EFFECTS OF GREEN SUPPLY CHAIN ADOPTION ON SUPPLY CHAIN PERFORMANCE OF AGRI-MANUFACTURING FIRMS IN RWANDA

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Effects of Green Supply Chain Adoption on the Performance of Agri-manufacturing Firms in Rwanda

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University

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DEDICATION

This Thesis is dedicated to all my family members for their support.

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LIST OF ACRONYMS AND ABBREVIATIONS

CAS	Complex Adaptive Systems
CIC	Climate Innovation Centre
CT	Complexity Thinking
EM	Environmental Management
EOL	End-Of-Life
EU	European Union
EVA	Economic Value Added
GDP	Gross Domestic Product
GSCM	Green Supply Chain Management
MVA	Manufacturing Value Added
NISR	National Institute of Statistics Rwanda
NRBV	Natural-Resource-Based View
RBV	Resource Based View
RDT	Resource dependence theory
REMA	Rwanda Environment Management Authority
RRECPC	Rwanda Resource Efficient and Cleaner Production Centre

SA	Systems Approach
SCM	Supply Chain Management
SEZ	Special Economic Zone
SSCM	Sustainable Supply Chain Management
TCE	Transaction cost economics
WBCSD	World Business Council for Sustainable Development

DEFINITION OF OPERATIONAL TERMS

Eco-design	Refers to manufacturers design products that minimize consumption of materials and energy, that facilitate the reuse, recycle, and recovery of component materials and parts, and that avoid or reduce the use of hazardous products within the manufacturing process (Green *at al.,* 2012).
External environmental management	Refers to cooperation with customers requires working with customers to design cleaner production processes that produce environmentally sustainable products with green packaging (Green *at al*., 2012).
Internal environmental management	is the practice of developing green supply chain management as a strategic organizational imperative through commitment and support of the imperative from senior and mid-level managers (Green *at al.,* 2012)?
Investment Recovery (IR)	Refers to an organization's strategic use of reverse logistics recycling, redeployment, reselling and similar techniques to derive greater value from materials and products (Kumar & Chandrakar, 2012).
Supply Chain	The movement of materials as they flow from their source to the end customer. Supply Chain includes purchasing, manufacturing, warehousing, transportation, customer service, demand planning, supply planning and Supply Chain management. It is made up of the people, activities, information, and resources involved in moving a product from its supplier to customer (Chen & Labadi, 2015).

ABSTRACT

Green supply chain has been a major component of competitive strategy to enhance organizational productivity and profitability as well as metric measure, however performance pertaining to green supply chain and supply chain performance among Agri-Manufacturing firms in Rwanda has not received adequate attention from researchers or practitioners today. Thus, the general objectives determined effects of green supply chain adoption on supply chain performance: survey of Agri-Manufacturing Firms in Rwanda. The study was guided by the following objectives; to determine the effect of internal environment management practices on supply chain performance, to assess the effect of green purchase on supply chain performance, to ascertain the effect of eco-design practices has no significant effect on supply chain performance , to establish the effect of investment recovery on supply chain performance and to determine the moderating effect of institutional pressures on the relationship between green supply chain and supply chain performance among Agri-Manufacturing Firms in Rwanda. The study was informed by Resource-Based View, Natural-Resource-Based View, Resource, Dependence Theory, Institutional Theory and Stakeholder Theory. This study employed both cross-sectional and explanatory research design and is in line with positivism approach. The target population was 567; including Operations Manager, Chief Supply Chain Officer, Logistics Specialist, Supply Technician, IT Technician, Production Technician, Returns Specialist. Procurement specialist in supply chain department from 67 Agri-Manufacturing Firms. Stratified and simple random sampling was used to select a sample of 226. This study collected both secondary and primary data, but mainly primary data using a structured questionnaire. Data analysis was performed with the aid of SPSS version 22.0 using both descriptive and inferential statistics. Hypothesis 1 to 4 was tested using multiple regression model, while hypothesis 5 was tested using hierarchical regression. Findings showed that internal environmental management, green purchasing, eco-design results and investment recovery positively and significantly influences supply chain performance. In addition, institutional pressure significantly moderates the relationship between internal environment management, green purchasing, eco-design results and investment recovery and supply chain performance. It is therefore important for both the senior managers and mid – level managers to be committed and supportive of GSCM. Also, firms need to make an initiative towards identifying a recycling system for used and defective products. Therefore, managers need to ensure that the raw materials acquired from suppliers can be recyclable, reusable, and re-manufactured. As such, the firms need to ensure that the environmental impacts of the product's life cycle are understood before even engaging in manufacturing decisions.

CHAPTER ONE

INTRODUCTION

This chapter marks the beginning of this thesis and it includes the background of the study, which focuses on the global, regional, and local perspectives of Green Supply Chain Management and its effect on Supply chain Performance. In this chapter, the statement of problem under investigation is presented, objective of the study, significance and scope of the study and definition of terms. This chapter has been targeted to help the reader to understand and get the rhythm of the subject matter of the thesis.

1.1 Background of the Study

Green supply chain refers to the idea of integrating sustainable environmental processes into the traditional supply chain. This can include processes such as supplier selection and purchasing material, product design, product manufacturing and assembling, distribution and end-of-life management (Kumar & Chandrakar, 2012). Recent scholarly works have investigated different definitions and conceptualizations of green supply chain management and its implications on business processes and the environment moving into the future (Setyadi, 2019). The consensus is that it involves innovations that ensure a company's purchasing and production units is sustainable and promotes the wellness of its employees, consumers, and the environment (Sung Rha, 2010).

Rwanda has prioritized investments in production, value addition and agro-processing to create quality jobs through sectoral linkages as articulated in the crop intensification programme. Enhance agricultural production and profitability by promoting irrigation, increased use of fertilizers, mechanisation of agricultural practices, and securing of access to high-value markets for smallholder farmers (NISR, 2019).

In National GDP Accounts (2018), within manufacturing, food processing increased by 19 percent mainly due to an increase of 32 percent in the processing of cereals and 6 percent in the processing of tea, coffee, and sugar. This is linked with the green initiatives because the current market requires the green processes in manufacturing products. The Aug 2018 workshop presented emissions reduced of 22,437tons of Carbon dioxide equivalent from 14,697tons in 2017 and water use reductions of 44,195m3 from 32,180m3 in 2016. The number of best green production practices implemented by companies was increased to 274 from 220 in 2016 whereas number of new green technologies adopted increased to 47 from 39 in 2016. The number of companies in the Special Economic Zone implementing green production practices increased to 17 from 10 in 2016 (Ministry of Environment, 2018).

Green supply chain management involves all strategies aimed at making business processes more conscious to the needs and conservation of the environment and involves improving product design, production, and delivery of products to ensure little wastage of resources. It also considers the lifespan of products to create a closed loop that involves recycling. The strategy of GSCM entails reverse logistics, green procurement, green operations, green designs, waste management and green manufacturing (Azevedo *et al*., 2011).

Before green supply chain, environmental considerations did not feature in the research of early manufacturers because industrial pollution was relatively low due to the few industries at the time and there was an abundance of raw materials relative to their demand. The concept under greening is to sustainably extract resources from the environment, either in mining or in agricultural production while reducing pollution by managing the byproducts, e-packaging, and recycling (Zhu *et al.,* 2013). The procedures entail the whole chain which involves creating and adopting practices known as Green Supply Chain Management.

GSM is now growing trend among many businesses because of its proven ability to improve the sustainability and practicality of a business's strategy development (Wagner & Bode, 2016). Moreover, GSM production-oriented policies have evolved over time and embrace a monitoring at all levels within the supply chain to ensure that environmental protection is considered (Ellis, 2019). Indeed, many firms have increasingly adopted practices aimed at addressing environmental issues in their supply chains. The preponderance of extant literature suggests that the implementation of green supply chain management practices (GSCM) has a positive effect on both environmental performance (Geng *et al*., 2017; Sadia et al., 2019) and operating cost performance (Schmidt *et al.*, 2017). Other studies suggest managers face significant challenges to realizing fully the benefits of GSCM practices (Kirchoff *et al*., 2016), perhaps resulting from a host of possible barriers to their implementation (Goyal *et al*., 2017).

1.1.1 Global Perspective of Green Supply Chain Management Practices on the performance

Global enterprises must maintain a high level of flexibility in their structures and processes if they are to attain their set goals and objectives with the least number of resources and on time. In highly developed Nations like Germany for example, companies are working towards creating closed loop systems as part of their initiatives to make their supply chains greener (Seuring, 2014). Their focus lies in the materials used in development and the design process to ensure the perpetuity of the business and the reduction of overall waste. Streamlining their functions from their purchasing of raw materials up till the delivery of finished goods to the final consumers and coming up with sufficient systems to track all the information and materials generated and used in the entire process is seen as a major source of competitiveness (Zhu & Sarkis, 2013).

Similarly, in the United States, many companies are embracing and advocating for green processes (for example, green packaging, green purchasing, green production, and green manufacturing) because of the cost savings hence improving supply chain performance

(Seuring, 2014). All these strategies are carried out together with those aimed at increasing productivity and boost revenues and profits because they can only implement environmentally conscious practices if they have the funds to invest (Toke *et al.*, 2012). Examining how GSCM is practiced by UK food retail SMEs and how that impacts on the performance outcome is essential because in the UK approximately 99% businesses fall under SMEs (Ward & Rhodes, 2014). In addition, the recent horse meat scandal in the UK has triggered a massive corporate storm throughout the SC of every company, food supply networks, to make SCs more transparent and more visible to achieve consumers' confidence and to avoid reputational damage (Touboulic & Walker, 2015).

In other developed economies like China, increasing consumer awareness of the breakdown of the environment brought about by increased industrial activity fueled the advancement of GSCM (Zhu & Sarkis, 2013). While in Thailand, green design and green manufacturing had positive and significant effects on the agri-firms (Kamolkittiwong & Phruksaphanrat, 2015). Moreover, in In Jordan, Al Khattab et al. (2015) found a positive relationship between GSCP (green purchasing, cooperation with customers on GSC practices, inventory recovery, green information systems, green production, and green design) and green performance.

1.1.2 Regional Perspective of Green Supply Chain Adoption on Supply Chain Performance

The adoption of green supply chain management in Africa has been shown to improve supply chain performance (Economic Commission for Africa, 2010). In Nigeria, for example Ofori (2010) confirmed that GSM is positively related to environmental performance through green innovation, while in Kenya involvement of supply chain suppliers in green practices enhances performance of manufacturing firms (Nixon, 2011; Nderitu & Ngugi, 2014; Carter *et al*, 2018). In the relatively developed economy of South Africa, reverse logistics and legislation and regulation, positively and significantly

predicted environmental performance. In turn, environmental performance positively and significantly predicted supply chain performance (Epoh, & Mafini, (2018).

1.1.3 Local Perspective of Green Supply Chain Adoption on Supply Chain Performance

A baseline established in 2005 guides the development of green economy in Rwanda with the country having to make changes to its strategies while maintaining the focus on their long-term sustainability goals. The goal of the plan is to ensure the country has a low carbon footprint throughout the period of development and at the time when it attains its desired level of economic performance and industrialization (Government of Rwanda, 2011). Rwanda's current position about green initiatives for Agri-manufacturing firms makes it a great example of sustainable development and growth in the continent (Government of Rwanda, 2011).

Rwanda's mission to maintain a clean and healthy environment has been going since 2008 when it banned the use of non-biodegradable plastic bags and packaging materials. To date, Rwandans use only bags made from paper, cloth, banana leaves and papyrus, among other biodegradable materials. It has made a difference. The plastic-bag ban has earned the country a reputation as one of the cleanest countries in Africa. In 2008, Rwanda's capital, Kigali, was declared one of the cleanest cities in Africa by UN Habitat. It also created opportunities for entrepreneurs who invested in alternative packaging materials (cloths, papers, banana leaves and papyrus). As a fast-growing nation, Rwanda can bypass old technologies and environmentally destructive development and build an economy that can withstand a changing climate and that provides prosperity for generations to come (World Economic Forum, 2016).

Rwanda has initiated green Development which focuses on empowering people to adopt practices that enhance social cohesion, economic prosperity, and environmental integrity. All three dimensions are equally important, so offsets in one dimension can

also adversely affect the other two. In practice this is seldom the case. In practice, the economic dimension will be more prominent, in detriment of the social and (lastly) the environmental. The way we manage the economy and political and social institutions has critical impacts on the environment, while environmental quality and sustainability, in turn, and are vital for the performance of the economy and social well-being (REMA, 2014).

Agro-processing in Rwanda is a flourishing sector that contributes up to a third of Rwanda's GDP. This sector is a major source of employment and income, thus providing access to food and other necessities to large groups of the population. Rwanda has suitable agro-climatic conditions that allow the production of a broad range of diverse agricultural commodities suitable for processing. The sector has seen the adoption of improved and validated food processing technologies, enforcement of good quality standards, hygiene and regulatory instruments which have assisted local agro-processing industries to compete favourably in the international marketplace. The agro-processing sector consists of processing locally available raw materials to produce products such as wine, beer, soft drinks, flour, rice, cheese, honey, cooking oil, among others. There is an increasing diversification to new innovative products such as Stevia and essential oils which have increased the agro-processing export base. Rwanda is among the largest Pyrethrum exporters globally; the pyrethrum flower is used worldwide to produce a natural insecticide that controls pests and plant diseases (RDB, 2020).

In general, all agro-processing activities use a certain number of materials. This does not necessarily mean that these materials are used efficiently. Often, in fact, the final product contains only a low percentage of the original raw materials and the rest is waste. Important materials include biomass (animal feed, food, and forestry). However, most agro-processing requires energy for transformation of raw materials to finished products. There are several challenges about energy use. Firstly, electricity is not available in many rural areas where agricultural production takes place, requiring that agro-processing activities be located away from source of raw materials. Even where

there is electricity, the supply is rather erratic and occasioned by frequent power-cuts. Existing agro-processing plants must either use standby diesel engines or stop their production frequently (MINICOM, 2014).

1.1.4 Components of an Agri-supply chain

Agribusiness, supply chain management (SCM) implies managing the relationships between the businesses responsible for the efficient production and supply of products from the farm level to the consumers to meet consumers' requirements reliably in terms of quantity, quality, and price. In practice, this often includes the management of both horizontal and vertical alliances and the relationships and processes between firms. Agri-supply chains are economic systems which distribute benefits and apportion risks among participants. Thus, supply chains enforce internal mechanisms and develop chain wide incentives for assuring the timely performance of production and delivery commitments. They are linked and interconnected by virtue of shared information and reciprocal scheduling, product quality assurances and transaction volume commitments. Process linkages add value to agricultural products and require individual participants to coordinate their activities as a continuous improvement process. Costs incurred in one link in the chain are determined in significant measure by actions taken or not taken at other links in the chain. Extensive pre-planning and co-ordination are required up and down the entire chain to affect key control processes such as forecasting, purchase scheduling, production and processing programming, sales promotion, and new market and product launches etc (Ganesh *et al.*, 2017).

Following are the components of an organised agri-supply chain: (1) Procurement or sourcing, (2) Logistic management, composed of; (a) Transportation, (b) Material management, (c) On the premise of supplying mostly from production not stock, (d) Warehousing, (e) Logistics Network modelling, (3) Organizational management, composed of; (a) Contracting, (b) Strategic alliances and partnerships, (c) Vertical integration; (i) Long term storage, (ii) Packaging technology, (iii) Cold chain

management, (iv) Energy efficient transport, (v) Quality and safety, (4) Application of Efficient Consumer Response (ECR) System, composed of; (a) Electronic scanning of price and product at the point of sale, (b) Streamline the entire distribution chain (Ganesh *et al.*, 2017).

1.1.5 Agriculture policy orientation in Rwanda

The vision as stated in the revised National Agriculture Policy (NAP, 2018) is to have a nation that enjoys food security, nutritional health, and sustainable agricultural growth from a productive, green, and market-led agriculture sector. The mission of the sector is to "ensure food and nutrition security of Rwandans by using modern agribusiness technologies, professionalizing farmers in terms of production, commercialization of the outputs and then creating a competitive agriculture sector". To fulfil the National Agriculture policy (NAP, 2018), the Ministry of Agriculture and Animal Resources (MINAGRI) has developed its fourth Strategy Plan for Agriculture Transformation (PSTA 4) to promote the growth of the agriculture sector in partnership with the private sector.

1.1.6 Agriculture and agribusiness in Rwanda

Agriculture and agribusiness remain the backbone of the Rwandan economy and continue to be a key catalyst for growth and poverty reduction. Over the period of EDPRS1, the sector grew at 5.4 %, sustained by higher-than-expected expansion of food production, attributed to scaled-up public investments such as the crop-intensification programme (CIP). During the same period, the agriculture sector contributed 32-34 percent of GDP and 27 percent of total growth. In the recent past, there was significant expansion of interventions which drove productivity gains, including successful land consolidation, increased areas under irrigation and protected land against soil erosion. Access to important services including agricultural financing and proximity extension services was improved, and farmers are now more likely to use specific crops according

to agro-climatic zones. There has also been an increase in the use of inputs, including agrochemicals and improved seeds. Distribution of livestock through programs such as Girinka has expanded the animal resource sector. Since the implementation of the crop intensification programme (CIP), yields have grown significantly. Post-harvest infrastructure investments and subsidized transport has improved product quality and market accessibility. As a result of these interventions, production of maize, wheat, roots and tubers, soybeans, rice, and cassava as well as meat, milk and horticulture products rose to the ambitious national levels predicted in EDPRS-I (NISR, 2018).

However, agriculture remains on the threshold of subsistence since many rural households' farm plots are too small to support commercial production under present productive systems and agro-processing remains underdeveloped. But the overall goal under EDPRS 2 is to move Rwandan agriculture from a largely subsistence to a modernized, nationally integrated and knowledge intensive sector with more emphasis on diversification, agro-processing, productivity-enhancement, and capacity development (NISR, 2019).

The manufacturing of food products constitutes 20.5% of economic activities in Rwanda. The leading activities within the food subsectors are manufacturing of beverages and other related food products (5.5%), processing and preserving of meat (3.8%), the processing of grain flour in mills (3.3%), manufacturing of bakery products (3.6%), and manufacturing of dairy products (2.5%). Activities of production of coffee products (0.3%), manufacturing of starches and starch products (0.3%), and manufacturing of prepared animal feeds 0.3% have the least representation (MINICOM, 2014).

1.1.7 GSCM in Agri-Manufacturing Firms in Rwanda

The Rwandan economy is agricultural dominated but with rising industrial growth. The country's economic performance grew to $5.5 billion nine years ago (a per capita of $5404). The Rwandan economy is predominantly agricultural with punctuations of low-

value service industries with subsistence farming being the largest contributor to the country's GDP at 31% (MINECOFIN, 2011). Agri-manufacturing mainly deals with the conversion of agricultural products with the major products being food, beverages and tobacco products accounting for almost 3 quarters of the output from manufacturing in 2012, the food products manufacturing, and processing industry say a close to double growth that saw its share rise to 44%. The increased manufacturing output has encouraged exports in the country which experienced an increase of 1000% in the 12-year period ending in 2012 (AfDB, 2014).

Talking about Green Supply Chain, Bralirwa incorporated the use of energy and water in an efficient way as green brewer, green packaging which aims at addressing the footprint of CO_2 in its packaging. Bralirwa has also a policy to manage and measure packaging materials in CO_2 performance. Programs are being put in place to improve CO_2 performance of packaging materials. Green cooling: the cooling equipment is the most environmentally friendly, securing minimum energy use and lowest carbon footprint. Green distribution which aims at addressing the footprint of the distribution of our products through, they include increased distribution efficiency; increased fuel efficiency (Bralirwa, 2017).

To promote Green Supply Chain in the industrial sector, Rwanda instituted the Rwanda Cleaner Production Centre that was tasked with advocating for greener practices. The agency focuses on improving the efficient use of resources through the development of closed-loop structures that reduce wastage and encourage the reuse and repurposing of materials and labour. The use of environmentally safe materials and reducing the discharge of harmful wastes and by-products into the environment is key to ensuring environmental sustainability. The firm's activities have helped many companies to improve the sustainability of their processes by employing the funding they get from UNIDO to transform manufacturing processes to be greener (MINECOFIN, 2011).

Most of agro-processing firms' use of alternative clean energy, energy efficiency, Clean Development Mechanism projects are prioritized. Vehicle are checked for vehicle gas emission, import of relatively new vehicles is priority (REMA, 2014). The country's 50-year plan that ends in 2050 strategizes how to bring the country into an age of high industrialization and a mature financial services sector that should create hundreds of thousands of jobs and support millions more. The strategic plan anchors its plans on the already low carbon footprint that the country's predominantly agro-processing manufacturing industry produces to encourage innovations in green processing. The innovations should also encourage the improvement of domestic energy consumption by increasing the effectiveness of appliances which increases the country's overall environmentally friendly strategy (Government of Rwanda, 2011).

The economy in Rwanda has little differentiation relative to other economies in the region. It currently consists of food and beverages, tobacco, textiles and clothing, wood, paper and printing, chemicals, rubber and plastics, non-metal minerals and furniture. Manufacturing mainly deals with the conversion of agricultural products (agro-processing) with the major products being food, beverages and tobacco products accounting for almost 3 quarters of the output from manufacturing in 2012. While all the areas mentioned above experienced growth in the periods between 2000 and 2012, the food products manufacturing, and processing industry say a close to double growth that saw its share rise to 44%. The increased manufacturing output has encouraged exports in the country which experienced an increase of 1000% in the 12-year period ending in 2012. However, despite the increase in the country's export markets, it still pales when compared to those in the region because of its main subsistence form of production. That is to say that most production is aimed at catering to the local market (AfDB, 2014).

In this research, the researcher will compare the results with the observations made by other researchers for developed and developing countries and provide managerial implications for the government and manufacturers as to what steps need to be taken to generate awareness towards environmental sustainability and facilitate the adoption of

GSCM practices among Rwandan firms to a greater extent. This research was analyzing different aspect of interaction of Green Supply Chain with the agro-processing firms in Rwanda. The research concluded this research by indicating directions for future research on GSCM/SSCM.

1.2 Statement of the Problem

Increased industrial actions take a heavy toll on the environment (Pratten & Mashat, 2009). As such, it is imperative that the country takes measures to mitigate any adversities that might result and, therefore, enhance environmental responsibility in business practices (Byron, 2015; Rahman, 2013). This creates the need for companies to adopt GSCM (World Business Council for Sustainable Development, 2012).

An ensample is Kitabi Tea Factory which started in 1969. It had the capacity of producing 2,400 tons of black tea per year in 2015 with a projected production of 4,800 tons of black tea in 2019. To ensure sustainable energy sources, the Factory dedicated 45% of its land to eucalyptus plantations that are available for exploitation. In addition to this, Kitabi has also benefited from RECPC's initiative to resource efficient and cleaner production training and application of best practices such as: Installation shed for scraps in the factory. Scraps are reused for scaffolds making for general repairs and maintenance; Lagging fully done in all steam lines; Installation of boiler economizer to recover lost heat from chimney; Improvement of the lighting system with each machine being provided with its own lighting or reducing the height of lamps; Factory wide water saving program to reduce wastage; and Awareness creation on power saving techniques and the partial covering of the firewood shed requiring an initial investment of 9,020 USD, saving up to 28,657 USD in less than 6 months (REMA, 2015).

In 2017 Bralirwa Ltd continued to reduce its climate impact throughout the value chain, bringing several sustainability initiatives under one goal to reduce our carbon footprint, 5% decrease in average water consumption in brewery compared to 2016; 16% cut in

CO2 emissions compared to 2016, all these changes are due to the Green Supply Chain initiatives (Bralirwa, 2017). In 2017, Bralirwa Ltd's overall financial performance improved substantially compared to 2016 despite the challenging business environment. (Government of Rwanda, 2011).

Ikirezi Natural Product, a factory located in Kirehe District produce essential oil through steam distillation and extraction of geranium. The factory uses a combination of diesel and wood for heating purposes. Ikirezi has an industry standard smoke control system that limits/reduces the amount of CO_2 released to the environment. Ikirezi was producing 250 to 400 tons of geraniums per year in 2015 with projections of producing 1,000 tons of geraniums in 2020. (REMA, 2015).

There were not enough data on green supply chain and its relationship to the supply chain performance for agro-processing in Rwanda and this was considered as a gap in the literature. So, it is in this gap the current study is fitting.

1.3 Objectives of the Study

1.3.1 General objectives

The general objective was to determine effects of green supply chain adoption on supply chain performance of agro-manufacturing firms in Rwanda.

1.3.2 Specific Objectives

The study was guided by the following objectives.

1) To determine the effect of Internal Environment Management on supply chain performance of agro-Manufacturing Firms in Rwanda
2) To assess the effect of green purchase on supply chain performance among agro-Manufacturing Firms in Rwanda

3) To ascertain the effect of eco design practices has no significant effect on supply chain performance among agro-Manufacturing Firms in Rwanda
4) To establish the effect of investment recovery on supply chain performance among agro-Manufacturing Firms in Rwanda
5) To determine the moderating effect of institutional pressures on the relationship between green supply chain and supply chain performance among agro-Manufacturing Firms in Rwanda

1.4 Research Hypotheses

H_{01}: There is no significant effect of internal environment management practices on supply chain performance among Agri-Manufacturing Firms in Rwanda

H_{02}: There is no significant effect of green purchase on supply chain performance among Agri-Manufacturing Firms in Rwanda

H_{03}: There is no significant effect of eco design on supply chain performance among Agri-Manufacturing Firms in Rwanda

H_{04}: There is no significant effect of investment recovery on supply chain performance among Agri-Manufacturing Firms in Rwanda

H_{05}: There is no significant moderating effect of institutional pressures on the relationship between green supply chain and supply chain performance among Agri-Manufacturing Firms in Rwanda.

1.5 Justification of the Study

The study was significant to the following parties.

1.5.1 To management of Agri-Manufacturing Companies

This study is going to recognize the challenges that are faced in implementation of green supply chain management approaches by the Agri-Manufacturing Companies in Rwanda. The management of the Agri-Manufacturing Companies should increase their knowledge on how to increase the value to their stakeholders by adopting the appropriate green supply chain management practice that improves supply chain performance.

1.5.2 To Investors

New investors will make use of the study to verify critical aspects relating to the environmental responsible Agri-Manufacturing Companies. The information to be gathered from the study was of essence to the investor's as a guiding principle to understand the dynamics and operations related to the Agri-Manufacturing Companies. The study was a source of information to the investors to understand the effect of green supply chain management practice on supply chain performance and therefore elect managements who have knowledge on green supply chain management practice.

1.5.3 To Government

The information can help the government to develop frameworks on enhancing the adoption of relevant green supply chain management practice, therefore, ensuring higher levels of environment sustainability. Higher levels of green supply chain management practice translate into better use of ecofriendly supply chain activities. In addition to enhancing the effectiveness of its own programs, the government can improve its policy development by using the information it generates to form objective baselines rather than relying on the results of private developers which are often biased.

1.5.4 Policy Makers

The policy maker can know how well to incorporate the sector and how effectively to ensure its full participation. The study will provide information for policy makers that was relevant for ensuring that adoption of green supply chain management practice is well-regulated. The study helps the policy makers in formulating policies that contributes to the growth and development of supply chain performance which as a result improves the economic development of the country.

1.5.5 Researchers and Academicians

Researchers and academicians will use the data to expose further on the study topic. The study data and information obtained was to explore further the topic for more understanding. This was used for referencing on the topic and guide interested persons on the same for details and deliberations.

1.6 Scope of the Study

The content scope of the study was to only determine effects of green supply chain adoption on supply chain performance: survey of Agri-Manufacturing Firms in Rwanda. Further the study assessed the moderating effect of institutional pressures. The study only focused on four practices of GSCM which includes internal environment management practices, green procurement practices, eco design practices, investment recovery and institutional pressures. In geographical scope the study was only survey Agri-Manufacturing Firms in Rwanda. On time scope, the study was conducted within the estimated budget and for between May 2019- January 2021.

1.7 Limitation of the Study

This study expands our knowledge effects of green supply chain adoption on supply chain performance of Agri-Manufacturing Firms in Rwanda. Though this study has

fulfilled its aim and objectives, there are several areas for additional studies and empirical research, given the limitations of the research.

On a geographical dimension, this study was primarily limited to Agri-Manufacturing Firms in Rwanda. Therefore, it may not be appropriate to generalize to the whole population of the SMEs in this country or any other country. For this reason, further empirical investigations in different regions and countries are needed.

The methodology that has been chosen to achieve the research objectives was limited to questionnaires. As such, future research could build on this study by examining green supply chain adoption in different sectors and industries in both a qualitative and quantitative way. Future studies could use the same basic hypotheses but implement the study in terms of a longitudinal rather than a cross- sectional design. Finally, only a single research methodological approach was employed and future research through interviews could be undertaken to triangulate.

Given that Agri-Manufacturing Firms are pervasive in all economies this will call for a careful selection of samples that can help provide a representative picture of green supply chain adoption. Also, a replication of this research on different industries in different geographical regions would provide data for comparison.

Lastly, this study used subjective measures as opposed to objective measures to assess supply chain performance. Nonetheless, several studies have reported that there exists a strong association between subjective and objective measures.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The aim of this chapter is to gain considerable insight into earlier literature and comprehend the theories that underlie this study. It outlines the theoretical review, conceptual framework, empirical review, and critique of the existing literature relevant to the study, summary, and research gaps.

2.2 Theoretical Literature Review

The major hypothetical points of view of this investigation incorporate the resource-based view, characteristic asset-based view, asset reliance hypothesis, institutional hypothesis, partners' hypothesis, and exchange cost financial matters hypothesis. These speculations give a sound hypothetical focal point to comprehend the potential impact of GSCM rehearses on the ecological, operational, and consequently monetary and advertising execution of the firm.

2.2.1 Resource-Based View

Zegarra (2016), point out, the sources of sustainable competitive advantage are found in the effects of each process of the organization and therefore must be sought both in the organization and in the interaction of the environment. The traditional literature has sufficient methodological proposals that unequivocally identify these internal and external factors and propose comprehensive designs for exploration (Mweru *et al*., 2015). This study will consider the structure and stages proposed by these authors to advance an analysis of organizational performance from the perspective of RBV claims. Resource Based View (RBV) contends that supported upper hand and enhanced

authoritative execution might be acknowledged by abusing assets that are profitable, uncommon, incompletely imitable, and non-substitutable (Volberda & Karali, 2015).

Kozlenkova, Samaha and Palmatier (2014) defined capabilities as a special kind of resource, specifically an organizationally non-transferable resource whose purpose was to progress the productivity of the other resources possessed by the organization. In fact, it is recommended that resources, which are tangible assets, intangible assets, and capabilities, maintain the potential to provide firms with a sustainable competitive advantage. Assets that have a physical form are tangible assets include both fixed assets, such as machinery, buildings, land, real estate, vehicles, equipment, and precious metals and current assets, such as inventory and currencies. Intangible assets include both nonphysical resources, such as patents, trademarks, copyrights, goodwill, brand recognition, and computer programs that have a value to the firm and finance assets, including such items as accounts receivable, bonds and stocks. In this respect, capabilities are used to engage the resources within the firm, such as implicit processes to transfer knowledge within the firm (Akroush, 2010).

Resources may be considered as inputs that enable firms to carry out its activities. Internal resources and capabilities determine strategic choices made by firms while competing in its external business environment. According to RBV, not all the resources of firm will be strategic resources. Competitive advantage occurs only when there is a situation of resource heterogeneity (different resources across firms) and resource immobility (Madhani, 2010).

