

An Evaluation of the Fruit Supply Chain in Selected Food Markets in Lagos, Nigeria

Fatai A. Yakeen*; Bisiriyu Christy

School of Transport and Logistics; Lagos State University, Ojo, Lagos, Nigeria

*Corresponding Author

DOI: <https://doi.org/10.51244/IJRSI.2024.1110020>

Received: 04 April 2024; Revised: 27 April 2024; Accepted: 01 May 2024; Published: 05 November 2024

ABSTRACT

The logistics practices of vegetable supply chains play a crucial role in ensuring the efficient and timely delivery of fresh produce to consumers in Lagos State, Nigeria. However, the evaluation of these logistics practices, including transportation, storage, handling, and distribution, remains a critical area for research and improvement. This study aims to assess the logistics practices of the vegetable supply chain in Lagos State to identify strengths, weaknesses, and opportunities for enhancement. Through a combination of qualitative interviews, on-site observations, and data analysis, this study examines various aspects of logistics practices within the vegetable supply chain. Key areas of focus include transportation modes and routes, storage facilities and conditions, handling processes, inventory management, and distribution networks. The findings of this study will provide valuable insights into the current state of logistics practices within the vegetable supply chain in Lagos State. By identifying areas for improvement and best practices, this research aims to inform stakeholders, including farmers, wholesalers, retailers, transporters, and policymakers, about strategies to optimize logistics operations and enhance the competitiveness of the vegetable supply chain. Overall, this study contributes to the existing literature on supply chain management and logistics in the agricultural sector, particularly in urban settings like Lagos State. The insights gained from this research can guide future interventions and policy initiatives aimed at improving the efficiency, reliability, and sustainability of vegetable supply chains, ultimately benefiting both producers and consumers in Lagos State, Nigeria.

Keywords: Evaluation, Logistics Practices, Vegetable Supply Chain, Lagos State, Nigeria

INTRODUCTION

The efficient functioning of the vegetable supply chain is vital for ensuring the timely delivery of fresh produce to consumers in urban areas such as Lagos State, Nigeria. With the population of Lagos State growing rapidly and urbanization increasing, the demand for fresh vegetables is on the rise, underscoring the significance of effective logistics management within the supply chain (Oyebisi et al., 2017). However, the logistics practices governing the transportation, storage, handling, and distribution of vegetables in Lagos State are often challenged by infrastructural limitations and operational inefficiencies.

In Lagos State, Nigeria, where the vegetable supply chain traverses from rural farms to bustling urban markets, logistics challenges are particularly pronounced. The state's congested road networks, inadequate cold storage facilities, and limited transportation infrastructure contribute to delays, spoilage, and quality degradation of vegetables during transit and storage (Ojo et al., 2019). These logistical hurdles not only affect the freshness and quality of vegetables but also impact the profitability of farmers and the affordability of produce for consumers.

An evaluation of the logistics practices within the vegetable supply chain in Lagos State is imperative to identify areas for improvement and optimize supply chain efficiency. By assessing transportation modalities, storage conditions, handling procedures, distribution networks, and other logistical factors, stakeholders can gain valuable insights into the strengths and weaknesses of the current system (Oladele et al., 2020). Understanding these dynamics is essential for devising targeted interventions and strategic initiatives aimed at enhancing the overall performance of the vegetable supply chain.

This study aims to evaluate the logistics practices of the vegetable supply chain in Lagos State, Nigeria, with a focus on identifying opportunities for improvement and avenues for enhancement. Through on-site assessments, interviews with key stakeholders, and analysis of relevant data, this research endeavors to provide a comprehensive overview of the current state of logistics management within the vegetable supply chain (Adebisi et al., 2018). Additionally, the study seeks to highlight best practices and recommend strategies for optimizing logistics operations to improve efficiency, reliability, and sustainability.

The evaluation of logistics practices within the vegetable supply chain in Lagos State, Nigeria, is critical for addressing challenges and enhancing supply chain performance. By identifying areas for improvement and proposing actionable recommendations, this research aims to contribute to the enhancement of vegetable supply chain management in urban settings, ultimately benefiting both producers and consumers in Lagos State.

LITERATURE REVIEW

Logistics Practices of Vegetable Supply Chain

Efficient logistics practices within the vegetable supply chain are essential for maintaining the quality and freshness of produce while minimizing costs and losses. Previous research has shed light on various aspects of logistics management within agricultural supply chains, providing valuable insights into challenges and opportunities for improvement.

Transportation logistics play a crucial role in the vegetable supply chain, especially in urban areas like Lagos State. Studies have highlighted challenges such as traffic congestion, poor road infrastructure, and inadequate transportation facilities, which contribute to delays and losses during transit (Ojo et al., 2019). Addressing these challenges requires innovative solutions, such as route optimization, modal shifts, and the use of refrigerated transport to maintain product quality.

Storage logistics are equally critical for preserving the freshness and extending the shelf life of vegetables within the supply chain. Inadequate storage facilities and improper handling practices contribute to post-harvest losses, particularly in perishable commodities like vegetables (Oladele et al., 2020). Research suggests the need for investment in cold storage infrastructure, proper packaging, and handling techniques to minimize losses and ensure product quality.

Handling logistics, including sorting, grading, and packaging, are essential for maintaining product quality and marketability. Adebisi et al. (2018) discuss the importance of efficient handling practices within the vegetable supply chain, emphasizing the need for standardization and automation to improve efficiency and reduce labor costs. Additionally, proper handling practices contribute to food safety and compliance with regulatory requirements.

Distribution logistics involve the movement of vegetables from wholesalers to retailers and ultimately to consumers. Efficient distribution networks and last-mile delivery systems are critical for ensuring timely delivery and minimizing product losses (Oyebisi et al., 2017). Research suggests the use of technology-enabled solutions, such as GPS tracking and real-time monitoring, to optimize delivery routes and improve supply chain visibility.

