

The Impact of Logistics Management on Food Security in Ghana

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Abstract

The assurance that food insecurity is minimized with enabling logistics provisions is evident in the literature, however, the quantified relation between logistics management and food security was limited. This article examines the relationship between logistics management and food security, focusing on the efficacy of the Infrastructure for Poverty Eradication Program (IPEP) warehouses in coordinating Logistics in the agricultural sector. Using a multi-stage sampling technique, 384 smallholder farmers from two regions having access to the IPEP initiative were sampled, in the aftermath, regression analysis was performed. Contrary to the GSS, 2022 Annual Household Income and Expenditure Survey, which claims around 50 percent food insecurity, Ghana's food security has improved, with over 90 percent of foods produced now escaping post-harvest losses.

However, Logistics management has a weak relationship with Ghana's food security at $p=0.073$ and Pearson's $R=0.149$, indicating that Logistics management has a slight influence ($p=0.001$) on food security ($R^2=1\%$), and recent improvements in food security cannot be linked to its well-roundedness. Ninety-nine percent of the underlying food security cannot be correlated to effective logistics management; therefore, effective implementation of a national plan is essential to institute the IPEP as the fulcrum in carrying out this administrative responsibility for the optimum gain.

Keywords: Logistics Management, Food Security, Agricultural Sector, Infrastructure for Poverty Eradication Program (IPEP), Ghana

INTRODUCTION

An early evaluation of the Sustainable Development Targets 2030 (SDG2 targets 2.1 and 2.2) of the United Nations suggests that COVID-19 pandemic may have led to an increase in the number of undernourished individuals by 83 to 132 million people globally (Times of India 2020: 1). There are currently 282 million malnourished individuals in Africa, more than on any other continent, according to a report by Rédaction Africa news and AP (2020: 1).

While African governments are committed to boosting commerce and industry by implementing the African Continental Free Trade Area (AfCFTA) agreement, the continent still needs more logistical infrastructure and unlimited intra-African trade. A century after the introduction of the Western-styled logistics system to Africa, it has produced different outcomes than other regions (Adeleke 2022:1), as such, a logistics system, suited explicitly to Africa's socioeconomic conditions and the distinctive characteristics of its population must be developed to support the AfCFTA and mitigate the number of malnourished individuals on the African continent.

Food processing, value addition, proper storage logistics, and efficient distribution networks are just a few of the ways that food insecurity can be reduced (Adeyeye 2017:122). Due to rancidity and insufficient processing enterprises in Ghana, the majority of agricultural produce does not prosper in the value chain (Asiedu 2018). Given the nation's current expanding population, it is crucial to encourage logistics outside of the processing and value chain.

Planning, implementing, and controlling the efficient, and effective flow and storage of goods, services, and related information from the point of origin to the end of consumption to satisfy customer requirements is known as logistics management which is part of the supply chain process (Calixto 2016). It involves the integration of various activities, including transportation, inventory management, warehousing, material handling, packaging and security (Puri 2022) this term is all-inclusive in its definition. The movement of goods in a forward and reverse order is another crucial issue that logistics management considers, particularly the application of ICT; these sectors are given less priority in the agricultural industry.

Without a doubt, historical evidence shows that the native people of pre-colonial Africa established and managed an Indigenous Logistics System (ILS) to support intra-African trade and industry. The Indigenous Logistics System was developed using efficient resource management and local environmental expertise. Culture, values, trust, and brotherhood were the cornerstones of the system (Adeleke 2022) akin to the application of Ubuntu to a system.

Ubuntu is the bedrock upon which much African social policy is anchored (Mugumbate *et al.* 2023: 5), applying decolonization and indigenization to social work, practices and methods (Mupedziswa *et al.* 2019, Mugumbate *et al.* 2023: 6). However, the ILS has drawbacks such as irregular delays, poor communication, dangerous tracking methods, and no insurance. The ILS would be positioned as the solution to the logistics challenges and the continent's main engine for intra-African trade if logistics could be scaled up and enhanced utilising basic technology while keeping its distinctively African cultural characteristics (Adeleke 2022: 15) for food security.

BACKGROUND

Food insecurity has been a long-existing developmental challenge for the continent of Africa (McCarthy *et al.* 2018:1). It has become further complicated because of its interwoven connectivity with social, economic, technological, political, and environmental systems, which are all aggravating factors. Therefore, a comprehensive systems-based approach will be necessary for sustainable global food security and this approach must be founded on policy and technological reform, leveraging current systems and cutting-edge technologies, methodologies, and best practices (McCarthy *et al.* 2018:1).

Agricultural food security issues gained prominence in Ghana in the 1970s and have since gotten a lot of attention. The Ghanaian agriculture business contributed 21 percent to GDP in the second quarter of 2023, third placed behind the largest sector, which is the service with 32 percent contribution to the GDP (GSS 2023), however, it is characterised by low productivity and low competitiveness. This results from the industry being dominated by subsistence and smallholder production units primarily employing primitive and low-level technology (Duffour, 2010, Adeleke 2022: 15).

In rural areas, agriculture is the main source of employment, despite the outstanding agricultural contribution, food insecurity is an issue, particularly among growers. Undernourishment and malnutrition are widespread in rural Ghana, and many peasant farmers live in abject poverty.

According to the Comprehensive Food Security and Vulnerability Analysis (CFSVA) research, ten percent of urban and 19 percent of rural households experienced food insecurity in 2009.

Ghana's overall agricultural productivity and production performance need improvement, and there should be more effort to ensure food security, this is why many academics, political figures, and various professionals are concerned about the problem of food insecurity now.

CONCEPTUALISATION

Food Security

The Committee for World Food Security (CFS) set the benchmark as “when all people, at all times, have physical, social and economic access to food which is safe and consumed in sufficient quantity and quality to meet their dietary needs and food preferences and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life” (FAO, 1996, 2012:41-42; Ingram 2020)

The concept of food security has evolved from the idea of food available on the market to a term that recognizes, changes in the global food system, climate and environmental change, changing global demography dynamics, and human rights, to its current constituents of availability, accessibility, and use of food as well as the stability that underpins it (Ericksen, 2008; FAO, 2008, 2017).

Ghanaian Ministry of Food and Agriculture (2019) operational definition compliments that food security exist when households have physical, social and economic access to sufficient, safe and nutritious food at all times that meets their dietary needs and food preferences for an active and healthy life.

