GREEN PRACTICES, SUPPLY CHAINS & PERFORMANCE OF KENYA'S BREWING INDUSTRY

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A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION (MBA), SCHOOL OF BUSINESS, UNIVERSITY OF NAIROBI.

DECLARATION

I hereby declare that this project is my original work and has not been submitted for examination to any other academic institution

…….. ……

Alice W. Waruguru DATE

D61/6684/2017

I hereby declare that this research project has been submitted for examination with my approval as the university supervisor

……. …….

Prof. X. N. Iraki DATE

Associate Professor, School of Business

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DEDICATION

I would like to dedicate this research report to the academia, farmers, maltsters, brewers, other participants in the brewing supply chain and anyone else who stands to benefit from the findings contained herein.

ACKNOWLEDGEMENT

The completion of this study would not have been possible without the material and moral support from various people. I therefore wish to extend my gratitude to them.

First, I thank the Almighty God for His grace and for guiding me through this entire endeavor. I am thankful to Prof. X.N Iraki, my supervisor, for his effective supervision, dedication, availability and professional advice. I extend my gratitude to all the respondents who participated in this research, for the information they shared and to those who granted me access to their organizations. Finally, I thank the management of the University of Nairobi, my classmates and support staff for enabling me to have a seamless journey in the pursuit of my MBA.

ABSTRACT

Green supply chain management is a relatively new area of study especially in the African and Kenyan context. This study set out to find out how well the brewing industry in Kenya has adopted and implemented green practices in its supply chain. It sought to investigate how well the major barley commercial farmers, the malting plant, the commercial breweries and major craft brewers have adopted and implemented green practices within their processes. This is because Kenya is one of the countries that are adversely affected by water scarcity and the brewing sector is one that heavily interacts with the environment, given that it obtains all its raw materials (barley, malt, sorghum etc.) and process requirements like water and energy from the environment. The study investigated the key drivers of green practices in these organizations, the common practices and any opportunities that are yet to be explored in this area. It sought to find out any impact on financial and environmental performance in the organizations within the brewing supply chain that had effectively implemented green practices. The research took on a cross-sectional case study of the following organizations in the brewing supply chain: East African Maltings Limited and associated barley farmers, Kenya Breweries Limited, Keroche Breweries Limited and craft breweries like Brew Bistro and Sierra lounge. Findings from the study revealed that adoption and implementation of green practices within the brewing supply chain ranged from low to moderate adoption, with the farmers and three of the breweries demonstrating a low level of adoption and implementation of green practices, and one brewery and the malting plant demonstrating moderate levels of the same. The finding also revealed that the key drivers across all were cost reduction and strict government regulations, while factors like internal management structures such as ISO 14001 certification were found to have propelled the afore mentioned organizations to moderate levels of 'greening'. Top management support was found to be an essential success factor in successful greening, and for the brewery that had moderately adopted and implemented green practices through set internal structures, financial savings were able to be demonstrated especially in the area of energy management. The data obtained was not enough to conclude a direct correlation between implementation of green practices and positive financial performance, although it gave give a good indication that investment in the right green practices can result to financial savings.

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CHAPTER ONE: INTRODUCTION

1.1 Background of The Study

A supply chain refers to the well-coordinated and structured functionality of various teams such as suppliers, assemblers/manufactures, distributors etc. in an interlinked manner that ensures timely delivery of a valuable good or service to the customers in exchange for money. It is therefore a set of entities directly involved in the downstream and upstream flow of services, products, finances, and information from source to customer. Mentzeret al. (2001). Supply chain management practices are the set of activities undertaken in an organization to promote effective management of its supply chain. Li et al. (2006).

Greening the supply chain involves incorporating environmental concerns into organizational purchasing decisions and long-term relationships with suppliers. Gilbert (2001). GSCM thus means inculcating practices, attitudes and processes that ensure that the environment is protected and improved right from raw material sourcing to waste disposal after product consumption. This includes aspects such as water and energy efficiency, proper waste management practices, prevention of harmful air emissions and land reclamation practices. Green supply chain management (GSCM) is increasing in popularity as consumers become more conscious about the impact manufacturing has on the environment. Climate change and its negative impact on the world has necessitated environmental sustainability. As a result, manufacturers are being left with little choice but to design and redesign their processes with environmental protection and improvement being one of their key considerations. Zhu and Sarkis (2004) suggest that GSCM practices consist of four

major dimensions: internal environmental management, external environmental management, investment recovery, and eco design.

Green supply chain management is currently being practiced across industries within and outside of Kenya. Examples of industries that are practicing green supply chain management across the world include; Manufacturing firms in Germany, Thompson C.G & Large, R.O. (2011), Automotive manufacturing industry in China Yu Wangao et al. (2014), The cement manufacturing industry in India, Seth et al.(2016), the Jordanian food industry, Diab, Al-Bourini & Abu-Ramman, (2015), Mining sector in Ghana, Peprah, Opoku-Fofie & Nduro (2016) just to name a few. Within the country, green supply chain management is being practiced in the sugar processing industry, Malaba, Ogolla & Mburu (2014), Food & Beverage processing industry, Okemba & Namusonge (2014) and multi-dimensional organizations such as HACO Industries, Makena, (2014). However, there are no studies that show how the brewing industry in Kenya has 'greened' its processes from suppliers to consumers, a gap which this research aims to address.

Brewing is a practice that is as ancient as civilization. It involves the production of beer by steeping starch in water and fermenting it using yeast. It is an activity that needs a long chain of interlinked processes for the valued liquid (beer) to reach the consumer, thus linking the farmer to the bottle. In Kenya, it is a huge booster of the economy, supporting barley, wheat and sorghum farmers, the malting plant, the brewing plants, bottle manufacturers, label makers, a complex distribution channel down to the final consumer at home or in the pubs/clubs/bars/restaurants. It forms a supply chains that heavily relies on and impacts the environment, with the main raw material coming from the farms (barley, sorghum, wheat), intense consumption of

water and energy at every step and generation of huge amounts of byproducts and waste.

The Kenyan brewing industry is characterized by two main commercial players; East African Breweries Limited and Keroche Breweries Limited, as well as several craft brewers such as Brew Bistro (the big 5) and Sierra Ozzbeco. It is a major driver of the Kenyan economy, with taxes alone accounting for slightly under 5% of the government's revenue. Irungu G. (2012). Given the enormity and significance of this industry to the economy and more importantly to the environment, there is need to analyze the brewing supply chains and the extent to which they have 'greened'.

1.1.1 Green Practices in organizations And Factors That Drive (GSCM)

Quite a number of organizations have incorporated green thinking in the design of their supply chains. They have done so through; sourcing environmentally friendly process inputs such as recyclable and/or biodegradable packaging material, treating the effluent water generated from production activities and in some cases reusing the water in the process and in other activities such as cleaning, harvesting and use of rain water, trapping of storm drains and reusing the same in other non-critical activities, use of non-fossil sources of energy such as solar energy, optimization of energy use in all process areas, reducing solid waste generation and recycling any solid waste generated and safe disposal of non-recyclable waste, just to name a few ways.

GSCM was previously considered something that was nice to do, grounded in personal principles and giving organizations a marketing edge. However, this is no longer the case, as the heavily industrialized nations continue to try and remedy their

impact on the environment. One of the ways they have done so is by developing agreements and enacting legislature that now requires nations to conserve the environment. Other factors that have led to the adoption of GSCM include customer pressure, top management support, societal pressure, supplier corporation & other mutually beneficial partnerships as revealed in a study of small and medium enterprises in Malaysia. Ramakrishnan, Haroun & Goh (2015).

1.1.2 Impact of Green Practices on Performance of An Organization

There are strong ties between green practices and a positive improvement on an organization's financial and environmental performance. This is because, green practices embed within them reduction in waste generation, recycling of any waste generated e.g. effluent water generated, use of alternative sources of energy such as solar, which leads to an overall reduction in cost of production for a well-designed supply chain.

Studies carried out in different industries across the world have shown that green supply chain management leads to beneficial results for an organization, especially in the area of environmental and financial performance. For instance, a study conducted in Germany investigating the factors driving of GSCM performance, Large, R.O & Thomson (2011) revealed that environmental performance is directly affected by the level of green supplier assessment and green collaboration. Both practices having being driven by strategic purchasing and strong commitment to the environment by the organization. It also revealed that environmental performance has a positive impact on purchasing performance.

For the mentioned benefits to be obtained, top management support, Supplier Corporation and an investment in the human resource and technological capability of an organization is required. Seth, Shrivastava, Shrivastava (2016)

1.1.3 Supply Chains in The Brewing Industry

The brewing industry consists of a supply chain that supports thousands of livelihoods while significantly impacting the environment and the economy. The chain starts right from the farm, through the malting process, brewery, various consumption points and ends when packaging material such as bottles, crowns and cans are recovered/returned back to the brewery for re-use or disposal.

The key raw material in production of beer is modified barley, which is called malt in the brewing industry. Commercial and craft brewing requires dedicated large- and small-scale farming of barley. Barley in Kenya is grown in the rainy parts of the rift valley and is farmed in seasons. It is moderately water intensive and cannot be done in dry areas. Other raw materials and adjuncts like sorghum can be grown in dry areas, but these contribute to at best, 20% of the product and their use is limited only to certain brands. Harvested barley cannot be processed as is because of the high moisture content. In order to lower the moisture content, farmers can choose to sun dry it, but often based on demand, it is usually passed through diesel powered driers to fast track the process. This in effect leads to consumption of water and diesel as well as emission of greenhouse gases to the air. Sometimes drying is done at the malting plant.

The barley malting process consists of 3 key processes; steeping, germination and kilning. Steeping involves soaking the grain in thousands of cubic meters of water intermittently so that the modification process can start. The soaked grain is then

transferred to boxes where they are continuously sprayed with water. Often, this is water abstracted from the ground (portable borehole water) and the two processes generate effluent that is high in chemical oxygen demand (COD) and biochemical oxygen demand (BOD). Such effluent is extremely harmful to life in the water bodies. In order to dry the malt to the desired moisture content for use in the brewery, it is passed through the kilning process. This involves using hot air to heat and dry the grain. The energy used in heating the hot air is obtained from burning fossil fuels, often heavy fuel oil (HFO) which also leads to emission of substantial amounts of carbon dioxide, amongst other flue gases.

Beer is essentially ninety percent water. Water is heavily consumed at almost every stage of the brewing process. In addition to being the primary constituent of the product, it is used in cleaning the system (vessels and pipes) to the level demanded by food safety requirements, in quality analyses, cleaning of the company, other sanitary requirements and food preparation, just to name a few. Energy is also heavily consumed since temperature is one of the most important parameters to control at all stages in the brewing process i.e. at mashing, wort boiling, fermentation, conditioning and filtration. Additionally, water and other solutions at high temperatures are used to sanitize the vessels and pipes while very low temperatures are required to remove certain unwanted properties from the intermediate products. Energy sources are primarily electricity, fossil fuels and in some cases, solar energy.

The packaging section also consumes large amounts of water, primarily in the cleaning and rinsing of packaging bottles. It is also a huge producer of effluent as most of the cleaning is done by caustic solution. In commercial beer

production, the packaging section is heavily automated and most of the machines are driven by electricity. A lot of hot water is used in the pasteurization stage and usually, this water is heated using a fossil fuel like HFO.

Commercial breweries often have several distribution channels and often the distribution is done by a contracted third party. From the fuels burned and the gases exhausted during transit, one cannot help but observe that the larger the distribution network, the greater the impact to the environment. Of course, this would also be affected by the quality of fuels and vehicles used as well as the maintenance practices.

At every stage of beer production, different types of waste in significant quantities are generated. This ranges from liquid effluent, packaging material wastes, hazardous wastes, electronic wastes, etc. Waste disposed irresponsibly by commercial processing firms is one of the things currently plaguing the environment. It is thus important to learn how the breweries are managing their waste.

