THE INFLUENCE OF SUPPLY CHAIN LOGISTICS ON FOOD WASTAGE IN KENYA: PERSPECTIVES OF SELECTED SUPPLIERS IN NAIROBI'S WESTERN PRECINCTS

BY

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SUMMER 2017
STUDENT’S DECLARATION

I, the undersigned, declare that this is my original work and has not been submitted to any other college, institution or university other than the United States International University-Africa for academic credit.

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ABSTRACT

The purpose of the study was to determine the effect of supply chain logistics on food wastage in Kenya. The research questions were; what is the influence of inbound logistics on food wastage in Kenya? What is the influence of operations on food wastage in Kenya? What is the influence of outbound logistics on food wastage in Kenya?

Descriptive research design was used. Census sampling method was used due to the small size of the target population. Thus, the sample size was 51 suppliers, representing 100 percent of the population size. Data was collected using a structured questionnaire. The data was analyzed by computing the mean and standard deviation scores. Inferences were drawn using Spearman’s Rank Correlation Coefficient technique. Data was analyzed using SPSS and presented in figures and tables.

The major findings of the study revealed that regarding the influence of inbound logistics on food wastage in Kenya, a weak negative correlation was obtained between inbound logistics and food wastage. Top in the list of challenges respondents associated with inbound logistics was poor quality products and delivery delays.

Concerning the influence of operations on food wastage in Kenya, a weak negative correlation was obtained between operations and food wastage. The greatest challenge identified by most of the respondents was inadequate storage facilities, followed by high equipment cost and maintenance and incompetent staff/poor food handling. The respondents identified pests and rodents, high storage costs and overstaying with products as the most challenging aspects of supply chain operations.

As pertains the influence of outbound logistics on food wastage in Kenya, a weak negative correlation was obtained between outbound logistics and food wastage. Maintaining customer quality standards was identified by most of the respondents as the greatest challenge, followed by delays of goods while in transit to customers.

In conclusion, inbound logistics had a negative influence on food wastage since it accounted for the highest proportion of post-harvest food wastage in the fruits and vegetable supply chain in Nairobi’s western precincts. Operations also negatively influenced food wastage mainly due to the challenge of inadequate storage facilities and infrastructure. The traders lacked cold storage facilities suitable for the fruits and vegetable trade they engaged in and those that were at their disposal were inadequately equipped to
prevent food wastage. Outbound logistics similarly had a negative influence on food wastage. This was potentially caused by delays in processing and delivery of customer orders and failing to fulfill deliveries according to customer requirements and specifications.

It was recommended that the traders pursue backward integration to have better control of inbound logistics in order to minimize wastage associated with inbound fruits and vegetable handling and delivery quality. Firms that are not able to integrate this way should form strategic partnerships and information collaboration with upstream supply chain actors in order to enhance the efficiency of inbound logistics. The installation and enhancement of properly equipped storage facilities in Nairobi’s western precincts as well as recruitment and training of competent food handlers is also recommended. Given the potentially high capital outlay required to set up a suitable storage facility single-handedly, the intervention of development partners as well as involvement of government would go a long way in facilitating post-harvest supply chain players in Nairobi’s western precincts towards reducing unnecessary food waste by slowing down the ripening process. Another study should investigate the supply chain logistics associated with food waste among last mile distributors such as supermarkets, fruits and vegetable vendors, and other players in the value addition process such as restaurants and salad stores.
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<tr>
<td>FAO</td>
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<td>GDP</td>
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<td>Statistical Package for the Social Sciences</td>
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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study
Supply chains refer to networks of companies that work together and coordinate their actions to deliver a product to a market (Hugo, 2010). Another conceptualization of supply chain is that it is a set of more than three companies from supplier to customer that include factories, warehouses, retailers and end customers depending on the complexity and the maturity of the chain (Haasis, Kreowski, & Scholz-Reiter, 2008). Supply chain management views the supply chain and the organizations in it as a single entity. It brings a systems approach to understanding and managing the different activities needed to coordinate the flow of products and services to best serve the ultimate customer (Hugo, 2010). Its activities encompass the planning and managing of demand, and the organization supply, involving the holding and moving of stock, with value addition at each step across the supply chain (Chandrasekaran & Raghuram, 2014).

Supply chain management refers to the integration of supply and demand management within and across supply chain members (Thomas, 2011). According to Hugo (2010), companies in any supply chain must make decisions, individually and collectively, regarding their actions in five areas. The first is production, which takes into account plant capacities, workload balancing, quality control and equipment maintenance. The second is inventory and this addresses the optimal inventory levels and reorder points. The third is location, which answers the question of where facilities for production and storage can be cost efficiently located. The fourth is transport, which involves movement of inventory from one supply chain location to another. The last is information which is concerned with providing clarity about where to locate inventory and how best to transport it, among others.

The necessity of collective decisions regarding the five areas identified by Hugo (2010) calls for the strategic partnering of various supply chain actors as well as a controlled sharing of business data and processes to optimize supply chain profits (Chandrasekaran & Raghuram, 2014). This is derived from the realization that if each actor in the supply chain
tries to optimize its own operations in isolation, the entire supply chain members suffer in the long run (Kerber & Dreckshage, 2011).

According to Chandrasekaran and Raghuram (2014), the management of food wastage is one of the major challenges facing supply chain management in the agricultural sector. Food wastage is a composite term that includes both food loss and food waste, whereby loss results out of deterioration in quantity and quality of food or waste as a result of food being discarded (Kiaya, 2014). Quality losses include those that affect the nutrient/caloric composition, the acceptability, and the edibility of a given product whereas quantity losses refer to those that result in the loss of the amount of food (Kitinoja & Gorny, 2010). The problem of food wastage has been the subject of a duality of approaches depending on the angle of interest: either with the associated environmental concerns, in which case, a food waste perspective predominates, or with the associated food security concerns, whereby the angle of interest in food security assumes prominence (Food Aid Organization, 2014).

The duality of approaches to the problem of food wastage has had implications on the definition and scope of food wastage, with the terms food loss and food waste assuming distinct definitions (FAO, 2014). Lipinski, Hanson, Lomax, Kitinoja, Waite and Searchinger (2013) provided a simplified definition of the two terms that helps put an understanding of the problem of food wastage into perspective. In their view, food loss refers to food that spills, spoils, incurs an abnormal reduction in quality such as bruising or wilting, or otherwise gets lost before it reaches the consumer. They distinguish this definition from food waste, which they construe to mean food that is of good quality and fit for human consumption but that does not get consumed because it is discarded – either before or after it spoils.

Notwithstanding the duality inherent in the definition of food loss and food waste that, according Food Aid Organisation (FAO) (2014), adds confusion to the efforts towards curbing the problem of food wastage, reducing food loss and waste has assumed primary importance in the global food security debate, environmental sustainability and economic development agenda. The United Nation has set a goal of halving worldwide food wastage by 2030 as part of its Sustainable Development Goals (SDG) agenda (Sheahan & Barrett, 2016).
The increased attention and visibility accorded to food wastage is because food wastage has an impact on the environment, food security, food safety and economic development (FAO, 2014). According to the Rockefeller Foundation (2013), over one billion people are at risk of food insecurity. Meanwhile, just 43% of the fruit and vegetables produced are consumed globally while the remaining 57% is wasted (FAO, 2012). Lipinski et al. (2013) estimated that if the current rate of food loss and waste were cut in half, by the year 2050, the world would need about 1,314 trillion kilocalories representing about 22% less food per year than it would if the status quo continues.

Economically, food wastage represents a wasted investment that can reduce farmers’ incomes and increase consumers’ expenses (Lipinski et al., 2013). The results of a study commissioned by the FOA showed that roughly one-third of food produced for human consumption is lost or wasted globally, which amounts to about 1.3 billion tons per year (FAO, 2011). The monetary value of this wastage is estimated at nearly one trillion US dollars (FAO, 2012). The direct economic cost of food wastage of agricultural products based on producer prices only is about 750 billion dollars, equivalent to the gross domestic product (GDP) of Switzerland (FAO, 2013).

Environmentally, food wastage is responsible for a host of adverse effects on the environment including unnecessary greenhouse gas emissions and inefficiently used water and land, which in turn can lead to diminished natural ecosystems and the services they provide (Lipinski et al., 2013). Post-harvest losses and discarded foodstuffs are a waste of the resources used in food production, such as fertilizer, pesticides, land, water and labour. Pedrick and Stuart (2012) estimated that the water used globally for irrigation to grow food that is wasted would meet the domestic needs of 9 billion people. Preventing food wastage reduces the use of resources required for food production, labour and disposal costs, and reduces all the environmental, economic and social impacts linked to food waste disposal (FAO, 2013).

According to FAO (2014), the distribution of food wastage along the food chain varies greatly by region and product. Statistics suggest that food wastage in industrialized countries is as high as in developing countries, but in developing countries more than 40% of the food wastage occur at post-harvest (FAO, 2011); defined as the degradation in both
quantity and quality of a food production from harvest to consumption (Kiaya, 2014). Collectively, upstream stages in the food value chain from production, processing and distribution account for nearly 65% of food wastage in developing countries (FAO, 2012). In contrast, most of the food wastage in middle and high-income countries occur at distribution and consumption (FAO, 2014). In addition, quality losses are generally more common in developed economies whereas quantity losses more common in developing countries (Kitinoja & Gorny, 2010).

According to FAO (2011), the causes of food wastage in developing economies are mainly connected to financial, managerial and technical limitations in harvesting techniques, storage and cooling facilities in difficult climatic conditions, infrastructure, packaging and marketing systems (FAO, 2011). For example, Kiaya (2014) identified biological spoilage as the main cause of food wastage in developing countries, with livestock products, fish, fruit and vegetables losing value very quickly without refrigeration. Parfitt, Barthel and Macnaughton (2010) explain that most of the rural poor rely on short food supply chains (FSCs) with limited post-harvest infrastructure and technologies while more extended FSCs feeding urban populations are likely to involve many intermediaries between growers and consumers, which may limit the potential for growers to receive higher prices for quality. Parfitt et al. (2010) further observes that farming in less developed countries is mostly small scale with varying degrees of involvement in local markets and a rapidly diminishing proportion of subsistence farmers who neither buy nor sell food staples.

In sub-Saharan Africa, lack of proper storage facilities has been identified as a major cause of post-harvest food waste as cold storage facilities are non-existent or inaccessible to the majority of smallholder farmers (FAO, 2014). In Kenya, it is estimated that more than 50% of fresh horticultural crops like banana go to waste annually at post-harvest levels due to poor storage and handling (IITA, 2010) and at 18-45% by Kitinoja and Cantwell (2010). Further, 95 million litres of milk worth an estimated US$22.4 million is wasted (Kiaya, 2014). Meanwhile, over 10 million Kenyans are designated as food insecure (Wambua, Omoke, & Mutua, 2014). Kenya Vision 2030 which is the country’s long term development policy identifies food security as the agricultural sector’s primary goal under the economic pillar. Wambua et al. (2014) studied the effect of socioeconomic factors on food security situation in Kenyan dry lands ecosystem and found that food security was a function of,
among others, the prevailing market system and infrastructural facilities. It is against this backdrop that the role of food supply chain logistics in the western precincts of Nairobi assumes particular relevance.

The history of Nairobi City dates back to 1896 when it became a depot on the railways line from the port city of Mombasa on the east coast of Africa to the east African interior in Uganda (Varma, 2011). The city is located 140 kilometres south of the equator and 500 kilometres west of the Indian Ocean in Kenya’s central highlands at the southern end of the country’s agricultural heartland (Hendricks, 2010). It is described as both the political and cultural capital as well as the national communication center by road and rail and a continental air hub – a city of rapidly growing industrial development in a location that encourages substantial migration (Coulby, Jones, & Harris, 2013). As a result, the city plays host to a population of over 3.5 million people (Solomon, 2011).

According to Sigrid, Wachira, Gladys and Schuler (2015), the Wakulima market in Nairobi is the largest terminal market handling more than half of all agricultural food supplied in Nairobi. Studies have revealed that except for the Nairobi County facility at the Wakulima market in Nairobi, storage and ripening facilities for most fruits and vegetables supplied to Nairobi are inadequate and lack electricity, water and produce handling infrastructure (FAO, 2014). The sanitary conditions of food handling in Nairobi have also been found to be deplorable (Okojie & Isah, 2014). Improvements in physical infrastructure for food supplied to the city is overdue but the efforts of the international donor community to convince the Kenya Government and the County Government of Nairobi to set up a new market terminal outside the city centre has failed (Sigrid et al., 2015).