The evaluation of logistics practices within the vegetable supply chain is essential for identifying areas for improvement and optimizing supply chain efficiency. Challenges related to transportation, storage, handling, and distribution impact the quality, freshness, and availability of vegetables in urban markets like Lagos State. Addressing these challenges requires collaborative efforts from stakeholders and investments in infrastructure, technology, and best practices.

Logistics Practices of Vegetable Supply Chain in Developed Countries

In developed countries, the evaluation of logistics practices within the vegetable supply chain has received significant attention due to the emphasis on efficiency, sustainability, and food safety. Research in this area has focused on various aspects of logistics management to ensure the timely delivery of high-quality produce to consumers.

Transportation logistics are critical components of the vegetable supply chain in developed countries. Studies have explored innovative transportation solutions, such as refrigerated trucks, containerized shipping, and intermodal transportation, to maintain product freshness and minimize spoilage during transit (Kazemi et al., 2019). Additionally, advancements in logistics technology, such as GPS tracking and real-time monitoring, have improved route optimization and supply chain visibility, leading to enhanced efficiency and reduced transportation costs.

Storage logistics play a vital role in preserving the quality and extending the shelf life of vegetables within the supply chain. Cold chain management systems, including temperature-controlled storage facilities and packaging materials, are widely adopted to maintain product freshness and prevent spoilage (Inderfurth et al., 2018). Research has also focused on optimizing inventory management practices to minimize stockouts and reduce inventory holding costs while ensuring product availability.

Handling logistics, including sorting, grading, and packaging, are essential for maintaining product quality and enhancing marketability. Automation and robotics technologies have been increasingly integrated into handling processes to improve efficiency, reduce labor costs, and minimize human errors (Bogue, 2020). Additionally, standardized handling practices and quality control measures are implemented to meet regulatory requirements and ensure food safety standards.

Distribution logistics involve the efficient movement of vegetables from farms to retailers and ultimately to consumers. Studies have examined various distribution models, including direct-to-consumer delivery, online platforms, and community-supported agriculture (CSA) programs, to optimize supply chain efficiency and meet changing consumer preferences (Hobbs et al., 2019). Furthermore, collaborations between supply chain partners, such as farmers, wholesalers, and retailers, are crucial for streamlining distribution processes and reducing inefficiencies.

The evaluation of logistics practices within the vegetable supply chain in developed countries is characterized by a focus on efficiency, sustainability, and food safety. Transportation, storage, handling, and distribution logistics are optimized through the adoption of advanced technologies, best practices, and collaborative partnerships among supply chain stakeholders. By continuously evaluating and improving logistics practices, developed countries ensure the reliable and sustainable delivery of fresh vegetables to meet consumer demand.

Logistics Practices of Vegetable Supply Chain in Developing Countries

In developing countries, the evaluation of logistics practices within the vegetable supply chain is essential for addressing challenges related to transportation, storage, handling, and distribution. Research in this area highlights the unique logistical hurdles faced by developing countries and explores strategies to improve supply chain efficiency and reduce post-harvest losses.

Transportation logistics are particularly challenging in developing countries due to inadequate infrastructure, poor road conditions, and limited access to transportation facilities. Studies have identified these challenges

as significant contributors to delays, spoilage, and increased costs along the supply chain (Benedict et al., 2019). Innovative solutions, such as the use of intermediate storage facilities, decentralized distribution networks, and improved transportation technologies, are explored to overcome transportation challenges and ensure timely delivery of vegetables to markets.

Storage logistics play a crucial role in preserving the quality and extending the shelf life of vegetables in developing countries. Limited access to refrigerated storage facilities and improper handling practices contribute to significant post-harvest losses (Ogunniyi et al., 2017). Research suggests the need for investment in cold chain infrastructure, training programs for farmers and handlers, and the adoption of low-cost storage technologies, such as evaporative cooling and modified atmosphere packaging, to mitigate losses and improve market access.

Handling logistics, including sorting, grading, and packaging, are essential for maintaining product quality and marketability. Studies emphasize the importance of improving handling practices through training programs, the adoption of appropriate packaging materials, and the implementation of quality control measures (Koerhuis et al., 2018). Additionally, the integration of technology, such as mobile applications for real-time monitoring and traceability, can enhance efficiency and transparency in handling operations.

Distribution logistics are challenging in developing countries due to fragmented supply chains, limited infrastructure, and inadequate market linkages. Research explores strategies to improve distribution efficiency, such as the development of market infrastructure, the establishment of producer cooperatives, and the promotion of alternative distribution channels, including local markets and community-based initiatives (Mendoza et al., 2020). Collaborative partnerships between stakeholders, including farmers, wholesalers, and retailers, are crucial for strengthening distribution networks and reducing inefficiencies.

The evaluation of logistics practices within the vegetable supply chain in developing countries is essential for addressing challenges and improving supply chain efficiency. Transportation, storage, handling, and distribution logistics are optimized through the adoption of innovative solutions, capacity-building initiatives, and collaborative partnerships among supply chain stakeholders. By improving logistics practices, developing countries can enhance food security, reduce post-harvest losses, and promote economic development in rural communities.

Logistics Practices of Vegetable Supply Chain in Africa

Logistics practices within the vegetable supply chain in Africa are essential for ensuring the efficient movement of produce from farms to markets, yet they are often hindered by numerous challenges. Research in this area sheds light on the unique logistical hurdles faced by African countries and explores strategies to improve supply chain efficiency and reduce post-harvest losses.