The essential components of the term are the nutritive quality of food, self-sufficiency, safety/sanitation and physical and financial availability such that ensuring safety and nutrition in post-harvests, food security often referred to in this study as the "ability to escape significant postharvest losses (PHL) by 90%"; a significant concern to mitigating hunger and malnutrition amid the hiking populace of the globe, which is expected to rise to 9.7 billion by 2050 and 11.2 billion by 2100 (United Nations Department of Economic and Social Affairs (2015). The growth of food needed to feed this enormous population is linear now rather than exponential.

Logistic Management

Logistics management on the other hand is "the process of planning, implementing, and controlling the efficient, effective flow of goods" (Li, 2018: 7) by the Council of Logistics Management, now known as the Council of Supply Chain Management Professionals.

Food specialists acknowledge that no one solution will solve the problem of sustainable food security in the future. True sustainable global food security will require a systems-based, holistic strategy built on change to policy and technology as well as by, utilizing, current systems with cutting-edge tools, methods, and best practices (Ultan *et al.* 2018, *ibid*).

Sugri *et al.* (2021:1) found that PHL may be reduced to 3.1 percent from 36.7 percent for maize and 6.4 percent from 77.8 percent for cowpea during 12 months of storage by providing farmers with the right technologies. Packaging, transport management, warehousing and post-harvest food management are intertwined in this setting, with technology as a moderator.

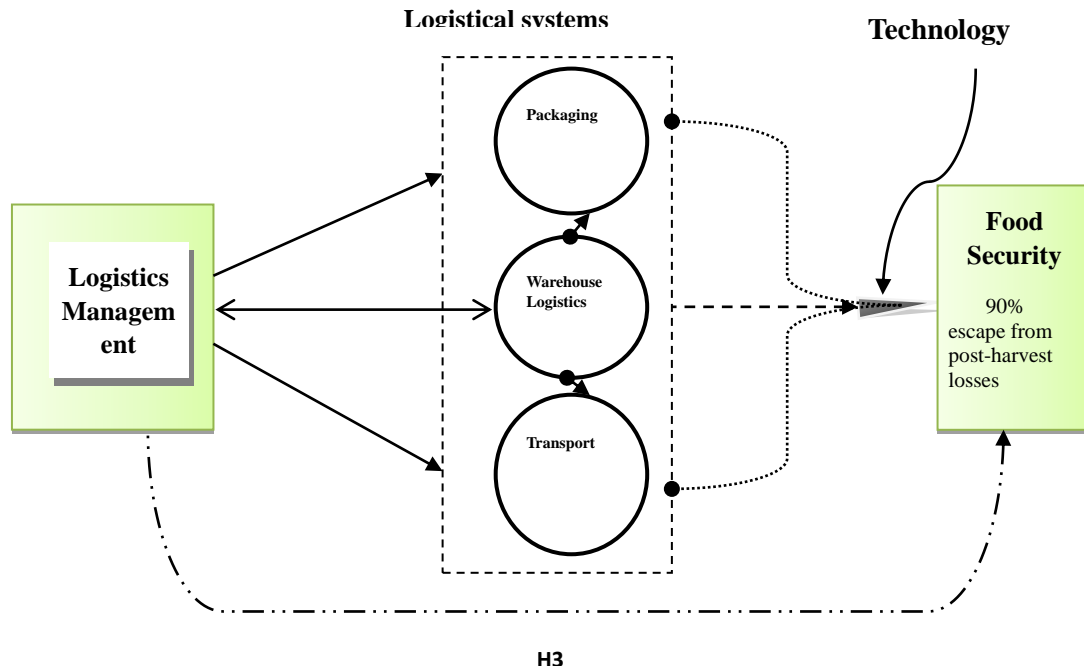


Figure 1.1: Influence of Logistics Management on Food Security

Model Author’s conceptual Model based on FAO (2014); Manners-Bell (2012) and Fugate, Mentzer and Stank (2010:43)

The model illustrates logistics management's impact on postharvest food security, emphasizing the escape of postharvest losses with at least 90 percent of grain harvests delivered to consumers in their nutrient (quality) state. It focuses on the efficient management of warehousing, transportation, and packaging (at government warehouses) to reach the appropriate level of food security. Technology is a critical component in managing these logistics for effectiveness.

RESEARCH PROBLEM

Due to continual post-harvest losses, Ghana's agriculture industry is in decline (GSS 2019:3). The sector grew by 4.8 percent in 2018 in contrast to a growth rate of 6.1 percent in 2017 and its contribution to the GDP fell from 21.1 percent in 2017 to 19.7 percent in 2018 (GSS 2019:3). A classic result is the annual loss of about 318,514 tons of maize due to post-harvest losses, accounting for about 18 percent of the nation's annual production (Bruce, 2016; SESI Technologies 2021). (changed position)

Similar to Cameroon, Uganda, and the United Republic of Tanzania, Ghana's agricultural sector has issues from both internal and external sources, such as insufficient or inefficient infrastructure (external factors), a lack of efficient logistical systems and management (internal elements), or both (FAO 2015:6, 2017).

Global competitive and economic progress are fueled by effective logistics management, which facilitates the movement of people and goods and is crucial to achieving sustainable food security; despite the growing population and literature assertions (FAO and FIVIMS 2009 cited in GCP-2IP follow the Food Research Project 2017), Ghana's food insecurity is rising even with recent government storage interventions. It needs to be determined how much of an influence logistics has on the Agricultural industry and how well the government can affect this situation.

Although prior governments have already created storage facilities in some areas of the nation, most are vacant and unavailable to farmers for various reasons, including the high cost of storage, and transportation challenges (Asiedu 2018) with packaging inclusive. Spending time and taxpayers' funds, the newest project launched, IPEP warehousing, was to address these inefficiencies in former storehouses (Ministry of Special Development Initiatives 2019). Therefore, this study looks at the agricultural sector to examine the relationship between logistics management and Ghana's food security, probing the efficacy of logistics management through the IPEP initiative.

INFRASTRUCTURE for POVERTY ERADICATION PROGRAMME (IPEP)

The IPEP programme provides the framework for disbursing special funds of cedi equivalent of one million US dollars annually to each of the 275 constituencies in the country to be invested in priority initiatives such as one village, one dam, one district, one warehouse (Ministry of Special Development Initiative n.d.) under the auspices of the Ministry for Special Development Initiatives.

