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The Influence of Green Logistics, Food Distribution Strategy on Post-Harvest Loss Reduction: The Moderating Effect of Facility Location

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Abstract

Purpose – *This paper aims to investigate the input of green logistics and food distribution strategy on post-harvest loss reduction: the moderating effect of facility location.*

Design/method/approach – *using an explanatory research design, the study relied on primary data from a questionnaire survey. Questionnaires were self-administered to the extension officers and farmers in the agriculture industry of Ghana, the management in the freight forwarding companies and the local food distribution companies. A total sample size of two hundred and thirty-eight (238) was used for the analysis.*

Findings – *The study indicates that green logistics positively and significantly influences post-harvest losses. Food distribution strategy has a positive and considerable influence on post-harvest loss reduction. Facility location was found to positively and significantly moderate the relationship between food distribution strategy and post-harvest loss reduction. Additionally, facility location was found to positively and significantly mediate the relationship between green logistics and post-harvest loss reduction.*

Research implications – *The study's findings indicated that organisations can achieve good green logistics if they are committed to using environmentally friendly technology.*

Originality/value – *This is an original study based on primary data from the agriculture industry of Ghana, the management of the freight forwarding companies in Ghana and the local food distribution companies.*

Keywords: *Green Logistics, Food Distribution Strategy, Post-Harvest Loss Reduction, Facility Location*

1.0 INTRODUCTION

The concept of green logistics has attracted wide interest that every country is in the state of promoting the concept (Fahimnia, Sarkis and Davarzani, 2015). Rodrigue, Slack and Comtois (2013) defined green logistics as the practices and strategies of the supply chain management which aims to reduce environmental effects and energy consumption caused cargo handling, waste handling, packaging and transportation. The consumer awareness about the impact of food production, processing and distribution on the health has increased and there is the need to for integrating green logistics practices into the supply chain management of agri-food products (Fahimnia, Sarkis and Davarzani, 2015).

The government, industries and nongovernment organizations (NGOs) are promoting the eco-friendly products for protecting the environment. Also, the protection of the environment is an ethical itself. The industries are planning their environmental programs by incorporating green logistics practices to play their role to avoid long-term damage to the planet and are interested in identifying and evaluating the drivers or performance indicators or critical success factors accountable for the green logistics management implementation. It may be noted that the organizational environmental commitment provides a competitive advantage and also ensures sustainable development. Green logistics practices also ensure waste reduction, energy consumption reduction, environmental degradation reduction and improves the overall supply chains performance (Choudhury et al., 2018; Gardas and Narkhede, 2013; Gardas et al., 2015).

The agri-food supply chain management involves a series of activities and processes during the flow of the food products from farm to fork (Dinu, 2016; Shukla and Jharkharia, 2013). The factors affecting new agri-food supply chains such as globalisation, technological innovations, trade agreements, consumer awareness and environmental concerns, raise serious economic, environmental, and social concerns (Shukla and Jharkharia, 2013). The global population is presumed to reach 9.70 billion, and the demand for food is prognosticated to rise in the span of 59.0 to 98.0 per cent by the year 2050 (Elferink and Schierhorn, 2016; Tsolakis et al., 2014). It may be noted that there is a significant pressure on food supply chains to ensure the availability of food, and for fulfilling its demand.

A study that seeks to examine the moderating role of facility location on the relationship between green logistics and post-harvest loss reduction is one that cannot be overemphasized. There have been several studies on green logistics. Khan, Yu and Nathaniel (2020) analyzed the relationship between green logistics operations, national economic and environmental indicators. The findings of this study indicate that green logistics business has a positive and statistically significant relationship with foreign direct investment inflows, renewable energy consumption, and energy demand.

On the other hand, there is a significant negative correlation between CO2 emissions and green logistics. Reyes et al. (2016) considered lean and green in the transport and logistics sector. The results obtained indicate that deployment of the green and lean paradigms is an effective approach to improve both operational efficiency and environmental performance of road transport operations. Ramanathan et al. (2014) suggest use of collaboration to reduce CO2e. There is significant evidence in the literature on attempts made in reducing the CO2e associated with food supply chain in the developed countries but less attention is given to those in the developing countries specifically Africa (Oglethorpe and Heron, 2013; Ramanathan et al., 2014). There is the need to look at the influence of green logistics and post-harvest loss reduction and therefore this study sought to analyze the influence of green logistics and post-harvest loss reduction.

Caixeta-Filho (2018) investigated losses in the transportation of fruits and vegetables and results indicate that implementation of new technological options for diminishing losses would first benefit the consumer at the wholesale market. Parmar, Hensel and Sturm (2017) considered post-harvest handling practices and associated food losses and limitations in the sweet potato value chain of southern Ethiopia and results show that Harvest and handling at farm level and shelf-life issues at distribution were identified as vulnerable hot-spots of the sweet potato food losses. Wu (2017) empirically analyzed factors influencing rice harvest losses based in China. Gunasekera (2017) further investigated post-harvest loss reduction in Asia-Pacific developing economies and the results indicate that limited access to vital farm inputs and credit, poor infrastructure and lack of technical and market information are some of the critical challenges confronting many small farmers in developing economies and suggested that a further work is urgently required to collect more up-to-date data on food losses along the food supply chain, including post-harvest losses, in many economies across the world. This necessitated this study to consider the moderating role of facility location on the relationship between green logistics and post-harvest loss reduction.

Shi, Zhang and Qu (2016) assessed optimizing distribution strategy for perishable foods. Wang, Yang and Hou (2019) investigated risk management in perishable food distribution operations. None of the studies considered the influence of food distribution on post-harvest loss reduction. This necessitated this study to examine the influence of food distribution strategy on post-harvest loss reduction and the extent in which facility location moderating the relationship between food distribution strategy and post-harvest loss reduction.

2.0 LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Green logistics and post-harvest losses reduction

Currently, there is a global and interconnected system in food industry that has various complex relationships for the logistics management of food products, because of consumers' concerns related to food safety scandals and globalization of food production (Trienekens and Zuurbier, 2008). Also, food security is still a considerable problem due to the growing population which is projected to reach 9Billion by 2050 (Global Food Security, 2012) that necessitates emphasis on the reduction of food waste. In Food Supply Chains reaching the right customer (higher revenue) at the right level of quality, with the appropriate remaining shelf life and with the proper routing through the chain are crucial factors for solidifying and maintaining competitive advantage (Ahumada and Villalobos, 2011). However, this claim needs to be extended when sustainability concerns are involved in decision making. Thereby, the ultimate goal in a sustainable Food Supply Chain is ensuring customer satisfaction with the most efficient/effective way possible while being aware of the impacts of operations on the environment and society.

