

The Effect of Inventory practices on Beef Supply Chain Performance among Lusaka-Based Meat Companies

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Abstract

The beef supply chain in Lusaka District faces operational challenges associated with the perishability of beef, infrastructure limitations, and inadequate inventory management practices. Although large meat companies have started integrating semi-automated inventory management practices, many medium and small-scale beef firms continue to depend on traditional and manual inventory control practices, leading to stockouts, spoilage, inefficiencies in distribution, and increased operational costs. Therefore, this study was conducted to assess the inventory management practices used by Lusaka-based meat companies and examine their effect on beef supply chain performance. A descriptive survey design was employed under a positivist paradigm using a quantitative research approach. The study targeted 128 registered meat companies in Lusaka District. Out of these, 120 companies participated in the study, representing a 93.8% response rate. Data were collected using structured questionnaires and analysed using descriptive and inferential statistics through SPSS version 20. The findings revealed that basic inventory management practices such as First-In-First-Out (FIFO), cold storage, and Just-In-Time (JIT) are widely employed by beef companies, while advanced practices such as Vendor Managed Inventory (VMI), automated forecasting tools, and batch ordering systems remain underutilised. Hypothesis testing using the chi-square test indicated no statistically significant relationship between FIFO adoption and spoilage reduction among Lusaka meat companies ($\chi^2 (1, N = 120) = 2.069, p = 0.150$). Fisher's Exact Test also confirmed non-significance ($p = 0.300$); the null hypothesis was not rejected. The study recommends that beef companies should enhance inventory management practices through staff training, FIFO adherence, and digital tools to minimise stockouts. Medium-term strategies include investing in forecasting systems, semi-automated technologies, and cold chain infrastructure.

1. Introduction

Supply chains play a central role in ensuring that beef products move efficiently from producers to consumers. In this regard, retail operations require detailed monitoring of stock movement from receiving, storage, and sale to the final exit point, as inefficiencies at any stage can negatively affect business performance (Chanda and Mwanza, 2023). In the beef sector, effective supply chain management is particularly important due to the perishable nature of meat products. In addition, retail store operations significantly influence costs, profits, and service delivery and are considered key success factors in business performance (Teller et al., 2018, cited in Chanda and Mwanza, 2023). The beef industry is an important component of Zambia's agricultural economy because it contributes to food security, employment creation, and income generation for farmers, processors, and retailers. However, inefficiencies within the beef supply chain continue to affect product availability, operational costs, and market stability.

Inventory management is one of the key components of supply chain management. It involves the planning, monitoring, and control of stock to ensure that the right quantity of goods is available at the right time and place. Proper inventory management helps organisations or companies reduce operational costs, minimise waste, improve customer satisfaction, and maintain a consistent product supply (Heizer et al., 2020). In contrast, weak inventory management can lead to stockouts, overstocking, spoilage, and increased operational inadequacies.

Therefore, this study examined the inventory management practices used by beef companies in Lusaka District and explored how these practices relate to supply chain performance. The study aimed to provide empirical evidence that may inform policy formulation and strategies for improving inventory practices within the beef industry in Lusaka.

1.2 Statement of the Problem

The performance of the beef supply in Lusaka District is affected by supply chain management inefficiencies. At the national level, every year, operational inefficiencies in the supply chain cause Zambia to lose almost 20% of its beef products (Ministry of Fisheries and Livestock, 2023). Furthermore, according to the Zambia Statistics Agency (2023), about 35% of meat sellers in Lusaka encounter stockouts at least twice a month, which results in an estimated 15% of inventory losses. These challenges suggest weaknesses in inventory management practices among beef companies operating within Lusaka District.

While previous studies have explored livestock production, logistics constraints, and market access challenges, there remains limited empirical research focusing specifically on how firm-level inventory management practices affect supply chain performance in the beef sector. Most existing research on inventory management focuses on advanced supply chain practices in developed economies (Wang et al., 2021). Such studies often assume the availability of sophisticated technologies and infrastructure that may not be present in developing nations like Zambia, Lusaka District in particular. As a result, there is limited empirical evidence on how inventory management practices influence supply chain performance within Zambia's beef industry. Without such empirical evidence, beef companies may continue to operate with inefficient stock management practices, leading to revenue losses. This study, therefore, sought to address this knowledge gap by examining inventory management practices and their effect on beef supply chain performance.