Inauguration of the IPEP was felt in April 2019 during the launch of the government flagship programme for "Planting for Food and Jobs (PF&J)". The implementation of the PF&J in 2017 had grain at heart, and domestic cultivation of grains increased appreciably.

The nation reinforced the Government's intention to construct a 1,000 metric ton capacity warehouse in each of the 216 districts in Ghana – "1-District-1-Warehouse". The purpose of the warehouses is to store produce and provide storage for the anticipated surpluses under the "Planting for Food and Jobs" programme. (Ministry of Special Development Initiative, n.d.).

Construction of the warehouses was said not only to minimize PHL but to improve the marketing of agricultural produce, which is part of Ghana's Global Food Security Strategy (GFSS). The warehouses address poor farm-level practices, poor handling, and poor storage activities that expose farm produce to mold, rodents and other pests; therefore, each is set to be fitted with modern equipment, including drying or freezing systems. "The warehouses were to be certified to enable them to participate in the Warehouse Receipting System, implemented under the Ghana Commodities Exchange project.

This system was to promote financial inclusion of smallholder farmers. The farmers will be able to deposit their farm produce in these warehouses and use them to address their financial needs in various ways under the Warehouse Receipt System," It is believed that with a successful implementation of the Warehouse Receipt System, many smallholder farmers will no longer have to sell their farm produce immediately after harvest, especially during periods when market prices are generally low. This will further help address the challenges of price volatility (Ministry of Special Development Initiative, n.d.) and food insecurity amid the growing populace.

THEORETICAL FRAMEWORK

Neo Malthusianism

Neo-Malthusianism advocates for human population planning to ensure resources like food and environmental integrities for current and future human populations and other species. This differs from Malthus's theory of the 18th century mainly in its support for contraception (Lesley 2000), thus, a common system for Ghana population control and the Sub-Saharan region. Thomas Malthus saw that food shortages become worse if food production grew more slowly than population increase hence opined to Positive checks like war, famine, and disease that will occur if preventive measures aren't taken to keep the balance. Modern neo-Malthusians are generally more concerned than Malthus with

environmental degradation and catastrophic famine than with poverty. It remains the chief cause of family size restrictions; however, countering overpopulation hysteria remains important given the looming food security threats.

According to the GSS (2022) Survey, food insecurity still affects nearly 50 percent of Ghana's population and a startling 49.1 percent of the population experienced food insecurity in the first three months of the year, according to data from the 2022 Annual Household Income and Expenditure Survey. Of the 30.8 million people in Ghana, this amounts to 15.1 million. Even with a fervent commitment to neo-Malthusianism, people nevertheless experience hunger. It is becoming clear that the basics are flawed, and contraception is also an overly simplistic answer to a country's food crisis. A strong logistical system is required in the agricultural supply chain.

The Network Theory of Supply Chain Management (SCM)

The concept of SCM involves managing the flow of products, information, and finance upstream and downstream, coordination and collaboration with channel partners, involving suppliers, intermediaries, third-party service providers, and customers (Ballou, 2007; Habib, 2010:80, 2021).

It is the network architecture encompassing all logistics Management activities according to the Council of Supply Chain Management Professionals (CSCMP), which is the premier organization of supply chain practitioners, researchers, and academicians. In essence, the Network Theory of Affect, introduced by Bower (1981), attempts to account for the mood-congruency effect, examining the relationships and interactions between the various entities within the supply chain for a robust.

This theory also helps to understand how the information flows, collaborations and partnerships among the different actors influence the overall efficiency and resilience of the chain (Trivedi 2023).

Agricultural inputs, outputs, and services, like transportation, warehousing, purchasing, packaging, inventory management etc, are all included in the logistics of the food value chains (FAO, 2020), helping to maintain equilibrium between population and nature.

At present, Ghana depends considerably on food imports (e.g. rice, wheat, chicken, etc.) to feed its population. There is an urgent need for improvement in food production and performance of intermediaries in the Agri supply chain (Muntaka *et al*, 2021:1) dwelling on producers/suppliers and logistics handlers (Figure 1.1). The procedures needed to handle supply chain logistics vary if there is a disruption in the activity, making it necessary to relook at the efficiency of the chain.

Because of limited resources and the world's growing population (despite the use of contraceptives), experts should question the effectiveness of logistics management in the food sector, this is yet unexplored.

Moreover, the role of warehousing in overseeing the effective running of Agri logistics is an area of concern in Ghana and literature at large. In Ghana, for instance, it is common to hear comments on this area from political rendezvous, leaving the topic obscured.

Not only will the findings of this study advance and contribute to Logistics management theory and practices and, more broadly, food security; it will also be a whistle-blower, raising awareness and serving as a lens for stakeholders involved in government and policymakers in making strategic decisions on logistics at the agricultural sector.

The two observed theories are relevant to the study and are aligned to the investigation of the relationship of logistics and food security initiatives.

LITERATURE REVIEW

Logistics Management

The term “logistics” has become popular recently, carrying aspects of innovative management to food security that makes good use of its real meaning. Logistics is closely associated with the term “Supply Chain Management” (SCM) and is frequently confused and mixed up with the SCM. Whereas SCM drives the coordination of processes and activities with and across marketing, sales, product design, finance, and information technology, Logistics management (LM) is that part of supply chain management that plans, implements, and controls the efficient, and effective forward and reversed flow and storage of goods, services and related information between the point of origin and the point of consumption to meet customers’ requirements, Logistics management is a subset of SCM. Logistics (or logistical activities) may be broadly classified into two categories:

I. Inbound logistics – Inbound activities involve the steps to order, receive, store, transport and manage incoming supplies. It ensures a seamless and economical flow of these supplies.

Continual communication with suppliers (vendors) is necessary to manage inbound logistics effectively.

II. Outbound logistics (physical distribution management) - This focuses on moving goods and other relevant information from the business to the client. It makes inference to the activities involving the transportation of goods from the storehouse, the storage of finished goods and the delivery to customers. The management must maintain constant communication with transport providers and distribution channels to manage outbound logistics effectively.