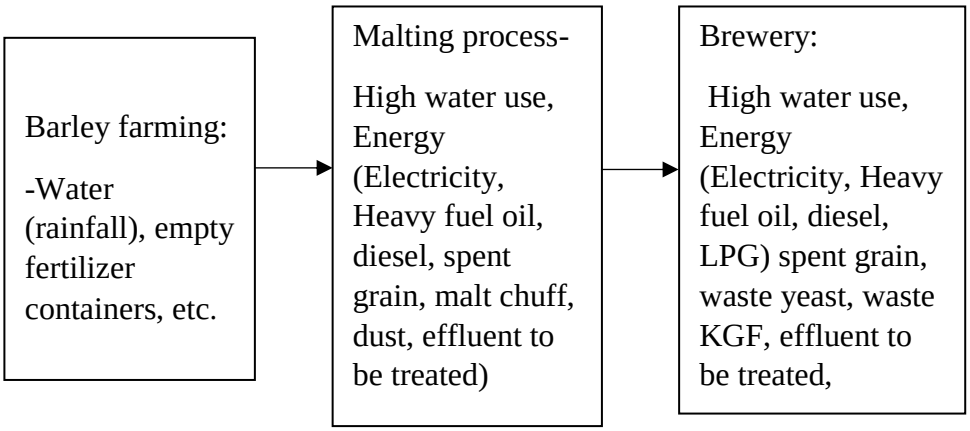


Figure 1.3 1 ***Summary of the upstream section of a brewing supply chain***

This study will find out how water, energy, waste water and solid waste are being managed by the identified players in the beer making industry in Kenya, what

attitudes and motivations are required for the success of their management. It will explore the impact and opportunities that the breweries have felt/observed from sustainably managing energy, water, greenhouse gas emissions, waste and waste water management.

1.2 Research Problem

Green supply chain management (GSCM), as a relatively novel area of research has generated a lot of interest amongst researchers. It is an area that has been found to have a positive impact on an organization's financial and environmental performance. Green supply chain management is based on practices that both reduce cost of production as well as conserving the environment. For instance, recycling of waste water generated reduces cost of purchasing process water as well as ensuring that no untreated effluent is released into the water bodies. Reduction of waste generated ensures that process inputs are used optimally. Green practices are postulated to have ripple effects. For instance, green practices can endear an organization to its customers as well as attract new customers thus increasing market share and consequently, financial returns for an organization.

The beer making industry is one that heavily interacts with the environment, from the farm all the way to the bottle. It is one that requires continuous supply of water, energy and raw materials such as barley and sorghum. It also generates several types of waste that impacts the environment negatively such as carbon dioxide from the fermentation process. In Kenya, it is especially critical that these supply chains are greened since we are in a drought prone/water starved region. It is a necessity for these supply chains to inculcate green practices in their production processes for the sake of their survival.

Studies have been conducted to investigate how GSCM has been implemented in various industries across various parts of the world. These include but are not limited to: the computer manufacturing in Thailand, Ninlawan et.al, (2011), Electronics industry in Taiwan, Chiou T, Y et.al, (2011), Aluminium industry in India, Diabat, Govindan (2011), as well as across manufacturing industries in Japan, Zhu et. Al. (2010). Additionally, studies on drivers of GSCM have been conducted across manufacturing firms in Japan, Ammura et.al (2011), China, Yan Li,(2011), UK, Holt D. & Ghobadian A, (2009) and Sweden, Nawrocka et.al (2008). In Kenya, we have, green supply chain management in the sugar processing industry, Malaba, Ogolla & Mburu, (2014), Food & Beverage processing industry, Okemba & Namusonge, (2014) and multi-dimensional organizations such as HACO Industries, Makena, (2014).

However, there are no studies currently that address GSCM in the brewing industry in Kenya. This research aims to close that gap.

Research Objectives

This study seeks to explore the extent to which green supply chain management is being practiced in the brewing industry in Kenya. It will specifically look into the following;

1) To analyze the extent to which the beer supply chains have 'greened' and impact of that on organizational performance
2) To identify the key drivers of green supply chain management amongst East African Breweries, Keroche Brewing Limited and Craft brewers

3) To identify opportunities available in green supply chain management at EABL, Keroche Brewing Limited and craft brewers

1.3 Value of The Study

This study will serve to shed light in an area that is so critical and yet quite under studied and consequently, under practiced. It will create awareness on the extent to which organizations have implemented GSCM practices in the brewing industry in Kenya. It will reveal underlying attitudes and drivers to GSCM practices, as well as the benefits obtained by the organizations practicing GSCM in this industry. It will show the importance of GSCM and consequently, the knowledge obtained can be transferred and adopted by other industries across the country as well as brewing industries in other countries in Africa.

It will be of value to barley and sorghum farmers, to the malting plants, to the brewers, the academic world as well as to upcoming breweries within and outside of Kenya.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This section looks into theories that explain why green supply chain management is essential and why it needs to be ingrained in all the supply chain practices. It discusses the brewing industry, globally and locally and its impact to the economy. Additionally, it reviews other studies that have been carried out in the field of GSCM by various scholars. It shows the relationship between previous studies carried out, the gaps revealed and how this study will attempt to fill the knowledge gap existing with regard to this field and in the context specified.

2.2 Theoretical Review

2.2.1 Resource Based View of The Firm.

Most firms aspire to be the best in their industry on a local and global level. In a market filled with cut throat competition, a firm needs to have at least one, if not many competitive advantages to stay ahead of the competition and consequently dominate the market. The resource-based theory of the firm explains that firms possess resources, some which enable them to achieve competitive advantage, and a portion of those which further lead to superior long-term performance. A resource offers competitive advantage if it is rare, valuable, non-imitable, non-transferrable and non-substitutable. Ultimately, the aim of supply chain management is to optimize value for all the stake holders in the chain.

With this in mind, green supply chain management, if proactively run and sustained can be an instrumental source of competitive advantage. This basically means incorporating environmental thinking in the whole supply chain, from sourcing to reverse logistics as well as at each step of the product cycle. Green practices are

generally those actions that minimize generation of waste and pollutants considering the product life cycle, supplier environmental practices, in compliance to legal requirements thus minimizing a firm's environmental impact, Klassen and Johnson (2004); Rao (2002); Zhu et al. (2008a); Stock et al. (2010); Handfield et al. (2005). How an organization has organized its supply chain is a critical source of competitive advantage.

When firms employ such practices, they develop processes that control waste generated, consequently lowering costs and improving both their performance and reputation, Handfield et al. (2005); Hoffman (2000); Klassen and Johnson (2004); Bowen et al. (2001); Zhu et al.(2008b) Markley and Davis (2007); Vachon and Klassen (2008).

2.2.2 Social Capita Theory

This theory looks at the relational obligations put on a firm as a result of existing in a community and interacting with various stakeholders. Social capital is the ability to obtain resources through utilization of social relationships, i.e. a firm's advancement through its social network. It can be categorized into three aspects:

Cognitive - This encompasses commonalities in terms of vision, values and goals among persons in the social network. These points of connections allow the persons/parties interacting to share in representations, understanding and systems of meaning. It provides a comfortable environment that allows suppliers and buyers to share each other's thinking processes in the process of trade. This encourages the development of shared understanding and collective ideologies. By aligning goals, the joint returns for both parties are enhanced

and conflicts are reduced since both parties give synergetic energies to their relationship.

Structural - This looks at how the partners interact. Set times, environments and rules of interaction allows for timely exchange of information and resources. These include carefully planned social events, joint cross functional problem-solving forums and team building activities. This fortifies the relationships already established.

Relational -This revolves around issues of trust, respect, friendship and mutual obligation. Trust gained from repeated interactions encourages open communication and minimizes opportunistic behavior. Friendship, respect, and reciprocity are strengthened through repeated transactions. Relational social capital focuses on the long-term development of trust and friendship thereby leading to reciprocity of business through transacting repeatedly. The outcome is reduced transaction costs because of the developed cooperative behavior.

The current market consists of consumers that are becoming increasingly conscious of the impact that organizations' activities and products or services have on the environment, both immediate and in the long term. As a result, most consumers are no longer choosing products or remaining loyal to organizations blindly. Organizations that proactively and visibly show that they care about the environment, through embracing green practices (such as green sourcing, recycling and reusing of products, little or no pollution to the environment etc.), implementing projects that lead to sustainable environmental conservation are increasingly endearing themselves to the consumers, members of the communities, regulatory bodies as well as attracting top level partnerships. This is a source of increased returns in form of reduced operation costs, community goodwill, increased customer recruitment and retention, regulatory

compliance that avoid heavy fines and, in some cases, obtaining tax rebates, just to name a few.

2.2.3 Theory of Technology-Organization and Environmental Framework.

This theory argues that the organizational context, technological context and environmental context influences how a firm adopts and implement innovation in technology, DiPietro, Wierda, & Fleischer (1990). The technological context includes both internal and external technologies (equipment and processes). For a firm to successfully green its supply chain, improved technology and techniques of production need to be employed. Some of these may be expensive to install or institutionalize (for example designing and constructing a waste water recycling plant) but may prove profitable in the long term (i.e. calculating the amount of waste water that will be recycled and re-used over time).

The characteristics of the firm i.e. degree of centralization, size of firm, human resources, formalization, employee linkages, managerial structure etc. are covered under the organizational context. For instance, several aspects of green supply chain management are heavily behavioral. This means, for them to succeed, there needs to be buy in that includes behavioral adjustments and support from top management to shop floor staff. Activities as simple as recycling of paper can only be profitable if they are consistently practiced by everyone in the organization.

The macroeconomic context, competitors, size and structure of the industry and the regulatory environment are covered under the environmental context.

Looking at the brewing industry, competitors, firm's capabilities and structure are just some of the factors that may motivate organizations to implement and sustain their

green practices. This is in addition to the need to have a sustainable source of locally available raw material (farmed barley and sorghum), sustainable supply of inputs such as water and energy.

2.3 Empirical Review

Studies have been conducted to explore how green supply chain practices have been implemented in industries such as the cement, electric and electronic industries in countries like India, Thailand and Korea. For instance, in India, a study was conducted to explore critical success factors and performance measures for green manufacturing across the cement industries. The study revealed weaknesses in GSCM implementation due to lack of connection between critical success factors and performance measurements in a green management framework. The study discusses how critical success factors and key performance measures influence green manufacturing business aspects. It indicates that in the long term, investing resources and efforts to raise green organizational identity may offer competitive benefits. It also shows that investing in human resource activities is necessary to promote and sustain green manufacturing. Practices and over time, may be beneficial for the organization. Top management commitment is also shown to be critical so that green manufacturing can be embraced. The study recommends an integrated assessment that takes care of green cement production processes as well as managerial and economic aspects is required, Seth, Shrivastava, Shrivastava, (2016).

A study in Taiwan used Structural Equation Modelling to explore the relationship between green innovations and greening the supplier in electronic industry. It concluded that through green innovation, greening the supplier could lead to significant benefits to the environmental performance of the firm Chiou et al. (2011).
A study in Italy examined the green supply chain practices adopted by Third Party

Logistics (3PLs) service providers Cagno et al. (2012). These included a study of the implementation of specific practices as well as a look into how well each practice has been adopted. It also examined the relationship between implementation of various green supply chain practices and performance of the company. The work offers a better understanding of potential effects of green supply chain practices on the performance of a company.

Another study conducted in the Thailand electronic industry investigated the implementation of green supply chain management practices. It revealed that collaboration amongst stakeholders is important for efficient and effective green supply chain management. The study recommended practices such as eco-design and suggests implementation of extended producer responsibility. It looks at key drivers of green supply chain management in the electronic industry and most are linked to intellectual capacity, technological capabilities as well as the role of social pressures and by extension social capita, on implementation of the same, Ninlawan, Seksan, Tossapol, & Pilada (2009)

A study conducted in Germany investigating the factors driving of GSCM performance, Large, R.O & Thomson (2011) revealed that environmental performance is directly affected by the level of green supplier assessment and green collaboration. Both practices having being driven by strategic purchasing and strong commitment to the environment by the organization. It also revealed that environmental performance has a positive impact on purchasing performance.

A study conducted by Arimura et al. (2011) used Japanese facility level data to determine the influence of ISO 14001 certification on the green supply chain

management. It proved that GSCM practices are greatly influenced by ISO 14001 and voluntary EMS government programs. These programs encourage the facilities to assess their suppliers' environmental performance and require their suppliers to undertake specific environmental practices. A different study in Japan conducted by Zhu et al. (2010) investigated GSCM practices of large Japanese manufactures. The findings reveal that through creating mutually beneficial relationships with their partners, the huge companies can green their supply chains and, in the process, realize growth that is sustainable for the whole supply chain. The findings also show that government policies and regulations can fast track adoption of GSCM by smaller companies (borrowing from the larger companies).

In Kenya, GSCM has been adopted across various industries. For instance, a study conducted across the food and beverage industry investigated the impact of reverse logistics on supply chain performance. The findings revealed a disconnect between adoption and actual practice of reverse logistics as well as an incomplete reverse logistics loop. The study also showed that the supply chain and social performance of the company were significantly linked to environmental and economic performance, Okemba & Namusonge (2014). In a study exploring the influence of GSCM strategy on procurement performance in the Sugar Industry in Kenya, findings reveal that green manufacturing and green purchasing had direct impact on organizational procurement performance. The findings also showed that procurement performance is influenced by supply knowledge training, green purchasing, technical knowledge, quality and reliability, professional experience, innovation, delivery, morale, customer relations and productivity, Malaba, Ogolla & Mburu (2014).