1.3 Specific Objectives of the Study

- To establish the types of inventory management practices used among Lusaka-based meat companies.
- To assess the effect of inventory management practices on beef supply chain performance in Lusaka.
- To identify appropriate strategies for improving inventory practices to enhance supply chain performance.

1.4 Research Questions

- What types of inventory management practices are used by Lusaka-based meat companies?
- How do inventory management practices affect the beef supply chain performance in Lusaka?
- What strategies can be implemented to improve inventory management practices among meat companies?

1.5 Hypothesis

- H1: The adoption of FIFO inventory management practices significantly reduces spoilage levels among Lusaka-based meat companies.
- H0: The adoption of FIFO inventory management practices does not significantly reduce spoilage levels among Lusaka-based meat companies.

2 Literature Review

This section presents a review of relevant literature on inventory management practices within the beef supply chain. The review of relevant literature focused on three main areas, namely the inventory management practices currently employed by meat companies in Lusaka, the impact of these practices on the performance of the beef supply chain, and the strategies that can be implemented to enhance beef supply chain performance.

2.1 Theoretical Framework of the Study

This study was guided by two major theories, the Economic Order Quantity (EOQ) model and the Theory of Constraints (TOC). These theories provided a framework for understanding how beef inventory management practices influence supply chain performance in Lusaka.

The Economic Order Quantity model explains how organisations can determine the optimal order quantity that minimises total inventory costs. The model focuses on balancing two key costs associated with inventory management, namely ordering costs and holding costs. When companies order large quantities of products, holding costs such as storage and spoilage increase (Heizer et al., 2020). Conversely, smaller orders increase ordering costs. Generally, this model helps companies or organisations determine the most efficient order quantity that minimises these costs while ensuring adequate inventory levels. In the context of this study, the EOQ model is relevant because beef products are highly perishable and require careful inventory planning to avoid overstocking and spoilage. By determining appropriate order quantities and replenishment cycles, meat companies can improve efficiency and reduce waste.

The study also employed the Theory of Constraints, developed by Eliyahu Goldratt, which emphasises the identification and elimination of bottlenecks that limit system performance. According to this theory, every system has at least one constraint that restricts its overall performance. Improving supply chain performance, therefore, requires identifying these constraints and implementing strategies to overcome them (Goldratt, 1990; McMullen, 1998). In the beef supply chain, constraints may include inadequate cold storage facilities, poor transportation infrastructure, unreliable electricity supply, and limited technology adoption. It is assumed that addressing these constraints may improve inventory management and overall beef supply chain efficiency.

2.2 Inventory Management Practices

Inventory management refers to the systematic control of stock levels to ensure operational efficiency and product availability. Effective inventory management enables organisations to balance supply and demand while minimising operational costs and product losses (Christopher, 2016). Several inventory management practices are commonly used in supply chains. The FIFO method ensures that older stock is used before newer stock, reducing the risk of spoilage. Just-In-Time inventory practices aim to reduce storage costs by receiving goods only when they are needed for production or sale. Safety stock management involves maintaining additional inventory to protect against unexpected demand fluctuations. Studies have shown that these practices can improve supply chain performance by reducing waste, improving product availability, and increasing operational efficiency (Heizer et al., 2020). However, their effectiveness often depends on the availability of reliable data, proper storage facilities, and coordinated supply chain relationships. In many industries, preventing inventory losses is considered critical, as unmanaged losses directly affect profitability and operational efficiency (Lambordi, 2020, cited in Chanda & Mwanza, 2023, p. 30)

2.3 Inventory Management and Supply Chain Performance

Supply chain performance refers to the ability of a supply chain to deliver products efficiently, reliably, and cost-effectively. Performance indicators commonly used in supply chain studies include delivery reliability, inventory turnover, lead time, cost efficiency, and customer satisfaction. Studies have

demonstrated that effective inventory management contributes to improved supply chain performance by ensuring consistent product availability and reducing operational costs (Nethra et al., 2023). However, in food supply chains, inventory management must also address challenges related to product perishability and cold chain requirements.