Transportation logistics present significant challenges in Africa due to inadequate infrastructure, including poorly maintained roads and limited access to transportation facilities. These challenges lead to delays, spoilage, and increased costs along the supply chain (Benedict et al., 2019). To address these issues, studies suggest the need for investment in transportation infrastructure, including road upgrades and the development of alternative transportation modes such as rail and waterways.

Storage logistics are critical for preserving the quality and extending the shelf life of vegetables in Africa, where post-harvest losses are often high. Limited access to refrigerated storage facilities and unreliable electricity supply contribute to spoilage and wastage of perishable produce (Ogunniyi et al., 2017). Research recommends the adoption of appropriate storage technologies, such as solar-powered cold rooms and evaporative cooling systems, to mitigate losses and improve market access for farmers.

Handling logistics, including sorting, grading, and packaging, are essential for maintaining product quality and marketability. However, inadequate handling practices and the lack of proper packaging materials contribute to losses and reduce the value of produce (Koerhuis et al., 2018). Studies emphasize the

importance of capacity-building initiatives to train farmers and handlers in proper handling techniques and the adoption of affordable packaging solutions suitable for local conditions.

Distribution logistics pose significant challenges in Africa due to fragmented supply chains, inadequate market infrastructure, and poor market linkages. Research suggests the need for improved market infrastructure, including the development of wholesale markets and cold storage facilities, to facilitate efficient distribution (Mendoza et al., 2020). Additionally, the promotion of alternative distribution channels, such as farmers' markets and community-based initiatives, can help reduce inefficiencies and improve access to markets for smallholder farmers.

The evaluation of logistics practices within the vegetable supply chain in Africa is crucial for addressing challenges and improving supply chain efficiency. Transportation, storage, handling, and distribution logistics are optimized through targeted interventions, including infrastructure development, technology adoption, and capacity-building initiatives. By improving logistics practices, African countries can enhance food security, reduce post-harvest losses, and promote economic development in rural communities.

MATERIALS AND METHODS

This study evaluates the Logistics practices of vegetable supply chain focusing on Lagos State with an estimated population of 14.8 million people according to the National Population Commission of Nigeria (2021). Two major markets were chosen for the study (Mile 12 and Oyingbo). Mile 12 market is a popular food market located in Kosofe Local Government area of Lagos state. Oyingbo on the other hand is also a popular food market located in Lagos mainland Local Government area of Lagos State.

The focus and target of the study is on agricultural produce- Vegetables (onions, tomato, pepper, amaranthus and Lettuce) and its supply chain in Lagos state and the major markets used are Mile 12 market and Oyingbo Market. The markets were used based on the quantity of vegetables in this market and the great number of intermediaries available in these markets. Moreover, these markets were used because they are public markets where farmers, wholesalers, retailers and occasionally consumers can easily be located. This study covers some selected wholesalers, retailers and final consumers in Mile 12 and Oyingbo market.

A purposive sampling or judgmental sampling techniques was used to select two vegetable markets and a total of 115 questionnaires were administered to respondents in the fields. Data was collected using interviews, Observations and questionnaire. the study strategy used for data collection is the descriptive techniques such as frequencies and percentages.

RESULTS

Socio-Demographics of Respondents

A summary of the socio-demographic characteristics of the respondents is presented in table 1. Most of the respondents fall within the age range 36 – 45 (48%). In terms of gender, majority were male (70%) while 30% were females. Regarding educational qualification, most of the respondents (52%) were holders of secondary school certificates. In addition, majority of the respondents (51%) had less than ten (10) years' experience in the vegetable supply business.

Table 1: Socio-Demographics of Respondents

CHARASTERISTICS	FREQUENCY	PERCENTAGE %
AGE		
18-25	5	5
26-35	8	8
36-45	51	49

46-55	37	34
56 ABOVE	4	4
TOTAL	105	100
GENDER		
MALE	73	70
FEMALE	32	30
TOTAL	105	100
EDUCATION LEVEL		
SCHOOL CERT	55	52
DIPLOMA/NCE	39	37
HND/BSC	11	11
MASTERS	0	0
TOTAL	105	100
YEARS IN VEGETABLES BUSINESS		
BELOW 10 YEARS	54	51
10-20 YEARS	25	24
20-30 YEARS	24	23
31 ABOVE	2	2
TOTAL	105	100

Logistics Practices of Vegetable Supply Chain in the Study Area

This part involves the activities carried out in the vegetable supply chain as obtainable in the study areas. We are looking at the processes of transporting, handling, loading and Un-loading of vegetables in the study area

Respondents Role in Vegetable Distribution

From the above table 32% of the respondents are wholesalers, 30% Retailers, 27% Farmers and 11% consumers. These group were responsible in driving the direction of the Vegetable Supply chain in the two study areas

Table 2: Respondents Role Distribution

DISTRIBUTION	FREQUENCY	PERCENTAGE
FARMER	28	27
WHOLESALE	34	32
RETAILER	31	30
CONSUMER	12	11
TOTAL	105	100

Product Loss Occurrence

Losses does occur at various stages of the Vegetable supply chain as attested to by the respondents in this study. Majority of these respondents (70%) agreed that Products are lost as against 30% who said products there are no product loss.

Table 3. Product loss Occurrence

DESCRIPTION	FREQUENCY	PERCENTAGE
YES	74	70
NO	31	30
TOTAL	105	100

Product loss Occurrence Stage

From table 4 respondents posited that Transportation (43%) is the highest source of product loss in the vegetable supply chain, followed by packaging (25%), Storage (21%) and Sorting/Grading (11%). It is worthy to note from above that losses can occur at any stage of the vegetable supply chain and addressing these losses require holistic approach that involves handling, processing, distribution and consumption patterns.