In view of this, the consideration is relation to cover the core issues in sustainable food logistics management in three groups: cost reduction and improved responsiveness, improved food quality and a reduction of food waste, and improved sustainability and transparency. Moreover, some scholars believe that the use of advanced IoT equipment and quality vehicles can reduce food safety risks during the distribution process (Pal and Kant, 2018; Tsang et al., 2018). In addition, the optimization of the distribution path is also the focus of scholars. A class of VRP can be found in Eksioglu et al. (2009). Hsu et al. (2007) extended the VRP to include time windows by considering randomness in the perishable food delivery process and constructing an SVRPTW model to obtain optimal delivery routes, loads, fleet dispatching schedules and departure times for delivering perishable food from a distribution center.

Osvald and Stirn (2008) dealt with the problem of distributing fresh vegetables with time windows and time-dependent travel times, in which the travel times between two locations depend on both the distance and the time of the day. Rabbani et al. (2015) proposed a multi-objective mixed integer non-linear programming model to maximize the total freshness of several products to be delivered to customers with respect to their demands while considering different soft time windows for each customer. Song and Ko (2016) examined a VRP that encompasses both refrigerated and general-type vehicles for multi-commodity perishable food product delivery. Li et al. (2017) presented an extended production inventory routing model for handling perishable food for which the quality is explicitly formulated. Wang et al. (2018) proposed a multi-objective VRP optimization model with different time windows and perishability to minimize the

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distribution costs and maximize the freshness of perishable products. Chao et al. (2019) proposed a two-stage location–routing–inventory problem with time windows for food products. The first stage corresponds to a location–routing–inventory problem with time windows, and the second stage is the transportation problem with vehicle capacity constraints. Risk management is receiving increasing attention, especially in fresh food supply chain operations. Food safety risks have also been quantified in many ways from different perspectives, and scholars have expressed different opinions on how to control risks. As seen in the above literature, it is therefore proposed that:

H1: Green logistics has a positive and significant effect on post-harvest losses reduction

2.2 Food Distribution and Post-Harvest Losses Reduction

Food chain logistics comprises organisations that are responsible for the production and distribution of vegetable or animal-based products. These products can be fresh (such as vegetables, flowers and fruit) or processed (such as portioned meats, snacks, desserts and canned food products). In general, these chains may comprise growers, auctions, wholesalers, importers and exporters, retailers and specialty shops and their input and service suppliers. In fresh supply chains, the main processes are the handling, conditioned storing, packing, transportation and especially trading of goods. Basically, these supply chain steps leave the intrinsic characteristics of the product grown or produced in the countryside untouched. In processed food supply chains, agricultural products are used as raw materials for producing consumer products with higher added value. In most cases, conservation and conditioning processes extend the shelf life of the agricultural and consumer products.

Bourlakis and Weightman (2004) and van der Vorst, Tromp, and van der Zee (2009) discuss a list of specific process and product characteristics of food chains that impact the (re)design process, including the following: Seasonality in production, requiring global sourcing; Variable process yields in quantity and quality due to biological variations, seasonality and random factors connected with weather, pests and other biological hazards; Keeping quality constraints for raw materials, intermediates and finished products, and quality decay while products pass through the supply chain. As a result, there is a chance of product shrinkage and stock-outs in retail outlets when products' best-before dates have passed and/or product quality level has declined too much; Requirement for conditioned transportation and storage means (e.g. cooling) and Necessity for lot traceability of work in process due to quality and environmental requirements and product responsibility.

Due to these specific characteristics of food products, it is vital for industrial producers to contract suppliers to guarantee the supply of raw materials in terms of the right volume, quality, place and time. Actors in food chain logistics understand that products are subject to quality decay as they traverse the supply chain, while the degree and speed of decay may be influenced by environmental conditions.

Next to this, companies operating in the food sector are confronted with (i) accelerating environmental and social impact assessment policies and standards (such as the risk inventory Hazard Analysis and Critical Control Points, the British Retail Consortium (BRC) Global Standards programme and the ISO 22000 standard on food safety management systems); (ii) the emerging concept of extended producer responsibility supporting the shift from 'seed to meat' to 'cradle to cradle' (the philosophy that all used materials after life can be useful again in another product) and (iii) increasing preoccupation in society to live well without compromising future generation's rights to prosper. Consequently, it is important that actors in food chains obtain a 'licence to produce and deliver'; that is, society has to accept the way they produce and deliver goods. The argument raised is establishing that:

H2: *food distribution has a positive and significant effect on post-harvest losses reduction*

2.3 Green Logistics: Food Distribution and Post-Harvest Losses Reduction

The concept of green logistics has attracted wide interest (Fahimnia, Sarkis, and Davarzani 2015). Rodrigue, Slack, and Comtois (2001a) define green logistics as the practices and strategies of supply chain management which aim to reduce environmental effects and energy consumption caused by cargo handling, waste handling, packing and transportation. According to Byrne and Deeb (1993), the difference between traditional and green logistics includes reverse logistics and re-use of materials. van Hoek (1999) suggests green logistics is not enough, and that a supply chain perspective is needed. According to Srivastava (2007), green SCM notices connections and effects between natural resources and supply chain management. The benefits of green logistics are generally accepted (Meixell and Gargeya 2005). Lower energy consumption and cost savings caused by reduced fuel and resources are typical benefits. Implementation details vary, as do the required investments for changes.

Food supply chains have not only an essential role in the global economy (Ghosh 2010; Baldwin 2012) but also in global ecology. Food is produced and consumed in every part of the world, and at the same time resources are needed and emissions produced. Food chains are typically quickly delivered and have large production and market volumes. Compared to other supply chains food systems have some special supply chain managerial characteristics (Bourlakis and Weightman 2004). These include short shelf-life time of the products and high demand for traceability and low-cost pressure (Opara 2003). According to Cohen and Garrett (2010), vulnerability and food safety are global issues. Consumers need information about environmental effects, and sustainable supply chain evaluation is needed (Adams and Larrinaga-González 2007; Nissinen et al. 2007).