A case study of Delmonte explored factors that influence the adoption of green supply chain management strategy. The findings showed that; management support through

budgetary allocations, employee encouragement and clear communication of strategies influence the adoption of GSCM. Findings also led to the conclusion that formal training sessions for staff members had the largest influence the adoption of GSCM, Machogu, (2014).

2.3.1 Global Brewing Supply Chain

Beer is one of the most consumed beverages in the world. It has an average consumption of 23 liters/person, Fillaudeau, Blanpain-Avet & Daufin (2006). Anheuser-Busch InBev, Heineken, Kirin, Diageo are the largest global companies leading the beer market, with craft beers continuing to increase their market share. As of 2016, Beer accounted for around 30-35% of the alcoholic drinks market revenue with Poland and Czech Republic countries recording the highest per capita consumption of beer in 2017 Trent (2019). Other significant players are SAB miller and Carlsberg.

The Kenyan brewing industry is characterized by two main commercial players; East African Breweries Limited and Keroche Breweries Limited, as well as several craft brewers such as Brew Bistro, Serville and Sky Bar. It is a major driver of the Kenyan economy, with taxes alone accounting for slightly under 5% of the government's revenue, Irungu. G (2012)

Sustainability, especially in the areas of water and energy efficiency, waste and water management and greenhouse gas emissions have remained areas of great concern in the brewing industry globally across time. For instance, in a study conducted across the UK brewing industry found the following opportunities in water efficiency improvement: 660 million liters of water worth over £2m could be saved annually with just a 10% improvement in water and waste water management. The areas

registering high water usage were established to be cleaning operations (especially CIPs (Cleaning in place)), Packaging and lack of effective waste water management (www.wrap.org.uk.).

Additionally, a different study analyzing the waste and waste water management across the global brewing industry finds that water and wastewater management is still a critical problem in breweries. There are major differences observed in water and waste water management as a result of the different production capacities of different breweries. In the wake of stringent legislation governing waste water disposal, breweries still work to keep their disposal costs as low as possible. Water consumption determines process performance in addition to being a critical economic parameter. Water and waste water management can be improved using some recommended biological and technical alternatives, Fillaudeau, Blanpain-Avet & Daufin, (2006).

Breweries in various parts of Africa face a similar challenge according to a study on the brewing industries in Uganda, Ghana, Ethiopia and Morocco. Water consumption per hectoliter of beer produced varies greatly amongst the countries under study. With 22 hl/hl in Ethiopia and 7.2 hl/hl in Uganda, most breweries still operate at way above the accepted international benchmark of 6.5 hl/hl. In Morocco, Ghana and Uganda, breweries are already competing for water with other industrial and domestic users. Ethiopian breweries on the other hand compete with water used in irrigation. In addition, water bodies continue to be affected by the wastewater that has been minimally treated before disposal, which also affects water supply to communities. With no government programs designed to champion water conservation in the brewing sector, water conservation policies and awareness remains poor in all four study countries. Several recommendations have been made from the report including

promotion of cleaner production as a tool for enhancing process efficiency with explicit environmental cost accounting, Svennigsen & Mebratu (2006). In light of the substantial environmental footprint of both farmers and big brewers, the question arises as to whether the sustainability efforts of smaller breweries are meaningful. This is considering the significant increase in the number of small brewers joining the industry over the last decade and the increased consumption of water as a natural resource, Crouch (2015).

The brewing supply chain in unique in that it gets all its materials from the environment. A slight change in the climatic patterns affects the activities of breweries all over the world. For instance, a shift in rainfall patterns creates an imbalance in the supply of malt, sorghum and other materials such as hops, which in turn affects production timelines and costs of a brewery. This cascades to high costs of product for the consumers.

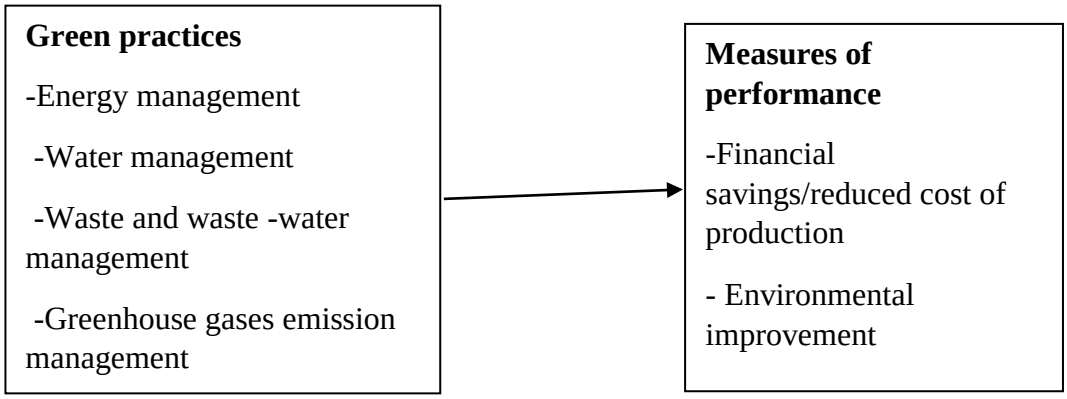
2.4 Summary of Literature Review

Green supply chain adoption and implementation is more advanced in the developed countries as compared to Africa and Kenya specifically. Globally, studies have been conducted to investigate the implementation, practices, challenges and opportunities observed in implementing GSCM, the drives, benefits and cost implication of GSCM and synergies with lean supply chain management. This is across industries such as automotive, electronic, manufacturing, food and beverage just to name a few.

In Kenya, the industries that have ‘greened’ their supply chains have primarily focused on only one aspect of green supply chain; reverse logistics. There is little evidence to show any research of how the brewing supply chains have adopted and implemented GSCM. This study aims to address this gap identified by looking at

other parameters such as water and energy efficiency, waste and waste water management and greenhouse gas emissions.

2.5 Conceptual Framework



CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the manner in which the study will be conducted. It covers the research design, population and sample selection, tools and techniques to be used in collection of data as well as the methods that will be in data analysis

3.2 Research Design

This study will be conducted in form of a cross-sectional case study. A case study is an explorative and descriptive analysis of a person, group or event. It is a methodology that enables one to investigate a phenomenon within its real-life context. Cross-sectional case studies are carried out at one time point or over a short period of time. They are usually carried out to estimate the prevalence of the outcome of interest for a given population. They are sometimes carried out to investigate associations between risk factors and the outcome of interest. They are limited however, by the fact that they are carried out at one point in time and give no indication of the sequence of events before or after the specific event of interest. Olsen, St. George (2004)

This research will involve multiple case studies and will include quantitative and qualitative real-life based evidence. It will enable an in-depth analysis of how the following organizations in the brewing supply chain: East African Maltings Limited (and associated barley farmers like Sanora limited), Kenya Breweries Limited, Keroche Breweries Limited and craft breweries like Brew Bistro and Sierra lounge. It will involve the use of a standardized semi- structured questionnaire that will be administered in different ways, as well as analysis of previously recorded information

such as energy consumed, water consumed, waste and waste water generated as well as financial statements as available.

3.3 Population

The research targets the key participants in the brewing supply chain who directly impact the environment and have or need to green their supply chains. These include: East African Maltings Limited and associated barley farmers like Sansora farm, Kenya Breweries Limited, Keroche Breweries Limited and craft breweries i.e. Brew Bistro and Sierra lounge. The key respondents will include production managers, utilities managers/engineers, environment managers, agricultural managers and 2 barley farmers.

There are other players in the industry (e.g. Traditional and illicit brewers) but they are not the focus of this study. This is because the study will be look into past recorded data evidencing tracking of energy, water, waste and waste water generation that the Traditional and illicit brewers do not have. Additionally, the identified population are operated in a formal way governed by legal and internal structures while the Traditional and illicit brewers are very informal and in the case of illicit brewers, illegal. There is also no guarantee of business continuity for the Traditional and illicit brewers rendering any information obtained from them irrelevant to others in the future.

3.4 Data Collection

Data collection will be done using standardized but semi structured questionnaires that will be administered in different ways as per need. The rest of the information will be obtained from recorded (secondary) data capturing energy consumed, water

consumed, waste water generated, solid waste generated, financial gains obtained in each case as well as general observation through plant/site visits.

3.5 Data Analysis

The quantitative data collected will be analyzed using correlation, as well as using measures of central tendency (mean, mode, median, standard deviation and variance). It will be tabulated and depicted in graphical form. The qualitative data collected will be analyzed using comparative content analysis.

Table 3.1 1 Summary of methodology

	Objective	**Data required and collection**	**Respondents**	**Methods of data analysis**
1	To find out to what extent the brewing industry has greened its supply chain with respect to water and energy efficiencies, waste management practices and air emissions and impact on organizations' environmental and financial performance	Past recorded data capturing energy consumption, water consumption, waste management records, waste water treatment records and emissions records from the identified organizations in the brewing supply chain -review of financial statements to assess financial savings observed	Utilities managers, Agricultural managers, Environment managers	-Correlation analysis -Parametric statistics -Measures of central tendency

2	To compare green practices amongst the key participants; East African Breweries (EABL), Keroche Brewing Limited and Craft brewers	-Explanation of how the different participants have greened their supply chains and observation -Collected using questionnaires, face to face interviews and observation	Utilities managers, Agricultural managers, Environment managers, production managers	Comparative content analysis
3	To find out the common drivers of green supply chain management amongst East African Breweries, Keroche Brewing Limited and Craft brewers	-Explanation of what drives the different participants to green their supply chain -Collected using questionnaires, face to face interviews.	Utilities managers, Agricultural managers, Environment managers, logistics managers, production managers	Comparative content analysis
4	To identify any opportunities available in green supply chain management at EABL, Keroche Brewing Limited and craft brewers	-Review of past recorded data as well as explanations from the respondents on the benefits (actual and perceived) obtained from greening their supply chains	Utilities managers, Agricultural managers, Environment managers, production managers	-Comparative content analysis

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents analysis and findings of the study as set out in the research methodology. The results presented here are on green practices in the brewing supply chain in Kenya and their impact on the financial and environmental performance of the organizations involved. The study objectives were;

To find out to what extent the brewing industry has greened its supply chain with respect to water and energy efficiencies, waste management practices and air emissions and impact on organizations' environmental and financial performance, to compare green practices amongst the key participants; East African Breweries (EABL), Keroche Brewing Limited and Craft brewers, to find out the common drivers of green supply chain management amongst East African Breweries, Keroche Brewing Limited and Craft brewers and to identify any opportunities available in green supply chain management at EABL, Keroche Brewing Limited and craft brewers

The study targeted 8 respondents. These were two barley farmers, one malting plant, two commercial breweries and three craft breweries. 7 out of the 8 respondents responded. This is because, one craft brewery was found to have been acquired by one of the respondents making the responding craft breweries two. This was a response rate of 87.5% and was deemed to be sufficient based on the original scope of the study and was successful as a result of consistent follow ups with the relatively busy respondents. The chapter discusses the research findings and presents some of the results in graphical, tabular and pictorial format.

4.2 Background information

The study identified key participants in the brewing supply chain who interact significantly with the environment. It targeted organizations and farms that were operated in a relatively formal organizational structure. Consequently, small scale barley farmers and upcoming craft brewers such as traditional brewers were left out of the study, though the findings obtained can be extrapolated to give an idea of the extent of green supply chain management in the brewing supply chain in totality. The questionnaires were administered in different ways and where possible, site visits were made.

4.3 The Farmers

Barley is a very important crop ranking fifth in the world crop production. It is the raw material from which beer is obtained, but can also be used as animal feed and for human consumption. It is a short season, early maturing crop with high yield and can be grown in widely varying environments, including extremes of latitudes and altitudes, Akar, Avci, Dusunceli (2004). KBL started barley growing in Kenya, with the development of local barley varieties dating as far back as 1942 after the establishment of the East African malting plant. In Kenya, all barley is grown for commercial purpose, primarily in the Rift Valley region in the areas of Timau and Mau Narok.

Barley farming is done by large commercial farms such as Sanora farm on areas greater than 350 ha as well as individual farmers who lease land on a seasonal basis. Most of the barley grown is grown under contractual agreements with East African Breweries Limited, the largest commercial brewer in the East African region, in a bid to develop and promote the local economy.