Table 3: Product loss Occurrence Stage

DESCRIPTION	FREQUENCY	PERCENTAGE
TRANSPORTATION	45	43
SORTING/GRADING	12	11
PACKAGING	26	25
STORAGE	22	21
CONSUMPTION	0	0
TOTAL	105	100

Vegetable Handling Frequencies

The majority (50%) of respondents handle vegetables daily, another (22%) handles vegetables weekly. This shows that vegetable supply chain activities continue almost every other day. This shows how important vegetables are to the respondents as a constant source of income.

Table 5: Vegetable Handling Frequencies

DESCRIPTION	FREQUENCY	PERCENTAGE
DAILY	53	51
WEEKLY	23	22
MONTHLY	18	17
OCCASSIONALLY	11	10
TOTAL	105	105

Ways of Ensuring hygiene during handling

Ensuring proper hygiene in vegetable supply chain is essential for preventing the spread of foodborne illnesses and ensuring the safety of consumers. From this survey, the aspect of proper hygiene is overlooked, this is attested to the fact that 47% of respondents do not give this aspect of the vegetable supply chain the needed attention. Only 28% of them consider regular washing of hands an important requirement. 16% wear hand glove while only 9% use sanitizers and disinfectants as a source of ensuring hygiene in the vegetable supply chain.

Table 6: Ways of Ensuring hygiene during handling

DESCRIPTION	FREQUENCY	PERCENTAGE
BY REGULAR HAND WASHING	29	28
BY WEARING HAND GLOVES	17	16
BY USING SANITIZERS/DISINFECTANTS	9	9
OTHERS	50	48
TOTAL	105	100

Source: Author’s Survey 2023

Transportation mode during loading and Un-loading

From this study 37% of respondents said trucks are majorly used while 30% went for Buses. 24% went for others which included tricycles, motorcycles, Boats. Only 9% of respondents affirm that trains are sometimes used to move vegetables in the supply chain.

Table 7: Transportation mode during loading and Un-loading

TRANSPORTATION MODE UTILIZED FOR LOADING/UN-LOADING	FREQUENCY	PERCENTAGE
TRUCKS	39	37
BUSES	32	30
TRAINS	9	9
AIRPLANES	0	0
SHIPS/BOATS	0	0
OTHERS	25	24

Source: Author’s Survey 2023

Challenges during Loading/Unloading

The are challenges that can be encountered during the processes of Loading and Unloading in the vegetables supply chain. 88% of respondents affirmed the existence of challenges and only 12% said there were no challenges. Table 8 gives a clear picture of the status of each respondent regarding this issue

Table 8: Challenges during Loading/Unloading

DESCRIPTION	FREQUENCY	PERCENTAGE
YES	92	88
NO	13	12
TOTAL	105	100

Source: Author’s Survey 2023

Common Challenges during loading /Unloading process.

Challenges abound in all businesses and the vegetable supply chain is not an exception. Some of these challenges are tabulated representing the views of the central actors in the vegetable supply chain.

Table 9: Common Challenges during loading /Unloading process.

COMMON CHALLENGES	AGREE (%)	DISAGREE (%)
INADEQUATE LOADING FACILITIES	82 (78%)	23(22%)
INSUFFICIENT WORKFORCE	91(87%)	14(13%)
LACK OF PROPER EQUIPMENT	97(92%)	8(8%)
INADEQUATE SPACE FOR MANUVERING VEHICLES	0	105 (100%)

The above table (9) reveals that the respondents had majority view that lack of proper equipment (92%), Insufficient workforce (87%) and Inadequate loading facilities (78%) are the greatest challenges faced during loading and unloading processes in vegetable supply chain in Lagos state. Inadequate space for maneuvering vehicles has never been a challenge during loading and Un-loading process. Also some challenges include poor infrastructure, inefficient loading and unloading, theft and pilferages, inadequate storage facilities, poor communication among stake holders contribute to delays and damage to products thereby creating significant losses in the supply chain.

Delay occurrences during loading/unloading.

Delays affect the quality of the vegetables, 31% of respondents confirmed that delays are always experienced in the supply chain. 30% affirmed that it occurs frequently ,22% said it is occasionally and 17% were of the view that it rarely occurs. Delays have a few negative effects on the overall supply chain.

Table 10: Delay occurrences during loading/unloading

DESCRIPTION	FREQUENCY	PERCENTAGE
RARELY	18	17
OCCASSIONALLY	23	22
FREQUENTLY	31	30
ALWAYS	33	31
TOTAL	105	100

Negative effects include increased cost, reduced shelf life, decreased quality, dissatisfaction on the part of consumers, disruptions to the vegetable supply chain and increased risk of theft and pilferage. It is pertinent to have an efficient and well-organized loading and unloading processes in place with a view to minimizing delays and their associated negative effects.

Safety and Quality Measures Enhancement

Enhancing safety and quality measures in vegetables supply chain is important to ensure that fresh, nutritious, and safe vegetables reach the consumer. There are many ways to enhance safety and quality of vegetables. The Respondents views are as presented in table 11

Table 11. Enhancing Safety and Quality measures

DESCRIPTION	FREQUENCY	PERCENTAGE
TEMPERATURE CONTROLLED FACILITIES	48	46
PROPER PACKAGING & LABELLING	16	15
QUALITY INSPECTION	15	14
TRAINING ON HANDLING PRACTICES	18	17

OTHERS	8	8
TOTAL	105	100

The respondents had majority view (46%) on Temperature Controlled facilities, 17% preferred adequate training on handling practices, 15% went for proper packaging and labelling, 14% think quality inspection will make a great difference in enhancing safety and quality. Generally, enhancing safety and quality in the vegetable supply chain will require a collaborative effort among stake holders involved at the various stages of the supply chain to ensure the delivery of fresh and safe products to consumers.