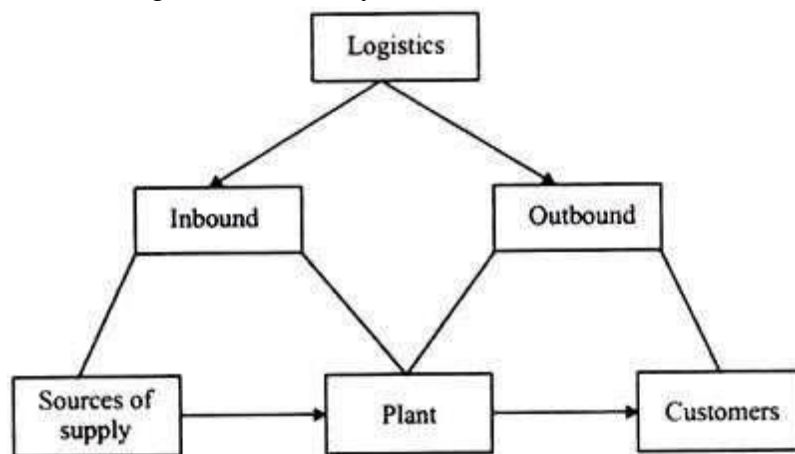


Figure 4.1 Scope of logistical Activities (Sathyabama Institute of Science and Technology, a.n.d: 5)

Logistics management is therefore crucial for the agricultural sector. In the article “the Role of Logistics Management in the Agri-Business”, Driver Logistics (2022) emphasize that agricultural sector is the backbone of many economies, providing food and raw materials for industries. However, the sector is often beset by logistical problems and issues. Food waste is a crucial problem in reducing hunger and enhancing food security. While increasing output has been the goal, minimizing losses in the food supply chain has mostly gone ignored until very recently. Inefficient logistics can lead to increased costs, delays in production, and even spoilage of goods.

Improving the efficiency of agricultural logistics is a critical component of creating a more sustainable food system and some of the ways according to Driver Logistics, (2022) include.

- Use advanced data analytics to understand your supply chain performance, and implement GPS tracking for everything you transport
- Implement multiple types of supply chain optimization strategies, including digital technology and automation, as well as on-farm operations like field management and animal health management.
- Improve efficiencies through transportation planning, inventory management and distribution techniques that minimize shipping costs while minimizing delays in receiving products or services from suppliers or customers.
- Optimize logistical operations through better coordination between departments such as accounting, acquisition, production, and logistics management as well as with suppliers, and customers based on their needs (i.e., seasonal changes). Don't forget about cold chain logistics – if you can get your food into stores faster then, they might be able to sell so you could save money on unnecessary transportation costs and losses due to spoilage or other problems along the way (like refrigeration issues). Inbound activities involving transport, storage and packaging are of concern in this study dealing with Smallholder farmers' post-harvest handlings.

Food Security Outlook.

An update on global progress towards the targets of ending hunger (SDG Target 2.1) and all forms of malnutrition (SDG Target 2.2), the State of Food Security and Nutrition in the World 2023 report by FAO provides an estimate on the number of people who are unable to afford a healthy diet. Since its 2017 edition. The FAO 2017 edition report, has repeatedly highlighted the intensification and interaction of conflict, climate extremes and economic slowdowns and downturns, combined with highly unaffordable nutritious foods and growing inequality, are pushing the globe off track to meet the SDG 2 Targets. New evidence shows that food purchases in some countries are no longer high only among urban households but also among rural households so that Consumption of highly processed foods is also increasing in peri-urban and rural areas in some countries and these changes are affecting people's food security and nutrition in ways that differ depending on where they live across the rural–urban continuum (FAO, 2023), the situation is aggravating in Africa.

The African Regional Overview of Food Security and Nutrition 2021 by FAO indicates that Africa is not on track to meet the Sustainable Development Goal (SDG) 2 targets to end hunger and ensure access by all people to safe, nutritious and sufficient food all year round, and to end all forms of malnutrition. The most recent estimates show that 281.6 million people on the continent, over one-fifth of the population, faced hunger in 2020, which is 46.3 million more than in 2019. This deterioration continues a trend that started in 2014, after a prolonged period of improving food security. In addition to hunger, millions of Africans suffer from widespread micronutrient deficiencies, while overweight and obesity are already significant public health concerns in many countries. Progress towards achieving the global nutrition targets by 2030 remains unacceptably slow (FAO, 2023).

In the south Sahara Africa, the share of the population facing food insecurity is more than double that of any other region in the world, according to a report by IFPRI Global Food policy in 2023: *Rethinking Food Crises Responses*. Approximately 282 million people in Africa south of the Sahara, or around 20 percent of the population, were undernourished and food-insecure in 2021.

Over the past 20 years Ghana has made progress in reducing poverty and hunger among its population (WFP, 2023), however, improvements at the national level mask huge inequalities between the north and south of the country, and between rural and urban areas. Hunger and malnutrition persist primarily in

northern Ghana, as well as many rural and peri urban communities across the country. The disparity between the north and the south is in large part due to Ghana's geography which is characterized by marked climate, agro-ecological and economic differences (WFP, 2023).

Post-harvest losses are the primary feature in Ghana's food security challenges for instance an annual loss of about 318,514 tons of maize was experienced due to post-harvest losses, accounting for about 18% of the nation's annual production (Bruce, 2016; SESI Technologies 2021). In 2018, Ghana's loss of cereals was valued around US\$141.12 million and that is more than GH¢680.19 million, using that year's average exchange rate of US\$1 to GH¢4.82. Clearly, the outlook of post-harvest losses in Ghana does not look good (SESI Technologies 2021).

Food Security and Logistics Management Relations.

In Uganda, Ssennoga, Mugurusi and Olukac (2019:1) investigated the supply chain inhibitions in the production of bananas. The finding suggests that smallholder banana producers lose, on average, 29 percent of the total production of bananas in the supply chain. Adenyi and Ojo (2013: 8210) compliment that 69.9 percent of rural farming households in Local Government Areas (LGAs) of Osun State [Nigeria] are food insecure. There is a rapid growth in food insecurity across SSA due to weak logistical systems. The infrastructural bottlenecks range from poor roads (during rainy seasons), inadequate handling equipment, inappropriate storage facilities, high cost of transport to farm areas, and so on (Ssennoga, Mugurusi and Olukac 2019:1). Positive correlations exist between infrastructural bottlenecks and food insecurity. However, one cannot stereotype the finding owing to environmental dynamics across nations.