These aspects increase interest in and need for green logistics research. A share of 13.5% of global emissions is caused by transportation (World Resource Institute 2011). Vehicle, load capacity, return and distance have environmental effects. The concept of the food mile (Pretty et al. 2005) describes the cumulative distance of parts of the food supply chain. Usually, food miles correlate with environmental effects. The structures of food logistics are more integrated (Gimenez 2006) and hub distribution centre distribution networks are usual. Based on industrial surveys, logistics costs create 10% to 15% of the price of the food product. This makes food logistics an interesting topic among producers and retailers. Food supply chain sustainability development is also of interest to companies (Hamprecht et al. 2005).

Food production caused 1.2MCO_2 equivalent tons of emissions at the global level in 2003. About 40% of Finnish food supply chain CO_2 equivalent emissions, equal to 472,000 tons, was produced in terminals or markets because of the used electric and warming energy. Transportation caused a further 27%, which is equal to 329,000 tons of emissions (Päivittäistavarayhdistys ry 2008). From the supply chain distribution structure point of view, food production occurs in different places compared to food consumption. In order to illustrate this, we can analyse the case of Finland.

In addition to this, the role of food logistics is especially important in Finland because most food products produced in Finland are transported to retailers' distribution centres in the Helsinki area for order collection, which means many food products travel long distances before eating or wasting. Most food produced anywhere in Finland is directly transported from factories to retailers' distribution centres. The arguments above suggest that:

H3: *facility location positively and significantly moderates the relationship between food distribution and post-harvest losses reduction*

2.4 Moderating Role of Facility Location On The Relationship Between Green Logistics And Post-Harvest Losses Reduction

Food supply chains produce Greenhouse gases (GHGs), mainly CO2e, throughout all the stages of the life cycle from farming processes through to warehousing, production, storage, distribution, retailing, consumption and disposal of waste. Many studies have examined the CO2e generated throughout a Food Supply Chain; e.g. Garnett (2011); L_opez et al. (2015); Porter et al. (2018) and Vitali et al. (2018). There is significant evidence in the literature on attempts made in reducing the CO2e associated with Food Supply Chain (Gadema and Oglethorpe, 2011; Oglethorpe and Heron, 2013; Ramanathan et al., 2014). Ramanathan et al. (2014) suggest use of collaboration to reduce CO2e; Oglethorpe and Heron (2013) and Hendry et al. (2019) advocate local Food Supply Chain; and Gadema and Oglethorpe (2011) focus on carbon labelling and carbon footprint.

Modern FSC entails many stages and mostly spans multiple nations and continents (Schoenherr et al., 2015). In that regard, examining the food supply of a country needs a holistic perspective, taking into account where the food is grown and what stages are involved through to the final consumer. Nevertheless, food miles – the distance from farm to the fork of the final consumer (Moxham, 2004; Pullman and Wikoff, 2017) have played a role as a relative CO2e indicator. Conversely, Coley et al. (2011) question the use of food miles as a driving force for communicating the value of CO2e. Likewise, early research by Watkiss (2005) argued that a single indicator based on food miles (total food distance) is an inadequate indicator. So, estimating CO2e associated with the entire FSC needs to be assessed through a wider lens, taking into consideration all stages of the FSC in communicating the "true" value of CO2e arising across every activity that contributing to producing and consuming the food item. This will enable tailoring appropriate measures to tackle that stage or factor within the FSC while stakeholders make wiser decisions.

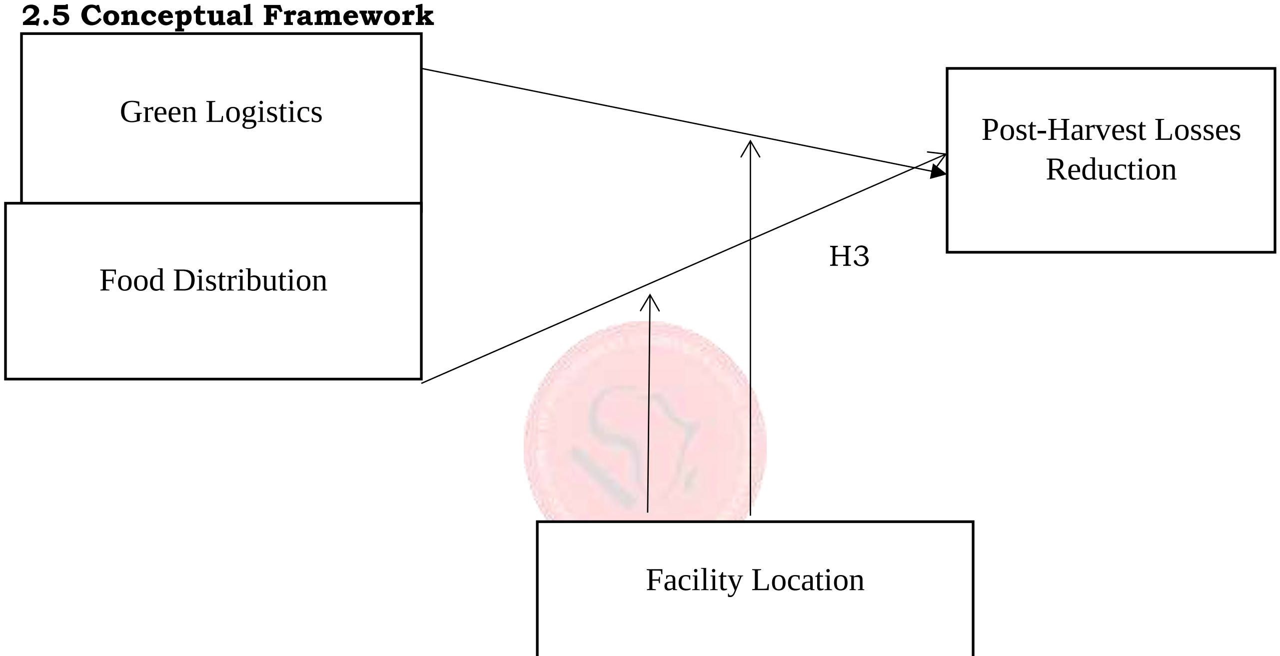
The UK's FSC emits between 152Mt CO2 and 159Mt CO2 (Audsley et al., 2010), which makes up 20% of the overall UK total emission. Further, in 2014, UK FSC CO2e increased and was responsible for 176 million tonnes of CO2e (Tassou et al., 2014). Bates et al. (2019) claim that food consumption generates 30% of the environmental impacts of households, while the Committee on Climate Change (2019) estimated UK's consumption related CO2e as 784 MtCO2e. This is a significant contribution to the UK's total CO2e and calls for urgentattention. Food is imported from across the globe and the UK shift from manufacturing to services is one reason for the drift in CO2e in the UK FSC (Baiocchi and Minx, 2010).

