. Such constraints force municipalities to consider other SWM options such as recycling and incineration with or without energy recovery.

In Lebanon, the cost of land is very expensive due to much of it being privately owned, which is prohibitive to the SWM administrators obtaining it for landfills (Nuwayhid et al., 1996). Rugged terrain causes most Brazilians to live within 100 kilometres of the sea. "This coast-hugging pattern of human settlement has exerted an increasing pressure on available space to bury much of the 90,000 tonnes of SW that Brazilians generate every day" (Wells, 1994). Sri Lanka and Mauritius are two small island developing nations that face issues of high importation of goods and tourism resulting in increasing amounts SW without a management solution in place.

2.4.3 SWM Personnel Education

Although the SWM Personnel Education factor was only recognized by six of the twenty-two case studies, the lack of trained labourers and skilled professionals in SWM positions was a barrier to sustainable SWM in every case but one. Brazil is the one case study with SWM Personnel Education as an incentive due to Cempre's numerous programs and publications that assist decision-makers in stimulating recycling in a community as part of sustainable SWM (Wells, 1994).

2.4.4 The importance of Recycling Metal Scraps

2.4.5 Greenhouse Gas Emissions

Recycling offers an important environmental benefit in that these actions help to reduce the emission of greenhouse gases that may contribute to global climate change. Greenhouse gases, such as carbon dioxide, methane, nitrous oxide and

chlorofluorocarbons, trap heat in the lower atmosphere that would otherwise escape to the stratosphere. Both the manufacture and distribution of products and the disposal of associated solid waste in landfills can contribute to the emission of greenhouse gases. Recycling and composting help to reduce greenhouse gas emissions by: decreasing the energy needed to make products from raw material; reducing emissions from incinerators and landfills, which are major sources of methane gas emissions in the U.S.; and slowing the harvest of trees, thereby maintaining their carbon dioxide storage benefit.

2.4.6 Air and Water Pollution Emission Reduction

By decreasing the need to mine and process virgin materials from the earth, recycling can eliminate the pollution associated with material extraction and material processing which are the first two stages of a product's development. Mineral mining and processing pollute the air, land and water with toxic materials, such as ammonia, carbon dioxide, carbon monoxide, methane and sulphur dioxide. Recycling reduces, and in many cases eliminates, these pollutants. In addition, recycling keeps materials out of landfills where they can produce landfill gas and can introduce leachate into groundwater and surface waters.

2.4.7 Energy Savings

The manufacturing of products with recovered or recycled materials as feedstock instead of virgin materials uses significantly less energy. Energy is saved by reducing the need to extract and process raw materials so that new products can be manufactured. For example, by recycling one ton of plastics, the equivalent of 3.85 barrels of oil is saved. Less energy used means less burning of fossil fuels such as coal, oil and natural gas. Most of the energy used in industrial processes and in related transportation involves

burning fossil fuels. When these fuels are burned, pollutants such as sulphur dioxide, nitrogen oxide and carbon monoxide are released into the air.

2.4.8 Natural Resource Savings

By using recycled materials instead of trees, metal ores, minerals, oil and other raw materials taken or harvested from the earth, recycling-based manufacturing helps to conserve limited natural resources. Sound conservation practices help to reduce the need to expand logging and mining operations. Furthermore, it also can help to reduce the disturbance of areas which are home to a variety of endangered flora and fauna.

2.5 The main difficulties currently preventing people engaged in metal scrap collection

2.5.1 Lack of finances and Inadequate Recycle Plants

In a developing country framework, though solid waste management accounts for 20 to 50 percent of the municipal budget (Bartone 2000), the service is provided to only about 50 percent of the urban population; actual collection only accounts for around 60 to 70 percent of the refuse (Khawas 2003). For instance, Latin American countries were generating approximately 275,000 tons of solid waste per day in urban areas, necessitating a fleet of 30,000 trucks and 350,000 m of land a day to properly collect and dispose the waste (Chakrabarti et al 2003). The insufficiency of services results in the deterioration of the urban environment in the form of water, air, and land pollution; which not only poses risks to human health but to the environment as well (Medina 2002). Another impact of the increasing population is the creation of a vicious cycle of pollution. Rise in population is not met by equal increase in infrastructural facilities, which leads to increase in the filth and garbage.

As filth gets accumulated, less and less number of inhabitants are willing to pay for the retrieval services leading to loss of revenue to the municipality and further deterioration of the quality of services rendered (Zerboc 2003). The impact of deteriorating services are directly felt, as there is visible increase in waste being dumped right besides the human habitats, which causes tremendous risk to both environment and human health. The present situation is expected to deteriorate even more due to rapid unchecked urbanization and growth in human population (Zurbrugg, 2003).

2.5.2 Waste disposal

Lack of finances and infrastructure has multi-level impacts. Nowhere are these impacts more evident than in the case of waste disposal. In most of the developing countries the main disposal method for solid waste is open dumping, more often than not the dumping sites are very near to areas of human habitation (Medina 2002). Little care is given to the status of water table, water pollution and emission of hazardous and toxic gases. The disposal of hazardous, biomedical, or slaughterhouse wastes are rarely controlled and in very few cases certain sections of the dumping grounds are designated for slaughterhouse and biomedical wastes (Inanc et al. 2004). Illegal disposal of wastes in water bodies is a common practice that not only causes toxins to get dispersed in the environment (Hoornweg et al. 1999, Zurbrugg 2003) but also often ends up coagulating the water bodies and destroying the whole ecosystem of the area.

2.5.3 Lack of effective collection and transportation facilities

The infrastructural problems are not just confined to waste disposal. Frequently, developing countries lack facilities for proper handling, collection and transportation of the generated wastes. Inadequate planning and layout due to rapid urbanization causes

urban centres in the developing countries to be more congested and populated. Often the waste collection trucks cannot reach every part of the town, compelling the residents to throw their garbage in open dumping spaces near human settlement. Congestion of traffic makes transportation of waste more time consuming and as a result more expensive and less efficient (Zerboc 2003). Another problem associated with handling of waste relates to lack of "standardized containers" to store waste before being picked up causing the wastes to be infested by animals, pests or blown out in the street (Zerboc 2003, Zurbrugg 2003). For example, in many towns in India, there is no "standardized container" to store waste; old oil cans are used to store wastes, before dumping it into nearby small streams. Lack of proper transportation vehicles for waste also adds to the problem. For instance in Darjeeling, India, the municipality uses open tractor trailers to transport waste and often some portion of waste ends up on the road through which other vehicle pass. Most of the vehicles used for transporting wastes are often outdated, improper and non-functional. Zerboc (2003) points out that the vehicles used for transporting wastes in developing countries do not function efficiently and often break down, thus adding further to the problem.

2.5.4 Waste composition

One of the most significant differences between the waste generated in developed and developing nations is in terms of its composition. The wastes generated in developed countries are mainly inorganic in nature, whereas organic contents form a large portion of waste in developing countries (Hoornweg et al. 1999, Medina 2002, Zerboc 2003, and Zurbrugg 2003). In the developing country scenario, the proportion of organic contents in waste is almost three times higher than that in developed countries (Medina 2002, Zerboc 2003). Even though the volume of waste generated in developing countries is

much lower as compared to that in developed countries, the nature of waste is denser and has very high humidity content (Medina 2002). The nature and composition of waste is highly dependent on income and lifestyle of the population.

2.5.5 Health Problems

Serious public health problems arise due to uncollected solid waste and waste often leading to many infectious diseases including water borne diseases such as cholera and dysentery. Such incidence of diseases puts additional burden on the scanty health services available in resource poor developing countries. Insect and rodent vectors are attracted to the waste and one may recall that as many as 200,000 people had to flee after the outbreak of pneumonic plague in Surat in Western India (1994). The outbreak is attributed to the uncontrolled fermentation of wastes which created favourable conditions for the breeding and growth of rodents and insects that acted as vectors of diseases (Venkateshwaran 2006). A similar study by WHO (1995) observed in 1994 that 616960 cases of cholera resulting in 4389 deaths were reported in Angola, Malawi, Mozambique and Tanzania (UNCEA 1996) which can be linked to the fact that in Northern Africa as much as 20 to 80 per cent of urban solid wastes are dumped in open spaces (Chakrabarti et al, 2003). Contamination of ground water by disease causing organisms from water seeping through dumps is likely to include the viruses of hepatitis, poliomyelitis and gastroenteritis (Medina 2002); thus such water contamination may have long run health effects apart from dysentery and cholera.

The U.S. Public Health Service identified 22 human diseases that are linked to improper solid waste management (Hanks, 1967 in Hoornweg et al., 1993). The most immediate health threat due to solid waste in developing countries is to the waste workers, rag pickers and scavengers. Waste workers and rag pickers in developing

countries are seldom protected from direct contact and injury. The co-disposal of hazardous and medical wastes with municipal wastes poses serious health threat. Exhaust fumes from waste collection vehicles, dust stemming from disposal practices, and open burning of waste also contribute to overall health problems (Hoornweg et al 1993)

The magnitude of the health problems due to solid waste in case of developing countries are particularly alarming where the proper collection and disposal of solid waste is impeded by paucity of funds and technological capacity. The areas, which are not serviced, are left with clogged sewers and litters which create serious health problems for the resident population (Khawas 2003). Crowding and unsanitary conditions are important amplifiers of the transmission of infectious diseases. Many infectious diseases thrive where there is a lack of water, and inadequate drainage, sanitation and solid waste removal (Mcmichael 2002).

2.5.6 Environmental Problems

The impacts of solid waste on environment is immense, from release of harmful green house gases (GHGs) to contamination of ground water, improper solid waste can wreck havoc on the environmental health. The most serious environmental problem in terms of solid wastes is the emission of GHGs. According to Thorneloe et al (2002), the waste management sector represents 4% of total anthropogenic GHG emissions and landfills contribute the largest anthropogenic source of methane, contributing 90% to the total GHGs release from the waste sector in the United States. Methane is a primary constituent of landfill gas (LFG) and a potent greenhouse gas when released to the atmosphere. LFG is created as a natural by-product of decomposing organic matter, such as food and paper disposed of in these landfills and it consists of about 35-50 % methane (CH4) and 35-50 % carbon dioxide (CO_2), and a trace amount of non-methane organic

compounds. Each day millions of tons of municipal solid waste are disposed of in sanitary landfills and dump sites around the world. According to Methane to Markets Partnership, website (2004); "globally, landfills are the third largest anthropogenic (human influenced) emission source, accounting for about 13 percent of global methane emissions or over 223 million metric tons of carbon equivalent" (MMTCE). The status of solid waste management system thus considerably influences the problems associated with climate change and global warming.

CHAPTER THREE

METHODOLOGY

3.0 INTRODUCTION

In this chapter an attempt is made to look at the research design, target population, data sources, sampling procedures (size and technique), data collection instruments, fieldwork / data collection and data analysis.

3.1 Profile of the Study Area

Cape Coast Municipality lies within latitudes 5^0.07' to 5^0.20' north of the Equator and between longitudes 1°.11' to 1°.41' west of the Greenwich Meridian. Cape Coast Municipal is bounded on the East by Abura-Asebu-Kwamankese District, West by Komenda-Edina-Eguafo-Abrem (K. E. E. A.) District and South by the Gulf of Guinea and North by Twifo Heman Lower Denkyria District. The Capital of the Municipality is Cape Coast. Other major communities include Efutu, Koforidua, Abura, Pedu and Nyinasin. Cape Coast Municipality covers a total land area of approximately 122 sq. km. (12,200 ha.). The total population is 118,106 out of which 57,365 are males and 60,741 females. Farmers and fishermen as well as those into agricultural-related activities form about 60% of the population (Statistical Services, 2000 population census). Active agricultural population is approximately 28,000. Commercial farmers are approximately 0.3% and peasant farmers approximately 99.7% (GSS, 2000).