Ghana Logistics Managers' Index report for 2022 shows indications of growth in inventory costs, warehousing and transportation prices; however, inventory levels, warehousing capacity; warehousing utilization, transportation capacity and transportation utilization have decreased owing to high inventory cost and the associated cost of warehousing and transporting inventory [Researchers at the Centre for Applied Research and Innovation in Supply Chain – Africa (CARISCA 2022; Quansah, Boso, Muntaka 2022:1]. From a policy standpoint, the government of Ghana has an industrial policy which covers some strategies to improve the Argo-based local raw materials supply, acquire modern technology, and deploy state-of-the-art plants and machinery for agricultural-based industries. In principle, Ghana's industrial policy seeks to improve facilities such as efficient electricity and water supply, telecommunications transport infrastructure, and ICT for industrial development. Ghana also has a trade policy with a logistics management component.

This deals with airport cargo handling, storage and cold chain, and customs clearance issues. There is also a new private-public partnership (PPP) management of warehousing systems to be established, and market information systems improved under the trade policy.

The Ghanaian Government has plans to solve logistics challenges in the agricultural sector, as such, bottlenecks in infrastructures must be factual. There is a clarion call for a more in-depth study of the country's logistical systems and to probe the latent effect of its management on the nation's food security.

Considering the complicated nature of food security, Subramaniam, Macron and Naseem (2023:3431-3435) investigated the impact of logistics performance on food security in 51 developing countries covering the period 2010–2016, under 4 unique dimensions of food security. Applying the Generalized Method of Moments (GMM), the results provide supportive evidence that the level of food security

tends to improve in countries with a higher level of logistic performance. Similarly, it was observed that every dimension of food security, namely food availability, accessibility, utilization, and stability, can be improved with better logistics;

H3: Logistics management has a significant positive relationship with food security

Bozsik *et al.* (2022) presented the analysis of the food security policy effectiveness on the component of food availability and access in two developing countries, Colombia and Kyrgyzstan, from 2000 to 2018. In determining the state of the food balance trade and the regression analysis for the food production index of these countries, four economic indicators were considered. Among other things, the results highlighted the need to integrate food security with the monetary and trade policies of these countries.

So far, we know that Food security risk is prevalent among households based on the results on determinants of food security, scholars like Acheampong *et al.* (2022) using data collected from 2,603 farm households across Ghana and employing an ordered probit model assessed determinants of food security among farm households. The food security indicator, Food Consumption Score (FCS) which combines diet diversity, frequency of consumption and relative nutritional importance of different food groups was used to determine the food security status of farm households, aftermath of the work suggests that government and private institutions should create an enabling environment to enhancing credit access and encouraging adoptions of improved crops varieties for increased production;

Kabue (2022) said it has been established that much of the farm produce losses happen during handling, production, and storage. Additionally, the (Food and Agriculture Organization n.d.) has depicted that much food can also be lost or wasted at the consumption stage. Without refuting the importance of proper storage, handling, and transport climate control, the most recent studies have shown that modernized technology and value chains have played a significant role in the reduction of post-harvest losses. However, for small farmers to benefit economically, it is crucial to take charge of the losses up the value chain.

The assurance that Food insecurity is minimized with enabling logistics provisions is evident in literature; however, a quantified impact of logistics management on food security is unknown. Moreover, it must be noted that no unanimous tool has been used to probe food security and logistics relation throughout the review hence a methodical approach is dependent on the research goal. This study fills the gap identified.

5. METHODOLOGY

The research followed the direction of a descriptive exploratory design (Richters and Melis 2017: 146) based on the central goal, of a mixed study.

A multi-stage sampling technique was used for 384 smallholder grain commercial farmers from the upper West (Nadowli Kaleo district) and upper East regions (Garu district) of Ghana having a population size of 901502 and 1301226 people respectively (GSS, 2021), with an average of 40% of residents growing crops (World Bank, 2017) including maize, millet and rice accordingly with 128 farmers into each crop. The chosen farmers were those using or have ever experienced the IPEP warehouse designated for their districts.

A four sectioned interview administered questionnaire was used to gather the primary data around the constructs; dependent and independent variables were measured on a five-point Likert scale, strongly disagree to strongly agree, and other relevant constructs were pre-tested to check validity and reliability

in collecting the needed data from the survey. A regression analysis was performed, justifying the set hypothesis following the operational path using IBMSPSS V28.

Four management members from the IPEP warehouse, two per selected region were also interviewed.

AIM

The aim of this study is to assess the impact of logistic management on food security in Ghana. This assessment intends to recommend practical strategies to enhance food security in Ghana.

The following questions will be addressed:

1. How is Ghana’s food security currently?
2. How effective is logistics management at the agricultural sector?
3. What is the relationship between logistics management and food security?

OBJECTIVES of the STUDY

1. Find out how Ghana’s food security is faring
2. Examine the effectiveness of logistics management at the agricultural sector
3. Examine the relationship between logistics management and food security.

RESULTS AND DISCUSSION

A total of 384 questionnaires were sent targeting smallholder farmers growing Maize, Rice or Millet growers with a 100% response recorded.

Biographic Detail

Of the 384 respondents, were 19% (N=75) males and 81% (N=309) females signifying majority of the respondents were females. However, logistics and contract management are still predominated by males since there is heavy labour intensity (Deyi and Zenda, 2022). Globally, there is a drive to improve gender disparity in food security and logistics industries.

| Gender | Male | | | | Female |
|-----------|-----------|-------|----------------------|-------|--------------|
| | 75 | | | | 309 |
| | 19.53% | | | | 80.47% |
| Age | 18-25 | 26-30 | 34-41 | 42-49 | 50 and above |
| | 2 | 15 | 246 | 5 | 116 |
| | 0.52% | 3.91% | 64.06 % | 1.30 | 30.21 |
| Education | Below SHS | | Above SHS < Tertiary | | |
| | 357 | | 27 | | |
| | 92.97% | | 7.03% | | |

Table 6.1: Demographics of the Study Respondents

Ninety-three percent (N=357) of the farmers were below senior high school level, whereas 7 percent were above but not in the tertiary. Based on these statistics, it is clear that this industry is dominated by players of no tertiary education. While a few respondents are part of the management with tertiary education, a few of them are engineers. This implies that there is a need to improve skills and education in the logistics and food security industries. Sixty four percent (N=246) were between 34 and 41,

signifying a wide involvement of late youths in Ghana’s agricultural business, and thirty percent (N=116) were in their 50’s and above. Four percent (N=15) were between 26 and 30, whereas the early youth at 18-25 makes the least response at 0.5 percent, (N=2). Fewer young people are entering the logistics and food security industry, though there are various reasons for their under-representation involving urbanization.