A firm “is more than an administrative unit; it is also a collection of productive resources the disposal of which between different uses and over time is determined by administrative decision”. Thus, firms are heterogeneous from the resource-based perspective. A distinctive competencies perspective provided the next input into the resource-based view. The distinctive competency is an action that a firm can perform better than competitors and that allows achieving higher efficiency and effectiveness

compared to rivals (Borch & Solesvik, 2015). Thus, it has been admitted by distinctive competency scholars that the sources of competitive advantage are internal in the firm. Distinctive and superior competencies in functional areas (management, marketing, production design, and others) are positively associated with performance.

The resource-based view claims that the sources of sustained competitive advantage of the firm are inside the firm, namely that are the businesses have unique and valuable resources and capabilities that are rare, hard to imitate, imperfectly substitutable, and mobile, and may attain and keep competitive advantage (Solesvik, 2017). The resource-based motives are often crucial for a firm's decisions to join collaborative relationships.

Hart (2015) asserts that a standout amongst the most critical drivers of new asset and ability improvement for firms is the limitations and difficulties presented by the common habitat. Practically all associations are at a point where their business activities affect somehow on the common habitat. RBV with regards to ecological responsibility necessitates that organizations utilize vital assets and capacities to make exceptional and hard to emulate rehearses that can bring down the impact of the company's tasks on the regular habitat (Hart, 2015). Resource based view will be used in the study to test the resource management during green production and the internal environmental management. This theory supports the variable internal environment management.

2.2.2 Natural-Resource-Based View

This is the key theory on which this investigation was founded. The hypothesis is an expansion of RBV, and it sets that a firm can assemble supported upper hand dependent on its connection with the normal or biophysical condition (Dowell, 2011). According to NRBV, pollution prevention technologies involve much tacit knowledge through skill development and "green" teams (Yang *et al*., 2015)

As indicated by RBV, if an asset or heap of assets is to bear the cost of a firm upper hand, at that point it must be profitable, non-substitutable, uncommon, and supreme. The

nutural resource-based view (NRBV) contends that three attributes are viewed as critical for an asset or heap of assets to be key (Shi *et al*., 2012). To start with, the asset or heap of assets must be explicit to a firm. Second, the asset or heap of assets ought to be causally vague or unsaid. This suggests the asset is individuals based and hard to see practically speaking since individuals or groups secure information through continued learning by doing and clean it as they acquire understanding. At long last, the asset or heap of assets ought to be socially intricate (Foo *et al*, 2018). The vast industrial development and economic globalization have brought considerable environmental concerns over the last five decades such as pollution, climate change, natural resources depletion, and environmental degradation. The adoption of GSCM practices can assist organizations to reduce their environmental impact through reducing waste, conserving resources, minimizing energy and water usage, etc. Much has been written about the adoption of GSCM in developed countries such as practices, drivers, effects on performance. Organizational responses to these concerns have grown beyond internal operations to cover the entire supply chain, and thus organizations at all levels of the supply chain are contemplating the adoption of different sustainable initiatives and practices. This has led to the development of the terms Sustainable Supply Chain Management (SSCM) and Green Supply Chain Management (GSCM) (Shi *et al.,* 2012).

Along these lines, they learn by doing as well as refine their aptitudes as they gain more involvement. The representatives additionally work in groups to achieve this goal. The decentralized and implied nature of this fitness makes it difficult to see by and by and, consequently, hard to impersonate rapidly (Shi *et al*., 2012). Subsequently, the firm is managed the open door for supported upper hand through a one-of-a-kind causally vague asset. Green obtainment, naturally mindful structure, green appropriation and turn around coordination make socially complex assets since these exercises rely on an extensive system of individuals or groups occupied with composed activity which couple of people, assuming any, have adequate broadness of learning to execute (Shi *et al.,* 2012).

These exercises require foundation of agreement among providers, clients, and other production network individuals and in this manner includes numerous groups and associations. To achieve the objective of community oriented green production network, the firm should ceaselessly facilitate their tasks and associations in attempted these exercises (Shi *et al*., 2012). This it can do through defining ecological objectives mutually, shared natural arranging, and participating to lessen contamination. This requires simple correspondence and exchange of data crosswise over capacities, divisions, and authoritative limits. The exercise in careful control among production network individuals to guarantee that the execution of these exercises is upgraded without hurting the indigenous habitat is a socially mind-boggling asset which can make an open door for supported upper hand for the firm (Shi *et al*., 2012).

According to Handfield and Nichols (2012), "SCM is an integrated management system of supply chain organizations and activities through cooperative organizational relationships, business processes, and high levels of information sharing systems that provide member organizations a sustainable competitive advantage". GSCM is whereby the organization uses inputs into its production process that are environmentally friendly with the aim of reducing environmental impact. Green manufacturing enables the organization to have a competitive advantage since they will incur lower raw material costs, higher production efficiency and improved corporate image (Ninlaw *et al*., 2010). The supply chain network's environmental impact should not only consider suppliers, distributors, and consumers, but also the transportation between the supplier and the consumer, along with the environmental effects of research and development, production, and storage; in effect all sources that make up the overall stream of waste and pollution.

Similarly, Zhu *et al.* (2013) identify the scope of GSCM practices ranging from "green purchasing to integrated life-cycle management of supply chains flowing from supplier, through to manufacturer, customer, and closing the loop with reverse logistics". Such a holistic value chain approach is also reflected in Zsidisin and Siferd's (2010) definition:

"green supply chain management is the set of supply chain management policies held, actions taken, and relationships formed in response to concerns related to the natural environment with regard to the design, acquisition, production, distribution, use, reuse and disposal of the firm's goods and services". Although there are several research studies that have attempted to link NRBV theory with GSCM to explain a firm's competitive position and performance improvement, there are still questions that remain. Essentially, it is still unclear as to how the specific types of GSCM practices would translate into a firm's strategic resources that in turn leads to competitive advantage and performance improvement (Shi & Koh, 2012). The variable supports green purchasing variable.

2.2.3 Resource Dependence Theory

Since its publication, resource dependence theory (RDT) has become one of the most influential theories in organizational theory and strategic management. RDT characterizes the corporation as an open system, dependent on contingencies in the external environment. Though Resource Dependence's influence has spread to several disparate fields beyond management (Davis and Cobb, 2010), focuses on scholarly work published in management journals and related fields such as strategy and economic sociology which collectively comprise the core Resource Dependence literature. To understand the behaviour of an organization you must understand the context of that behaviour that is, the ecology of the organization." RDT recognizes the influence of external factors on organizational behaviour and, although constrained by their context, managers can act to reduce environmental uncertainty and dependence. Central to these actions is the concept of power, which is the control over vital resources (Hillman *et al*., 2009).

Resource dependence theory (RDT) is concerned with the resources available in the environment external to the focal firm and in the custody of other companies (Hollos *et al.*, 2012). Companies holding those resources try to continue their grip to maintain their

authority and dominance while the companies in need of them try to find alternate resources or new sources to minimize their dependence (Sheu, 2014). RDT can guide the management of companies on how to minimize their dependence concerning the most critical and scarce resources specifically related to greening of overall production process (Wolf, 2014). Customers and suppliers are identified as the most critical resources that should be managed in addition to the physical resources such as raw materials, labor, or capital (Hillman *et al.*, 2009; Lai *et al.*, 2015). RDT lens can be used to understand and explain GSCM practices and their adaptation (Sarkis *et al.*, 2011) for dependence on external resources and the direct or indirect influence of the stakeholder on the focal organization (Wolf, 2014). For example, governments or regulatory bodies can enforce a ban on the use of certain raw materials to protect the environment, or suppliers can minimize the delivery of highly sought-after materials or increase their prices.

Customers with high demanding power can ask for strict compliance to environmental standards or compulsion to obtain certain certifications. Pressure groups, e.g., vibrant media or NGOs, can indirectly influence a focal firm to stop doing business with certain suppliers or customers when such clients are not complying with environmental standards as in the case of Greenpeace and Nestle (Wolf, 2014; Liu *et al*., 2015).

All together for GSCM practices to be executed effectively all through the entire production network, cooperation with providers, clients and other store network accomplices is incredibly pivotal (Zhu, Geng & Lai, 2010). Resource dependency theory is based on the principle that an organization, such as a business firm, must engage in transactions with other actors and organizations in its environment to acquire resources. Although such transactions may be advantageous, they may also create dependencies that are not. Resources that the organization needs may be scarce, not always readily obtainable, or under the control of uncooperative actors (Archibald, 2017). In the meantime, clients may assist providers with understanding the related issues, for example, potential upper hand and the criteria utilized for assessment and rating. RDT

along these lines gives hypothetical grapple to the job of natural joint efforts with production network accomplices (a GSCM practice) as an approach to abuse integral capacities to accomplish upper hand and thus enhanced authoritative execution. This variable supported the eco design practices.

2.2.4 Institutional Theory

The institutional theory sets that endeavours grasp certain procedures to pick up authenticity or acknowledgment inside society (Zhu & Sarkis, 2007). The hypothesis investigates the impact on a firm by outside weights. Organizational decisions are based upon a set pattern of cultural values, norms, and behaviours under the influence of an external environment (Gualandris & Kalchschmidt, 2014). When all organizations within the same industry adopt a similar kind of institutionalized practices and decision-making approaches, it depicts an attempt by them to legitimize themselves (Williams *et al.,* 2009). Institutional theory is used to understand different types of external factors that force any organization to initiate or adopt any new practice (De Grosbois, 2016). Institutional theory highlights three kinds of isomorphic pressures, where coercive pressures are a set of formal or informal pressures from influential organizations on which the focal firm is dependent due to specific resources, abiding by the law, or even societal expectations (Sarkis *et al.,* 2010).

These pressures can take the form of invitations by industrial bodies to join them to acquire benefits, or a source of fear to become banned/fined for non-compliance of specific government laws or regulations (Yang, 2017, Sarkis *et al*., 2010). Normative pressures are a result of certain norms and standards formalized by the environment from a cultural expectation of that environment. Different groups can be the source of normative pressures including educational institutions inculcating cognitive behavior; professionals from industry groups and associations; nongovernment organizations (NGO) having an interest in a particular industry; and the public. Suppliers and customers are also one of the core components of these pressures (Zhu *et al.,* 2013, Shu

et al., 2017). Mimetic pressures play their role in driving organizations to avoid uncertainty and risk by copying or replicating the processes or structure of other successful institutions. In the event of any significant change in the external environment that creates a threat to their existence, organizations look for role models that they believe were successful in facing those external challenges to try to modify themselves according to those model organizations (Williams *et al.,* 2009).

The manufacturing sector around the globe is facing immense pressure from different quarters to adopt and implement GSCM practices (Shu *et al.,* 2017). Pressures being exerted by the above-mentioned stakeholders have made it compulsory for manufacturers to prove themselves as a legitimate company by adopting GSCM practices (Gualandris & Kalchschmidt, 2014).

Regulating weights are advanced by outer partners who have personal stake in the firm (Zhu & Sarkis, 2007). These partners incorporate clients, social gatherings, investors, and providers. Firms that respect these weights are seen to be progressively real. Sarkis *et al*. (2011) distinguish the client as the center regulating weight to makers to execute GSCM rehearses. Natural and local gatherings draw the general population's consideration on the negative ecological impacts of firms' tasks by driving dissents and blacklists. Worker's organizations additionally put weight on these organizations to guarantee the security of their association individuals from damage that may result from ecological mishaps. Zhu and Sarkis (2007) contend that institutional weights may make firms participate in proactive natural practices, for example, GSCM. Firms that respect these weights are seen to be increasingly authentic and are probably going to increase upper hand and consequently enhanced hierarchical execution (Zhu & Sarkis, 2007; Darnall *et al*., 2008). This variable supported the institutional pressures variable.

2.2.5 Stakeholder Theory

Stakeholder theory perceives the way that other than investors, there are different people or gatherings who the association is committed to and who are probably going to be specifically impacted by the moves made by it or have an unequivocal authoritative association with it (Mainardes *et al.,* 2011). The partners incorporate clients, overall population, providers, representatives, and money related organizations. These partners determine what they anticipate from the association, encounter the impacts of relating with it, evaluate the outcomes acquired and act as per these appraisals, solidifying their association with the association or something else. The activities of companies affect both internal and external parties. Corporate social responsibility can be understood as the responsibility for a business to meet the expectations of its various stakeholders. Firms can ensure their long-term survival and preserve their license to operate by considering the broad network of actors into their strategy (Park-Poaps & Rees, 2010).

Kit (2010) conducted a descriptive study on financial aspects involved in SCM of rural entrepreneurship and advocated that financing SCM implies establishing link between financial institutions and all stakeholders in supply chain management. The author suggested that providing finance to facilitate flow of products and establishing relationships among different stakeholders of supply chain should immensely contribute to boost the efficiency of SCM practices. Solér, *et al*. (2010) analysed the Swedish food SCM practices and found that consumers perceive information about the environment relating to food SCM distinctly and this distinct perception is affected by their location in the supply chain in relation to other stakeholders.

From a key point, firms that embrace GSCM rehearses observe these activities to be a wellspring of upper hand, particularly, if the company's essential partners esteem such natural activities. There is proof connecting these to GSCM rehearses which is considered to have business esteem (Jaegler & Sarkis, 2014; Foerstl *et al.,* 2010). The management of material, information, and capital flows as well as cooperation among

companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental, and social, into account, which are derived from customer and stakeholder requirements (Seuring & Müller, 2008). Stakeholder theory supported the variable institutional pressures.

2.2.6 Transaction Cost Economics

Transaction cost economics (TCE) contends that a firm will develop if it can direct its activities in house cost adequately with respect to getting the administrations from the market. Modes of governance and organisational action in buyer-supplier relationships to implement social and green practices. The impact of transaction costs on the adoption and diffusion of sustainability practices across a Supply Chain (Vachon & Klassen, 2006). Sarkis *et al*. (2011) characterize exchange costs as the expenses past that of an item or administration required to trade the item or administration between at least two elements.

Transaction cost economics (TCE) is flexibly applied, for example, to explore the link between buyer-supplier relationship stability (Lai *et al*., 2014); and with multi-objective minimization green supply chain risk. TCE can help explore mutual transactional relationships among multiple entities in a circular economy system. For example, enterprises exchange their wastes, by-products, and energy for second use in eco-industrial parks or regional networks. Transactional costs exist among these enterprises. Evaluation and minimization of transaction cost among inter-enterprises within eco-industrial parks can help optimize circular economy networks. Investing in assets (asset specificity) may allow for greater relationship building between members in a circular economy context, how “strong” the relationships are in an eco-industrial park and network settings, and where whole industrial parks can invest in specific assets to form networks (Liu *et al*, 2018).

Information asymmetries exist for circular economy actors and their stakeholders including governments, non-governmental organizations, and consumers. Material availability and flows, by products, and their costs, have similar information asymmetry and power issues as GSCM material flows. Examining and dealing with information asymmetries among actors and stakeholders within the circular economy context require exploration (Liu *et al*, 2018).

The central studies of TCE, by often discussing the suppliers' decision to buy or produce internally, relate naturally with the SCM. Chicksand *et al*. (2012) highlighted the potential of using TCE to investigate the SCM. In 2008, Williamson (2008), the most prominent theoretician of TCE, published an article highlighting the potential of the use of TCE in SCM and proposing some research agendas seeking to integrate the two concepts. The trend identified by Chicksand *et al*. (2012) is replicated in GSCM and environmental purchasing, but in a more significant manner, as very few studies use TCE to investigate such phenomena (Carter & Easton, 2011; Sarkis *et al.,* 2011; Appolloni, Sun, Jia & Li, 2014). Toubolic and Walker (2015), in a literature review about sustainable supply chain covering the period between 1995 and 2013, found out only 14 papers that use TCE to ground their analysis. For the same period, Appolloni *et al*. (2014) identified only two papers using TCE as theoretical lens to analyse environmental purchasing. There is a trend in most of the papers of not using any theoretical lenses. Thus, lack research both empirically and theoretically grounded in order both to test and build theory (Apolloni et al., 2014; Toubolic & Walker, 2015).

On the off chance that clients and providers pull back, the exchange costs are probably going to increment particularly in situations where the firm has put resources into exchange explicit resources. The potential for selfish conduct is likewise fundamentally expanded. On the off chance that then again, the firm actualizes GSCM rehearses, these expenses are enormously decreased bringing about expanded authoritative execution. Transaction cost economy theory supported the variable investment recovery.

2.2.7 Complexity Theory

GSCM is a complex system with forward and reverse material flows involving product recalls, remanufacturing, and safe disposal procedures (Hallam and Contreras, 2016). Vertical integration involving collaboration with suppliers and customers aids the effective flow in the closed loop. Therefore, GSCM can be used as a vital tool in the context of a circular economy for the sustainable use of resources (Mangla *et al*., 2018).

Such complex processes call for the development of a special theory to study its behaviour. GSCM can be viewed as a system with subsystems and processes aiming to minimize environmental impact. Koh *et al.* (2012) suggest that the entire GSCM system must understand the co-benefits, but simultaneously disregard suboptimal solutions. Systems thinking and systems theory allow practitioners to study the complete system rather than individual elements separately. It enables the investigation of all element linkages in the system and manages the system functioning in a more comprehensive fashion (Koh *et al.,* 2016). This situation is particularly evident for external GSCM practices on activities, such as providing design specification to suppliers involving environmental requirements, auditing suppliers' environmental management systems, cooperating with customers for eco-design, and handling product returns from customers (Sarkis *et al.,* 2011)

The GSCM implementation difficulties can be intensified by the complexities associated with broader organizational complexities such as size and relationships (Vachon & Klassen, 2006), or specific activities such as product return, recycling, remanufacturing, balancing as well as the roles of production and consumption in the supply chain. Although their work focused on a linear relationship from an extraction to disposal, some loops were incorporated into the evaluation and there were concerns about the possibility of integrating 'residuals' back into the system. Interestingly, not only were solid and water pollution waste included in the discussion, but warnings of global climate change due to carbon and other greenhouse gas emissions was also prevalent in

the argumentation on evaluating the roles of inter-organizational relation- ships. Further refinement of the industrial metabolism and material flow balance ideas occurred throughout the 1970s (Sarkis *et al.*, 2011).

The execution of GSCM includes various individual gatherings working in the framework. This circumstance is especially obvious for outer GSCM rehearses on exercises, for example, giving plan particular to providers including natural prerequisites, evaluating providers' ecological administration frameworks, collaborating with clients for eco-structure, and taking care of item comes back from customers. GSCM usage challenges can be strengthened by the complexities related with more extensive hierarchical complexities, for example, size and connections (Vachon & Klassen, 2006), or explicit exercises, for example, item return, reusing, remanufacturing, investigation, and quality checking. These complexities innate in shutting the circle for a store network have been perceived in past examinations (Guide & Wassenhove, 2009; Matos & Hall, 2007). Because of the limited levelheadedness of individual gatherings, the execution result of a GSCM action cannot be precisely anticipated without knowing the real commitments by other included gatherings in the framework.

There was exacerbated complexities for executing GSCM if the more extensive ecological, financial, administrative, social, and political elements are considered with a bigger number of gatherings associating with others. At the point when a mind-boggling framework grows with an expanding number of communicating gatherings, or frameworks, it ends up hard to derive the practices and gauge the collaboration results of the framework. For dealing with a provider framework, Choi, and Krause (2006) distinguished supply base multifaceted nature as a key zone of administrative thought which is conceptualized in three measurements: 1) the quantity of providers in the supply base, 2) the level of separation among these providers, and 3) the dimension of between connections among the providers. They allude to multifaceted nature as how the individuals from a framework (e.g., providers in a base) are differed and connect with each other. Through understanding the intricacy of a framework, matters identifying

with the exchange costs, supply hazard, provider responsiveness, and provider advancement in a supply base can be better overseen (Choi & Krause, 2006). This thought has likewise been connected to informal community hypothesis (SNT) and its suggestions to GSCM (Miao & Xi, 2007). Complex versatile frameworks have been utilized to likewise clarify the development and the executives of eco-mechanical parks (Shi et al., 2010)

One ramifications of multifaceted nature hypothesis for GSCM are that a few exercises, e.g., client collaboration for item returns, include a dynamic system of connections in the framework. Provider incorporation in item advancement (e.g., for eco-structure in GSCM) will likewise decide execution in item development and quality in a framework (Koufteros *et al*., 2007; Vachon & Klassen, 2006). It is the association among the included gatherings that considers the sharing of information and formation of significance. In doing as such, it will help diminish the vulnerability that emerges from actualizing the GSCM exercises and guide the working of the framework. This theory supported the complexity of supply chain adoption on performance of agri-manufacturing firms in Rwanda.

2.3 Conceptual Framework

The reasonable structure gives an outline of the sorts of the exploration factors which assume a job in the examination. In this exploration there are two sorts of factors: the autonomous factors which are additionally alluded to as control factors manage all hypotheses and practices identified with Green Supply Chain appropriation among them are inward green supply reception, clients green supply selection, providers green supply reception (Green *et al.,* 2010). Then again there are needy factors additionally called estimation variable are for the most part identified with Supply Chain Performance and among them in this examination more accentuation was put on operational execution, monetary execution, and natural execution. This speculative relationship is reflected in Figure 2.1 below.

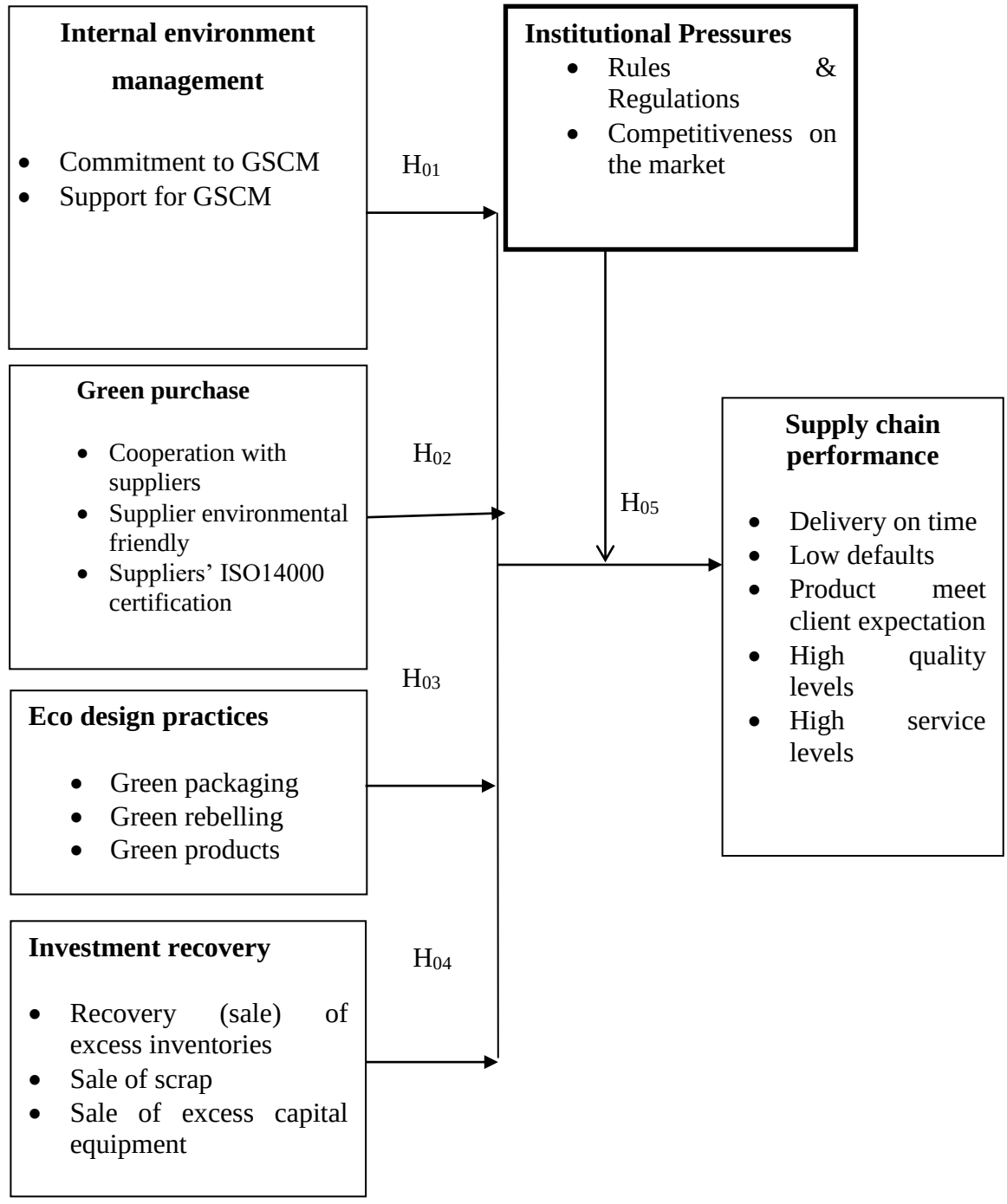

Figure 2.1: Conceptual Framework

2.3.1 Internal environment management

Interior ecological administration is the act of creating green inventory network the board as a vital authoritative basic through responsibility and support of the basic from senior and mid-level chiefs (Green *et al*, 2010). Internal environment management contains support and encouragement from senior managers. Internal management is a key critical success factor for enterprises to adopt green practices. Pressure employees bring about, encouragement and support from environmental protection motivate senior management. Meanwhile, the perception of environmental risks involved could bring positive change in adoption of green practices (Luthra, Garg & Haleem, 2016, Yusuf *et al.,* 2013).

The integrating of the imperative GSCM practices into the overall strategy of the firms is necessary to ensure a successful implementation of GSCM practices. Firms can start implementing GSCM practices into their operations such as green purchasing, collaboration with customers and suppliers, eco design and investment recovery (Green, 2012). The internal environmental practices require full commitment and support from top management and middle-level management. Top management needs to be fully committed with the GSCM practices to ensure environmental excellence. In addition, top management needs to identify the importance of environmental problems along a supply chain and supports the initial assessment by taking a full responsibility for the environmental monitoring efforts (Chin, *et al.,* 2015).

2.3.2 Green purchase

Green obtaining centers on coordinating with providers to develop items that are ecologically feasible (Green *et al.,* 2010). Green sourcing means sourcing or purchasing materials and components which have such enviable ecofriendly characteristics as reusability, recyclability and nonuse of hazardous/dangerous chemicals (Eltayeb *et al.,* 2011). With more and more concerns on environmental protection, procurement

professionals have been motivated to reconsider their existing sourcing, purchasing strategy and their impact on environmental sustainability Govindan *et al.,* 2015). The role of ecofriendly purchasing is the involvement of recycling and remanufacturing. The green sourcing supporting waste reduction enhances recycling and remanufacturing and other activities in supply chain. Zailani *et al.* (2015) highlighted that ecofriendly purchasing has positive relationship with firms' operational and environmental performance. Yang *et al.* (2010) ascertain that green purchasing was categorized into five main facets: design operation management, supply chain management, environmental authentication, ecological, and external environmental management. They confirmed that green purchasing improved to the overall firms' performance (Chen *et al.,* 2012). The adoption of green purchasing in supply chain and business operations is a reliable tool in mitigating waste, air, and water pollution.

2.3.3 Eco design practices

Luthra et al. (2016) highlighted that 80% impacts on environment from product and process related could be controlled with the adoption of ecological design in supply chain management. Ecological design incorporates many ideas such like using cleaner technology processes, green raw material, and components (Eltayeb *et al.,* 2011). Green design of products reduces ecological impacts of products during their life (Luthra *et al.,* 2016). In addition, green design of products also supports reusing, recycling, and remanufacturing of products, which not only helps firms to improve their environmental performance but also provide opportunity to reduce their costs (Khan & Dong, 2017).

Design for Environment (DfE) or Eco-design refers to environmental design of a product and/or a process. It focuses on reducing (preventing) the environmental effects of a product before it is produced, distributed, and used. DfE examines the disassembly of products at the end-of-life and reveals the associated cost benefits and environmental impact of revision, reuse, and recycling Harrison (Harrison & Hoek, 2011). DfE has its origins in the concepts of concurrent engineering and design for manufacturability and

assembly (DFMA). Concurrent engineering, also defined as simultaneous engineering, is the practice by management and operations of designing products and processes by multi-functional teams throughout a product's life cycle from idea generation, design, development, manufacturing, service, maintenance, and disposal. Closely related to this principle is Design for Manufacture and Assembly (DFMA), where DFMA is defined the process of proactively designing products to 1) optimize all the manufacturing functions: fabrication, assembly, test, procurement, shipping, delivery, service, and repair, and 2) assure the best cost, quality, reliability, regulatory compliance, safety, time-to-market, and customer satisfaction. The major goals of these programs are to simplify product designs so that they could be made inexpensively over the full product's life cycle, but also considered the other elements of product and process control. The DfE process usually entails five major steps: 1) Assess environmental impacts, 2) Research the market, 3) Run an ideas workshop (brainstorm), or ideas generation, 4) Select design strategies, 5) Design the product.

Previous work of Eco-designs was clearly considered the technical improvements to reduce the environmental cost by their products and processes. The improvements become possible when factors of designs externally control of producers, relationship of suppliers and customers, government authorities and recyclers, include important GSCM practice. Eco-designs success demands cooperation's of cross functional between intra-organizational units for both outside partners and inside company throughout the supply Malaysia management. Previous studies of US overall support the product and GSCM (Melander, 2017). Studies like Hanim *et al.* (2012), further support eco-designs link with GSCM practice into the Environmental Protection programs which give the green supply chains as core aspect of their designs for especially in their environment programs.

Eco-design practices are important aspects to reach the. Sustainability goals can be considered design requirements such as: reduced use of energy, materials, packaging, and transportation; reduction of waste and emitted pollutants, reduction of hazardous materials and substances in the manufacturing process, improvement of waste handling

protocols or techniques, recycle and reuse, utilization of greener technologies and materials, etc. to mention some (Ghazilla *et al.*, 2015; Zhu & Geng, 2013). Eco-design offers different benefits and opportunities to companies, not only environmentally but also from the economic and social perspectives (Borchardt et al., 2011). Moreover, the implementation of eco-design methodologies might promote the application of Environmental Management Systems (EMS). As external drivers, environmental data can be used for communication-to-user and marketing purposes while increasing the presence of environment as a decision-making criterion during purchase (Sanyé-Mengual *et al.*, 2014).

Eco-design was applied to different types of products and several guides were developed not only for the methodology but also for specific sectors: urban furniture (e.g., streetlight, bin, and bench), household products (e.g., appliances). Furthermore, the implementation of eco-design in different product sectors were also analyzed in the literature through case studies, such as wooden products (González-García *et al.*, 2011a, 2012a, 2012b, 2012c, 2013), lighting sector (Casamayor & Su, 2013), automotive (Alves *et al*., 2010, packaging (Almeida et al. 2010).

The enormous increment out there an item goes before achieving the client, rather than privately created products, is most likely the primary negative impact on condition. In spite of the fact that these are the results of winning financial choices, streamlining the load as well as the volume of the item and its bundle assumes an imperative job in decreasing both ecological effect and cost because of transportation Eco-structure necessitates that makers plan items that limit utilization of materials and vitality, that encourage the reuse, reuse, and recuperation of segment materials and parts, and that stay away from or diminish the utilization of risky items inside the assembling process (Green *et al,* 2010)

The greater part of the ecological impact of any item or material is 'bolted' into the item at the plan phase of an item, when materials and procedures are chosen and item natural

execution is to a great extent decided (Lewis & Gretsakis, 2001). Spearheading firms have discovered that creation item returns gainful depends on great item structure (Krikke et al., 2004). It has been contended that for successful item stewardship and turn around coordinations rehearses, eco-structure (which would incorporate plan for dismantling, structure for reusing, and structure for other invert coordinations rehearses) is fundamental (van Hoek, 1999). Therefore, eco-structure or Design for Environment (DfE) is an imperative and rising GSCM practice to enhance organizations' CLSC.