2.4 Inventory Management in Developing Economies

In developing countries like Zambia, inventory management practices are often influenced by resource limitations, inadequate infrastructure, and limited technological adoption. Many small and medium enterprises depend on manual record-keeping and traditional stock management methods. Phiri et al. (2020) note that agricultural supply chains, including the beef sector in Zambia, face challenges related to transportation, storage infrastructure, and market coordination. These constraints may limit the effectiveness of modern inventory management practices. Despite these challenges, improving inventory management practices has the potential to enhance supply chain efficiency and reduce beef losses in developing economies like Lusaka.

However, the literature reveals several gaps in the study of inventory management practices within Zambia's beef sector. There is limited research on the adoption and effectiveness of firm-level inventory management practices, with few studies linking specific techniques such as FIFO, JIT, and safety stock to measurable supply chain outcomes. The practical application of inventory management theories, including EOQ and TOC, also remains largely unexplored in the Zambian context as far as beef supply performance is concerned. It was also noted that some studies had negligible sample sizes as low as 3 to 18 research participants, rendering the findings less generalisable to a larger district like Lusaka.

3 Methodology

3.1 Research Design and Paradigm

This study employed a descriptive survey design guided by a quantitative research approach within a positivist research paradigm. The positivist paradigm was considered appropriate because it emphasises objective measurement, quantification of variables, and statistical analysis of data.

3.2 Population Size

The population size of this study comprised of 128 registered beef companies and specialised butcheries operating within Lusaka District. The respondents were randomly selected from these companies. These firms were selected because they are actively involved in meat processing, storage, and distribution activities that require effective inventory management practices.

3.3 Sampling Technique and Sample Size Determination

The study employed simple random sampling to ensure that each firm in the population had an equal chance of being selected. Using this technique, a total of 128 meat companies and specialised butcheries were selected from the sampling frame.

The sample size was determined by using Yemani's (1967) statistical formula; $n = N / 1 + N \cdot (e)^2$

Where n = sample size (firms where respondents were selected), N = population of meat companies, e = level of significance (or limit of tolerance error) 0.05, and 1 = constant value.

Calculation of the sample size was done as follows, where $N = 188$ is the number of meat companies and $e = 0.05$:

$$n = 188 / 1 + 188(0.05)^2$$

$$n = 188 / 1 + 188(0.0025)$$

$$n = 188 / 1 + 0.47$$

$$n = 188 / 1.47$$

$$n = 128$$

3.4 Data Collection Instrument

Primary data were collected using a structured questionnaire. The questionnaire consisted of both closed-ended questions and Likert-scale items designed to collect information on inventory management practices, supply chain performance indicators, and operational challenges experienced by meat companies. The questionnaires were distributed to supply chain managers, inventory officers, and operational staff responsible for inventory management within the selected companies. These respondents were considered knowledgeable about the inventory management systems used within their respective organisations.

Out of the 128 targeted companies, 120 respondents successfully participated in the study, representing a response rate of 93.8%. This high response rate improved the reliability and credibility of the collected data. The unit of analysis for this study was the individual respondent rather than the firm. Although the sampling frame was based on registered meat companies and specialised butcheries, the data were collected and analysed at the individual level because respondents were directly involved in inventory management activities.

3.5 Data Analysis Methods

The collected data were coded and entered into the Statistical Package for Social Sciences (SPSS) version 20 for analysis. Both descriptive and inferential statistical techniques were employed. Descriptive statistics such as frequencies and percentages were used to summarise the responses from participants. In addition, inferential statistical analysis was conducted to examine relationships between key variables.

3.6 Ethical Considerations and Limitations

Ethical principles guided the study, ensuring voluntary participation and confidentiality for respondents who participated in the research. The study

focused on meat companies in Lusaka District thereby limiting the generalisability of findings to other districts. Additionally, dependence on self-reported responses raised concerns about respondent bias and reporting inaccuracies.

