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Abstract

Purpose: This study sought to examine the relationship between consumer tracking traceability and performance of Horticultural Firms in Kenya.

Methodology: This study adopted a cross-sectional survey research design. The unit of analysis for this study was 658 registered Horticultural firms in Kenya. Target population was 2,632 respondents. Who comprised of the heads of procurement, head of production, head of administration and head of Finance in horticultural firms in Kenya formed the unit of observation. That was four respondents from each of 658 registered Horticultural firms in Kenya. The sample size was determined using Slovin's Formula and stratified random sampling in the selection of 256 respondents from the target population. The study used both primary as well as secondary data. Secondary data was collection from the annual reports of different horticultural firms in Kenya. Primary data was obtained using both structured and semi-structured questionnaires. A pilot test of 10% was conducted to assess the validity and reliability of the research instruments. The semi-structured questionnaires generated qualitative and quantitative data. Thematic analysis was used to analyse qualitative data and the results were presented in a prose form. Descriptive as well as inferential statistics were used in analysing quantitative data with the help of Statistical Package for Social Science version 28. Descriptive statistics comprised of frequency distribution, percentages, standard deviation and mean. Inferential statistics included correlation analysis, multiple regression analysis and stepwise regression analysis.

Findings: The study found that consumer tracking traceability positively and significantly affects the performance of horticultural firms in Kenya.

Unique Contribution to Theory, Practice and Policy: The study concludes and recommends that Horticultural firms should enhance consumer optimization traceability systems to improve operational efficiency, quality control, and customer satisfaction.

Keywords: *Consumer Tracking Traceability, Performance, Horticultural Firms, Customer Satisfaction*

JEL Codes: *L15, L25, M31, Q13, Q16*

INTRODUCTION

Horticultural firms play a crucial role in society and the economy by engaging in the cultivation, production, and distribution of plants and plant-based goods (Maharjan & Kato, 2023). These businesses are integral to both local and global markets, contributing significantly to food security, employment, and economic growth. The horticultural sector faces challenges in profitability, market share, and customer satisfaction due to supply chain inefficiencies, logistical disruptions, and intense competition, requiring businesses to adapt to evolving consumer preferences. Horticultural firms are responding to evolving consumer preferences for organic and locally sourced products by adopting supply chain traceability. The components of supply chain traceability include raw materials tracking traceability, product tracking traceability, distribution tracking traceability and consumer tracking traceability (Zhou & Xu, 2021). Supply chain traceability enhances transparency, ensures product quality, and reduces risks, helping businesses meet sustainability demands and stay competitive (Schuitemaker & Xu, 2020; Gupta & Boyd, 2018). However, the extent to which such traceability systems, particularly consumer tracking traceability, translate into measurable improvements in firm performance remains unclear, forming a critical gap this study seeks to address.

Consumer tracking traceability (CTT) is a critical aspect of effective supply chain management, particularly in manufacturing and distribution processes (Kafetzopoulos et al., 2024). In supply chain and logistics literature, CTT is defined as the ability to trace and verify product movement and consumer interactions after delivery for purposes of ensuring quality, safety, and feedback management (Fortuna & Gaspar, 2022; Corallo et al., 2020). It involves systematically verifying consumers, monitoring product usage, and conducting root cause analysis to address issues affecting customer satisfaction and product quality. CTT ensures that products reach their intended recipients, prevents counterfeiting, and maintains product integrity while supporting regulatory and contractual compliance (Bhutta & Ahmad, 2021; Fortuna & Gaspar, 2022). The core elements of CTT, consumer feedback, requirements compliance, and root cause analysis—work together to detect problems early, implement corrective actions, and enhance operational efficiency (Corallo et al., 2020). These practices strengthen customer trust, safeguard brand reputation, and enable firms to proactively manage uncertainties, ultimately improving supply chain performance, resilience, and value delivery to consumers (Dietrich & Melcher, 2022). Therefore, CTT serves as a post-production extension of supply chain traceability systems, linking end-consumer feedback with operational and performance improvements within firms.

Globally, consumer tracking traceability (CTT) is critical for ensuring product authenticity, safety, and quality. In Norway, the seafood and forestry sectors use CTT to track products from capture or harvest through distribution, supporting sustainability and ethical sourcing (Nilsson, 2022; Eriksen & Lien, 2020). Similarly, in Pakistan, the textile and pharmaceutical industries employ CTT to monitor product journeys, prevent counterfeiting, and improve quality assurance (Khan et al., 2021; Ali & Bashir, 2020). In Africa, Ethiopia and Rwanda have adopted CTT in coffee and horticulture supply chains, enabling verification of product origin, quality compliance, and enhanced market access (Amare, 2022; Nshimiyimana et al., 2022). In Kenya, initiatives like HOTI, FPEAK, and KFC implement CTT to track horticultural products from farm to international markets, ensuring transparency, freshness, compliance with standards, and improved consumer confidence. These developments suggest that CTT could serve as a strategic tool to enhance performance by strengthening supply chain reliability, brand reputation, and customer satisfaction. However, empirical studies linking consumer tracking

traceability to firm performance within Kenyan horticultural firms are scarce, thereby justifying the need to examine this relationship.