Eco-plan rehearses best fit inside van Nunen and Zuidwijk's (2004) item viewpoint, which concerns sorts of item arranged connections that happen in CLSC. In our depiction here, eco-plan is intended to address item usefulness while at the same time limiting life-cycle ecological effects. The accomplishment of eco-plan requires interior cross-useful participation inside the organization and the outer collaboration with different accomplices all through the store network. Early eco-plan work concentrated principally on specialized enhancements to items and procedures to relieve ecological expenses. Acknowledgment that progressively significant upgrades are conceivable just when configuration factors outside of the immediate control of makers, incorporating associations with providers, buyers, recyclers, and administrative experts, are incorporated for eco-plan to end up a vital GSCM practice (Benito & Benito, 2005).

The achievement of eco-structure requires interior cross utilitarian collaboration among intra-authoritative units inside an organization as participation with outside accomplices all through the production network. Concentrates in the US bolster this position particularly for item configuration based joining of providers into the green production network to meet the explicit inventory network natural structure necessities. To additionally bolster eco-design’s fundamental linkage to GSCM practice, the U.S. Ecological Protection Agency’s program has green supply chains as a center part of their structure for the earth programs. Chinese associations are additionally subject to eco-plan necessities in their job as production network accomplices, particularly given the weight for worldwide administrative consistence (Kumar & Chandrakar, 2012).

2.3.4 Institutional Pressure

In fact, businesses are operated in several interrelated pressures from different parties such as shareholder, society, governments, customer, market, and business organization when respond to environmental matters such as conserving materials, reduced water, and energy use. Recent years have seen an increasing role of institutional pressure in the fields of OM and SCM (Kauppi, 2013). Institutional pressure suggests that external forces motivate firms to undertake similar strategic actions. Under institutional pressure, firms are not only profit-seeking entities, but also recognize the importance of achieving social legitimacy. Institutional pressure has two main forms, an economic variant and asocial variant. The manufacturing sector around the globe is facing immense pressure from different quarters to adopt and implement GSCM practices (Chu *et al.*, 2017). Pressures being exerted by the above-mentioned stakeholders have made it compulsory for manufacturers to prove themselves as a legitimate company by adopting GSCM practices (Gualandris & Kalchschmidt, 2014).

The mechanisms identified are coercive, mimetic, and normative, which lead to wards institutional isomorphism). The coercive mechanism consists of formal or informal pressures created on firms by other firms on which they are dependent and by expectations from the society (Kauppi, 2013). As shown by Liu *et al.* (2010), government offices are the undeniable factor that impact the reception of green practices by associations through the implementation of standards and controls. For example, to diminish contamination to the earth, associations are required to utilize contamination control innovations and report their contamination emanations to demonstrate their effect on nature. Inability to do as such may make these associations confront legitimate authorizations which influence the business advance unfavorably. The dread of legitimate authorizations is considered as the primary purpose behind associations to proactively advance green practices (Zhu, Sarkis & Lai, 2013).

Besides, the ecological conduct of sending out organizations may likewise be affected by the coercive weight from remote enactments. The ecological arrangement and controls of the legislature are basic determinants as firms need to adjust with these prerequisites (Schrettle *et al.,* 2014). In one study Wong *et al.* (2012) studied the moderation effect of environmental management and green operations on manufacturing firm performance.

However, we further extend this research from an institutional theory perspective. Institutional pressure drives organizations to adopt environmental management initiatives; for example, Wu *et al.* (2012) studied the impact of GSCM drivers on GSCM practices under the moderation effect of institutional pressures, with reference to Taiwan's textile industry. Hence, we submit that institutional pressures have a moderation effect on the impact of SRM and TQM on environmental performance. However, one can argue that there are reasons why institutional pressure is not regarded as a mediating variable. Very often researchers get confused between moderating, mediating and controllable variables. However, a proper understanding and critical review further helps to resolve the conflicts. Similarly, in our case we have enough literature which supports the moderation role of institutional pressure.

2.3.5 Investment recovery

Venture recuperation requires the clearance of overabundance inventories, scrap and utilized materials, and abundance capital hardware (Green *et al,* 2010). Effective and efficient control of the purchasing and handling of materials can significantly reduce waste generation. Inventory control is meant to minimize costs and appropriate planning will help minimize the number of materials and products that are lost due to a variety of inventory reasons including obsolescence, spoilage and losing products. There are issues with managing the control and various lean principles (JIT and lean manufacturing philosophies) may help to manage in these environments Ming-Kuei (2014) more effectively. Material remaining after the product has expired will require disposal.

Companies should store materials in a locked space and limit access to a few designated employees. By controlling access to raw materials, operators will ensure that containers are completely empty before new containers are opened.

Management should establish standard operating procedures for inventory control and purchasing, working with suppliers to take back empty or off-spec containers. Inventory appears throughout the supply chain, including inside an organization and through the logistics network. Efficient inventory planning and management does not only help to decrease solid wastes, but also decrease air emissions such as greenhouse gas emissions. Information technology in inventory management plays a crucial role in improving control of the inventory and maintaining a greater positive environmental influence. This issue relates to the discussion on having appropriate enterprise resource planning systems. In fact, it has been found that for organizations that there is a correlation between those organizations that have lessened inventory and good environmental performance Al Khattab and Fraij (2011).

IR alludes to an association's vital utilization of turn around coordination reusing, redeployment, exchanging and comparable systems to get more prominent incentive from materials and items (Kumar & Chandrakar, 2012). IR looks to transform surplus resources into income by moving inactive resources, lessening storage room, and sending inert advantages for other corporate areas to abstain from acquiring extra hardware or materials. Out-of-benefit hardware, abundance stock or crude materials, waste and process side-effects and wrecked offices are incorporated into these non-working resources.

Investment recovery (IR) is used as an important aspect of organizational strategic use of redeployment, reselling, and recycling and other use full similar techniques to extract greater value from materials and products by organization. IR is also unique technique to generate revenue by selling useless assets, for reducing storage, space and deploying idle assets from other corporate locations to avoid extra purchasing additional requirement of

equipment for materials and processes (Atmadja & Saputra, 2018). Investment recovery also provides the facilities of non-working assets (Fragouli & Yankson, 2015).

Investment recovery (IR) is both environmental and economically beneficial practices for organization and society. Galbraith (2015) stated in his study that 70% at least every sales of dollar generate by investment recovery become surplus and it is possible if industries are as diverse as well. Use full practice of IR are as the reverse logistics practices such as recycling, reuse, remanufacturing and other like reclamation (Pandian & Abdul-Kander, 2017). In Malaysia, investment recovery (IR) not specific much attention such as in other developed countries like US and Germany, reasons are less waste management policies in Malaysia and same lack of closed-loop systems infrastructure (Callaway, 2017). The government of Malaysia changed their focus from resources of subsides into some important resources such as coal and natural gas, for the sack of renewal of new seek of interest in IR practices.

2.3.6 Supply chain performance

Many researchers tend to show growing interest in examining the contribution of suppliers in the improvements of the buying firms. While only a few studies have clearly proved that social capital has a meaningful influence on environmental performance, Mitra and Datta (2014) showed that supplier collaboration has a positive effect on environmental performance, specifically toward green product design and logistics.

We believe that a shared vision of environmental achievements between the buyer and supplier firms will naturally have a positive influence on environmental performance. Essentially, the cognitive social capital accumulated by GSCM will bring improvements for environmental performance. Structural social capital represented by frequent communication, information sharing, and joint activities will lead to knowledge transfer, which can assist in discussing and finding solutions for achieving environmental capability and performance. Long-term and trust-based relationships, namely relational

social capital, can increase the commitment between the two parties and provide incentives to improve environmental capabilities. Overall, strong relationship-based interaction, sharing of information, communication and trust will enable development of new solutions for various environmental challenges (Parmigiani, 2011). Thus, this brings great improvements to environmental performances.

Operational performance is concerned with the financial impact of a firm's GSCM practices. Regarding operational performance, several studies have been supportive of the theory that social capital acts as a strong driving force for improvements. Cognitive capital allows buyers and suppliers to share vision, combine each other's thinking processes, and seek resource integration. This alliance of goals aiming for a synergistic effect tends to reduce the chance of conflicts and enhance joint returns for both parties, increasing the willingness of both parties to mutually improve operational and strategic performance (Carey, 2011).

Structural social capital, which acts as a channel for communication and information sharing, generates better goal setting, planning, and problem solving, which can improve performances of both the buyer and supplier. Interactions, including technical exchanges, are factors that can positively influence supply chain performance. Several studies have provided evidence that relational social capital has significant effects on the improvement of quality, cost, flexibility, and productivity performance. Dyer and Singh explain that relational social capital reduces opportunistic behavior and monitoring costs, which is the main reason for operational improvement. (Chu *et al.*, 2017). In general, social capital, accumulated by frequent communication, timely information sharing, shared problem solving and good relationships, provide opportunities to improve operational performance.

2.4 Empirical review

2.4.1 Internal Environment Management and Supply Chain Performance

Internal organizational supply chain activities are related to traditional production and operations management topics of an organization. Also, stress the need to examine internal factors (IF) as well as external environmental factors driving green logistics is highly recommended. Within an organization, pressure from employees, leadership from environmentally committed management and perception of possible environmental risk might all contribute to changes in environmental practices in organizations (Harrison, 2011).

It is difficult to define which of this range within an organization influences GSCM initiatives and their relative success. There is consensus within the literature that internal environmental management is a key to improving enterprises' performance (Hanna *et al.*, 2011). It is well known that senior managers' support is necessary and, often, a key driver for successful adoption and implementation of most innovations, technology, programs, and activities. To ensure complete environmental excellence, top management must be totally committed (Al Khattab, 2012).

In a research done by Laari *et al.* (2016) found that manufacturers with strong internal GSCM practices combined with arm's length environmental monitoring of suppliers are likely to perform well in environmental issues. If a firm seeks to improve financial performance, it needs to form more collaborative relationships with customers to achieve environmental goals. In the same way, the study conducted by Sharma *et al.* (2017), concluded that internal environmental management, environmental design, and regulatory pressure are ranked as the top three performance indicators. The sensitivity analysis has also been performed to see the effect of weightage on the final ranking of performance indicators. This is one of the first studies that suggest the performance indicators for implementation of green supply chain management in agro industry.

The results from data analysis showed that both of green human resource management and green supply chain management practices have a positive effect to sustainable performance in a joint manner. In fact, the results revealed that green human resource management practices have a direct effect on the sustainable performance, with the green supply chain management practices mediating this effect. In particular, internal green supply chain management practices positively mediate between green human resources management practices and sustainable performance, whereas external green supply chain management practices mediate only the relationship between GHRM bundle practices and environmental dimension of sustainable performance, thus suggesting absence of awareness among manufacturers regarding the effectiveness of this type of GSCM practices for an improved economic and social dimensions of sustainable performance, and calling for more attention from green training programs (Zaid *et al.,* 2018) .

Lakshmimeera and Palanisamy (2013) merged a paper on a Conceptual Framework on Green Supply Chain Management rehearses for Indian Manufacturing industry. They reason that inner natural administration can enhance aggressiveness and ecological execution prompting manageability. Chien (2014), clarify the impacts of inner ecological administration on authoritative feasible execution and found that Green Supply Chain Management polished by Taiwan Electrical and Electronic producers and will decidedly influence the financial, natural, and social exhibitions.

A study done by Khan and Qianli (2017) investigated the impact of five determinants of the green supply chain practices on organizational performance in the context of Pakistan manufacturing firms. A sample of 218 firms was collected from the manufacturing industry. The green supply chain practices were measured through five independent variables including green manufacturing, green purchasing, green information systems, cooperation with customers, and eco-design. By using exploratory factor and simultaneous regression analysis, the results indicate that except green purchasing, rests of the four independent variables have been found statistically

significant to predict organizational performance. However, the eco-design of green practices followed by green information systems has revealed the greatest impact on organizational performance. Another valuable result is that green purchasing is an important antecedent of firm's economic performance in the US manufacturing firms (Green *et al.* 2012), although not significantly related to organizational performance in our study.

2.4.2 Green purchase and Supply Chain Performance

Diab *et al.*, (2014) tried the effect of Green Supply Chain Management Practices on Organizational execution and their examination dependent on Jordanian Nutrition Industries and chose six organizations represented considerable authority in sustenance industry. Consequences of the investigation appeared there was an effect on green buy on authoritative execution which are natural execution, budgetary execution, and operational execution. According to Govindan *et al.* (2013), the practices with the main driving power are just-in-time (lean practice), flexible transportation (resilient practice) and environmentally friendly packaging (green practice). Customer satisfaction is the performance measure with strong dependence and weak driving power; that is, it is strongly influenced by the other researched variables but does not affect them. Muma *et al.,* (2014) examine the impact of Green Supply Chain Management on natural Performance among tea preparing firms in Kericho County. Considering the Findings, consider affirm that there is a positive connection between Green obtaining, and turn around coordinations and natural execution.

Al Khattb *et al.*, (2015) tried the effect of the green inventory network the board on natural based promoting execution. Their chose five Jordan organizations and disseminated 125 surveys. It has demonstrated that Green Supply chain the executives such Green Purchasing, influenced the ecological promoting execution. Chiu and Hsieh (2016) tried the green store network rehearses in Taiwan Restaurant and firm exhibitions. GSCM practices and firm exhibitions are interceding with green ability and

their exploration presumed that Green Practices in eateries in Taiwan indirectly affect firm execution through green capacity and featured that if it is a higher degree it will add to the authoritative execution.

2.4.3 Eco design practices and Supply Chain Performance

Chin *et al.* (2015) talked about applied models which are identified with Relational View. The GSCM rehearses are conceptualized with Green acquirement, Green assembling, green dissemination, and green coordination. The manageability execution is estimated through Economic, Environmental and Social execution with the directing impact of Environmental Collaboration including trust, devotion, and reasonableness in arrangement, responsibility. An embedded case study involving four companies, two manufacturers and two suppliers was carried out using in-depth interviews. It enabled to depict particularities of how these companies deal with sustainable aspects of design in their respective business. Critical issues identified as obstacles for eco-design implementation in these industries were: control of both, productive process, and product durability; product distribution; rational use of space for transportation and storage (Sellitto *et al.,* 2017).

Mohamad and Koilpillai (2018) contemplate relationship of Green store network the board rehearses and hierarchical execution and chose ISO affirmed organizations in Malaysia. The investigation demonstrates that every green practice is not trailed by the organizations the accessible assets and abilities are differ towards that GSCM usage. Rao (2012) contends that GSCM practices ought to incorporate working cooperatively with providers on green item plans, holding mindfulness courses, helping providers build up their own ecological projects, etc. To green the production network, from the viewpoint of professionals, organizations need to incorporate the thoughts of green buying all out quality administration as far as representative strengthening, client center, ceaseless enhancement and zero waste, life cycle examination and natural advertising (Ji *et al.,* 2016). The initial framework was proposed based on the review of the literature

associated with environmentally sustainability supply chain management, Industrial Ecology, and Industrial Symbiosis. The initial framework is improved by corroborating the case study company's experience, a large UK distributor. Different hierarchies in waste management have also been considered when developing the framework (Leigh & Li, 2015). Rao (2012) called attention to that the green inventory network the executives exercises incorporate the association itself the green exercises and parts providers.

Green Supply Chain Management into the outside condition the executives and interior ecological administration (Rao, 2012). Duty of senior chiefs is amazingly helpful for the execution and reception stages for GSCM, on the grounds that without such upper administration responsibility most projects will undoubtedly fizzle. All GSCM rehearses are integrative and require cross-practical collaboration as opposed to just being focused to a solitary capacity or division. They proposed that green acquiring, and eco-plan are two rising methodologies and organizations should concentrate on the inbound or early parts of the item store network. Transportation strategy can help stakeholders realize certain transportation goals with less resource consumption and pollution emission. Association's the usage of green store network the executives rehearses, and the association's ecological execution and financial execution have the positive relations (Zhu & Sarkis, 2004).

2.4.4 Investment recovery and Supply Chain Performance

Investment recovery shows that there is significant impact of the investment recovery on the environmental-based marketing performance. Commitment in venture recuperation exercises makes a decrease in transfer costs through reusing and fixing things and an expansion in incomes through the closeout of remanufactured and reused products (Eltayeb *et al.,* 2011). On the other hand, venture recuperation exercises may require one-of-a-kind capacities that vary among firms to imply an extra speculation cost. While speculation recuperation exercises manage the finish of production network squander,

green buying exercises manage the aversion of waste toward the start of the store network.

Proprietor/chiefs must guarantee that the crude materials gained from providers can be recyclable, reusable and remanufacture empowered (Rao & Holt, 2005). This outcomes in a cost decrease for materials bought and bring down charges for waste treatment and release. Squander from crude materials can be changed over into an attractive state or be utilized amid the make of new items; be that as it may, this relies upon client request. Both green buying and speculation recuperation rehearses are related with eco-plan rehearses (see Zhu *et al.*, 2010).

2.4.5 Institutional Pressures and Supply Chain Performance

Zhu *et al.* (2013) contemplated 396 producers in China and uncovered that coercive weights have driven the makers to embrace inside green production network the executives rehearse. This by implication influenced their financial execution. Moreover, Zhang *et al*. (2014), in their examination out and about cargo transportation industry in Nanjing, China, found that one of the primary driving components of green coordinations rehearses for truck armadas is coercive weight.

Zhu *et al.* (2013) found that in China, mimetic weight drives producers to embrace green production network the executives rehearse that in a roundabout way influence the monetary execution of the organizations. Liu *et al.* (2010) likewise revealed that mimetic weight has a huge beneficial outcome on corporate ecological administration in China, making the Chinese organizations have a higher affectability towards the market factor. Along these lines, as per institutional hypothesis, mimetic weight could likewise turn into a solid driver for the selection of green activities and thusly enhance authoritative execution.

Zhu *et al.* (2013) uncovered that standardizing weight drives the Chinese producers to receive inward green production network the executive's practices and this by

implication influence their monetary execution. Additionally, Zhang *et al.* (2014), reviewed the street cargo transportation industry in Nanjing, China, and found that one of the principles driving components of green coordinations rehearses for truck armadas is standardizing weight. Henceforth, considering the institutional hypothesis, regulating weight could be a key determinant for the appropriation of green activities and in this way, to improve hierarchical execution. Wongthongchai and Saenchaiyathon (2019) found that the relationships exist among isomorphism institutional pressure, top management support, GSCM practices, and performance. The isomorphism institutional pressure for environmental concern has driven Thailand manufacturers to implement GSCM practices. The results suggest that GSCM practices do significantly affect performance by improved environmental practices. The isomorphism institutional pressure related to GSCM practices. Though top management may require increased environmental investment, it can be a resource for firms to gain economic benefit. Further, top management brings collaboration with customers and suppliers which can indirectly increase performance through environmental improvement.

A study done by Khan and Qianli (2017) investigated the impact of five determinants of the green supply chain practices on organizational performance in the context of Pakistan manufacturing firms. A sample of 218 firms was collected from the manufacturing industry. The green supply chain practices were measured through five independent variables including green manufacturing, green purchasing, green information systems, cooperation with customers, and eco-design. By using exploratory factor and simultaneous regression analysis, the results indicate that except green purchasing, rests of the four independent variables have been found statistically significant to predict organizational performance. However, the eco-design of green practices followed by green information systems has revealed the greatest impact on organizational performance. Therefore, the managers of the manufacturing firms should not only implement eco-design in their supply chain but also concentrate on proper monitoring and implementation of green information systems to increase their firms' performance. A main contribution of this research from theoretical side is that it is

possible to notice a negative effect of “green purchasing” towards organizational performance particularly in the scenario of Pakistan manufacturing industry. Another valuable result is that green purchasing is an important antecedent of firm’s economic performance in the US manufacturing firms (Green *et al.* 2012), although not significantly related to organizational performance in our study. In addition, we also discussed research limitations, areas for future research, and implications for practitioners.

2.4.6 Critique of existing literature

Green production network rehearses (GSCPs) ordinarily include venture recuperation, natural structure, green acquiring, client participation and interior ecological administration (Chien & Shih, 2014). The quantity of studies utilizing GSCP selection as a free factor and execution as a needy variable is less than those that utilization outer inspirations as the autonomous variable and reception as the reliant variable. Green supply chain management (GSCM) has in recent years been a subject of much debate among academia and practitioners. Increased environmental consciousness has triggered one of the greatest revolutions in human thought, uniting the entire world in a fight against the emissions which are produced during economic activities. Manufacturing and transportation activities are indicted as major reasons behind environmental degradation.

While there is a rich body of literature on GSCM practices, the research on GSCM theory building is scant. One of the few studies which have used case methodology to build theory is the seminal work of Pagell and Wu (2009), who attempted to build a complete theory of methodology to build a complete theory of sustainable supply chain management using multiple cases. Ketokivi and Choi (2014) have argued in their works that in recent years there has been a significant rise in case study methodology in the operations management field. However, most of such studies still lacks rigour in case research. Barratt *et al.* (2011) argued in their research that the use of theory can lead to better conclusions in terms of theoretical framework and insights.

Besides, among these investigations, the factors contrast, the discoveries are conflicting and, notwithstanding the significance of green practices in supply chains to creating nations, the minimum created nations are not spoken to. There is an absence of consistency in the factors used to quantify the two practices and execution. Most examinations on the connection between explicit GSCPs (inner natural administration, green buying, eco-structure, speculation recuperation and client collaboration) and execution results center around possibly one, a few GSCPs as opposed to every one of the five practices. Execution factors in investigations of GSCP appropriation and execution incorporate the accompanying factors, either independently or in blend: ecological execution; money related execution (monetary advantages); financial costs; operational execution; focused execution; social execution; showcase execution; and immaterial execution (see Eltayeb *et al.,* 2011; Kim *et al.,* 2011; Yang *et al.,* 2013).

Among the discoveries on the connections among GSCPs and execution, there is little understanding or clarification of the clashing outcomes. For example, a few investigations discover positive connections among training and execution (Green et al., 2012), some negative connections but then others discover no relationship (Laosirihongthong *et al.,* 2013). A conceivable purpose behind these irregularities, aside from strategy contemplations, is the distinction in settings in which the exploration is directed, for example, national controls and industry type and market.

Appropriation of GSCP is particularly significant in creating countries where contamination is increasingly extreme and prompts sick wellbeing, passing and handicaps of many individuals every year (Oluwasola, 2014). Destitution, absence of interest in current innovation, frail ecological enactment and industrialisation consolidate to cause high contamination levels in creating nations (Oluwasola, 2014). Industrialisation in creating nations is a high need given the requirement for basic change from little scale horticulture to assembling to achieve comprehensive and expert poor development (Oluwasola, 2014). For instance, apparently China would not have accomplished its great financial development and advancement had it been worried

about contamination in its underlying phases of improvement (Oluwasola, 2014). The development in research on GSCPs is dominating in creating countries, for example, China and other Asian nations; be that as it may, a large portion of these countries are well while in transit to improvement (Malviya & Kant, 2015). The minimum created countries such Rwanda have not been liable to inquire about.

When discussing the relationship between GSCM practices and performance (Vanalle *et al.,* 2017). Every country has its own cultural, legal, ethical, political, and work behavior issues, which can add some new dimensions into the investigation of institutional pressures, practice implementation, and performance outcomes (Geng *et al.,* 2017, Vanalle *et al.,* 2017, Sarkis, 2012). GSCM is in its evolving stage in developing countries, and there is a dearth of empirical research related to environmental practices and their relationship with performance (Liu *et al.,* 2015, Seuring & Gold, 2013). To develop a generalized theory of GSCM and to provide more specific guiding principles for policymakers and executives, it is sine qua non to conduct GSCM research in developing countries and strengthen the contextual dimension (Vanalle et al., 2017, Liu *et al.,* 2015, Jabbour, Frascareli & Jabbour, 2015). Thus, overall, there is a need for a conceptually and theoretically rich contextual study that uncovers the rationale for GSCM practices and the impact of GSCM practices on economic and environmental performance.

2.5 Research gaps

The writing audits have explained in subtleties the GSCM rehearses just as the different investigations done in the region of GSCM. Advantages of buying in to the GSCM rehearses are additionally referenced. They show that there is a positive connection between GSCM practices and execution of firms for example store network execution, monetary and natural execution. An examination done by Rha (2010) concentrated on assembling firms where he prescribes inquire about on the equivalent ought to be done and different practices ought to be incorporated and furthermore in various firms. The

writing audit through speculations clarifies the connections between GSCM rehearses and the firms‟ execution. They additionally depict different advantages a firm gain by buying in to GSCM. Absence of generally acknowledged structure on what to consider and what not to consider in operational execution is one more test. It has likewise unmistakably shown that there is an absence of one-way or all-around satisfactory system on the GSCM rehearses. Therefore, associations receive distinctive practices that suit their authoritative needs. In such manner, the GSCM practices and its effect on execution of a firm are resolved. The writing audit gives us learning of the GSCM practices and its suggestions on execution of firms. The inquiry we inquired as to whether there were changes in operational execution in the agro-manufacturing in Rwanda if GSCM rehearses are received? Were ecological and financial advantages related with the GSCM rehearses pertinent for our situation?

2.6. Summary of Literature Review

Among the many academic articles, there is still a notable gap in this research study that has been undertaken to date in the context of financial risk management which will help firm to improve on financial performance. This study therefore aims at investigating and widening their scope on the impact of green supply chain to the supply chain performance of Agri-manufacturing firms. The study will provide scholars with useful information on how to avert the exposure in their research. It will also be of use to supply chain managers who have the responsibility of adopting and implement GSCM. To this end most research on the impact of GSCM on supply chain performance has focused on the exposure of multinational companies and most of the focus has been other manufacturing institutions. This chapter has discussed theories relating to GSCM and supply chain performance, presented a diagrammatical and empirical relationship between GSCM practices and supply chain performance.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research methodology as follows; study area, philosophical foundation, research design, target population, sampling procedures used to get the appropriate sample size, data type and collection procedure, reliability and validity, measurements of variables, data analysis, limitations of study and ethical considerations.

3.2 Research Design

This study employed both cross-sectional and explanatory research design as it seeks to describe and establish associations among key study variables, namely, effect of green supply chain adoption on supply chain performance of Agri-Manufacturing firms in Rwanda. The study used a cross-sectional survey as data was collected at a given point in time (Creswell, 2014). The design is suitable where the study seeks to describe and portray characteristics of a phenomenon. It also enables the study to profile the sample of a population by collecting accurate information (Houghton *et al.,* 2013). Cross-sectional survey is appropriate for the study in that the data collected from HODs during one period can be generalized to the whole population. Additionally, cross-sectional studies have been found to be robust for effects of relationships studies (Yan *et al.,* 2019). The study adopted explanatory design since it uses theories and hypothesis to account for the forces that caused a certain phenomenon to occur (Cooper & Schindler, 2011).

The design is also considered appropriate for the study as it allowed the survey to be carried out in the natural settings and permitted the study to employ probability samples. This allowed for statistical inferences to be made to the broader populations and permit generalizations of findings to real-life situations, thereby increasing the external validity

of the study (Hubbard, Haig & Parsa, 2019). The probability sample minimizes bias and enhances reliability of data. Additionally, the design allowed use of questionnaires and thus use of inferential statistics in establishing the significant relationships between the variables (Devid & Muthini, 2019).

3.3 Philosophical Foundation of the Study

This study is in line with positivism approach, which seeks to use existing theory to deduce and formulate variables, assume hypotheses that are tested and established wholly, in part, or otherwise refuted leading to further development of theory to be tested with future research. Pearlson and Saunders (2013) affirms that through positivism the study is concerned with proofs and not impressions that could be studied empirically. The positivist paradigm emphasizes that genuine and factual occurrences could be studied and observed scientifically and empirically (Aliyu *et al*., 2014). The scientific approach to research consists of the familiar process of proposing hypotheses as explanations of phenomena and then collecting data to scientifically test the hypotheses. Therefore, the study derived variable, constructs and formulated hypotheses based on existing theories of logistic capabilities and then statistically verify through rational investigation and analysis.

3.4 Target Population

The target population was the employees from 67 agri-manufacturing firms in the department of supply chain management (REMA, 2018). The target population for a survey is the entire set of units for which the survey data are to be used to make inferences. Thus, the target population defines those units for which the findings of the survey are meant to generalize. Establishing study objectives is the first step in designing a survey. Defining the target population should be the second step. Target populations must be specifically defined, as the definition determines whether sampled cases are eligible or ineligible for the survey. The geographic and temporal

characteristics of the target population need to be delineated, as well as types of units being included. In some instances, the target population is restricted to exclude population members that are difficult or impossible to interview (Lavrakas, 2010). The employees in agro-processing firms in Rwanda are over twenty thousand. This invoked the use of representative population, where 536 people from 8 branches of supply chain department were used to make a population of 536 people from which the sample size was calculated.

3.5 Sampling Frame

A sample frame consists of a list of items from which a sample is to be drawn. The sampling frame consisted of the entire employees in supply chain department of the Agri-manufacturing firms in Rwanda as shown in table 3.1. A representative sample was selected from the sampling frame.

3.6 Sampling Design and Procedures

The procedure of sampling comprises using a portion of a population to make inferences about the whole population (Zikmund *et al.,* 2010).

3.6.1 Sampling Design

The sample was drawn from the agri- manufacturing sector in Rwanda. A list of all agri-manufacturing firms was obtained from the Rwanda Standard Board (2018), see sampling frame Appendix III. Cluster sampling combined with simple random sampling technique was used to select sampled respondents from the representative population of 567 employees from 67 in Rwanda. The employees were divided into clusters-based employee cadre. Each employee was assigned a unique identifying number and simple random sampling was used to select the firm in each cluster. This method of sampling gives each unit in the population a known chance of selection.

Probability sampling was used for this study. Probability samples keep sampling error low and generally offer a sample which can be seen to be representative. This is an appropriate way to draw a sample from a small population (Zikmund *et al.,* 2010). Once the firms were selected, employees from supply chain department were picked, to be included in the study the respondent would be among 8 branches of supply chain department.

3.6.1 Sample Size

The sample size determines the statistical accuracy of the findings. Sample size is a function of change in the population parameters under study and the estimation of the quality that is needed by the study. The sample size of this study was computed based on the following formula as proposed by Gall *et al.* (2014):

$$n = \frac{NZ^2 X\, 0.25}{[d^2 X\,(N-1)] + [Z^2 X\, 0.25]} = \frac{536 X 1.96^2 X\, 0.25}{[0.05 X\,(536-1) + [1.96^2 X\, 0.25]} = \mathbf{226}$$

Were.

n = sample size

N= total population size (known or estimated)

d= precision level (usually .05 or.10)

z= number of standard deviation units of the sampling distribution corresponding to the desired sample size

To determine the number of employees per category, the study applied cluster and simple random sampling proportionate to the cluster size as indicated in Table 3.1 below. According to Meysamie *et al.* (2014) calculations, a sample population of 67 firms results in 226 as respondents.

Table 3.1: Sample Size per category

Employee category	Population	sample size
Operations Manager	67	28
Chief Supply Chain Officer	67	28
Logistics Specialist	67	28
Supply Technician	67	28
IT Technician	67	28
Production Technician	67	30
Returns Specialist	67	28
Procurement specialist	67	28
Total	**536**	**226**

3.7 Data Type and Data Collection Procedure

This study collected both secondary and primary data, but mainly primary data using a structured questionnaire.

3.7.1 Sources and Types of Data

Primary data was collected using a structured questionnaire whereby three questionnaires was given to each of the sampled manufacturing firms to generate qualitative data, to achieve the study objectives. The questionnaire in each firm was answered by employees in supply chain department. In the absence of any of the stated employees, similarly senior managers in the firm were sampled. Questionnaires was sent to all sampled employees, who deal directly with supply chain management activities daily and can develop relationships strategic decision on supply chain performance. These employees were knowledgeable key informants, since they are the direct entities in most cases responsible for supply chain performance.