Efficiency Rating of Loading/Unloading Time

This is an important metric for evaluating the performance of vegetables supply chain. The faster the loading and unloading times, the more efficient the supply chain is. Efficient loading and unloading times can lead to several benefits like reduced transportation costs, improved delivery times, and increased customer satisfaction.

Table 12: Efficiency rating of loading/unloading time.

DESCRIPTION	FREQUENCY	PERCENTAGE
VERY EFFICIENT	9	8
EFFICIENT	18	17
AVERAGE	20	19
INEFFICIENT	29	28
VERY POOR	29	28
TOTAL	105	100

From the outcome of this study, with particular reference to the study areas, 28% of the respondents rated the efficiency very poor and inefficient, 19% rated it average ,17 % said it was efficient and 8 % said very efficient. Generally, the rating can be generalized to be low based on the majority view of respondents.

Use of Temperature control storage

Most respondents (79%) do not use temperature-controlled storage. Only 21% are aware of its benefits and use it. The high percentage shows the researcher that respondents do not understand that these practices are critical for ensuring the quality and freshness of vegetables in the supply chain. There is a need for training and capacity building to minimize spoilage and waste and to also improve consumer satisfaction

Table 13: Use of Temperature control storage

DESCRIPTION	FREQUENCY	PERCENTAGES
YES	22	21
NO	83	79
TOTAL	105	100

Choice of storage method

Lagos state has a rapidly growing population with an increasing demand for fresh vegetables. To ensure an efficient and effective vegetable supply chain, the researcher wants to know the view of respondents regarding the choice of a storage method

Table 14: Choice of storage method

DESCRIPTION	FREQUENCY	PERCENTAGE
REFRIGERATOR	32	30
CONTROLLED ATMOSPHERE STORAGE	45	43
COLD ROOMS	18	17
OTHERS	10	10
TOTAL	105	100

Table 14 shows that 43% of respondents preferred a controlled atmosphere method of storage method, 30 % went for a refrigerator as storage method, 17 % preferred a cold room method and 10% went for other methods for storing vegetables- this set preferred traditional methods that often rely on locally available resources and simple techniques like pit storage, cool, dark well-ventilated rooms, sand storage, bamboo or wooden racks etc.

Stacking Method Used in Storage Area

Stacking methods play an important role in the vegetable supply chain, as they help to maximize storage space, facilitate transportation, and maintain the quality and freshness of the vegetables. The researcher was interested to know the common stacking methods used in the two selected areas of study

Table 15: Stacking Methods in Use

DESCRIPTION	FREQUENCY	PERCENTAGE
SINGLE LAYER STACKING	12	11
MULTILAYER STACKING	49	47
USE OF PALLETS	18	17
OTHERS	26	25
TOTAL	105	100

Multi-layer stacking got 47% respondents, others went with 25% respondents, 17 % respondents consider Use of pallets and 11 % were of the view that single layer stacking is preferable by them. Regardless of the stacking method used, it is essential to note that each of the respondents focus on a particular kind of vegetables they deal with thus having specific needs and characteristics for the different vegetables they are dealing with. Proper stacking methods combined with appropriate storage conditions and handling practices, can help to ensure the quality and freshness of the vegetables throughout the supply chain in Lagos state.

Provision of Proper Ventilation

Proper ventilation is crucial in the vegetable supply chain to maintain the quality and freshness of the products while minimizing losses due to spoilage and decay. Providing proper and adequate ventilation throughout the supply chain offers several benefits.

Table 16: Provision of Proper ventilation

DESCRIPTION	FREQUENCY	PERCENTAGE
YES	84	80
NO	21	20
TOTAL	105	100

The survey affirmed that 80% of respondents do provide proper ventilation. This means they are aware of the benefits derivable from this singular act. 20% of the respondents do not provide proper ventilation.

Method Adopted in Packaging for Distribution

The packaging of vegetables for distribution can vary depending on the type of vegetable and the distribution channel. The packaging is aimed at protecting vegetables during transportation and storage, maintaining their quality and freshness, and making them attractive and convenient for consumers to purchase.

Table 17: Packaging Method for Distribution of vegetables

DESCRIPTION	FREQUENCY	PERCENTAGE
BULK PACKAGING	67	64
PRE-PACKING PORTION	9	9
OTHERS	29	27
TOTAL	105	100

The survey showed that 64% of Respondents use the Bulk packaging method, 27 % use other methods and 9% use the pre-packaging method. From these results, it is pertinent to emphasize that all participants understand the essence of packaging and they adhere to it in one form or the other.

Should Vegetables Be Packaged to Attract Consumers?

Packaging vegetables can be an effective way to attract consumers and increase sales. Packaging can also help to protect the vegetables during transportation and storage, maintain their freshness and quality, and make them more convenient for consumers to purchase and use.

Table 18: Preference on Packaging

DESCRIPTION	FREQUENCY	PERCENTAGE
YES	83	79
NO	22	21
TOTAL	105	100

The table above informs (79%) respondents agree that vegetables should be packaged. This indicates an understanding of the benefits of packaging in the vegetables supply chain in Lagos state. Packaging provides an opportunity to communicate important information to consumers by educating them and increasing their confidence in the product. It is also important to draw attention to the fact that packaging might not always be necessary for some types of vegetables, but it is agreed that it can be an effective way of consumer attraction and increase sales.

Receiving, Conservation and Preservation

Receiving, conservation and preservation of vegetables are critical aspects of the vegetable supply chain that can impact the quality and safety of the vegetables. Some common practices must be imbibed in the supply chain.

How Are Vegetables Received in The Supply Chain?

Table 19: How vegetables are received.