Among the food imported by the UK, fruit and vegetables are the leading food import in terms of trade value and CO2e. Fruits and vegetables have overtaken food items such as sugar, coffee, fish cereal, meats and beverages (Defra, 2017b). Fresh fruit and vegetables are supplied by various local and global producers to help maintain price stability and resilience of food supply, while also complementing domestic production. Fruits and vegetables imported by the UK were estimated at £5.2bn in 2015 as against

£199 million for export with the EU countries (namely the Netherlands, Germany, France and Spain) supplying 40% of the fruit and vegetables. The remaining 60% are supplied by Africa, Asia and the rest of the world (AHDB, 2016). Fruit and vegetables produced in the UK is less than 10% (Defra, 2017b); therefore, large volumes of fresh fruits and vegetables are imported into the UK regularly, leading production of significant amount of CO2e yearly. Previous studies reveal that the UK fruits and vegetables supply is responsible for about 2.5% of the UK GHG emissions. Based on the arguments raise, it is therefore proposed that:

H4: facility location positively and significantly moderates on the relationship between green logistics and post-harvest losses reduction

2.5 Conceptual Framework



3.0 METHODOLOGY

3.1 Data

To test for the hypotheses, this study utilized data from extension officers and farmers in the agriculture industry of Ghana, the management in the freight forwarding companies and the local food distribution companies. A total of 300 questionnaires were administered to the extension officers and farmers, freight forwarding companies and local food distributors. The final analysis was based on the usable that was received within the stipulated time frame 238 representing 79%.

3.2 Measurement of Variables

A 8-item scale that was used to measure post-harvest loss reduction was adopted from (Gunasekera, Parsons and Smith, 2017). The post-harvest loss reduction was regarded as first order construct. The packaging of post-harvest loss reduction comprised of 3 items, storage of post-harvest loss reduction comprised of 2 items and transportation of post-harvest loss reduction comprised of 3 items. 14 items used to measure facility location was adopted from (Gunasekaran, 2001). The cost of facility location comprised of 2 items, productivity of facility location comprised of 2 items, service time of facility location comprised of 3, flexibility of facility location comprised of 3 items and quality of facility location comprised of 4 items. 16 items used to measure green logistics was adopted from (Pazırandeh and Jafarı, 2013). Environmental operations of green logistics comprised of 4 items, operation positive economic of green logistics comprised of 3 items, operational negative economic of green logistics comprised of 3 items, operational green of green logistics comprised of 2 items, collaboration customers/suppliers for green logistics of green logistics comprised of 2 items and green product design of green logistics comprised of 2 items. 5 items used to measure food distribution strategy was adopted from (Chandrasekaran and Ranganathan, 2017).

3.3 Model of Assessment

The study analyzed the data based on structural equation modeling using Analysis of Moment Structures (AMOS). AMOS-SEM is distinct analytical software that makes it possible to analyze complex models with many constructs, indicator variables and structure paths. The AMOS-SEM comprises of two basic assessments: the measurement model and structural model. The study also checks the data validity and reliability tests.

4.0 RESULTS AND ANALYSIS

Reliability is said to be particular important when latent variables are calculated from underlying item scales. Since these scales consist of a group of interrelated items designed to measure underlying constructs, it is important to establish whether the same set of items would extract the same responses if they were re-administered to the same sample group on more than one occasion. Variables derived from test instruments are only said to be reliable when it is clear that they elicit stable responses over multiple measurements of the instrument's surveys (Bhattacherjee, 2012). Cronbach's Alpha coefficient was used as a measure of internal consistency-reliability of the scale used in this study. Cronbach's Alpha is a measure of internal reliability for multi-item summated rating scales. Its values range 0 and 1, where the higher the score, the more reliable the scale. A coefficient reliability of 0.70 or higher indicated that the instrument used is reliable (Cronbach, 2004).

Also, in order to analyze the data in relation to ascertain the validity threshold, the measurement of the response using Kaiser Mayer Olkin test to be certain that the data is acceptable to proceed to the inferential statistics to make fair and valid conclusions. Kaiser (1974) proposes that values above 0.5 are acceptable and appropriate. In a situation that the value is less than 0.5, then there is a need to collect additional data or reconsider which variable is to take into consideration. The table 4.1 presents the results on the reliability and the validity of the constructs.

Table 4.1 Reliability and Validity Results

Variable	**Loadings**	**KMO**	**Cronbach's Alpha**
Green Logistics		**.685**	**.785**
ENOP01	.603		
ENOP02	.824		
ENOP03	.719		
ENOP04	.684		
OPEC01	.832		
OPEC02	.780		
OPEC03	.433		
ONEC01	.726		

ONEC02	.585		
ONEC03	.717		
OPG01	.647		
OPG02	.778		
CCGL01	.603		
CCGL02	.558		
GDP01	.746		
GDP02	.781		
Facility Location		**.682**	**.812**
FLC01	.637		
FLC02	.801		
FLP01	.590		
FLP02	.760		
FLST01	.737		
FLST02	.698		
FLST03	.735		
FLF01	.820		
FLF02	.760		
FLF03	.606		
FLQ01	.748		
FLQ02	.703		
FLQ03	.813		
FLQ04	.740		
Post-Harvest Losses		**.709**	**.827**
PCK01	.727		
PCK02	.719		
PCK03	.686		
ST01	.816		
ST02	.775		
TRSP01	.740		
TRSP02	.678		
TRSP03	.707		
Food Distribution		**.851**	**.880**
FD01	.768		
FD02	.820		
FD03	.860		
FD04	.910		
FD05	.764		

The Cronbach's Alpha is the basic measure of the reliability which indicates relative reliability of each factor as a scale. The sufficient value of Cronbach's Alpha is 0.6 (Nunnally, 1967). In order to improve the reliability, items with values less than 0.6 not for the first time are to be eliminated. All of the reliability coefficient values in this study are above 0.7 which show that each factor is sufficiently reliable measure. The suitability of the sample was tested by applying KMO measure. The KMO values are also generally acceptable because Kaiser (1974) proposes that values above 0.5 are acceptable.