The large commercial farms grow barley alongside other crops such as wheat, oats, sorghum, maize and legumes on a rotational basis. This crop rotation is crucial for the restoration of soil nutrients and preservation of soil integrity and water table. The large commercial farmers manage a collection of farms under one brand name and trade the crop products under the established brand name. The individual farmers operate on land areas that are less than 100 ha. They also practice crop rotation albeit on the same piece of leased property or by leasing a different piece of land. Below are findings obtained from individual and group commercial farmers.

1. **Individual farmer**

Aspect	**Is it tracked?**	**Keys sources**	**Amount consumed**	**Any aspect saving/ mgt initiatives?**	**List initiatives undertake**	**% savings obtained**	**% expense reduction**
Energy	Yes	Diesel (diesel powered tractors)		No	-None	-	-
Water	No	Rainfall		yes	Used in mulching	None	None

Waste water (effluent)	No		-	no	no	none	none
Solid waste	No	Barley harvesting	-	yes	Used for mulching Composted for manure	100% recycled	
Greenhouse gas emissions	No	Emissions during tractor operation	-	no		None	none

Table 4.3 1 Summary of findings from Farmer 1

The individual farmers are not very focused on green practices. The only aspect that is tracked is energy consumed in form of diesel, and this is because it has a cost implication on the bottom line of the farmer to whom every coin count. Additionally, there are no structures to implement green practices since they operate on land that is leased seasonally. The solid waste generated is channeled back to the farm as mulch and manure and there is minimal to zero effluent generated since there are no office establishments near the farms. Water is not tracked since the farms are not irrigated, they depend on rainfall and the yield are heavily affected by the weather patterns. Green supply chain management practices are not really practiced due to the scale of

operation involved. This is a representative of the individual farmers and thus gives an overview.

2. **Group/Commercial farmer.**

One group commercial farmer responded to the questionnaire. This was Sansori Farm. Below are findings from the responses.

Table 4.3 2 Summary of findings from Farmer 2

Aspect	Is it tracked?	Keys sources	Amount consumed	Any aspect saving/mgt initiatives?	List initiatives undertake	% savings obtained	% expense reduction
Energy	yes	Diesel Electricity	4000 liters/month	no	none	-	-
Water	no	Rivers Borehole (unmetered)	-	no	none	-	-
Waste water (effluent)	n/a	n/a	n/a	n/a	n/a	-	-
Solid waste	yes	Barley straws	600 MT/year	no	Reselling at a profit	>5%	>2%

					to other users		
Greenhouse gas emissions	no	Diesel combustion	-	no	none	-	-

4.3.1 Key drivers of green practices in amongst the commercial group farmers

Despite the large scale of operation (approximately 2000+ acres), the green practices are relatively under practiced. This is due to the nature of operation (farming) and the level of awareness and concern amongst the employees and farmers. The aspect that is closely monitored is energy in the form of diesel consumed and the key driver is cost reduction. Additionally, solid waste generated from the farm is also tracked and it is also sold for profit. Green supply chain management is not yet rooted in these organizations because of the simplicity of operations, the natural availability of resources such as water and low level of environmental awareness amongst teams involved. This is a representative of the group farmers and thus gives an overview.

4.3.2 Challenges and opportunities amongst the farmers

There are opportunities, albeit limited by the nature of operation, that can be explored in this area. The first step should be to first increase the level of awareness, audit the process and identify areas of incorporate environmental thinking into the processes.

4.4 The Malting Plant

The malting plant in this research was East African Maltings Limited. It was started in 1952 and its core business is to supply Malted barley, raw barley and sorghum to

identified breweries in East Africa. It also has a plant in Molo that specializes in barley seed research and variety development. The following were the findings from EAML with regards to green practices and impact on company performance.

Table 4.4 1 Summary of findings from the Malting plant

Aspect	Is it tracked?	Keys sources	Amount consumed	Any aspect saving/ mgt initiatives?	List initiatives undertake	% savings obtained	% expense reduction
Energy	Yes	Heavy fuel oil, Electricity Diesel	8,400,000 MJ/month	Yes	-Heat recovery at the kiln -Boiler efficiency management -Process optimization	2 % (largely contributed by process optimization)	2% in total energy costs
Water	Yes	Underground water (boreholes)	100,000 m^3/month	yes	Humidification water recovery -Process optimization (2 wet	None	None

					phases instead of 3)		
Waste water (effluent)	Yes	Barley steeping process	8416 m^3/month	yes	Treated and released to offsite facility	none	none
Solid waste	Yes	Barley malting process -sorghum cleaning -barley cleaning process	108 MT/month	yes	Sold as a by product Composted within and off site	100% recycled	<1% of total financial earnings
Greenhouse gas emissions	Yes	Effluent treatment process -Boiler operations	590 MT/year (49.16 MT/Month)	yes	Boiler optimization - reabsorption at the effluent treatment plant (designed in the plant)	None	none

4.4.1 Key drivers of the green practices at the Malting plant.

The main driver for engaging in energy saving initiatives was found to be cost reduction. The company is engaging in activities and has plans for more initiatives that will drive down the energy costs currently obtained. The internal energy management systems supported this endeavor by giving structure to how these initiatives were undertaken. Government regulations and corporate social responsibility were moderate drivers.

Water saving initiatives are mainly driven by internal management systems and water managing targets, with government regulations, cost reduction and corporate social responsibilities being moderate drivers.

Waste water management, solid waste management and greenhouse gas emission management are strongly driven by internal management systems (ISO 14001;2015) set in place, government regulations, corporate social responsibility and brand improvement. Cost reduction remains a moderate driver. Over all, the figure below shows the key drivers with internal management systems being the lead driver and cost only driving one aspect i.e. energy.

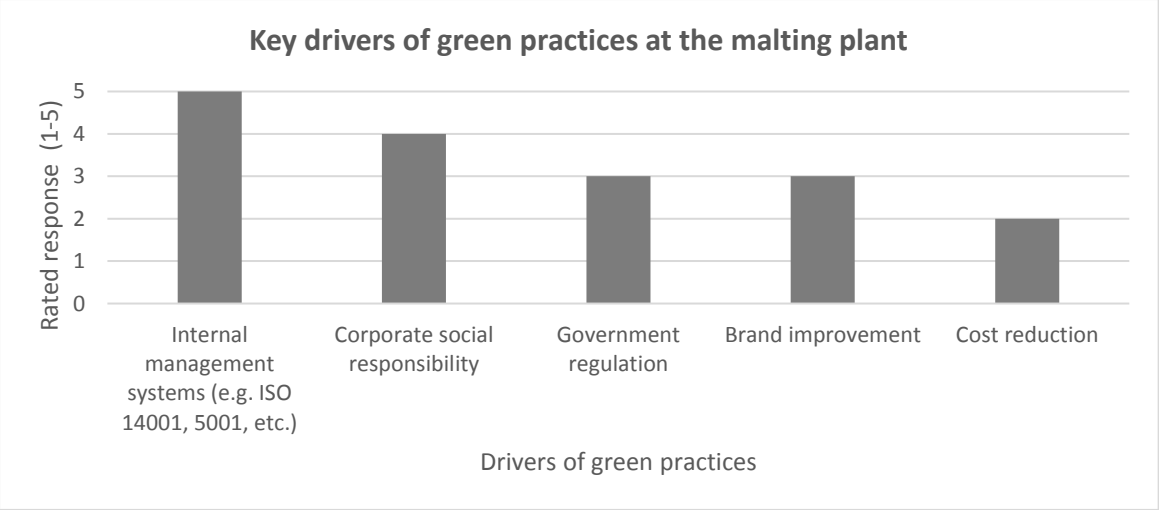


Figure 4.4 1 Key drivers of green practices at the malting plant

4.4.2 Challenges and Opportunities

High cost of implementation, slow adoption by suppliers and partners and technical capability were identified as some key hindrances to the fast adoption and implementation of green supply chain management practices. That notwithstanding, there are a number of opportunities that can be explored to improve the extent of 'greening' at the malting plant. These include; installation of solar energy systems, recycling of treated effluent, use of biomass boilers and harvesting of rain water for internal housekeeping needs.

4.5 The Breweries

Five breweries were identified as respondents for this study; two commercial ones and three craft brewers. Four out of five responded because one of the craft breweries had been acquired by another craft brewery leaving only two craft breweries. In respect of the confidentiality requests, the breweries will be identified as brewery 1, brewery 2, brewery 3 and brewery 4. All the four produce alcoholic drinks, but some of them produce fortified alcoholic drinks and nonalcoholic drinks.

4.5.1 Brewery 1.

Table 4.5.1 1 Summary of the findings from brewery 1.

Aspect	*Is it tracked ?*	*Keys sources*	*Amount consumed*	*Any aspect saving/mgt initiatives?*	*List initiatives undertake*	*% savings obtained*	*% expense reduction*

Energy	Yes	Electricity -Diesel -Heavy fuel oil	N/A	no	N/A	none	none
Water	Yes	Boreholes Municipal	10,0000 m^3/month	yes	Re-use of R.O reject water for internal non critical processes	>20%	>20%
Waste water (effluent)	No	-CIP processes -Bottle washing -General plant cleaning	N/A	no	None (waste water not treated – released to municipal drains)	none	none
Solid waste	Yes (partially)	-bottle labels from bottle washing -broken bottles -spent grains	N/A	yes	-selling of spent grains to farmers -recycling of broken glass bottles	>50% recycled	>3%

		from brewing			-sale of labels for carton manufacture - contracted disposal		
Greenhouse gas emissions	No	-Boiler operations - fumes from plant operations	N/A	yes	-Use of appropriate bottle washing additives to minimize release of Sulphur dioxide -Control of boiler combustion ratios -Reuse of CO_2 generated in the fermentation process	N/A	N/A

4.5.1.2. Key drivers of green practices at brewery 1

The main driver for engaging in energy and water saving initiatives was found to be cost reduction. The internal energy and water management systems supported this endeavor by giving structure to how these initiatives were undertaken. Government regulations and corporate social responsibility were moderate drivers.

Waste water management, solid waste management and greenhouse gas emission management are strongly driven by government regulations. Cost reduction is not a key driver in waste water management but is a moderate driver in solid waste management (reuse of bottles). Over all, the figure below shows the key drivers with internal management systems being the lead driver and cost only driving one aspect i.e. energy.

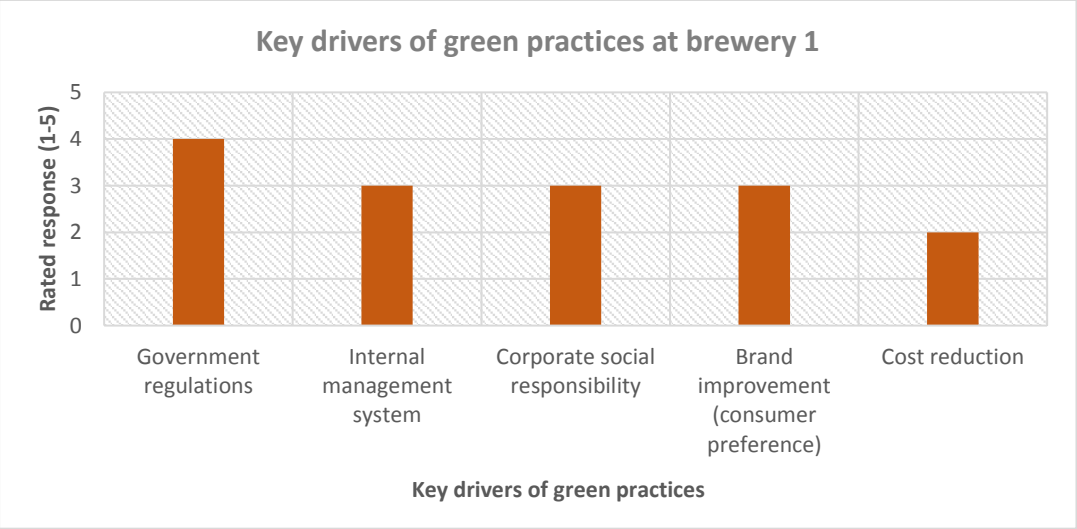


Figure 4.5.1 1 Key drivers of green practices at brewery 1

4.5.1.3 Challenges and opportunities at brewery 1

Several opportunities exist in brewery 1. These include treatment and recycling of waste water, recovery of energy through adoption of solar energy and other bio

systems, intensified recovery of water and control of emissions to the environment, and recovery of CIP water.