Statement of the Problem

The horticultural sector in Kenya is a key contributor to economic development, accounting for approximately 26% of agricultural GDP, which forms the backbone of the national economy (Horticultural Crops Directorate, 2022). Despite significant growth over the past decade, horticultural firms face persistent challenges including increased competition in export markets, fluctuating foreign exchange rates, climate change, and evolving consumer demands (Fresh Produce Exporters Association of Kenya, 2022). To address these challenges and remain competitive, firms have increasingly adopted elements of supply chain traceability, including consumer tracking traceability (CTT), which enables firms to monitor product movements, verify consumer interactions, and enhance quality assurance (Masudin et al., 2021). Evidence suggests that CTT can improve supply chain performance by reducing product losses, enhancing customer satisfaction, and strengthening operational efficiency. However, from a theoretical perspective, such performance gains are only realized when traceability systems effectively capture, analyze, and utilize consumer feedback data to inform decision-making and continuous improvement. Persistent challenges in responsiveness, accuracy, and data flow within CTT mechanisms may therefore weaken the link between traceability practices and firm performance. This implies that existing fluctuations in horticultural performance may stem from weaknesses in feedback integration and traceability implementation frameworks. Moreover, the relationship between CTT and firm performance may be mediated by contextual factors such as the level of technology adoption, regulatory compliance requirements, the quality of traceability data, and variations in consumer behavior across domestic and export markets, which may either strengthen or constrain the expected benefits of CTT.

Despite these interventions, the performance of horticultural firms in Kenya has remained inconsistent over the last five years (Wawire et al., 2018). Data from the Central Bank of Kenya (2023) shows that earnings in the horticultural sector declined from Ksh. 144 billion in 2020 to Ksh. 107.8 billion in 2023, while customer satisfaction dropped from 89.1% in 2020 to 78.9% in 2023. Similarly, return on assets decreased from 13.9% in 2019 to 11.3% in 2022, and return on investments fell from 21.6% in 2019 to 17.9% in 2023. Market share also fluctuated sharply, with a decline from 26.21% in 2019 to 12.69% in 2020 before partially recovering in subsequent years (Fresh Produce Exporters Association of Kenya, 2022). These downward trends and fluctuations imply that despite the presence of traceability systems, their operationalization may not be sufficiently robust to generate consistent performance outcomes. Theoretically, this inconsistency indicates potential weaknesses in CTT's role as a feedback-driven mechanism that should close the loop between consumers and producers, thereby enhancing learning, adaptability, and performance optimization. Additionally, mediating variables such as inadequate technological integration, limited enforcement of regulatory compliance standards, poor data quality management, and variable consumer response patterns could be contributing to the observed volatility in performance metrics, highlighting the complexity of translating CTT adoption into measurable firm success. These fluctuations suggest gaps in the effectiveness of current traceability systems, highlighting the need to specifically investigate the role of CTT in improving firm performance.

While several studies have explored supply chain traceability, few have focused on CTT in the horticultural sector. For instance, Lesiit (2020) examined the use of blockchain technology to enhance food traceability and safety in Kenya's agricultural industry, while Onyango (2022)

investigated output traceability in public health facilities in Kisumu County. Additionally, Issack and Noor (2020) explored the effect of supply chain traceability on the performance of food and beverage manufacturing firms in Nairobi City County, and Gichure and Wahome (2019) examined traceability in organic fresh produce value chains in Nairobi City County. However, these studies either focused on different sectors, employed different methodologies, or did not specifically investigate the impact of consumer tracking traceability on horticultural firms. This gap necessitates the present study to understand how CTT influences the operational and financial performance of horticultural firms in Kenya.

The null hypothesis in this study was;

H_{01}: Consumer tracking traceability has no significant effect on performance of horticultural firms in Kenya.