SOURCES	FREQUENCY	PERCENTAGE
DIRECTLY FROM FARMERS	64	61
FROM WHOLESALE MARKET	27	26

THROUGH DISTRIBUTOR	14	13
OTHERS	0	0
TOTAL	105	100

The table above shows that 61% of respondents receive their vegetables directly from the farmers who bring them to the markets themselves. 26% get them from the wholesalers in the same markets while 13 % get it through distributors. In receiving from these different sources, they all agreed that the process of inspection, temperature control and record keeping are adhered to consistently.

Methods Used to Ensure Quality

Several methods are used to ensure quality of the vegetables as seen in table 20

Table 20: Quality assurance methods

DESCRIPTION	FREQUENCY	PERCENTAGE
VISUAL INSPECTION	82	78
PACKAGING INTEGRITY CHECKS	0	0
TEMPERATURE MONITORING	21	20
QUALITY CONTROL TESTS	0	0
OTHERS	2	2
TOTAL	105	100

78 % of respondents use the Visual inspection method. Quality inspection is done to ensure that only good quality vegetables are received and sold to consumers. 20 % use the temperature monitoring method. This entails the use of refrigerators or cold rooms to store the vegetables to prevent spoilage thus maintaining freshness. Only 2% of respondents use other methods like traceability system wherein they track vegetables right from the farms to the point of sale thus helping them identify the source of any quality or safety issues and this allows for rapid response to any incidents that may arise regarding quality.

It is pertinent to note that these methods are used to ensure that vegetables in the supply chain are of high quality and safe for consumption. Thus, implementing them ensures that the vegetable supply chain in Lagos state can provide consumers with fresh, healthy, and high-quality vegetables.

Preservation Method to Minimize Waste

Vegetables are an essential part of a healthy balanced diet. However, they can spoil quite quickly, leading to waste and financial losses. There are so many ways for preserving vegetables to minimize waste. The researcher was interested to understand how the respondents achieve this in the study area.

Table 21: Waste Minimization methods

CANNING	0	0
FREEZING	21	20
DRYING	84	80
FERMENTATION	0	0
OTHERS	0	0
TOTAL	105	100

From the above table, 80% of respondents focus on drying as the easiest way to preserve vegetables. This might be necessitated by lack of access to other methods of preservation. 20% adopted the freezing method.

The all agreed that the methods adopted helps them reduce their vegetable waste thus enjoying the supply of fresh and healthy product to consumers.

Transportation and Packaging

Transportation and Packaging play important roles in the vegetables supply chain as they can impact the quality, shelf life, and safety of the products.

Mode of Transport

Vegetables are to be transported in a manner that minimizes damage, preserves quality, and maintains freshness.

Table 22: Mode of Transportation

DESCRIPTION	FREQUENCY	PERCENTAGE
ROAD	83	79
RAIL	0	0
WATER	17	16
AIR	0	0
OTHERS	5	5
TOTAL	105	100

Road transportation mode is used in bringing vegetables to the study areas as submitted by the respondents (79%). Water transport accounts for (16%) and other means of transportation (5%)

Packaging Method for Transportation

Packaging is another important factor in transportation and storage of vegetables. The right packaging helps to protect the product from damage, prevent spoilage and extend shelf life.

Table 23: Packaging for transportation

DESCRIPTION	FREQUENCY	PERCENTAGE
BAGS	2	2
SACKS	41	39
BASKETS	54	51
OTHERS	8	8
TOTAL	105	100

The packaging materials used in the vegetable supply chain according to the respondents in this study include baskets (51%), sacks (39%) others (8%) and Bags (2%). These packaging materials are designed to protect the vegetables from damage and contamination during transportation and storage. The packaging process is done at the farm and sometimes at the central packaging facility inside the markets after undergoing further sorting. The packages are then loaded onto trucks or other transportation means to the wholesalers, retailers, and consumers. When the packaging is done in the markets, it is transported in bulk and then packaged into smaller quantities.

Most Suitable Packaging Materials from Experience

The Respondents over the years have experience on various packaging materials, 32 % preferred mesh bags, 30% preferred using cardboard boxes, 26% use plastic bags while 12 % prefer using wooden /plastic crates. The researcher noticed the predominance of baskets mostly used for tomato and pepper.

Table 24: Most suitable packaging materials

DESCRIPTION	FREQUENCY	PERCENTAGE
PLASTIC BAGS	27	26
CARDBOARD BOXES	31	30
WOODEN/PLASTIC CRATES	13	12
MESH BAGS	34	32
OTHERS	0	0
TOTAL	105	100

The most used packaging materials in the vegetable supply chain in Lagos state from this survey and observations, are plastic crates, baskets, cartons and polyethylene bags. It was also observed that the choice of packaging material depends on the type of vegetable being transported, its quantity, and the distance of transportation.

Availability of Protection During Packaging

Packaging plays a crucial role in protecting vegetables during their journey from farm to table. The availability of product protection during packaging can ensure that the vegetables remain fresh and intact until they reach their destination.

Table 25: Availability of product protection during packaging

DESCRIPTION	FREQUENCY	PERCENTAGE
YES, ALWAYS	23	22
MOST OF THE TIME	27	26
OCCASSIONALLY	18	17
RARELY	16	15
NO, NEVER	21	20
TOTAL	105	100

From this study, the respondents (26%) agree that vegetables are protected during packaging most of the time, (22%) agreed that yes, protection is always available. (20%) posit that there is no product protection during packaging while (17%) agree that occasionally product protection is made available during packaging. The remaining respondents, making up (15%), say it rarely occurs.

Product protection during packaging is essential in ensuring that vegetables remain fresh and intact during their journey from farm to table. By choosing the right packaging materials, handling vegetables carefully, controlling temperature, protecting from external factors, and conducting quality control checks, product protection can be ensured throughout the vegetables supply chain.

Management and Control

Management and control of the vegetables supply chain involves the coordination of various activities involved in the production, transportation, storage, and distribution of vegetables.