The two results of the second order confirmatory factor analysis are the determination of factor loading of each item and factors that develop scale. Initially, the researchers provided four factor that involve 43 items, but based on the threshold of 0.7, 33 valid items were selected to perform the convergent and discriminant validity. Thus, during the validation process, items with factor loading less 0.7 were subsequently removed.

4.1 Construct Validity

According to Furr & Bacharach (2003) construct validity refers to an extent to which the measurement score reflects latent construct to be measured. Meanwhile, Hair et al. (2019) define construct validity as an approach to make sure that a set of variables represents the theoretical latent construct which is being measured. Fornell & Larcker (1998), Agarwal (2013) note that construct validity of confirmatory factor analysis includes two main tests, namely convergent validity test and discriminant validity test. Campbell & Fiske (1959) describe that convergent and discriminant validity are essential requirements on every instrument development to obtain accountable data psychometrically. Accordingly, this research reported both convergent and discriminant validity.

Table 4.2 Convergent, Discriminant and Composite Reliability

Constructs	Loadings	AVE	DV	CR
Green logistics				
ENOP02	0.824	**0.589**	**0.768**	**0.928**
ENOP03	0.719			
OPEC01	0.832			
OPEC02	0.78			
ONEC01	0.726			
ONEC03	0.717			
OPG02	0.778			
GDP01	0.746			
GDP02	0.781			
Facility Location				
FLC02	0.801	**0.573**	**0.757**	**0.929**
FLP02	0.76			
FLST01	0.737			
FLST02	0.698			
FLST03	0.735			
FLF01	0.82			
FLF02	0.76			
FLQ01	0.748			
FLQ02	0.703			
FLQ03	0.813			
FLQ04	0.74			
Post-Harvest Losses				
PCK01	0.727	**0.536**	**0.732**	**0.902**
PCK02	0.719			
PCK03	0.686			
ST01	0.816			
ST02	0.775			

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TRSP01	0.74			
TRSP02	0.678			
TRSP03	0.707			
Food Distribution Strategy				
FD01	0.768	**0.683**	**0.826**	**0.915**
FD02	0.82			
FD03	0.86			
FD04	0.91			
FD05	0.764			

Igbaria et al. (1997) demonstrated that a variable is of good fit if the latent variable shows the factor loading of > 0.50. Haire et al. (2019) recommended that an Average Variance Extracted (AVE) as convergent validity measure since AVE could explain the degree to which items are shared between the construct in Structural Equation Modeling (SEM) where AVE 0.5 or more are acceptable as convergent validity. The scale development in this study involved four constructs namely Green Logistics, Facility Location, Post-Harvest Loss Reduction and Food Distribution Strategy. The result shown that the AVE values for the four constructs respectively were 0.5899, 0.5729, 0.5362 and 0.6827. As all the constructs were within and above the threshold of > 0.05, it is concluded that they could measure the latent variables. Hence, they fulfilled the convergent validity criteria.

Haire et al. (2019) stated that discriminant validity could be established by correlating one construct to another. If the correlation value of both constructs is lower than 0.85, it means that the discriminant validity exists. Besides, Furnell and Larker (1981) argue that discriminant validity exists if latent variable shows more variance on related indicator variable rather than share with other construct in the same model.

Table 4.3 correlation among the constructs

Constructs	FD	PHL	FL	GL
FD	1	.713**	.625**	.373**
PHL	.613**	1	.660**	.416**
FL	.625**	.660**	1	.466**
GL	.373**	.416**	.466**	1

The results presented in the table 4.4 indicate that the correlation value of both constructs is lower than 0.85, it means that the discriminant validity exists according to Haire et al. (2019). Also, the Post- Harvest Loss Reduction AVE of: 0.7322, Food Distribution Strategy AVE of 0.8263, Green Logistics AVE of 0.7681 and Facility Location of 0.7569 were greater than the inter-construct correlation therefore the four constructs had fulfilled the criteria of discriminant validity and reliability.

4.2 Testing of the Hypotheses

In order to test to ascertain the magnitude in which the independent variables influence the dependent variable and also the extent in which the moderating variable is moderating on the relationship between the dependent and the independent variable, Amos version 24 was used. The issues considered were the influence of green logistics on post-harvest loss reduction, the influence of food distribution strategy on post-harvest loss reduction, the moderating effect of facility location on the relationship between food distribution strategy and post-harvest losses reduction and finally, the

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moderating effect of facility location on the relationship between green logistics and post-harvest loss reduction.