4 Results and Discussions

4.1 Results

Table 1: Participants by gender and age group

Age group	Gender		Total
	Male	Female	
25-29	24	6	24
30-34	6	10	16
35-39	9	23	32
40-44	40	6	40
45-49	3	5	8
Total	64	56	120

Table 1 shows that 53 percent were male respondents and 47 percent female respondents, with most aged 40–44 and 35–39. A total of 120 took part out of 128 respondents, representing 93.75% participation rate.

Table 2: Participants by position at work

Designation of respondents	Frequency	%
Inventory Officers/Managers	10	8.3
Procurement and marketing officers	6	5
Logistics coordinators	19	15.8
Cashiers	15	12.5
Supply chain officers/ managers	10	8.3
Regional Managers	3	2.5
Accounts Manager	23	19.2
Merchandiser	26	21.7
Veterinary Assistants	8	6.7
Total	120	100

In terms of designation, the respondents included inventory officers/managers, procurement and marketing officers, logistics coordinators, cashiers, supply chain officers/ managers, accounts officers/managers, and merchandisers.

Table 3: Adoption of inventory management practices among beef companies

Inventory Management Practices	Mostly Used (%)	Not Used (%)
Cold Storage Management	91.7	8.3
Reorder Point Planning	60	40
Vendor-Managed Inventory (VMI)	30.8	69.2
Batch Ordering	9.2	90.8
Safety Stock Maintenance	77.5	22.5
First-In, First-Out (FIFO) Method	96.7	3.3
Regular Inventory Audits	86.7	13.3
Demand Forecasting	32.5	67.5
Just-in-Time (JIT) Inventory	90	10
Automated Inventory Tracking Systems	11.7	88.3

Table 3 shows that the highly adopted inventory methods are FIFO (96.7 percent), cold storage management (91.7 percent), JIT inventory (90 percent), and regular audits (86.7 percent). The findings also show that Safety stock maintenance is also widely practised, accounting for 77.5 percent of the total sample. However, more advanced strategic methods, such as vendor-managed inventory (30.8 percent), Automated Inventory Tracking Systems (88.3 percent), and demand forecasting (32.5 percent), are less widely practiced by the beef companies, with Batch ordering being rarely used (9.2 percent)

Table 4: Respondents' perceptions of the effectiveness of inventory management practices in beef companies

Inventory Management Practices	Most Effective (%)	Not Effective (%)
Cold Storage Management	94.2	5.8
Reorder Point Planning	49.2	50.8
Vendor-Managed Inventory (VMI)	54.2	45.8
Batch Ordering	36.7	63.3
Safety Stock Maintenance	86.7	13.3
First-In, First-Out (FIFO) Method	88.3	11.7
Regular Inventory Audits	73.3	26.7
Demand Forecasting	47.5	52.5
Just-in-Time (JIT) Inventory	86.7	13.3
Automated Inventory Tracking Systems	69.2	30.8

Table 4 shows that respondents consider Cold Storage Management as the most effective inventory management practice, accounting for 94.2 percent, FIFO (88.3 percent), Safety Stock Maintenance (86.7 percent), and Just-in-Time systems (86.7 percent). The findings also reveal that Regular Inventory

Audits (73.3 percent) and Automated Tracking Systems (69.2 percent) are also widely viewed as effective modes of inventory management practices that can enhance the beef supply in Lusaka. Conversely, Batch Ordering (36.7 percent) and Demand Forecasting (47.5 percent) are seen as less effective by most respondents. Reorder Point Planning and VMI received mixed perceptions, as shown in the table.

Table 5: Chi-Square Test Results for the Association Between FIFO Inventory Method and Product Spoilage

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.069 ^a	1	.150		
Continuity Correction ^b	.808	1	.369		
Likelihood Ratio	3.312	1	.069		
Fisher's Exact Test				.300	.193
N of Valid Cases ^b	120				
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.33.					
b. Computed only for a 2x2 table					

Table 5 presents the chi-square test results examining the association between the FIFO inventory practices and product spoilage. The Pearson chi-square result, $\chi^2(1, N = 120) = 2.069$, $p = .150$, indicates that the relationship is not statistically significant at the 0.05 level. This is because some expected cell counts were below 5, thereby opting for Fisher's Exact Test, which also showed no significant association ($p = .300$).