The western precincts of Nairobi sit on high ground with rugged topography (Hendricks, 2010). The main food market terminal in this region is Dagoretti Market, an informal market where most of the fruits and vegetables and other food supplied from the western parts of Kenya first arrives (Roesel & Grace, 2014). This market faces many challenges including inadequate trading space, inadequate sanitary facilities and inadequate storage facilities for the agricultural products (Roesel & Grace, 2014).
1.2 Problem Statement

Post-harvest food wastage accounts for the largest share of food waste, with 90% of wastage occurring within the post-harvest food value chain (Rockefeller Foundation, 2013). Reduction of food wastage at post-harvest stage forms not only a strategic component of ensuring future global food security but also enhancing economic development through increased business performance of enterprises in the food supply chain (FAO, 2014). Both the private and public sectors need to increase investments in infrastructure, transportation, processing and packaging (FAO, 2013). For example, private sector investments can improve storage and cold chain facilities as well as transportation (FAO, 2011). To this end, the strategic investment in effective and efficient supply chain logistics would make an important positive contribution to increasing food security and economic development.

The extent to which supply chain management can contribute to reducing post-harvest food wastage in Kenya is far from clear. This proposed study is a response to a call by Pedrick and Stuart (2012) for more research on post-harvest techniques likely to provide an incentive to cutting wastage suggesting that more information about sound post-harvest practices is needed. Food wastage in Kenya is critical because of the perennial problem of food insecurity in the country. However, very little is known about the contributory role of supply chain logistics in solving the problem of food insecurity facing Kenya. This study sought to fill the knowledge gap on postharvest supply chain management in Kenya by investigating the state of postharvest supply chain logistics within Nairobi’s western precincts.

1.3 Purpose of the Study

The purpose of the study was to determine the effects of supply chain logistics on food wastage in Kenya.

1.4 Research Questions

1.4.1 What is the influence of inbound logistics on food wastage in Kenya?
1.4.2 What is the influence of operations on food wastage in Kenya?
1.4.3 What is the influence of outbound logistics on food wastage in Kenya?
1.5 Significance of the Study

This research might be of importance to the following stakeholders:

1.5.1 Enterprises in the Food Supply Chain

Intermediaries at postharvest food supply chain within Nairobi’s western precincts would gain from the findings of this study in identifying the related supply chain logistics gaps that could be addressed to increase efficiency of their business processes.

1.5.2 Government

The government of Kenya, represented by the Ministry of Agriculture and other related government agencies would have an illumination of the infrastructural development needs of the sector that can contribute to prevention and reduction in food wastage.

1.5.3 Development Partners

The study provides evidence-based data that development partners can use to appropriate development resources towards the attainment of global food security goals. This includes focal points in the postharvest food supply chain that merit prioritization.

1.5.4 Prospective Investors

The study identifies postharvest investment opportunities related to supply chain management that could be tapped at a profit through value addition in areas of warehousing, storage and product handling.

1.5.5 Academia

The academic community in Kenya who wish to extend studies on postharvest supply chain logistics can use the study as a reference point. The study enhances development of theoretical knowledge on suitable supply chain management practices applicable to perishable agricultural products.
1.6  **Scope of the Study**

The focus of the study was food wastage at postharvest stage. Specifically, the research was limited in scope to inbound logistics, process and outbound logistics of selected suppliers located in Nairobi’s western precincts. This region is characterized by high population growth as the city expands all over to its peri-urban outskirts. Many inhabitants of this region practice subsistence farming and accounts for a significant share of the food supplied at its main market terminal called Dagoretti Market. Data was collected in the month of May 2017. The diversity of food wastage and different types of foods wasted reduces the chance to undertake a deep analysis of the food waste problem. Reference was made to perishable agricultural products with a bias to fruits and vegetables.

1.7  **Definition of Terms**

1.7.1  **Food wastage**

Food lost out of deterioration in quantity and quality of food or waste as a result of food being discarded (Kiaya, 2014).

1.7.2  **Food waste**

Food of good quality and fit for human consumption but that does not get consumed because it is discarded – either before or after it spoils (Lipinski et al., 2013).

1.7.3  **Food loss**

Food that spills, spoils, incurs an abnormal reduction in quality such as bruising or wilting, or otherwise gets lost before it reaches the consumer (Lipinski et al., 2013).

1.7.4  **Supply chain**

Processes that comprise physical, informational, financial and knowledge flows intended to satisfy end-user requirements with physical products and services from multiple, linked suppliers (Ayers & Odegaard, 2007).
1.7.5 **Supply chain logistics**

The organization, planning, implementation and control of the acquisition, transport and storage activities from the purchase of raw materials up to delivery of finished products to the customers (Taylor, 2007).

1.7.6 **Value chain**

A chain of activities for transforming inputs into outputs that customers value (McIvor, 2005).

1.7.7 **Inbound logistics**

Activities associated with receiving, storing, and disseminating input to the product, such as materials handling, warehousing, inventory control, vehicle scheduling and returns to suppliers (Sekhar, 2009).

1.7.8 **Operations**

Activities associated with transforming input into the final product such as machining, packing, assembly, equipment maintenance, testing, printing and facility operations (Sekhar, 2009).

1.7.9 **Outbound logistics**

Activities related to collecting, storing and physically distributing the product to buyers, such as finished goods warehousing, material handling, delivery vehicle operation, order processing and scheduling (Sekhar, 2009).

1.8 **Chapter Summary**

This chapter has presented the broad background to the study including the global, regional and local perspectives. It has also stated the problem, the purpose of the study and research questions. It has further explained the scope of the study, discussed its significance to various stakeholder groups and defined key terms. Chapter two presents the literature review. Chapter three described the methodology used. Chapter four presents the study findings. Lastly, chapter five summarizes the study, discusses the findings and draws conclusions and recommendations.
CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction
This chapter reviews related literature with respect to the topic of study. The chapter presents a review of the conceptual literature on inbound logistics, operations and outbound logistics and contextualizes the literature to the problem of food wastage. A critical review of management thought and empirical literature on the same is made. A summary of the literature review is provided at the end of the chapter.

2.2 Inbound Logistics and Food Waste
Inbound logistics involves the movement of raw materials into the firm (Lai & Cheng, 2016). It is one of the primary processes of logistics, concentrating on purchasing and arranging the inbound movement of farm outputs from suppliers to warehouses or retail stores (Joshi, 2013). From a value chain perspective, the activities that characterize inbound logistics include the buying process, receiving, warehousing and cold storage (Sekhar, 2009). The function of inbound logistics is to satisfy the operations needs of service operations line by meeting the needs of a firm for inbound items in an orderly, efficient and low-cost manner (Lai & Cheng, 2016). Distributors frequently distinguish between inbound logistics, the movement of raw materials, unfinished products and other goods from a supplier whereby for foodservice and retail distributors, inbound logistics is an essential topic that covers how food is brought from the farm or manufacturer to a restaurant, grocery store or buyer before reaching the final consumer (Rogoff, 2014).

2.2.1 Buying process
According to Takika and Leite (2016), inbound logistics commences with the buying process, which they divide into three parts: purchase requisition, request for quotation and purchase order. They explain that purchase requisition authorizes the purchasing department to acquire the products and services. This requisition includes an identification of requested object, quantity, date or requested delivery schedule, how the purchase must be charged, where the product or service must be delivered and the confirmation of the personnel responsible for the approval of the purchase. Subsequently, quote request is prepared by the purchasing department and sent to suppliers that are able to meet the
requirements of cost and quality defined by the company. This includes: material specifications, purchase amount, date and delivery schedule wanted, where the product or service purchased must be delivered, and the date that the supplier chooses will be completed. Quotation requests generally ask each supplier the unit price and total price, information on whether the supplier will pay the freight cost, discounts for immediate payment, and other terms of payment, date or delivery schedule, and any special conditions of the supplier.

Takika and Leite (2016) explain that the buying process ends with a purchase order, which provides the basis of the authority of suppliers to supply the farm products, and represents the obligation of buyers to pay for the items. Purchase order forms include: the purchase order number, shipping and billing, unit price and total price, discounts for payment in cash and any special terms of purchase. After the order issue, which is the last step in purchasing process, the supplier and the owner or carrier, are contacted to align the delivery process. All these processes must be seamless to avoid delays in postharvest logistical activities. Any misstep, for example, delivery to a wrong location, can cause a chain of effects downstream that can lead to significant wastage.

Emeka (2014) argues that in order to economize all costs of materials, firms have to adopt definite method of deciding the quantity of materials to be ordered, quantity to be stored as inventory and work in progress inventory. He further asserts that in order to reduce the material cost, there has to be some efficient and effective material management techniques, which must be dynamic to adjust with changing demand and production. He goes on to delineate materials for use in manufacture as raw materials primarily from agriculture to the various extractive industries such as mineral resources, fruits and vegetables sold to processors.

Sahu, Gaur and Srivastav (2016) point out that procurement as an aspect of inbound logistics has to do with determining order quantity, work in progress, store requisition, issue of enquiries, evaluation of quotations, supplier appraisal, negotiations, placing of contracts, processing of deliveries and clarifying payments. In their view, the main logistic responsibility is to formulate a master program for the timely provision of materials, components and work-in-process. They observe that logistics including materials and
goods flowing in and out of a production facility as well as its internal handling has become very important to a firm as the companies struggle to deliver the right product at the correct place and time.

Langat, Kavale, Nduta and Yego (2015) emphasize that only if procurement does a good job and forwards order information to inbound logistics, only then operations will be able to schedule production in a way that guarantees the delivery of products in a timely and effective manner. They assert that linkages are about seamless cooperation and information flow between the value chain activities which if not properly adhered would affect supply chain agility. Efficiency and effectiveness is created not just by the focal firm in a network, but also by all the entities that connect to each other.

2.2.2 Receiving of food supplies
According to Moreno (2015), receiving of food supplies is an important next step in the logistical process of agricultural food value chain that heralds the stage at which the firm has greater control. Receiving is concerned with whether the right items procured are received at the right place and time and in the right condition. Moreno (2015) suggest that receiving practices should include preparing in advance the list of goods to be received the next day, using daily receiving report as evidence of items received, checking items received as to specification such as quality, quantity, size and weight, and recording shortages, excesses, missing items and unacceptable ones.

2.2.3 Warehousing
A warehouse is defined as a building with usually many dock doors around its sides for receiving, storing and dispatching goods (Pagcaliwagan, De Leon, De Rio, Flores, & Hornilla, 2015). Warehousing is another aspect of a firm’s logistical system, which function as a storage of agricultural food products after harvesting either as raw materials, goods in progress or finished goods (Radzi, Azmi, & Samicho, 2016). Within the post-harvest handling stages, food items can be stored from a few hours to several months depending on the product and storage conditions. Storage serves as a means to deal with time, enabling delayed marketing and consumption of the produce. This can only be realized if the storage conditions are optimized, otherwise there are significant losses. It should be noted, however, that even with the best storage conditions, the shelf life is dependent on the initial
quality and storage stability resulting from decisions made at the earlier stages of the supply chain (FAO, 2014).

According to Ramaa et al. (2012), a warehouse is a key aspect of the supply chain that consolidates products to reduce transportation cost, achieve economies of scale in manufacturing or in purchasing or provide value-added processes and shorten response time. Warehousing has also been recognized as one of the main operations where companies can provide tailored services for their customers and gain competitive advantage. The warehouse is quantified by using indicators such as total cost of storage, processing time of orders, the value of damaged goods, the percentage of space dedicated to handling the total space utilization of the deposit, the annual percentage of accidents, quantity or possible delivery units moved in an hour by a person and so on (Dinu, 2016). On this respect, Ramaa et al. (2012) classified warehouses into production warehouses and distribution centers as well as by their roles in the supply chain namely; raw materials warehouses, work-in-process warehouses, finished good warehouses, distribution warehouses, fulfillment warehouses, local warehouses direct to customer demand, and value-added service warehouses.