LITERATURE REVIEW

Theoretical Review

The Theory of Constraints (TOC) was developed by Eliyahu M. Goldratt in 1984 to explain how organizations can improve overall system performance by identifying and managing constraints (Goldratt, 1984). The theory posits that every production or operational system has at least one limiting factor, or bottleneck, which restricts the system's throughput and efficiency. TOC provides a systematic methodology, including five focusing steps: identify the constraint, exploit it, subordinate other processes to it, elevate it, and repeat the process for new constraints (Gupta & Boyd, 2018; Kuppaeva, 2022). By concentrating on these constraints, firms can optimize resource allocation, improve process flows, and increase profitability. The theory emphasizes that performance improvements result not from optimizing every part of the system independently but by addressing the most critical limiting factor. Recent empirical studies validate TOC's relevance in modern agribusiness and digital supply chains, showing its effectiveness in improving production flow, minimizing waste, and increasing responsiveness to market dynamics (Musau et al., 2021; Ajagbe et al., 2023; Wanyonyi & Muathe, 2022). These studies illustrate how TOC principles can be integrated with technology-enabled data systems to detect bottlenecks and streamline value chain performance.

TOC assumes that a single constraint largely determines system performance and that optimizing it can significantly enhance overall outcomes (Ray & Sanyal, 2020). Critics, however, argue that this focus on a single bottleneck oversimplifies complex systems, which often have multiple interacting constraints (Li et al., 2019). Additionally, TOC's stepwise approach may overlook systemic inefficiencies and fail to adapt quickly in dynamic or rapidly changing environments (Mabin & Balderstone, 2020; Gupta & Boyd, 2018). The theory also largely neglects human and cultural factors such as employee engagement, leadership, and organizational culture, which are essential for sustainable improvement and innovation (Goldratt, 2015). While TOC provides a practical framework for process optimization, its limitations suggest that firms must complement it with broader strategies that address multiple constraints and support adaptability. In light of these critiques, integrating TOC with the Dynamic Capabilities Theory (DCT) offers a more comprehensive lens for understanding how firms leverage traceability data to sense, seize, and reconfigure operational resources in response to external market feedback (Teece, 2021; Ngugi & Kirima, 2023). DCT emphasizes the ability of firms to use information from systems such as CTT to rapidly adapt to consumer demands and regulatory changes, an aspect TOC alone may not sufficiently explain.

In the context of Kenyan horticultural firms, TOC explains how consumer tracking traceability can enhance performance by identifying and addressing operational constraints. Traceability systems monitor products from cultivation through distribution, providing real-time data on production, storage, and supply chain bottlenecks (Mishra & Kumar, 2021). Specifically, CTT data enables firms to pinpoint external and internal constraints by highlighting areas such as delivery delays, recurring quality defects, product recalls, and mismatches between consumer feedback and production output. This information allows managers to identify whether constraints lie in production capacity, logistics coordination, or customer response times. Firms can leverage this information to optimize throughput, reduce lead times, and improve process efficiency (Ray & Sanyal, 2020). Moreover, traceability enhances quality control and compliance, enabling firms to maintain high standards and build customer trust. By linking consumer-level data with internal process performance, CTT operationalizes TOC's principle of constraint identification through feedback-driven diagnostics, effectively bridging internal and external performance parameters. By aligning operations with market demand, traceability supports TOC principles of throughput maximization and constraint management. When combined with dynamic capabilities, this integration enables horticultural firms to continuously learn from CTT insights, adjust production strategies, and strengthen responsiveness to shifting market conditions. Additionally, the continuous feedback provided by traceability systems fosters a culture of continuous improvement, allowing horticultural firms to adapt processes, meet consumer expectations, and sustain competitive advantage (Mtimet, Martínez-Carrasco & Bailey, 2016; Modgil, 2020; Ajagbe et al., 2023; Wanyonyi & Muathe, 2022).

Conceptual Framework

Conceptual framework is a diagrammatic representation of the relationship between the independent variables and the dependent variable (Devi, 2019). The independent variable in this study was consumer tracking traceability. The dependent variable was performance of Horticultural Firms in Kenya. Figure 1 shows the relationship between the independent variable and the dependent variable.