The choice of the several employees was informed by Marolt *et al*. (2020) and Fain *et al*. (2019), who suggested that it is more beneficial to collect data from multiple intra-

organizational respondents. Further, Ketokivi (2019) recommend that when using subjective measures of performance, data be collected from multiple respondents. This is a practice that is intended to improve validity and reliability. Secondary data was obtained from the Rwanda Manufacturing Association or firm website Web page or the NISR.

3.7.2 Data Collection Procedure and Instrument

The researcher obtained a research approval authorization letter from University facilitate acquisition of permission to carry out the studies. Then the researcher, proceeded to the country trade Officer in respective countries to seek the consent to conduct the research. Once the permission is granted, the researcher was arranged to visit each of the randomly selected firms for familiarization purposes and to seek permission from the management concerning the intended of data collection within their firm. Respondents were informed about the purpose of study and were assured of confidentiality of their responses. The researcher then trained research assistant and supervisors during actual data collection where questionnaire was distributed to the selected respondents. The instructions on how to fill the questionnaires was carefully explained to the respondents. Sufficient time was allowed for them to respond to the instruments accurately. After responding to the questionnaires, the researchers had then collected them for data analysis and thanked the respondents.

The employees understanding of the questionnaire tool, items and terminology was assessed during the pilot study. A drop-off and pick-up technique were employed to enhance the response rate (Allred and Ross-Davis, 2011). Prior to dropping off the questionnaires, the manufacturing firms were contacted requesting them to participate. The questionnaire was sent with a cover letter explaining its importance and stating that the responses were confidential.

After introducing the study and giving the questionnaires, the employees was allowed a maximum of three days to fill up before the completed questionnaires was picked up by a research assistant. During the collection of the questionnaires, a note was sent to thank participants and at the same time encouraging those that had not responded. A follow update was agreed upon (Zhang, 2015). Respondents was asked to rate their firm in comparison with their competitors in the same industry over the last three years on each measure of performance. Firm performance was measured using the following dimensions: customer satisfaction, customer retention and sales growth.

3.8 Validity and Reliability of Research Instrument

Validity is attained by aligning the content of the questionnaire with the research objectives (Van Tonde and Ehlers, 2011). Validity test must produce information that is not only relevant but also free from systematic errors.

3.8.1Validity of Study Instrument

Validity refers to the accuracy of a measurement instrument and to the extent to which the instrument measures what it is intended to measure (Zikmund *et al.,* 2010). It also refers to the extent to which a specific measure is free from systematic and random errors (Patrescu, 2017). There are two types of validity, including internal and external (Van Tonde & Ehlers, 2011). External validity refers to the extent to which the results of the study could be generalized to other research settings and other samples. In this study, to ensure external validity, the results were generalized to other Agri-Manufacturing firms' settings and other emerging economies. Additionally, the following kinds of internal validity were ensured, namely, content and construct validity.

Content validity refers to the extent to which a research instrument adequately covers the constructs under study. Content validity was ensured in various ways to include First, content validity was achieved by seeking opinion of experts (study supervisors). As far as construct validity is concerned, Treiblmaier and Filzmose (2011) asserts that it is the

extent to which a measurement instrument is grounded in theory. This means that the instrument must have existing conceptual or theoretical bases in the literature. In this study, construct validity was assured by deriving dimensions of financial management, financial innovation, and firm performance from existing literature.

Consequently, the questionnaire tool adopted was aligned with the research objectives. Further, essential adjustments were made to the questionnaire based on feedback obtained from the pilot study. Similarly, a large sample size was used to boost the accuracy of the results. Treiblmaier and Filzmose (2011) further postulates that other aspects of construct validity are convergent and discriminant validity. This was ensured through Exploratory Factor Analysis (EFA). Dikko (2016) posits that factor analysis basically involve four stages as follows; First, preparation of correlation matrix which is the number in main distance of matrix called communality. Second, factor extraction which is getting the main factors that have caused changes in the proposed variable. This may be done through commonly used methods like the Principal Component Analysis (PCA), maximum likelihood, principal axis factoring and least Square, among others. This study used PCA as the extraction method.

Third, the selection and rotation of factors. Factor loading for each item in the factor matrix which shows the amount of correlation each item has is analysed through PCA, used together with variance maximization (varimax) rotation and Kaizer normalization. This brings out easy interpretation as only components with Eigen values greater than 1 are extracted and renamed accordingly as recommended by Hair *et al*. (2010).

Finally, a statistical test of sampling adequacy using by Kaiser-Meyer-Olkin (KMO) was used to indicate the proportion of variance in the variables that might be caused by the underlying factors. The value of 1.0 is regarded as useful for factor analysis. Consequently, Bartlett's tests of Sphericity were used to check the hypothesis which states that the correlation matrix is an identity matrix. If the variables are unrelated then it is an indication that they are unsuitable for structure detection. Accordingly, Hair *et al*.

(2012) recommends that values of less than 0.05 indicate that the data is good for factor analysis.

3.8.2 Reliability of Study Instrument

Reliability is a pointer of a measures' internal consistency (Zikmund, 2010). Before commencement of the main field work, filtering of the measurement scales started with computing reliability coefficient (Cronbach's alphas) in accordance with Du Plessis (2010) recommendations. The questionnaires were pilot tested amongst the respondents in selected firms. These Agri-Manufacturing firms and employees was considered to possess characteristics like the ones in actual survey. However, respondents from pilot-tested firms were not part of the study as this would have introduced assessment biases. Connelly (2011) recommends that a pilot study sample should be 10% of the projected sample for research. Equally, similar recommendations are by Cooper and Schilder (2011); Creswell (2014).

Therefore, pilot test for this study consisted of 2 Agri-Manufacturing firms a randomly selected. The responses from 10 employees in each of the 2 Agri-Manufacturing firms was coded, summed, and entered in the SPSS and a Cronbach alpha (α) coefficient test of reliability was calculated based on a threshold of at least 0.7 as recommended by Hair *et al*. (2006). To determining the reliability of the study constructs, the Cronbach's alpha test was conducted on all the scales, using a 0.70 cut-off point which is recommended as commonly acceptable (DeVellis, 2012). The reliability statistics for the questionnaire are presented in Table 4.30. The closer the Cronbach's alpha is to 1, the higher the internal consistency reliability (Sekaran & Bougie, 2010).

The rationale for the assessment is that the individual items in each scale should all be measuring the same construct and thus be highly inter-correlated. A questionnaire with a good internal consistency should have high alpha coefficients (Hair *et al*., 2010). The

study results indicated that the minimum required Alpha values of 0.70 was exceeded in all the cases, signifying that the instrument used was reliable.

3.9 Data Analysis and Presentation

Data analysis was performed with the aid of SPSS version 22.0 (Hayes & Montoya, 2017) using both descriptive and inferential statistics. Descriptive analysis was done for comparison of means, frequency distribution, standard deviation, skewness, and Kurtosis values and are discussed as follows.

Initial, normality of the study variables was assessed using skewness and Kurtosis values. The range of -1.96 to 1.96 for skewness and -3 to 3 Kurtosis as suggested by Ghasemi and Zahediasl (2012) was used to detect the existence of skewness and Kurtosis, respectively. Missing value analysis was conducted as recommended by Tabachnik and Fidell (2013). Equally, both cases of outliers (univariate and multivariate) were dealt with as recommended by Tabachnik and Fidell (2013).

Distances of cases from the centroid of remaining cases created at the intersection of means of all variables were used to inspect multivariate outliers. Consequently, Mahalanobis Distances was calculated using IBM SPSS Regression by evoking Mahalanobis D^2 values. A case was therefore deemed a multivariate outlier if p-value related with Mahalanobis chi-square value was below 0.001.

Scale reliability and validity was assessed using Cronbach's coefficient alpha and factor analysis. To test the linear relationship and usability of variables in regression analysis, correlation analysis was done using Pearson's Product Moment Correlation (PPMC).

We used the Harmon's factor test to examine whether common methods variance in the predictor and outcome variables inflates the empirical relationship among variables (Podsakoff *et al*., 2012).

3.9.1 Model Specification

Model 1and 2 specified below sought to establish effect of control variables and direct effects of GSCM dimensions variables against supply chain performance, respectively.

$$y = \beta_0 + C + \varepsilon \text{..} \quad \text{Model 1}$$

$$FP = \beta_0 + C + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \varepsilon \text{.........................} \quad \text{Model 2}$$

Where:

Y is dependent variable (Agri-Manufacturing firm's supply chain performance)

X_1 is independent variable # 1 (internal environment management)

X_2 is independent variable # 2 (green purchase)

X_3 is independent variable # 3 (eco design practices)

X_4 is independent variable # 4 (investment recovery)

C is control variable.

β_0 is a constant

ε is Error term (random variation due to other unmeasured factors).

Moderation Test

To perform mediated hierarchical regression, each dependent variable underwent a series of steps to determine if mediation existed and if that mediation was partial or full. Research by Hair *et al*. (2010), was applied. The steps are as follows: 1. The control variables (C) was entered into the model as block one, then the independent variables (X) were entered into the model as block two and regressed on the dependent variables (Y). 2. The control variables (C) was entered into the model as block one, then the mediator variable (Z) was entered into the model as block two and regressed on the

dependent variable (Y). 3. The control variables (C) was entered into the model as block one, then the independent variables (X) were entered into the model as block two and regressed on the mediator variable (Z). 4. If steps 1–3 produced significant models, control variables (C) were entered into the model as block one, then the mediator variable (Z) was entered into the model as block two, and then the independent variables (X) was entered into the model as block three and regressed on the dependent variable (Y). If a significant model for step four resulted, partial mediation existed, whereas, if a non-significant model resulted, full mediation existed.

Further, the third sub-hypotheses of the fifth hypothesis sought to establish the moderating effects of institutional pressures on specific GSCM techniques - performance relationship. That is, would show the effect of institutional pressures strengthen or weaken the relationship between GSCM techniques and firm performance in an intensely financial innovation than in a less competitive one.

The hypotheses were tested using moderated regression analysis to establish the extent that the moderator variable affects the relationship between the specific GSCM and performance. The moderator effect was examined using regression analysis procedures as outlined by Tingley *et al.* (2014); Aiken and Karazsia *et al.* (2014). The moderating effect of institutional pressures on firm performance relationship respectively, was consequently assessed using the following models.

$$Y = \beta_0 + C + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_{4a} X_1 * M + \varepsilon \text{.....Model 3}$$

$$Y = \beta_0 + C + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_{4a} X_1 * M_4 + \beta_{4b} X_2 * M + \varepsilon \text{..... Model 4}$$

$$Y = \beta_0 + C + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_{4a} X_1 * M_4 + \beta_{4b} X_2 * M + \beta_{4c} X_3 * M + \varepsilon \text{.... Model 5}$$

Where: -

Y is dependent variable (firm performance)

Y is dependent variable (Agri-Manufacturing firm's supply chain performance)

X_1 is independent variable # 1 (internal environment management)

X_2 is independent variable # 2 (green purchase)

X_3 is independent variable # 3 (eco design practices)

X_4 is independent variable # 4 (investment recovery)

M is moderating variable (institutional pressures)

β_0 is a constant

ε is Error term (unexplained variation due to other unmeasured factors).

3.9.2 Hypothesis Testing

Multiple regression analysis is used to predict the value of dependable variable based on the value of two or more independent variables. The study hypotheses were therefore tested using multiple regression analysis where the significant level was set at 0.05. The null hypotheses were either rejected at $p<0.05$ level, otherwise fail to reject at $p>0.05$ level.

3.9.3 Underlying Assumptions of Multiple Regression Model

A regression model is a mathematical representation of what and how independent variables are related to the dependent variables. All regression models have assumptions, and violation of these assumptions can lead to unreliable results. The following assumptions that underline multiple regression model of analysis was assessed:

i. Normality is the assumption that the scores on a continuous variable are normally distributed about the mean, (Silverman, 2016). Normality of

independent variables was tested using mathematical methods. The normality of distribution was inspected using the degree of Skewness and kurtosis of variables. Similarly, the normality of distribution was also checked by use of Kolmogorov-Smirnov test.

ii. Linearity refers to the degree to which the change in the dependent variable is related to change in the independent variables (Hair *et al*., 2010). Linearity between the dependent variable and each independent variable was tested using PPMC. The goal was to assess the strength of linear relationships among variables.

iii. Homoscedasticity refers to the assumption that dependent variable exhibits similar amounts of variance across the range of values for independent variable around the regression line, meaning they have equal spread. The Levene's statistic for equality of variances would be used to test for the assumption of homoscedasticity.

iv. Multi-Collinearity refers to the presence of high correlations between independent variables (Ali *et al*., 2013). In this study, multi-collinearity was assessed by means of tolerance and Variance Inflation Factor (VIF) values. Normally, a tolerance value of below 0.10 or a VIF value greater than 10 reveals serious multi-Collinearity problem (Leech *et al*., 2011). Tolerance indicates the amount of variability of the independent variable not explained by other independent variables, whereas VIF is the inverse of tolerance statistic.

v. No autocorrelation – linear regression analysis requires that there be little or no autocorrelation in the data. Autocorrelation occurs when the residuals are not independent from each other. This study used Durbin-Watson test to check for autocorrelation.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSIONS

4.1 Introduction

The study employed different statistical techniques aided by SPSS to determine effects of green supply chain adoption on supply chain performance: survey of Agri-Manufacturing Firms in Rwanda. This chapter describes the data analysis, presentation, and interpretation of the findings. The findings relate to the objectives that guided the study. The chapter begins with the bio data, results on the objectives, then explains factor analysis and reliability techniques adopted by the study, correlation, and regression analysis. Factor analysis was adopted to reduce the number factors under each research variable and retain the indicators capable of explaining effects of green supply chain adoption on supply chain performance: survey of Agri-Manufacturing Firms in Rwanda. Reliability analysis was carried out using Cronbach alpha which is a coefficient of reliability that gives an unbiased estimate of data generalizability.

4.2 Data preparation and Screening

The survey was first screened for response rates and missing values. It was necessary to establish whether the response rate was sufficient to allow for generalizations of the study.

4.2.1 Response Rate

Response rate also known as completion rate in survey research refers to the number of respondents who answered the survey divided by the sample size. Babbie (2007) posits that a survey response rate is viewed as an important indicator of survey quality and it is presumed that a higher response rate ensures more accurate survey results. The study distributed 226 questionnaires to the respondents. Out of which 220 questionnaires from

226 were returned. However, of the 220 returned, a total of 212 were reasonably and adequately completed representing approximately 93.8% response rate (Table 4.1). This response rate falls within the confines of a large sample ($n \geq 30$). Additionally, the response rate was deemed satisfactory as suggested by Fowler (1993) who recommends 75% as a rule of the thumb for minimum responses. Further, regarding the works of Jaworski and Kohli, (1993); Prasad *et al*. (2001), this response rate is considered satisfactory and is comparable to research on similar topics in marketing.

Table 4.1: Response Rate of Questionnaires

Responses	**No.**	**Percentages**
Administered questionnaires	226	100%
Returned	220	97.3%
Unusable questionnaires	8	0.04%
Usable questionnaires	212	93.8%

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4.2.2 Missing Values Analysis

Studies have shown that missing values are a common occurrence in social research (Hayes, 2012). As noted by Fichman *et al*. (2005), missing values can seriously affect results of statistical analysis. Consequently, the study attempted to eliminate or reduce missing values right from the field. The research assistants personally delivered each questionnaire to firm managers. Thereafter, a time and date to return and collect the questionnaire was agreed upon. To ensure that the questionnaire was completed, a follow-up phone call was made prior to the second visit. In case the completed questionnaire was still not available, a second visit was arranged to encourage participation. Personalized thank-you notes were delivered when the questionnaires were collected. Missing values were evaluated with respect to both cases and variables.

Initially, missing values were evaluated with respect to cases and their distribution as shown in Table 4.2. Most cases had non-missing (96.4%) values and 3.5% had missing values.

Table 4.2: Distribution of the Number of Missing Values on Cases

Number of missing values	Number of cases	Percentage
0	212	96.4
1	5	2.2
2	1	0.4
3	2	0.9
Total	**220**	**100.0**

Thereafter, missing values were assessed with respect to variables. Table 4.3 shows the number of missing values by variables. 55 variables did not have missing values while 7 had only minimal missing values. Specifically, 3 variables had one missing value and 4 variables had one missing value. These were deemed useable and missing data were replaced with mean substitution before further analysis was conducted (Tabachnick & Fidell, 2013).

Table 4.3: Distribution of the Number of missing Values by Variables

Number of missing values	Number of variables
0	55
1	3
2	4

4.2.3Analysis of Outliers

An outlier is a point that is far from observing other observations. Outlier may be due to variation in the measurement and can perhaps show an experimental error (Churchill Jr. & Iacobucci, 2004). The latter is sometimes excluded from the data set. There is high tendency of outliers in any random distribution, but they are often indicative either of

measurement error or that the population suffers hard-tail distribution. Scrutinizing outliers is an important step because skipping initial examination of outliers can distort statistical tests if there happens to be problematic outliers (Hair *et al*., 2010). It distorts statistics and may lead to results that do not generalize to certain sample except one with the same type of outliers (Tabachnick & Fidell, 2013).

In line with the recommendation of Tabachnick and Fidell (2013) this study used Mahalanobis D^2 measure to identify and deal with multivariate outliers. Additionally, handling multivariate outliers would take care of univariate outliers. However, treating univariate outliers would not necessarily take care of multivariate outliers (Hair*et al*., 2010). Hence, Mahalanobis D^2 were calculated using linear regression methods in SPSS, followed by the computation of the Chi-square value. Given that 4 items were used, 3 represent the degree of freedom in the Chi-square table with $p < 0.001$, (Tabachnick & Fidell, 2013). This means that any case with a probability Mahalanobis D^2 value of less than 0.001 is a multivariate outlier and should be removed. Therefore, cases with a value of less than 0.001 were excluded from further analysis.

4.2.4 Reliability analysis

Reliability analysis was done with the use of Cronbach's Alpha which measures the internal consistency by establishing whether certain items within a scale measure the same construct. Nunnally (1978) recommends that instruments used in research should have reliability of 0.70 and above, thus forming the study's benchmark. Cronbach Alpha was established for every objective which formed a scale. The table below shows that Institutional Pressure had the highest reliability (α=0.837), followed by Eco Design (α=0.762), Green Purchasing(α=0.741), supply chain performance (α=0.717) and internal environment management (α=0.655). Other than internal environment management, the other scales were reliable as their reliability values exceeded the prescribed threshold of 0.7.

Table 4.4: Reliability analysis

	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Internal environment management	0.655	0.701	8
Green Purchasing	0.741	0.73	9
Eco Design	0.762	0.756	10
Investment Recovery	0.772	0.774	7
Institutional Pressure	0.837	0.84	10
Supply chain adoption on the performance of agri-manufacturing firms	0.717	0.76	8

4.3 Sample Characteristics

4.3.1 Firm years of operation

Table 4.5 illustrates the results on firm age. From the results, 32.7% (70) of the respondents noted that the firms have been in operation for a period ranging a year to 3 years, 27.6% (59) for 4 to 7 years, 24.3% (52) for over 15 years and 7.5% (16) for 8 to 11 years. On average, most of the firms have been in operation for a period ranging from a year to seven years. As a result, the firms are likely to have better supply chain performance because they are more experienced and enjoy the benefits of "learning by doing" (Coad *et al.,* 2013; Vassilakis, 2008).

Table 4.5: Firm Years of Operation

	Frequency	Percent
1-3 years	70	32.7
4-7 years	59	27.6
8-11 years	16	7.5
12-15 years	17	7.9
Over 15 years	52	24.3
Total	**214**	**100**

4.3.2 Firm size

Firm size was measured by assessing the number of employees in the firms as shown in table 4.6. From the results, 63.1% (135) of the respondents noted that their firm has between 1 to 100 employees, 21% (45) between 101 to 200 employees, 9.8% (21) between 201 to 300 employees while 6.1% (13) of the respondents stated that their firm has between 301 to 400 employees. Generally, most of the firms are small as evidenced by employees ranging from 1 to 100.Since the firms are small, it could be that they lack the market power possessed by large firms in charging higher prices thereby earning more profits. They could also lack stronger negotiating power that provides larger firms more favourable financing conditions.

Table 4.6: Firm Size

No of employees	Frequency	Percent
1-100	135	63.1
101-200	45	21
201-300	21	9.8
301-400	13	6.1
Total	214	100

4.4 Descriptive Statistics for Study Constructs

Respondents were asked to provide information regarding their level of agreement to items concerning internal environment management, green purchasing, eco-design, investment recovery, institutional pressure, and supply chain performance.

4.4.1 Internal Environment Management

The study deemed it important to establish the effect of internal environment management practices on supply chain performance among Agri-Manufacturing Firms in Rwanda. Table 4.7 highlights the results. Basing on the results, the firm senior managers are committed to GSCM (Mean = 4.51, SD = 0.551). In that way, top management support is a step further towards ensuring that there is commitment to GSCM. Other than that, there is also support for GSCM from the mid – level managers (mean = 3.94, SD = 0.882).

Besides, the firm has teams responsible for environmental improvements (mean = 4.05, SD = 0.732). The implication is that there is special dedication to environmental improvement by the firms which is key in ensuring the attainment of superior green supply chain management.

Moreover, the firm has total quality environmental management (mean = 4.24, SD = 0.799). On the same note, there is ISO 14001 certification for complying with environmental compliance and auditing programs (mean = 4.00, SD = 0.884). The results suggest that the firms in question comply with the quality standards pertaining environmental management.

In addition, the firm supports environmental regulations (mean = 4.04, SD = 0.561). The only challenge is that there is no emphasis on Eco labeling of products (mean = 2.56, SD = 1.409). This is an area that needs urgent attention if supply chain performance is to be enhanced.

Table 4.7: Internal Environment Management Distribution

Statement	Mean	Std. Deviation	Skewness	Kurtosis
The firm senior managers are committed to GSCM	4.51	0.551	-0.704	0.58
The firm mid-level managers support for GSCM	3.94	0.882	-0.828	1.165
The firm has teams responsible for environmental improvements	4.05	0.732	-0.73	1.758
The firm has total quality environmental management	4.24	0.799	-1.257	2.323
The firm has ISO 14001 certification for complying with environmental compliance and auditing programs	4.00	0.884	-0.308	-1.027
The firm has environmental management systems	3.92	0.936	-0.61	-0.283
the firm emphasizes for Eco-labeling of Products	2.56	1.409	0.266	-1.388
The firm support for environment regulations	4.04	0.561	-0.709	1.165
Internal environment management	**3.8777**	**0.48356**	**-0.868**	**2.17**

Overall, the findings on internal environment management summed up to a mean of Neutral=3.8777, standard deviation of 0.48356, skewness of -0.868 and kurtosis of 2.17. The implication is that the respondents were agreeable on most of the items on internal environment management. There was also less variations in the responses as indicated by the standard deviation. The extant literature has also indicated that programs encompassing GSCM and CLSC practices are not for the faint hearted hence the need for top management support for successful implementation (Matthews, 2014; Seitz and Peatty, 2014). Similarly, the literature has indicated that the top management must be fully committed if progress is to be realized in environmental management. As well, support from the mid – level managers are key in the implementation of environmental practices (Carter *et al.*, 2018; Bon et al., 2011).

4.4.2 Green Purchasing

Table 4.8 highlights the results on Green Purchasing. The study established that the firms provide design specifications to suppliers that include environmental requirements for purchased items (mean = 3.78, SD = 0.914) with mean of 3.78 implying that a higher proportion of the respondents agreed to the statement. Consequently, the firms ensure that the supply chain partners adhere to environmental requirements for the specific products that they supply. Besides, the firm cooperates with its suppliers for environmental objectives through sharing ideas most of the interviewees agreed to the statement at (mean = 3.74, SD = 1.099).

Moreover, across the variables higher proportion of respondents agreeing to the statement at means ranging from 3.5 - 3.9 firm does audit on environmental suppliers' internal management (mean = 3.86, SD = 0.875) and it ensures that it only deals with suppliers with ISO1400 certification (mean = 3.64, SD = 0.924). Furthermore, the firm cooperates with customers for both cleaner production (mean = 3.62, SD = 0.862) and green packaging (mean = 3.49, SD = 0.949).

To sum up, the results on Green Purchasing summed up to a mean of 3.8629 implying that most of the respondents agreed with Green Purchasingand a standard deviation of 0.50137, Skewness 0.337 and kurtosis 0. 191. The implication is that the respondents agreed on most items on green purchasing. As well, there were less variations in the responses as indicated by the standard deviation. The study findings are in line with that of Diab *et al.*, (2014) which tested the effect of green Purchasing on organizational performance and established that green purchase had an influence on organizational performance, which are environmental performance, financial performance, and operational performance.

Table 4.8: Green Purchasing distribution

Statement	Mean	Std. Deviation	Skewness	Kurtosis
The firm provide design specification to suppliers that include environmental requirements for purchased item	3.78	0.914	-0.323	-0.511
The firm cooperate with its suppliers for environmental objectives through sharing ideas	3.74	1.099	-0.239	-1.293
The firm does audit on environmental for suppliers' internal management	3.86	0.875	0.08	-1.097
The deals with Suppliers' with ISO1400 certification	3.64	0.924	-0.396	0.051
The firm cooperate with customers for cleaner production	3.62	0.862	-0.396	-0.233
The firm cooperate with customers for green packaging	3.49	0.949	-0.157	-0.438
Green Purchasing	**3.8629**	**0.50137**	**0.337**	**0.191**

4.4.3 Eco Design

As part of the objectives, the study sought to ascertain the effect of eco design practices on supply chain performance among Agri-Manufacturing Firms in Rwanda. Table 4.9 illustrates the findings. Across the eco design practices, variables had higher proportion of respondents agreeing to the statement at means ranging from 3.2±1.31 – 4.01±0.94. Evidently the firm designs its products for reduced consumption of material/energy (mean = 3.84, SD = 0.72). On the same note, the firm designs its products for reuse, recycle and recovery of material (mean = 3.74, SD = 0.91).

Moreover, the firm designs its products to avoid or reduce use of hazardous products (mean = 3.97, SD = 0.84). Similarly, the firm designs its products for support regulation (mean = 3.74, SD = 1.04). However, it is undefined whether the firm designs products that weigh the least capacity for decreased time taken and the energy during transportation (mean = 3.17, SD = 1.31).

Furthermore, the firm designs its products in such a way that they are easy to set up by the users and at the same time energy saving (mean = 3.76, SD = 0.96). Finally, the firm design usability of part particularly for extend using products, repair easy and increase efficiency (mean = 4.01, SD = 0.94). In general, the findings on Eco Design summed up to a mean of 3.86, standard deviation of 0.56, skewness 0.28 and kurtosis -0.6.

Table 4.9: Eco Design Distribution

Statement	Mean	Std. Deviation	Skewness	Kurtosis
The firm design its products for reduced consumption of material/energy	3.84	0.72	-0.3	-0
The firm design its products for reuse, recycle, recovery of material, component parts	3.74	0.91	-0.1	-0.9
The firm design its products to avoid or reduce use of hazardous of products and/or their manufacturing process	3.97	0.84	-0.9	1.54
The firm design its product for support regulation	3.74	1.04	-0.4	-0.9
The firm design its products that weight and the least capacity for decrease taking time, the area stores, and the energy between the transportation leas	3.17	1.31	-0.2	-1.1
The firm design it is the products to be easy set up for the users in the most energy saving way	3.76	0.96	0.05	-1.3
The firm design usability of part particularly for extend using products, repair easy and increase efficiency	4.01	0.94	-0.9	0.56
Eco Design	3.86	0.56	0.28	-0.6

4.4.4 Investment Recovery

This section of the analysis highlights the results on Investment Recovery. The findings are as presented in table 4.10. Across the investment recovery variables had most of the respondents agreeing to the statement at means ranging from 3.43±1.11 – 3.80±0.98. It is evident from the results that the firm sales its excess inventories/ materials (mean = 3.71, SD = 1.223). Also, the firm sales its scrap and used materials (mean = 3.68, SD = 1.439). Excess capital equipment is also sold (mean = 3.43, SD = 1.11).

Furthermore, the firm does recycle some of its used products (mean = 3.6, SD = 1.026). Specifically, the firm collects and recycles end-of-life products and materials (mean = 3.8, SD = 0.984). However, there is uncertainty as to whether the firm has established a recycling system for used and defective products (mean = 3.55, SD = 0.74069). To sum up, the findings on Investment Recovery summed up to a mean of 3.550 and standard deviation of 0.74069, skewness -0.777 and kurtosis 0.198.

Table 4.10: Investment Recovery distribution

Statement	Mean	Std. Deviation	Skewness	Kurtosis
The firm sales its excess inventories/materials	3.71	1.223	-0.94	-0.096
The firm sales its scrap and used materials	3.68	1.439	-0.725	-0.822
The firm sales its excess capital equipment	3.43	1.11	-0.288	-0.536
The firm does recycle some of its used products	3.6	1.026	-0.29	-0.698
The firm Collect and recycle end-of-life products and materials	3.8	0.984	-0.44	-0.25
The firm has Established a recycling system for used and defective product	3.35	1.016	-0.043	-0.723
Investment Recovery	3.55	0.74069	-0.777	0.198

4.4.5 Institutional Pressure

This section of the analysis highlights the findings on institutional pressure. The results are as presented in table 4.11. The findings of the study have shown that the local environmental laws put pressure on the firms GSCM (mean = 3.95, SD = 0.779). Other than that, the environmental protection demands from the firms' domestic customers put increasing pressure on their GSCM (mean = 3.78, SD = 0.835).

Table 4.11: Institutional Pressure distribution

Statement	Mean	Std. Deviation	Skewness	Kurtosis
Local environmental laws put pressure on our GSCM.	3.95	0.779	-0.496	0.365
The environmental protection demands from our domestic customers put increasing pressure on our GSCM.	3.78	0.835	-0.806	0.509
The increase of environmental awareness of the society boosts pressure on our GSCM.	3.77	0.965	-0.822	0.671
The collaboration in environment with our suppliers boosts pressure on our GSCM.	3.76	0.732	-0.162	0.222
The improvements in developing green products of our suppliers boost pressure on our GSCM.	3.5	1.007	-0.458	-0.004
The improvements in products green packaging of our suppliers boost pressure on our GSCM.	3.72	0.913	-0.379	-0.051
The green strategy of the manufacturers who produce the same products as we boost pressure on our GSCM	3.08	1.134	-0.207	-0.551
The green strategy of the manufacturers who produce the substitute products as we boost pressure on our GSCM.	3.35	1.316	-0.26	-1.033
The requirements of green development from the industry association boost pressure on our GSCM.	4.13	0.78	-0.872	0.779
Institutional Pressure	3.72	0.594	0.122	0.281

Furthermore, the increase of environmental awareness of the society boosts pressure on the firms' GSCM (mean = 3.77, SD = 0.965). Also, the collaboration in the environment with the suppliers boost pressure on GSCM (mean = 3.5, SD = 1.007). In addition, the pressure on GSCM is boosted by improvements in developing green products by

suppliers (mean = 3.5, SD = 1.007), improvements in products green packaging of the firms' suppliers (mean = 3.72, SD = 0.913) and the requirements of green development from the industry association (mean = 4.13, SD = 0.78).

However, there is doubt whether the green strategy of the manufacturers who produce the same products as the firms boost pressure on GSCM (mean = 3.08, SD = 1.134). Similarly, it is uncertain if the green strategy of the manufacturers who produce the substitute products as the firm boost pressure on their GSCM (mean = 3.35, SD = 1.316). Generally, the results on Institutional Pressure summed up to a mean of 3.715, standard deviation of 0.59476, skewness 0.122 and kurtosis 0.281.