4.5.2 Brewery 2

Table 4.5.2 1 Summary of findings from brewery 2

Aspect	*Is it tracked?*	*Keys sources*	*Amount consumed*	*Any aspect saving/ mgt initiatives?*	*List initiatives undertake*	*% savings obtained*	*% expense reduction*
Energy	Yes	Heavy fuel oil Electricity LPG Diesel	47,000,000 MJ	yes	Intensive process optimization and Improvement of technical capabilities through energy saving equipment - Installation of solar tubes for	>20%	>20%

					general lighting - installation of LED lighting and motion sensed lighting		
Water	Yes	Municipal supply Boreholes	150,400 m^3/month	yes	Re-use of process water	4.4%	4.4%
Waste water (effluent)	Yes	CIP Bottle washing	45,120 m^3/month	yes	-Recovered back for general use -Treated before release to offsite treatment facility	<2%	<2%
Solid waste	Yes	-Beer filtration - packaging material	2.2 MT/month	Yes	- Recycling and reuse of packaging material	>40% recycled	>5%

					- sale of spent grains minimization of waste generation - Contracted disposal of hazardous waste		
Greenhouse gas emissions	Yes	Fermentation Boiler emission Effluent treatment during flaring of methane	3200 MT/year (266.67 MT/month)	yes	-Reuse of carbon dioxide generated - Flaring of Methane generated Optimization of boiler combustion rations - Treatment of HFOs	>5% production costs (re use of CO_2)	>5%

4.5.2.2. Key drivers of green practices at brewery 2

The key driver for energy management initiatives was found to be cost reduction. For water, effluent, solid waste and greenhouse gas emissions, it was found that an intricate system of internal management structures and government regulations were the main drivers. Brand improvement and corporate social responsibilities were found to be moderate drivers and seemed to be accomplished as a result of the other drivers.

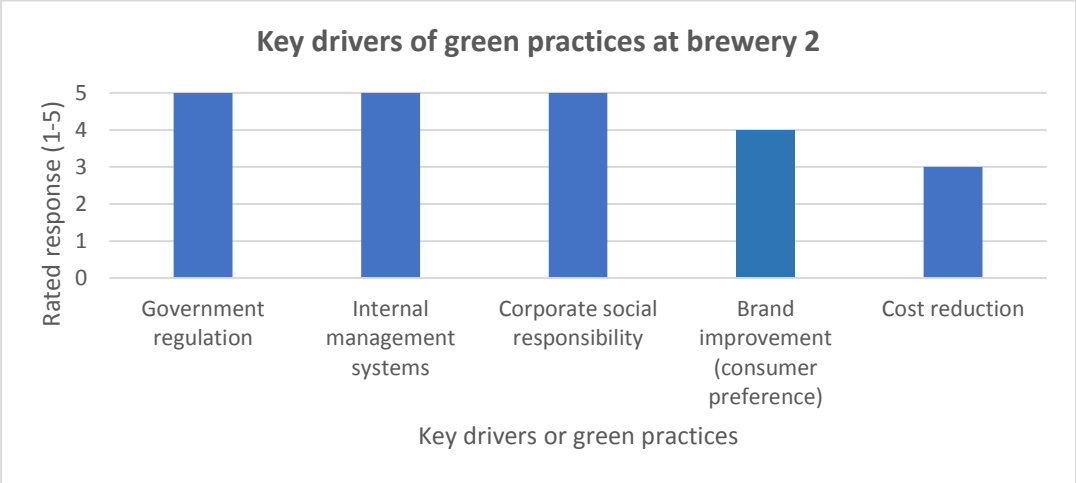


Figure 4.5.2 1 Key drivers of green practices at brewery 2

4.5.2.3 Challenges and opportunities at brewery 2

There are exists several opportunities with respect to green practices. These include, optimized installation of solar and biomass energy systems, recycling of all the pretreated effluent water released to an offsite facility, optimized recovery of process water and upgrade of systems to eliminate the need for use of biodegradables like paper.

4.5.3 Brewery 3

Table 4.5.3 1 Summary of findings from brewery 3

Aspect	*Is it tracked?*	*Keys sources*	*Amount consumed*	*Any aspect saving/ mgt initiatives?*	*List initiatives undertake*	*% savings obtained*	*% expense reduction*
Energy	Yes	Electricity LPG	-	No	-	-	-
Water	Yes	Municipal supply	300 m^3/month	No	-	-	-
Waste water (effluent)	Yes	CIP Kitchen and other cleaning activities	20-30 m^3/month	no	-	-	-
Solid waste	no	- Beer processing -Office activities -Kitchen wastes	-	Yes	- Recycling and reuse of packaging material - sale of spent grains	>40% recycled	>2%

					minimization of waste generation - Contracted disposal of hazardous waste		
Greenhouse gas emissions	no	Fermentation process	-	yes	-	-	-

4.5.3.2. Key drivers of green practices at brewery 3

The key driver for energy management was found to be cost reduction. For water, effluent, solid waste and greenhouse gas emissions, compliance to government regulations was the key driver. Corporate social responsibility was found to be moderate driver. The brewery is in the process of establishing internal management systems.

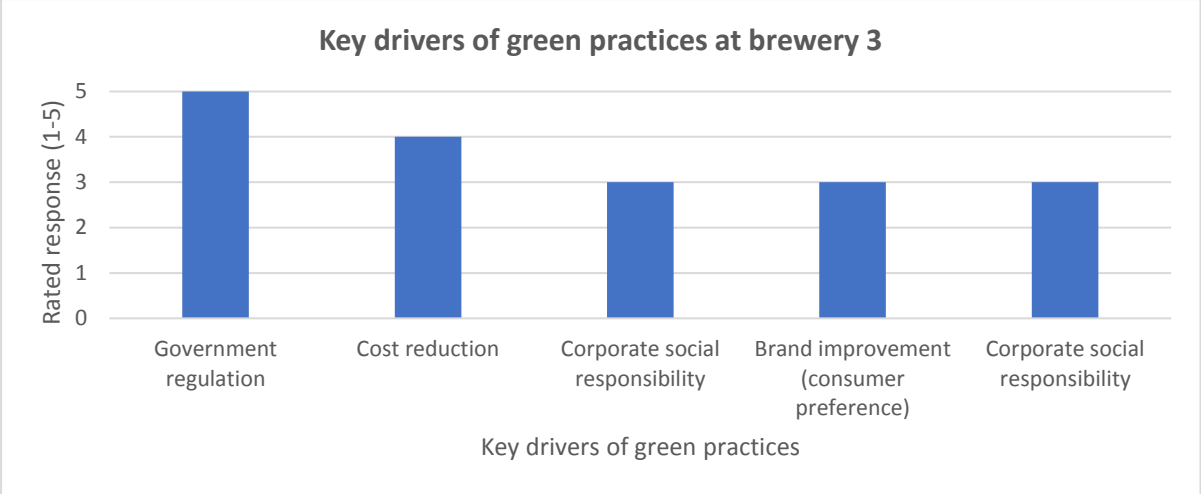


Figure 4.5.3 1 Key drivers of green practices at brewery 3

4.5.3.3 Challenges and opportunities at brewery 3

There are exists several opportunities with respect to green practices. These include, installation of solar and biomass energy systems, recycling of all the pretreated effluent water released to an offsite facility, optimized recovery of process water and upgrade of systems to eliminate the need for use of biodegradables like paper. The brewery is currently operated from a rented premise which makes it impractical to makes some of the long-term investments required for effective adoption of green practices.

4.5.4 Brewery 4

Table 4.5.4. 1 Summary of findings from brewery 4

Aspect	*Is it tracked?*	*Keys sources*	*Amount consumed*	*Any aspect saving/ mgt*	*List initiatives*	*% savings*	*% expense*

				initiatives?	***undertake***	***obtained***	***reduction***
Energy	Yes	Electricity HFO Diesel	33,400 kwh/Month	No	-	-	-
Water	Yes	Municipal supply	1500 m^3/month	yes	-dry cleaning -Use of water guns on hoses	15%	4 %
Waste water (effluent)	No	CIP Bottle washing Beer filtration	-	no	-	-	-
Solid waste	yes	- Spent grain -Bottle breakages	0.5 MT/Month	Yes	- Recycling and reuse of packaging material - sale of spent grains minimization of	>5% recycled	<1%

					waste generation - Incineration hazardous waste		
Greenhouse gas emissions	no	- Fermentation -Boiler emission	-	yes	-Reuse in bottle packaging - Scrubbing mechanism in the boiler exhaust	-	-

4.5.4.2. Key drivers of green practices at brewery 4

The key driver for energy management was found to be cost reduction. For water, effluent, solid waste and greenhouse gas emissions, compliance to government regulations and adherence to internal aspect management systems were the key drivers. Corporate social responsibility and brand improvement were found to be moderate driver. The brewery is in the process of constructing a complete effluent treatment plant

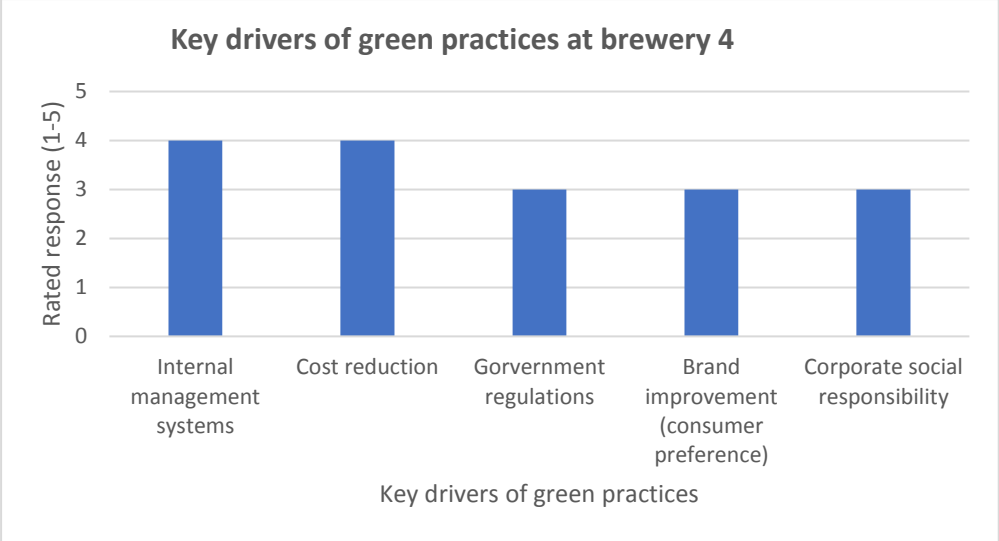


Figure 4.5.4 1Key drivers of green practices at brewery 4

4.5.4.3 Challenges and opportunities

Opportunities observed in adoption of green practices include, installation of solar and biomass energy systems, recycling of all the pretreated effluent water released to an offsite facility, optimized recovery of process water and upgrade of systems to eliminate the need for use of biodegradables like paper. Government partnership, employee awareness and community engagement were cited as challenges that are yet to be addressed to improve adoption of green practices by the brewery.