One of the megatrends in the study of the supply chain as identified by Alzate and Castro (2014) is the need to incorporate “green practices” in the design and management of a warehouse. This aims to avoid waste of resources during the food product life cycle, to ensure not only environmental sustainability but also more efficient operation, taking into consideration a balance with the environment as a competitive priority that generates value added for the customer. Pattnaik (2015) analyzed the supply chain management of a vegetable and fruit company and found that merchandise is assembled and space allotment is done. Vegetables and fruits are stored in open chillers with proper temperature regulations. Sophisticated large-sized, specially designed and germ resistant metallic crates are used for storing the vegetables and fruits. A weekly inspection is done under the supervision of hygiene inspector. Special fly resistant sprays and pest controlling substances are used to maintain health, hygiene and freshness. Consequently, because of such warehousing practices, vegetables and fruits, which are seasonal in nature, are available at any time unlike the local marketers and vendors. In Kenya, mango wastage has fallen from 30% to 10% due to value added processing whereby warehouse receipts
systems have proved successful in providing farmers with improved storage facilities (Pedrick & Stuart, 2012). Improvement of storage conditions has been acknowledged as a key intervention along food chains (FAO, 2014), suggesting the need for increased investment in reducing postharvest losses in developing countries (Lipinski et al., 2013).

### 2.2.4 Cold storage

Prevention is the most efficient way to deal with food wastage, as it is about limiting food wastage on the front end (FAO, 2013). The use of cold storage – short term warehousing of chilled or frozen foods – is another aspect of supply chain logistics, which is increasingly being practiced. Kitinoja (2013) identify many technical, logistical and investment challenges as well as economic opportunities related to the use of the cold chain. The primary segments of an integrated cold chain include packing and cooling fresh food products. The need for cold chain is illustrated by the author who argues that fresh foods continue to metabolize and consume their nutrients throughout their shelf life, from harvest or slaughter through packing, distribution, marketing and sale. Carbohydrates, proteins and other nutrients are broken down into simpler compounds often resulting in reduced quality or quantity of the foods, through respiration, enzymatic breakdown and microbial degradation.

Food and Agriculture Organization (2014) observes that in developed countries, storage facilities are well established right from the production stage and throughout the supply chain. Cold storage coupled with advanced complementary post-harvest technologies (such as controlled atmosphere, enables the supply chain actors to significantly extend the shelf-life and marketing period for perishable foods. In this case, losses during storage could arise from a breakdown of the refrigeration systems, temperature abuse resulting in freezing or chilling injury. Overall, poor management of conditions such as temperature, gas composition and relative humidity may lead to deterioration or contamination of stored products, just as over storage periods, due to lack of transportation and other infrastructure requirements.

Kitinoja (2013) asserts that, foods may host microorganisms such as bacteria and fungi, which can cause molds, rots or decays, and are subject to water loss which result in wilting, shriveling or darkening. Both the rate of microbial growth and the rate of water loss occur more rapidly as temperature increases. Kitinoja argues that few other interventions
can so dramatically maintain the visual quality and nutritional value, and increase shelf life and ultimate market value of fresh foods as much as simply holding the foods at a lower temperature. He suggests that cold storage provides the following benefits for perishable horticultural foods: reduces respiration thus lessening perishability, reduces transpiration (that is, lessens water loss, less shriveling) slows ripening, decreases activity of microorganisms, and reduces browning and loss of texture, flavor and nutrients.

2.3 Operation and Food Waste

Operations are concerned with all the activities directly related to the production of goods or services as a value addition process (Shhtub & Karni, 2010). A firm’s operation entails materials handling, inventory control and vehicle scheduling (Sekhar, 2009) From a value chain perspective, operations are activities associated with transforming inputs into the final product form, such as machining, packing, assembly, equipment maintenance, testing, printing and facility operations (Sekhar, 2009). Key performance aspects of operation include production quantity, production time, processing, quality standard, packaging and maintenance (Sopadang, Tippayawong, & Chaowarut, 2012).

2.3.1 Materials handling

Material handling refers to the tasks, functions and routines involved in the transfer of external materials and services into the organization and the administration of the same until they are consumed or used up in the process of production, operation or sales (Emeka, 2014). This definition can be further decomposed by considering materials handling as the movement, storage, control and protection of material, goods, and products throughout the value chain to distribution, consumption and disposal (Vieira, Pasa, Borsa, Milan, & Pandolfo, 2011). Material handling activities start with unloading of goods from delivery transportation, the goods then pass into storage, onto machining, assembly, testing, storage, packaging, storage and finally loading onto transport (Bahale & Deshmukh, 2014). Pattnaik (2015) identified elements of store operations as follows; checking of refrigeration and temperature, forecasting merchandizing requirements, managing chillers with temperature regulation, time-to-time inspection for hygiene maintenance, valuation of closing stock and replenishment issue.
The importance of materials handling springs from its relationship with production flow. Sahu, Gaur and Srivastav (2016) argue that when materials flow does not proceed at sufficient rate and transportation time is long, the system does not accomplish the goals of customers when they require it. Sahu et al. (2016) assert that materials handling accounts for an important proportion of operations expenses, thus, the most critical material handling decisions are the arrangement and design of material flow pattern, which integrates the production operations. This view is supported by Ramaa, Subramanya and Rangaswamy, 2012) who sees the function of materials handling as critical because it acts as a node in linking the material flows in the agricultural food value chain as illustrated in figure 1. The figure suggests that in the entire supply chain logistics operation, materials are handled right at inspection and receiving, storage, case picking, sorting, accumulation and packing all through to shipping. Each stage has quality implications in the food value chain.

Figure 2.1 Typical materials handling function


Emeka (2014) highlights four main factors that affect the effectiveness and efficiency of materials management which can constrain or enhance food wastage depending on how
they are handled. They include the materials procurement, materials inventory, materials storage, and interdepartmental collaboration. Sahu (2016) extends this understanding by adding that when dealing with equipment, a broad classification that covers five categories: transporters (belts, chains, rollers); cranes, hoists and lifts; industrial vehicles (carts, tractors, pallet transporters, forklifts); positioning equipment, weighing and control (ramps, transfer equipment); and stents and support structures (pallets, holders, reels) should be planned for.

Vieira et al. (2011) note an intrinsic association between materials handling and production flow. They go ahead to assert that due to this, it has direct influence on transit time, resources usage, and service levels. They came to this conclusion after evaluating the impact of implemented changes in materials handling management on the internal customers’ perceptions of cost, safety in service, service reliability, agility and overall satisfaction. In their view, an imbalance in materials handling leads to formation of extra stock or rupture in supply; and when the flow does not have enough velocity, transit time is lost and the system is not capable of serving the customers when they need it. Thus, materials management should focus on the methods, mechanical equipment, systems and related controls used to achieve these functions. These should cover activities of sequencing, velocity, layout and routing.

2.3.2 Materials Analysis

Bahale and Deshmukh (2014) observe that a material may be handled even 50 times or more before it changes to finished product and account for roughly 10-30% of the total production cost depending upon product to process. Vieira et al. (2011) put emphasis on undertaking analysis of the material itself before handling commences. They thus provide a list of aspects to analyze such as: physical state (solid, liquid, gas); size (volume, length, width, height); weight; (condition (hot, cold, dry, dirty, sticky, adhesive); risk of damage (weak or strong); and safety hazards (explosive, flammable, toxic, corrosive), among others. Afterwards, equipment selection should be based on some preliminary considerations such as the utilization of the production floor and its load capacity; the dimensions of doors and corridors; ceiling height, environmental conditions and their nature, avoidance of combustion engines traction equipment in storage of food products, safety standards to protect humans and to eliminate the possibility of incurring criminal and
civil liabilities arising from accidents, and all kinds of available energy options and their
capacity to supply required movements.

Bahale and Deshmukh (2014) contend that without proper analysis of materials’ handling
needs, inefficient operations may result and this can lead to cluttered aisles, over-handling
of goods, confusion during in loading and unloading, use of too much manual labour, poor
use of skilled labour, frequent stock out on parts and supplies, lack of standardization, high
loss and damage, excess wastage, flow inefficiencies, confusing products storage, too much
walking, excessive indirect and labour cost, idle cube storage, excessive long hauls, dirty
facilities and excess amounts of employees. Further, when time is not optimally organized
waiting time occurs, which can be the result of numerous reasons such as waiting for
material, stoppages during operation or insufficient maintenance.

Food and Agriculture Organization (2011) identified five aspects with respect to food waste
concerning vegetable commodities and products. Postharvest handling and storage:
including losses due to spillage and degradation during handling, storage and transportation
between farm and distribution. Processing: including losses due to spillage and degradation
during industrial or domestic processing. FAO (2011) further observed that losses may
occur when crops are sorted out if not suitable to process or during washing, peeling, slicing
and boiling or during process interruptions and accidental spillage. Materials’ analysis is
therefore a key operations function because of its involvement in various stages of sourcing,
production and distribution of goods, from the handling of raw materials, work-in-progress
through to finished products. For this reason, different activities take place in the value
chain thereby requiring different nature of facilities, staff and equipment to suit each
function.

2.3.3 Inventory management
Inventory management is about keeping stock levels as low as possible while providing the
desired level of stock available to service customers’ demand. Effective and efficient
inventory control can lead to significant reduction in logistics costs (Lai & Cheng, 2016).
According to Liberatore and Miller (2016), analysis of inventory carrying costs, days of
inventory on hand, and obsolete inventory costs provide a perspective on a firm’s costs of
inventory, its commitment to having inventory available for customers and how well a firm
plans its inventory. In particular, the level of obsolete inventory a firm may experience
offers insight into how well a firm can accurately forecast long-term demand for its products and then execute its plan.

Bhattacharya and Bhadra (2015) discussed the concept of lean management in the context of inventory control aspects of the agricultural food value chain and considered a number of trends. They noted that in lean management, members of the value chain take initiatives that reflect war on waste especially in non-quality areas; savings through optimization of processes; streamlining in the planning activity while maintaining focus on further improving quality and competitiveness. Ramaa et al. (2012) summarized the metrics for measuring inventory management performance as illustrated in table 1. All the measures listed in the table can affect food wastage and stem postharvest losses.

<table>
<thead>
<tr>
<th>Category</th>
<th>Measure</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory management measures</td>
<td>Inventory accuracy</td>
<td>Actual inventory quantity to system inventory</td>
</tr>
<tr>
<td></td>
<td>Damaged inventory</td>
<td>Damage measure as a percentage of inventory value</td>
</tr>
<tr>
<td></td>
<td>Storage utilization</td>
<td>Occupied space (square footage) as a percent of storage capacity (square footage)</td>
</tr>
<tr>
<td></td>
<td>Dock to stock time</td>
<td>Average time from carrier arrival until product is available for order picking</td>
</tr>
<tr>
<td></td>
<td>Inventory visibility</td>
<td>Time from physical receipt to customer service notice of availability</td>
</tr>
</tbody>
</table>

Source: Ramaa et al. (2012, p. 16).

2.4 Outbound Logistics and Food Waste

Outbound logistics is the process related to the movement of the final product and the related information flows from the end of the production line to the end user (Joshi, 2013). Outbound logistics deals with the movement, storage and processing of orders for a firm’s outputs. The main activities are primarily concerned with finished and semi-finished products (Lai & Cheng, 2016). From a value chain perspective, outbound logistics are activities associated with collecting, storing and physically distributing the products to buyers such as order processing, delivery vehicle operation and order fulfillment (Sekhar,
The objective of outbound logistics is to minimize the cost involved in physically moving and storing the items from their point of production to the point where they are delivered (Lai & Cheng, 2016).

### 2.4.1 Order processing

Order processing refers to all outbound activities responsible for the fulfillment of orders that come from retailers and wholesalers (Morawicki, 2010). It involves all the activities concerned with collecting, checking, entering and transmitting sales-order information. It is the means by which suppliers and firms exchange order information (Lai & Cheng, 2016). It typically deals with the orders submitted by customers and ensures that their deliveries are properly organized (Monczka, Handfield, Giunipero, Patterson, & Waters, 2010).

Order processing is considered a primary logistics activity because there is a critical time element in getting goods and services to customers, and it triggers product movement and service delivery. The challenge to the firm is to compress the order cycle time, that is, the time a customer transmits an order to the time the customer receives that order (Lai & Cheng, 2016). Ramaa et al. (2012) developed the metrics for measuring order-processing performance as illustrated in table 2. A key aspect of order processing is the time taken in processing orders for fulfillment. Each hour, wastage reduces the shelf life of agricultural foods and increases the chance of wastage.