3.2 Research Design

The research design includes an outline of what the researcher is writing on including their operational implications to the final analysis of the data. This study adopted the case study strategy. Among the various research designs, case studies are frequently regarded as using both quantitative and qualitative research and a combination

of both approaches (Bryman, 2004). The researcher used both primary and secondary data sources, which were considered to be more appropriate for this study. These types of research were used because it eventually enables the researcher to make judgement about the effectiveness, relevance or desirability of the programme. Research methods can be placed into two basic categories: quantitative or qualitative. Qualitative research gathers information that is not in numerical form. Qualitative data is typically descriptive data and as such is harder to analyze than quantitative data. Qualitative research is useful for studies at the individual level, and to find out, in depth, the ways in which people think or feel (e.g. case studies). The researcher used both qualitative and quantitative research approach for the study.

3.3 Population

The population for the study was four hundred and fifty seven (457). The population of the study is made up of scrap dealers and locally manufactured domestic machines manufacturers in the Cape Coast Metropolis.

3.4 Sampling Procedure and Sample Size

The ever increasing need for a representative statistical sample in empirical research has created the demand for an effective method of determining sample size. To address the existing gap, Krejcie et al (1970) came up with a table for determining sample size for a given population for easy reference. According to the Krejcie et al (1970), table of determining sample size, a population of 457 requires a sample size of 210.

A purposive and random sampling method was used to select a sample size of two hundred and ten (210) respondents for the study (100 domestic machine

manufacturers and 110 scrap dealers). Thus, random sampling and purposive sampling methods was adopted for the study. Manufacturers of domestic machines were purposively selected for the study. These calibres of people were approached and questioned with well-designed questionnaires.

Stratified random sampling technique was used to select scrap dealers. This method of sampling therefore ensured that all participants have an equal opportunity of being selected for the study. From a review of literature, a survey questionnaire was developed to collect data for the study. Data was collected through the use of a written questionnaire hand-delivered to participants' in their workshops.

3.5 Data Collection Instrument

The main instrument that was used to collect information for the study was questionnaire. The questionnaire was structured to consist of closed ended and open ended type of questions in order to elicit feedback from respondents. Other information that would be collected includes demographic information and most of the questions were centred on waste management and the importance of using metal scraps to manufacture domestic machines. Likert scale was used to design the questionnaire, as categories mainly ranging from strongly disagree, disagree, neutral, agree to strongly agree. Care was taken in order not to be biased but to come out with objective interpretations of what was questioned. The questionnaire consisted of four sections. Section 1 contains the demographic information of the respondents including the respondent's age, gender, and educational qualification. Section 2 investigated into the effect of scrap metal usage on locally manufactured domestic machines in the Cape Coast Metropolis. Section 3 assessed the quantity and quality of current waste generation and metal scrap usage in the Cape Coast Metropolis. Section 4 evaluated the importance

of recycling metal scraps in the Cape Coast metropolis and section 5 identified the main difficulties currently preventing people engaged in metal scrap collection and improves the current recycling system in order to increase the recycling rate, and at the same time reduce the biodegradable waste going into landfills. The questionnaires focused on the main objectives of the study.

3.6 Pilot Testing

The pilot instrument was given to 10 people (5 domestic machine manufacturers and 5 scrap metal dealers) to answer to correct errors which could take the form of repetition of questions and typological mistakes and the avoidance of double questions.

3.7 Data Collection Procedure

Primary data was collected through a field survey domestic machine manufacturer and scrap metal dealers in the Cape Coast metropolis. Data was collected through the use of a designed questionnaire administered to participants in their workshops. Questionnaires were filled out by participants and the researcher had to go for the questionnaires on the same day.

3.8 Data Analysis

The raw data obtained from a study is useless unless it is transformed into information for the purpose of decision making (Emery et al, 2003). The data analysis involved reducing the raw data into a manageable size, developing summaries and applying statistical inferences. Consequently, the following steps were taken to analyze the data for the study. The data was edited to detect and correct, possible errors and omissions that were likely to occur, to ensure consistency across respondents.

The data was then coded to enable the respondents to be grouped into limited number of categories. The SPSS version 18 was used to analyse data. Data was presented in tabular form, graphical and narrative forms. In analyzing the data, descriptive statistical tools such as bar graph and pie charts was used.

CHAPTER FOUR

ANALYSIS OF RESULTS / FINDINGS

4.1 Analysis of domestic machine manufacturer's questionnaires.

The researcher used 100 domestic machine manufacturers for the study. All 100 questionnaires sent out for primary data were retrieved. Therefore, the analysis of the study was based on 100% response rate.

4.1.2 Biographic Information of the Respondents.

This section contains Tables and charts that depict the biographic information of the respondents including the respondent's gender, age, working experience and educational qualifications.

Table 4.1 depicts that 100% of the respondents were males. This means that the domestic machine manufacturing business is a male dominated industry. This contradicts with the study conducted by Steel (1996), following a national study of environmentalism among Americans, Steel (1996) found a correlation between attitude and self-reported behavior with respect to recycling, as well as females behaving more environmentally-responsible than males, especially among the elderly. This may be due to the fact that males in Ghana dominate this sector for economic reasons. Data gathered on the gender of domestic machines manufacturers is presented in Table 4.1.

Table 4. 1: Gender of Respondents.

Gender of the Respondents	Frequency	Percent
Male	100	100.0
Total	100	100

Source: field work, (2016)

Table 4.2 shows that 32% of the respondents were between the age ranges 56-65 years, 21% were between the age range 36-45 years and 46-55 years respectively whiles 6% were more than 66 years. Data collected on the ages of domestic machines manufacturers is presented in Table 4.2.

Table 4. 2: Age range of the Respondents.

Age range of the Respondents	Frequency	Percent
26-35 years	20	20.0
36-45 years	21	21.0
46-55 years	21	21.0
56-65 years	32	32.0
more than 66 years	6	6.0
Total	100	100.0

Source: field work, (2016)

Figure 4.1 indicates that 69% of the respondents were BECE/MSLC qualification holders, 22% were holding NVTI certificates whiles 9% were SSSCE/WASSCE certificates holders.

Figure 4.1 shows the highest educational qualification of the respondents.

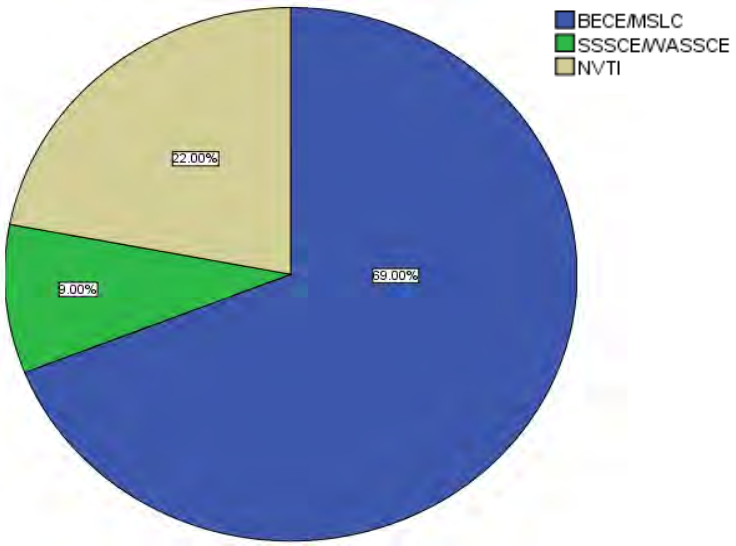

Figure 4. 1: Educational Qualification of Respondents.

Source: field work, (2016)

Table 4.3 shows that 32% of the respondents confirmed that they had 16-20 years and more than 20 years working experience respectively whiles 18% had 5-10 years and 11-15 years working experience. Information gathered on the experience of domestic machines manufacturers is presented in Table 4.3.

Table 4. 3: Working experience of Respondents.

Working experience of Respondents	Frequency	Percent
5-10 years	18	18.0
11-15 years	18	18.0
16-20 years	32	32.0
Above 20 years	32	32.0
Total	100	100.0

Source: field work, (2016)

Table 4.4 depicts that 41% of the respondents affirmed that they manufacture flour mill, 29% manufactured cassava grater, 19% manufactured vegetable mill whiles 11% manufactured corn mill. Data gathered on the type of domestic machines manufactured is presented in Table 4.4.

Table 4. 4: Type of domestic machine manufactured?

What type of domestic machine do you produce?	Frequency	Percent
Vegetable mill	19	19.0
Cassava Grater	29	29.0
Flour Mill	41	41.0
Corn Mill	11	11.0
Total	100	100.0

Source: field work, (2016).

This means that the respondents are using waste resources to create valuable machines which promote human sustainability. According to the United Nations Environment Programme (UNEP, 2001), Further investigation of SWM in developing countries is needed to ensure health and safety of all global citizens and to protect the environment from which all humans seek resources. Therefore, the overall goal of this research is to study recycling as one possible solution to the solid waste management problem of the developing world while embracing the idea of sustainability.

4.2 The effects of scrap metal usage on locally manufactured domestic machines in the Cape Coast Metropolis.

Figure 4.2 indicates that 66% of the respondents affirmed that state of the materials used in fabricating domestic machines were new whiles 34% used scrapped materials. The manufacturing of products with recovered or recycled materials as feedstock instead of virgin materials uses significantly less energy. Energy is saved by reducing the need to extract and process raw materials so that new products can be manufactured.

Figure 4.2 depicts the state of materials used in manufacturing domestic machines.

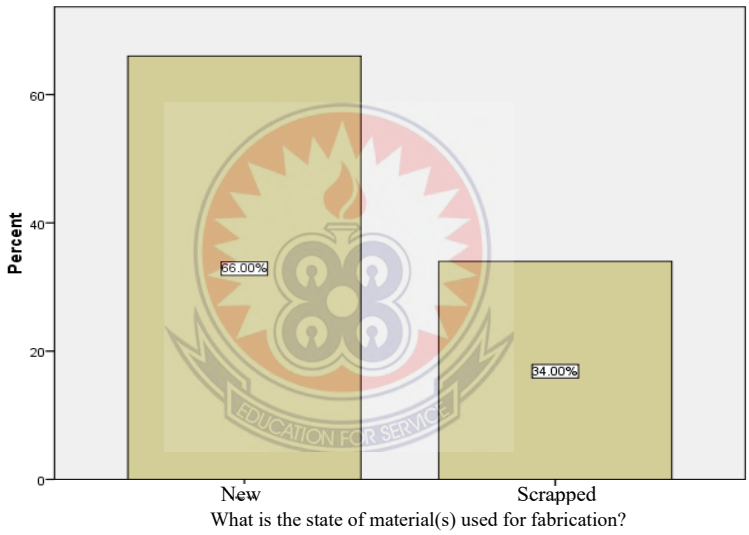

Figure 4. 2: The state of material used for fabrication of domestic machines.
Source: field work, (2016).

For a locally made domestic machine to be manufactured 34 percent scrap metal is used and 66 percent of new metal is used in the Cape Coast Metropolis.

4.2.1 Type of equipment used in the manufacture of domestic machines.

Table 4.5 shows the type of equipment used in the manufacturing of domestic machines. Table 4.5 shows that 91% of the respondents affirmed that they used pillar drilling machines to manufacture domestic machines whiles 9% do not use pillar drilling machines. Moreover, 91% also said that they used lathe machines to manufacture

domestic machines whiles 9% do not use lathe machines. The study further affirmed that 88% of the respondents used milling machines to manufacture domestic machines whiles 12% do not use milling machines. To add more, 57% of the respondents do not use spot welding machines whiles 43% used spot welding machines to manufacture domestic machines. The study results show that 92% of the respondents affirmed that they use arc welding machines to manufacture domestic machines whiles 8% do not use arc welding machines. Moreover, 91% of the respondents used gas welding machines to manufacture domestic machines whiles 9% do not use gas machines. The study finding indicate that 91% of the respondents used pedestal grinder to manufacture domestic machines whiles 9% do not use pedestal grinder. The study revealed that 53% of the respondents do not use shaping machines to manufacture domestic machines whiles 47% used shaping machines. The study shows that 84% of the respondents do not use sensitive drilling machines whiles 16% used sensitive drilling machines to manufacture domestic machines. The study depicts that 80% of the respondents do not use power hacksaw to fabricate domestic machines whiles 20% used power hacksaw. The study concluded that the use of these tools to domestic machines improved the quality of the machines. The quality of decent work described by ILO is one that ensures job security, reliability and social protection, while the incomes should be capable of lifting workers from poverty (Rogers, 2007). The baseline machines that can be used are, arc welding machine, lathe machine, pedestal grinder, angle grinding machine etc.