Effective management and control of the supply chain can help to ensure that vegetables reach their destination in a timely and efficient manner while maintaining their quality and freshness.

Frequency of Vegetable Purchase

Table 26: Frequency of vegetables purchase

DESCRIPTION	FREQUENCY	PERCENTAGE
2-3 TIMES A WEEK	53	50
ONCE A WEAK	27	26
LESS THAN ONCE A WEEK	25	24

From the field results, 50% of respondents purchase vegetables 2-3 times a week. 26% purchase once a week and 24 % purchase less once a week. Effective management and control of the vegetables supply chain involves planning, quality control, transportation, storage, communication, and technology. By implementing these measures, the supply chain can be optimized to ensure that the vegetables reach their destinations in a timely and efficient manner while maintaining their quality and freshness.

Frequency of Purchases

The frequency of purchases in the vegetable supply chain depends on various factors such as seasonality, availability, and demand. From our survey vegetable purchases as posited by majority (50%) of the respondents signify 2-3 times a week, 26% do it once a week while the remaining 24% went for purchases less than once a week. Consumers in Lagos state may purchase vegetables on a daily basis or weekly basis depending on their household needs and budget. During peak harvest seasons, when there is a surplus of vegetables, the frequency of purchase increase as the prices drop. On the other hand, during off season, when there is a shortage of vegetables, the frequency of purchase may decrease as price rise.

Vegetable Waste Disposal Methods

The waste disposal method depends on the stage of the supply chain. It could be on-farm, market, recycling, and other methods. From the survey Animal feeds (41%) is the major source of waste disposal, donating to the food bank (25%), Composting (17%) Landfill (10%) and others (7%).

The Vegetable waste disposal methods of vegetables in Lagos state can be improved through better waste management practices as can be seen by the methods ongoing like composting, waste collection systems and recycling programs.

Challenges of Adopting Best Logistics Practices for Reducing Wastage

Reducing wastage in the vegetables supply chain requires effective logistics management. There are several challenges that need to be addressed to adopt the best logistics practices and minimize waste.

1. The lack of proper temperature-controlled storage facilities leads to significant food wastage in the vegetable supply chain.
2. Inadequate transportation infrastructure and logistics systems contribute to increased spoilage of vegetables during transit.
3. Insufficient collaboration and communication among stakeholders (e.g., farmers, distributors, retailers) hinder effective implementation of best logistics practices.
4. Limited awareness and understanding of the benefits of adopting best logistics practices pose challenges in reducing food wastage in the vegetable supply chain.
5. Inconsistent and unreliable forecasting of demand for vegetables leads to overproduction and subsequent wastage.
6. The absence of standardized quality control measures and grading systems in the vegetable supply chain contributes to increased food wastage.

7. Inefficient handling and packaging practices during sorting, packing, and loading processes contribute to vegetable spoilage and wastage.
8. Insufficient training and education for workers involved in the vegetable supply chain affect the adoption and implementation of best logistics practices.
9. High costs associated with implementing and maintaining effective logistics practices act as barriers to reducing food wastage in the vegetable supply chain.
10. Inadequate monitoring and tracking systems for temperature, humidity, and other environmental factors lead to increased spoilage and food wastage.

Addressing these challenges requires a collaborative effort from all stake holders in the vegetable supply chain, including farmers, transporters, distributors, and retailers. Adopting best logistics practices, investing in infrastructure, and improving data collection and analysis can help minimize wastage in the vegetable supply chain.

In what order of ranking are the challenges of vegetables supply chain in Lagos State

The vegetable supply chain in Lagos state, like any other supply chain, faces a number of challenges that can impact the quality, availability and affordability of vegetables. Some of the key challenges are outlined in the table below.

Table 27: Descriptive analysis showing the order of ranking are the challenges of vegetables supply chain in Lagos State

Items	Mean	STD	Ranking
The lack of proper temperature-controlled storage facilities leads to significant food wastage in the vegetable supply chain	4.5048	0.70879	1 st
Inadequate transportation infrastructure and logistics systems contribute to increased spoilage of vegetables during transit.	4.4095	0.80498	2 nd
Insufficient collaboration and communication among stakeholders (e.g., farmers, distributors, retailers) hinder effective implementation of best logistics practices.	4.1524	0.92799	4 th
Limited awareness and understanding of the benefits of adopting best logistics practices pose challenges in reducing food wastage in the vegetable supply chain.	4.2	0.87046	6 th
Inconsistent and unreliable forecasting of demand for vegetables leads to overproduction and subsequent wastage.	3.8286	0.94520	9 th
The absence of standardized quality control measures and grading systems in the vegetable supply chain contributes to increased food wastage.	4.2	0.89227	6 th
Inefficient handling and packaging practices during sorting, packing, and loading processes contribute to vegetable spoilage and wastage.	4.3238	0.87151	5 th
Insufficient training and education for workers involved in the vegetable supply chain affect the adoption and implementation of best logistics practices.	4.1333	0.91006	8 th
High costs associated with implementing and maintaining effective logistics practices act as barriers to reducing food wastage in the vegetable supply chain.	3.5143	1.02013	10 th
Inadequate monitoring and tracking systems for temperature, humidity, and other environmental factors lead to increased spoilage and food wastage.	4.4381	0.77116	3 rd

SOURCE: Survey 2023

CONCLUSION AND RECOMMENDATIONS

Conclusion

The evaluation of Logistics practices in the vegetable supply chain in Lagos state, Nigeria involves an assessment of the various activities involved in the movement of vegetables from the point of production to

the point of consumption. The logistics practices in the vegetable supply chain include transportation, storage, packaging, handling, and distribution. Also, the evaluation focuses on assessing the logistics practices within the vegetable supply chain to minimize wastage. The study explores various stages of the supply chain, including procurement, transportation, storage, and distribution, to identify potential areas for improvement. The evaluation reveals that inconsistent demand forecasting and inadequate communication between suppliers and retailers contribute to overstocking and subsequent wastage. Additionally, improper quality control and insufficient inspection processes lead to the inclusion of damaged or low-quality vegetables in the supply chain.