<table>
<thead>
<tr>
<th>Category</th>
<th>Measure</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order processing</td>
<td>Orders per hour</td>
<td>Average number of orders picked and packed per person – hour</td>
</tr>
<tr>
<td></td>
<td>Lines per hour</td>
<td>Average number of orders lines picked and packed per person – hour</td>
</tr>
<tr>
<td></td>
<td>Items per hour</td>
<td>Average number of orders items picked and packed per person – hour</td>
</tr>
<tr>
<td></td>
<td>Cost per hour</td>
<td>Total order processing costs- Fixed: space, utilities and depreciation (Variable: Labour/supplies)</td>
</tr>
<tr>
<td></td>
<td>Cost as a percent of</td>
<td>Total order processing cost as a percent of total company sales</td>
</tr>
<tr>
<td></td>
<td>sales</td>
<td></td>
</tr>
</tbody>
</table>

Source: Ramaa et al. (2012, p. 16).
2.4.2 Delivery vehicle operation (transportation)

Transportation refers to the various methods for moving products between different parties in the supply chain in order to “place” value to agricultural food products (Lai & Cheng, 2016). According to Food and Agriculture Organization (2014), transport can be a major cause of food wastage, by introducing a time span between production and consumption, of particular importance for fresh products, as well as additional risks of mechanical and heat injury. By and large, trucks remain the most common mode of transportation used by companies distributing agricultural products nationwide (Rogoff, 2014).

Somuyiwa (2014) explains that vehicle scheduling involves timing and coordination (reduced delivery time, energy cost and vehicle wears). Vehicle scheduling problems can be thought of as routing problems with additional constraints imposed by time periods during which various activities may be carried out. Three constraints commonly determine the complexity of the vehicle scheduling problems. The length of the time that a vehicle may be in operation before it must return to the depot for service or refueling; the fact that certain tasks can only be carried out by certain vehicle types.

With respect to vehicle scheduling, Bahale and Deshmukh (2014) hold the view that long and unnecessary transports should be avoided to the most possible extent because transportation is not value adding and can also affect the condition of goods. Long distance transports can be avoided by placing processes closer to each other. They also add that the waste concerning the off-loading of material may be associated with the interim storage of goods. Because there is not enough off-loading space at some sites, the goods get offloaded at the opposite side of the building leading to long, unnecessary transportation on a daily bases which could be avoided by rearranging the off-loading sites to allow more space for interim storage. Examples of cost drivers related to downstream logistics activities that should be considered when scheduling vehicles are: volume of goods carried, transportation cost, weight of goods carried, distance over which the goods are carried, information cost, labour cost, information technology investment cost, number of deliveries and service cost, and maintenance cost (Somuyiwa, 2014).

Managing transportation is concerned with selecting and utilizing the appropriate modes, routings and so on (Lai & Cheng, 2016). In order to transport products across longer
distances or pick up products from a geographically dispersed group of suppliers, distributors enter into contracts with commercial carriers, which are businesses that own and operate a fleet of trucks, freight trains or other mode of transportation. By partnering with a carrier familiar with making runs in a geographic region, this approach can reduce operating costs, get more competitive prices for shipping and relieve the burden of performing these functions in house (Rogoff, 2014).

A developing trend in outbound logistics is the use of third party logistics (3PLs). According to Rogoff (2014), 3PLs include: brokers (partnering with carriers upon request to acquire rates and then resell shipments at higher rates) and freight forwarders (consolidating shipments from a producer to a final point of distribution, frequently for overseas markets and cross regional hauls).

Reports published by FAO (2014) suggest that in developed countries, transportation of the perishable foods in refrigerated trucks is standard practice, with mechanized and well-coordinated loading and offloading. Losses occur when the cooling system malfunctions during transport, the trucks break down or are involved in accidents. Sometimes losses occur when there are delays in loading docks where no cooling is provided. Conversely, in developing countries, lack of proper transportation vehicles, poor roads and poor/inefficient logistical management hinder proper conservation of perishable commodities during transport (Rolle, 2006). It is not uncommon to find highly perishable produce being transported in open, unrefrigerated trucks. Additionally, casual laborers who handle the products roughly, causing extensive mechanical injury, do loading and off-loading of fruits and vegetables manually. Usually the fragile products are stuffed into the truck to accommodate more volume without paying attention to care (FAO, 2014).

2.4.3 Order fulfilment
Order fulfillment is the most important logistical activity that assures continuity of operation. Activities concerned with order fulfillment include: reviewing the order-to-cash cycle, understanding the supply capabilities, defining the lead-time and customer service requirements (Lambert, 2008). Lai and Cheng (2016) define order fulfillment as the quality with which the flow of goods and services is managed. Sopadang, Tippayawong and Chaowarut (2012) give performance measurement attributes that characterize effective order fulfillment. They are: reliability: the performance related to the delivery, that is;
whether the correct product (according to specifications) is delivered to the correct place, in the correct quantity, at the correct time, with the correct documentation and to the right customer; responsiveness: the speed at which a supply chain provides the products to customers; flexibility: the agility of a supply chain to respond to market changes in demand in order to gain or maintain its competitive advantage; cost – all the costs related to the operation of a supply chain. Ramaa (2012, p.16) outline a set of metrics that can be used to measure order fulfillment performance. These are shown in table 2.3. Of the measures defined, surveys of supply chain practitioners invariably show that practitioners rate on-time delivery as the most important measure of a supplier’s service to a customer (Liberatore & Miller, 2016).

Table 2.3 Order Fulfillment Metrics of Inbound Logistics

<table>
<thead>
<tr>
<th>Category</th>
<th>Measure</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order fulfillment</td>
<td>On time delivery</td>
<td>Orders delivered on time per customer requested date</td>
</tr>
<tr>
<td></td>
<td>Order fill rate</td>
<td>Orders filled completely on the first shipment</td>
</tr>
<tr>
<td></td>
<td>Order accuracy</td>
<td>Order picked, packed and shipped perfectly</td>
</tr>
<tr>
<td></td>
<td>Line accuracy</td>
<td>Line picked, packed and shipped perfectly</td>
</tr>
<tr>
<td></td>
<td>Order cycle time</td>
<td>Time from order placement to shipment</td>
</tr>
<tr>
<td></td>
<td>Perfect order</td>
<td>Order delivered without changes, damage or invoice errors</td>
</tr>
</tbody>
</table>


2.5 Chapter Summary

This chapter has reviewed the theory and practice of supply chain logistics within the context of agricultural food value chain. It has explored conceptual literature as well as past studies done on inbound logistics, operations and outbound logistics and considered their implications on food waste. The next chapter presents the methodology adopted.
CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction
This chapter provides details of the research methodology that was followed. This is essentially a blue print for the collection and analysis of data. It discusses the research design, population and sampling design which entails an explanation of the sampling frame, sampling technique and sample size. The chapter also discusses the research instrument, data collection and analysis techniques. Ethical aspects of the research are also discussed.

3.2 Research Design
Different research designs lend themselves to different processes of collecting and analyzing. In this study, descriptive research design was used. According to Saunders, Lewis and Thornhill (2012), this research design is utilized to ascertain and describe the phenomenon being studied and provide some pointers to the occurrence and association between variables. In this study, the research design facilitated the description of food wastage in Nairobi’s western precincts and how the three independent variables namely; inbound logistics, operations and outbound logistics influence the same.

3.3 Population and Sampling Design
3.3.1 Population
Population refers to the entire subject from which the researcher wishes to draw a sample (Saunders et al., 2012). For the purposes of this study, the target population was 51 fruits and vegetable suppliers who are members of Fresh Produce Exporters Association of Kenya (FPEAK). The Association is based along Rhapta Road, off Waiyaki Way in Westlands and within the western precincts. The western prescient covers the entire west of Nairobi region between the Southern Bypass and Waiyaki Way from Gitaru Junction to the heart of Westlands. FPEAK is an association, which represents exporters and suppliers of fruits and vegetables (FPEAK, 2017).
3.3.2  Sampling Design

3.3.2.1 Sampling Frame
A sampling frame is defined as a listing of all the subjects that makes up the target population (Denscombe, 2014). The sampling frame for this study was the list of fruit and vegetable members of FPEAK as presented in Appendix II.

3.3.2.2 Sampling Technique
Denscombe (2014) suggests that for a very small population, a census technique should be used instead of sampling. Census sampling is whereby all the subjects of the population are included in the sample (Saunders et al., 2012). This technique was used due to the small nature of the target population. The sampling unit was the traders of fruits and vegetables.

3.3.2.3 Sample Size
A sample size is a section of the population, which is used to represent the whole population (Kothari, 2004). Since census technique was used, the sample size was 51 suppliers, representing 100 percent of the population size.

3.4  Data Collection Methods
Data was collected using a structured questionnaire. A structured questionnaire is simply a data collection tool with a set of questions in a sequence, each with a pre-determined set of possible answers from which respondents can choose the answer which most accurately reflect the true state of affairs (Saunders, Lewis, & Thornhill, 2012). This method was chosen because of its user-friendliness as it gives respondents an easy time of picking answers and reduces the researcher’s work of coding data. The questionnaire was divided into four sections. The first section contained questions seeking to establish the demographic information of the respondents. This included whether the participant is involved in trade of fruits or vegetables, number of years their business has been in existence, type, quantity and frequency of food wastage and impact on business. The rest of the sections contained a battery of Likert scale statements and multichotomous questions measuring the effects of inbound logistics, operations and outbound logistics, respectively. These were interspersed with open-ended questions to allow respondents to provide more information and elaborate on their answers without restrictions.
3.5 Research Procedures
Clearance was sought from the university before embarking on fieldwork. The researcher pilot-tested the instrument on fruits and vegetable resellers outside the sample. This was undertaken in order to gauge the robustness of the instrument in terms of its clarity of questions and statements and its reliability in measuring the variables of research (Denscombe, 2014). Based on the responses obtained during the pilot-test, the questionnaire was refined by paraphrasing statements to eliminate ambiguity and redundancy and enhance clarity. The final questionnaire was then administered face-to-face. The data was collected in the month of May 2017.

3.6 Data Analysis Methods
Data analysis is the process of applying statistical techniques systematically to summarize, display and interpret raw data into meaningful information that can aid in drawing accurate conclusions (Saunders et al., 2012). In this study, both descriptive and inferential statistical techniques were used. Descriptive data analysis techniques entail the determination of the mean and standard deviation of the dataset as well as computing percentage frequencies. The inferential analysis technique used in this study was correlation analysis whereby Spearman’s Correlation Coefficients were determined. This technique was considered appropriate because the findings obtained contained ordinal data measured using ordinal rank numbers. When computed, the coefficients denote the strength of the relationship between two variables ranging from 0= no association to ± 1= perfect association (Healey, 2011). The closer the coefficient to 0, the weaker the correlation and vice versa; the closer the coefficient to ± 1, the stronger the correlation. Data was analyzed using the Statistical Package for the Social Sciences, Version 21 and presented in figures and tables.

3.7 Chapter Summary
This chapter has presented and described the research methodology that guided the study. The choice of the research design has been discussed as well as the population and sampling design. The chapter has also explained the data collection method used, the research procedure followed and the data analysis plan. The findings are presented in the next chapter.
CHAPTER FOUR

4.0 RESULTS AND FINDINGS

4.1 Introduction

This chapter presents and interprets the results and findings of the study. The chapter commences with a descriptive analysis of the prevalence of food wastage in Nairobi’s western precincts as the first section. Section two presents the analysis of the influence of inbound logistics on food wastage in Kenya. Section three analyzes the influence of operations on food wastage in Kenya. Section four presents results on the influence of outbound logistics on food wastage in Kenya. A summary of the major findings is presented at the end of the chapter.

4.2 Descriptive Statistics of Suppliers and Prevalence of Food Wastage

This section presents a descriptive analysis of the suppliers’ tenure of operation, core trade, forms of food waste incurred by the business, quantity of food wasted due to rejection by the supplier, quantity wasted due to customers.

4.2.1 Core business

The distribution of respondents by the core business their enterprises were engaged in is shown in table 4.1. The table shows that 36.5% specialized in vegetables and 28.8% of them focused on fruits. However, 34.7% of the respondents traded in both.