4.2 Discussion

This section discusses the study findings on inventory management practices and their influence on beef supply chain performance among meat companies operating in Lusaka District.

The findings indicate that meat companies in Lusaka rely on several inventory management practices to manage the storage and distribution of beef products. The most commonly used practices include FIFO, cold storage management, JIT inventory systems, safety stock maintenance, routine inventory audits, and computerised inventory tracking systems. Among these practices, FIFO emerged as the most widely used method, with the majority of firms reporting that they depend on it to ensure effective stock rotation. This is expected given the perishable nature of beef products. According to Chołodowicz and Orłowski (2021), FIFO inventory practices help firms manage deterioration by ensuring that older inventory items are dispatched first in order to minimise losses caused by product decay. This approach is particularly important in the meat industry, where products have limited shelf life.

Cold storage management also emerged as a critical practice among meat companies in Lusaka. A large proportion of respondents reported using refrigerated storage facilities to maintain meat quality and prevent spoilage. The importance of cold chain systems is widely recognised in food supply chains. Ren et al. (2022) explain that effective cold chain logistics plays a critical role in maintaining meat quality and safety during storage and transportation. Similarly, Qian et al. (2022) note that temperature-controlled storage systems significantly improve food preservation and reduce quality deterioration in perishable supply chains. However, despite the widespread use of cold storage facilities, the study noted challenges such as high electricity costs and unreliable power supply. These infrastructural challenges affect refrigeration efficiency and increase operational costs for meat companies. The situation reflects broader challenges within Lusaka's beef sector.

The study also found that Just-In-Time inventory practices are widely used by meat companies in Lusaka. JIT systems are primarily adopted to minimise storage time and reduce inventory holding costs. According to Chhonker and Rai (2021), JIT systems allow firms dealing with perishable goods to reduce inventory carrying costs while ensuring the timely availability of products for customers. However, JIT systems require reliable supply networks and efficient transportation systems in order to function effectively.

Despite the widespread use of these inventory practices, the study found that advanced inventory management technologies remain underutilised among Lusaka-based meat companies. For instance, Vendor Managed Inventory and demand forecasting tools were used by only a small proportion of firms. This finding contrasts with studies that highlight the growing importance of digital technologies in supply chain management. Haji et al. (2020) emphasise that technological systems improve visibility, coordination and efficiency across perishable food supply chains.

The limited adoption of advanced technologies in Lusaka's beef sector may be attributed to financial constraints, limited technological infrastructure, and a shortage of skilled personnel. Similar findings were reported by Mubanga et al. (2023), who observed that many meat processing firms in Zambia still rely on manual inventory systems and traditional management practices.

The second objective of the study examined how inventory management practices influence supply chain performance. The findings reveal that inefficient inventory systems contribute to challenges such as stockouts, overstocking, delayed deliveries, and product spoilage. Stockouts were identified as a major challenge affecting supply chain performance. When companies fail to maintain adequate inventory levels, they are unable to meet customer demand. According to Kumar, Garg and Agarwal (2019), poor inventory planning can lead to imbalances between supply and demand, resulting in shortages and reduced service levels. This study found that the stockouts often result from supply disruptions, transportation delays, and limited cold storage capacity. Overstocking was also identified as a common operational challenge. While maintaining some level of safety stock is necessary, excessive inventory increases the risk of spoilage and raises operational costs. Greenwood (2021) notes that in perishable supply chains holding excess inventory increases waste and reduces profitability. Local studies indicate that poor inventory management, inadequate staff training, and delivery inconsistencies significantly contribute to inventory losses in Zambian organisations (Chanda and Mwanza, 2023). This finding is consistent with the experiences reported by meat companies in Lusaka, where excess stock often leads to product losses.

Another important finding relates to the role of technology in improving inventory management. Respondents acknowledged that digital tools such as inventory management software and mobile tracking systems may improve supply chain coordination. Luong, Nguyen, and Pham (2023) argue that technology-enabled logistics systems improve inventory optimisation, traceability, and operational efficiency in meat supply chains. However, despite these benefits, the adoption of technologies such as barcode systems and blockchain-based traceability tools remains limited among many meat companies in Lusaka.