Inefficient transportation practices, such as improper handling and inadequate temperature control, result in spoilage and deterioration of vegetables during transit. Furthermore, sub-optimal route planning and a lack of coordination between suppliers and logistics providers contribute to delays and increased product losses. Inadequate storage facilities, including improper temperature and humidity control, contribute to accelerated spoilage and wastage. Inefficient inventory management practices, such as inadequate stock rotation and lack of real-time monitoring, further exacerbate the issue. Ineffective coordination between different players in the supply chain, including growers, distributors, and retailers, leads to delays, miscommunication, and increased wastage. Poor packaging practices, including the use of non-optimized packaging materials, also contribute to product damage and spoilage during distribution.

The evaluation of logistics practices in the supply chain in Lagos state is important for identifying areas where improvements can be made to ensure that vegetables are delivered to consumers in a timely and efficient manner while maintaining their quality and freshness.

In conclusion, the evaluation of logistics practices in the vegetable supply chain underscores the importance of reducing wastage and addressing challenges to achieve improved efficiency and sustainability. By implementing best logistics practices, such as optimizing packaging, enhancing cold chain management, and embracing technological advancements, we can overcome these challenges and create a more resilient and effective supply chain. Ultimately, this will not only lead to reduced wastage but also contribute to meeting the increasing demand for fresh and nutritious vegetables while minimizing environmental impact.

Recommendations

The following recommendations were provided in analysing the current practices and their impact on wastage generation to enhance the efficiency and sustainability of the vegetable supply chain.

- **Implement Demand-Driven Procurement:** This will encourage suppliers and retailers to adopt accurate demand forecasting methods and establish effective communication channels to minimize overstocking and ensure timely replenishment. Enhance quality control measures to eliminate damaged or low-quality vegetables from entering the supply chain.
- **Enhance Transportation Practices:** This will improve handling techniques and invest in appropriate transportation equipment to ensure proper product care during transit. Optimize route planning and foster collaboration between suppliers and logistics providers to reduce delays and improve overall efficiency.
- **Upgrade Storage Infrastructure:** Upgrading storage facilities to include temperature and humidity control systems, ensuring optimal conditions for vegetable preservation. Implement efficient inventory management systems with real-time monitoring capabilities to track stock levels and reduce wastage due to expiration or spoilage.
- **Strengthen Distribution Coordination:** Facilitate improved communication and collaboration among supply chain stakeholders to enhance coordination and minimize delays. Promote the use of sustainable and protective packaging materials to reduce product damage during distribution.
- **Embrace Technology Solutions:** Explore the adoption of emerging technologies such as IoT (Internet of Things) sensors, block chain, and data analytics to monitor and optimize various aspects

of the vegetable supply chain. These technologies can provide real-time visibility, improve decision-making, and enable proactive measures to reduce wastage.

- **Training and Awareness Programs:** This will conduct training programs to educate all stakeholders involved in the vegetable supply chain about best practices for waste reduction. Promote awareness about the environmental and economic benefits of minimizing wastage and encourage the adoption of sustainable practices.

By implementing these recommendations, the vegetable supply chain can significantly reduce wastage, improve overall efficiency, and contribute to a more sustainable and environmentally friendly industry.

REFERENCES

1. Adebisi, B., et al. (2018). Analysis of the Vegetable Supply Chain in Lagos State, Nigeria. *International Journal of Agricultural Management and Development*, 8(3), 255-265.
2. Benedict, A.K., et al. (2019). A review of challenges in the fresh fruit and vegetable supply chain in developing countries. *Journal of Agribusiness in Developing and Emerging Economies*, 9(1), 98-119.
3. Bogue, J. (2020). Robotics in the food supply chain: Efficiency is just the beginning. *International Food and Agribusiness Management Review*, 23(3), 421-435.
4. Hobbs, J.E., et al. (2019). The changing landscape of food distribution in Canada: A case study of the fresh fruit and vegetable supply chain. *Agricultural and Food Economics*, 7(1), 1-16.
5. Inderfurth, K., et al. (2018). Integrated inventory management in perishable goods supply chains: A review. *European Journal of Operational Research*, 269(1), 1-15.
6. Kazemi, M., et al. (2019). A review of refrigerated container shipping in the transportation of perishable fresh agricultural products. *Transport Reviews*, 39(1), 123-144.
7. Koerhuis, A., et al. (2018). Innovations in postharvest handling of fresh fruits and vegetables in developing countries: A review. *Postharvest Biology and Technology*, 139, 110-125.
8. Mendoza, J.M.F., et al. (2020). Food supply chain in developing countries: A review. *Asian Journal of Agriculture and Development*, 17(2), 1-17.
9. Ogunniyi, L.T., et al. (2017). Postharvest handling and losses in developing country supply chains: A review. *International Journal of Postharvest Technology and Innovation*, 7(2), 129-149.
10. Ojo, M.A., et al. (2019). Assessing the Challenges of Agricultural Transportation in Lagos State, Nigeria. *International Journal of Transportation Science and Technology*, 8(3), 215-228.
11. Oladele, O.I., et al. (2020). Challenges and Strategies for Improving Agricultural Value Chains: Evidence from Lagos State, Nigeria. *Journal of Agricultural and Food Economics*, 5(1), 1-19.
12. Oyebisi, T.O., et al. (2017). An Assessment of Logistics Management in Vegetable Supply Chain: A Case Study of Lagos State. *International Journal of Management and Economics*, 4(2), 86-98.