4.6 Objective 1: The extent of GSCM in the brewing supply chain and impact on financial and environmental performance

The brewing supply chain overall ranks on the low spectrum with regards to adoption and consistent implementation of green practices. 28.5% of the participants rated their level adoption of implementation as moderate, 28.5% rated themselves as very low and 43% rated themselves as low.:

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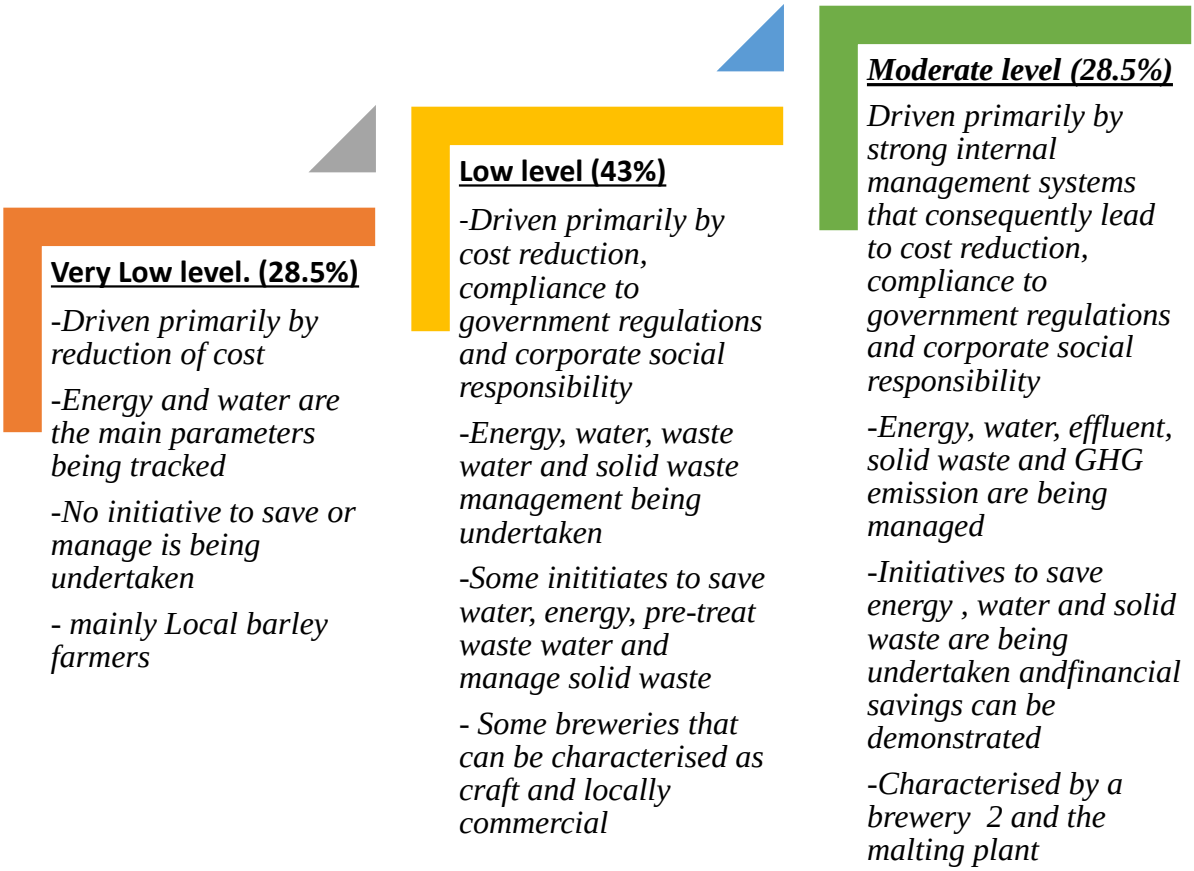

Figure 4.6 1Diagrammatic illustration of extent of greening in the brewing supply chain in Kenya

Out of the 7 identified respondents, only one brewery has been able to invest and engage consistently in green practices and can demonstrate savings from the green practices undertaken, especially in the area of energy management. While this may not be the best in class, it is a step in the right direction and an encouragement to those who are just familiarizing themselves with green supply chain management. The energy saving initiatives that were undertaken were intensified from the year 2017 and below are the results;

Table 4.6 1 Savings obtained from energy saving initiatives at brewery 2

	2017	2018	Energy savings (GJ/Hl of beer produced)	Return on initial investment
Electrical energy (GJ/Hl of beer produced)	0.02796	0.02667	0.00129	4 times investment made
Fossil fuel energy (GJ/Hl of beer produced)	0.075496	0.069287	0.006209	7 times investment made

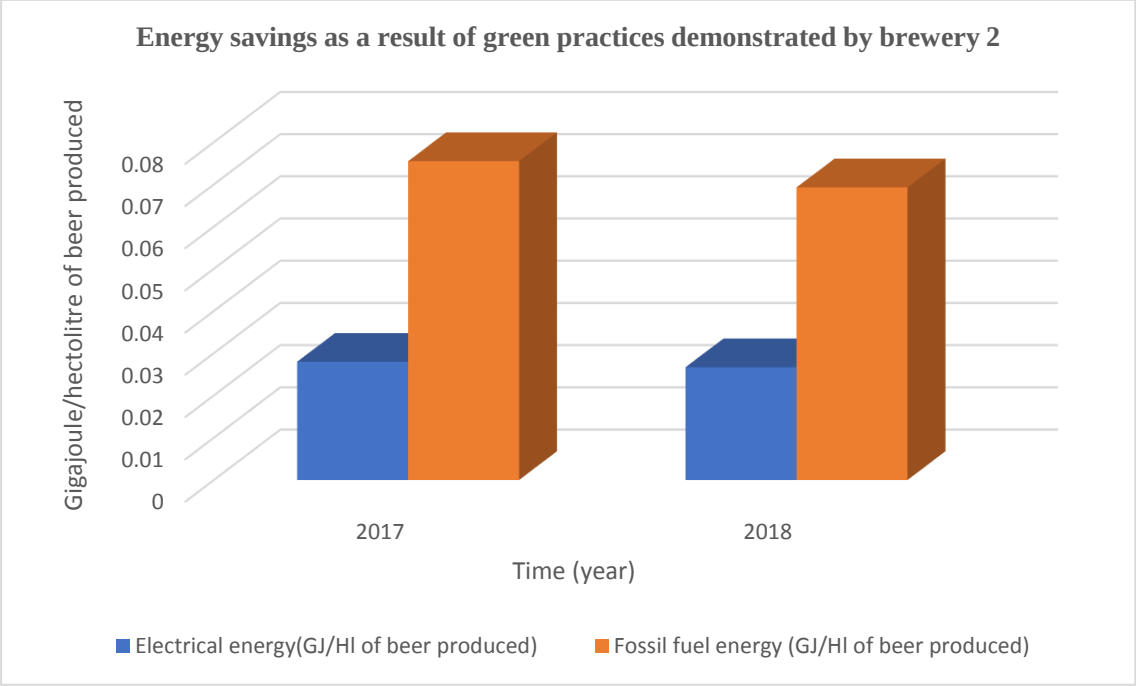

Figure 4.6.2 Savings obtained from energy saving initiatives at brewery 2

The reduced consumption in energy translates to a reduction in overall production cost per hectoliter of beer produced.

4.7 Objective 2: Comparison of GSCM practices of organizations in the brewing industry

Table 4.7 1 Comparison of green practices of organizations in the brewing industry in Kenya

	Farmers	**Malting plant**	**Brewery 1**	**Brewery 2**	**Brewery 3**	**Brewery 4**
Energy mgt	*Metered tracking of diesel received and consumed*	*Metered tracking of electricity and heavy fuel received and consumed* *Recovery and reuse of boiled water* *Process optimization through regulation of fan speeds, temperature-controlled boiler operation, minimization of startups and stoppages, installation of devices like variable speed drives, etc.*	*Metered tracking of incoming and consumed electricity* *Metered tracking of HFO consumed*	*Metered tracking of electricity and heavy fuel received and consumed* *Intensive condensate recovery* *Process optimization through regulation of fan speeds, temperature controlled boiler operation, minimization of startups and stoppages, installation of devices like variable speed drives, etc.*	*Metered tracking of incoming and consumed electricity* *Metered tracking of LPG consumed*	*Metered tracking of incoming and consumed electricity* *Metered tracking of HFO consumed*

		Semi automation of processes and installation of solar heaters for some areas		*Intensive team participation and commitment in normal activities such as autonomous maintenance, DMAIC streams etc.* *Implementation of additional technical and cost intensive break through projects*		
Water mgt	*No tracking implemented. Dependence on natural sources like rain, rivers and bore holes*	*Metered tracking of received municipal and borehole water* *Process adjustments such as implementation of two wet phases during steeping instead of three*	*Metered tracking of incoming and consumed municipal water* *Recovery of R.O reject water*	*Metered tracking of incoming and consumed municipal water* *Partial recovery of water used in CIPs, R.O reject water UF reject water* *Improved*	*Metered tracking of incoming and consumed municipal water* *Extensive creation of awareness amongst the employees*	*Metered tracking of incoming and consumed municipal water* *Extensive creation of awareness amongst the employees* *Improved cleaning*

		Recovery of humidification water and use of nozzles for optimal spraying *Vigilance in maintenance of systems to prevent and arrest leakages* *Extensive creation of awareness amongst the employees*		*cleaning practices such as dry cleaning, use of hoses in pressure cleaning* *Vigilance in maintenance of systems to prevent and arrest leakages* *Extensive creation of awareness amongst the employees*		*practices such as dry cleaning, use of hoses in pressure cleaning*
Effluent mgt	*No effluent generated*	*Pre-treatment before release to an offsite treatment facility*	*No treatment. Effluent directly released to offsite treatment facility*	*Pretreatment before release to an offsite treatment facility*	*Pretreatment before release to an offsite treatment facility*	*Pretreatment before release to an offsite treatment facility*
Solid waste mgt	*Used in mulching* *Sold for profit* *>60% recycled*	*Composted onsite for manure and sold for profit* *Other waste sold directly as*	*Spent grain sold directly as animal feed* *Packaging material like*	*Spent grain sold directly as animal feed* *Packaging material like glass and*	*Spent grain sold directly as animal feed* *Hazardous waste*	*Spent grain sold directly as animal feed* *Packaging material like*

		animal feed *Paper sold to contracted company for recycling* *Hazardous waste disposed of by licensed contractor*	*glass and cartons are recycled* *Hazardous waste disposed of by licensed contractor*	*cartons are recycled* *Hazardous waste disposed of by licensed contractor*	*disposed of by licensed contractor*	*glass and cartons are recycled* *Hazardous waste disposed of by licensed contractor*
GHG emissio n mgt	*not tracked*	*Tracked* *Reabsorbed at the effluent treatment plant* *Optimization of boiler operation*	*not tracked* *Carbon dioxide generated used in carbonatio n of beer in bottles*	*Tracked* *Optimization of boiler operation* *Reuse of generated Carbon dioxide in the process* *Methane generated from effluent treatment plant is flared*	*not tracked*	*not tracked* *Carbon dioxide generated used in carbonatio n of beer in bottles*

4.8 Objective 3: Comparison of drivers of GSCM practices in the brewing supply chain

From the findings obtained, the brewing supply chain overall ranks on the low spectrum with regards to adoption and consistent implementation of green practices. There is minimal adoption of green practices amongst the farmers, with those undertaken involving energy and being primarily driven by the need to minimize operational costs. Even at this level, what is mostly being done is tracking so as to enable easy accounting of every coin. No energy saving initiative has been put in place due to a number of reasons. These include lack of awareness amongst team, little focus on green practices in farming and lack of monitoring and partnership with regard to this area by government institutions

Amongst the breweries and malting plant, cost minimization is a common driver for energy and water management while stringent government regulations and corporate social responsibility remain the primary drivers behind waste water (effluent) and solid waste management. The scale of operations is a determinant of GHG emission management with the larger facilities being required to mitigate their GHG emissions to the atmosphere.

However, for the organizations (breweries and malting plant) that were able to demonstrate impact on financial and environmental performance from adoption and implementation of green practices, it was found that strong, effective and efficient internal management systems such as Environmental management systems like ISO 14001 and Energy management systems like ISO 5001, amongst other internal management systems played a key role.

Table 4.8 1 Comparison of drivers of green practices in the brewing supply chain

Primary drivers	**Moderate drivers**	**Key success factors**
Cost reduction	Corporate social responsibility	1. Top management support
Compliance to government regulations	Brand improvement	2. Technical capability
Internal management structures		3. Employee awareness and buy in.

Fig 4.8.1 Key determinants of levels of adoption and implementation of green practices in the brewing supply chain

Additionally, the two sited top management support, in the areas of policy development, communication and financial investment were key in ensuring adoption of and implementation of green practices. This is because, for some of the initiatives, there is need to purchase and install devices operating using new technology as well as modification of systems for enhancement of efficiencies. Top management support also heavily influenced the behavior of employees with regard to engaging consistently in green practices. It ensured that the rest of the employees gave the initiatives the weight required and consequently, everyone in the company participated in green practices like reducing waste generation, recycling and reusing of material.

4.9 Inferential statistics (Chi Square test (x^2)

The data collected was tested for good fit using the Chi square test to establish how far apart or discrepant the observed data was from the expected data from all the respondents for selected questions.

$$X^2 = \Sigma\{\frac{(O-E)2}{E}\}$$

Where; X^2= Chi Square

O – Observed results

E- Expected results.