4.4.6 Supply chain performance

This section of the analysis highlights the results on supply chain performance. Basing on the findings in table 4.12, the firms can customize product to meet specific customer demand (mean = 4.03, SD = 0.779). Besides, the firm has customer responsiveness flexibility (mean = 4.18, SD = 0.816). Moreover, the firm has low percentage of defects (mean = 4.05, SD = 0.624) and high percentage of finished goods in transit (mean = 4.05, SD = 0.804). However, there is no efficiency of purchase order cycle time (mean = 1.07, SD = 0.259). Generally, the findings on supply chain performance summed up to a mean of 3.6878, standard deviation of 0.42973, skewness -0.736 and kurtosis 1.007.

Table 4.12: Supply Chain Performance distribution

Statement	Mean	Std. Deviation	Skewness	Kurtosis
The ability to customize product to meet specific customer demand	4.03	0.779	-0.94	1.093
The firm has customer responsiveness flexibility	4.18	0.816	-0.433	-1.117
The firm has low percentage of defects	4.05	0.624	-0.168	0.046
The firm has high percentage of finished goods in transit	4.05	0.804	-0.33	-0.455
There is efficiency of purchase order cycle time	1.07	0.259	3.33	9.14
Supply chain performance	3.6878	0.42973	-0.736	1.007

4.5 Factor analysis

To assess the construct validity, items were examined by principal components extraction with varimax rotation. The Kaiser Meyer- Olkin (KMO) measure of sampling adequacy was used to compare the magnitude of the observed correlations coefficients and that of partial coefficient correlations. KMO values below 0.5 do not permit the use of factor analysis. The factor loading for internal environment management, green purchasing, eco design, investment recovery, institutional pressure and supply chain performance are as shown below.

4.5.1 Internal environment management

Factor analysis for internal environment management was conducted to ensure that all the constructs used are valid and reliable before proceeding for further analysis. The study requested that all loading less than 0 and more than 1 be suppressed in the output, hence providing blank spaces for many of the loadings. All internal environment

management factors notably, the firm senior managers are committed to GSCM, the firm mid-level managers support for GSCM, the firm has teams responsible for environmental improvements, the firm has total quality environmental management, the firm has ISO 14001 certification for complying with environmental compliance and auditing programs, the firm has environmental management systems and the firm emphasizes on Eco-labelling of Products were retained for further data analysis. Additionally, the first factor accounted for 26.004% of the total variance, the second factor 49.978% of the total variance and the third factor 66.971% of the total variance. Sampling adequacy was tested using the Kaiser- Meyer- Olkin Measure (KMO measure) of sampling adequacy. As evidenced in table 4.13, KMO was smaller than 1, and Bartlett's Test was significant.

Table 4.13: Internal Environment Management

	1	2	3
The firm senior managers are committed to GSCM	0.811		
The firm mid-level managers support for GSCM	0.579		
The firm has teams responsible for environmental improvements	0.889		
The firm has total quality environmental management		0.755	
The firm has ISO 14001 certification for complying with environmental compliance and auditing programs		0.594	
The firm has environmental management systems			0.519
the firm emphasizes for Eco-labeling of Products			0.886
Rotation Sums of Squared Loadings			
Total	2.08	1.918	1.359
% of Variance	26.004	23.974	16.993
Cumulative %	26.004	49.978	66.971
KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.55	
Bartlett's Test of Sphericity	Approx. Chi-Square	779.578	
	Df	28	
	Sig.	0.000	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

4.5.2 Green Purchasing

Factors with factor loadings of above 0.5 are excellent and should be retained for further data analysis. Green purchasing items namely the firm provide design specification to suppliers that include environmental requirements for purchased item, the firm cooperate with its suppliers for environmental objectives through sharing ideas, the firm does auditing on environmental for suppliers' internal management, the firm deals with Suppliers' with ISO1400 certification, the firm cooperate with customers for cleaner production and the firm cooperates with customers for green packaging were retained for further data analysis. Moreover, the first factor accounted for 26.004% of the total variance, the second factor 49.978% of the total variance and the third factor 66.971% of the total variance. Sampling adequacy was tested using the Kaiser- Meyer- Olkin Measure (KMO measure) of sampling adequacy. As evidenced in table 4.14, KMO was greater than 0.5, and Bartlett's Test was significant.

Table 4.14: Green Purchasing

Statement	1	2	3
The firm provide design specification to suppliers that include environmental requirements for purchased item	0.604		
The firm cooperate with its suppliers for environmental objectives through sharing ideas	0.789		
The does auditing on environmental for suppliers' internal management		0.839	
The deals with Suppliers' with ISO1400 certification		0.617	
The firm cooperate with customers for cleaner production			0.846
The firm cooperate with customers for green packaging			0.901
Rotation Sums of Squared Loadings			
Total	2.08	1.918	1.359
% of Variance	26.004	23.974	16.993
Cumulative %	26.004	49.978	66.971
KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.64	
Bartlett's Test of Sphericity	Approx. Chi-Square	1453.442	
	Df	45	
	Sig.	0.000	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

4.5.3 Eco design

Factor analysis was conducted to make sure that the items belong to the same construct. Table 4.15 illustrates the factor analysis for adaptive capacity. As shown in the table, there were no exceptions, as all variables scored above the threshold of 0.5. The criterion for communality was fulfilled by eco design items notably, the firm design its products for reduced consumption of material/energy, the firm design its products for reuse, recycle, recovery of material, component parts, the firm design its products to avoid or reduce use of hazardous of products and/or their manufacturing process, the firm design its product for support regulation, the firm design its products that weight and the least capacity for decrease taking time, the area stores, and the energy between the transportation leas, the firm design it's the products to be easy set up for the users in the most energy saving way and the firm design usability of part particularly for extend using products, repair easy and increase efficiency were retained for further analysis. Additionally, the first factor accounted for 25.236% of the total variance and the second factor 46.74% of the total variance and the third factor 66.489. The KMO Measure is an index for comparing the magnitude of the observed correlation coefficients to the magnitude of the partial correlation coefficients. As shown in table 4.18, KMO was greater than 0.5, and Bartlett's Test was significant.

Table 4.15: Eco Design

Statement	1	2	3
The firm design its products for reduced consumption of material/energy	0.718		
The firm design its products for reuse, recycle, recovery of material, component parts	0.818		
The firm design its products to avoid or reduce use of hazardous of products and/or their manufacturing process	0.638		
The firm design its product for support regulation		0.771	
The firm design its products that weight and the least capacity for decrease taking time, the area stores, and the energy between the transportation leas		0.914	
The firm design it is the products to be easy set up for the users in the most energy saving way			0.718
The firm design usability of part particularly for extend using products, repair easy and increase efficiency			0.762
Rotation Sums of Squared Loadings			
Total	2.271	1.935	1.777
% of Variance	25.236	21.504	19.749
Cumulative %	25.236	46.74	66.489
KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.577	
Bartlett's Test of Sphericity	Approx. Chi-Square	1239.043	
	Df	36	
	Sig.	0.000	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

4.5.4 Investment Recovery

Table 4.16 shows that the factor loadings results were above 0.5. This implies that all the factors were retained for further analysis. All Investment Recovery items namely, the firm sales its excess inventories/materials, the firm sales its scrap and used materials, the firm sales its excess capital equipment, the firm does recycle some of its used products, the firm Collect and recycle end-of-life products and materials, the firm has established a recycling system for used and defective product were later used for further analysis. To sum up, the first factor accounted for 38.077% of the total variance and the second factor accounted for 64.509% of the total variance. The Kaiser-Meyer-Olkin Measure value (0.658) was above 0.5 hence acceptable. Also, the Bartlett's Test was significant.

Table 4.16: Investment Recovery

Statement	1	2
The firm sales its excess inventories/materials	0.806	
The firm sales its scrap and used materials	0.818	
The firm sales its excess capital equipment	0.759	
The firm does recycle some of its used products	0.547	0.536
The firm Collect and recycle end-of-life products and materials		0.556
The firm has Established a recycling system for used and defective product		0.664
Total Variance Explained: Rotation Sums of Squared Loadings		
Total	2.665	1.85
% of Variance	38.077	26.432
Cumulative %	38.077	64.509
KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.658
Bartlett's Test of Sphericity	Approx. Chi-Square	966.747
	df	21
	Sig.	0.000

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

4.5.5 Institutional Pressure

Factors with factor loadings of above 0.5 are excellent and should be retained for further data analysis. Institutional Pressure items namely, local environmental laws put pressure on our GSCM, the environmental protection demands from our domestic customers put increasing pressure on our GSCM, the increase of environmental awareness of the society boosts pressure on our GSCM, the collaboration in environment with our suppliers boosts pressure on our GSCM, the improvements in developing green products of our suppliers boost pressure on our GSCM, the improvements in products green packaging of our suppliers boost pressure on our GSCM, the green strategy of the manufacturers who produce the same products as us boost pressure on our GSCM, the green strategy of the manufacturers who produce the substitute products as us boost pressure on our GSCM and the requirements of green development from the industry association boost pressure on our GSCM were retained for further data analysis.

Table 4.17: Institutional Pressure

Statement	1	2	3
Local environmental laws put pressure on our GSCM.	0.744		
The environmental protection demands from our domestic customers put increasing pressure on our GSCM.	0.588		
The increase of environmental awareness of the society boosts pressure on our GSCM.	0.635		
The collaboration in environment with our suppliers boosts pressure on our GSCM.	0.849		
The improvements in developing green products of our suppliers boost pressure on our GSCM.		0.783	
The improvements in products green packaging of our suppliers boost pressure on our GSCM.		0.697	
The green strategy of the manufacturers who produce the same products as we boost pressure on our GSCM		0.788	
The green strategy of the manufacturers who produce the substitute products as we boost pressure on our GSCM.			0.859
The requirements of green development from the industry association boost pressure on our GSCM.			0.696
Total Variance Explained: Rotation Sums of Squared Loadings			
Total	3.044	2.246	1.768
% of Variance	30.439	22.463	17.677
Cumulative %	30.439	52.902	70.579
KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			0.671
Bartlett's Test of Sphericity	Approx. Chi-Square		1629.768
	df		36
	Sig.		0

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Additionally, the first factor accounted for 30.439% of the total variance; the second factor accounted for 52.902% of the total variance and the third factor 70.579% of the total variance. Sampling adequacy was tested using the Kaiser- Meyer- Olkin Measure (KMO measure) of sampling adequacy. As evidenced in table 4.20, KMO was greater than 0.5, and Bartlett's Test was significant.

4.5.6 Supply Chain Performance

Factors with factor loadings of above 0.5 are excellent and should be retained for further data analysis. Supply chain performance items namely, the ability to customize product to meet specific customer demand, the firm has customer responsiveness flexibility, the firm has low percentage of defects, the firm has high percentage of finished goods in transit and there is efficiency of purchase order cycle time were retained for further data analysis. Additionally, the first factor accounted for 33.906% of the total variance, the second factor accounted for 48.7% of the total variance and the third factor 60.926% of the total variance. Sampling adequacy was tested using the Kaiser- Meyer- Olkin Measure (KMO measure) of sampling adequacy. As evidenced in table 4.18, KMO was greater than 0.5, and Bartlett's Test was significant.

Table 4.18: Supply Chain Performance

Statement		1	2	3
The ability to customize product to meet specific customer demand		0.73		
The firm has customer responsiveness flexibility		0.766		
The firm has low percentage of defects			0.858	
The firm has high percentage of finished goods in transit			0.837	
There is efficiency of purchase order cycle time				0.837
Rotation Sums of Squared Loadings				
Total		3.391	1.479	1.223
% of Variance		33.906	14.794	12.226
Cumulative %		33.906	48.7	60.926
KMO and Bartlett's Test				
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			0.685	
Bartlett's Test of Sphericity	Approx. Square		Chi- 1337.20 5	
	Df		45	
	Sig.		0.000	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

4.6 Data transformation and scoring

Table 4.19 highlights the results on data transformation and scoring. Basing on the results, supply chain performance had the highest numerical mean (mean = 3.6706) while Investment Recovery the lowest mean (mean = 3.3756). The results imply that the manufacturing firms have exhibited a degree of satisfaction concerning factors such as customization of products and low percentage of defects. Further, Skewness and Kurtosis values were used to test for normality distribution. From the results, the values of Skewness and kurtosis revealed that the data was normally distributed where the values were well below the threshold of +/- 10.

Table 4.19: Data Transformation and Scoring

	N	Min	Max	Mean	Std. Deviation	Skewness
Internal environment management	21	1.13	4.88	3.6286	0.73328	-1.027
Eco Design	376	1.5	5	3.5661	0.81687	-0.606
Green Purchasing	376	1.44	5	3.573	0.78943	-0.745
Investment Recovery	376	1.57	4.86	3.3756	0.76558	-0.455
Institutional Pressure	376	1.23	4.8	3.5638	0.66658	-1.507
Supply chain performance	376	2	5	3.6706	0.59429	-0.548

4.7 Assumption of regression model

The following assumption was tested: linearity, normality, homoscedasticity, and multicollinearity as shown below.

4.7.1 Linearity

Hair *et al.* (2010) argue that linearity is an assumption of all multivariate techniques based on co-relational measures of association, including regression, multiple regression, and factor analysis. Therefore, it is crucial to test the relationship of the variables to identify any departure that may impact the correlation. The result in table 4.20 showed that all the variables are linear with each other. Based on the ANOVA

output table, value Sig. Deviation from Linearity of >0.05, it can be concluded that there is a linear relationship between the variables of green supply chain adoption on the performance of Agri-manufacturing firms

Table 4.20: Linearity

		Sum of Squares	df	Mean Square	F	Sig.
supply chain performance * internal environment management	(Combined)	72.494	22	3.295	19.404	0.5
	Linearity	61.987	1	61.987	365.00	0.432
supply chain performance * Eco Design	(Combined)	84.622	28	3.022	21.93	0.670
	Linearity	63.809	1	63.809	463.03	0.124
supply chain performance * Green Purchasing	(Combined)	80.147	22	3.643	24.59	0.432
	Linearity	60.181	1	60.181	406.23	0.321
supply chain performance * Investment Recovery	(Combined)	65.264	28	2.331	12.04	0.456
	Linearity	38.17	1	38.17	197.16	0.237
supply chain performance * Institutional Pressure	(Combined)	105.306	124	0.849	7.86	0.334
	Linearity	74.994	1	74.994	693.68	0.345

4.7.2 Normality

The normality is fundamental assumption in multivariate analysis (Tabachnick & Fidell, 2007; Hair *et al.,* 2010). The main assumption in normality is that the data distribution in each item and in all linear combination of items is normally distributed (Tabachnick and Fidell, 2007; Hair *et al.,* 2010). To identify the shape of distribution, Kolmogorov-Smirnov was used (Shapiro & Wilk, 1965) which were calculated foreach variable. The results from these tests revealed (Table 4.21) that all the variables were not significant, which meets the assumptions of normality.

Table 4.21: Normality

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**Df**	**Sig.**
Internal environment management	0.171	376	0.145	0.873	376	0.200*
Eco Design	0.271	376	0.111	0.902	376	0.132
Green Purchasing	0.213	376	0.123	0.915	376	0.093
Investment Recovery	0.207	376	0.131	0.871	376	0.115
Institutional Pressure	0.181	376	0.102	0.91	376	0.073
Supply chain performance	0.142	376	.200*	0.97	376	0.786

* This is a lower bound of the true significance.
a Lilliefors Significance Correction

4.7.3 Homoscedasticity

The Levenne Statistic for equality of variances was used to test for the assumption of homoscedasticity. In this regard, the study hypothesized that the variance of each sub-group was the same. The desired result for non-violation of homoscedasticity was therefore to reject this hypothesis. Table 4.22 shows that testing at the 0.05 level of significance; none of the Levenne statistics was significant. The assumption of homoscedasticity was not violated.

Table 4.22: Homoscedasticity

Test of Homogeneity of Variances				
	Levene Statistic	**df1**	**df2**	**Sig.**
Internal environment management	1.324	3	372	0.266
Eco Design	2.27	3	372	0.08
Green Purchasing	1.098	3	372	0.35
Investment Recovery	10.032	3	372	0.66
Institutional Pressure	1.49	3	372	0.217
Supply chain performance	1.077	3	372	0.359

4.7.4 Test of Multicollinearity

Multicollinearity means that two or more of the independent variables are highly correlated and this situation can have damaging effects on the results of multiple regressions. High multicollinearity is signaled when inter-correlation among the independents is above 0.9 (Hair *et al.,* 2006 as cited by Saunders *et al.* 2009), 0.8(Garson, 2013), 0.7 (Sekaran & Bougie, 2010), or when high R-squared and significant F tests of the model occur in combination with non-significant t-tests of coefficients. From the results in table 4.23, there was no multicollinearity. In addition, VIF<10 is acceptable and a threshold of "10" as the maximum level of VIF (Hair et al., 1995).

Table 4.23: Test of Multicollinearity

	Correlations	Collinearity Statistics	
	Zero-order	Tolerance	VIF
Internal environment management	0.684	0.224	4.473
Eco Design	0.694	0.168	5.951
Green Purchasing	0.674	0.209	4.795
Investment Recovery	0.537	0.422	2.37
Institutional Pressure	0.752	0.165	6.047
a Dependent Variable: supply chain performance			

4.8 Correlation analysis

Correlation coefficients are the statistical method utilized to explore the six variables: supply chain performance, internal environment management, Eco Design, Green Purchasing, Investment Recovery, Institutional Pressure and Supply Chain performance. A Pearson correlation analysis was conducted to investigate whether there is relationship between the dependent variable (Supply Chain performance) and the independent variables, l supply chain performance, internal environment management, Eco Design, Green Purchasing, Investment Recovery, Institutional Pressure. The analysis revealed

that there was a positive relationship between the dependent variable and all the independent variables. The results of the correlation analysis are presented in Table 4.24. There was a positive statistically significant correlation between internal environment management and supply chain performance at, $r = 0.684$, $P < 0.01$. The correlation between Eco Design and supply chain performance was also significant, $r = 0.694$, $P < 0.01$. Moreover, the correlation between Green Purchasing and supply chain performance was significantly positive at $r = 0.674$, $P < 0.01$. In addition, there was a positive statistically significant correlation between investment recovery and supply chain performance at $r = 0.537$, $P < 0.01$. Also, the correlation between institutional pressure and supply chain performance had a negative statistically significant correlation at $r = 0.752$, $P < 0.01$. The test was at 95% level of significance.

Table 4.24: Correlation Analysis

	Supply chain performance	**Internal environment management**	**Eco Design**	**Green Purchasing**	**Investment Recovery**	**Institutional Pressure**
Supply chain performance	1					
Internal environment management	.684**	1				
Eco Design	.694**	.551**	1			
Green Purchasing	.674**	.600**	.641**	1		
Investment Recovery	.537**	.604**	.679**	.518**	1	
Institutional Pressure	-.752**	.636**	.546**	.437**	.709**	1

** Correlation is significant at the 0.01 level (2-tailed).

4.9 Hypothesis Testing

Regression is one of the pertinent and commonly used statistical method in research. It provides a platform for which causal-effect relationships among variables of interest in the study are examined. Hence, it provides a method for quantifying the effect of changes in the response variable because of change in predictor variables (Darlington &

Hayes, 2016; Mills & Tosic, 2011; Hair *et al.,* 2010). Therefore, regression analysis was performed to test the model fit and to establish the predictive power of the models in the response variable. Although there are quite number of methods of regression such as forced entry, hierarchical method, and stepwise methods (Field, 2009), the present study used the hierarchical regression model since it indicates precisely what happens to the regression model as different predictor variables are introduced. Thus, enabled the researcher to systematically acknowledge the contribution of each independent variable in explaining the predictive power of the model.

Tests for moderation was done based on the works of Barron and Kenny (1986); Aiken and West (1991); Jose (2008) to examine the moderating effect of institutional pressure in the link Internal environment management, Eco Design, Green Purchasing, Investment Recovery, and supply chain performance among Agri-Manufacturing Firms in Rwanda. Nevertheless, according to Jose (2008), the interaction effects of both moderators were plotted on a Mod Graph so as depict its influence on the dependent variable (supply chain performance among Agri-Manufacturing Firms in Rwanda). This section presents the results for control effects, direct effects and eventually the interaction effects of the variables in the study.

4.9.1 Effect of Internal Environment Management on Supply Chain Performance

$H_{01:}$ *There is no significant effect of internal environment management practices on supply chain performance among Agri-Manufacturing Firms in Rwanda*

Table 4.25 illustrates that the model summary of multiple regression model, the results showed that internal environment management practices explained 57.8 percent variation of supply chain performance. This showed that considering internal environment management practices, there is a probability of predicting supply chain performance by 57.8% (Adjusted R squared =0.578).

The first hypothesis of the study stated that there is no significant effect of internal environment management practices on supply chain performance among Agri-manufacturing firms in Rwanda. However, findings in table 4.26 further showed that internal environment management practices had significant ANAOVA table value basing on F = 66.147 (p-value = 0.000 which is less than $\alpha = 0.05$) thus we reject the null hypothesis and conclude that internal environment management practices have a significant effect on supply chain performance.

Table 4.27 suggests that there is up to 0.624-unit increase in supply chain performance for each unit increase in internal environment management practices. Also, the effect of internal environment management practices is more than the effect attributed to the error, this is indicated by the t-test value = 11.640.

Consistent with the results, Lakshmimeera and Palanisamy (2013) posited that internal environmental management is key in enhancing competitiveness and environmental performance which in turn lead to sustainability. Similarly, Yeung *et al.* (2003) confirmed that senior management confidence is the most influential factor for the development of quality management system.

Table 4.25: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.780[a]	.609	.587	.597

a. Predictors: (Constant), Effect of Internal Environment Management

Table 4.26: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.922	1	9.922	66.147	.000[b]
	Residual	32.036	213	.150		
	Total	41.958	214			

a. Dependent Variable: Supply Chain Performance

b. Effect of Internal Environment Management

Table 4.27: Coefficients Table

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	1.836	0.164		11.179	0.000
Internal environment management	0.503	0.043	0.624	11.640	0.000

a Dependent Variable: Supply Chain Performance

4.9.2 Effect of Green Purchase on Supply Chain Performance

$H_{02:}$ *There is no significant effect of green purchase on supply chain performance among Agri-Manufacturing Firms in Rwanda*

The second hypothesis stated that green purchase has no significant effect on supply chain performance among Agri-Manufacturing Firms in Rwanda. Table 4.28 results showed that green purchase explained 61.9% percent variation of supply chain performance. This showed that considering green purchase, there is a probability of predicting supply chain performance by 61.9% % (adjusted R squared =61.9%).

Nonetheless, table 4.29 study findings showed that green purchase has a positive and significant effect on supply chain performance basing on F= 16.42 (p-value = 0.025 which is less than $\alpha = 0.05$) implying green purchase has a significant effect on supply chain performance among Agri-Manufacturing Firms in Rwanda. The null hypothesis is therefore rejected.

Furthermore, table 4.30 the effect of green purchase was stated by the t-test value = 11.303 which implies that the standard error associated with the parameter is less than the effect of the parameter and the green purchase was statistically significant with p value 0.000 <0.05 (level of significance). In corroboration with the findings, the study by Muma *et al.,* (2014) established that there is a positive relationship between Green purchasing, and reverse logistics and environmental performance. On the same note, Al Khattb *et al.* (2015) proved that Green Supply chain management such Green Purchasing, affected the environmental marketing performance.

Table 4.28: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.782[a]	.720	.619	.931

a. Predictors: (Constant), Green Purchase

Table 4.29: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.841	1	5.841	16.42	.025[b]
	Residual	75.449	213	0.354		
	Total	81.290	214			

a. Dependent Variable: Supply Chain Performance

b. Predictors: (Constant), Green Purchase

Table 4.30: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.008	0.154		13.029	0.000
	Green purchase	0.468	0.041	0.613	11.303	0.000

a. Dependent Variable: Supply Chain Performance

4.9.3 Effect of Eco Design on Supply Chain Performance

$H_{03:}$ There is no significant effect of eco design on supply chain performance among Agri-Manufacturing Firms in Rwanda

The third hypothesis of the study stated that eco design has no significant effect on supply chain performance among Agri-Manufacturing Firms in Rwanda.

Table 4.31 showed that considering eco design, there is a probability of predicting supply chain performance by 74.6% (Adjusted R squared =0.746).

ANOVA table on table 4.32 study findings in the table indicated that the above discussed coefficient of determination was significant as evidence of F ratio of 33.168 with p value 0.023 <0.05 (level of significance) implying that we reject the null hypothesis stating that eco design has no significant effect on supply chain performance.

However, the study findings showed that eco design had coefficients of estimate which was significant basing on β_3= 0.59 (p-value = 0.000 which is less than α = 0.05) Furthermore, the effect of eco design was stated by the t-test value = 10.64 which implies that the standard error associated with the parameter is more than the effect of the parameter. Consistent with the findings, Rao (2012) elucidated that GSCM practices should include working collaboratively with suppliers on green product designs, holding

awareness seminars together with assisting suppliers to establish their own environmental programs. The results are also in tally with that of Krikke *et al.*, (2004) which established that pioneering firms have learned that making product returns profitable is dependent on the product design.

Table 4.31: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.873[a]	.813	.746	.892

a. Predictors: (Constant), Eco design

Table 4.32: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.012	1	11.012	33.168	.023[b]
	Residual	70.819	213	.332		
	Total	81.832	214			

a. Dependent Variable: Supply Chain Performance

b. Predictors: (Constant), Eco design

Table 4.33: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.97	0.17		11.85	0.00
	Eco design	0.47	0.04	0.59	10.64	0.00

a. Dependent Variable: Supply Chain Performance

4.9.4 Effect of Investment Recovery on Supply Chain Performance

$H_{04:}$ *There is no significant effect of investment recovery on supply chain performance among Agri-Manufacturing Firms in Rwanda*

The fourth hypothesis of the study stated that investment recovery has no significant effect on supply chain performance among Agri-Manufacturing Firms in Rwanda. Table 4.34 model summary indicates that investment recovery had 81.3 percent variation of supply chain performance. This showed that considering investment recovery, there is a probability of predicting supply chain performance by 81.3% (R squared =0.813). Study findings in the table 4.35 indicated that there was significant evidence of F ratio of 73.48 with p value 0.000 <0.05 (level of significance).

Table 4.36 indicates that investment recovery has a positive and significant effect on supply chain performance basing on $\beta_4 = 0.555$ (p-value = 0.000 which is less than $\alpha = 0.05$) thus we fail to accept the hypothesis and conclude that investment recovery has a significant effect on supply chain performance. This suggests that there is up to 0.555-unit increase in supply chain performance, for each unit increase in investment recovery. The effect of investment recovery is more than the effect attributed to the error; this is indicated by the t-test value = 9.726.

Table 4.34: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.927[a]	.878	.813	.648

a. Predictors: (Constant), investment recovery

Table 4.35: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.300	1	13.300	73.48	.000[b]
	Residual	38.658	213	.181		
	Total	81.958	214			

a. Dependent Variable: Supply Chain Performance
b. Predictors: (Constant), investment recovery

Table 4.36: Coefficients'

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1 (Constant)	2.209	0.158		13.962	0.000
investment recovery	0.435	0.045	0.555	9.726	0.000

a. Dependent Variable: Supply Chain Performance

4.10 Overall multiple regression

4.10.1 Model Summary

Table 4.37 illustrates the model summary of multiple regression model, the results showed that all the four predictors (investment recovery, Eco design, internal environment management and green purchase) explained 46 percent variation of supply chain performance. This showed that considering the four study independent variables, there is a probability of predicting supply chain performance by 46% (R squared =0.46).

Table 4.37: Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
0.68	0.46	0.45	0.42	2.15

Predictors: (Constant), Investment Recovery, Eco Design, Internal Environment Management, Green Purchase
Dependent Variable: SCP

4.10.2 ANOVA Model

Study findings in table 4.38 indicated that the above discussed coefficient of determination was significant as evidence of F ratio of 45.246 with p value 0.000 <0.05 (level of significance)

Table 4.38: ANOVA Model

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	32.503	4	8.126	45.246	.000b
Residual	37.534	209	0.18		
Total	70.036	213			

a Dependent Variable: SCP
b Predictors: (Constant), investment recovery, eco design, internal environment management, green purchase

4.10.3 Coefficients of Estimate

Findings showed that internal environment management had coefficients of estimate which was significant basing on $\beta_1 = 0.262$ (p-value = 0.004 which is less than $\alpha = 0.05$). It was therefore concluded that internal environment management had a significant effect on supply chain performance. This suggested that there was up to 0.262 unit increase in supply chain performance for each unit increase in internal environment management. The effect of internal environment management was twice the effect attributed to the error; this was indicated by the t-test value = 2.945.

Research findings showed that green purchase =had coefficients of estimate which was significant basing on $\beta_2 = 0.107$ (p-value = 0.296 which was more than $\alpha = 0.05$) hence green purchase had no effect on supply chain performance. Furthermore, the effect of green purchase was stated by the t-test value = 1.047 which implied that the standard error associated with the parameter was less than the effect of the parameter.

Findings showed that eco design had coefficients of estimate which was significant basing on $\beta_3 = 0.189$ (p-value = 0.000 which is less than $\alpha = 0.05$) implying that eco design has significant effect on supply chain performance. This indicated that for each unit increase in eco design, there was up to 0.189 units increase in supply chain performance. The effect of eco design was stated by the t-test value = 2.112 which indicated that the effect of eco design was twice that of the error associated with it.

Finally, investment recovery had coefficients of estimate which was significant basing on $\beta_4 = 0.223$ (p-value = 0.002 which is less than $\alpha = 0.05$). It was therefore concluded that investment recovery had a significant effect on supply chain performance. This suggested that there was up to 0.223 unit increase in supply chain performance for each unit increase in investment recovery. The effect of investment recovery was thrice the effect attributed to the error; this was indicated by the t-test value = 3.168.

Table 4.39: Coefficients of Estimate

	Unstandardized Coefficients		**Standardized Coefficients**		
	B	**Std. Error**	**Beta**	**T**	**Sig.**
(Constant)	1.469	0.171		8.581	0.000
Internal environment management	0.211	0.072	0.262	2.945	0.004
Green purchase	0.082	0.078	0.107	1.047	0.296
Eco design	0.151	0.071	0.189	2.112	0.036
Investment recovery	0.174	0.055	0.223	3.168	0.002

a Dependent Variable: SCP

4.11 Hierarchical regression model

The moderating effects were tested in a series of hierarchical blocks. Initially, the independent variables were standardized to z-scores to reduce the effects of multi-collinearity and simplify interpretations. Then a cross-product of z-scores of the moderator with each independent variable was then computed. In model I the independent variables were entered. These included internal environment management, green purchasing, eco-design, and investment recovery. In model II institutional pressure which is the moderator was entered. In model four to six the interaction terms (internal environment management* institutional pressure), (green purchasing * institutional pressure), (eco-design* institutional pressure) and (investment recovery* institutional pressure) were hierarchically entered.

None of the control variables significantly affected supply chain performance. All the independent variables significantly affected supply chain performance. Table 4.40presents results on the moderating effect of institutional pressure. Hypothesis five (a) postulated that there is no significant moderating effect of institutional pressure on relationship between internal environment management and supply chain performance. It can be seen from the table that institutional pressure significantly moderates the relationship between internal environment management and supply chain performance ($\beta= 0.008$; $\rho < 0.05$).

Hypothesis 5 (b) presumed that there is no significant moderating effect of institutional pressure on the relationship between green purchasing and supply chain performance. As can be read from the table, institutional pressure had a negative and significant moderating effect on the relationship between green purchasing and supply chain performance ($\beta= -0.09$; $\rho < 0.05$).

Hypothesis five (c) showed that there was no moderating effect of institutional pressure on the relationship between eco-design and supply chain performance. As can be seen

from the table, institutional pressure had a negative and significant moderating effect on the relationship between eco-design and supply chain performance (β= -0.83; $\rho < 0.05$).