Not only with Ghana, this should have a woeful impact on global food crisis for instance in the report by Food and Agriculture Organization State of Food Security and Nutrition in the World 2023, since its 2017 edition, there is intensification and interaction of conflict, climate extremes and economic slowdowns and downturns, combined with highly unaffordable nutritious foods and growing inequality, are pushing the globe off track to meet the SDG 2 target. However, other mega-trends to fully understand the challenges and opportunities for meeting the SDG 2 target are urbanization. New evidence shows that food purchases in some countries are no longer high only among urban households, but among rural households. Rural–urban drift is a global saga devastating the agricultural industry and this could have a more daunting impact on food production and movement in the near future. To think of the rural zone buying more food is not fun. The observation as with the case of Ghana supports FAO (2023), therefore, there is a need for more youth development initiatives that can encourage and lead the placement of young people in food production and security.

Socio- Demographics of the Study Respondents.

As the sampled grains maize, millet and rice contributed 33.33 percent each (N=128) to the response collected, 64 percent (N=244) of the farmers cultivate 2-5 acres of land, with 36 percent (N=140) growing more than 5 acres per season, a common characteristic of peasant farmers.

| Grain | Maize | Millet | Rice |
|---------------------|-------------------|----------------------|-------------|
| | 128 | 128 | 128 |
| | 33.33% | 33.33% | 33.33% |
| Acre | 2-5acres | above 5acres | |
| | 244 | | 140 |
| | 63.54% | 36.46% | |
| District/ region | Garu (upper east) | Nadowli (upper west) | |
| | 227 | | 157 |
| | 59.00% | 41.00% | |
| Years of experience | 1-5yrs | 6-10yrs | above 10yrs |
| | 59 | 119 | 206 |
| | 15.36% | 30.99% | 53.65% |

Table 6.2: Socio- Demographics of the Study Respondents

Studies show that about 60 percent of all farms in the country are less than 1.2 hectares in size, 25 percent are between 1.2 to 2.0 hectares, with a mere 15 percent above 2.0 hectares. The mean farm size is less than 1.6 hectares on the average with small and medium-size farms of up to 10.0 hectares accounting for 95 percent of the cultivated land. About 136,000 km² of land, covering approximately 57 percent of the country’s total land area of 238,539 km² is classified as "agricultural land area" out of which 58,000 km² (24.4 percent) is under cultivation and 11,000 hectares under irrigation. (SRID, 2001:

FAO 2023). Ghana's agriculture is predominantly smallholder farming forming the backbone of the sector. Fifty nine percent were sampled from the Garu district of Upper East region and 41 percent from Nadowli of Upper West region due to population differences.

Data Analysis and Interpretation

The questionnaires and interviews were analyzed and triangulated to provide meaning that was interpreted into different themes.

Theme 1 examines the effectiveness of logistics management at the Ghanaian agricultural sector dwelling on the IPEP initiative for coordination. Bottom-line of the scrutiny tells of the overall Logistics management inefficiency owing to an insignificant role technology plays in the warehouse management (Table 6.6b). Logistical systems involving packaging and storage structures are inadequate to warrant the warehouse effort effective to combat farmers Post-

Harvest Losses (PHL); nonetheless, the warehouse makes no contribution to aid farmer transport challenges. Driver Logistics (2022) emphasize that agricultural sector is the backbone of many economies, providing food and raw materials for industries. However, the sector is often beset with logistical problems and issues. It seems a fact that logistics are being jeopardized in the industry and the current study supports this claim, calling for a substantial attention.

Theme 2 explains the current state of food security in the country contrary to GSS, 2022 Annual Household Income and Expenditure Survey, claiming around 50 percent food insecurity in Ghana. The country's food security is improving through communications services (such as phone calls and SMS), zero-fly/hermetic bags, and fumigation methods (in some of the warehouses), the warehouse management divulged. The finding also contravenes the report by Bruce, 2016; SESI Technologies 2021 that 18 percent of the nation's production going waste through PHL; at least 90 percent of food produced in the country escapes PHL and are safe for human consumption.

Theme 3 examines logistics management and food security relation culminating with a weak relationship, justified by $R = 0.149$ and the regression coefficient $R^2 \text{ adj} = 1$ percent (approx.), a meagre impact does logistics management has on the criterion denoting 99 percent of the country's food security inexplicable by the predictor variable. Other implicit variable(s) appear driving behaviour of the criterion as being informed by the constant $p=0.001$ (significant), craving for a further search.

Literature postulates a positive relationship between infrastructure constraints and food insecurity, (Subramaniam, Macron and Naseem 2023:3431-3435; Bozsik *et al.* 2022, Acheampong *et al.* 2022) in essence this study validates.

Akin to Sennoga, Mugurusi, and Oluka 2019, this study affirms that Farmers' food security is assured with efficient logistics management; only that, the observed association as in the case of Ghana connotes logistics systems very ineffectual to sufficiently reduce the farmers' PHL

Logistics Management via the IPEP Warehouse

Seventy-five percent (N=287) of the respondents patronized the warehouse to date though 25 percent (N=97) having used it argued their stoppage to using the facility for reasons involving insufficient harvest, N=69 of 97 responses, reflecting 18 percent of the response collated. 6 percent (N=24) have

their storage thus seeing no need for further use of the IPEP and one percent (N = 4) lack prior knowledge (Table 6.3).

| | | | |
|--|-----------------------------|----------------------------|--------------------------------|
| The warehouse usage | Yes | No | |
| | 287 | 97 | |
| | 74.70% | 25.30% | |
| Why stopped using the warehouse | Insufficient harvest | Have my own storage | Lack of prior knowledge |
| | 69 | 24 | 4 |
| | 18.00% | 6.26% | 1.04% |

Table 6.3: The Use of IPEP Warehouse

One of the participants had this to say:

“After all, at the moment the facility is indifferently resourced”, said a participant in Garu.