<table>
<thead>
<tr>
<th>Core trade</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits</td>
<td>15</td>
<td>28.8</td>
</tr>
<tr>
<td>Vegetables</td>
<td>19</td>
<td>36.5</td>
</tr>
<tr>
<td>Both</td>
<td>18</td>
<td>34.7</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100.0</td>
</tr>
</tbody>
</table>

4.2.2 Years of Operation

Respondents were asked how long their enterprises had been in operation. Figure 4.1 shows that on average, the firms had been operational for about 10 years (M=10.29, SD=6.077). The oldest firm had been in existence for 20 years whereas the youngest firm had been in business for two years. The mean score implies that most of the firms had been in operation for the last ten years.
4.2.3 Common forms of food wastage

The study sought to establish the forms of food wastage the enterprises incurred most often. Figure 4.2 indicates that the most common form of food wastage was due to insect damage (61.5%), followed by overripe (53.8%), then rotting (44.2%) and decomposing (36.5%). Deformity was observed by 5.8% of the respondents. No respondent identified spillage, bruising or wilting as a form of food wastage.
4.2.4 Quantity of fruits/vegetables rejected/returned by traders

Respondents were asked to estimate how much quantity of fruits/vegetables they rejected or returned to their suppliers in the last one month. Figure 4.3 ranks the average kilos of fruits/vegetables each firm rejected/returned to suppliers. The figure shows that on average, each supplier rejected or returned about 25kgs of fruits/vegetables because of they were overripe, 19kgs insect damaged, 13kgs decomposing, another 13kgs rotting, and 8kgs due to deformity. The total average fruits/vegetables rejected by each supplier in the last one month was 78kgs. In a year, this translates to 936kgs per supplier.

Figure 4.2 Common forms of food wastage
4.2.5 Quantity of fruits/vegetables rejected/returned by customers/consumers

Respondents were asked to estimate how much quantity of fruits/vegetables their customers returned or rejected in kilograms. Figure 4.4 shows the mean quantities by form of wastage. The figure shows that on average, each trader lost 11kgs of stock because they were overripe by the time they reached customers, 10kgs due to insect damage, another 10kgs decomposing, 8ks rotting and 5kgs due to deformity. The total average quantity of fruits/vegetables rejected by customers per trader in the last one month was 44kgs. In a year, this translates to 528kgs.
4.3 **Influence of Inbound Logistics on Food Wastage**

This section presents the analysis of the influence of inbound logistics on food wastage. This includes descriptive statistics of respondents’ opinion on influence of inbound logistics on food wastage and the greatest challenge that the fruits and vegetable traders associated with inbound logistics.

4.3.1 **Descriptive Statistics on Opinion on Influence of Inbound Logistics**

The opinion of respondents on the influence of various aspects of inbound logistics on food wastage is presented in Table 4.2. This includes inbound delivery delays, delivery location, related paperwork, goods handling while in transit, information flow in the supply chain, goods inspection. The table presents the frequencies (f), percentages (%), mean (M) and standard deviation (Std.Dev) of the opinions on a 5-point scale ranging from 1=Strongly Disagree (SD), 2=Disagree (D), 3=Neutral (N), 4=Agree (A) and 5=Strongly Agree (SA).
Table 4.2 Opinion of respondents on influence of inbound logistics on food wastage

<table>
<thead>
<tr>
<th>Dimensions of inbound logistics</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
<th>Total</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suppliers sometimes delay to deliver goods on time</td>
<td>f</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>22</td>
<td>28</td>
<td>51</td>
<td>4.53</td>
</tr>
<tr>
<td>There are incidences where the goods we ordered have been delivered at the wrong location</td>
<td>f</td>
<td>0</td>
<td>2</td>
<td>16</td>
<td>25</td>
<td>8</td>
<td>51</td>
<td>3.76</td>
</tr>
<tr>
<td>The paperwork involved in the purchasing process sometimes take too much time</td>
<td>f</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>30</td>
<td>10</td>
<td>51</td>
<td>3.98</td>
</tr>
<tr>
<td>Some of our suppliers handle the goods carelessly while in transit or when unloading.</td>
<td>f</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>36</td>
<td>15</td>
<td>51</td>
<td>4.29</td>
</tr>
<tr>
<td>Information flow to and from our suppliers is not as good as it should be</td>
<td>f</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>28</td>
<td>11</td>
<td>51</td>
<td>3.98</td>
</tr>
<tr>
<td>All the supplies are inspected thoroughly on receiving</td>
<td>f</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>26</td>
<td>51</td>
<td>4.51</td>
</tr>
<tr>
<td>We maintain a daily receiving report for all goods we procure</td>
<td>f</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>31</td>
<td>20</td>
<td>51</td>
<td>4.39</td>
</tr>
</tbody>
</table>

Table 4.1 shows that with respect to whether suppliers sometimes delay to deliver goods on time, 43.1% of the respondents agreed and 54.9% strongly agreed whereas 2.0% of the respondents were neutral. A very high mean score was obtained on a 5-point scale (M=4.53,
SD=0.54), which means that inbound goods were fraught with delays in delivery, which potentially contributed to food wastage.

As to whether there were incidences where the goods ordered were delivered to the wrong location, 49.0% and 15.7% of the respondents agreed and strongly agreed, respectively. However, 31.4% of the respondents were neutral whereas 3.9% of the respondents disagreed. On a 5-point scale, the mean score was moderately high (M=3.76, SD=0.76), which implies that incidences of goods being delivered to the wrong location were common and this potentially contributed to food wastage.

Respondents were asked whether the paperwork involved in the purchasing process sometimes took too much time. Table 4.2 shows that 58.8% of the respondents agreed and a further 19.6% of the respondents strongly agreed while 21.6% of the respondents were neutral. On a 5-point scale, the mean score obtained was high (M=3.98, SD= 0.65), suggesting that too much time taken due to the paperwork involved potentially contributed to food wastage.

The study sought to establish whether some suppliers handled the goods carelessly while in transit or when unloading. As per Table 4.2, 70.6% and 29.4% of the respondents agreed and strongly agreed, respectively. A high mean score (M=4.29, SD=0.46) was established on a 5-point scale. This suggests that carelessness in goods handling while in transit potentially contributed to food wastage.

The opinion of the respondents was sought as to whether information flow to and from their suppliers was not as good as it should be. Table 4.1 shows that 54.9% of the respondents agreed and 21.6% strongly agreed. However, 23.5% of the respondents were neutral. On a 5-point scale, the mean score was high (M=3.98, SD=0.68). This indicates that the process of flow information in the supply chain was not robust.

Concerning whether respondents were of the opinion that all the supplies were inspected thoroughly on receiving, Table 4.2 shows that 49.0% and 52.0% of the respondents agreed and strongly agreed, respectively. A very high mean score (M=4.51, SD= 0.51) was
obtained, implying that the goods were subjected to a thorough inspection before acceptance.

Respondents were also asked whether they maintained a daily receiving report for all goods they procured. As per Table 4.2, 60.8% of the respondents agreed and a further 39.2% of the respondents strongly agreed. A high mean score was established on a 5-point scale (M=4.39, SD=0.49), implying that most of the respondents maintained a daily receiving report for all goods procured.

4.3.2 Greatest challenge faced with in-bound logistics

The question sought to establish respondents’ views on the greatest challenge they experienced as it relates to inbound logistics. The findings are ranked in Figure 4.5. Top in the list of challenges was poor quality products, and delivery delays accounting for 32.4% of the respondents and 29.4% of the respondents, respectively. This was followed by price instability/fluctuation (20.6%) and shortage of products (17.6%).

![Figure 4.5 Respondents' identification of the greatest challenge they faced with in-bound logistics](image)

4.4 Influence of Operations on Food Wastage

In this section, the finding on the influence of supply chain operations on food wastage is presented. This comprises of descriptive statistics on the opinion of respondents regarding various aspects of supply chain operations and challenges.
### 4.4.1 Descriptive Statistics on Opinion on Influence of Operations

The opinion of respondents on the influence of various dimensions of supply chain operations on food wastage is presented in Table 4.3.

#### Table 4.3 Opinion of respondents on influence of operations on food wastage

<table>
<thead>
<tr>
<th>Dimensions of operations</th>
<th>SD 1</th>
<th>D 2</th>
<th>N 3</th>
<th>A 4</th>
<th>SA 5</th>
<th>Total</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>We have cold storage facilities suitable for each type of goods we store in our warehouse</td>
<td>f 9</td>
<td>14</td>
<td>28</td>
<td>0</td>
<td>0</td>
<td>51</td>
<td>2.37</td>
<td>0.77</td>
</tr>
<tr>
<td></td>
<td>% 17.6%</td>
<td>27.5%</td>
<td>54.9%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The storage facilities at our disposal are adequate to prevent food wastage due to spoilage</td>
<td>f 3</td>
<td>36</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>51</td>
<td>2.18</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td>% 5.9%</td>
<td>70.6%</td>
<td>23.6%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We regularly inspect storage facilities to control pests and flies and other contaminants</td>
<td>f 0</td>
<td>1</td>
<td>1</td>
<td>36</td>
<td>13</td>
<td>51</td>
<td>4.18</td>
<td>0.65</td>
</tr>
<tr>
<td></td>
<td>% 0.0%</td>
<td>2.0%</td>
<td>2.0%</td>
<td>70.6%</td>
<td>25.5%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes packaging process is fraught with delays</td>
<td>f 0</td>
<td>0</td>
<td>12</td>
<td>16</td>
<td>23</td>
<td>51</td>
<td>4.22</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>% 0.0%</td>
<td>0.0%</td>
<td>23.5%</td>
<td>47.1%</td>
<td>5.9%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some of the products are not handled with care by in-house staff</td>
<td>f 0</td>
<td>1</td>
<td>24</td>
<td>23</td>
<td>3</td>
<td>51</td>
<td>3.55</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>% 0.0%</td>
<td>2.0%</td>
<td>47.1%</td>
<td>45.1%</td>
<td>5.9%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We have the right equipment for handling goods while sorting, weighing and packaging them</td>
<td>f 0</td>
<td>2</td>
<td>28</td>
<td>20</td>
<td>1</td>
<td>51</td>
<td>3.39</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>% 0.0%</td>
<td>3.9%</td>
<td>54.9%</td>
<td>39.2%</td>
<td>2.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The right temperature of chillers is maintained at all times</td>
<td>f 0</td>
<td>13</td>
<td>35</td>
<td>3</td>
<td>0</td>
<td>51</td>
<td>2.80</td>
<td>0.53</td>
</tr>
<tr>
<td></td>
<td>% 0.0%</td>
<td>25.5%</td>
<td>68.6%</td>
<td>5.9%</td>
<td>0.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is a seamless flow of products from one stage to the next during operation</td>
<td>f 0</td>
<td>3</td>
<td>34</td>
<td>14</td>
<td>0</td>
<td>51</td>
<td>3.22</td>
<td>0.54</td>
</tr>
<tr>
<td></td>
<td>% 0.0%</td>
<td>5.9%</td>
<td>66.7%</td>
<td>27.5%</td>
<td>0.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-in first-out method is used to ensure that all goods are released while still fresh</td>
<td>f 1</td>
<td>2</td>
<td>0</td>
<td>33</td>
<td>15</td>
<td>51</td>
<td>4.20</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td>% 2.0%</td>
<td>3.9%</td>
<td>0.0%</td>
<td>64.7%</td>
<td>29.4%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We undertake regular analysis of the physical state, size and weight of the fruits/vegetables to control quality</td>
<td>f 0</td>
<td>0</td>
<td>0</td>
<td>33</td>
<td>18</td>
<td>51</td>
<td>4.35</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>% 0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>64.7%</td>
<td>35.3%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All our food handlers are trained on food quality and safety procedures</td>
<td>f 0</td>
<td>18</td>
<td>20</td>
<td>12</td>
<td>1</td>
<td>51</td>
<td>2.92</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>% 0.0%</td>
<td>35.3%</td>
<td>39.2%</td>
<td>23.5%</td>
<td>2.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We forecast demand in order to maintain the right quantity of inventory at all times</td>
<td>f 0</td>
<td>0</td>
<td>25</td>
<td>24</td>
<td>2</td>
<td>51</td>
<td>3.55</td>
<td>0.58</td>
</tr>
<tr>
<td></td>
<td>% 0.0%</td>
<td>0.0%</td>
<td>49.0%</td>
<td>47.1%</td>
<td>3.9%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.3 shows that 27.5% and 17.6% of the respondents disagreed and strongly disagreed, respectively, that they had cold storage facilities suitable for each type of goods stored in their warehouse. However, 54.9% of the respondents were neutral. On a 5-point scale, the mean score obtained was low (M=2.37, SD=0.77), implying that most of the traders did not have cold storage facilities suitable for the food products they traded in.