Hypothesis five (d) posited that there was no moderating effect of institutional pressure on the relationship between investment recovery and supply chain performance. From the table, institutional pressure had a positive and significant moderating effect on the relationship between investment recovery and supply chain performance (β= 0.83; $\rho < 0.05$).

The hierarchical multiple regression results also revealed an increase in R-square with the addition of the blocks of variables. For instance, the controls contributed to an R-square change of 59.6%. With the addition of the direct variables (internal environment management, green purchasing, eco-design, and investment recovery), the R-square increased to 60.7%. With the moderator (institutional pressure) it increased to 62.4% meaning that the moderator did contribute to the variance explained on supply chain performance by the controls and the direct effects. This implied that the interaction did not contribute to the variance of supply chain performance.

Table 4.40: Hierarchical regression model

	Model 1 B Std. Error	Model 2 B Std. Error	Model 3 B Std. Error	Model 4 B Std. Error	Model 6 B Std. Error	Model 7 B Std. Error
	0.00	0.00	0.00	0.02	0.01	0.01
(Constant)	(0.04) 0.17	0.04 0.15	0.04 0.77	0.04 0.72	0.04 0.27	0.04 0.43
Zscore (IEM)	(0.057) * 0.19	0.057* 0.16	0.196** 0.15	0.196** 0.17	0.305* 0.15	0.31 0.18
Zscore (GP)	0.072* 0.24	0.072** 0.21	0.071* 0.18	0.071* 0.18	0.071* 0.69	0.072* 0.95
Zscore (ED)	0.081* 0.28	0.081* 0.22	0.08* 0.18	0.079* 0.17	0.279** 0.17	0.303* -0.28
Zscore (IR)	0.068**	0.072* 0.16	0.071* 0.70	0.071* 0.67	0.07* 0.74	0.22 0.65
Zscore (IP)		0.065*	0.175* 0.98	0.174* -0.90	0.177** -0.21	0.181* -0.47
Zscore (IEM_IP)			0.298*	0.298* 0.09	0.47 0.07	0.48 0.09
Zscore (GP_IP)				0.041	0.04 0.83	0.042* 1.29
Zscore (ED_IP)					0.434*	0.482** 0.83
Zscore (IR_IP)						0.385*
model's summary statistics						
R	*0.772*	*0.779*	*0.790*	*0.795*	*0.799*	*0.804*
R Square	*0.596*	*0.607*	*0.624*	*0.633*	*0.638*	*0.646*
Adjusted R Square	*0.589*	*0.598*	*0.614*	*0.622*	*0.626*	*0.632*
Change Statistics						
R Square Change	*0.596*	*0.011*	*0.017*	*0.000*	*0.006*	*0.007*
F Change	*86.3*	*6.3*	*10.8*	*5.4*	*3.6*	*4.6*
df1	*4.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*
df2	*234.0*	*233.0*	*232.0*	*231.0*	*230.0*	*229.0*
Sig. F Change	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.0*

a Dependent Variable: Zscore (supply chain performance)

From the hierarchical regression beta coefficients, the following regression equation was obtained for predicting the relationships of the study variables as suggested in Chapter 3 of this study.

The general analytical model for the *direct relationship* was represented as follows:

$$Y = .00 + .17X_1 + .19xX_2 + .24X_3 + .28X_4 + e$$

Where:

Y= Supply chain performance

$X_{1=}$ Internal environment management

$X_{2=}$ Green purchasing

$X_{3=}$ Eco design

$X_{4=}$ Investment recovery

Specifically, the hierarchical regressions models were as follows.

1.) The equation for model one had all the direct effect variables (internal environment management, green purchasing, eco-design, and investment recovery) significant. Hence the equation for model 1 was:

$$Y = 0.00 + 0.17X_1 + 0.19X_2 + 0.24X_3 + 0.28X_4 + \varepsilon_2$$.....Model

Where:

Y= Supply chain performance and X_1, X_2, X_3 and X_4 were internal environment management, green purchasing, eco-design, and investment recovery respectively and E_2

is the error term associated with this model. Control variables were not included in the equation because of their insignificance.

2.) Model two had the inclusion of the moderating variable institutional pressure, which was significant to the direct variables, which were internal environment management, green purchasing, eco-design, and investment recovery. However, just like in model two the control variables were not added in the equation because of their insignificant nature. Hence, the equation for model three was:

$$Y = 0.00 + 0.77X_1 + 0.15X_2 + 0.18X_3 + 0.18X_4 + 0.70M + \varepsilon_3$$.....Model 2

Where:

Y= Supply chain performance

X_1, X_2, X_3 and X_4 are internal environment management, green purchasing, eco-design, and investment recovery, respectively.

M is the moderator institutional pressure.

E is the error term associated with this model?

3.) Model 4 had the inclusion of first interaction variables internal environment management multiplied by institutional pressure. Hence the equation for model four was:

$$Y = 0.00 + 0.77X_1 + 0.15X_2 + 0.18X_3 + 0.18X_4 + 0.70M + 0.298X_1 * M + \varepsilon_3$$.....Model 3

Where Y, X_1, X_2, X_3, X_4, X_5 are internal environment management, green purchasing, eco-design and investment recovery and institutional pressure.

$X_1 * m$ is the interaction between internal environment management and institutional pressure.

4) Model 4 had the inclusion of second interaction variables green purchasing multiplied by institutional pressure; however, the model was not significant. Hence the equation for model four was:

$$Y = 0.00 + 0.77X_1 + 0.15X_2 + 0.18X_3 + 0.18X_4 + 0.70M + 0.298X_1 * M + 0.041X_2 * M + \varepsilon_3 \text{.....}$$

Model 4

Where Y, X_1, X_2, X_3, X_4, $X_{5\ are}$ internal environment management, green purchasing, eco-design and investment recovery and institutional pressure.

$X_2 * M$ is the interaction between green purchasing and institutional pressure.

5) Model 5 had the inclusion of third interaction variables eco-design multiplied by institutional pressure. Hence the equation for model four was:

$$Y = 0.00 + 0.77X_1 + 0.15X_2 + 0.18X_3 + 0.18X_4 + 0.70M + 0.298X_1 * M + 0.041X_2 * M + 0.434X_3 * M + \varepsilon_3 \text{....}$$

.....Model 5

Where Y, X_1, X_2, X_3, X_4, $X_{5\ are}$ internal environment management, green purchasing, eco-design and investment recovery and institutional pressure.

$X_3 * M$ is the interaction between eco-design and institutional pressure.

6) Model 6 had the inclusion of third interaction variables eco-design multiplied by institutional pressure. Hence the equation for model four was:

$$Y = 0.00 + 0.77X_1 + 0.15X_2 + 0.18X_3 + 0.18X_4 + 0.70M + 0.298X_1 * M + 0.041X_2 * M + 0.434X_3 * M + 0.385X_4 * M + \varepsilon_3$$

.....Model 6

Where Y, X_1, X_2, X_3, X_4, X_5 are internal environment management, green purchasing, eco-design and investment recovery and institutional pressure.

$X_4 * M$ is the interaction between eco-design and institutional pressure.

To better understand the nature of the interaction between institutional pressure and green supply chain and supply chain performance, the moderated results are presented on a moderation graph as suggested by Aiken & West (1991) who proposed that it is insufficient to conclude that there is interaction without probing the nature of that interaction at different levels of the moderator. The moderation effects of institutional pressure on the relationship between green supply chain and supply chain performance was determined using the graphical method.

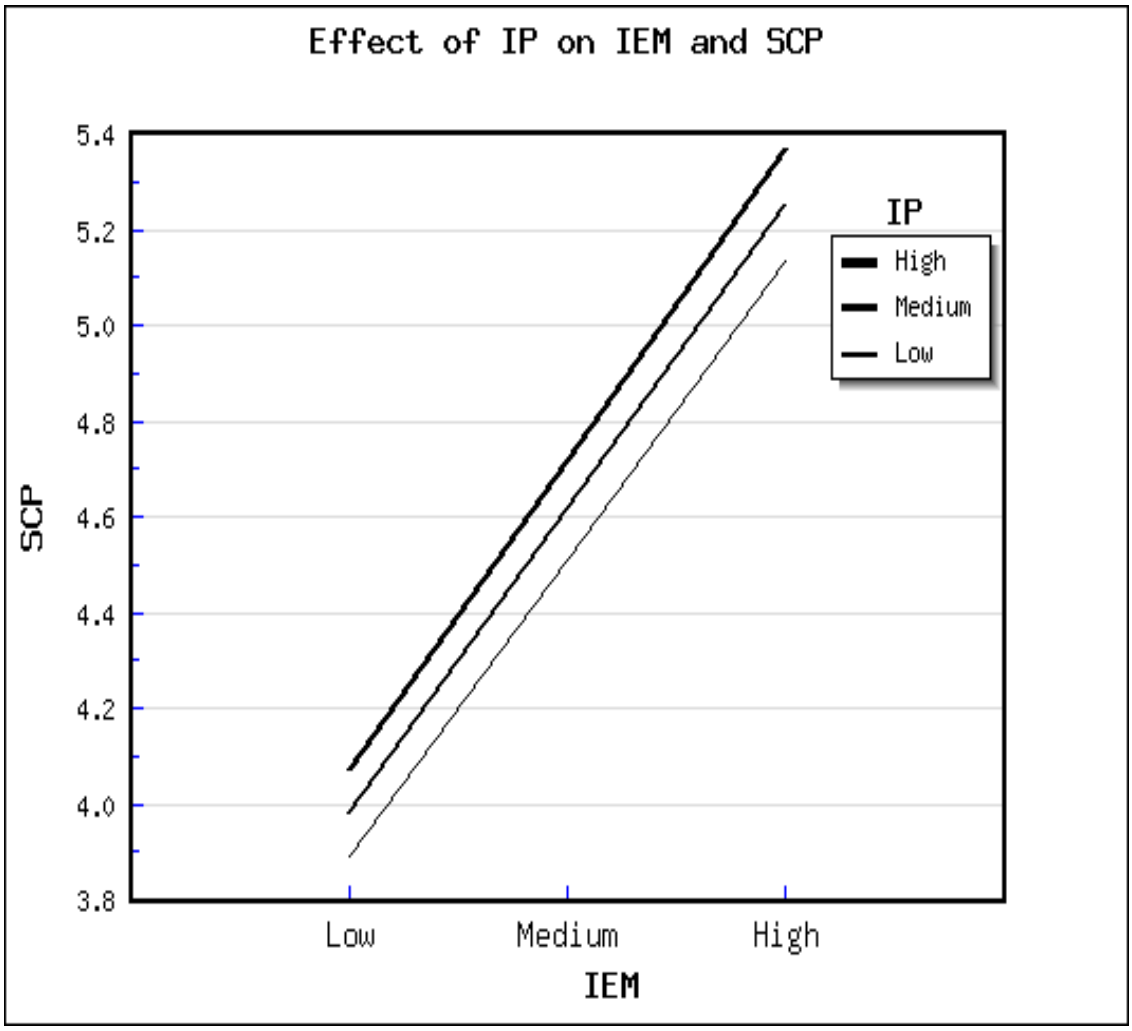

Figure 4.1: Moderation of Institutional Pressure on the Relationship between internal Environment Management and Supply Chain Performance

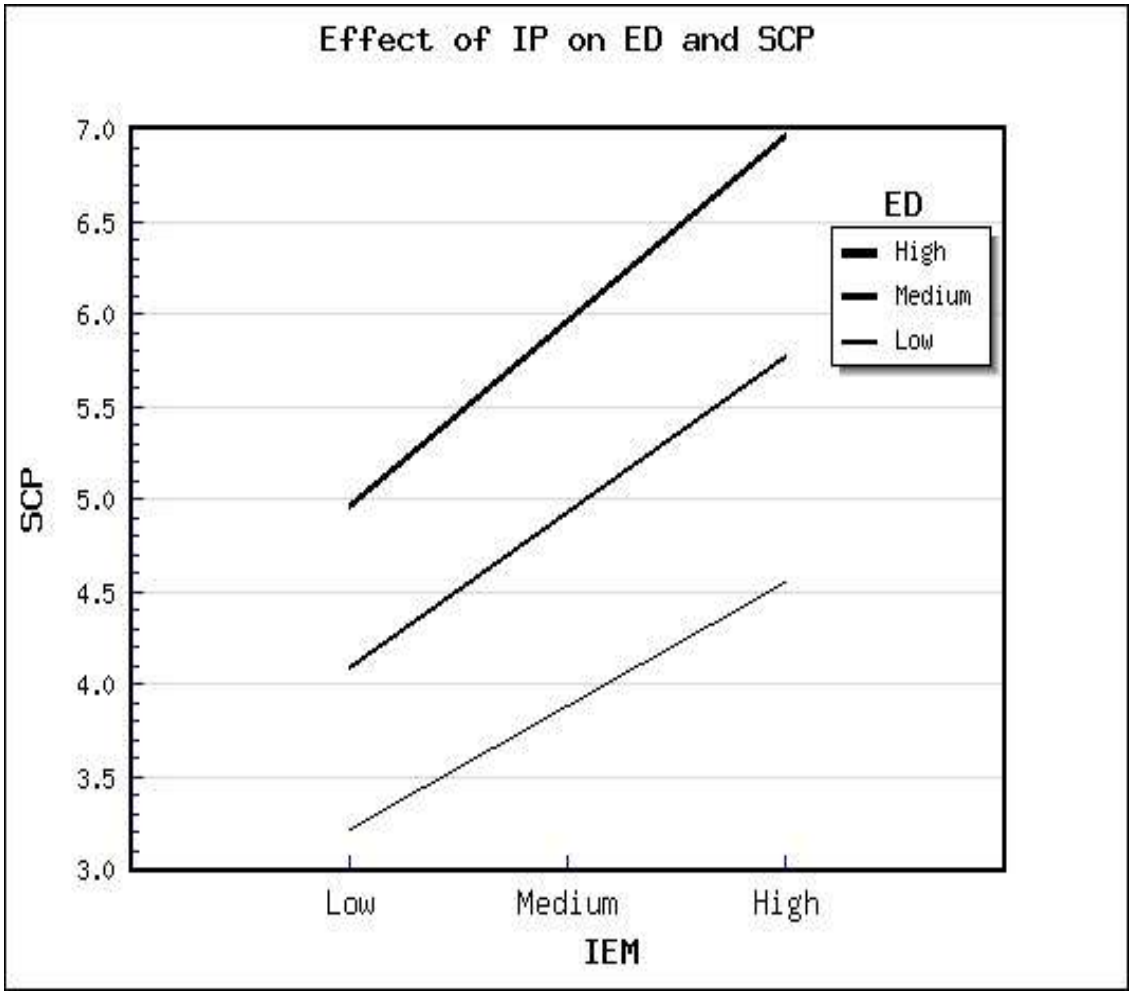

Figure 4.2: Moderation of Institutional Pressure on the Relationship between Eco design and Supply Chain Performance.

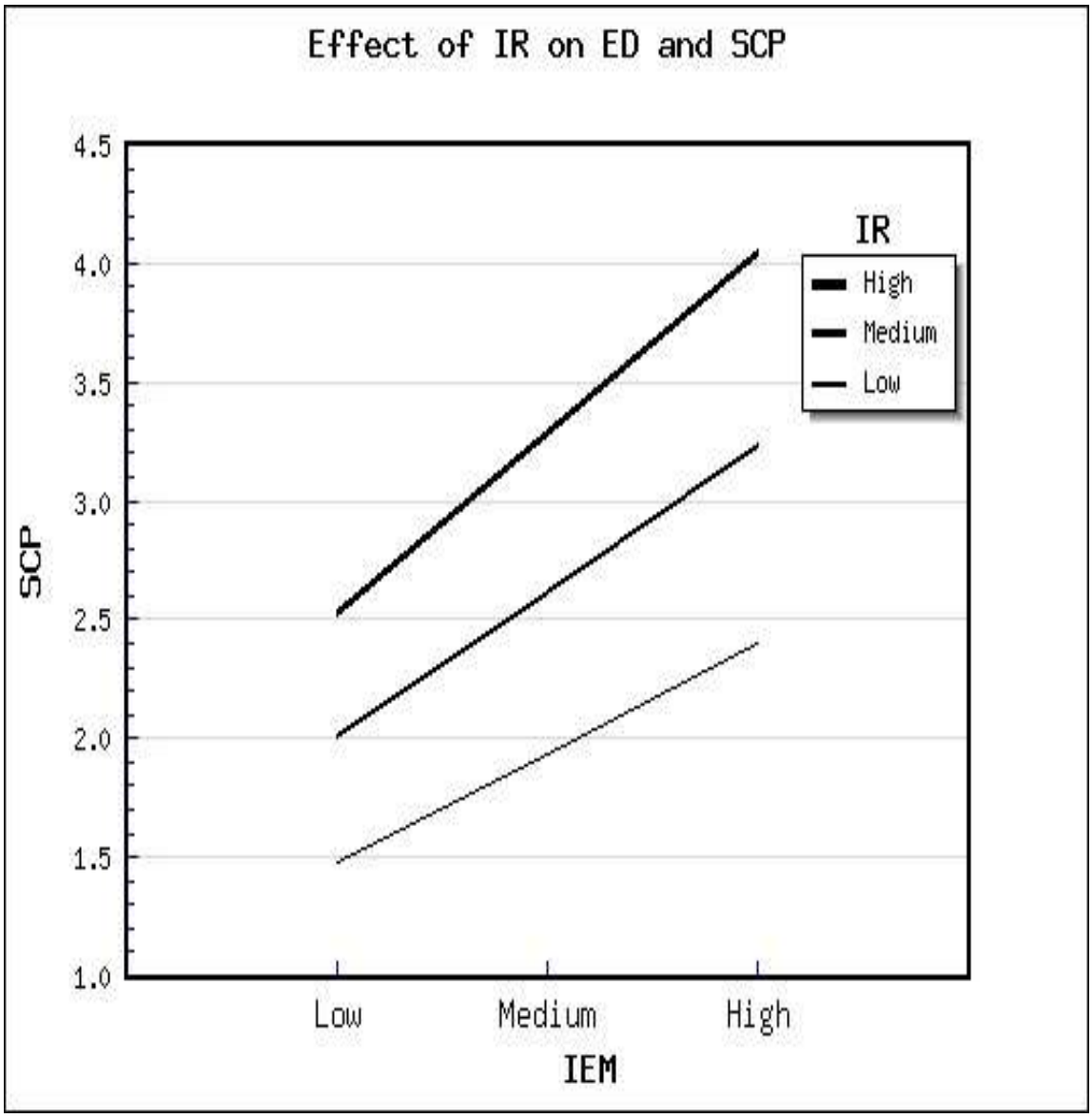

Figure 4.3: Moderation of Institutional Pressure on the Relationship between Investment Recovery and Supply Chain Performance.

Table 4.41: Summary of the Study Results

Hypotheses	*p* – Values	Decision
Hypothesis Ho_1: There is no significant effect of internal environment management practices on supply chain performance among Agri-Manufacturing Firms in Rwanda	0.020	Reject
Hypothesis Ho_2: There is no significant effect of green purchase on supply chain performance among Agri-Manufacturing Firms in Rwanda	0.013	Reject
Hypothesis Ho_3: There is no significant effect of eco design on supply chain performance among Agri-Manufacturing Firms in Rwanda	0.021	Reject
Hypothesis Ho_4: There is no significant effect of investment recovery on supply chain performance among Agri-Manufacturing Firms in Rwanda	*0.932*	Reject
Hypothesis $Ho5_a$: There was no significant moderating effect of institutional pressure on relationship between internal environment management and supply chain performance	0.048	Reject
Hypothesis $Ho5_b$: There was no significant moderating effect of institutional pressure on relationship between green purchasing and supply chain performance	0.034	Reject
Hypothesis $Ho5_c$: There was no significant moderating effect of eco design on relationship between internal environment management and supply chain performance	0.021	Reject
Hypothesis $Ho5_d$: There was no significant moderating effect of institutional pressure on relationship between investment recovery and supply chain performance	0.039	Reject

4.12 Supply chain and Agri-manufacturing in Rwanda

The agri-products supply chain has been and remains intricate with its complex network of stakeholders who cater to diverse segments within the agri-ecosystem. Among them, actors involved in supply chain (sourcing and procuring) for agri-commodities play an indispensable role in connecting farming communities with food processing companies around the world and ensure that the best quality raw materials reach the manufacturing units to produce the finest agri- products. The complexities in the supply chain do come with a fair share of challenges. Let us look at five major ones that affect Rwandan agri-business operators, and how agricultural technology is helping agribusinesses overcome them.

4.12.1 Limiting post-harvest losses at the earliest point in the supply chain.

One of the biggest questions that procuring companies in Rwanda face at the time of harvest is whether the harvested products they receive will be of the quality they expect and the quantity they were assured. It is a known fact that agriculture is extremely climate-sensitive, and numerous factors can affect the cultivation of crops at different growth stages. Unpredictable and unfavourable weather conditions, pest infestations, crop diseases, and a change in soil conditions are only some of the factors that can severely impact agricultural productivity. We can discuss what farming communities could do to overcome this challenge although these factors are out of man's control. In Rwanda like any other developing country, the adoption of an agri-technology platform is inarguably the most effective way to enhance agricultural productivity and efficiency of the field staff by digitising the various field operations and constantly improving farming practices based on the ground-truth intelligence that provide actionable insights. As a result, farming companies in Rwanda can provide procuring companies with a near-accurate estimate of the harvest quantity and quality, and monitor the cultivation closely to ensure the result is as close as possible to the agreed figures. Procuring companies can also remotely monitor the growth and the health of the crop from time to time through satellite monitoring. Subsequently, this prevents the procuring companies from incurring heavy losses after the purchase has been made. However, unfortunately the level of technology in agri-business is still very low despite the efforts Rwandan government has put in this section.

4.12.2 Supply chain versus quality compliance and products safety in Rwanda

Local markets in Rwanda protect the interests of their consumers by way of strict import regulations on the quality of the agri-food product. Each country has its own specifications, and exporting organizations strive to comply with them to get the clearance for trade. While at one end it empowers the consumers to know about the product they consume in much detail, at the other end it enables food producers to

establish a rapport with the consumer through the transparency of processes. What Rwandan agri-stakeholders can do to provide high levels of transparency to add value further to their business products is discussed here below. Rwanda Agri-manufacturing Companies that procure agri-commodities from one region to export it to another can establish a system that allows farming companies to monitor crop cultivation and ensure that farming practices adhere to the compliance stipulated for trade. Digital farm management systems such as CropIn's enable the field staff to capture farm data for each activity, which can be extracted as customized reports to provide evidence of compliance with import/export regulations along with vital information from lab reports and quality control processes. The infusion of technology to achieve transparency and traceability in the cultivation process has empowered organizations involved in procuring and exporting to proceed with the process without any setbacks or delays.

4.12.3 Ensuring quicker movement of produce along the supply chain.

According to The 'State of Food and Agriculture' (SOFA) 2019 report states that we lose a significant 14% of the world's food between harvest and retail sales, and logistics is a critical loss point in addition to various others. An organised system for logistics is highly critical to ensure the perishable commodities such as fresh fruits and vegetables, remains as fresh as possible until it reaches the consumer, particularly if it has not been locally produced. IN Rwanda, it was observed that lack of clear communication between the producers and the procuring companies can impede the commodity's movement and lead to considerable post-harvest losses. Cloud-based networks should enable organizations to overcome this challenge by providing a reliable multi-stakeholder platform for clear communication between the different parties involved. Future in Rwanda are to set up technologies such as satellite monitoring also allow the procuring party to monitor the growth of the harvest remotely and arrive at a near-accurate harvest date, which further facilitates them to plan the logistics more effectively. These digital systems will offer a wide array of services to suit each user's requirement and allow close monitoring of the commodity's movement from end to end. Also, the direct link

between the interested parties eliminates the need for a middle-man, thus making the process more cost- and time-efficient.

4.12.4 Traceability of Agri-products for increased trust in the brand

Many food products are widely popular only for the ingredients they use, sourced from regions known for them. Big brands that cater to consumers around the world need to keep a sharp eye on the supply chain to ensure they provide only the choicest products. Farm-to-fork traceability is an important factor in establishing the origin of a food ingredient and is being perceived by the end-consumers as a benchmark of quality and food safety. Supply chain organisations, being an indispensable player in the agri supply chain, can leverage state-of-the-art digital tools to track all the processes involved in the cultivation of the agri-commodity, and utilise this intelligence to further strengthen the supply chain and earn the trust and loyalty of the end-consumers.

4.12.5 Other factors which affect supply chain of agricultural products in Rwanda.

It was observed that their big disconnection between suppliers and consumers of products due to limited information sharing and poor marketing strategies. It was also observed that some factors are related to limited or poor production of raw materials (Agricultural commodities) expected to be transformed or processed by factories. This ends up in have few commodities which cannot satisfy the consumers. In some areas also, there is an issue of high cost of transports or absence of feeder roads, which results in high prices of commodities. On the other hand, lack of advanced technologies for mass production, limited access to fertilizers, most of farmers are not educated and use traditional methods, subsistence farming. A combination of all these factors causes poor production of agri-commodities and hence agri-manufacturing firms struggle to have enough raw commodities for their factories and as results, the supply chain will be not be effective and there will be shortage of some products on the market.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The chapter covers the summary of major findings, conclusion based on the findings and the recommendations.

5.2 Summary of the Findings

5.2.1 Internal environment management

The findings on internal environment management indicated that both the senior managers and mid-level managers are committed to GSCM. There is also a team tasked with environmental improvements. Besides that, the manufacturing firms have total quality environmental management and ISO 14001 certification for environmental compliance and auditing programs. As well, the manufacturing firms supports environmental regulation though there has been no emphasis on eco-labeling.

5.2.2 Green purchasing

Regarding green purchasing, the study established that the manufacturing firms provides design specifications to suppliers that include environmental requirements for purchased items. Also, the manufacturing firms cooperates with its suppliers for environmental objectives through sharing ideas. Furthermore, the manufacturing firms does audit on environmental suppliers' internal management and it ensures that it only deals with suppliers with ISO1400 certification. As well, the manufacturing firms cooperates with customers for both cleaner production and green packaging.

5.2.3 Eco design

The results on eco design revealed that the manufacturing firms designs its products for reduced consumption of material/energy. Besides, the manufacturing firms designs its products for reuse, recycle and recovery of material. Moreover, the manufacturing firms designs its products to avoid or reduce use of hazardous products. Similarly, the manufacturing firms designs its products for support regulation. However, it is undefined whether the firm designs products that weigh the least capacity for decreased time taken and the energy during transportation. Further, the manufacturing firms designs its products in such a way that they are easy to set up by the users and at the same time energy saving. As well, the manufacturing firms design usability of part particularly for extend using products, repair easy and increase efficiency.

5.2.4 Investment Recovery

With reference to investment recovery, the findings revealed that the manufacturing firms' sales its excess inventories/ materials. It also sales its scrap, used materials and excess capital equipment. Further, the manufacturing firms recycles some of its used products together with collecting and recycling end-of-life products and materials. It was however not fully established if the manufacturing firms have established a recycling system for used and defective products.

5.2.5 Institutional Pressure

In relation to institutional pressure, the study established that the local environmental laws put pressure on the firms GSC. Also, the environmental protection demands from the firms' domestic customers put increasing pressure on their GSCM. Similarly, increase of environmental awareness of the society, collaboration in the environment with suppliers, improvements in developing green products by suppliers, improvements in products green packaging of the firms' suppliers and the requirements of green development from the industry association boosts pressure on the firms' GSCM.

However, there is doubt whether the green strategy of the manufacturers who produce the same products as the firms boost pressure on GSCM. Similarly, it is uncertain if the green strategy of the manufacturers who produce the substitute products as the firm boost pressure on their GSCM.

5.2.6 Supply chain performance

The results on supply chain performance indicated that the manufacturing firms could customize product to meet specific customer demand. Besides, the manufacturing firms have customer responsiveness flexibility. Moreover, the manufacturing firms have low percentage of defects and high percentage of finished goods in transit. However, there is no efficiency of purchase order cycle time.

5.2.7 Moderated effect of institutional pressures on the relationship between green supply chain and supply chain performance

Basing on the findings in chapter four, institutional pressure significantly moderates the relationship between internal environment management and supply chain performance. The implication is that environmental regulation induces the top management to adopt environmentally friendly practices in the manufacturing process. In so doing, the supply chain performance is improved. In tally with the results, the study shows that regulatory requirements have a significant effect on organizational green approaches and consequently both profitability and growth. In a similar vein, it is established that the main driving factors of green logistics practices for truck fleets in is coercive pressure.

Furthermore, institutional pressure had a negative and significant moderating effect on the relationship between green purchasing and supply chain performance. The results suggest than increased institutional pressure weaken the relationship between green purchasing and supply chain performance. As such, regulations are deleterious to the relationship between supply chain partners that is effective in increasing supply chain

performance. Similarly, institutional pressure had a negative and significant moderating effect on the relationship between eco-design and supply chain performance.

Finally, institutional pressure had a positive and significant moderating effect on the relationship between investment recovery and supply chain performance. The results suggest that environmental laws and environmental protection demands induces manufacturing firms to adopt best practices in recycling, reusing as well as sale of idle assets which in turn improves the supply chain performance. The reason for this is that there is no wastage and at the same time there is adherence to green supply chain. In conformity with the findings, the study established that government agencies are the obvious factor that influence adoption of green practices by organizations through enforcement of rules and regulation.

5.3 Conclusion

5.3.1 Internal Environmental Management

In conclusion, internal environmental management positively and significantly influences supply chain performance. The implication is that support from the top management is extremely essential in the implementation as well as the adoption of green supply chain management. Without the presence of senior managers, GSCM is bound to fail. Not only do the senior management enhance GSCM but they also enhance the relationships among the supply chain management practices and natural environment. Therefore, for manufacturing firms to exhibit superior supply chain performance, the commitment and support from both the mid – level and senior-level management is crucial.

5.3.2 Green Purchasing and Supply Chain Performance

Also, green purchasing which entails cooperating with suppliers for the purpose of developing products that are environmentally sustainable had a positive and significant

influence on supply chain performance. The results suggest that the attainment of GSCM is a collaborative effort between the firm and its supply chain partners in aspects such as sharing ideas on environmental objectives and ensuring that there is cleaner production and green packaging. It is therefore easier for the manufacturing firms to audit its suppliers and choose one that complies with ISO1400 certification since there is close interaction in the supply chain.

5.3.3 Eco-Design and Supply Chain Performance

Furthermore, eco-design results in the improvement of supply chain performance once manufacturers design products that minimize consumption of materials and energy and at the same time facilitate the reuse and recycle of component materials. In fact, the study has shown that the manufacturing firms have been able to integrate environmental aspects into the product design process while taking into consideration the flow of the product in the supply chain. Consequently, eco-design by the manufacturing firms has led to improved supply chain performance.

5.3.4 Investment Recovery and Supply Chain Performance

In addition, investment recovery has also been found to have a positive and significant effect on supply chain performance. The reason for this is that used materials and defective products that are likely to be deleterious to the environment are put into better use by recycling or even reusing such products. In such a way, the manufacturing firms can earn revenue from the sale of idle assets and save on cost by reusing material.

5.3.5 Institutional Pressure and Supply Chain Performance

The study findings on moderation effect concludes that under high levels of institutional pressure, internal environmental management, eco design and investment recovery increase supply chain performance of agro processing firms in Rwanda. It was inferred that this institutional pressure mostly comes from the environmental protection demands

from domestic customers, increase of environmental awareness of the society, collaboration in environment with suppliers and local environmental laws.