Data gathered on the type of machines used in the manufacture of domestic machines is presented in Table 4.5.

Table 4. 5: Type of equipment used in the manufacture of domestic machines.

Type of equipment used in the manufacture of domestic machines	Yes Freq. (%)	No Freq. (%)	Total Freq. (%)
Pillar Drilling Machine	91 (91%)	9 (%)	100 (100%)
Lathe Machine	91 (91%)	9 (9%)	100 (100%)
Milling Machine	88 (88%)	12 (12%)	100 (100%)
Spot Welding Machine	43 (43%)	57 (57%)	100 (100%)
Arc Welding Machine	92 (92%)	8 (8%)	100 (100%)
Gas Welding Machine	91 (91%)	9 (9%)	100 (100%)
Pedestal Grinder	91 (91%)	9 (9%)	100 (100%)
Shaping Machine	47 (47%)	53 (53%)	100 (100%)
Sensitive Drilling Machine	16 (16%)	84 (84%)	100 (100%)
Power Hacksaw Machine	20 (20%)	80 (80%)	100 (100%)

Source: field work, (2016).

4.2.2 The type of metal used to manufacture domestic machines.

Table 4.6 shows that 37% of the respondents affirmed that they used mild steel to fabricate domestic machines, 32% used galvanised plate, 26% used stainless steel whiles 5% used cast iron. The study concluded that quality of the metals used to fabricate the domestic machines met the quality management systems. The implementation of quality management systems such as ISO 9000, and ISO 9001 in industries have been beneficial at a greater extent despite its draw-backs observed by some companies. In spite of these,

in production and manufacturing networks where metal mill plates is a critical enabling technology, the quality of welding is highly essential and cannot rely only on quality management systems as mentioned. Data gathered on the use of different metals in the fabricating of domestic machines as shown in Table 4.6.

Table 4. 6: The type of metal used to manufacture domestic machines.

Type of metal used for the fabrication of domestic machines	Frequency	Percent
Mild Steel	37	37.0
Galvanized Plate	32	32.0
Stainless Steel	26	26.0
Cast Iron	5	5.0
Total	100	100.0

Source: field work, (2016).

4.2.3 Respondents rating of the cost of material used to manufacture domestic Machines.

Table 4.7 shows that majority 58% of the respondents affirmed that the cost of mild steel is high, 35% said that the cost of mild steel is average whiles 7% said that the cost of mild steel is low. The study shows that 97% of the respondents affirmed that the cost of galvanized is high whiles 3% said that the cost of galvanized is average. The study depicts that 97% of the respondents said that the cost of stainless steel is high whiles 3% affirmed that the cost of stainless is average. The study indicates that 96% of the respondents said that the cost of cast iron is high whiles 4% said that the cost of cast iron is average. The provision of metallic quality standards is to assure quality in metallic

product as well as standardizing manufacturing operations globally to streamline international trade barriers. A metallic product can therefore be considered as "quality" if the product has been manufactured according to quality standard requirements laid down by technical experts such as the international organization for standardization technical committee (ISO/TC 44) (Finnish Standard Association -SFS, 2005).

Data gathered on the rating of materials used in manufacturing of domestic machines are presented in Table 4.7. Data gathered on the rating of material used in the manufacture of domestic machines are presented in Table 4.7.

Table 4. 7: Respondents rating of the cost of material used to manufacture domestic machines.

Material	**1**	**2**	**3**	**4**	**5**	**Total**
	Freq. (%)	**Freq. (%)**	**Freq. (%)**	**Freq. (%)**	**Freq. (%)**	**Freq. (%)**
Mild Steel	-	7 (7%)	35 (35%)	40 (40%)	18 (18%)	100 (100%)
Galvanized	-	-	3 (3%)	74 (74%)	23 (23%)	100 (100%)
Stainless steel	-	-	3 (3%)	41 (41%)	56 (56%)	100 (100%)
Cast Iron	-	-	4 (4%)	75 (75%)	21 (21%	100 (100%)

Key: 5 = very high; 4 = High: 3 = Average; 2 = Low; 1 = Very low)

Source: field work, (2016).

4.3 The availability of materials used to manufacture domestic machines.

The study shows that 100% of the respondents affirmed that mild steel is available for the production of domestic machines. Moreover, 100% of the respondents said that galvanized steel is available for the fabrication of domestic machines. Furthermore, 100% of the respondents confirmed that stainless steel is available. To add more, 100% of the respondents said that cast iron is available for production of domestic machines. The study concluded that the availability of the manufacturing metals ensured the sustainability of human development.

A lot of information was gathered on the availability of materials for the manufacture of domestic machines. This is presented in Table 4.8.

Table 4. 8: The availability of materials used to manufacture domestic machines.

The availability of materials used to manufacture domestic machines	1 Freq. (%)	2 Freq. (%)	3 Freq. (%)	Total Freq. (%)
Mild steel	82 (82%)	18 (18%)	-	100 (100%)
Galvanized steel	93 (93%)	7 (7%)	-	100 (100%)
Stainless steel	6 (6%)	94 (94%)	-	100 (100%)
Cast iron	91 (91%)	9 (9%)	-	100 (100%)

Key: 1- Easily available, 2 - Somehow available, 3 - Not available

Source: field work, (2016).

4.3.1 The Respondents rating of the safety of the material used to manufacture domestic machines.

The study depicts that 100% of the respondents agreed that cast iron is safe to work with during the manufacturing of domestic machines. The study shows that 100% affirmed that it is safe to use galvanised steel to manufacture domestic machines. Moreover, 100% of the respondents affirmed that mild steel is safe when used to manufacture domestic machines. The study revealed that 100% of the respondents said that working with stainless steel is safe when fabricating domestic machines. The study concluded that is safe to work with recycled metals to fabricate domestic machines. Data gathered on the rating of safety of material used in the manufactured of domestic machines are presented in Table 4.9.

Table 4. 9: The Respondents rating of the safety of the material used to manufacture domestic machines.

The safety of the material used to manufacture domestic machines	1 Freq. (%)	2 Freq. (%)	3 Freq. (%)	4 Freq. (%)	5 Freq. (%)	Total Freq. (%)
Mild Steel	-	-	-	23 (23%)	77 (77%)	100 (100%)
Galvanized steel	-	-	-	56 (56%)	44 (44%)	100 (100%)
Stainless steel	-	-	-	22 (22%)	78 (78%)	100 (100%)
Cast iron	-	-	-	82 (82%)	18 (18%)	100 (100%)

(Key: 5 = Very safe; 4 = Safe: 3 = Average; 2 = not safe; 1 = not safe at all)

Source: field work, (2016).

4.3.2 The type of bearings used to manufacture domestic machines.

Table 4.10 indicates that 41% of the respondents affirmed that they used ball bearing to manufacture domestic machines, 27% of the respondents used Plummer bearings, 22% used machined brass bushes whiles 10% half brass bushes. Data gathered on the type of bearings used in the manufacture of domestic machines are presented in Table 4.10

Table 4. 10: The type of bearings used to manufacture domestic machines.

What type of bearings do you use?	Frequency	Percent
Ball Bearing	41	41.0
Machined Brass bushes	22	22.0
Plummer Bearings	27	27.0
Half Brass Bushes	10	10.0
Total	100	100.0

Source: field work, (2016).

The study results hold that majority 94% affirmed that they used grinding plates in manufacturing of domestic machines whiles 6% do not use grinding plates. The study holds that the use of grinding plate improved the quality of decent work. Information gathered on the use of grinding plates is presented in Table 4.11.

Table 4. 11: Do you use grinding plates in your machine?

Do you use grinding plates in your machine?	Frequency	Percent
Yes	94	94.0
No	6	6.0
Total	100	100.0

Source: field work, (2016).

Table 4.12 depicts that 98% of the respondents affirmed that they used locally manufactured grinding plate to fabricate domestic machines whiles 2% used foreign/imported grinding plate. The study concluded that most of respondents used locally manufactured grinding plate from scrap metal collection. Data gathered on the type of grinding plates used in the manufacture of domestic machines is presented in Table 4.12.

Table 4. 12: What kind of grinding plate / disc do you use for your machine?

Kind of grinding plate/ disc used for the machine	**Frequency**	**Percent**
Locally manufactured	98	98.0
Foreign / imported	2	2.0
Total	100	100.0

Source: field work, (2016).

4.4 Challenges faced by domestic machine manufacturers

Table 4.13 indicates that 74% of the respondents said that the challenge they face is that they spent more time on cleaning the surfaces of scrapped metals before they use them to manufacture domestic machines, 17% had difficulty in preparing of scrap surfaces whiles 9% had difficulty in welding of scrap metals due to corrosion. The preparing of scrap metal surfaces before using them is very essential to improve the quality of the domestic machines. Ratnayake presented five “Ps” of metallic manufacturing quality in his paper as suggested by Lincoln Electric Company. It was so that, in order to achieving quality in metallic products, requirement such as: process selection, preparation, procedure, pretesting and personnel must be considered (Ratnayake, 2013). Information gathered on the challenges faced by manufacturers of domestic machines is presented in Table 4.13.

Table 4. 13: Challenges faced by domestic machine manufacturers

Challenges faced by domestic machine manufacturers	Frequency	Percent
Difficulty in preparing of scrap surfaces	17	17.0
Difficulty in welding of scrap metals due to corrosion	9	9.0
More time spent on cleaning of surfaces	74	74.0
Total	100	100.0

Source: field work, (2016).

4.5 Analysis of metal scraps dealer's questionnaires

The researcher used 110 scrap metals dealers for the study. Out of 110 questionnaires sent out for primary data, 110 questionnaires were retrieved. Therefore, the analysis of study was based on 100% response rate.

4.5.1 The quantity and quality of current waste generation and metal scrap recycling behaviour in the Cape Coast Metropolis.

Table 4.14 indicates that 86.4% of the respondents confirmed that they are involved in metal scrap collection to make money for a living, 9.1% of the respondents are involved in metal scrap collection for a hobby whiles 4.5% engaged in metal scrap collection because their friends are involved. Chan (1998) concluded that more publicity messages promoting recycling should be utilized to influence behavior in a study of voluntary waste recycling in Hong Kong (a developed part of China) to predict behavioral intention and actual behavior (Chan, 1998). Again, Werner and Makela (1998) link attitudes with

behavior by explaining how people persist at a perceived boring, mundane task like recycling by cognitively transforming the behavior as satisfactory and pleasurable (Werner et al, 1998). Information gathered on some of the reasons why people engage in scrap metal collection is presented in Table 4.14.

Table 4. 14: Why are you involved in metal scrap collection?

Why are you involved in metal scrap collection?	Frequency	Percent
To make money for a living	95	86.4
I do it for a hobby	10	9.1
Because my friends do it	5	4.5
Total	110	100.0

Source: field work, (2016).

Table 4.15 shows that 50% of the respondents confirmed that they earn below GH¢ 500 from the sale of metal scraps and usage, 33.6% earn between GH¢ 500-1000, whiles 16.4% earn between GH¢1000-15000. In a developing country framework, though solid waste management accounts for 20 to 50 percent of the municipal budget (Bartone 2000), the service is provided to only about 50 per cent of the urban population; actual collection only accounts for around 60 to 70 per cent of the refuse per annum. (Khawas 2003).

Data gathered on the net income of metal scrap dealers and their usage is presented in Table 4.15.

Table 4. 15: The net income from metal scrap sale and usage

The net income from metal scrap sale and usage	Frequency	Percent
Below GH¢500	55	50.0
GH¢ 500 -1000	37	33.6
GH¢ 1000 -1500	18	16.4
Total	110	100.0

Source: field work, (2016).