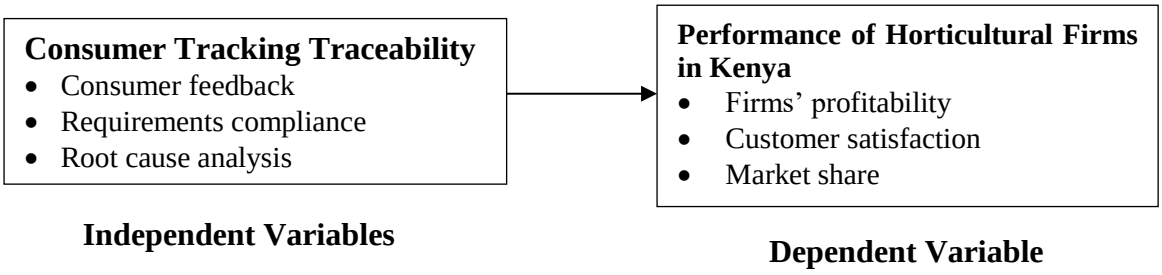

Figure 1: Conceptual Framework

Empirical Review

In China, Zhuo, Sun and Zhou (2025) evaluated the impact of consumer awareness on the adoption of blockchain technology (BCT) in supply chain traceability. The study targeted a supply chain comprising a manufacturer and a retailer, with data collected through scenario-based modeling and simulation. The findings revealed that BCT adoption enhances overall supply chain performance and increases sensitivity to consumer traceability awareness levels. Additionally, the study highlighted that while manufacturers consistently benefit from BCT adoption, retailers' outcomes depend on the level of consumer awareness. The research further

indicated that low consumer awareness leads retailers to target all consumers, whereas high awareness shifts their focus to knowledgeable consumers. The findings underscore the importance of integrating BCT and consumer education to optimize supply chain efficiency, improve targeted marketing strategies, and strengthen stakeholder value. Moreover, the study suggested that increasing consumer awareness can drive greater adoption of BCT across the supply chain, leading to improved transparency and trust among all participants.

Similarly, Xia et al. (2025) conducted a study to examine the effects of blockchain adoption and pricing strategies in supply chains, considering consumer traceability preferences and power structures in China. The study adopted a game-theoretic modeling research design and analyzed supply chain decisions of manufacturers and retailers under varying proportions of high-type and low-type consumers with different levels of traceability awareness. The findings revealed that blockchain investment strategies are jointly determined by the proportion of high-type consumers and the associated usage costs. It further highlighted that both manufacturers and retailers will invest in blockchain only if the proportion of high-type consumers exceeds their respective investment thresholds, and that investment propensity declines as blockchain implementation costs increase. The study also revealed that when the proportion of high-type consumers lies between the two thresholds, low blockchain costs prompt manufacturer-led adoption, whereas high costs shift the initiative to the retailer. Additionally, the study emphasized that blockchain adoption, combined with strategic pricing, can create win-win outcomes, enhance consumer surplus, and improve social welfare.

Liu et al. (2024) conducted a study examining the influence of traceability label trust on consumers' traceable pork purchasing behavior in Shanghai, China, with consideration of the moderating effect of food safety identification. The study primarily targeted consumers across 15 urban areas, with structured questionnaires serving as the main tool for data collection, resulting in 908 valid responses. The study revealed that traceability label trust had a significant and positive effect on consumers' purchasing behavior for traceable pork. Specifically, the findings indicated that food safety identification significantly strengthened this relationship, encouraging more informed and confident purchasing decisions. Moreover, traceable pork consumption scenarios and price labels were found to positively influence consumer behavior, while households with permanently elderly members exhibited a negative impact on purchase decisions. The study further highlighted that enhancing consumer education on traceable product attributes and food safety knowledge, as well as improving risk perception, can promote greater adoption of traceable pork and strengthen overall consumer confidence in food safety.

Hoque, Akhter and Chowdhury (2022) conducted a study examining consumers' preferences for traceability information related to seafood safety in emerging markets, with a focus on Bangladesh. The study primarily targeted seafood consumers in urban and peri-urban areas, with structured questionnaires and an experimental survey serving as the main tools for data collection. The study revealed that traceability information—including production mode, safety claims (e.g., formalin-free), vitamins, and cholesterol content—had significant and positive effects on consumers' purchasing decisions. Specifically, the findings indicated that consumers highly valued safety-related traceability attributes and were willing to pay a premium for seafood with verified safety and local origin. Moreover, consumers showed lower preference for imported and farmed seafood, highlighting a reliance on traceability cues to assess quality and safety. The study further emphasized that providing reliable traceability

information enhances consumer trust, encourages informed decision-making, and can drive improvements in supply chain transparency and food safety management.

In Kenya, Lesiit (2020) conducted a study to examine the use of blockchain technology in enhancing food traceability and safety within the agricultural industry. The study adopted a descriptive research design and focused on key stakeholders across the agricultural supply chain, including farmers, processors, distributors, and regulatory authorities. Primary data was collected using structured questionnaires, semi-structured interviews, and observations. The study revealed that blockchain technology significantly enhanced the traceability of agricultural produce, ensuring transparency, accountability, and integrity throughout the supply chain. Specifically, the findings indicated that blockchain enabled rapid identification and isolation of contaminated produce, reduced the risk of food fraud, and ensured compliance with safety standards among producers and distributors. Furthermore, the system's decentralized, time-stamped, and immutable ledger strengthened digital trust, facilitated secure transactions among stakeholders, and improved overall market safety. The study further highlighted that integrating blockchain in Kenya's agricultural sector supports regulatory oversight, mitigates public health risks, and enhances efficiency and accountability in food production and distribution processes.