5.4 Recommendations

5.4.1 Internal Environmental Management and Supply Chain Performance

Basing on the study findings, internal environmental management is key in the attainment of improved supply chain performance by manufacturing firms. It is therefore important for both the senior managers and mid – level managers to be committed and supportive of GSCM. Besides that, there is need for the firm to have total quality environmental management and ISO 14001 for environmental compliance. As well, having a team within the firm that is tasked with environmental improvements will go a long way in enhancing supply chain performance.

5.4.2 Green Purchasing and Supply Chain Performance

Since green purchasing enhances supply chain performance, it is recommended or manufacturing firms to exert pressure on their suppliers for better environmental performance. Specifically, the firms need to provide design specifications to suppliers that include environmental requirements for purchased items. Besides, there is need for the firms to do auditing on environmental suppliers' internal management and ensure that it cooperates with customers for both cleaner production and green packaging.

5.4.3 Eco-Design and Supply Chain Performance

In addition, eco-design has been found to improve supply chain performance of manufacturing firms. As such, the firms need to ensure that the environmental impacts of the product's life cycle are understood before even engaging in manufacturing decisions. Moreover, the firm needs to design its products for reuse, recycle and recovery of material. As well, is it utmost necessary for the manufacturing firms to

design products that are easy to set up by the users and are at the same time energy saving.

5.4.4 Investment Recovery and Supply Chain Performance

Undoubtedly, investment recovery has a positive and significant influence on supply chain performance. Therefore, managers need to ensure that the raw materials acquired from suppliers can be recyclable, reusable, and remanufactured (Rao and Holt, 2005). Also, firms need to make an initiative towards identifying a recycling system for used and defective products. Other than that, it is important for firms to sell their excess capital equipment and inventories to enhance supply chain performance.

5.4.5 Institutional Pressure and Supply Chain Performance

Based on the study findings that institutional pressure moderates the relationship between internal environmental management, green purchasing, eco-design and investment recovery and supply chain performance. Therefore, government should ensure there are strict Local environmental laws. In addition, customer should demand for environmental protection product. Moreover, there need to increase of environmental awareness of the society and collaboration in environment with our suppliers. There is need for improvements in developing green products of suppliers and products green packaging of suppliers.

5.5 Further Research Recommendations

This study expands our knowledge on effects of green supply chain adoption on supply chain performance: survey of Agri-Manufacturing Firms in Rwanda. Though this study has fulfilled its aim and objectives, and there are several areas for additional studies and empirical research, given the limitations of the research.

On a geographical dimension, this study was primarily limited to Agri-Manufacturing Firms in Rwanda. Therefore, it may not be appropriate to generalize to the whole population of firms in Rwanda or any other country. For this reason, further empirical investigations in different regions and countries are needed.

The methodology that has been chosen to achieve the research objectives was limited to questionnaires. As such, future research could build on this study by examining effects of green supply chain performance in different sectors and industries in both a qualitative and quantitative way. Also, a replication of this research on different industries would provide data for comparison.

REFERENCES

AfDB. (2014). *Eastern Africa's Manufacturing Sector-Rwanda Country Report.* Retrieved from https://www.afdb.org/fileadmin/uploads/afdb/Documents/ Publications/RWANDA_manufacturing_COUNTRY_report.pdf.

Agro processing sector / Official Rwanda Export Website. Rwanda Development Board. (2020). Retrieved from http://rdb.rw/export/export/products-directory/ agro-processing-sector/.

Akroush, M. N., & Al-Mohammad, S. M. (2010). The effect of marketing knowledge management on organizational performance: An empirical investigation of the telecommunications organizations in Jordan. *International journal of emerging markets*, *5*(1), 38-77.

Al Khattab, S. (2012). Marketing Strategic Alliances: The Hotel Sector in Jordan. *International Journal of Business and Management*, ***7***, 222-232.

Al Khattab, S. & Fraij, F. (2011). Assessing Students' Satisfaction with Quality of Service of Students Information System. *Management and Marketing Journal*, *9*, 111-225.

Al Khattab, S., Abu-Rumman, A. & Massad, M. (2015). The Impact of the Green Supply Chain Management on Environmental-Based Marketing Performance. *Journal of Service Science and Management*, *8*, 588-597.

Ali, A. Y. S., Ali, A. A., & Adan, A. A. (2013). Working conditions and employees' productivity in manufacturing companies in sub-Saharan African context: Case of Somalia. *Educational Research International*, *2*(2), 67-78.

Ali, S. S., Kaur, R., Ersöz, F., Lotero, L., & Weber, G. W. (2019). Evaluation of the effectiveness of green practices in manufacturing sector using CHAID analysis. *Journal of Remanufacturing*, *9*(1), 3-27.

Aliyu, A., Bello, M. U., Kasim, R., & Martin, D. (2014). Positivist and Non-Positivist Paradigm in Social Science Research: Conflicting Paradigms or Perfect Partners? *Journal of Management and Sustainability*, *4*(3), 79-95.

Allred, S. B., & Ross-Davis, A. (2011). The drop-off and pick-up method: An approach to reduce nonresponse bias in natural resource surveys. *Small-Scale Forestry, 10*(3), 305-318.

Amoroso, D. L. (2018). Predicting brand loyalty by measuring the strength of consumer habit. *Diverse Methods in Customer Relationship Marketing and Management*, 256-276.

Appolloni, A., Sun, H., Jia, F., & Li, X. (2014). Green procurement in the private sector: A state of the art review between 1996 and 2013. *Journal of Cleaner Production*, *85*, 122-133.

Archibald, M.E. (2017). Resource dependency theory. Retrieved from https://www.britannica.com/topic/resource-dependency-theory. Encyclopædia Britannica, inc.

Atmadja, A., & Saputra, K. (2018). The influence of village conflict, village apparatus ability, village facilitator competency and commitment of local government on the success of budget management. *Academy of Accounting and Financial Studies Journal, 22*(1), 850-871.

Azevedo, S. G., Carvalho, H., & Cruz Machado, V. (2011). The influence of green practices on supply chain performance: a case study approach. *Transportation Research Part E: Logistics and Transportation Review, 47*(6), 850-871.

Barratt, M., Choi, T. Y., & Li, M. (2011). Qualitative case studies in operations management: trends, research outcomes, and future research implications. *Journal of Operations Management*, *29*(4), 329-342.

Bhyrovabhotla, N. (2012). Resource Dependency Theory: Renaissance and Extensions: A Conceptual Basis. *Electronic Journal*. Retrieved from: https://ssrn.com/abstract=2015273

Borch, O. J., & Solesvik, M. (2015). Innovation on the Open Sea: Examining Competence Transfer and Open Innovation in the Design of Offshore Vessels. *Technology Innovation Management Review*, *5*(9), 17−22.

Borchardt, M., Wendt, M.H., Pereira, G.M, & Sellitto, M.A. (2011). Redesign of a component based on eco-design practices: environmental impact and cost reduction achievements. *Journal Cleaner of Production*, *19*(1), 49-57.

Callaway, S. K. (2017). How the Principles of the Sharing Economy Can Improve Organizational Performance of the US Public School System. *International Journal of Public Policy and Administration Research, 4*(1), 1-11.

Carey, S., Lawson, B., & Krause, D.R. (2011). Social capital configuration, legal bonds and performance in buyer-Supplier relationships. *Journal of Operations Management, 29,* 277-288

Carter, C. R., & Easton, P. L. (2011). Sustainable supply chain management: Evolution and future directions. *International Journal of Physical Distribution & Logistics Management, 41*(1), 46-62.

Chakravarthy, B., (1997). A new strategy framework for coping with turbulence. *Sloan Management Review*, *38*(4), 69-82.

Chen, C.C, Shih, H.S, Shyur, H.J, & Wu K.S. (2012). A business strategy selection of green supply chain management via an analytic network process. *Computers & Mathematics with Applications, 64*(8), 2544-2557

Chen, J.Z. (2009). Material flow and circular economy. *Systems Research and Behavioural Science*. *26*(2), 269-278.

Chicksand, D., Watson, G., Walker, H., Radnor, Z., & Johnston, R. (2012). Theoretical perspectives in purchasing and supply chain management: An analysis of the literature. *Supply Chain Management: An International Journal*, *17*(4), 454-472.

Chien, M. K., & Shih, L. H. (2014). An empirical study of the implementation of green supply chain management practices in the electrical and electronic industry and their relation to organizational performances. *International Journal of Environmental Science and Technology*, *4*(3), 383-394.

Chien, M. K., & Shih, L. H. (2014). An empirical study of the implementation of green supply chain management practices in the electrical and electronic industry and their relation to organizational performances. *International Journal of Environmental Science and Technology*, *4*(3), 383-394.

Chin, T., Tat, H., Sulaiman, Z., & Muhamad, Z, S. (2015). Green Supply Chain Management Practices and Sustainability Performance. *Advanced Science Letters*, *21*(5), 1359-1362.

Chiu, J., & Hsieh, C. (2016). The Impact of Restaurants' Green Supply Chain Practices on Firm Performance. *Sustainability*, *8*(1), 42.

Choi, T.Y., & Krause, D.R. (2006). The supply base and its complexity: implications for transaction costs, risks, responsiveness, and innovation. *Journal of Operations Management, 24*(5), 637-652.

Chu, S., Yang, H., Lee, M., & Park, S. (2017). The Impact of Institutional Pressures on Green Supply Chain Management and Firm Performance: Top Management Roles and Social Capital. *Sustainability*, *9*(5), 764.

Chu, S. H., Yang, H., Lee, M., & Park, S. (2017). The impact of institutional pressures on green supply chain management and firm performance: Top management roles and social capital. *Sustainability, 9*(5), 764.

Connelly, L. M. (2011). Cronbach's alpha. *Medsurg nursing*, *20*(1), 45-47.

Cooper, A. C., Gascon, F. Sexton, D. & Kasarda, J. (2012). *Entrepreneurs, processes of founding and new-firm performance in the state of the art of entrepreneurship*, (eds.), Boston: PWS-Kent.

Cooper, D. R. & Schindler, P. S. (2011). *Business Research Methods.* (11th ed.) New York: McGraw-Hill.

Cooper, D., & Schinlder, P. (2011). *Business research method. New York*: McGrow-Hill Higher Education.

Creswell, J., Codlin, A. J., Andre, E., Micek, M. A., Bedru, A., Carter, E. J., & Brouwer, M. (2014). Results from early programmatic implementation of Xpert MTB/RIF testing in nine countries. *BMC infectious diseases*, *14*(1), 2.

Cruz, J.M. (2009). The impact of corporate social responsibility in supply chain management: multicriteria decision-making approach. *Decision Support Systems*. *48*(1), 224-236.

Cruz, J.M. & Matsypura, D. (2009), "Supply chain networks with corporate social responsibility through integrated environmental decision-making", *International Journal of Production Research*. *47*(3), 621-648.

David, R. A., & Muthini, J. N. (2019). Influence of green supply chain management practices on procurement performance of private health institutions in Kenya: A case of Aga Khan Hospital Kisumu. *The Strategic Journal of Business & Change Management*, *6*(2), 1378-1396.

Davis G. F. & Cobb J. A. (2010). *Resource Dependence Theory: Past and Future*. Oxford: Oxford Biography.

De Grosbois, D. (2016). Corporate social responsibility reporting in the cruise tourism industry: A performance evaluation using a new institutional theory based model. *Journal of Sustainable Tourism. 24*, 245-269.

DeVellis, R. F. (2012). Factor Analysis. *Scale development: Theory and applications*, (Vol. 26). New Jersey: Sage publications.

Diab, S., AL-Bourini, F & Abu-Rumman, A. (2014). 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.

Dikko, M. (2016). Establishing Construct Validity and Reliability: Pilot Testing of a Qualitative Interview for Research in Takaful (Islamic Insurance). *Qualitative Report*, 21(3), 521 - 528.

Du Plessis, L. (2010). *The relationship between perceived talent management practices, perceived organizational support (POS), perceived supervisor support (PSS) and intention to quit amongst Generation Y employees in the recruitment sector* Unpublished PhD dissertation, Pretoria: University of Pretoria.

Ellis, J. (2019). Crisis, Resilience, and the Time of Law. *Canadian Journal of Law & Jurisprudence. 32*, 305-320.

Eltayeb, T., Zailani, S., & Ramayah, T. (2011). Green supply chain initiatives among certified companies in Malaysia and environmental sustainability: Investigating the outcomes. *Resources, Conservation and Recycling*, *55*(5), 495-506.

Eltayeb, T.K., Zailani, S. & Ramayah, T. (2011). Green Supply Chain Initiatives among Certified Companies in Malaysia and Environmental Sustainability: Investigating the Outcomes. *Resources, Conservation and Recycling*, *55*, 495-506.

Epoh, L., & Mafini, C. (2018). Green supply chain management in small and medium enterprises: Further empirical thoughts from South Africa. *Journal of Transport and Supply Chain Management*, *12*(1), 12.

Fain, J. S., Van Tongelen, A., Loriot, A., & De Smet, C. (2019). Epigenetic Coactivation of MAGEA6 and CT-GABRA3 Defines Orientation of a Segmental Duplication in the Human X Chromosome. *Cytogenetic and genome research*, *159*(1), 12-18.

Biruta, V. (2016). Five ways Rwanda is leading on green growth. In *World Economic Forum. Retrieved from: https://www. weforum. org/agenda/2016/05/5-waysrwanda-is-leading-on-green-growth*.

Foo, P.Y., Lee, V.H., Tan, G.W.H., & Ooi, K.B. (2018). A gateway to realizing sustainability performance via green supply chain management practices: A PLS–ANN approach. *Expert Systems with Applications*. *107*, 1-14.

Fragouli, E. & Yankson, J.K. (2015). The Role of Strategic Planning on the Management of Organizational Change. *Financial Risk and Management Reviews, 1*(2), 68-87.

Galbraith, J. K. (2015). *The new industrial state*. Princeton: Princeton University Press.

Gall, M. D., Gall, J. P., & Borg, W. R. (2014). *Applying educational research: How to read, do, and use research to solve problems of practice*. New Delhi: Pearson Higher Education.

Ganesh Kumar, C., Murugaiyan, P., & Madanmohan, G. (2017). Agri-food supply chain management: literature review. *Intelligent Information Management*, *9*, 68-96.

Geng, R.; Mansouri, S.A. & Aktas, E. (2017). The relationship between green supply chain management and performance: A meta-analysis of empirical evidences in Asian emerging economies. *International Journal of Production Economy*, *183*, 245–258.

Ghasemi, A., & Zahediasl, S. (2012). Normality tests for statistical analysis: a guide for non-statisticians. *International journal of endocrinology and metabolism, 10*(2), 486.

Ghazilla, R.A.R., Sakundarini, N., Abdul-Rashid, S.H., Ayub, N.S., Olugu, E.U. & Musa, S.N. (2015). Drivers and Barriers Analysis for Green Manufacturing Practices in Malaysian SMEs: A Preliminary Findings. *Procedia CIRP*, *26*, 658-663.

González-García, S., Garcia L.R., Estévez, J., Pascual, R., Moreira, M.T., Gabarrell, X., Rieradevall, J., & Feijoo, G. (2012). Environmental Assessment and Improvement Alternatives of a Ventilated Wooden Wall from LCA and DfE Perspective. *The International Journal of Life Cycle Assessment*, *17*(4), 432-443.

González-García, S., García L.R., Moreira, M.T., Gabarrell, X., Rieradevall, J., Feijoo, G., & Murphy, R.J. (2012). Eco-innovation of a Wooden Childhood Furniture Set: An Example of Environmental Solutions in the Wood Sector. *Science Total Environment*, *426*, 318-26.

González-García, S., García, L.R., Buyo, P., Pascual, R.C., Gabarrell, X., Rieradevall, J., Moreira, M.T., & Feijoo, G. (2012). Eco-innovation of a Wooden Based Modular Social Playground: Application of LCA and DfE Methodologies. *Journal of Cleaner Production*, *27*, 21-31.

González-García, S., Gasol, C. M., Lozano, R. G., Moreira, M. T., Gabarrell, X., i Pons, J. R., & Feijoo, G. (2011). Assessing the global warming potential of wooden products from the furniture sector to improve their ecodesign. *Science of the Total Environment*, *410*, 16-25.

González-García, S., Salinas-Mañas, L., García, L.R., Gabarrell, X., Rieradevall, J., Feijoo, G., & Moreira, M.T. (2013). The application of eco-design

methodology in SMEs run according to lean management: the case of a furniture publishing company. *Environmental Engineering Management Journal*, *13*(12), 2977 - 2988.

González-García, S., Silva, F.J., Moreira, M.T., Castilla, P.R., García, L.R., Gabarrell, X., & Government of Rwanda. (2011). *Green Growth and Climate Resilience National Strategy for Climate Change and Low Carbon Development*. Kigali: Government of Rwanda.

Govindan, K, Khodaverdi R, Vafadarnikjoo A. (2015). Intuitionistic fuzzy based DEMATEL method for developing green practices and performances in a green supply chain. *Expert Systems with Applications*, *42*(20), 7207-7220

Govindan, K., Azevedo, S., Carvalho, H., & Cruz-Machado, V. (2013). Lean, green and resilient practices influence on supply chain performance: interpretive structural modeling approach. *International Journal of Environmental Science and Technology*, *12*(1), 15-34.

Green K. W., Zelbst, P. J., Meacham, J., & Bhadauria, V. S. (2012). Green supply chain management practices: impact on performance. Supply Chain Management: *An International Journal*, *17*(3), 290-305.

Gualandris, J., & Kalchschmidt, M. (2014) Customer pressure and innovativeness: Their role in sustainable supply chain management. *Journal of Purchase and Supply Management. 20*, 92-103.

Guide, V.D R., & Wassenhove, L.N.V. (2009). The evolution of closed-loop supply chain research. *Operations Research*, *57*(1), 10–18.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2012). Partial least squares: the better approach to structural equation modeling?. *Long Range Planning*, *45*(5-6), 312-319.

Hallam, C. & Contreras, C. (2016). Integrating lean and green management. *Management Decision*, *54*(9), 2157-2187.

Handfield, R.B. & Nichols, E.L. (2012). *Supply Chain Redesign: Transforming Supply Chains into Integrated Value Systems*. Upper Saddle River, NJ: Financial Times Prentice Hall.

Hanna, J.B., Hazen, B.T. & Cegielski, C. (2011). Diffusion of Green Supply Chain Management Examining Perceived Quality of Green Reverse Logistics. *The International Journal of Logistics Management*, *22*, 373-389.

Harrison, A., & Hoek, R. (2011). *Logistics management and strategy*. Harlow, England: Pearson/Financial Times Prentice Hall.

Harrison, V. (2011). *Logistic Management and Strategy: Competing through the Supply Chain*. London: Prentice Hall.

Hayes, A. F., & Montoya, A. K. (2017). A tutorial on testing, visualizing, and probing an interaction involving a multicategorical variable in linear regression analysis. *Communication Methods and Measures*, *11*(1), 1-30.

Hillman, A., Withers, M. & Collins, B. (2009). Resource Dependence Theory: A Review. *Journal of Management*. *35*(3), 383-396.

Hollos, D., Blome, C., & Foerstl, K. (2012). Does sustainable supplier co-operation affect performance? Examining implications for the triple bottom line. *International Journal of Production Research*. *50*, 2968-2986.

Houghton, C., Casey, D., Shaw, D., & Murphy, K. (2013). Rigour in qualitative case-study research. *Nurse researcher*, *20*(4), 12–17.

Hubbard, R., Haig, B., & Parsa, R. (2019). The Limited Role of Formal Statistical Inference in Scientific Inference. *The American Statistician*, *73*(1), 91-98.

Jabbour, A., Frascareli, F., & Jabbour, C. (2015). Green supply chain management and firms' performance: Understanding potential relationships and the role of green sourcing and some other green practices. *Resources, Conservation and Recycling*, *104*, 366-374.

Jaegler, A., & Sarkis, J. (2014). The Theory and Practice of Sustainable Supply Chains. *Supply Chain Forum: An International Journal*, *15*(1), 2-5.

Ji, X., Wu, J., & Zhu, Q. (2016). Eco-design of transportation in sustainable supply chain management: A DEA-like method. *Transportation Research Part D: Transport and Environment*, *48*, 451–459.

Kankanit, K., & Busba, P. (2015). The Influence of Green Supply Chain Management on Business Performance of Electronic Industry in Thailand. , *International Journal of Management and Applied Science (IJMAS)*, *1*(11), 54-59.

Karazsia, B. T., Berlin, K. S., Armstrong, B., Janicke, D. M., & Darling, K. E. (2014). Integrating mediation and moderation to advance theory development and testing. *Journal of pediatric psychology*, *39*(2), 163-173.

Kaur, J., Sidhu, R., Awasthi, A., Chauhan, S., & Goyal, S. (2017). A DEMATEL based approach for investigating barriers in green supply chain management in Canadian manufacturing firms", *International Journal of Production Research*, *56*(1-2), 312-332.

Ketchen Jr. D. J., & Hult, G. T. M. (2007). Bridging organization theory and supply chain management: The case of best value supply chains. *Journal of Operations Management*. *25*(2), 573-580.

Ketokivi, M. (2019). Avoiding bias and fallacy in survey research: A behavioural multilevel approach. *Journal of Operations Management*, *65*(4), 380-402.

Ketokivi, M., & Choi, T. (2014). Renaissance of case research as a scientific method. *Journal of Operations Management, 32*(5), 232-240.

Khan, S., & Qianli, D. (2017). Impact of green supply chain management practices on firms' performance: an empirical study from the perspective of Pakistan. *Environmental Science and Pollution Research, 24*(20), 16829-16844.

Kim, J.H., Youn, S. and Roh, J.J. (2011). Green supply chain management orientation and firm performance: evidence from South Korea. *International Journal of Services and Operations Management, 8*(3), 283-304

Kirchoff, J. & Omar, A. & Fugate, B. (2015). A Behavioral Theory of Sustainable Supply Chain Management Decision Making in Non-Exemplar Firms. *Journal of Supply Chain Management. 52*(1), 41-65.

Kit, I. (2010). *Value Chain Finance beyond Microfinance for Rural Entrepreneurs*. Nairobi: Royal Tropical Institute, Amsterdam, and International Institute of Rural Reconstruction.

Koh, S.C.L., Gunasekaran, A. & Tseng, C.S. (2012). Cross-tier ripple and indirect effects of directives WEEE and RoHS on greening a supply chain. *International Journal of Production Economics, 140*(1), 305-317.

Koh, S.C.L., Morris, J., Ebrahimi, S.M. & Obayi, R. (2016). Integrated resource efficiency: Measurement and management. *International Journal of Operations and Production Management, 36*(11), 1576-1600.

Koufteros, X.A., Cheng, T.C.E., & Lai, K.H. (2007). Black-box and grey-box supplier integration in product development: antecedents, consequences and the moderating role of firm size. *Journal of Operations Management, 25*(4), 847–870.

Kozlenkova, I.V., Samaha, S.A., & Palmatier, R.W. (2014). Resource-based theory in marketing. *Journal of the Academy of Marketing Science*, *42*(1), 1–21.

Krause, D. R., Vachon, S. & Klassen, R. D. (2009). Special topic forum on sustainable supply chain management: Introduction and reflections on the role of purchasing management. *Journal of Supply Chain Management*. *45*(4), 18-25.

Kumar, R., & Chandrakar, R., (2012). Evaluation and Measurement of Performance of GSCM in Chhattisgarh Manufacturing Industries (INDIA). *International Journal of Application or Innovation in Engineering & Management*, *2*(6), 240-249.

Laari, S., Töyli, J., Solakivi, T., & Ojala, L. (2016). Firm performance and customer-driven green supply chain management. *Journal of Cleaner Production*, *112*, 1960-1970.

Lai, K., Wong, C.W., & Lam, J.S.L. (2015). Sharing environmental management information with supply chain partners and the performance contingencies on environmental munificence. *International Journal Production Economy, 164*, 445-453.

Lai, K.H., Wong, C.W.Y. & Lun, Y.H.V. (2014). The role of customer integration in extended producer responsibility: a study of Chinese export manufacturers", *International Journal of Production Economics*. *147*(1), 284-293.

Lakshmimeera, B.L. & Palanisamy, C. (2013). A Conceptual Framework on Green Supply Chain Management Practices. *Industrial Engineering Letters*, *3*(10), 42-52.

Lavrakas, P. (2010). Target Population. Encyclopedia of Survey research methods. *Reference Reviews*. *24*(10, 26-27.

Leech, N. L., & Onwuegbuzie, A. J. (2011). Beyond constant comparison qualitative data analysis: Using NVivo. *School Psychology Quarterly*, *26*(1), 70.

Leigh, M., & Li, X. (2015). Industrial ecology, industrial symbiosis and supply chain environmental sustainability: a case study of a large UK distributor. *Journal of Cleaner Production*, *106*, 632-643.

Liu, J., Feng, Y., Zhu, Q., & Sarkis J. (2018). Green supply chain management and the circular economy: Reviewing theory for advancement of both fields. *International Journal of Physical Distribution & Logistics Management*, 2017-2049.

Luthra S, Garg D, & Haleem A. (2016). The impacts of critical success factors for implementing green supply chain management towards sustainability: An empirical investigation of Indian automobile industry. *Journal of Cleaner Production*, *121*, 142-158.

Madhani, P., M. (2010) Resource Based View (RBV) of Competitive Advantages: Importance, Issues and Implications. *Journal of Indian Management Research and Practices*, 1(2), 2-12.

Malviya, R.K. & Kant, R. (2015). Green supply chain management (GSCM): A structured literature review and research implications. *Benchmarking: An International Journal*, *22*(7), 1360-1394.

Mangla, S.K., Luthra, S., Mishra, N., Singh, A., Rana, N.P., Dora, M. & Dwivedi, Y. (2018). Barriers to effective circular supply chain management in a developing country context. *Production Planning and Control*, *29*(6), 551-569.

Markley, M., & Davis, L. (2007). Exploring future competitive advantage through sustainable supply chains. *International Journal of Physical Distribution & Logistics Management*, *37*(9), 763-774.

Marolt, M., Zimmermann, H. D., Žnidaršič, A., & Pucihar, A. (2020). Exploring Social Customer Relationship Management Adoption in Micro, Small and Medium-Sized Enterprises. *Journal of theoretical and applied electronic commerce research*, *15*(2), 38-58.

Matos, S., & Hall, J. (2007). Integrating sustainable development in the supply chain: the case of life cycle assessment in oil and gas and agricultural biotechnology. *Journal of Operations Management, 25*(6), 1083–1102.

Meysamie, A., Taee, F., Mohammadi-Vajari, M., Yoosefi-Khanghah, S., Emamzadeh-Fard, S., & Abbassi, M. (2014). Sample size calculation on web, can we rely on the results? *Journal of Medical Statistics and Informatics, 2*(1), 3.

Miao, X., & Xi, B. (2007). CAS-based social network analysis for collaborative management in the green supply chain network system. *International Journal of Networking and Virtual Organisations 4*(4), 446–458.

MINECOFIN. (2011). *Budget Framework Paper (2010/11-2012/13).* Kigali: MINECOFIN.

Ming-Kuei, C. (2014). Influences of Green Supply Chain Management Practices on Organizational Sustainable Performance. *International Journal of Environmental Monitoring and Protection*, ***1***, 12-23.

MINICOM. (2014). *Industrial Master Plan for the Agro-Processing Subsector (2014 - 2020)* (p. 46). Kigali: MINICOM.

Ministry of Environment, (2017). *Evaluation of the Green Growth and Climate Resilience Strategy (GGCRS) Implementation*. Kigali: Ministry of Environment, p.39.

Mohamad, M., & Koilpillai, C. (2018). The Influence of Green Supply Chain Practices towards Environmental Development: The Malaysian ISO14001 Certified

Manufacturing Companies Perspective. *Journal of Southeast Asian Research, 2018*, 1-10.

Muma, B. O., & Nyambega, E. K. (2014). Green Supply Chain. *International Journal of Economics, Finance and Management Science*, 270-276

Mweru, C. & Maina, T. (2015). Features of Resource Based View Theory: An Effective Strategy in Outsourcing. *International Journal of Management and Commerce Innovations, 3*, 215-218.

Nderitu, K. M & Ngugi, K. (2014). Effects of Green Procurement Practices on an Organization Performance in Manufacturing Industry: Case Study of East African Breweries Limited. *European Journal of Business Management, 2*(1), 341-352.

Ninlawan, C., Seskan, P., Tossapol, K. & Pilada, W. (2010). *The implementation of Green Supply Chain Management Practices in Electronics industry*.

NISR, (2018). *Gross Domestic Product Second Quarter 2018.* Kigali: National Institute of Statistics.

NISR, (2019). *Rwanda Seasonal Agriculture Survey 2017*. Kigali: National Institute of Statistics.

Nixon, R. (2006). Slow Violence, Gender, and the Environmentalism of the Poor. *Journal of Commonwealth and Postcolonial Studies*. *13.* 14-37.

Nunes, B., Bennett, D., Shaw, D., & Theodorakopoulos, N. (2012). Philosophy, Theory and Practice of Green Operations Management. In *Khalil T, Hosni Y and Hung SC (Eds) Managing Technology-Service Convergences in the Post-Industrialized Society, Proceedings of 21st International Conference of the*

International Association for Management of Technology, IAMOT/National Tsing Hua University, Hsinchu, Taiwan..

Ofori, G. (2010) Greening the construction supply chain in Singapore. *European Journal of Purchasing and Supply Management, 6,* 195-206.

Oluwasola, O. (2020). Environmental Pollution is Inevitable in Developing Countries. Retrieved from: http://breakingenergy.com/2014/09/23/environmental-pollution-is-inevitable-in-developing-countries/

Pagell, M., & Wu, Z. (2009). Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars. *Journal of supply chain management*, *45*(2), 37-56.

Pandian, G. R. S., & Abdul-Kader, W. (2017). Performance evaluation of reverse logistics enterprise–an agent-based simulation approach. *International Journal of Sustainable Engineering*, *10*(6), 384-398.

Park-Poaps, H. & Rees, K. (2010). Stakeholder Forces of Socially Responsible Supply Chain Management Orientation. *Journal of Business Ethics*. *92*(2), 305-322.

Pearlson, K. E., & Saunders, C. S. (2013). *Managing and using information systems: a strategic approach*. Hoboken, NJ: John Wiley & Sons.

Petrescu, M. (2013). Marketing research using single-item indicators in structural equation models. *Journal of Marketing Analytics*, *1*(2), 99-117.

Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual review of psychology*, *63*, 539-569.

Prigogine, L., (1984). *Order out of Chaos.,* New York: Random House.

Pullman, M., Maloni, M., & Carter, C. (2009). Food For Thought: Social Versus Environmental Sustainability Practices And Performance Outcomes. *Journal of Supply Chain Management*, *45*(4), 38-54.

Rao, P. (2012). Greening the supply chain: a new initiative in South East Asia. *International Journal of Operation and Production Management, 22*(6), 632-655.

REMA, (2014). *Training Manual on Environment and Climate Change for Environmental Organizations*. Kigali: REMA, p.10.

REMA. (2015). *Sector Specific Guidelines For Mainstreaming Climate Change In The Manufacturing Industry Sector In Rwanda.* Rwanda: REMA.

REMA. (2017). *Evaluation of the Green Growth and Climate Resilience Strategy (GGCRS) Implementation* (p. 39). Kigali: REMA.

Rha, J.S. (2010). *The Impact of Green Supply Chain Practices on Supply Chain Performance.* Unpublished MA, University of Nebraska at Lincoln Available at http://digitalcommons.unl.edn/businessdiss/l 1

Rieradevall, J., González-García, S., Silva, F. J., Moreira, M. T. Pascual, R. C., Lozano, R. G., Gabarrell, X., ... & Feijoo, G. (2011). Combined application of LCA and eco-design for the sustainable production of wood boxes for wine bottles storage. *The International Journal of Life Cycle Assessment, 16*(3), 224-237.