Table 4.16 shows that 96.4% of the respondents confirmed that they sell their metal scrap collection per kg for less than GH¢50.00 whiles 3.6% sell theirs for GH¢100-200 per kg. The quality of decent work described by ILO is one that ensures job security, reliability and social protection, while the incomes should be capable of lifting workers from poverty (Rogers, 2007). It is apparent that the purpose of poor people's engagement in scrap metal collection is to realize economic benefit that will lift them out of poverty. The failure of the income to meet improved standards of living can be regarded as an unsustainable livelihood activity. Furthermore, the continuity of the economic benefit should be seen in the long term perspective, specifically as long as individuals are engaged in the activity. Information gathered on how much metal scrap per kilogram is sold is presented in Table 4.16.

Table 4. 16: How much do you sell your metal scrap collection per kg?

How much do you sell your metal scrap collection per kg?	Frequency	Percent
Below GH¢ 50	106	96.4
GH¢ 100-200	4	3.6
Total	110	100.0

Source: field work, (2016).

Table 4.17 indicates that 90.9% of the respondents affirmed that they are engaged in other income generating activities whiles 9.1% were not engaged in any other income generating activities. Information gathered on other income generating activities of metal scrap dealers is presented in Table 4.17.

Table 4. 17: Are you engaged in any other income generating activity?

Are you engaged in any other income generating activity?	Frequency	Percent
YES	100	90.9
NO	10	9.1
Total	110	100.0

Source: field work, (2016).

Table 4.18 indicates that majority 91.8% of the respondents affirmed that the funds generated from scrap scavenging is not adequate to support their household / dependants whiles 8.2% said that the money is adequate to support their household. Recycling offers an important environmental benefit in that these actions help to reduce the emission of greenhouse gases that may contribute to global climate change. Greenhouse gases, such as carbon dioxide, methane, nitrous oxide and chlorofluorocarbons, trap heat in the lower atmosphere that would otherwise escape to the stratosphere. Both the manufacture and distribution of products and the disposal of associated solid waste in landfills can contribute to the emission of greenhouse gases. Recycling and composting help to reduce greenhouse gas emissions by: decreasing the energy needed to make products from raw material; reducing emissions from incinerators and landfills, which are major sources of methane gas emissions in the

U.S.; and slowing the harvest of trees, thereby maintaining their carbon dioxide storage benefit. Information gathered on funds generated from metal scrap scavenging is presented in Table 4.18**.**

Table 4. 18: Information on funds generated from scrap scavenging

Are the funds generated from scrap scavenging adequate to support your household/dependants?	**Frequency**	**Percent**
YES	9	8.2
NO	101	91.8
Total	110	100.0

Source: field work, (2016).

4.5.2 The importance of recycling metal scraps in the Cape Coast metropolis?

The study indicates that majority 88.2% of the respondents affirmed that they do not recycle metal scraps whiles 11.8% of the respondents said that they recycle metal scraps. The study concluded that wastes are properly managed. This agrees with Hanks, 1967 in Hoornweg et al., (1993), the U.S. Public Health Service identified 22 human diseases that are linked to improper solid waste management. The most immediate health threat due to solid waste in developing countries is to the waste workers, rag pickers and scavengers. Waste workers and rag pickers in developing countries are seldom protected from direct contact and injury. The co-disposal of hazardous and medical wastes with municipal wastes poses serious health threat. Data gathered on recycle of metal scraps is presented in Table 4.19.

Table 4. 19: Do you recycle metal scraps?

Do you recycle metal scraps?	Frequency	Percent
Yes	13	11.8
No	97	88.2
Total	110	100.0

Source: field work, (2016).

Table 4.20 depicts that 100% of the respondents affirmed that it is important to recycle. The study concluded that it is very important to recycle because it saves energy. The manufacturing of products with recovered or recycled materials as feedstock instead of virgin materials uses significantly less energy. Energy is saved by reducing the need to extract and process raw materials so that new products can be manufactured. For example, by recycling one ton of plastics, the equivalent of 3.85 barrels of oil is saved. Less energy used means less burning of fossil fuels such as coal, oil and natural gas. Most of the energy used in industrial processes and in related transportation involves burning fossil fuels. When these fuels are burned, pollutants such as sulphur dioxide, nitrogen oxide and carbon monoxide are released into the air.

Recycling offers an important environmental benefit in that these actions help to reduce the emission of greenhouse gases that may contribute to global climate change. Greenhouse gases, such as carbon dioxide, methane, nitrous oxide and chlorofluorocarbons, trap heat in the lower atmosphere that would otherwise escape to the stratosphere. Both the manufacture and distribution of products and the disposal of associated solid waste in landfills can contribute to the emission of greenhouse gases. Recycling and composting help to reduce greenhouse gas emissions by: decreasing the energy needed to make products from raw material; reducing emissions from incinerators and landfills, which are major sources of methane gas emissions in the U.S.; and slowing

the harvest of trees, thereby maintaining their carbon dioxide storage benefit. Information gathered on the need for recycling of metal scraps is presented in Table 4.20.

Table 4. 20: Do you think it is important to recycle?

Do you think it is important to recycle?	Frequency	Percent
Yes	110	100.0
Total	110	100

Source: field work, (2016).

Table 4.21 shows that 79.1% of the respondents said that in case of recycling metal scraps, they use homemade recycling facility to recycle whiles 20.9% used commercial recycling plant. By decreasing the need to mine and process virgin materials from the earth, recycling can eliminate the pollution associated with material extraction and material processing which are the first two stages of a product's development. Mineral mining and processing pollute the air, land and water with toxic materials, such as ammonia, carbon dioxide, carbon monoxide, methane and sulphur dioxide. Recycling reduces, and in many cases eliminates, these pollutants. In addition, recycling keeps materials out of landfills where they can produce landfill gas and can introduce leachate into groundwater and surface waters.

By using recycled materials instead of metal ores, minerals, oil and other raw materials taken or harvested from the earth, recycling-based manufacturing helps to conserve limited natural resources. Sound conservation practices help to reduce the need to expand logging and mining operations. Furthermore, it also can help to reduce the disturbance of areas which are home to a variety of endangered flora and fauna. Information on the type of recycling methods employed is presented in Table 4.21.

Table 4. 21: How do you recycle?

How do you recycle?	Frequency	Percent
Commercial Recycling plant	23	20.9
Homemade recycling facility	87	79.1
Total	110	100.0

Source: field work, (2016).

Table 4.22 indicates that 100% of the respondents revealed that they paid for recycled materials. According to Rogers, (2007), it is apparent that the purpose of poor people's engagement in scrap metal collection is to realize economic benefit that will lift them out of poverty. The failure of the income to meet improved standards of living can be regarded as an unsustainable livelihood activity. Furthermore, the continuity of the economic benefit should be seen in the long term perspective, specifically as long as individuals are engaged in the activity. Information gathered on wages received from recycling of metal scraps is presented in Table 4.22.

Table 4. 22: Do you get paid for recycled materials?

Do you get paid for recycled materials?	Frequency	Percent
Yes	110	100.0
Total	110	100

Source: field work, (2016).

4.6 The main difficulties currently preventing people engaged in metal scrap collection and recycling of scraps

Table 4.23 shows the main difficulties currently preventing people engaged in metal scrap collection and recycling of scraps.

Table 4.23 shows that 91.8% of the respondents confirmed that the main difficulties preventing people engaged in metal scrap collection and recycling of scraps is non availability of recycling plants, 6.4% of the respondents said that recycling is too expensive whiles 1.8% revealed that there is no time to recycle. The infrastructural problems are not just confined to waste disposal. Frequently, developing countries lack facilities for proper handling, collection and transportation of the generated wastes. Information gathered on the difficulties people encounter in metal scrap scavenging and recycling is presented in Table 4.23.

Table 4. 23: The main difficulties preventing people engaged in metal scrap collection and recycling of scraps

The main difficulties preventing people engaged in metal scrap collection and recycling of scraps	Frequency	Percent
Non availability of recycling plants	101	91.8
No time to recycle	2	1.8
Recycling is too expensive	7	6.4
Total	110	100.0

Source: field work, (2016).

CHAPTER FIVE

DISCUSSION OF RESULTS

5.0 INTRODUCTION

This chapter discusses the findings of the study based on research questions used for the research.

5.1 The effects of scrap metal usage on locally manufactured domestic machines in the Cape Coast Metropolis.

The study shows that 41% of the respondents affirmed that they manufacture flour mill, 29% manufactured cassava grater, 19% manufactured vegetable mill whiles 11% manufactured corn mill. This means that the respondents are using waste resources to create valuable machines which promote human sustainability. According to the United Nations Environment Programme (UNEP, 2001), Further investigation of SWM in developing countries is needed to ensure health and safety of all global citizens and to protect the environment from which all humans seek resources. Therefore, the overall goal of this research is to study recycling as one possible solution to the solid waste management problem of the developing world while embracing the ideal of sustainability.

5.1.1 The state of material used for fabrication of domestic machines

The study indicates that 66% of the respondents affirmed that state of the materials used in fabricating domestic machines were new whiles 34% used scrapped materials. The manufacturing of products with recovered or recycled materials as feedstock instead of virgin materials uses significantly less energy. Energy is saved by reducing the need to extract and process raw materials so that new products can be

manufactured. For example, by recycling one ton of plastics, the equivalent of 3.85 barrels of oil is saved. Less energy used means less burning of fossil fuels such as coal, oil and natural gas. Most of the energy used in industrial processes and in related transportation involves burning fossil fuels. When these fuels are burned, pollutants such as sulphur dioxide, nitrogen oxide and carbon monoxide are released into the air.

5.1.2 Type of equipment use in the manufacture of domestic machines

The study shows that 91% of the respondents affirmed that they used pillar drilling machines to manufacture domestic machines whiles 9% do not use pillar drilling machines. Moreover, 91% also said that they used lathe machines to manufacture domestic machines whiles 9% do not use lathe machines. The study further affirmed that 88% of the respondents used milling machines to manufacture domestic machines whiles 12% do not use milling machines. To add more, 57% of the respondents do not use spot welding machines whiles 43% used spot welding machines to manufacture domestic machines. The study results show that 92% of the respondents affirmed that they use arc welding machines to manufacture domestic machines whiles 8% do not use arc welding machines. Moreover, 91% of the respondents used gas welding machines to manufacture domestic machines whiles 9% do not use gas machines. The study finding indicate that 91% of the respondents used pedestal grinder to manufacture domestic machines whiles 9% do not use pedestal grinder. The study revealed that 53% of the respondents do not use shaping machines to manufacture domestic machines whiles 47% used shaping machines. The study shows that 84% of the respondents do not use sensitive drilling machines whiles 16% used sensitive drilling machines to manufacture domestic machines. The study depicts that 80% of the respondents do not use power hacksaw to fabricate domestic machines whiles 20% used power hack saw. The study concluded that

the use of these tools to domestic machines improved the quality of the machines. The quality of decent work described by ILO is one that ensures job security, reliability and social protection, while the incomes should be capable of lifting workers from poverty (Rogers, 2007). It is apparent that the purpose of poor people's engagement in scrap metal collection is to realize economic benefit that will lift them out of poverty. The failure of the income to meet improved standards of living can be regarded as an unsustainable livelihood activity. Furthermore, the continuity of the economic benefit should be seen in the long term perspective, specifically as long as individuals are engaged in the activity.

Much research aims to understand how policy can act as a catalyst to decrease waste generation and increase material recovery. In a study on policy that aims to minimize solid waste and divert it from landfills in the US, Taylor (2000) concluded the three main influential policy types are command-and-control, social psychological incentives, and economic incentives, and that the latter two function best at shaping positive attitudes and behavior about waste generation and disposal (Taylor, 2000). Shinkuma (2003) investigated the following three policies affecting the economics of material recycling in more developed countries: unit pricing with an advance disposal fee, a deposit-refund system, and a producer take-back requirement (Shinkuma, 2003).