Table 4.9 1 Population means for responses from selected questions

		Farmer	*Malting plant*	*Brewery 1*	*Brewery 2*	*Brewery 3*	*Brewery 4*
Q5	***% parameters tracked***	0.6	1.0	0.6	1.0	0.8	0.6
Q6a	***% Energy sources***	0.400	0.670	0.500	1.000	0.400	0.500
Q6h	***Mean factor of motivation for energy management***	2.200	3.500	2.800	4.000	2.200	3.200
Q7a	***% Water sources***	0.750	0.500	0.500	0.500	0.250	0.250
Q7g	***Mean factor of motivation for water management***	1.670	3.000	3.000	4.200	1.830	2.500
Q8c	***% effluent treatment options***	0.000	0.200	0.200	0.400	0.200	0.200

Q8d	***Mean factor of motivation for effluent management***	1.670	4.500	1.830	3.830	2.670	4.000
Q9i	***Mean factor of motivation for solid waste management***	2.800	4.400	3.500	4.000	2.670	2.830
Q10d	***Mean factor of motivation for Greenhouse gases emission management***	1.7	3.8	3.5	4.2	0.0	3.3
Q11c	***Mean factor of Key drivers for Green supply chain management***	2.7	3.6	3.9	4.4	2.8	2.7

Hypotheses set

H_0: Pf=Pm=Pb1=Pb2=Pb3=Pb4

There is no significant difference between observed and expected results

H_1: Pf≠Pm≠Pb1≠Pb2≠Pb3≠Pb4

There is some significant difference between observed and expected results

α: 0.995

Where: f – farmer, m-malting plant, b1 – brewery 1, b2- brewery 2, b3- brewery 3, b4- brewery 4

Table 4.9 2Summary of Chi square values, evaluation based on x2 distribution table, decision on hypotheses and interpretation

Question	*x2*	*Degrees of freedom = no off groups -1*	*α*	*Critical value from x2 distribution table*	*Results*	*Evaluation*	*decision*	*Interpretation*
Q5	0.255	5.00	0.995	0.412	x^2(5), 0.995 = 0.255	x^2<0.412	*Do not reject the null hypothesis Ho*	*There is no significant difference between the observed and expected values*
Q6a	0.453	5.00	0.995	0.412	x^2(5), 0.995 = 0.453	x^2>0.412	*Reject null hypothesis Ho*	*There is some significant difference between the observed and expected values*
Q6h	0.874	5.00	0.995	0.412	x^2(5), 0.995 = 0.874	x^2>0.412	*Reject null hypothesis Ho*	*There is some significant difference between the observed and expected values*

Q7a	0.386	5.00	0.995	0.412	$x^2(5)$, 0.995 = 0.386	x^2<0.412	*Do not reject the null hypothesis Ho*	*There is no significant difference between the observed and expected values*
Q7g	1.588	5.00	0.995	0.412	$x^2(5)$, 0.995 = 1.588	x^2>0.412	*Reject null hypothesis Ho*	*There is some significant difference between the observed and expected values*
Q8c	0.400	5.00	0.995	0.412	$x^2(5)$, 0.995 = 0.400	x^2<0.412	*Do not reject the null hypothesis Ho*	*There is no significant difference between the observed and expected values*
Q8d	2.317	5.00	0.995	0.412	$x^2(5)$, 0.995 = 2.317	x^2>0.412	*Reject null hypothesis Ho*	*There is some significant difference between the observed and expected values*

Q9i	0.767	5.00	0.995	0.412	$x^2(5)$, 0.995 = 0.767	x^2>0.412	*Reject null hypothesis Ho*	*There is some significant difference between the observed and expected values*
Q10d	4.667	5.00	0.995	0.412	$x^2(5)$, 0.995 = 4.667	x^2>0.412	*Reject null hypothesis Ho*	*There is some significant difference between the observed and expected values*
Q11c	0.781	5.00	0.995	0.412	$x^2(5)$, 0.995 = 0.781	x^2>0.412	*Reject null hypothesis Ho*	*There is some significant difference between the observed and expected values*

The findings show that parameters tracked as observed are similar to what is expected due to similarity of the needs of the organizations. However, for individual parameters and level of management as well as key drivers, there is a significant difference between the expected results and observed results. These differences arise as a result

of difference in scale of operations, age and level of establishment, top management support as well as establishment of factors like internal management systems.

4.10 Opportunities identified GSCM practices in the brewing supply chain

The brewing supply chain is far from fully adopting and implementing green supply chain management. Several opportunities exist especially in creation of awareness amongst the farmers and the upcoming breweries. The farmers and some of the breweries are still at the stage of monitoring and stabilization of what they consume in terms of energy and water and tracking what they generate in terms of effluent water, solid waste and greenhouse gases. They are yet to fully optimize their processes and so the prospects of using biomass energy systems and solar energy will take a while to be adopted. Adoption of proper internal management structures is yet to be fully done, leaving a huge gap for systematic adoption and implementation of green practices. Cost of installation (initial investments) and top management support remain a major challenge, with some facing challenges as unique as operating from rented space. Therefore, from individual opportunities discussed under each respondent, it is evident that we still have a long way to go.

4.11 Discussion

The findings from the study are in the line with the theories that were earlier proposed in this study, that is, the theory of Technology-Organization and Environmental Framework, the resource-based view of the firm and the Social Capita theory.

The resource-based theory of the firm explains that firms possess resources, some which enable them to achieve competitive advantage, and a portion of those which further lead to superior long-term performance. Although at a moderate level of

implementation of green practices, brewery 2 engaged in energy saving initiatives that resulted in significant savings, keeping it ahead of its competitors in terms of lower cost of production. The savings were obtained as a result of technical, managerial and behavioral improvements over time which can only indicate that should these be sustained, the brewery stands to remain ahead of its competitors since lower costs of production translate to lowered selling price of the final product, increased market share and increased profit margin, holding all other factors that affect product performance in the market constant. The rest of the breweries and farmers could not benefit from the same since their level of adoption and implementation of green practices still remain at low and very low levels as rated by their response.

The theory of Technology-Organization and Environmental Framework argues that the organizational context, technological context and environmental context influences how a firm adopts and implement innovation in technology, DiPietro, Wierda, & Fleischer (1990). The technological context includes both internal and external technologies (equipment and processes). The characteristics of the firm i.e. degree of centralization, size of firm, human resources, formalization, employee linkages, managerial structure etc. are covered under the organizational context. The macroeconomic context, competitors, size and structure of the industry and the regulatory environment are covered under the environmental context.

From the findings, the farmers, malting plant and all the breweries are heavily affected by the macro environmental factors like weather patterns that affects the non-irrigated farming, supply of barley & availability of water and strict government regulations that have forced the breweries and the malting plant to engage in effluent pre-treatment before releasing it from their premises. The organizational and technological context are what lead to the different levels of adoption and

implementation of green practices amongst the respondents. For instance, in the brewery and malting plant that are moderately 'greened', it was found that top management support in the form of financial support and policy development, institution of internal management structure, high employee awareness and buy in and management commitment to corporate social responsibility have enable these two to adopt and implement green practices to a greater degree than the other respondents. Lack of these factors were also cited by the other respondents as the reasons behind the low level of adoption and implementation of green practices. Additionally, these two organizations that are moderately green are older (were started much earlier) and are established on more permanent premises compared to the rest of the breweries and hence have the added advantage of having stabilized their costs and operations and hence could afford to invest in technical installations and other organizational aspects that have enabled them to be moderately greened.

The brewery and malting plant that were moderately 'greened' sited corporate social responsibility as a key driver of adopting and implementing the same. Guided by internal policies that push for zero waste to landfill, the two organizations are particularly keen on how they affect the surrounding environment and communities. In addition to green practices, brewery 2 frequently engages in tree planting activities and provision of clean water to the members of the community. Because of this, its social capita is higher as compared to the rest of their competitors. Although overall, the brewing supply chain has a long way to go with respect to green supply chain management, the findings point to the adoption and implementation of green practices being a source of competitive advantage and social capita and level of greening is affected by an organization's technological-organizational and environmental context.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary of the study, conclusions drawn from the findings and recommendations in line with the objectives of this study.

5.2 Summary of the study

The study found that green supply chain management is a relatively new concept amongst the participants of the brewing supply chain, with the adoption of green practices ranging between low to moderate. The breweries primarily motivated by cost and government legislation engaged in most of the green practices of interest as identified in the study while the farmers, primarily due to the nature of their core activities, did not really put focus on or engage in most of the green practices. 100% of the participants in the supply chain engaged in energy management initiatives in basic (only monitoring energy usage) to semi-advanced stages (venturing into energy saving alternatives such as solar system. This was primarily influenced by the need to reduce the energy costs of the organization.

The ones that engaged in effluent management such as pre-treatment (57.14 % of the respondents) only did so to comply to strict government regulations. None of the participants in the brewing supply chain was treating effluent for the purpose of recycling the water within the organization. Solid waste management was also practiced, especially if the waste had a cost value to it, such as spent grains for breweries, barley straws and recyclable packing material. Government legislation did not play a significant role in solid waste management.

Process water recovery and recycling was only done in one of the larger breweries and the malting plant (28.5% of the respondents). This was motivated by both cost

and the need to preserve water since they operate in a water stressed region. The rest of the participants in the brewing supply chain only engaged in water management (monitoring how much water is used vs. what is received) as a cost management initiative and not as a deliberate green practice.

For greenhouse gases, only one of the larger breweries and the malting plant deliberately tracked how much of their gases they were emitting into the atmosphere and had even made attempts to mitigate the impact. The rest of the breweries had not put in place any means to track and consequently control how much was emitted to the atmosphere. This was due to both scale of operation as well as process design. For instance, in all the breweries where beer was packed in bottles, the carbon dioxide generated from the process of fermenting was used in carbonating packaged beer. However, this only took care of process generated gases. Other activities such as boiler operation was not well accounted for.

It was found that in the organizations that had adopted and implemented green practices, that is brewery 2 and the malting plant, there was strong management support and internal management structures such as ISO 14001 amongst others, that guided and required the organizations to engage in green practices and document the process and the progress. As a result, these organizations were able to demonstrate progress in the form of financial savings obtained from engaging in green practices. As a result, both organizations have made plans to invest further in green supply chain management.

5.3 Conclusions

The objective of this study was to find out to what extent the brewing industry has greened its supply chain with respect to water and energy efficiencies, waste

management practices and air emissions and impact on organizations' environmental and financial performance. After analysis of the data collected, the conclusion made is that the brewing supply chain has been greened though to a low extent (only 28.5% of the respondents have moderately adopted and implemented green practices). As a result of this low level of adoption and implementation of green practices, only one of the organizations (brewery 2) could demonstrate impact of green practices on financial performance, through the energy management initiatives they had engaged in and the data recorded. However, this data was not sufficient to conclusively determine whether the financial savings impacted on market share as several factors come into play and determine performance of their finished product in the market. Sufficient recorded data was not available from the rest of the participants to demonstrate significant impact of green practices on financial savings.

The common practices amongst the breweries in the areas of energy management, water management and effluent and solid management are driven by cost reduction and government regulations. However, there is strong evidence to suggest that internal management structures such as ISO certification and top management support are key drivers to propelling adoption and implementation of green practices to a level that allows an organization to reap economic and environmental benefits. Top management support in the form of budget allocation for breakthrough projects and institution into organization policies, processes and practices were listed as what enabled brewery 2 to attain significant savings in the area of energy management.

Additionally, locational permanence was cited as a factor that enabled and or hindered organizations when it came to investing in green processes. For instance, brewery 3 cited operating from a rented premise as one of the reasons it had not greatly financially invested in processes and mechanisms that would lead to better adoption

and implementation of green practices. The scale and age of an organizations coupled with level of awareness were also determined to be key factors in determining the extent of adoption and implementation of green practices, as the larger and older of the organizations had adopted and implemented green practices. This is because, the ones that had started more recently were still working to stabilize their costs and expand and hence not much weight and focus was put on adoption and implementation green practices. The study thus concludes that top management support, internal management structures, scale and age of an organizations and level of awareness were key determinants in the extent of adoption and implementation of green practices.

5.4 Recommendations

From the study, several gaps exist in the area of green supply chain management especially in the beer making supply chain. The study recommends going forward, a partnership between academia, the government and the private sector with a goal to deliberately increase the level of awareness for the need to green their processes amongst organizations heavily rely on the environment such as the ones in the beer making supply chain. The study also recommends the development of a structured approach which enables different organizations to share best practices for the overall betterment of the environment and for increased sustainability within the country. Finally, the study recommends a partnership between government and private sector to ensure that green practices such as waste water treatment are no longer a matter of compliance but rather, a need for improved sustainability of the environment.

5.5 Limitations

The primary objective of the study was to establish the extent of greening in the beer making supply chain. One of the limitations encountered was the fact that the study focused only organizations that were had a formal structure and were legal entities, leaving out traditional brewers and home brewers who also interact with the environment in an ungoverned manner. Another limitation was in accessing some of the organizations listed and consequently, not obtaining enough data to make further extrapolations. Finally, there could be the element of bias since organizations can tend to augment that which they are doing well and diminish or minimize that which they are not doing as well as required.