The latent variables, Packaging logistics is inefficient (Mean = 3.11= neutral, SD=1.097) akin to transport management which isn’t given any care (Mean=2.59, SD=0.918) such that the overall efficiency of the IPEP warehouse (Mean=2.91, SD=1.00) is not guaranteed (Table 6.5).

| | | |
|--|--|------------|
| That Notwithstanding these indices to measuring the construct “logistics management” were found trustworthy to predicting food security in the specified regions, at Cronbach's alpha =0.573=0.60 > 0 (what’s the meaning of a number greater than 0 and <0) (Table 6.4) | | |
| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
| 0.552 | 0.573 | 4 |

Table 6.4: Reliability Test

Overall Logistics management is inefficient given the insignificant role technology is playing in the warehouse management (Table 6.6b)

Logistics management is meanwhile crucial for the agricultural sector and Driver Logistics (2022) emphasizes that agricultural sector is the backbone of many economies, providing food and raw materials for industries however; the sector is often beset by logistical problems and issues. Food waste is a crucial problem in reducing hunger and enhancing food security. While increasing output has been the goal, minimizing losses in the food supply chain has mostly gone ignored until very recently. Inefficient logistics can lead to increased costs, delays in production, and even spoilage of goods but little is being done for improvement.

Ability to Avoid Postharvest Losses.

The farmers iterated (Mean=4.036=agree, SD=1.2656) their ability to avoid Post-Harvest Losses (PHL) by at least 90 percent despite occasional losses, thus explaining that food security is currently on the ascent in Ghana.

An Interview with the four managers of the IPEP warehouse reveals that Contrary to the GSS, 2022 Annual Household Income and Expenditure Survey, which claims around 50 percent food insecurity,

Ghana's food security is improving through communications services (such as phone calls and SMS), zero-fly/hermetic bags, and fumigation methods (in some of the warehouses), they divulged. Intriguing to hear from a manager in Garu, who doubles as an Agri-extension officer saying; *“I can say boldly that over 90% of foods produced now escape post-harvest losses indeed, and I look forward to better, if farmers keep adhering to optimal practices, we teach them as extension agents”* **RI**

| | N | Min | Max | Mean | SD |
|--------------------|-----------|-----------|-----------|-----------|-----------|
| | Statistic | Statistic | Statistic | Statistic | Statistic |
| Food security | 384 | 1 | 5 | 4.036 | 1.2556 |
| TransAver | 384 | 1 | 5 | 2.59 | 0.918 |
| WareAver | 384 | 1 | 5 | 2.91 | 1.000 |
| PackageAver | 384 | 1 | 5 | 3.11 | 1.097 |
| Valid N (listwise) | 384 | | | | |

Table 6.5: Efficiency in Logistics Management at the Warehouse

Extant literature held that the outlook of post-harvest losses in Ghana does not look good (SESI Technologies 2021), giving credence of 2016 annual loss of about 318,514 tons of maize, accounting for about 18 percent of the nation's annual production (Bruce, 2016; SESI Technologies 2021); In 2018, losses of cereals were valued at around US\$141.12 million and that is more than GH¢680.19 million, using that year’s average exchange rate of US\$1 to GH¢4.82. The coin seems turning as the current study paints a distinct picture on the country’s PHL, perhaps farmers are indeed adhering to best practices instructions by the agricultural extension team.

Again, in the south Sahara Africa, the share of the population facing food insecurity was said to be more than double that of any other region in the world, according to a report by IFPRI on *Global Food Policy in 2023: Rethinking Food Crises Responses*. Approximately 282 million people in Africa, south of the Sahara, or around 20 percent of the population, were undernourished and food-insecure in 2021. Making inference to such a fraction is to say that 20 percent of the sub-Saharan regional population suffers food insecurity however this seems not the case. Out of the 384 Ghanaian farmers sampled have proven almost everyone escaping PHL by at least 90 percent. Therefore, it is not enough to say that food insecurity is affecting 20 percent of inhabitants until further proven to be a problem of inequitable distribution or inaccessibility. For instance, over the past 20 years Ghana has made progress in reducing poverty and hunger among its population (WFP 2023), however, improvements at the national level mask huge inequalities between the north and south of the country, and between rural and urban areas. World Food Programme, 2023 emphasized that Hunger and malnutrition persist primarily in northern Ghana, as well as many rural and peri-urban communities across the country. The present study was taken on two north regions, the outcome of which refutes this assertion to postulate that the northern part of the country is at presently improving food production and minimizing erroneous culture that aggravates PHL.

Logistics Management and Food Security Relation

Logistics management has a weak relationship with food security, justified by $R = 0.149$. The coefficient of determination (R^2 adj 1 percent approx.) confirms this meagre impact on the criterion, such that 99 percent of the sampled regions food security cannot be explained by the predictor variable but other

implicit variable(s) driving the behaviour of the criterion as being informed by the constant $p=0.001$ (significant). This craves for further research.

| a. Model Summary | | | | | | | | |
|--|------------------------|-----------------------------|-------------------|----------------------------|--------|--------------------|-------------------------------|-------------|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | | | | |
| 1 | 0.149 ^a | 0.022 | 0.012 | 1.2580 | | | | |
| a. Predictors: (Constant), moderator, Zscore(Packaging), Zscore(Transport), Zscore(Warehouse) | | | | | | | | |
| b. Coefficients ^a | | | | | | | | |
| | | Unstandardized Coefficients | | Standardized Coefficients | | | 95% Confidence Interval for B | |
| Model | | B | Std. Error | Beta | T | Sig. | Lower Bound | Upper Bound |
| 1 | (Constant) | 4.037 | 0.064 | | 62.876 | .001 | 3.910 | 4.163 |
| | Zscore (Packaging) | 0.232 | 0.091 | 0.183 | 2.547 | .011 | 0.053 | 0.411 |
| | Zscore(Warehouse) | -0.074 | 0.091 | -0.059 | -0.817 | .414 | -0.253 | 0.105 |
| | Zscore(Transport) | 0.040 | 0.077 | 0.032 | 0.521 | .602 | -0.112 | 0.192 |
| | Moderator (Technology) | -0.029 | 0.052 | -0.035 | -0.566 | .572 | -0.130 | 0.072 |
| a. Dependent Variable: Food security | | | | | | | | |
| c. ANOVA ^a | | | | | | | | |
| Model | | Sum of Squares | Df | Mean Square | F | Sig. | | |
| 1 | Regression | 13.681 | 4 | 3.420 | 2.161 | 0.073 ^b | | |
| | Residual | 599.809 | 379 | 1.583 | | | | |
| | Total | 613.490 | 383 | | | | | |
| a. Dependent Variable: Food security | | | | | | | | |
| b. Predictors: (Constant), moderator, Zscore (Packaging), Zscore (Transport, Zscore(Warehouse) | | | | | | | | |