5.1.3 The type of metal used to manufacture domestic machines

The study results show that 37% of the respondents affirmed that they used mild steel to fabricate domestic machines, 32% used galvanised plate, 26% used stainless steel whiles 5% used cast iron. The study concluded that quality of the metals used to fabricate the domestic machines met the quality management systems. The implementation of quality management systems such as ISO 9000, and ISO 9001 in

industries have been beneficial at a greater extent despite its draw-backs observed by some companies. Heras and his group presented in their survey paper a summary of the benefits and effects of implementing quality management systems such as ISO 9000. It was observed that certified companies stand higher chances of increasing their productivity, profitability, product quality and competitiveness, increasing market share as well as increasing customer satisfaction. However, the effects include long installation periods, and uncertain time to achieve return on investment (Heras et al, 2001).

In spite of these, in production and manufacturing networks where metal mill plates is a critical enabling technology, the quality of welding is highly essential and cannot rely only on quality management systems as mentioned. Even though ISO 9001 has been considered as a stand-alone quality standard, in metal industry, there is the need for more robust quality requirements. Moreover, due to increasing applications of welded products in relation to customer demands as well as health, safety and environmental issues, welded metallic products are therefore required to demonstrate quality attributes such as reliability, efficiency and consumers safety in a wide range of applications. This is evident in applications such as offshore structures where welded metallic products are made to withstand harsh environmental conditions (Royal Dutch Shell Plc., 2011).

Regardless of the product, quality must be efficiently ensured, thus meeting sound quality requirements (Martikainen, 2007). However, these attributes of a welded metallic product cannot be built only in the final stages in welding operation since the act and process of welding itself is characterized as a "special process in that the final result may not be able to be verified by testing, thus the quality of the weld is manufactured into the product, not inspected" (Finnish Standard Association -SFS, 2005). For this reason, metallic products require being quality assured through quality control and quality management systems before, during and after manufacturing operations. Most

research papers about metallic quality tend to focus on ways of achieving quality with respect to manufacturing processes and parameters, welding techniques, material types, welding consumables or a combination of either of them, and or monitoring of metallic product quality. However, very few papers have made mention of the needed requirements to achieving quality in metallic products.

5.1.4 Respondents rating of the cost material used to manufacture domestic machines

The study revealed that majority 58% of the respondents affirmed that the cost of mild steel is high, 35% said that the cost of mild steel is average whiles 7% said that the cost of mild steel is low. The study shows that 97% of the respondents affirmed that the cost of galvanized is high whiles 3% said that the cost of galvanized is average. The study depicts that 97% of the respondents said that the cost of stainless steel is high whiles 3% affirmed that the cost of stainless is average. The study indicates that 96% of the respondents said that the cost of cast iron is high whiles 4% said that the cost of cast iron is average. The provision of metallic quality standards is to assure quality in metallic product as well as standardizing manufacturing operations globally to streamline international trade barriers. A metallic product can therefore be considered as “quality” if the product has been manufactured according to quality standard requirements laid down by technical experts such as the international organization for standardization technical committee (ISO/TC 44) (Finnish Standard Association -SFS, 2005).

The approved quality standard which outlines the quality requirements for fusion welding of metallic materials is the ISO 3834 and it consists of six parts such as:

Part 1: Criteria for the selection of the appropriate level of quality requirements

Part 2: Comprehensive quality requirements

Part 3: Standard quality requirements

Part 4: Elementary quality requirements

Part 5: Normative references to fulfil the requirement of ISO 3834-2, ISO 3834-3 or ISO 3834-4

Part 6: Guideline on implementing ISO 3834 As a result of the different levels in variations. In design, materials and fabrication processes in any product group, a specific part of ISO 3834 cannot be designated to particular types of products. Therefore, compliance with a higher level of quality requirement from the above parts of ISO 3834 accords a manufacturer the compliance at a lower level (ISO 3834-1). It is advantageous to select a higher level of quality requirement from the list of ISO 3834 parts since it gives the opportunity to apply that quality requirement on a broader range of products. For example, complying with ISO 3834-2 (i.e. comprehensive quality requirement) for fusion welding of metallic materials both in workshops and at field installation sites gives an edge to demonstrate quality requirement for products which require compliance with ISO 3834-3 and ISO 3834-4 respectively (Finnish Standard Association -SFS, 2005).

The benefits of implementing ISO 3834 or in addition to ISO 9000 or ISO 9001 could be enormous and thus surpass the contributions quality standards such as ISO 9000 or ISO 9001 have brought to welding industries.

5.1.5 The availability of materials used to manufacture domestic machines

The study result indicates that, 100% of the respondents affirmed that mild steel is available for the production of domestic machines. Moreover, 100% of the respondents said that galvanized steel is available for the fabrication of domestic machines. Furthermore, 100% of the respondents confirmed that stainless steel is available. To add more, 100% of the respondents said that cast iron is available for production of domestic machines. The study concluded that the availability of the manufacturing metals ensured the sustainability of human development. According to Bell & Morse, (2003), sustainable development (SD) or sustainability has its significance embedded in intergenerational human development. The concept was borne from the notion of ensuring human development, while maintaining the planetary life support systems by the United Nations World Commission on Environment and Development in 1987.

5.1.6 The Respondents rating of the safety of the material used to manufacture domestic machines

The study depicts that 100% of the respondents agreed that cast iron is safe to work with during the manufacturing of domestic machines. The study shows that 100% affirmed that it is safe to use galvanised steel to manufacture domestic machines. Moreover, 100% of the respondents affirmed that mild steel is safe when used to manufacture domestic machines. The study revealed that 100% of the respondents said that working with stainless steel is safe when fabricating domestic machines. Availability and effective use of technology or human workforce and the safety considerations of each were recurrent barriers and incentives to recycling to warrant Technological and Human Resources to be a factor influencing sustainable SWM. In many cases in developing countries,

adequate funds are not available to implement technology that is reliable and appropriate. Even when a capital investment can be made for a piece of technical equipment, many times labourers are unskilled or funds are undependable to operate and maintain the equipment properly.

Many case studies advocate for the use of manual labour in place of technical machinery in developing countries, such as China, Guyana, Jamaica, Lebanon, and Turkey, whereas others simply wanted better technology, namely India, Indonesia, and the Philippines. The Laos and Mexico case studies demonstrated content with the mix of used collection vehicles and manual SW collection, respectively. In any case, with or without technological inputs, institutions must be in place to safeguard the health of the technicians and manual labourers.

5.1.7 The use of grinding plates to manufacture domestic machines

The study results hold that majority 94% affirmed that they used grinding plates in manufacturing of domestic machines whiles 6% do not use grinding plates. The study holds that the use of grinding plate improved the quality of decent work. The quality of decent work described by ILO is one that ensures job security, reliability and social protection, while the incomes should be capable of lifting workers from poverty (Rogers, 2007). It is apparent that the purpose of poor people's engagement in scrap metal collection is to realize economic benefit that will lift them out of poverty. The failure of the income to meet improved standards of living can be regarded as an unsustainable livelihood activity. Furthermore, the continuity of the economic benefit should be seen in the long term perspective, specifically as long as individuals are engaged in the activity.

5.1.8 The kind of grinding plate / disc used to fabricate domestic machine

The study finding depicts that 98% of the respondents affirmed that they used locally manufactured grinding plate to fabricate domestic machines whiles 2% used foreign/imported grinding plate. The study concluded that most of respondents used locally manufactured grinding plate from scrap metal collection. A thrilling issue specifically with regards to informal activities such as scrap metal collection is how should livelihoods from this activity be made sustainable? Several issues can be brought into the focus of livelihoods for a meaningful discussion. These issues include the economic, social and institutional concepts of sustainability, and issues of intra and inter-generational equity. The economic sustainability of livelihoods based on scrap metal collection deals with the adequacy (or inadequacy) of the economic benefits generated from the activity required to meet improved standards of living for those engaged in it as prescribed by the ILO conditions of decent work (ILO, n.d.).

5.2 Challenges faced by domestic machine manufacturers

The study indicates that 74% of the respondents said that the challenge they face is that they spent more time on cleaning the surfaces of scrapped metals before they use them to manufacture domestic machines, 17% had difficulty in preparing of scrap surfaces whiles 9% had difficulty in welding of scrap metals due to corrosion. The preparing of scrap metal surfaces before using them is very essential to improve the quality of the domestic machines. Ratnayake presented five “Ps” of metallic manufacturing quality in his paper as suggested by Lincoln Electric Company. It was so that, in order to achieving quality in metallic products, requirement such as: process selection, preparation, procedure, pretesting and personnel must be considered (Ratnayake, 2013). Contributes made by other authors suggest that metallic product

quality could be obtained if the design of the joint, electrode, technique, and the skill of the manufacturer are acknowledged (Cary and Helzer, 2005). However, achieving the required quality in a metallic product cannot be fully obtained by following general hypothesis or emulating only quality management system guidelines or standards such as ISO 9000:2005. As manufactured metallic products are bound to compete on both local and international markets, quality must be built in them right from the onset. It is therefore required that companies which operations chiefly depend on manufacturing of metallic products should comply with international quality standards in order to meet the expected quality in their metallic products.

5.3 Discussion of metal scraps dealer's questionnaires results

5.3.1 The quantity and quality of current waste generation and metal scrap Recycling behaviour in the Cape Coast Metropolis

The study indicates that 86.4% of the respondents confirmed that they are involved in metal scrap collection to make money for a living, 9.1% of the respondents are involved in metal scrap collection for a hobby whiles 4.5% engaged in metal scrap collection because their friends are involved. Chan (1998) concluded that more publicity messages promoting recycling should be utilized to influence behavior in a study of voluntary waste recycling in Hong Kong (a developed part of China) to predict behavioral intention and actual behavior (Chan, 1998). Again, Werner and Makela (1998) link attitudes with behavior by explaining how people persist at a perceived boring, mundane task like recycling by cognitively transforming the behavior as satisfactory and pleasurable (Werner and Makela, 1998).

5.3.2 The net income from metal scrap sale and usage

The study shows that 50% of the respondents confirmed that they earn below GH¢ 500.00 from the sale of metal scraps and usage, 33.6% earn between GHC 500-1000, whiles 16.4% earn between GH¢ 1000-15000.In a developing country framework, though solid waste management accounts for 20 to 50 per cent of the municipal budget (Bartone 2000), the service is provided to only about 50 per cent of the urban population; actual collection only accounts for around 60 to 70 per cent of the refuse (Khawas 2003).

Moreover, majority 96.4% of the respondents confirmed that they sell their metal scrap collection per kg for less than GH¢ 50.00 whiles 3.6% sell theirs for GH¢ 100-200 per kg. The quality of decent work described by ILO is one that ensures job security, reliability and social protection, while the incomes should be capable of lifting workers from poverty (Rogers, 2007). It is apparent that the purpose of poor people's engagement in scrap metal collection is to realize economic benefit that will lift them out of poverty. The failure of the income to meet improved standards of living can be regarded as an unsustainable livelihood activity. Furthermore, the continuity of the economic benefit should be seen in the long term perspective, specifically as long as individuals are engaged in the activity.

The results further indicates that majority 91.8% of the respondents affirmed that the funds generated from scrap scavenging is not adequate to support their household/dependants whiles 8.2% said that the money is adequate to support their household. Recycling offers an important environmental benefit in that these actions help to reduce the emission of greenhouse gases that may contribute to global climate change. Greenhouse gases, such as carbon dioxide, methane, nitrous oxide and chlorofluorocarbons, trap heat in the lower atmosphere that would otherwise escape to the stratosphere. Both the manufacture and distribution of products and the disposal of

associated solid waste in landfills can contribute to the emission of greenhouse gases. Recycling and composting help to reduce greenhouse gas emissions by: decreasing the energy needed to make products from raw material; reducing emissions from incinerators and landfills, which are major sources of methane gas emissions in the U.S.; and slowing the harvest of trees, thereby maintaining their carbon dioxide storage benefit.

5.4 The importance of recycling metal scraps in the Cape Coast metropolis?

The study indicates that majority 88.2% of the respondents affirmed that they do not recycle metal scraps whiles 11.8% of the respondents said that they recycle metal scraps. The study concluded that wastes are properly managed. This agrees with Hanks, 1967 in Hoornweg et al., (1993), the U.S. Public Health Service identified 22 human diseases that are linked to improper solid waste management. The most immediate health threat due to solid waste in developing countries is to the waste workers, rag pickers and scavengers. Waste workers and rag pickers in developing countries are seldom protected from direct contact and injury. The co-disposal of hazardous and medical wastes with municipal wastes poses serious health threat.