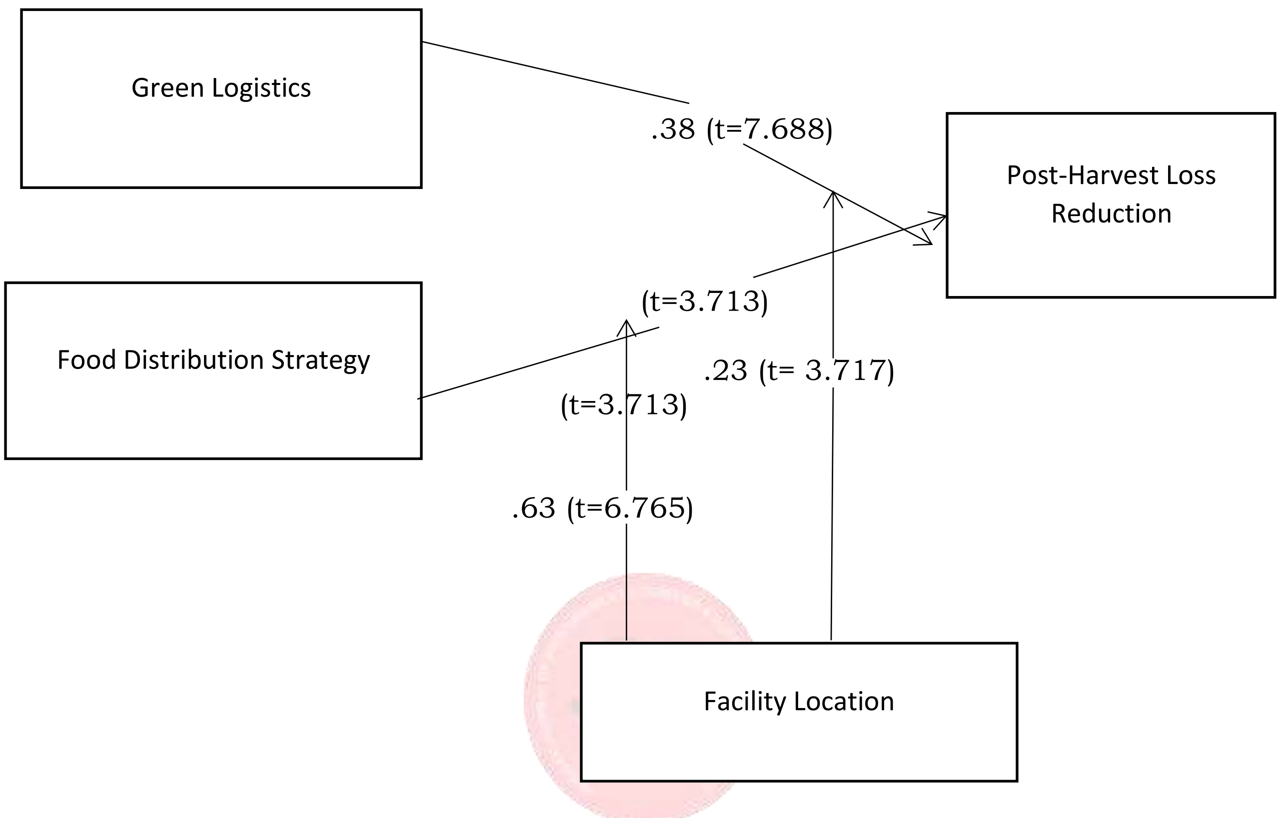

Figure 4.1 Hypothetical Model And Results

The study first considered the influence of green logistics on post-harvest loss reduction and the findings of the study indicate that green logistics can overall influence post-harvest loss reduction of about 38%. This explains that an increase in green logistics activities is extremely important for organizations to achieve positive results on post-harvest loss reduction. Therefore, organizations or a nation seeking to improve on post-harvest loss reduction must think of green logistics. The influence of green logistics on post-harvest losses, the (path coefficient estimate of .376; standard error of .049; critical ratio of 7.688; $p < .000$) statically indicate that green logistics has a positive and significant effect on post-harvest losses.

Then next hypothesis tested was the influence of food distribution strategy on post-harvest losses and the statistical results show that food distribution can overall influence post-harvest losses of about 25%. This also explains that effective and efficient food distribution can help to reduce post-harvest losses of about 25%. The influence of food distribution on post-harvest losses, the (path coefficient estimate of .249; standard error of .067; critical ratio of 3.713; $p < .000$) statically indicate that food distribution has a positive and significant effect on post-harvest losses reduction.

The third issues considered the moderating role of facility location on the relationship between food distribution and post-harvest losses and the statistical results show that facility location can overall moderate on the relationship between food distribution and post-harvest losses of about 68%. This also then explains that facility location is strongly facilitating the relationship between food distribution and post-harvest losses. The moderating role of facility location on the relationship between food distribution and post-harvest losses, the (path coefficient estimate of .634; standard error of .094; critical ratio of 6.765; p < .000) statically indicate that facility location positively and significantly moderates on the relationship between food distribution and post-harvest losses reduction.

Finally, the study also considered the moderating role facility location on the relationship between green logistics and post-harvest losses and the statistical results show that facility location can overall moderate the relationship green logistics and post-harvest losses of about 23%. This is explaining that facility location can help to improve on green logistics and post-harvest losses of about 23%. The moderating role of facility location on the relationship between green logistics and post-harvest losses, the (path coefficient estimate of .229; standard error of .062; critical ratio of 3.717; p < .000) statically indicate that facility location positively and significantly moderates on the relationship between green logistics and post-harvest losses.

Table 4.4 Regression Weights Results

Paths	**Estimate**	**S.E.**	**C.R.**	**P**
Green Logistics ---> Post-Harvest Losses	.376	.049	7.688	***
Food Distribution--- >Post-Harvest Losses	.249	.067	3.713	***
Facility Location ---> Food Distribution *Post Harvest Losses Reduction	.634	.094	6.765	***
Facility Location ---> Green Logistics *Post-Harvest Losses Reduction	.229	.062	3.717	***

4.3 Discussions of Results

The study examined the influence of green logistics on post-harvest losses and the findings of the study indicated that green logistics has a positive and significant effect on post-harvest losses. (Wang et al., 2018) posit that logistics is the only system that is used to plan, organize and control the flow of goods, materials and services from their point of origin or source to their destination or point of consumption. This means that proper logistics is to help the agriculture industry to plan ahead before the crops and the vegetables are harvested so they can be transported to their point consumption on time to avoid food waste and losses.

Logistics facilitates the delivery of four types of utility. It delivers goods, services and information needed by the customer (form utility), where the customer needs them (place utility), when needed (time utility), with ownership title (possession utility). Imagine if every customer has to do these by themselves, how adversely their individual efforts would impact the environment and resources utilization. Thanks to logistics organizations that have combined and absorbed these individual responsibilities for profit and positive social and environmental impacts (3BL). Nonetheless, this is only the cradle of logistics sustainability impact deeper applications and impacts are evident and discussed.

The application of green principles to logistics ensures a firm's logistics operations do not have adverse effect on the environment. Green logistics revolves around (not eliminating) the causes of environmental problems associated with business logistics functions. Green logistics is the process of greening the logistics functions such as transportation and shipping, warehousing and packaging. It deals with managing associated processes within transportation and shipping (e.g. routing and networking emissions intensity, energy efficiency, vehicle utilization efficiency, modal split, transportation intensity), warehousing (including design and practices) and packaging (namely design and materials), to ensure efficient resources utilization and lowest possible carbon footprint. It also includes logistics reverse logistics which is defined as post consumption logistics, including the process of collecting end-of-life products and transporting them for recycling , reuse or remanufacturing (Jabbour and de Sousa, 2016; Teixera et al., 2018).