The study also sought to establish as to whether the storage facilities at the traders’ disposal were adequate to prevent food wastage. Table 4.3 shows that 70.6% of the respondents disagreed and a further 5.3% of the respondents strongly disagreed. However, some 23.6% of the respondents were neutral. A low mean score was obtained on a 5-point scale (M=2.18, SD=0.52), implying that the storage facilities at the traders’ disposal were inadequate for preventing food wastage.

As to whether respondents regularly inspected storage facilities to control pests and flies and other contaminants, Table 4.3 indicates that 70.6% and 25.5% of the respondents agreed and strongly agreed, respectively. However, 2.0% of the respondents were neutral while another 2.0% of the respondents disagreed. A high mean score was obtained on a 5-point scale (M=4.18, SD=0.65), implying that the stores were regularly inspected in order to control pests.

The opinion of respondents was sought as to whether there were delays in the packaging process. Table 4.3 shows that 31.4% and 45.1% of the respondents agreed and strongly agreed respectively, that sometimes packaging process was fraught with delays. However, 23.5% of the respondents were neutral. On a 5-point scale, the mean score was high (M=4.22, SD=0.81), meaning that most of the respondents observed that delays sometimes occurred during the packaging process.

Respondents were also asked whether some of the products were not handled with care by in-house staff. Table 4.3 indicates that 45.1% of the respondents agreed and 5.9% strongly agreed. However, 47.1% of the respondents were neutral and 2.0% of the respondents disagreed. A moderately high mean score was obtained (M=3.55, SD=0.64), suggesting that sometimes care was not taken by the in-house staff when handling the food products.

The opinion of the respondents was further sought concerning whether they had the right equipment for handling goods while sorting, weighing and packaging them. As per table

36
4.2, 39.2% and 2.0% of the respondents agreed and strongly agreed, respectively, whereas 54.9% of the respondents were neutral and 3.9% of the respondents disagreed. The mean score on a 5-point scale was moderate (M=3.39, SD=0.60), suggesting that most of the respondents were unsure whether they had the right equipment for handling the food products.

Concerning whether the right temperature of chillers is maintained at all times, Table 4.3 shows that 68.6% of the respondents were neutral but 25.5% of the respondents disagreed while only 5.9% of the respondents agreed. On a 5-point scale, the mean score obtained was moderately low (M=2.80, SD=0.53), which suggests that respondents were unsure as to whether they maintained the right temperature of chillers.

With regards to whether there is a seamless flow of products from one stage to the next during operation, Table 4.3 indicates that 66.7% of the respondents were neutral while 27.5% of the respondents agreed. However, 5.9% of the respondents disagreed. On a 5-point scale, the mean score obtained was moderate (M=3.22, SD=0.54), meaning that most of the respondents were not sure whether the operations proceeded seamlessly.

The opinion of respondents was also sought as to whether first-in first-out method was used to ensure that all goods are released while still fresh. Table 4.3 shows that 64.7% and 29.4% of the respondents agreed and strongly agreed, respectively, whereas 3.9% of the respondents disagreed and a further 2.0% strongly disagreed. A high mean score was obtained on a scale of 1 to 5 (M=4.20, SD=0.69), meaning that first in first out methods was used, thereby potentially reducing food wastage associated with overstaying.

Respondents were also asked whether they undertook regular analysis of the physical state, size and weight of the fruits/vegetables to control quality. Table 4.3 shows that 64.7% and 35.3% of the respondents agreed and strongly agreed, respectively. A high mean score on a 5-point scale was found (M=4.35, SD=0.48), which means that the traders did regular analysis of the goods to control for quality.

As to whether all food handlers were trained on food quality and safety procedures, Table 4.3 shows that 39.2% of the respondents were neutral, 35.3% of the respondents disagreed while 23.5% and 2.0% of the respondents agreed and strongly agreed, respectively. A moderate mean score was obtained on a 5-point scale (M=2.92, SD=0.82), meaning that
respondents were unsure whether staff had the requisite training on food quality and safety procedures.

The study also sought to establish whether the traders forecasted demand in order to maintain the right quantity of inventory at all times. Table 4.3 shows that 49.0% of the respondents were neutral. However, 47.1% and 3.9% of the respondents agreed and strongly agreed, respectively. A moderately high mean score was obtained on a 5-point scale (M=3.55, SD=0.58), which suggests that demand forecasting was practiced by most of the traders.

4.4.3 Greatest challenge faced with supply chain operations

Respondents were asked to identify the greatest challenge they faced concerning the operational aspects of the business in relation to food wastage. As per Figure 4.6, the greatest challenge identified by most of the respondents was inadequate storage facilities (27.0%), followed high equipment cost and maintenance (16.2%) and incompetent staff/poor food handling (16.2%). The challenge of pests and rodents (13.5%), high storage costs (13.5%) and overstaying with products (13.5%) were also identified by the respondents as the most challenging aspects of supply chain operations.

![Figure 4.6 Greatest challenge faced by traders in terms of operations](image)

Figure 4.6 Greatest challenge faced by traders in terms of operations
4.5 Influence of Outbound Logistics on Food Wastage

This section presents the analysis of the influence of outbound logistics on food wastage and the challenges traders faced in relation to outbound logistics.

4.5.1 Descriptive Statistics on Opinion on Influence of Outbound Logistics

The opinion of respondents on the influence of various aspects of outbound logistics on food wastage is presented in Table 4.4.

Table 4.4 Opinion of respondents on influence of outbound logistics on food wastage

<table>
<thead>
<tr>
<th>Dimensions of outbound logistics</th>
<th>SD 1</th>
<th>D 2</th>
<th>N 3</th>
<th>A 4</th>
<th>SA 5</th>
<th>Total</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sometimes the time taken to process customer orders is too long</td>
<td>f: 0</td>
<td>0</td>
<td>9</td>
<td>11</td>
<td>31</td>
<td>51</td>
<td>4.43</td>
<td>0.78</td>
</tr>
<tr>
<td>%: 0.0%</td>
<td>0.0%</td>
<td>17.6%</td>
<td>21.6%</td>
<td>60.8%</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We always fulfill orders as per customer specification</td>
<td>f: 13</td>
<td>26</td>
<td>11</td>
<td>0</td>
<td>1</td>
<td>51</td>
<td>2.02</td>
<td>0.81</td>
</tr>
<tr>
<td>%: 25.5%</td>
<td>51.0%</td>
<td>21.6%</td>
<td>0.0%</td>
<td>2.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes goods in transit delay to reach customers</td>
<td>f: 0</td>
<td>0</td>
<td>1</td>
<td>46</td>
<td>4</td>
<td>51</td>
<td>4.06</td>
<td>0.31</td>
</tr>
<tr>
<td>%: 0.0%</td>
<td>0.0%</td>
<td>2.0%</td>
<td>90.2%</td>
<td>7.8%</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We have competent manpower to handle all customer orders</td>
<td>f: 0</td>
<td>4</td>
<td>44</td>
<td>3</td>
<td>0</td>
<td>51</td>
<td>2.98</td>
<td>0.37</td>
</tr>
<tr>
<td>%: 0.0%</td>
<td>7.8%</td>
<td>86.3%</td>
<td>5.9%</td>
<td>0.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We find market for all fruits/vegetables rejected or returned by our customers</td>
<td>f: 28</td>
<td>19</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>51</td>
<td>1.61</td>
<td>0.90</td>
</tr>
<tr>
<td>%: 54.9%</td>
<td>37.3%</td>
<td>3.9%</td>
<td>0.0%</td>
<td>3.9%</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We have a close partnership with efficient shipping companies</td>
<td>f: 1</td>
<td>3</td>
<td>44</td>
<td>3</td>
<td>0</td>
<td>51</td>
<td>2.96</td>
<td>0.45</td>
</tr>
<tr>
<td>%: 2.0%</td>
<td>5.9%</td>
<td>86.3%</td>
<td>5.9%</td>
<td>0.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We use mechanized loading and unloading</td>
<td>f: 1</td>
<td>23</td>
<td>25</td>
<td>2</td>
<td>0</td>
<td>51</td>
<td>2.55</td>
<td>0.61</td>
</tr>
<tr>
<td>%: 2.0%</td>
<td>45.1%</td>
<td>49.0%</td>
<td>3.9%</td>
<td>0.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our storage and operation facilities allow us the flexibility needed to market changes in demand</td>
<td>f: 8</td>
<td>24</td>
<td>17</td>
<td>2</td>
<td>0</td>
<td>51</td>
<td>2.25</td>
<td>0.77</td>
</tr>
<tr>
<td>%: 15.7%</td>
<td>47.1%</td>
<td>33.3%</td>
<td>3.9%</td>
<td>0.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All customer orders are delivered without damage or spoilage</td>
<td>f: 15</td>
<td>26</td>
<td>7</td>
<td>1</td>
<td>2</td>
<td>51</td>
<td>2.00</td>
<td>0.94</td>
</tr>
<tr>
<td>%: 29.4%</td>
<td>51.0%</td>
<td>13.7%</td>
<td>2.0%</td>
<td>3.9%</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The study sought to establish whether there were delays in order processing. As per table 4.4, 21.6% and 60.8% of the respondents agreed and strongly agreed, respectively, that sometimes the time taken to process customer orders was too long. However, 17.6% of the respondents were neutral. A high mean score on a 5-point scale was obtained (M=4.43, SD=0.78). This suggests that processing of customer orders were sometimes fraught with delays, which potentially contributed to food wastage.

Concerning whether customer orders were always fulfilled as per their specification, Table 4.4 shows that 51.0% and 25.5% of the respondents disagreed and strongly disagreed, respectively. However, 21.6% of the respondents were neutral whereas only 2.0% of the respondent’s strongly agreed. A low mean score was obtained on a 5-point scale (M=2.02, SD=0.81) meaning that customer orders were not always fulfilled according to customer requirements and specifications.

The study sought to determine whether there were delays in deliveries reaching customers. Table 4.4 shows that 90.2% and 7.8% of the respondents agreed and strongly agreed, respectively, that sometimes goods in transit delay to reach customers. However, 2.0% of the respondents were neutral. A high mean score on a scale of 1 to 5 was realized (M=4.06, SD=0.31); implying that goods en-route to customers were fraught with delays.

Respondents were asked whether they had competent manpower to handle all customer orders. Table 4.4 shows that 86.3% of the respondents were neutral. However, 7.8% of the respondents disagreed while 5.9% of the respondents agreed. A moderately low mean score was obtained (M=2.89, SD=0.37), meaning that respondents were not sure whether they had competent manpower to handle orders made by their customers.

The opinion of the respondents were also sought as to whether they found market for all fruits/vegetables rejected or returned by their key customers. As per table 4.4, 37.3% and 54.9% of the respondents disagreed and strongly disagreed, respectively. Some 3.9% of the respondents were neutral whereas another 3.9% of the respondents strongly agreed. A very low mean score was obtained on a 5-point scale (M=1.61, SD=0.90). This implies that the traders found no market for the food products rejected/returned by their customers.

The study sought to establish whether the traders had a close partnership with efficient shipping companies. Table 4.4 shows that 86.3% of the respondents were neutral. However,
5.9% and 2.0% of the respondents disagreed and strongly disagreed, respectively whereas 5.9% of the respondents agreed. On a 5-point scale, a moderately low mean score was obtained (M=2.96, SD=0.45), indicating that respondents were unsure whether they had a close partnership with efficient third party logistics companies.

Respondents were asked whether they used mechanized loading and offloading. As per Table 4.4, 49.0% of the respondents were neutral. However, 45.1% and 2.0% of the respondents disagreed and strongly disagreed, respectively whereas only 3.9% of the respondents agreed. A low mean score was established on a 5-point scale (M=2.55, SD=0.61), which means that most of the traders did not use mechanized loading and offloading of the food products.

The opinion of respondents was also sought as to whether their storage and operation facilities allow them the flexibility needed to respond effectively to market changes in demand. Table 4.4 shows that 47.1% and 15.7% of the respondents disagreed and strongly disagreed, respectively. However, 33.3% of the respondents were neutral while 3.9% of the respondents agreed. A low mean score was obtained on a 5-point scale (M=2.25, SD=0.77), implying that the storage and operational facilities of most of the traders did not allow them the flexibility needed to respond to market changes in demand.