Majority 100% of the respondents affirmed that it is important to recycle. The study concluded that it is very important to recycle because it saves energy. The manufacturing of products with recovered or recycled materials as feedstock instead of virgin materials uses significantly less energy. Energy is saved by reducing the need to extract and process raw materials so that new products can be manufactured. For example, by recycling one ton of plastics, the equivalent of 3.85 barrels of oil is saved. Less energy used means less burning of fossil fuels such as coal, oil and natural gas. Most of the energy used in industrial processes and in related transportation involves

burning fossil fuels. When these fuels are burned, pollutants such as sulphur dioxide, nitrogen oxide and carbon monoxide are released into the air.

Recycling offers an important environmental benefit in that these actions help to reduce the emission of greenhouse gases that may contribute to global climate change. Greenhouse gases, such as carbon dioxide, methane, nitrous oxide and chlorofluorocarbons, trap heat in the lower atmosphere that would otherwise escape to the stratosphere. Both the manufacture and distribution of products and the disposal of associated solid waste in landfills can contribute to the emission of greenhouse gases. Recycling and composting help to reduce greenhouse gas emissions by: decreasing the energy needed to make products from raw material; reducing emissions from incinerators and landfills, which are major sources of methane gas emissions in the U.S.; and slowing the harvest of trees, thereby maintaining their carbon dioxide storage benefit.

The study shows that 79.1% of the respondents said that in case of recycling metal scraps, they use homemade recycling facility to recycle whiles 20.9% used commercial recycling plant. By decreasing the need to mine and process virgin materials from the earth, recycling can eliminate the pollution associated with material extraction and material processing which are the first two stages of a product's development. Mineral mining and processing pollute the air, land and water with toxic materials, such as ammonia, carbon dioxide, carbon monoxide, methane and sulphur dioxide. Recycling reduces, and in many cases eliminates, these pollutants. In addition, recycling keeps materials out of landfills where they can produce methane gas and can introduce leachate into groundwater and surface waters.

By using recycled materials instead of trees, metal ores, minerals, oil and other raw materials taken or harvested from the earth, recycling-based manufacturing helps to conserve limited natural resources. Sound conservation practices help to reduce the need to expand logging and mining operations. Furthermore, it also can help to reduce the disturbance of areas which are home to a variety of endangered flora and fauna.

The study indicates that 100% of the respondents revealed that they paid for recycled materials. According to Rogers, (2007), It is apparent that the purpose of poor people's engagement in scrap metal collection is to realize economic benefit that will lift them out of poverty. The failure of the income to meet improved standards of living can be regarded as an unsustainable livelihood activity. Furthermore, the continuity of the economic benefit should be seen in the long term perspective, specifically as long as individuals are engaged in the activity.

5.5 The main difficulties currently preventing people engaged in metal scrap collection and recycling of scraps

The study shows that 91.8% of the respondents confirmed that the main difficulties preventing people engaged in metal scrap collection and recycling of scraps is non availability of large and medium scale recycling plants, 6.4% of the respondents said that recycling is too expensive whiles 1.8% revealed that there is no time to recycle. The infrastructural problems are not just confined to waste disposal. Frequently, developing countries lack facilities for proper handling, collection and transportation of the generated wastes. Inadequate planning and layout due to rapid urbanization causes urban centres in the developing countries to be more congested and populated. Often the waste collection trucks cannot reach every part of the town, compelling the residents to throw their garbage in open dumping spaces near human settlement. Congestion of traffic

makes transportation of waste more time consuming and as a result more expensive and less efficient (Zerboc 2003). Another problem associated with handling of waste relates to lack of "standardized containers" to store waste before being picked up causing the wastes to be infested by animals, pests or blown out in the street (Zerboc 2003, Zurbrugg 2003).

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

The main objective of the study was to investigate into scrap metal usage on locally manufactured domestic machines in the Cape Coast Metropolis. This study adopted the case study strategy. Both qualitative and quantitative research approaches were used for the study. The population for the study was four hundred and fifty seven (457). The population of the study was made up of scrap dealers and locally manufactured domestic machines manufacturers in the Cape Coast Metropolis. Purposive and random sampling methods were used to select a sample size of two hundred and ten (210) respondents for the study (100 domestic machine manufacturers and 110 scrap dealers). Questionnaires were the main instrument used to collect primary data for the study. Primary data was collected through a field survey of domestic machine manufacturers and scrap metal dealers in the Cape Coast metropolis. Data was collected through the use of a designed questionnaire administered to participants in their workshops. Questionnaires were filled out by participants and the researcher had to go for the questionnaires on the same day. The data was edited to detect and correct, possible errors and omissions that were likely to occur, to ensure consistency across respondents. The data was then coded to enable the respondents to be grouped into limited number of categories. The SPSS version 18 was used to analyse data. Data was presented in tabular form, graphical and narrative forms. In analyzing the data, descriptive statistical tools such as bar graph and pie charts, frequencies and percentages were used.

6.2 Key Findings of the Study

6.2.1 The role of machines in the manufacturing of locally made domestic machines

The study shows that 41% of the respondents manufactured flour mill, 29% manufactured cassava grater, 19% manufactured vegetable mill whiles 11% manufactured corn mill. Moreover, 66% of the respondents used new materials in fabricating domestic machines whiles 34% used scrapped materials. Also, 91% of the respondents affirmed that they used pillar drilling machines to manufacture domestic machines. Moreover, 91% also said that they used lathe machines to manufacture domestic machines. Furthermore, 88% of the respondents used milling machines to manufacture domestic machines. To add more, 57% of the respondents do not use spot welding machines to manufacture domestic machines. The study results show that 92% of the respondents affirmed that they use arc welding machines to manufacture domestic machines. Moreover, 91% of the respondents used gas welding machines to manufacture domestic machines. The study finding indicates that 91% of the respondents used pedestal grinder to manufacture domestic machines. The study revealed that 53% of the respondents do not use shaping machines to manufacture domestic machines. The study shows that 84% of the respondents do not use sensitive drilling machines to manufacture domestic machines. The study depicts that 80% of the respondents do not use power hacksaw to fabricate domestic machines.

6.2.2 The type of metal used to manufacture domestic machines

The study shows that 37% of the respondents affirmed that they used mild steel to fabricate domestic machines, 32% used galvanised plate, 26% used stainless steel

whiles 5% used cast iron. However, majority 58% of the respondents affirmed that the cost of mild steel is high,

97% of the respondents affirmed that the cost of galvanized is high, 97% of the respondents said that the cost of stainless steel is high whiles 96% of the respondents said that the cost of cast iron is high. The study shows that 100% of the respondents affirmed that mild steel is available for the production of domestic machines. Moreover, 100% of the respondents said that galvanized steel is available for the fabrication of domestic machines. Furthermore, 100% of the respondents confirmed that stainless steel is available. To add more, 100% of the respondents said that cast iron is available for production of domestic machines.

6.2.3 The safety of the material used to manufacture domestic machines

The study depicts that 100% of the respondents agreed that cast iron is safe to work with during the manufacturing of domestic machines. The study shows that 100% affirmed that it is safe to use galvanised steel to manufacture domestic machines. Moreover, 100% of the respondents affirmed that mild steel is safe when used to manufacture domestic machines. The study revealed that 100% of the respondents said that working with stainless steel is safe when fabricating domestic machines.

6.2.4 The type of bearings used to manufacture domestic machines

The study indicates that 41% of the respondents affirmed that they used ball bearing to manufacture domestic machines, 27% of the respondents used plumber bearings, 22% used machined brass bushes whiles 10% half brass bushes. The study results hold that majority 94% affirmed that they used grinding plates in manufacturing

of domestic machines. The study depicts that 98% of the respondents affirmed that they used locally manufactured grinding plate to fabricate domestic machines.

6.2.5 Challenges faced by domestic machine manufacturers

The study indicates that 74% of the respondents said that the challenge they face is that they spent more time on cleaning the surfaces of scrapped metals before they use them to manufacture domestic machines, 17% had difficulty in preparing of scrap surfaces whiles 9% had difficulty in welding of scrap metals due to corrosion.

6.2.6 Analysis of metal scraps dealer's questionnaires

6.2.6.1 The quantity and quality of current waste generation and metal scrap recycling behaviour in the Cape Coast Metropolis

The study indicates that 86.4% of the respondents confirmed that they are involved in metal scrap collection to make money for a living. Moreover, 50% of the respondents confirmed that they earn below GH¢ 500.00 from the sale of metal scraps and usage, 33.6% earn between GH¢ 500-1000, whiles 16.4% earn between GH¢ 1,000-15,000.The study further revealed that 96.4% of the respondents confirmed that they sell their metal scrap collection per kg for less than GH¢ 50.00.

6.2.7 The importance of recycling metal scraps in the Cape Coast metropolis?

The study indicates that majority 88.2% of the respondents affirmed that they do not recycle metal scraps whiles 11.8% of the respondents said that they recycle metal scraps. Moreover, 100% of the respondents affirmed that it is important to recycle. The study shows that 79.1% of the respondents said that in case of recycling metal scraps,

they use homemade recycling facility to recycle whiles 20.9% used commercial recycling plant.

6.2.8 The main difficulties currently preventing people engaged in metal scrap collection and recycling of scraps

The study results holds that 91.8% of the respondents confirmed that the main difficulties preventing people engaged in metal scrap collection and recycling of scraps is non availability of recycling plants.

6.3 Conclusions

The study concluded that domestic machines manufacturers fabricated flour mill, cassava grater, vegetable mill and corn mill. Moreover, the respondents used new and scrapped materials in fabricating domestic machines. Also the respondents used pillar drilling machines, lathe machines, arc welding machines, gas welding machines, pedestal grinder and milling machines to manufacture domestic machines. To add more, the respondents do not use spot welding machines, shaping machines, sensitive drilling machines and power hacksaw to fabricate domestic machines. The study further concluded that they used mild steel, galvanised plate, stainless steel and cast iron to manufacture domestic machines. However, the cost of mild steel, galvanized, stainless steel and cast iron is high. Furthermore, the respondents used ball bearing, Plummer bearings, machined brass bushes, half brass bushes and locally manufactured grinding plate to fabricate domestic machines. The challenges faced by domestic machines manufacturers are time spent on cleaning of surfaces of scrap metals and difficulty in welding of scrap metals due to corrosion. Majority of the respondents are involved in

metal scrap collection to make money for a living. Moreover, the respondents earned below GH¢500.00 from the sale of metal scraps and usage. Most of the respondents confirmed that they sell their metal scrap collection per kg for less than GH¢ 50.00.

Most respondents used homemade recycling facility to recycle and commercial recycling plant. The study results concluded that the main difficulties preventing people engaged in metal scrap collection and recycling of scraps is non availability of recycling plants. The use of scrap metal in the manufacturing of locally made domestic machines has a negative effect on the durability and the quality of the machines produced.

6.4 Recommendation

Based on the conclusion remarks from the study, the following recommendations were noted,

1. The government and stakeholders must provide adequate long and medium scale recycling plants to recycle scrap waste to minimize the high cost of locally manufactured machines. The availability of the machine tools will improve productivity of domestic machines manufacturing.
2. There is the need for the Government and other stakeholders to organize periodic workshops and seminars to educate the domestic machine manufacturers in the Cape Coast municipality in order to ensure quality of the domestic machines manufactured.
3. The Government and other stakeholders must resolve the power crisis and reduce the high cost of the manufacturing materials, unavailability of tools and equipment respectively.

6.5 Suggestions for Further Research

Based on the recommendations of the study, the researcher suggested that a similar study must be undertaken to investigate the impact of the availability of recycling plants on waste management, using the Cape Coast Municipality as a case study.

REFERENCES

Austin, J., Hatfield, D. B., Grindle, A. C., & Bailey, J. S. (1993). Increasing recycling in office environments: The effects of specific, informative cues. *Journal of Applied Behavior Analysis, 26,* 247-253.