The ultimate goal of green logistics is to among others reduce emissions, reduce the amount of waste products, reduce energy consumption align with environmental regulations and goals and increase awareness and motivate relevant stakeholders to practice the same. In literature, the aspect of shipping and transportation has been the main focal point as shipping and transportation is the most expensive component of logistics (Kovaks and Kot, 2016) and becsue shipping and transportation makes up 80-90 percent of the carbon footprint of logistics operations (McKinnon, 2010). In food supply chains reaching the right customer (higher revenue) at the right level of quality, with the appropriate remaining shelf life and with the proper routing through the chain are crucial factors for solidifying and maintaining ompetitive advantage (Ahumada and Villalobos, 2011).

Thereby the ultimate goal in a food supply chain is ensuring customer satisfaction with the most efficient/effective way possible while being aware of the impact operations on the environment and society. In view of this, the consideration is relation to cover core issues in food logistics management in three groups: cost reduction and improved responsiveness, improved food quality and reduction of waste and improved sustainability and transparency. The reasons provided by the scholars affirmed why green logistics has a positive and significant effect on post-harvest losses.

Also, the study assessed the effect of food distribution on post-harvest losses and the findings of the study indicated that food distribution has a positive and significant effect on post-harvest losses. Food chain logistics comprises organizations that are responsible for the production and distribution of vegetables or animal-based products. These can be fresh (such as vegetables, flowers and fruits) or processed (such as portioned meats, snacks, desserts and canned food products).

In general, these chains may comprise growers, auctions, wholesalers, importers and exporters, retailers and specialty shops and their input and service suppliers. In fresh supply chains, the main processes are the handling, conditioned storing, packing, transportation and especially trading of goods. In processed food supply chains, agriculture products are used as raw materials for producing consumer products with higher added value. In most cases, conservation and conditioning processes extend the shelf life of the agricultural and consumer products. Bourlakis and Weightman (2014) discuss a list of specific process and product characteristics of food chains that impact the (re) design process, including the following: seasonality in production, requiring global sourcing; variable process yields in quantity and quality due to biological variations, seasonality and random factors connected with weather, pests and other biological hazards.

Keeping the quality pass constraints for raw materials intermediates and finished products and quality decay while products pass through the supply chain. As results, there is a chance of product shrinkage and stock-out in retail outlets when products' best-before dates have passed and /or product quality level has declined too much. Requirement for conditioned transportation and storage means (e.g. cooling). Necessity for a lot of traceability of work in process due to quality and environmental requirements and product responsibility. Due to these specific characteristics of food products, it is

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vital for industrial producers to contract suppliers to guarantee the supply of raw materials in terms of the right volume, quality, place and time. Actors in food chain logistics understand that products are subject to quality decay as they traverse the supply chain, while the degree and speed of decay may be influenced by environmental conditions.

On the basis of the existing literature, the authors believed that food losses referred to reduction in the quantity and quality of edible food in the post-harvest supply chain and losses caused by human factors were called food waste. In the early 1990s, Zhejiang Academy of Agricultural Sciences (1991) subdivided the post-harvest grain losses of China into subsystems, i.e., harvest, threshing, transport, cleaning, drying, storage, processing, distribution and consumption. In food supply chains, there is a continuous change in the quality of the food product starting from the time the raw material leaves the grower (or e.g. the slaughter for meat products) to the time the product reaches the consumer (Dabbene et al., 2008).

Perishable products require special management that can deal with additional challenges such as temperature controls, quality decay modeling or waste reduction methods. Besides, current food supply chains are serving to consumers who are more concerned about food safety and security issues than ever before. Also, other stakeholders have growing concern on these issues leading to formation of global organizations dealing with food related problems the food and Agricultural Organ (FAO), the World Health Organization (WHO), both Un organs and the World Trade Organization than non-perishables and meet two criteria: high rate of deteriorating rate and an obsolescence date of the product. Regarding perishability issue van der Vorst et al. (2017) have proposed the innovative concept of Quality Controlled Logistics (QCL) and claimed that better supply chain design can be established, if product quality is tracked along the supply chain.

The study further examined the moderating role of facility location on the relationship between food distribution and post-harvest losses reduction and the findings of the study indicated that facility location positively and significantly moderate on the relationship between food distribution and post-harvest losses reduction. Decisions regarding facilities location are a crucial part of supply chain design (Chopra and Meindl, 2010). Location decisions are closely intertwined with capacity sizing and type decisions: together, they constitute a resource portfolio or network strategy. Facilities are the actual physical locations in the supply chain network where product is stored, assembled, or fabricated.

The facilities are the where of the supply chain. They are the locations to or from the inventory is transported. Within a facility, inventory is either transformed into another state (manufacturing) ot it is stored (warehousing) (Chopra and Meidl, 2010). The two types of facilities are production sites and storage sites. Location is the geographical positioning of an operation. Deciding where a company will locate its facilities constitutes a large part of the design of a supply chain.

Firm's regarding its choice of location of its warehouse is all supply design or strategic decisions. These decisions have a long term impact lasting several years. Consequently, when companies make these decisions, they must take into account uncertainty in anticipated market conditions over the next few years. Companies must consider a host of issiues related to the various characteristics of the local area in which the facility is situated. These include macroeconomic factors, quality of workers, cost of workers, cost of facility, availability of infrastructure, proximity to customers, the location of that firms other facilities tax and other strategic factors (Chopra and Meindl, 2010). A location strategy is a structured approach to deciding whwre to expand or contract capacity. It starts reviewing the competitive strategy: what is the value proposition to customers and shareholders. Then, the location decision must be aligned with the competitive strategy by comparing the priority rankings of competencies that location should provide, i.e., what is the relative importance of cost, quality, flexibility and responsiveness. This ranking guides how the various factors should be weighted in making the location decision. This means that the right facility location has a great tendency to influence food distribution and post-harvest losses reduction.

The study finally determined the moderating role of facility location on the relationship between green logistics and post-harvest losses reduction and the findings of the study indicated that facility location positively and significantly moderate on the relationship between green logistics and post-harvest losses reduction. Literature posits that the concept of green logistics has attracted wide interest (Fahimnia, Sarkis and Davarzani, 2015). Green logistics aim to reduce environmental effects and energy consumption caused by cargo handling, waste handling, packing and transportation. Tefera et al. (2011) studied the benefits of using metal silos in developing nations. The study reported that metal silos provide an effective storage technique for reducing post-harvest insect and pathogen losses. With either too expensive or frequently unavailable, economical storage techniques are needed. Metal silos are constructed from galvanized iron sheets are sealed.