Concerning product safety, Table 4.4 shows that 51.0% and 29.4% of the respondents disagreed and strongly disagreed, respectively that all customer orders were delivered without damage or spoilage. However, 13.7% of the respondents were neutral whereas 2.0% of the respondents disagreed and a further 3.9% of the respondents strongly agreed. On a 5-point scale, the mean score obtained was low (M=2.00, SD=0.94), implying that some customers got damaged or spoiled in the process of delivery.

4.5.3 Greatest challenge faced with outbound logistics

The study sought to establish the greatest challenge the traders faced in relation to outbound logistics. The findings are presented in Figure 4.7. The figure shows that maintaining customer quality standards was identified by most of the respondents as the greatest challenge (26.3%), followed by delays of goods while in transit to customers (23.7%). Other challenges mentioned by the respondents included unpredictable demand (13.2%), product rejections (13.2%), stiff competition (13.2%) and products deteriorating in quality before being delivered (10.5%).
Figure 4.7 The greatest challenge traders faced in relation to outbound logistics

4.6 Inferential Analysis

This section presents inferential analysis of the influence of outbound logistics on food wastage. Spearman’s rank correlation coefficient was run to establish the relationship between supply chain logistics and food wastage. The results are presented in Table 4.5.

Table 4.5 Correlation between supply chain logistics and food wastage

<table>
<thead>
<tr>
<th>Spearman’s Rho</th>
<th>Correlation Coefficient</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Food wastage</td>
<td>Correlation Coefficient</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>2. Inbound Logistics</td>
<td>Correlation Coefficient</td>
<td>-.026</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.950</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>3. Operations</td>
<td>Correlation Coefficient</td>
<td>-.234</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.230</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>4. Outbound Logistics</td>
<td>Correlation Coefficient</td>
<td>-.005</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.743</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
As per Table 4.4, a weak negative correlation was obtained between food wastage and inbound logistics \( (r=-.026, p>.05) \), operations \( (r=-.234, p>.05) \) and outbound logistics \( (r=-.005, p>.05) \). The results imply that the current supply chain logistics practices contributed to food wastage.

### 4.7 Chapter Summary

The major findings of the study revealed that with respect to the influence of inbound logistics on food wastage in Kenya, a weak negative correlation was obtained between inbound logistics and food wastage \( (r=-.026, p>.05) \).

Concerning the influence of operations on food wastage in Kenya, a weak negative correlation was obtained between operations and food wastage \( (r=-.234, p>.05) \).

As pertains the influence of outbound logistics on food wastage in Kenya, a weak negative correlation was obtained between outbound logistics and food wastage \( (r=-.005, p>.05) \).

In the next chapter, the findings are discussed in details and conclusions drawn. The chapter also provides the recommendations for practice and suggestions for future studies.
CHAPTER FIVE

5.0 SUMMARY, DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes the study findings, discusses the findings and draws conclusion based on the discussions. The discussions proceed in view of the study objectives and research questions. The chapter also makes recommendations for improvement and suggests further research directions.

5.2 Summary

The purpose of the study was to determine the effect of supply chain logistics on food wastage in Kenya. The research questions were; what is the influence of inbound logistics on food wastage in Kenya? What is the influence of operations on food wastage in Kenya? What is the influence of outbound logistics on food wastage in Kenya?

Descriptive research design was used. Census sampling method was used due to the small size of the target population. Thus, the sample size was 51 suppliers, representing 100 percent of the population size. Data was collected using a structured questionnaire. The data was analyzed by computing the mean and standard deviation scores. Inferences were drawn using Spearman’s Rank Correlation Coefficient technique. Data was analyzed using SPSS and presented in figures and tables.

The major findings of the study revealed that with respect to the influence of inbound logistics on food wastage in Kenya, a weak negative correlation was obtained between inbound logistics and food wastage ($r=-.026, p>.05$). Top in the list of challenges respondents associated with inbound logistics was poor quality products, and delivery delays accounting for 32.4% of the respondents and 29.4% of the respondents, respectively.

Concerning the influence of operations on food wastage in Kenya, a weak negative correlation was obtained between operations and food wastage ($r = -.234, p > .05$). The greatest challenge identified by most of the respondents was inadequate storage facilities (27.0%), followed high equipment cost and maintenance (16.2%) and incompetent staff/poor food handling (16.2%). The challenge of pests and rodents (13.5%), high storage
costs (13.5%) and overstaying with products (13.5%) were also identified by the respondents as the most challenging aspects of supply chain operations.

As pertains the influence of outbound logistics on food wastage in Kenya, a weak negative correlation was obtained between outbound logistics and food wastage ($r = -0.005$, $p > 0.05$). Maintaining customer quality standards was identified by most of the respondents as the greatest challenge (26.3%), followed by delays of goods while in transit to customers (23.7%). Other challenges mentioned by the respondents included unpredictable demand (13.2%), product rejections (13.2%), stiff competition (13.2%) and products deteriorating in quality before being delivered (10.5%).

5.3 Discussions

5.3.1 Influence of Inbound Logistics of Food Wastage

The findings showed that 43.1% of the respondents agreed and 54.9% strongly agreed that suppliers sometimes delayed to deliver goods on time (M=4.53, SD=0.54), implying that inbound goods were fraught with delays in delivery, which potentially contributed to food wastage. This finding agrees with the argument put forward by FAO (2014) that transport can be a major cause of food wastage, by introducing a time span between production and consumption, of particular importance for fresh products, as well as additional risks of mechanical and heat injury. In the current study, the statistics showed that food wastage because they were overripe was the second most common form of wastage according to 53.8% of the respondents and accounted for the highest quantity of kilos of fruits/vegetables rejected/returned to inbound suppliers. This suggests that a significant proportion of food fit for human consumption was being wasted due to post-harvest supply chain logistics as implied in the discourse by Lipinski et al. (2013).

It was also found that 49.0% and 15.7% of the respondents agreed and strongly agreed, respectively, that there were incidences where the goods ordered were delivered to the wrong location (M=3.76, SD=0.76), which implies that incidences of goods being delivered to the wrong location were common and this potentially contributed to food wastage. This goes contrary to supply chain management best practices which, according to Moreno (2015), emphasize the receiving of goods at the right place and time and in the right condition. The finding implies that the inbound delivery process was not aligned and
seamless leading to delivery of goods at the wrong location which, in line with the viewpoint of Takika and Leite (2016), can lead to significant wastage.

The findings showed that 70.6% and 29.4% of the respondents agreed and strongly agreed, respectively, that some suppliers handled the goods carelessly while in transit or when unloading (M=4.29, SD=0.46); implying that carelessness in goods handling while in transit potentially contributed to food wastage. It is instructive to note that deformation accounted for the fourth highest quantity of kilos of fruits/vegetables returned/rejected along the supply chain. This is consistent with the argument by Shirmohammadi and Yarlagadda (2013) that the quality of perishable food products are susceptible to deformation during postharvest handling of the goods in the process of packaging, grading and processing; wherein, high damage can result due to compression, impact and tensile loading.

The study established that 54.9% of the respondents agreed and 21.6% strongly agreed that information flow to and from their suppliers was not as good as it should be (M=3.98, SD=0.68); implying that the process of flow information in the supply chain was not robust. This agrees with Langat et al. (2015) who maintain that a lack of proper adherence to seamless cooperation and information flow between the value chain actors affects supply chain agility. The finding underscores the need for good supply chain management practices which, according to Hugo (2010), introduces a systems approach to understanding and managing the different activities needed to coordinate the flow of goods.

Concerning records management, it was found that 60.8% of the respondents agreed and a further 39.2% of the respondents strongly agreed that they maintained a daily receiving report for all goods they procured (M=4.39, SD=0.49). Thus, most of the respondents maintained a daily receiving report for all goods procured. This is in keeping with good supply chain management practices as explained by Moreno (2015) who assert that managers should use daily receiving report as evidence of items received, checking items received as to specification such as quality, quantity, missing items and unacceptable ones. The findings suggest that the traders acknowledge the caution made by FAO (2014) that the shelf life of fruits and vegetables depend on the initial quality resulting from decisions made at the earlier stages of the supply chain. This is reflected in further findings which
indicated that poor quality products was the greatest challenge experienced by the respondents in relation to inbound logistics.

5.3.2 Influence of Operations on Food Wastage

The study established that 27.5% and 17.6% of the respondents disagreed and strongly disagreed, respectively, that they had cold storage facilities suitable for each type of goods stored in their warehouse (M=2.37, SD=0.77), implying that most of the traders did not have cold storage facilities suitable for the food products they traded in. Further, 70.6% of the respondents disagreed and a further 5.3% of the respondents strongly disagreed that the storage facilities at their disposal were adequate to prevent food wastage (M=2.18, SD=0.52), implying that the storage facilities at the traders’ disposal were inadequate for preventing food wastage. This is in agreement with the claim made by FAO (2014) that lack of proper storage facilities is a major cause of post-harvest food waste as cold storage facilities are non-existent or inaccessible to most fruits and vegetable dealers. It also resonates the viewpoint of Radzi et al. (2016) that the time and place utility of storage facilities can only be realized if the storage conditions are optimized, otherwise significant losses abound. The finding is also consistent with prior research by Roesel and Grace (2014) in Nairobi’s western precinct which found that existing food terminals in the western precincts is fraught with many challenges such as inadequate storage facilities for the agricultural products.

The findings showed that 70.6% and 25.5% of the respondents agreed and strongly agreed, respectively, that they regularly inspected storage facilities to control pests and flies and other contaminants (M=4.18, SD=0.65). This is consistent with good supply chain management practices as explained by Pattnaik (2015) who make the observation that regular inspections are necessary to control pests and insects. However, despite such measures, the study established that 61.5% of the respondents identified insect damage as the most common reason for food wastage. This is in line with a report by the World Bank (2011) which identified insect damage as one of the causes of post-harvest food wastage. The findings suggest that inspection was not enough to reduce food wastage associated with insect damage. On this effort, the traders could benefit from consolidating the added value of regular inspection by acquiring pest controlling substance used to maintain hygiene and freshness as suggested by (Pattnaik, 2015).
The study also established that 31.4% and 45.1% of the respondents agreed and strongly agreed respectively, that sometimes packaging process was fraught with delays (M=4.22, SD=0.81), meaning that most of the respondents observed that delays sometimes occurred during the packaging process. This potentially contributed to food wastage due to overripe foods rejected as a result. This is consistent with the findings of a study by Vieira et al. (2011) which revealed an intrinsic association between materials handling and production flow which influence delivery time and therefore, shelf-life of perishable agricultural food products.

The findings showed that 45.1% of the respondents agreed and 5.9% strongly agreed that some of the products were not handled with care by in-house staff (M=3.55, SD=0.64), suggesting that sometimes care was not taken by the in-house staff when handling the food products. This agrees with the findings of Okojie and Isah (2014) that conditions of food handling in Nairobi were poor. It is also consistent with the observation made by Segre et al. (2014) that a significant proportion of fresh horticultural foods go to waste at post-harvest levels due to poor handling.

Related findings showed that 39.2% and 2.0% of the respondents agreed and strongly agreed, respectively, whereas 54.9% of the respondents were neutral with respect to whether they had the right equipment for handling goods while sorting, weighing and packaging them (M=3.39, SD=0.60). This suggests that most of the respondents were unsure as to whether they had the right equipment for handling the food products. The finding echoes the observation made by Rolle (2006) in developing countries that lack of proper equipment hinder proper conservation of perishable commodities at post-harvest.

Concerning whether the right temperature of chillers is maintained at all times, the study found that 68.6% of the respondents were neutral but 25.5% of the respondents disagreed (M=2.80, SD=0.53), suggesting that respondents were unsure as to whether they maintained the right temperature of chillers. This contrasts with the situation in developed economies where FAO (2014) have reported that storage facilities are well established right from the production stage and throughout the supply chain thereby significantly extending the shelf-life and marketing period for perishable foods. This is reflected in further findings which indicated that the greatest challenge identified by majority of the respondents was inadequate storage facilities, followed high equipment cost and maintenance. The finding echoes the viewpoint of Sigrid et al. (2015) that improvements in physical infrastructure
for food supplied to the city is overdue. It also highlights the opportunity and need to increase investments in infrastructure, transportation, processing and packaging as put forward by FAO (2013).