Arce, A. (2003) Value contestations in development interventions: community development and sustainable livelihoods approaches. Community Development Journal, 38 (3), pp.199-212.

Ashley, C. & Carney, D. (2009) Sustainable Livelihoods:

Brothers, K. J., Krantz, P. J., &McClannahan, L. E. (1994). Office paper recycling: A function of container proximity. *Journal of Applied Behavior Analysis, 27,* 153-160.

Bartone, C. (2000) Strategies for Improving Municipal Solid Waste Management: Lessons from World Bank Lending and CWG Activities. Workshop on Planning for Sustainable and Integrated Solid Waste Management, Manila, 18-22

September 2000. Washington, DC: Urban Management Division, World Bank.

ChakrabartiSnigdha and PrasenjitSarkhel (2003). Economics of Solid Waste Management: A Survey of Existing Literature. Economic Research Unit Indian Statistical Institute

Chan, K. (1998) "Mass communication and pro-environmental behaviour: waste recycling in Hong Kong," *Journal of Environmental Management*, Academic Press, vol. 52, pp. 317-325.

Daskalopoulos, E., Badr, O., Probert, S.D. (1998) "Municipal solid waste: a prediction methodology for the generation rate and composition in the European Union countries and the United States of America," *Resources, Conservation and Recycling*, Elsevier Science Publishers, London, vol. 24, issue 2, pp. 155-166.

Duffy, S. & Verges, M. (2009). It matters a hole lot: Perceptual affordances of waste containers influence recycling compliance. *Environment &Behavior, 41,* 741-749.

Dwyer, W. O., Leeming, F. C., Cobern, M. K., Porter, B. E., Jackson, J. M. (1993). Critical review of behavioral interventions to preserve the environment: Research since 1980. *Environment &Behavior, 25*(5), 275-321.

Ebreo, A. and Vining, J. (2004) "How Similar are Recycling and Waste Reduction? Future Orientation and Reasons for Reducing Waste as Predictors of Self-Reported Behavior," *Environment and Behavior*, Sage Publications, vol. 33, no. 3, pp. 424-448.

Europa (2005) Waste Management Planning, European Commission, Europa,

Farrington, J., Carney, D., Ashley, C. &Turton, C. (2009) Sustainable livelihoods in practice: early applications of concepts in rural areas. Natural Resource Perspectives, 42, pp.2005-06.

Geller, E. S., Brasted, W., & Mann, M. (1980). Waste receptacle designs as interventions for litter control. *Journal of Applied Behavior Analysis, 6,* 145-160.

Geller, E. S., Winett, R. A., Everett, P. B. (1982).*Preserving the environment: New strategies for behavior change.* New York, NY: Pergamon Press.

Ghana Statistical Service (2000).

Glasser, H. (2007). Minding the gap: The role of social learning in linking our stated desire for a more sustainable world to our everyday actions and policies. In A.E.

Grant, L. K. (2011). Can we consumer our way out of climate change? A call for analysis. *The Behavior Analyst, 34*(2), 245-266.

Hanyu, K., Kishino, H., Yamashita, M., Hayashi, C. (2000) "Linkage between recycling and consumption: a case of toilet paper in Japan," *Resources, Conservation and Recycling*, Elsevier Science Publishers, London, vol. 30, issue 3, pp. 177-199.

Hartig, T., Kaiser, F.G., Bowler, P.A. (2001) "Psychological Restoration in Nature as a Positive Motivation for Ecological Behavior," *Environment and Behavior*, Sage

Publications, vol. 33, no. 4, pp. 590-607.

Hockett, D., Lober, D.J., Pilgrim, K. (1995) "Determinants of Per Capita Municipal SolidWaste Generation in the Southeastern United States," *Journal of EnvironmentalManagement*, Academic Press, vol. 45, pp. 205-217.

Hornik, J., Cherian, J., Madansky, M., Narayana, C. (1995) "Determinants of Recycling Behavior: A Synthesis of Research Results," *The Journal of Socio-Economics*, JAI Press Inc., vol. 24, no. 1, pp. 105-127.

Hoornweg, Daniel Laura Thomas and KeshavVerma, (1999). What a Waste: Solid Waste Management in Asia, World Bank,

ILO Decent work for all - About the ILO (2009).

ILO (2007) Global Employment Trends Brief. ILO, (January).

Jacobs, H. E., Bailey, J. S., & Crews, J. I. (1984). Development and analysis of a Community-based resource recovery program. *Journal of Applied Behavior Analysis, 17,* 127-145.

Johnson, C.Y., Bowker, J.M., Cordell, H.K. (2004) "Ethnic Variation in Environmental Belief and Behavior: An Examination of the New Ecological Paradigm in a Social Psychological Context," *Environment and Behavior*, Sage Publications, vol. 36, no. 2, pp. 157-186.

Kelly, T.C., Mason, I.G., Leiss, M.W., Ganesh, S. (in press 2005) "University community responses to on-campus resource recycling," *Resources, Conservation and Recycling*, Elsevier Science Publishers, London.

Kishino, H., Hanyu, K., Yamashita, M., Hayashi, C. (1998) "Recycling and consumption in Germany and Japan: a case of toilet paper," *Resources, Conservation and Recycling*, Elsevier Science Publishers, London, vol. 26, issue 3, pp. 189-215.

Kollmuss, A., &Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8*(3), 239-260.

Khawas, Vimal. (2003). Urban Management in Darjeeling Himalaya: A Case Study of Darjeeling Municipality. Mountain Forum.

Kuniyal J. C., A. P. Jain and Shannigrahi.,A.S.(1998). Public Involvement in Solid Waste Management in Himalayan Trails in and Around the Valley of Flowers, India, Mountain Forum. 24(3-4): 299-322

Lehman, P. K., Geller, E. S. (2004). Behavior analysis and environmental protection: Accomplishments and potential for more.*Behavior and Social Issues, 13,* 12-32.

Lounsbury, J. W., &Tornatzky, L. G. (2007). A scale for assessing attitudes toward environmental quality. *Journal of Social Psychology, 101*, 299-305.

Ludwig, T. D., Gray, T. W., & Rowell, A. (1998). Increasing recycling in academic buildings: A systematic replication. *Journal of Applied Behavior Analysis*, *31,* 683-686.

Maloney, M. P., Ward, M. P., &Braucht, N. G. (2005). A revised scale for the measurement of ecological attitudes and knowledge. *American Psychologist, 30*, 787-790.

McCarty, J.A. and Shrum, L.J. (1994) "The Recycling of Solid Wastes: Personal Values, Value Orientation, and Attitudes about Recycling as Antecedents of Recycling Behavior," *Journal of Business Research*, Elsevier Science Ind., New York, vol. 30, pp. 53-62.

Medina, M. (1997) "The Effect of Income on Municipal Solid Waste Generation Rates for Countries of Varying Levels of Economic Development: A Model," *Journal of Solid Waste Technology and Management*, Widener University School of Engineering and theNationalCenter for Resource Management and Technology at the University ofPennsylvania, vol. 24, no. 3, pp. 149-155.

Mihelcic, J.R., Crittenden, J.C., Small, M.J., Shonnard, D.R., Hokanson, D.R., Zhang, Q.,Chen, H., Sorby, S.A., James, V.U., Sutherland, J.W., Schnoor, J.L. (2003). "Sustainability Science and Engineering: The Emergence of a New Metadiscipline," *Environmental Science and Technology*, American Chemical Society, vol. 37, no. 23, pp. 5314-5324.

Mcmichael, A. J. (2000). The Urban Environment and Health in A World of Increasing Globalization: issues for developing countries. Bull World Health Organ. 78(9):1117-1126.

Medina M. (1997). Globalization, Development, and Municipal Solid Waste Management in Third World Cities

Noehammer, H.C. and Byer, P.H. (1997) "Effect of Design Variables on Participation in Residential Curbside Recycling Programs," *Waste Management and Research*, Academic Press, London, vol. 15, pp. 407-427.

Nuwayhid, R.Y., Ayoub, G.M., Saba, E.F., Abi-Said, S. (1996) "The Solid Waste Management Scene in Greater Beirut," *Waste Management and Research*, Academic Press, London, vol. 14, issue 2, pp. 171-187.

O'Conner, R. T., Lerman, D. C., Fritz, J. N., &Hodde, H, B. (2010). Effects of number and location on plastic recycling at a university. *Journal of Applied Behavior Analysis*, *43,* 711-715.

Owens, J., Dickerson, S., MacIntosh, D.L. (2000). "Demographic Covariates of Residential Recycling Efficiency," *Environment and Behavior*, Sage Publications, vol. 32, no. 5, pp. 637-650.

Pendley, P.S. (2005). "Feasibility and Action Plan for Composting Operation Incorporating Appropriate Technology at Riverton Disposal Site, Kingston, Jamaica," Masters of Science in Environmental Engineering Report, Michigan Technological University.

Prüss, A., E. Giroult, and P. Rushbrook. (1999).*Safe Management of Waste from Health Care Activities*, ISBN: 92 4 154525 9, Order no. 1150453, World Health Organization.

Porter, B. E., Leeming, F. C., Dwyer, W. O. (2005). Solid waste recovery: A review of behavioral programs to increase recycling. *Environment &Behavior, 27*(2), 122-152.

Rogers, G. (2007). Decent Work, Social Inclusion, and Development. Indian Journal of Human Development, 1 (1), pp.21-32.

Schübeler, Peterin collaboration with Karl Wehrle and Jürg Christen (2006). Conceptual Framework for Municipal Solid Waste Management in Low-income Countries.United Nations Development Program, UMP Working Paper Series no. 9. St. Gallen, Switzerland: SKAT.

Schübeler, G. (2006).*Conceptual Framework for Municipal Solid Waste Management In Low-Income Countries*, Urban Management and Infrastructure, UNDP/UNCHS (Habitat)/World Bank/SDC Collaborative ProgrammeOn Municipal Solid Waste Management in Low-Income Countries, Working Paper No. 9, St. Gallen, Switzerland.

Shinkuma, T. (2003). "On the Second-Best Policy of Household's Waste Recycling," *Environmental and Resource Economics*, Kluwer Academic Publishers, Netherlands, vol. 24, issue 1, pp. 77-95.

Steel, B.S. (1996). "Thinking Globally and Acting Locally?: Environmental Attitudes, Behavior and Activism," *Journal of Environmental Management*, Academic Press, vol. 47, pp. 27-36.

Taylor, D.C. (2000) "Policy incentives to minimize generation of municipal solid waste," *Waste Management and Research*, Academic Press, London, vol. 18, issue 5, pp. 406-419.

Thapa, B. (1999). "Environmentalism: The Relation of Environmental Attitudes and Environmentally Responsible Behaviors Among Undergraduate Students," *Bulletin of Science, Technology & Society*, Sage Publications, vol. 19, no. 5, pp. 426-438.

Toner, A. & Franks, T. (2006). Putting livelihoods thinking into practice: implications fordevelopment management. Public Administration and Development, 26 (1), pp.81-92

UNEP Mountain Watch (2001). Environmental Change And Sustainable Development In Mountains.

UNESA (2001). Sustainable Development and Solid Waste VenkateshwaranSandhya, Ecological, Economic and Social Dimensions, Economic and Political Weekly, November 5-12.

UNDESA (2005).*Agenda 21 – Chapter 21 Environmentally Sound Management of Solid Wastes and Sewage-related Issues*, Division for Sustainable Development, UnitedNations Department of Economic and Social Affairs, Retrieved 1 July 2005.

UNEP (2001a). "Solid and Hazardous Waste," *Bangkok: State of the Environment 2001*, United Nations Environment Programme, Chapter 4 pp. 35-44.

UNEP (2001b).*Bhutan: State of the Environment 2001*, United Nations Environment Programme, Chapter 12 pp. 91-97.

UNEP (2001c).*India: State of the Environment 2001*, United Nations Environment Programme, Chapter 12 pp.133-149.

UNEP (2001d).*Lao PDR: State of the Environment 2001*, United Nations Environment Programme, Chapter 5 pp. 60-66.