To further examine the relationship between inventory management practices and supply chain performance, the study conducted a chi-square test of

independence to determine whether FIFO adoption significantly reduces product spoilage. The findings indicated that although most firms reported using FIFO inventory systems, spoilage incidents were still experienced by several companies. The statistical test produced a chi-square value of $\chi^2 (1, N = 120) = 2.069$ with a significance level greater than 0.05. This means that the relationship between FIFO adoption and spoilage reduction was not statistically significant. This finding suggests that while FIFO is an important inventory management practice, it cannot eliminate spoilage on its own. Instead, spoilage outcomes are influenced by multiple factors within the beef supply chain. Suryani et al. (2016) explain that supply chain performance is determined by the interaction of multiple operational components rather than a single management practice; in Lusaka, where this study was conducted, factors such as cold chain reliability, transportation efficiency, and supplier coordination also play a key role in ensuring that beef products are safe at all times.

The final objective of the study examined strategies that could improve inventory management practices among meat companies in Lusaka. The findings suggest that several interventions can enhance beef supply chain performance. One key strategy is improving supplier relationship management. Strong collaboration between suppliers and processors enhances coordination and reduces supply disruptions. Dubey et al. (2019) emphasise that effective supplier relationships improve supply chain resilience and operational performance. Another important strategy involves strengthening cold chain facilities. Nethra et al. (2023) emphasise that temperature management is one of the important factors influencing the shelf life of beef. However, the beef companies and specialised butcheries lack the necessary finance to modernise their inventory management practices

5 Conclusions and Recommendations

5.1 Contributions to Knowledge

The study assessed inventory management practices and their effect on beef supply chain performance among Lusaka-based meat companies. The findings indicate that most companies depend on basic inventory management practices such as FIFO, cold storage systems, and Just-In-Time inventory management methods. These practices play an important role in ensuring product rotation, maintaining product quality, and supporting supply chain operations. However, the study also found that the adoption of advanced inventory management practices remains limited among Lusaka-based meat companies. It was also found that practices such as automated inventory tracking systems, vendor-managed inventory, and advanced demand forecasting tools are still rarely used by the selected companies. This limited technological adoption reduces the ability of companies to enhance inventory operations and respond effectively to fluctuations in demand.

Furthermore, statistical analysis conducted in the study did not identify a significant relationship between FIFO adoption and spoilage reduction among the surveyed companies. This suggests that while FIFO is widely practiced, other factors, such as infrastructure limitations, cold chain reliability, staff training, and other factors, may influence supply chain performance.

Regarding the contributions to the field of operations, projects, and supply chain management, this study offers empirical data on inventory management practices in the beef sector, which emphasises the use of simple techniques for low-capital beef firms. It identifies operational constraints, informs policy, and demonstrates EOQ and TOC relevance in developing-country supply chains. Therefore, in order to increase generalisability and enhance understanding of efficient inventory practices in Zambia's beef sector, future comparative studies across company sizes with larger sample sizes are advised.

5.2 Limitations and Future Research

The study recommends the following operational and policy measures:

- One short-term action, meat companies in Lusaka should train staff on proper inventory control practices. They should also adopt simple digital tools such as spreadsheets or basic POS systems to track beef stocks and improve record-keeping.
- In a medium-term improvement, the government should provide low-interest financing to help small to medium-sized beef firms acquire modern inventory and processing equipment.
- Waive or reduce taxes on the beef supply chain technologies to encourage investment in the sector.
- Enhance supplier collaboration and performance monitoring among the beef companies.
- At the policy level on a long-term basis, the government should strengthen policies, provide incentives for modern equipment, promote digital integration, and support infrastructure to improve supply chain efficiency, competitiveness, and food safety.

Declaration of Competing Interests

The authors declare that they not aware of any competing financial interests or personal relationships that may have influenced the work described in this document.

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Ethical considerations

The article followed all ethical standards appropriate for this kind of research.

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