5.3.3 Influence of Outbound Logistics on Food Wastage

The findings showed that 21.6% and 60.8% of the respondents agreed and strongly agreed, respectively, that sometimes the time taken to process customer orders was too long (M=4.43, SD=0.78); which means that processing of customer orders were sometimes fraught with delays, which potentially contributing to food wastage. This agrees with the view of Sahu et al. (2016) that when materials flow does not proceed at sufficient rate and customer orders take too long, the system does not accomplish the goals of customers when they require it and this exposes the food products to the possibility of rotting before being sold. In the current study, the results showed that food wastage due to rotting was the third most common form of food wastage, going by 44.2% of the respondents and accounted for the third highest quantity of kilos of wasted foods. The findings also showed that the highest quantity of kilos of food rejected/returned by customers was because they were overripe. This agrees with the observation made in developing countries by Kitinoja and Gorny (2010) that quantity losses were more common. The finding suggests that food waste was prevalent in the post-harvest supply chain as food of good quality and fit for human consumption was being discarded after it spoils without getting consumed.

Concerning whether customer orders were always fulfilled as per their specification, it was established that 51.0% and 25.5% of the respondents disagreed and strongly disagreed, respectively (M=2.02, SD=0.81) meaning that customer orders were not always fulfilled according to customer requirements and specifications. It can thus be inferred that outbound logistics process did not reliably service customer orders contrary to best practices in supply chain management theorized by Sopadang et al. (2012). Related findings indicated that 90.2% and 7.8% of the respondents agreed and strongly agreed, respectively, that sometimes goods in transit delayed to reach customers (M=4.06, SD=0.31); implying that goods en-route to customers were fraught with delays. This further compounds the problems that arise due to inefficiencies during outbound logistics, thereby increase the risk of food wastage in the post-harvest value chain.

The opinion of respondents was also sought as to whether their storage and operation facilities allow them the flexibility needed to respond effectively to market changes in
demand. It was found that 47.1% and 15.7% of the respondents disagreed and strongly disagreed (M=2.25, SD=0.77). This means that storage and operational facilities of most of the traders did not allow them the flexibility needed to respond to market changes in demand. This potentially contributed to food wastage when the traders ended up with excess stock, since overstaying with products was one of the top five challenges faced by the respondents which they associated with food wastage. The finding echoes the need identified by Emeka (2014) to adopt definite method of deciding the quantity of materials to be ordered, quantity to be stored as inventory and dynamism in order to adjust with changing demand.

Concerning product safety, 51.0% and 29.4% of the respondents disagreed and strongly disagreed, respectively that all customer orders were delivered without damage or spoilage (M=2.00, SD=0.94), implying that some customers got damaged or spoiled in the process of delivery. This is further reflected in the findings which showed that maintaining customer quality standards was identified by majority of the respondents as the greatest challenge they associated with outbound logistics. This agrees with Sahu et al. (2016) who pointed out that logistics associated with goods flowing out of a production facility as well as its internal handling has become very important in mitigating post-harvest food wastage.

5.4 Conclusions

5.4.1 Influence of Inbound Logistics of Food Wastage

Inbound logistics had a negative influence on food wastage since it accounted for the highest proportion of post-harvest food wastage in the fruits and vegetable supply chain in Nairobi’s western precincts. This was potentially attributable to a myriad of factors within and without the control of post-harvest fruits and vegetable traders. Inbound goods sometimes delayed to arrive on time from the farms while in transit. Incidences of the goods also being delivered to the wrong location were also common. Further, too much time was wasted with regards to paperwork involving in the purchasing process. The traders also complained of careless handling of the inbound goods while in transit. There was little collaboration in information sharing and flow as each actor operated as separate entities rather than having a view of the supply chain as a whole unit. The greatest challenge attributable to food wastage was the quantity of goods rejected/returned due to insect damage and overripe fruits/vegetables lowering their quality and acceptability.
5.4.2 Influence of Operations on Food Wastage
Operations also negatively influenced food wastage mainly due to the challenge of inadequate storage facilities and infrastructure. The traders lacked cold storage facilities suitable for the fruits and vegetable trade they engaged in and those that were at their disposal were inadequately equipped to prevent food wastage. Most stores lacked chillers that could lower the speed of ripening and even in stores equipped with refrigeration devices, the traders were not sure whether they maintained the right temperatures. Further, although the traders regularly inspected their stores in order to control pests, damages associated with insects and pests continued to be a major cause of food wastage. Delays also sometimes occurred during the packaging process. In addition, in-house staff sometimes did not take proper care when handling the food products.

5.4.3 Influence of Outbound Logistics on Food Wastage
Outbound logistics similarly had a negative influence on food wastage. This was potentially caused by delays in processing of customer orders and failing to fulfill deliveries according to customer requirements and specifications. Further, goods en-route to customers were fraught with delays. Upon arrival at customer location, some also got damaged or spoiled; and the traders struggled to maintain customer quality standards, with many deteriorating in quality before being sold mainly because they were overripe. These end up being wasted as the traders find it difficult to get market for the supplies rejected or returned by customers.

5.5 Recommendations
5.5.1 Recommendations for Improvement
5.5.1.1 Influence of Inbound Logistics of Food Wastage
Backward integration is recommended for the traders to have better control of inbound logistics in order to minimize wastage associated with inbound fruits and vegetable handling and delivery quality. Firms that are not able to integrate this way should form strategic partnerships and information collaboration with upstream supply chain actors in order to enhance the efficiency of inbound logistics. This would help mitigate mistakes such as deliveries being made at the wrong location, thereby increasing the risks of food waste and food loss.
5.5.1.2 Influence of Operations on Food Wastage
The installation and enhancement of properly equipped storage facilities in Nairobi’s western precincts as well as recruitment and training of competent food handlers is recommended. Given the potentially high capital outlay required to set up a suitable storage facility single-handedly, the intervention of development partners as well as involvement of government would go a long way in facilitating post-harvest supply chain players in Nairobi’s western precincts towards reducing unnecessary food waste by slowing down the ripening process. Storage facilities equipped with adequate chillers would also significantly reduce the menace of insects, pests and rodents that cause damage at post-harvest. Recruitment and training of competent staff in food safety would increase operational efficiency.

5.5.1.3 Influence of Outbound Logistics on Food Wastage
Opportunities exist for third party logistics companies equipped with the right transport facilities to address the problems of the traders’ outbound logistics, especially with regards to foods becoming overripe before being delivered. The traders themselves should also explore how technology can be deployed to reduce the order-to-delivery cycle time.

5.5.2 Recommendations for Further Studies
This study established that insect damage was the most common form of food wastage identified especially during inbound logistics. This should therefore form the subject of further investigation in order to establish the etiology and effective pest control measures that can be put in place.

This study was limited in scope to selected suppliers in Nairobi’s western precincts. Another study should therefore investigate the supply chain logistics associated with food waste among last mile distributors such as supermarkets, fruits and vegetable vendors, and other players in the value addition process such as restaurants and salad stores.

This study could also be replicated in other major cities in Kenya to establish whether the same conclusions can be drawn with respect to food wastage. In addition, the reliability of statistical estimates can be increased by increasing the sample size used.
REFERENCES


APPENDIX I: QUESTIONNAIRE

Dear Respondent,

This is an academic research on “The effect of supply chain logistics on food wastage in Kenya”. I am undertaking this research in partial fulfillment of the requirements for the degree of Global Executive Master of Business Administration (GeMBA) at the United States International University. As such, the findings will be used strictly for academic purposes only and your responses will be treated with utmost confidentiality. I kindly request you to fill this questionnaire which contains four short sections. Please place a tick (✓) or fill in your response in the blanks as and where appropriate. Thank you for your support in this regard.

If you have any further questions regarding this study, please do not hesitate to contact:

Kenneth Mwatu (0722 512 424)
Researcher
United States International University

===============================================================================

SECTION A: PREVALENCE OF FOOD WASTAGE IN THE SUPPLY CHAIN

1. How long has the enterprise been in operation? _______ years

2. Which of the following constitute your company’s core trade?
   - Fruits ☐ Please specify? ____________________________
   - Vegetables ☐ Please specify? ____________________________
   - Other products ☐ Please specify? ____________________________

3. Which of the following forms of food waste or loss does your business incur most often? Please tick all that apply.
   Deterioration in quality/quantity due to:
   - Rotting ☐
   - Spillage ☐
   - Bruising ☐
   - Deformity ☐
   - Wilting ☐
   - Overripe ☐
   - Decomposing ☐
   - Insect damage ☐
   - Other (please list?) ______________________________________

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4. Approximately how much quantity of fruits/vegetables did you reject/return to your suppliers last month because of the following reasons? Please estimate in Kilograms.

- Rotten: _______ Kgs
- Spilled: _______ Kgs
- Bruised: _______ Kgs
- Deformed: _______ Kgs
- Wilted: _______ Kgs
- Overripe: _______ Kgs
- Decomposed: _______ Kgs
- Insect damaged: _______ Kgs

5. Approximately how much quantity of fruits/vegetables did your customers reject/return to you last month because of the following reasons? Please estimate in Kilograms.

- Rotten: _______ Kgs
- Spilled: _______ Kgs
- Bruised: _______ Kgs
- Deformed: _______ Kgs
- Wilted: _______ Kgs
- Overripe: _______ Kgs
- Decomposed: _______ Kgs
- Insect damaged: _______ Kgs

SECTION B: EFFECT OF INBOUND LOGISTICS ON FOOD WASTAGE

Please indicate whether you agree or disagree with the following statements

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<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
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<tr>
<td>6. Suppliers sometimes delay to deliver goods on time</td>
<td></td>
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<tr>
<td>7. There are incidences where the goods we ordered have been delivered at the wrong location</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>8. The paperwork involved in the purchasing process sometimes take too much time</td>
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<td>9. Some of our suppliers handle the goods carelessly while in transit or when unloading.</td>
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<td>10. Information flow to and from our suppliers is not as good as it should be</td>
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<td>11. All the supplies are inspected thoroughly on receiving</td>
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<td>12. We maintain a daily receiving report for all goods we procure</td>
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<td>13. We have cold storage facilities suitable for each type of goods we store in our warehouse</td>
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<tr>
<td>14. The storage facilities at our disposal are adequate to prevent food wastage due to spoilage</td>
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<tr>
<td>15. We regularly inspect storage facilities to control pests and flies and other contaminants</td>
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</table>

16. What is the greatest challenge you face with in-bound logistics for which you would wish to be improved?

________________________________________________________________
________________________________________________________________

SECTION C: EFFECT OF OPERATION ON FOOD WASTAGE

Please indicate whether you agree or disagree with the following statements

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
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</thead>
<tbody>
<tr>
<td>17. Sometimes packaging process is fraught with delays</td>
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<td>18. Some of the products are not handled with care by in-house staff</td>
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<td>19. We have the right equipment for handling goods while sorting, weighing and packaging them.</td>
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<td>20. The right temperature of chillers is maintained at all times</td>
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</table>
21. There is a seamless flow of products from one stage to the next during operation

22. First-in first-out method is used to ensure that all goods are released while still fresh

23. We undertake regular analysis of the physical state, size and weight of the fruits/vegetables to control quality

24. All our food handlers are trained on food quality and safety procedures

25. We forecast demand in order to maintain the right quantity of inventory at all times

26. What is the greatest challenge you face during operations for which you would wish to be improved? ______________________________________
   ______________________________________
   ______________________________________
   ______________________________________

SECTION D: EFFECT OF OUTBOUND LOGISTICS ON FOOD WASTAGE

Please indicate whether you agree or disagree with the following statements

<table>
<thead>
<tr>
<th>27. Sometimes the time taken to process customer orders is too long</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
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<tr>
<td>28. We always fulfill orders as per customer specification</td>
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<td>29. Sometimes goods in transit take delay to reach customers</td>
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<td>30. We have competent manpower to handle all customer orders</td>
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<td>31. We find market for all fruits/vegetables rejected or returned by our customers</td>
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<td>32. All our delivery vehicles have refrigeration facilities</td>
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<td>33. We have a close partnership with efficient shipping companies</td>
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<td>34. We use mechanized loading and offloading</td>
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<td>35. Our storage and operation facilities allow us the flexibility needed to market changes in demand</td>
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<td>36. All customer orders are delivered without damage or spoilage</td>
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</table>

37. What is the greatest challenge you face in your quest to avoid food wastage in the process of fulfilling customer orders? 

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________________________________________________________________________
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Thank you for your time and cooperation