UNEP (2001e). "Solid Waste Management," *Nepal: State of the Environment 2001*, United Nations Environment Programme, Chapter 3.3 pp. 97-118, 2001.

UNEP (2001f). "Waste Disposal," *Sri Lanka: State of the Environment 2001*, United Nations Environment Programme, Chapter 3.2 pp. 42-52.

UNEP (2001g). "Solid Waste State and Impact," *State of the Environment Vietnam*, United Nations Environment Programme, Retrieved 10 January 2005,

UNEP (2002). "Key environmental issues: management of solid waste and sewage," *Maldives: State of the Environment 2002*, United Nations Environment Programme, Chapter 3.3 pp. 41-44.

UNEP (2005a). Global Environment Outlook (GEO) 3 Data Portal, United Nations Environment Programme, Retrieved 1 July 2005, http://geodata.grid.unep.ch/.

UNEP (2005b). "Wastes," *State of the Environment Turkmenistan*, United Nations Environment Programme, Retrieved 04 February 2005.

UNEP and ISWA (2004).*Waste Management Planning, An Environmentally Sound Approach for Sustainable Urban Waste Management: An Introductory Guide for Decision-makers*, Integrative Management Series No. 6, International Environmental Technology Center, United Nations Environment Programme's Division of Technology, Industry, and Economics.

UNDESA (2004).*World Urbanization Prospects: The 2003 Revision*, Sales No.

UN-HABITAT (2005a). Sustainable Urbanization through Community Involvement – 3 Case Studies From the Colombo Core-Area, Sri Lanka, Fukuoka Office (Regional Office for Asia and the Pacific), United Nations Human Settlements Programme.

UN-HABITAT (2005b). Waste, Priorities, UN-HABITAT in Afghanistan, United Nations Human Settlements Programme, Retrieved 1 July 2005,

United States Environmental Protection Agency (2010). Municipal solid waste generation, recycling and disposal in the United States: Facts and figures for 2010. Retrieved from

Wang, H. and Nie, Y. (2001). "Municipal Solid Waste Characteristics and Management in China," *Journal of Air and Waste Management Association*, Air and Waste Management Association, vol. 51, pp. 250-263.

UNWCED (1987).

World Bank (2005). Decision Makers' Guide to Municipal Solid Waste Incineration. Washington D.C

Werner, C. M., Rhodes, M. U., &Partain, K. K. (2008). Designing effective instructional signs with schema theory: Case studies of polystyrene recycling. *Environment andBehavior, 30,* 709-735.

Wells, C. (1994). "The Brazilian Recycling Commitment: helping stimulate recycling in adeveloping country," *Industry and Environment*, United Nations Environment Program, Paris, France, vol. 17, issue 2, pp. 14-17.

Werner, C.M. and Makela, E. (1998). "Motivations and Behaviors that Support

Recycling," *Journal of Environmental Psychology*, Academic Press, vol. 18, pp. 373-386.

WHO (2005a). Pamphlets – Waste, Regional Office of Europe, World Health Organization, Retrieved 1 July 2005,

WHO (2005b).*Needle-removing and recycling of the plastic from auto-disable (AD) syringes*, Waste Management – WHO Policy and Activities, Immunization Safety, World Health Organization, Retrieved 1 July 2005,

WHO (2005c).*Information Management for Municipal Solid Waste Management Services*, Environmental Health Centre (EHC), Western Pacific Regional Office, World Health Organization, January 1993.

World Bank (2001).*Philippines Environment Monitor 2001*, World Bank - Country Office Manila, Pasig City, Philippines, 29 pp.

World Bank (2003a).*Indonesia Environment Monitor 2003*, World Bank Indonesia Office, Jakarta, Indonesia, pp. 33-41.

World Bank (2003b). "Waste Reduction, Reuse, and Recycling," *Thailand Environment Monitor 2003*, The World Bank Group, Washington, D.C., pp. 13-18.

World Bank (2004).*Mongolia Environment Monitor 2004*, World Bank Mongolia Office, Ulaanbaatar, Mongolia, 41 pp.

World Bank (2005). Urban Development, Urban Solid Waste Management, The World Bank Group,

ZerbockOlar, (2003). Urban Solid Waste Management: Waste Reduction in Developing Nations. Michigan Technological University.

Zurbrucc C. (2003). Solid Waste Management In Developing Countries. SANDEC/EAWAG

Závodská, A. (2003). "A Study on Residential Solid Waste Composition and Management in a Selected Developing Country - Guyana," *Journal of Solid Waste Technology andManagement*, vol. 29, no. 1, pp. 1-7.

APPENDIX 1

UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

QUESTIONNAIRE FOR DOMESTIC MACHINE MANUFACTURERS

Dear respondent, I am a postgraduate student of the Department of Technology Education, Kumasi. This questionnaire is to obtain information regarding the effect of scrap metal usage on locally manufactured domestic machines in the Cape Coast metropolis in the Central Region of Ghana. The information supplied will be the basis for coming out with a statistical data that can be used as a guide for improving the act of recycling metal scraps to manufacture domestic machines. Kindly supply as much information as you can.

Please provide answers or tick (√) as appropriate

Thank you.

SECTION A: Biographic Information of the Respondents

Please tick (√) to answer the following questions.

1. Gender: Male [ ] Female [ ]
2. Age: Less than 25 years [ ] 26-35 years [ ] 36-45 years [ ]
   46-55 years [ ] 56-65 years [ ] more than 66 years [ ]
3. Educational qualification

Never [ ] BECE/MSLC [ ] SSSCE/WASSCE [ ] NVTI [ ]

Diploma [ ] Bachelor's degree [] Master's degree []

4. No of years of operation:

a. Less than 5years [ ] b. 5-10 years [ ] c.11-15 years [ ]

d.16-20 years [ ] e. Above 20 years [ ]

5. What type of domestic machine do you produce?

i. Vegetable Mill [ ] ii. Cassava Grater [ ] iii. Flour Mill [ ]

iv. Corn Mill [ ] v. Other, Specify……..

SECTION C

What is the effect of scrap metal usage on locally manufactured domestic machines in the Cape Coast Metropolis?

6. How long have you been manufacturing domestic machines?

a. Under 5 years [ ] b. 5- 9 years [ ] c. 10- 14 years [ ]

d. 15-19 years [ ] e. 20 and above [ ]

7. What is the state of material(s) used for fabrication?

i. New [ ] ii. Scrapped / used [ ]

8. Type of equipment use in the manufacture of domestic machines? (Tick √as many as apply)

EQUIPMENT	YES	NO
Pillar Drilling Machine		
Lathe Machine		
Milling Machine		
Spot Welding Machine		
Arc Welding Machine		
Gas Welding Machine		
Pedestal Grinder		
Shaping Machine		
Dial Indicator		
Sensitive Drilling Machine		
Power Hacksaw Machine		

9. What type of material doyou use for the fabrication of domestic machines? (Tick √ as many as apply)

i) Mild Steel [ ] ii. Galvanized Plate [ ] iii. Stainless Steel [ ]

iv. Cast Iron [ ] v. Other, Specify ……

10. How would you rate the cost material used to manufacture domestic machines?

Please tick (√) the most appropriate answer: (Key: 5 = very high; 4 = High:

3 = Average; 2 = Low; 1 = Very low)

Type of material	Very High	High	Average	Low	Very low
Mild Steel					
Galvanized					
Stainless					
Cast Iron					

11. How would you rate the availability of materials used to manufacture domestic machines? Please tick (√) the most appropriate answer:

Type of material	Easily Available	Somehow Available	Not easily Available
Mild Steel			
Galvanized			
Stainless			
Cast Iron			

12. How would you rate the safety of the material used to manufacture domestic machines? Please tick (√) the most appropriate answer: (Key: 5 = very high; 4 = High:3 = Average; 2 = Low; 1 = Very low)

Type of material	Very High	High	Average	low	Very low
Mild Steel					
Galvanized					
Stainless					
Cast Iron					

13. What type of bearings do you use?

i. Ball Bearing [ ] ii. Machined Brass bushes [ ]

iii Plummer Bearings [ ] iv. Half Brass Bushes [ ]

14. Do you use grinding plates in your machine?

Yes [ ] No [ ]

15. What kind of grinding plate/ disc do you use for your machine?

i. Locally manufactured [ ] ii. Foreign / imported [ ]

16. Give reason(s) to your answer to question 15.

……

……

17. In all how would you rate your grinding machine in terms of the following? (Tick √ as many as apply)

(Key: 5 = very high; 4 = High: 3 = Average; 2 = Low; 1 = Very low)

	Very High	High	Average	Low	Very Low
Durability					
Cost of manufacturing					
Ease of operation					
Maintenance					
Safety					

18. Which of the following challenges do you face as a manufacturer of domestic machines?

i. Difficulty in preparing scrap metal surfaces [ ]

ii. Difficulty in welding of scrap metals due to corrosion [ ]

iii. More time spent on cleaning scrap metal surfaces [ ]

iv. Other, specify……

19. Do you have any recommendation?

.....

.....

.....

.....

APPENDIX 2

UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

QUESTIONNAIRE FOR METAL SCRAPS DEALERS IN THE CAPE COAST METROPOLIS

Dear respondent, I am a postgraduate student of the Department of Technology Education, Kumasi. This questionnaire is to obtain information regarding the effect of scrap metal usage on locally manufactured domestic machines in the Cape Coast metropolis in the Central Region of Ghana. The information supplied will be the basis for coming out with a statistical data that can be used as a guide for improving the act of recycling metal scraps to manufacture domestic machines. Kindly supply honest information.

Please provide answers or tick (√) as appropriate

SECTION A

Biographic information of respondents

1. 1. Sex: Male [ ] Female [ ]
2. How long have you been collecting metal scraps?

   Below 5 years [ ] 5-10 years [ ] 10-15 years [ ] 15-20 years [ ]
3. Age

   Below 18 years [ ] 18-25 years [ ] 25- 30 years [ ]

   30 -35 years [ ] above 35 years [ ]

4. Marital Status:

   Single [ ] Married [ ] Divorced [ ] Widowed [ ]

5. Level of Education

   Primary [ ] Secondary [ ] Tertiary [ ]

SECTION B

The quantity and quality of current waste generation and metal scrap recycling behaviour in the Cape Coast Metropolis

6. Why are you involved in metal scrap collection?

   To make money for a living [ ] I do it for a hobby [ ]

   Because my friends do it [ ]

7. What is your weekly, monthly, income from metal scrap sale and usage?

   Below GH¢ 500 [ ] GH¢ 500 -1000 [ ]

   GH¢ 1000 -1500 [ ] above GH¢ 1500 [ ]

8. How much do you sell your metal scrap collection per kg?

   Below GH¢ 50 [ ] GH¢ 100-200 [ ]

   GH¢250-350 [ ] GH¢ ABOVE 400 [ ]

9. Are you engaged in any other income generating activity? YES [ ] NO [ ]

10. Are the funds generated from scrap scavenging adequate to support your household / dependants?

    YES [ ] NO [ ]

SECTION C

What is the importance of recycling metal scraps in the Cape Coast metropolis?

11. Do you recycle metal scraps? YES [ ] NO [ ]
12. Do you think it is important to recycle? YES [ ] NO [ ]
13. How do you recycle?

    Commercial Recycling plant [ ] Homemade recycling facility [ ]

    Other [ ]
14. Do you get paid for recycled materials? YES [ ] NO [ ]
15. How much time is devoted to recycling each day or week?

    1-5 hours a day [ ] 6-10 hours a day [ ]

    11- 20 hours a week [ ] More than 24 hours a week [ ]
16. Do you think you could recycle more? YES [ ] NO [ ]

SECTION D

The main difficulties currently preventing people engaged in metal scrap collection and recycling of scraps?

17. What are the main difficulties currently preventing people engaged in metal scrap collection and recycling of scraps?

    Non availability of recycling plants [ ]

    No time to recycle [ ]

    Recycling is too expensive [ ]

    Inadequate waste management vehicles [ ]

    Lack of financial resources to manage waste [ ]

    Inadequate refuse dumping sites [ ]