Table 6.6: Relationship of Logistic management with food security

H1: Logistics management has a significant positive relationship with food security

The coefficient table shows that packaging ($p=0.011$) is the only logistics directly informing the regression model. The use of hermetic bags (for packaging), their access, and safety may have a one percent impact on the model. All other logistics contribute insignificantly to the model ($p=0.073$), as seen in Table 6.6c.

Convincingly, the moderator's conduct indicates ($p=0.572$ with $\beta = -0.029$) that there is now no efficiency in management methods at the IPEP warehouses. Although logistics management has an insignificant but positive link ($p=0.073$, Pearson's $R=0.149$) with food security (Table 6.6 a and c), the null hypothesis cannot be accepted. Pearson's R-value indicates a poor link.

During data collection a respondent/farmer fancily said

“We may not know what goes into managing these logistics otherwise I will say it's being done abysmally. For me, I do not see management” R2

The utterance seems to justify the result from the tested theory. There is no stringent roadmap for logistics management in the agricultural sector in Ghana and the observed results prove that five years down the IPEP life span a significant contribution to food security through the warehouse initiative is yet to be made. Little can be said about the effectiveness in the entire network architecture in the Agricultural supply chain, regarding logistics Ssenoga, Mugurusi, and Oluka (2019:1) explored supply chain constraints in banana production in Uganda. According to the findings, smallholder banana producers lose 29 percent of their total banana yield in the supply chain due to poor logistical management. According to Adenyi and Ojo (2013: 8210), 69.9 percent of rural agricultural households in Osun State (Nigeria) local government areas (LGAs) are food insecure. Food insecurity is spreading rapidly across SSA due to faulty logistical systems. Poor roads (during rainy seasons), insufficient handling equipment, inadequate storage facilities, and high transport costs to farm areas, among others, are examples of infrastructure obstacles (Ssenoga, Mugurusi, and Oluka 2019:1).

Effectiveness in the entire network architecture in the Agric supply chain, logistics-wise.

According to the literature, there is a positive relationship between infrastructure constraints and food insecurity, which the current study and scholars (e.g. Subramaniam, Macron and Naseem 2023:3431-3435; Bozsik *et al.* 2022; Acheampong *et al.* 2022) validate. Farmers' food security is ensured if logistics in the agricultural industry are efficiently managed. However, the identified association is weak (poor) in reducing PHL, implying that the criterion's management is ineffectual in sufficiently reducing farmers' PHL.

The other manager from Garu buttresses this in a lengthy comment;

“Our problem is that we do not have the required resources for the effective running of this facility. For instance, at the moment we do nothing about farmer transport issues; there are no systems to help us participate in this area, we have a cleaner machine in this warehouse but left idle owing to our inability to pay the electricity bill. Farmers bring their harvests and pay as minimal as 50 pesewas/day to keep a 100kg bag of their food at the facility. Packaging is the sole duty of the farmer adding to buying of hermetic bags regardless of market price from our distributor. In fact, some could buy zero, if not the due quantity to our dismay” R3

Elsewhere in Nadowli Kaleo of the upper west, the managers' report;

We lack pallets to aid storage, though we have no support system in this facility. As you can see, the warehouse was built to run with no resources as of yet” R4

These responses establish the bane that logistics are ineffectively managed from the warehouse standpoint. It is subtly important knowing that active food security clearly cannot be credited to a resilient logistics management (LM) practice that, LM is somewhat affirmed, having a shaky influence on Ghana's food security. Food security among farmers is strongly related to other latent variables. The coefficient model's constant variable β_0 's significance ($p=0.001$) says it all.

POLICY IMPLICATION

This study demonstrated that there is positive weak relationship between logistics and food security in Ghana. Therefore, the government and stakeholders need to pay more attention to the role(s) logistics management play in augmenting food security by embracing and instituting several Policy transformations to revolutionize the approach utilised in the movement of food in Ghana.

It is important that warehouses/food storages are inspected and upgraded at different regions. The upgraded warehouses/food storages must measure up to health and safety quality standards, whilst using cutting-edge technology to warrant innovation and efficiency in logistics management via the warehouses.

In addition, logistics conditions particularly in the agricultural sector needs to stay ahead as such should be managed proactively through operative monitoring, and evaluation to achieve overall operational efficacy in managing and securing food, thus stimulating and fashioning a robust and significant relationship between logistics management and food security in the agricultural business in Ghana.

CONCLUSION

Using a conceptual model to illustrate the impact of packaging, warehousing and transport logistics with technology as a moderator on post-harvest food security, this paper examines the relationship between logistics management and food security, focusing on the efficacy of the Infrastructure for Poverty Eradication Program (IPEP) warehouses in coordinating logistics; storage, transportation, and packaging in the agricultural sector.

Contrary to the GSS 2022 Annual Household Income and Expenditure Survey, which claims around 50 percent food insecurity, Ghana's food security is improving with over 90 percent of foods produced now escaping post-harvest losses.

However, Logistics management has a negligible relationship with Ghana's food security at $p=0.073$ and Pearson's $R=0.149$, which is confirmed by the coefficient of determination ($R^2=1$ percent), and recent improvements in food security cannot be linked to a well-rounded logistics management. Ninety-nine percent of the food security among farmers is strongly related to other latent variables and the coefficient model's constant variable β_0 's significance ($p=0.001$) says it all (Table 6.6b).

The theory that Logistics management has a significant positive relation with food security is refuted; to suggest that effective implementation of a national plan is essential, to institute the IPEP as the fulcrum in carrying out this administrative responsibility. Again, posterity study should target exploring latent variables responsible for 99 percent food security.

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