It is effective in protecting harvested grain from insects as well as rodent pests. The silos are air tight and thereby kill any pest due to the lack of oxygen. Several steps are taken to ensure no pests or pathogens get into the silo for long durations. The costs for producing metal silos include metal sheet, labor and transportation. As the capacity of the silo increases, the cost per kg of grain decreases. Seeds are usually stored in small capacity silos, while grains for consumption in larger metal silos. Good storage facilities provide advantages such as maintain of the quality of the stored product; air tightness creates effective non-residual fumigation; avoids the use of insecticides; requires little space and can be placed inside or near the home significantly reduces post-harvest losses. Bulk storage is done in warehouses which are storage structures constructed for the protection for the protection of the quality quantity of the stored products.

5.0 CONCLUSTION

5.1 Managerial Implications

The findings of the study indicated that organizations can achieve good green logistics if they are committed to the use of environmentally friendly technology, ensuring of partnerships with green organizations and suppliers inputs, organize training program for green personnel, ensure that there are rules and obligations for green management within the organization itself, engage in green logistics practices, cooperate with customers for eco-friendly designs and reduce the use of dangerous products and processes. Management of some organizations believe that green logistics increase their investment by purchasing environmentally friendly raw materials but the management should note that the initial cost of green logistics materials will also go a long way to help them to reduce operating cost and energy consumption cost.

Moreover, management of organization should take note that their organizations can reduce post-harvest losses drastically when they provide an appropriate training on packaging, encourage their to undertake packaging and labeling consistent with standards required by the food importing countries, use suitable and utensils for packing such as basket and crates to avoid damage of fruits and vegetables as relevant, organize training to help understand and monitor product quality, especially the moisture content of the produce, use cooling facilities and ensure that appropriate temperature and relative humidity are maintained specific to the types of produce in a controlled atmosphere, use relevant protocols to avoid contamination of farm produce while being transported and delivered to markets/consumers , ensure cold storage during transportation as applicable to particular products and relevant to the distance from collection/sorting centers to market or distribution centers or consumers and use accredited partners and freight forwarders for the export of produce including international partners and freight forwarders for transport and logistics services for export trade.

Also, management of organizations will consider the huge cost involve of setting up facilities and may be reluctant to do so to reduce investment cost but organizations should not forget that facilities location will help them to reduce inventory costs, transportation costs, increase labor productivity, increase capital productivity, achieve good delivery lead time, response time, right time of delivery, orders visibility, good order return-ability, stock availability, delivery reliability, perfect order fulfillment, delivery in full and quality of service. Therefore management of organizations should consider the enormous benefits of having facilities in the right locations.

Management in organizations should also note that the logistics sector plays a significant role in economic development, while it also brings badness to environmental sustainability in the long run (Petrini and Pozzebon 2009). A panel study that was conducted by Aldakhil et al. (2018) to investigate the determinants of green logistics in BRICS member states. The findings show that green practices in logistics operations are positively correlated with sustainable economic and environmental growth. Lai et al. (2014) did a cross-sectional survey for three transport logistics sectors, namely, air and water transport, freight forwarding and third-party logistics. They found that all these sectors have a sustained impact on supply chain performance and logistics. Khan et al. (2018) conducted empirical research on developed countries in Europe in order to explore the impact of logistics performance on macro-economic and environmental indicators.

The results show that greater performance of logistics spurs country's economic growth but has a negative effect on environmental sustainability in terms of air pollution, climate change and global warming. Khan and Dong, (2017a) warned that government and regulatory authorities should bring strict environmental policies into force as soon as possible and also encourage renewable/green energy as an alternative of fossil fuel in manufacturing and logistics industry for better environmental sustainability. Otherwise, it will be very late to take actions to protect environment and will be impossible to restore natural resources. The adoption of green practices in logistics and supply chain operations emphasizes the waste reduction for better environmental performance, while green practices directly lead towards cost reduction, improving the efficiency of operations and performance (Jr et al., 2012; Ruamsook et al., 2019). Therefore, it is very imperative for organizations incorporate green practices in their activities to attain sustainability.

5.2 Recommendations

The institutions and regulatory bodies mandated to ensure good environmental practices should endeavor to create more awareness to sensitize companies to understand why they should embark on green activities to help them attain sustainability and avoid sanctions that can affect the good image of their organizations. The awareness will then go a long way to help our industries to understand why even foreign investors consider green practices before they decide to transact business with local industries. Without awareness creation, most companies may not know the enormous benefits associated with green practices and therefore it is quite imperative for institutional and regulatory bodies to intensify green practices awareness so that the industries in Ghana will embrace green practices to reduce the negative impact that their activities will have on the environment.

The government of Ghana should support the ministry of agricultural to put up ultra-modern storage facilities that can help to prolong the shelf life of food stuffs produced to help reduce post-harvest losses. Without a standard ultra-modern storage facility, shelf life of the food stuffs cannot be prolonged and therefore the country will continue to experience post-harvest losses because an attempt to increase food production will then trigger for huge post-harvest losses. Therefore, building ultra-modern storage facilities in the districts and regional levels will help the nation to mitigate post-harvest losses.

The policy makers should engage the stakeholders to help design safe practices that will promote environmentally friendly. The stakeholders' engagement will help the technocrats and engineers to adopt the right technological approach to design products and services that are more environmentally friendly and will help to reduce the negative impact their activities will have on the environment. For example, the freight forwarders will then use vehicles that are environmentally friend to reduce carbon emission into the environment.

5.3 Limitation and Suggestions For Future Studies

This study considered the green logistics, food distribution and post-harvest losses the moderating role of facility location therefore a future study can look at food distribution, post-harvest losses and food security the moderating role of stakeholder's engagement. Also, a future study can look at the effect of post-harvest losses on food stuff economic value. This study was solely a quantitative approach and therefore a future study can consider the application of mixed method approach. The study is also limited to only three regions out of the sixteen regions in Ghana therefore a future study can consider the sixteen regions of Ghana.

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