5.6 Suggestions for further studies

From the findings of the study, it is evident that there are several opportunities that exist in the adoption and implementation of green practices and consequently, green supply chain management in the brewing industry. I therefore suggest further investigation of the relationship between green supply chain management and level of employee awareness, looking at factors like level of education, type of employment (permanent, contractual, casual) and organizational incentives that affect the same. I further suggest for an investigation of how partnership with suppliers and third-party contractors can influence the overall greening of an organization's supply chain, with a focus on a brewery. It can look into how this has successfully been done and how it can be transferred to other organizations within and outside of the brewing supply chain.

REFERENCES

Diabbat, A., & Govindan, K. (2011). *Analysis of the drivers affecting green supply chain management. Resources,* Conservation and Recycling, 1, 655-667

DiPietro, Rocco, Wierda, & Fleischer. (1990). *Https://istheorizeitorg/wiki/ Technology-organization-environment framework*. Retrieved 26 July, 2018, from https://is.theorizeit.org

Diab, S., Al-Bourinni, F., & Abu-Rumman, A. (2015). *The Impact of Green Supply Chain Management Practices on Organizational Performance*: A Study of Jordanian Food Industries. Journal of Management and Sustainability, 5(1), 149 – 157

Filladeau, L., Blanvain-Avet, P., & Daufin, G. (2006). *Water, Waste water and waste management in the brewing industry.* Journal of cleaner production, 14(1), 463 - 471.

Huho, J., & Mugalavai, E. (2010). *The Effects of Droughts on Food Security in Kenya.* The international journal of climate change; Impact and responses, 62 –72

Irungu G. (2012, August 8). *Kenya ranked Africa's third largest Beer market. Business Daily.* Retrieved May 12, 2019, from https://www.businessdailyafrica.com/Kenya-ranked-Africas-third-largest-beer-market-/-/539552/1474520/-/vvod6tz/-/index.html

Machogu, W. (2014). *Factors influencing the adoption of green supply chain management strategy in industries: a case of Delmonte company.* International Academic Journal of Information Sciences and Project Management, 1(2), 1-

Malaba, P., Ogolla, K., & Mburu, D. (2014*). Influence of green supply chain management strategy on procurement performance of sugar industry in Kenya*. International Journal of Economics, Commerce and Management, 2(11), 1-24.

Narayan, Cassidy. (2001*). Https://istheorizeitorg/wiki/Social_capital_theory*. Retrieved 26 July, 2018, from https://is.theorizeit.org

Ng'ang'a, J. (2006, September 23*). Climate change impacts, vulnerability and adaptation assessment in East Africa.* UNFCCC African Regional Workshop on Adaptation

Okemba, P. (2014). *Green supply chain management practices as determinants of supply chain performance in Kenya's manufacturing firms: a case study of Nairobi-based firms in the food and beverage sector*. Strategic Journal of Business & Change management, 2(22), 423 – 431

Ramakrishan, P., Haron, H., & Goh Y. (2015). *Factors influencing green purchasing adoption for small and medium enterprises (smes) in Malaysia*. International Journal of Business and Society, 16(1), 39-56.

Sarkis, J. (2011). *A boundaries and flows perspective of green supply chain management. Supply Chain Management*: An International Journal, 17(2), 202-216.

Seman, N., Zakuan, N., Jesoh, A., & Shoki, M. (2012). *GREEN SUPPLY CHAIN*

MANAGEMENT: A REVIEW AND RESEARCH DIRECTION. International Journal of Managing Value and Supply Chains (IJMVSC), 3(1), 1-18

Seth, D., Shrivastava, R., & Shrivastava, S. (2016). *An empirical investigation of critical success factors and performance measures for green manufacturing in cement industry.* Journal of manufacturing technology management, 27(8), 1076-1101.

Trent, N. (2019, June 4). *Market watch. Beer Market 2019*: Global Key Players, Trends, Share, Industry Size, Segmentation, Opportunities, Forecast To 2025.

Wantao Yu, Roberto Chavez, Mengying Feng, Frank Wiengarten, (2014) *"Integrated green supply chain management and operational performance", Supply Chain Management:* An International Journal, Vol. 19 Issue: 5/6, pp.683-696,

Zhu Q, Sarkis J, (2004) *Relationships between operational practices and performance among followers of green supply chain management practices in Chinese manufacturing enterprises;* Journal of Operations management;22; 265- 289.

Nichlas, S., & Mebrafu, D. (2006*). Sustainable Water Utilisation in African Breweries - current practices and prospects.* UNEP's project on African Brewery sector Water saving initiative (ABREW)

Akar T, Avci M & Dusunceli F. (2004). *BARLEY: Post-Harvest Operations*, The Central Research Institute for Field Crops, FAO, 2-3

APPENDICES

APPENDIX 1. RESEARCH QUESTIOINNAIRE

INTRODUCTION

Name:

Designation:

Department:

Company/organization:

Date:

PART A

The purpose of this section is to find out the extent to which your organization has 'greened' its processes. Please note that the response will remain confidential and will only be used for academic purposes and the report generated will be submitted to you upon request.

1. When was this organization established?
2. How many employees work for this organization?
3. What are the core business activities that you/your organization engage in?
4. What are some of your products (list at least two)?
5. Does your organization track the following parameter(s)?

	Yes	No
a. Energy	☐	☐
b. Water	☐	☐
c. Waste generated	☐	☐
d. Effluent (waste water) generated	☐	☐

e. Greenhouse gas emitted ☐ ☐

PART B

6. Energy:

a. What are the major sources of energy in your organization (please tick where appropriate and indicate the **%** of each of the energy sources you have listed)?

Energy source	**Yes/No**	**If yes, % contribution**
Electricity		
Heavy fuel oil		
Diesel		
Solar		
Biomass (e.g. wood, husks, etc)		
Other (please specify)		

b. Kindly list some of the largest energy **consumers** in your organizations (E.g. Drying, Kilning, Wort boiling, etc.)

c. How do you track the amount of energy **received** on site? (E.g. use of meters, excel sheets, online systems etc.

d. How do you track the amount of energy **used** on site? (E.g. use of meters, excel sheets, online systems etc.

e. On average, how much energy (in MJ) do you consume per month?

f. (i) Is your organization currently engaged in any energy saving initiative (*e.g. use of solar panels, solar tubes, wind operated equipment etc.)*? (**YES)/ (NO**)

(ii) If yes, which are these initiatives (*please list at least 2 initiatives*)?

g. (i) Have you observed any reduction in energy consumed as a result of any/all of these initiatives? (YES/NO)

(ii) If yes, which energy saving initiative led to the largest reduction in the amount of energy consumed at your site?

(iii) What was the **%** reduction in the amount of energy consumed?

(iv) Have these savings translated to savings in monetary terms (Kenya shillings)? **(YES)/ (NO)**

(v) If yes, by what % has your energy expense/budget been reduced?

h. Kindly rate the following factors on a scale of (1-5) based on how much they have motivated your organization to engage in energy management

Factors	**(very high)**	**(high)**	**(Moderate)**	**(Low)**	**(very low)**
Cost reduction					
Government regulation (e.g. Energy Act)					
Internal energy management system requirement (e.g. ISO 50001)					
Corporate social responsibility					
Brand improvement (consumer preference)					
Others (specify):					

7. Water

a. What are the sources of water in your organization?

Water source	**Yes/No**	**If yes, % contribution**
Municipal		
Boreholes		
Rain		
Other (please specify)		

b. Kindly list some of the largest consumers of water in your organization? (E.g. steeping, cleaning in place, etc.)

c. How do you track the amount water **received** in your organization? (E.g. use of meters, excel sheets, online systems etc.)

d. How do you track the amount water **consumed** in your organization? (E.g. use of meters, excel sheets, online systems etc.)

e. On average, how much water (in M^3) do you consume per month?

f. (i) Is your organization currently engaged in any water saving and recovery initiatives (*e.g. recycling of treated effluent, reuse of process water, harvesting of rainfall etc.*)? **(YES)/ (NO)**

(ii) If yes, which are these initiatives? (list at least 4)

(iii) Have you observed any reduction in water consumed as a result of any/all of these initiatives? (YES/NO)

(iv) If yes, which water saving initiative led to the largest reduction in the amount of water consumed at your site?

(v) How much was reduction in the amount of water consumed in %?

(vi) Have these savings translated to savings in monetary terms (Kenya shillings)? **(YES)/ (NO)**

(vii) If yes, by what % has your water expense/budget been reduced

g. Kindly rate the following factors on a scale of (1-5) based on how much they have motivated your organization to engage in water management

Factors	**(very high)**	**(high)**	**(Moderate)**	**(Low)**	**(very low)**
Cost reduction					
Government regulation (e.g. Environmental Management and Coordination Act - EMCA)					
Internal environmental management system requirement (e.g. ISO 14001)					
Corporate social responsibility					
Brand improvement (consumer preference)					
Others (specify):					

8. Waste water (effluent)

a. Are there any processes in your organization that generate waste water? (**YES)/ (NO)**

a. If yes, which are these processes? (list at least 3)

b. Do you track the amount of waste water generated? (**YES/NO).**

b. If yes, how much waste water is generated on average, per month?

c. How is this waste water disposed of? (*please tick where it applies*

	Waste water disposal methods	**Please tick where it applies**	**% Treated**
a	Treated and recycled on site		
b	Pre treated and released to an offsite treatment facility for further treatment		
c	Treated and released into rivers/land		
d	Not treated		
e	Others (specify)		

d. Kindly rate the following factors on a scale of (1-5) based on how much they have motivated your organization to engage in waste water management

Factors	**(very high)**	**(high)**	**(Moderate)**	**(Low)**	**(very low)**
Cost reduction					
Government regulation (e.g. Environmental Management and Coordination Act - EMCA)					
Internal environmental management system requirement (e.g. ISO 14001)					
Corporate social responsibility					
Brand improvement (consumer preference)					
Others (specify):					

9. Solid waste.

a. Are there any processes in your organization that generate solid waste? **(YES)/ (NO)**

b. If yes, which are these processes? (list at least 3)

c. Do you track the amount of solid waste generated? **(YES/NO**).

d. If yes, how much in metric tons solid waste is generated on average, per month?

e. Do you **Reuse, Reduce or Recycle** any of the solid waste generated from the activities? **(YES/NO**)

f. If yes, please give examples of some of the waste that is reused, reduced and/or recycled.

g. How do you dispose of hazardous waste generated from within your organization?

h. How much (in percentage %) of your solid waste is recycled?

i. Do you reuse any of your packaging material? **(YES)/(NO)**

Factors	**(very high)**	**(high)**	**(Moderate)**	**(Low)**	**(very low)**
Cost reduction					
Government regulation (e.g. Environmental Management and Coordination Act - EMCA)					

Internal environmental management system requirement (e.g. ISO 14001)					
Corporate social responsibility					
Brand improvement (consumer preference)					
Others (specify):					

j. Kindly rate the following factors on a scale of (1-5) based on how much they have motivated your organization to engage in solid waste management

10. Greenhouse gas emissions (GHG)

a. Which of the following gases is generated by the processes within your organization? (*please tick against the one(s) that apply)*
   i. Carbon dioxide
   ii. Methane
   iii. Nitrogen oxides
   iv. Sulfur oxides
   v. Chlorofluorocarbons (CFCs)
   vi. Others (specify)

b. How much in metric tons of the selected gas (es) is generated on average, per month?

c. Kindly list the measures put in place to prevent the release of the selected gas (es) to the atmosphere? (e.g. use of electrostatic precipitators)

d. Kindly rate the following factors on a scale of (1-5) based on how much they have motivated your organization to engage in GHG emission management

Factors	(very high)	(high)	(Moderate)	(Low)	(very low)
Cost reduction					
Government regulation (e.g. Environmental Management and Coordination Act - EMCA)					
Internal environmental management system requirement (e.g. ISO 14001)					
Corporate social responsibility					
Brand improvement (consumer preference)					
Others (specify):					

11. Green supply chain management

a. Are you familiar with the concept of green supply chain management? **(Yes)/(No)**

b. On a scale of 1-5, how much do you perceive your organization has 'greened' its supply chain?

   i. 1- very high

   ii. 2- high

   iii. 3-moderate

   iv. 4-low

   v. 5- very low

Factors	**(very high)**	**(High)**	**(Moderate)**	**(low)**	**(very low)**
Cost reduction					
Government regulations					
Internal management systems (ISO 14001, 50001, etc.)					
Technical capability					
Support from top management					
Customer demand					
Employee awareness and capability					

Strong partnerships with suppliers					
Societal/Community expectations					
Others (specify)					

c. Kindly rate the following factors on a scale of (1-5) based on how much they have contributed/driven your organization to engage Green supply chain management

d. What are some of the gaps/opportunities that you have observed in implementing green supply chain management in your organization? *(provide at least two gaps/opportunities identified)*