Rodes, C. & Ward, M. (2014). Small businesses and the UK economy. *Standard Note: SN/EP/6078. Office for National Statistics*.

Rwanda Standards Board. (2012). *Rwanda skills survey 2012*. Manufacturing sector report. Kigali: RSB.

Sanyé-Mengual, E., Lozano, R., Farreny, R., Oliver-Solà, J., Gasol, C., & Rieradevall, J. (2014). Introduction to the Eco-Design Methodology and the Role of Product Carbon Footprint. *Assessment of Carbon Footprint in Different Industrial Sectors, 1*, 1-24.

Sarkis, J. (2012). A boundaries and flows perspective of green supply chain management. *Supply Chain Management International Journal, 17*, 202-216.

Sarkis, J., Gonzalez-Torre, P., & Adenso-Diaz, B. (2010). Stakeholder pressure and the adoption of environmental practices: The mediating effect of training. *Journal of Operations Management*. *28*, 163-176.

Sarkis, J., Zhu, Q., & Lai, K. (2011). An organizational theoretic review of green supply chain management literature. *International Journal of Production Economy, 130,* 1–15.

Schmidt, C. G., Foerstl, K., & Schaltenbrand, B. (2017). The supply chain position paradox: green practices and firm performance. *Journal of supply chain management*, *53*(1), 3-25.

Schrettle, S., Hinz, A., Scherrer -Rathje, M., & Friedli, T. (2014). Turning sustainability into action: Explaining firms' sustainability efforts and their impact on firm performance. *International Journal of Production Economics*, *147*, 73-84.

Sekaran, U., & Bougie, R. (2010). Research for Business-A Skill Building Approach. *The Journal of Social Sciences Research*, *Special*, (4), 44-49.

Sellitto, M., Luchese, J., Bauer, J., Saueressig, G., & Viegas, C. (2017). Ecodesign Practices in a Furniture Industrial Cluster of Southern Brazil: From Incipient Practices to Improvement. *Journal of Environmental Assessment Policy And Management*, *19*(01), 1750001.

Setyadi, A., (2019). Does green supply chain integration contribute towards sustainable performance? *Uncertain Supply Chain Management*, pp.121-132.

Seuring, S. & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production. 16*(15), 1699-1710.

Seuring, S. (2014). Industrial ecology, life cycles, and supply chains: differences and interrelations. *Business Strategy and the Environment 13*(5), 306–319

Sezen, B., & Çankaya, S. Y. (2018). Green supply chain management theory and practices. In *Operations and Service Management: Concepts, Methodologies, Tools, and Applications* (pp. 118-141). IGI Global.

Sharma, V., Chandna, P., & Bhardwaj, A. (2017). Green supply chain management related performance indicators in agro industry: A review. *Journal Of Cleaner Production*, *141*, 1194-1208.

Shi, H., Chertow, M., & Song, Y. (2010). Developing country experience with eco-industrial parks: A case study of the Tianjin Economic-Technological Development Area in China. *Journal of Cleaner Production 18*(3), 191–199.

Shi, V. G., Koh, S. L., Baldwin, J., & Cucchiella, F. (2012). Natural resource based green supply chain management. *Supply Chain Management: An International Journal*, *17*(1), 54-67.

Silverman, D. (Ed.). (2016). *Qualitative research*. London: Sage.

Solér, C., Bergström, K. & Shanahan, H. (2010) Green Supply Chains and the Missing Link between Environmental Information and Practice. *Business Strategy and the Environment*, *19*, 14-25.

Solesvik, M. (2017b). The Triple Helix Model for Regional Development and Innovation: Context of Nordic Countries. *Forum Scientiae Oeconomia*, *5*(4), 5-21.

Tabachnik, B. G., & Fidell, S. L. (2013). Multicollinearity and singularity. *Using multivariate statistics. Boston: Pearson Education Inc*, *2*(013), 88-91.

Tingley, D., Yamamoto, T., Hirose, K., Keele, L., & Imai, K. (2014). Mediation: R package for causal mediation analysis. *Journal of Statistical Software*, *59*(5), 1-38.

Toke, L., Gupta, R.C. & Dandekar, M. (2012). An empirical study of green supply chain management in Indian perspective. *International Journal of Applied Sciences and Engineering Research*. *1*, 372-383.

Touboulic, Anne & Walker, Helen. (2015). Theories in sustainable supply chain management: A structured literature review. *International Journal of Physical Distribution & Logistics Management. 45*, 10.

Treiblmaier, H., & Filzmoser, P. (2011). *Benefits from using continuous rating scales in online survey research*. ICIS 2011 Proceedings. 1. Retrieved from: https://aisel.aisnet.org/icis2011/proceedings/researchmethods/1

United Nations Economic Commission for Africa. (2010). *Promoting High-Level Sustainable Growth To Reduce Unemployment In Africa*. Addis Ababa: UNECA.

Van Hoek, R.I. (2012). Case studies of greening the automotive supply chain through technology and operations. *International Journal of Technology Management*. *23*(1), 89-112.

Van Tonder, E., & Ehlers, L. (2011). Factors threatening the survival of independent financial advisers in their organisational life cycle: an exploratory study. *South African Journal of Economic and Management Sciences*, *14*(2), 155-169.

Vanalle, R.M.; Ganga, G.M.D.; Godinho Filho, M. & Lucato, W.C. (2017). Green supply chain management: An investigation of pressures, practices, and performance within the Brazilian automotive supply chain. *Journal of Clean Production*, *151*, 250–259.

Volberda, H., & Karali, E. (2015). Reframing the Compositional Capability: A Resource-Based View on 'A Composition-Based View of Firm Growth'. *Management and Organization Review*, *11*(3), 419-426.

Wagner, S. M., & Bode, C. (2016). An empirical investigation into supply chain vulnerability. *Journal of Purchasing & Supply Management*, *12*, 301-312.

Wolf, J. (2014). The relationship between sustainable supply chain management, stakeholder pressure and corporate sustainability performance. *Journal of Business Ethics. 119*, 317-328.

Yan, P., Yao, L., Li, H., Zhang, M., Xun, Y., & Li, M. (2019). The methodological quality of robotic surgical meta-analyses needed to be improved: a cross-sectional study. *Journal of Clinical Epidemiology*, *109*, 20-29.

Yang, C., Lu, C., Haider, J., & Marlow, P. (2013). The effect of green supply chain management on green performance and firm competitiveness in the context of container shipping in Taiwan. *Transportation Research Part E: Logistics and Transportation Review*, *55*, 55-73.

Yang, C.L., Lin, S.P., Chan, Y.H., & Sheu, C. (2010). Mediated effect of environmental management on manufacturing competitiveness: An empirical study. *International Journal of Production Economics*, *123*(1), 210-220.

Yang, C. S. (2017). An analysis of institutional pressures, green supply chain management, and green performance in the container shipping

context. *Transportation Research Part D: Transport and Environment, 61*, 246-260.

Yang, J., Han, Q., Zhou, J., & Yuan, C. (2015). The influence of environmental management practices and supply chain integration on technological innovation performance Evidence from China's manufacturing industry. *Sustainability, 7*(11), 15342-15361.

Yusuf, Y.Y, Gunasekaran, A., Musa, A., EI-Berishy, N.M, Abubakar, T., & Ambursa, H.M. (2013). The UK oil and gas supply chains: An empirical analysis of adoption of sustainable measures and performance outcomes. *International Journal of Production Economics, 146*(2), 501-514

Zaid, A., Jaaron, A., & Talib Bon, A. (2018). The impact of green human resource management and green supply chain management practices on sustainable performance: An empirical study. *Journal of Cleaner Production, 204*, 965-979.

Zailani, S, Govindan, K, Iranmanesh, M, Shaharudin, M.R, & Chong, Y.S. (2015). Green innovation adoption in automotive supply chain: The Malaysian case. *Journal of Cleaner Production, 108*, 1115-1122

Zhang, Y., Sun, Y., & Xie, B. (2015). Quality of health information for consumers on the web: a systematic review of indicators, criteria, tools, and evaluation results. *Journal of the Association for Information Science and Technology*, *66*(10), 2071-2084.

Zhu, Q. & Geng Y. (2013). Drivers and barriers of extended supply chain practices for energy saving and emission reduction among Chinese manufacturers. *Journal of Clean Production, 40*, 6-12.

Zhu, Q., Geng, Y. & Lai, K. (2010). Circular economy practices among Chinese manufacturers varying in environmental-oriented supply chain cooperation and the performance implications. *Journal of Environmental Management*, *91*(6), 1324-1331.

Zhu, Q., Sarkis, J., & Lai, K. (2013). Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices. *Journal of Purchasing and Supply Management*, *19*(2), 106-117.

Zhu, Q., Sarkis, J., & Lai, K. H. (2013). Examining the effects of green supply chain management practices and their mediations on performance improvements. *International Journal of Production Research*. *50*(5), 1377-1394.

Zhu, Q., Sarkis, J., & Lai, K. H. (2013). Examining the effects of green supply chain management practices and their mediations on performance improvements. *International Journal of Production Research*, *50*(5), 1377-1394.

Zikmund, W. G., Babin, B. J., Carr, J. C., & Griffin, M. (2010). *Business research methods.* (8th ed.). Mason, HO: Cengage Learning

Zsidisin, G.A. & Siferd, S.P. (2010). Environmental purchasing: a framework for theory development. *European Journal of Purchasing & Supply Management*, *7*(1), 61-73.

APPENDICES

Appendix I. Questionnaire

Dear Respondent,

RE: REQUEST TO FILL THE ATTACHED QUESTIONNAIRE

I am PHD student of JKUAT pursuing a doctorate course in the School of Business and Economic. I am currently on research work and would like to request your assistance to fill the attached questionnaire. The questionnaire has been designed to gather information on the "**EFFECTS OF GREEN SUPPLY CHAIN ADOPTION ON THE PERFORMANCE OF AGRI-MANUFACTURING FIRMS IN RWANDA"**, The information you will present was entirely for academic and learning purposes and was treated with utmost confidentiality.

Thank you.

SECTION A: DEMOGRAPHIC INFORMATION

In this section the study would like you to provide some background information about yourself.

Kindly tick (✓) appropriately where necessary.

How many employees does the firm have ……?

How many years has the firm been in operation……?

SECTION B: INTERNAL ENVIRONMENT MANAGEMENT PRACTICES

In this section the study is interested in your view about internal environment management practices. Read each of the statements carefully and tick the appropriate choice.

Key SA- Strongly Agree, A- Agree, N- Neutral, D- Disagrees, SD – Strongly Disagree

	INTERNAL ENVIRONMENT MANAGEMENT PRACTICES	**SA**	**A**	**N**	**D**	**SD**
IEM1	The firm senior managers are committed to GSCM					
IEM2	The firm mid-level managers support for GSCM					
IEM3	The firm has teams responsible for environmental improvements					
IEM4	The firm has total quality environmental management					
IEM5	The firm has ISO 14001 certification for complying with environmental compliance and auditing programs					
IEM6	The firm has environmental management systems					
IEM7	The firm emphasizes for Eco-labeling of Products					
IEM8	The firm support for environment regulations					

SECTION C: GREEN PURCHASING

In this section the study is interested in your view about External environment management practices. Read each of the statements carefully and tick the appropriate choice.

Key: SA- Strongly Agree, A- Agree, N- Neutral, D- Disagrees, SD – Strongly Disagree

	Green purchasing	SA	A	N	D	SD
GP1	The firm provide design specification to suppliers that include environmental requirements for purchased item					
GP2	The firm cooperate with its suppliers for environmental objectives through sharing ideas					

GP3	The does auditing on environmental for suppliers' internal management					
GP4	The deals with Suppliers' with ISO1400 certification					
GP5	The firm cooperate with customers for cleaner production					
GP6	The firm cooperate with customers for green packaging					

SECTION D: ECO DESIGN PRACTICES

In this section the study is interested in you view about Eco design practices. Read each of the statements carefully and tick the appropriate choice.

Key SA- Strongly Agree, A- Agree, N- Neutral, D- Disagrees, SD – Strongly Disagree

	Eco design practices	SA	A	N	D	SD
ED1	The firm design its products for reduced consumption of material/energy					
ED2	The firm design its products for reuse, recycle, recovery of material, component parts					
ED3	The firm design its products to avoid or reduce use of hazardous of products and/or their manufacturing process					
ED4	The firm design its product for support regulation					
ED5	The firm design its products that weight and the least capacity for decrease taking time, the area stores, and the energy between the transportation leas					
ED6	The firm design it is the products to be easy set up for the users in the most energy saving way					
ED7	The firm design usability of part particularly for extend using products, repair easy and increase efficiency					

SECTION E: INVESTMENT RECOVERY

In this section the study is interested in your view about Investment Recovery. Read each of the statements carefully and tick the appropriate choice.

Key SA- Strongly Agree, A- Agree, N- Neutral, D- Disagrees, SD – Strongly Disagree

	Investment Recovery	**SA**	**A**	**N**	**D**	**SD**
IR1	The firm sales its excess inventories/materials					
IR2	The firm sales its scrap and used materials					
IR3	The firm sales its excess capital equipment					
IR4	The firm does recycle some of its used products					
IR5	The firm Collect and recycle end-of-life products and materials					
IR6	The firm has Established a recycling system for used and defective product					

SECTION F: INSTITUTIONAL PRESSURE

IP1	Local environmental laws put pressure on our GSCM.					
IP2	The environmental protection demands from our domestic customers put increasing pressure on our GSCM.					
IP3	The increase of environmental awareness of the society boosts pressure on our GSCM.					
IP4	The collaboration in environment with our suppliers boosts pressure on our GSCM.					
IP5	The improvements in developing green products of our suppliers boost pressure on our GSCM.					
IP6	The improvements in products green packaging of our suppliers boost pressure on our GSCM.					
IP7	The green strategy of the manufacturers who produce the same products as we boost pressure on our GSCM					
IP8	The green strategy of the manufacturers who produce the substitute products as we boost pressure on our GSCM.					
IP9	The requirements of green development from the industry association boost pressure on our GSCM.					

SECTION G: **SUPPLY CHAIN PERFORMANCE**

In this section the study is interested in your view about supply chain performance. Read each of the statements carefully and tick the appropriate choice.

Key SA- Strongly Agree, A- Agree, N- Neutral, D- Disagrees, SD – Strongly Disagree

	supply chain performance	**SA**	**A**	**N**	**D**	**SD**
SCP1	The ability to customize product to meet specific customer demand					
SCP2	The firm has customer responsiveness flexibility					
SCP3	The firm has low percentage of defects					
SCP4	The firm has high percentage of finished goods in transit					
SCP5	There is efficiency of purchase order cycle time					

SECTION I: Supply Chain and Agribusiness in RWANDA

1. What do you suggest as a proper way of supply chain handling using green practices in agribusiness industry in Rwanda?
2. Where do you see the weakness in incorporating green practices in supply chain in agribusiness industry in Rwanda?

THANK YOU.

Appendix II: Agro-Processing Firms in Rwanda

S/N	COMPANY	PRODUCT/ BRAND	LOCATION	CONTACT
1.	ABDC	Honey	Nyarugenge District	Tel:(+250)788 355 616 E-mail: apibusiness2010@yahoo.fr
2.	ADMA International Ltd	Biscuits	Gasabo District	Tel:(+250)788 307 171 E-mail: info@admarwanda.com
3.	AFRICA IMPROVED FOODS Ltd.	SUPER CEREAL PLUS; NOOTRI TOTO; NOOTRI MAMA; NOOTRI FAMILY; SHISHA KIBONDO	Gasabo District	Tel:(+250) 788 389 517 E-mail: info@africaimprovedfoods.com
4.	AGAHEBUZO DRINKINGS Ltd	Ikaze iwacu Banana Based Alcoholic Beverage; Isonga Banana Based Alcoholic Beverage	Gasabo District	Tel:(+250) 788 536 434 E-mail: duschant2017@gmail.com
5.	AGASHINGURACUMU	Umunara urwagwa Mucyurabohoro Butunda Izimano Inkangaza	Rwamagana District	Tel:(+250) 788 505196 Email: agashinguracumultd@yahoo.com
6.	AGROPY Ltd	Tuuza Natural Spray Biretirepel insect killer Pyrethrum EWC+	Musanze District	Tel:(+250)788 384 846 E-mail: info@agropyltd.com
7.	AKANYAMUNEZA Ltd	Akanyamuneza Banana Based Alcoholic Beverage	Nyanza District	Tel:(+250) 788 751286 Email: bagambachristo@gmail.com
8.	BAKHRESA Grain Milling Rwanda Ltd	Azam Special Bakers Flour; Azam Cake Flour; Azam White Gold Flour; Azam Biscuit Flour; Azam Ngano Bora Plus Flour; Azam Atta Flour; Azam Brown Flour;	Gasabo District	Tel:(+250) 788 381 498 E-mail: bgmrwanda@bakhresa.com

		Azam Pattent Flour; Azam Home Baking Flour		
9.	BLESSED DAIRIES Ltd	Fermented Milk; Unsalted Butter. Mozzarella Cheese; Strawberry Flavoured Yoghurt; Vanilla Flavoured Yoghurt; Pineapple Flavoured Yoghurt Plain Yoghurt; Fresh Cream	Gicumbi District	Tel:(+250)788 652 783 E-mail: info@blesseddairies.com
10.	BRALIRWA Ltd	Primus Beer; Amstel Beer; Legend Beer Mützig Beer; Turbo King beer; Coke Coke Zero; Sprite; Fanta Fiesta; Fanta Citron; Fanta Orange; Stoney Tangawizi; Vital'o Eau Gazeuse	Rubavu & Kicukiro Districts	Tel:(+250) 252 587 200 E-mail: bralirwa@heineken.com
11.	BURERA DAIRY Ltd	Burera Fermented milk; Burera Processed cheese	Burera District	Tel:(+250)788 302 613 E-mail: umurungip@yahoo.com
12.	CAFERWA Ltd	Tora Roasted coffee beans. Tora Roasted ground coffee	Nyarugenge District	Tel:(+250) 788 562 663 E-mail:info @caferwa.com
13.	CARMEL SAINTE THERESE DE JESUS	La Carmela Delice Mango Wine La Carmela Delice Strawberry La Carmela Delice Jackfruit Wine La Carmela Delice Gooseberries La Carmela Delice Banana Wine La Carmela Delice Grape Wine	Nyarugenge District	Tel:(+250) 782 172 025 E-mail: carmel_kig@yahoo.fr

14.	CENTRE CANA	Vin de Maracuja Vin d'Ananas Vin de Banane	Rusizi District	Tel:(+250) 785 813 602 E-mail: centrecana@yahoo.fr
15.	CETRAF Ltd	Musanze Wine No.1 (Ginger flavoured wine) Musanze Banana Based Alcoholic Beverage	Musanze District	Tel:(+250)788 854 098 E-mail: cetrafltd@gmail.com
16.	COOPEDUSH Ltd	Passion Nectar Passion Squash	Karongi District	Tel:(+250)788 606 564 E-mail: dushishe@yahoo.fr
17.	COPROVIBA	Ibanga Banana Based Alcoholic Beverage	Ngoma Distcrict	Tel:(+250) 787 520 216 E-mail: coproviba@gmail.com
18.	CRYSTAL INDUSTRIES Ltd.	Crystal Citrus Flavoured Drink Crystal Orange Flavoured Drink Crystal Cola Flavoured Drink Crystal Apple Flavoured Drink	Bugesera District	Tel:(+250)788 300 017 E-mail: kam_charles@yahoo.co.uk
19.	DUSANGIRE PRODUCTION Ltd	Amahumbezi Urwagwa Agasembuye Inkangaza	Bugesera District	Tel:(+250) 788 853 089 E-mail: mugaba07@gmail.com
20.	EAST AFRICAN FOODS & BEVERAGES Ltd	Joy Strawberry FlavouredYoghurt Joy Natural/Plain Yoghurt; Joy Vanilla Flavoured Ice Cream; Joy Strawberry Flavoured Ice cream; Joy	Kicukiro District	Tel:(+250) 726 445 335 E-mail: eastafricanfoods

		Chocolate Flavoured Ice Cream; Joy Mango Flavoured Ice Cream		@gmail.com
21.	EMMERI Ltd	Iwacu-Inkangaza Intango-Butunda Umutako Urwagwa Rusanzwe	Gasabo District	Tel:(+250) 787 195 126 E-mail: mukacatheline10 @gmail.com
22.	FARM FRESH FOOD COMPANY LTD	Farm Fresh Mixed Beans Farm Fresh High Iron Beans	Gasabo District	Tel:(+250)781 285 042 E-mail: info@farmfresh.rw
23.	FROMAGERIE LA LUMIERE	Ikimuri Gouda Cheese (Non-coloured)	Musanze District	Tel:(+250)788305430 E-mail: mteoneste@yahoo.fr
24.	FUMBWE MULTI SECTORIAL FARM (FMSF) Ltd	Indatwa Fermented Milk Indatwa Vanilla Yoghurt Indatwa Strawberry Yoghurt Indatwa Fresh Cream	Rwamagana District	Tel:(+250) 788 304 525 E-mail: indatwadairyfarm @yahoo.com
25.	GABI Ltd	FHIA Banana Based Alcoholic beverage	Gisagara District	Tel:(+250)788 522 592 E-mail: gabilimited2014@gmail.com
26.	GISHWATI FARMS Ltd	Gishwati Farms fermented milk. Gishwati Farms Strawberry Flavoured Gishwati Farms Gouda Cheese Gishwati Farms Mozzarella Cheese	Rulindo District	Tel:(+250) 788 465 258 E-mail: kageruka10emmanuel100@gmail.com
27.	GLOBAL TRADING IMPEX	SERENA NICE CREAM Mango Flavored	Kicukiro	Tel:(+250) 788 300 979

	Ltd	SERENA NICE CREAM Strawberry SERENA NICE CREAM Passion fruit Flavored; SERENA NICE CREAM Coffee taste Flavored; SERENA NICE CREAM Chocolate taste; SERENA NICE CREAM Vanilla taste Flavored	District	E-mail: wtomini@hotmail.com
28.	GREEN FOOD LTD	Imena Fermented milk Imena Strawberry Yoghurt Imena Vanilla Yoghurt	Gasabo District	Tel:(+250) 788 306 441 E-mail: mugy5@yahoo.fr
29.	GREEN HARVEST PRODUCTS Ltd	Sabana Ketchup Sabana Classic Chili Sauce Sabana Gold Chili Sauce	Kicukiro District	Tel:(+250) 786 483 539 E-mail: greenharvestproducts@gmail.com
30.	HOLLANDA FAIR FOODS Ltd	Winnaz Potato Crisps	Musanze District	Tel:(+250)789 055 892 E-mail: info@winnazworld.com
31.	IHURIRO UBWIZA BWA NYUNGWE	Ubuzima Honey	Nyamagabe District	Tel:(+250) 788 846 664 E-mail: mukantwarimdiatrice@yahoo.fr
32.	INDAKEMWA Ltd.	Indakemwa Urwagwa rw'Ibitoki (Butun da)	Kicukiro District	Tel:(+250)788 532 355 E-mail: indakemwa@gmail.com
33.	INEZA AYURVEDIC Ltd	Meraneza Ginger Flavoured Wine	Musanze District	Tel:(+250) 784 863 030 E-mail: inezaayurvedic@gmail.com
34.	INGABO DAIRY Ltd	Strawberry Flavoured Yoghurt; Vanilla Flavoured Yoghurt; Gouda cheese; Unsalted butter	Nyabihu District	Tel:(+250) 788 730 063 E-mail: ingabocheese@yahoo.com

35.	INSTITUT ATHOLIQUE DE KABGAYI	Banana Juice of Kabgayi Butunda of Kabgayi	Muhanga District	Tel:(+250)788 478 500 E-mail: recteur@uck.ac.rw
36.	INYAMAMARE Ltd	Inyamamare Banana Based Alcoholic Beverage	Gisagara District	Tel:(+250) 785056215 E-mail: inyamamare1@gmail.com
37.	INYANGE INDUSTRIES Ltd	Inyange UHT Milk; Inyange UHT Low-Fat Milk; Inyange Ikivuguto Cultured Milk; Inyange Strawberry yoghurt. Inyange Vanilla yoghurt; Inyange Butter Inyange Orange based soft Drink; Inyange Mango based soft drink; Inyange Strawberry based soft drink. Inyange fruit cocktail soft drink. Inyange Pineapple juice, Inyange Apple; juice, Inyange Orange juice; Inyange Passion fruit nectar; Inyange Mango nectar	Gasabo District	Tel:(+250) 788 161 900 E-mail: info @inyangeindustries.com
38.	IPFG Ltd	Komezubuzima Composite Flour Komezubuzima Roasted Soybean Flour	Nyamagabe District	Tel:(+250)785 762 446 E-mail: ipfg2002@yahoo.fr
39.	IRUZU COMPANY Ltd	1000 Hills Whisky 1000 Hills Vodka 1000 Hills Gin 1000 Hills Rum	Kicukiro District	Tel: (+250) 788 313 399 Email: d.hogan@1000hills.com

40.	KABUYE SUGAR WORKS Ltd.	Kabuye Brown Sugar	Gasabo District	Tel:(+250) E-mail: gm@kabuyesugar.com
41.	KIGALI FARMS Ltd	Button Mushroom Crimini Mushroom Portobello Mushroom	Musanze District	Tel:(+250) 786 592 815 E-mail: penelope@kigalifarms.com
42.	MASAKA CREAMERY Ltd	Masaka Farms Strawberry Yoghurt Masaka Farms Vanilla Yoghurt Bonjour Strawberry Fruit Yoghurt Bonjour Vanilla Flavoured Yoghurt Masaka Farms Plain Yoghurt	Gasabo District	Tel:(+250)789 911 244 E-mail: jon@masakacreamery.com
43.	MIG	Nyungwe Highland Honey	Nyamagabe District	Tel:(+250) 789 892 748 E-mail: migltd2004@yahoo.fr
44.	MIKOANI TRADERS td.	Azania special baking flour premium Azania home baking powder flour Azania super flour	Gasabo District	Tel:(+250)783 813 559 E-mail: mpagaze.jerome@yahoo.com
45.	MUHANGA FOOD PROCESSING INDUSTRIES Ltd	TUNGUMUBIRI Composite flour	Muhanga District	Tel:(+250)788 530 710 E-mail: cocofuta@yahoo.com
46.	MUKAMIRA DAIRY Ltd	Pasteurized Milk	Nyabihu	Tel:(+250) 788 125 007

		Fermented (Cultured) Milk (Ikivuguto)	District	E-mail: mukamiradairies2017@gmail.com
47.	NORELGA MACADAMIA RWANDA	UTAMU Roasted Peanuts UTAMU Peanuts Butter Wihangire macadamia roasted nuts	Kicukiro District	Tel:(+250)788 561 860 E-mail: norce1969@gmail.com
48.	NSHILI KIVU TEA FACTORY LTD	Black Tea (CTC Black Tea)	Nyaruguru District	Tel:(+250)788 308776 E-mail: jayasekera.vj@yahoo.com
49.	NYANZA MILK INDUSTRIES Ltd	Fermented Milk Strawberry yoghurt Mixed Fruit flavor yoghurt	Nyanza District	Tel:(+250) 788 754 842 E-mail: ermexk@gmail.com
50.	PEMBE FLOUR MILLS RWANDA	Pembe Home Baking Flour Pembe Special Bakers Flour Pembe Special Andazi Flour	Gicumbi District	Tel:(+250) 788 307 072 E-mail: hakim@pemberwanda.com
51.	RWANDA FARMERS COFFEE COMPANY Ltd	Gorilla Roasted Coffee Beans	Kicukiro District	Tel:(+250) 788 635 676 E-mail: Emmanuel.m@gorillascoffee.com
52.	RWANDA NUT COMPANY Ltd	The Hills Roasted Macadamia	Kicukiro District	Tel:(+250) 787 888 767 E-mail: momoko.harada@organic-solutions.jp
53.	RWANDA TEA PACKERS Ltd	Black Loose Tea Black Tea bags Green Loose Tea	Kicukiro District	Tel:(+250)788 302 537 E-mail: accounts@rwandateapackers.com

		Green Tea bags		
54.	SHEKINA Ltd.	Akeza Millet flour Akeza Cassava flour Akeza Ground Cassava Leaves	Rulindo District	Tel:(+250)788 592 198 E-mail: sheki05 @yahoo.fr
55.	SKOL BREWERY Ltd	Skol Malt Beer, Skol Lager Beer, Skol Gatanu Beer, Skol Export Beer, Virunga Mist Beer, Virunga Gold Beer, Panache Lemon Beer, Panache Passion Beer	Nyarugenge District	Tel:(+250)788 381 640 E-mail: info@skolbrewery.rw
56.	SORWATHE Ltd	Strong Black Tea Light Black Tea Orthodox Tea (Long leaf) Green Tea	Rulindo District	Tel:(+250) 0788 302 645 E-mail: sorwathe@gmail.com
57.	SPERANZA GROUP LTD	Speranza Waragi Super Gin Ordinary Super Gin No.1 Millenium Hills Whisky Blue Hills Vodka Speranza Coffee rum	Gasabo District	Tel:(+250)788301623 E-mail: speranza963@gmail.com
58.	THE APIARY PTE Ltd.	Hillside Honey	Kicukiro	Tel:(+250)785 269 755

59.	TUZAMURANE COOPERATIVE	Akagera Dried pieneapples	Kirehe District	Tel:(+250) 788 613 618 E-mail: tuzamurane09@yahoo.fr
60.	UMURAGE ENTERPRISE Ltd	Heritage (Ginger flavoured wine) Umurage Banana and Pineapple drink (Banana Based Alcoholic Beverage)	Musanze District	Tel:(+250) 786 308 709 E-mail: umurage02@gmail.com
61.	UNICOAPIGI	Ibengeza Honey	Rubavu District	Tel:(+250) 788 804 604 E-mail: unicoapigi@yahoo.fr
62.	UNICOOPAV	Virunga Honey	Burera District	Tel:(+250)784 113 940 E-mail: unicoopav@yahoo.fr
63.	URUGO WOMEN'S OPPORTUNITY CENTER	Urugo Vanilla Yoghurt Urugo Strawberry Yoghurt	Kayonza District	Tel:(+250)788 350 577 E-mail: info@urugowoc.com
64.	URWIBUTSO ENTERPRISE	Ayera Pasteurized milk, Ayera Fermented milk, Akaryoshye Strawberry Yoghurt, Akarusho Banana Based Alcoholic Beverage, Agashya Strawberry Squash, Agashya Passion Fruit Squash, Agashya Pineapple Squash, Agashya Strawberry Based Soft Agashya Passion Based Soft Drink Agashya Pineapple Based Soft, Akandi packed mineral water, Pain Coupé. Pain Sanduich, Pain Croissant	Rulindo District	

		Pain Français, Akarabo Wheat flour biscuit, Akarusho dry white wine Akarusho Sweet Red Wine, Akarusho Dry red Wine, Akarusho Sweet white Wine, Akacu Hot Ketchup, Akacu Ketchup, Akiwacu Strawberry Jam Akarabo Golden Power biscuit		
65.	VOICE OF CALLING	Ubuki bw'iwacu I Rwanda	Kicukiro District	Tel:(+250)788 408 383 E-mail: cecilose11@yahoo.fr
66.	ZAMURA FEEDS Ltd	Broiler Starter Feeds Broiler Finisher Feeds Layer Feeds Pullet grower feeds Dairy Cattle feeds	Musanze District	Tel:(+250)788 318 870 E-mail: zamurafeeds@gmail.com
67.	ZIRAKAMWA MEZA NYANZA DAIRY Ltd	Natural Fermented Milk Strawberry Delight Yoghurt Vanilla Delight Yoghurt	Nyanza District	Tel:(+250)788520606 E-mail: mkayi2020@yahoo.fr

Based on RSB, 2019