From the reviewed empirical studies, several research gaps emerge that warrant further investigation. Most of the existing studies, such as those by Zhuo, Sun and Zhou (2025), Xia et al. (2025), and Liu et al. (2024), have primarily focused on blockchain adoption, consumer awareness, and traceability preferences in developed economies like China, emphasizing technological efficiency and consumer behavior rather than firm-level performance outcomes. Similarly, studies conducted in emerging markets, such as Hoque, Akhter and Chowdhury (2022) in Bangladesh and Lesiit (2020) in Kenya, have concentrated on food safety and supply chain transparency, overlooking how consumer tracking traceability (CTT) influences operational and financial performance within firms. Furthermore, most of these studies are technologically oriented and do not adequately consider the managerial, regulatory, and behavioral mediators, such as technology adoption capacity, data quality, consumer feedback utilization, and compliance frameworks, that may shape the effectiveness of CTT in improving firm outcomes. In addition, few empirical studies have examined CTT within the horticultural sector, especially in the African context, where dynamic consumer markets, infrastructural constraints, and varying regulatory environments may alter traceability effectiveness. Therefore, future research should focus on examining the relationship between consumer tracking traceability and firm performance, incorporating context-specific mediating factors to provide a comprehensive understanding of how CTT contributes to competitiveness and sustainability in horticultural firms.

METHODOLOGY

The study adopted a positivism research philosophy and a cross-sectional survey research design. The unit of analysis for this study was 658 registered Horticultural firms in Kenya as per the Horticultural Crops Directorate (2022). Horticultural Firms were used in this study because the horticultural sector in Kenya contributes 26% of the agricultural GDP in Kenya, which in turn contributes about 34% of the national economy. The heads of procurement, production, finance, and administration in horticultural firms is justified due to their integral roles in the supply chain in horticultural firms in Kenya formed the unit of observation. The target population was 2632 heads procurement, production, finance, and administration departments from 658 registered Horticultural firms in Kenya.

This study made use of Slovin's Formula to determine the study's sample size. Slovin's formula is a mathematical equation used to determine the sample size needed for a simple random sample when the population size is known.

$$n = \frac{N}{1 + NE^2}$$

Where by: n = no. of samples; N = total population; E = error margin / margin of error (0.05)

$$n = \frac{2{,}632}{1 + 2{,}632\ (0.05^2)} = 256 \text{ Respondents}$$

This study adopted stratified random sampling in the selection of 256 respondents from the target population. The strata in this study were procurement, production, finance, and administration departments in horticultural firms in Kenya. This sampling technique will be used because horticultural firms have distinct departments such as procurement, production, finance, and administration, each with its unique responsibilities and challenges. Stratifying the sample based on these departments ensures that the study captures the diversity and specific dynamics within each functional area. Different departments may have varying levels of expertise and involvement in supply chain activities. Stratified sampling allows for the inclusion of respondents with specific knowledge and experience related to their department's role in the supply chain, providing a more nuanced understanding of the research questions.

Table 1: Sample Size Distribution

Departments	Target Population	Sample Size
Procurement	658	64
Finance	658	64
Production	658	64
Administration	658	64
Total	**2632**	**256**

The study used both primary as well as secondary data. Secondary data, including profitability, market share and customer satisfaction index, was collected from the annual reports of different horticultural firms in Kenya.

Primary data was obtained using semi-structured questionnaires. To ensure the validity and reliability of the research instrument, a pilot test was conducted with 26 respondents (10% of the sample) from 10 horticultural firms in Kenya. Validity was examined through content, face, and construct validity. Content validity was enhanced by expert feedback, ensuring the questionnaire addressed all relevant aspects of the study. Face validity was improved by refining ambiguous questions identified during the pilot test. Construct validity was evaluated using Confirmatory Factor Analysis (CFA) to confirm the relationships between variables and constructs. Reliability was assessed using Cronbach's alpha, ensuring internal consistency.

Semi-structured questionnaires were used to gather both qualitative and quantitative data. Thematic analysis was used to analyse qualitative data and the results were presented in a narrative form. On the other hand, quantitative data analysis involved the use of SPSS version 28.0 statistical software to apply both descriptive and inferential statistics. Descriptive statistics were employed to summarize and describe the key characteristics of the dataset, including measures of central tendency such as means and medians, and measures of variability such as standard deviations and ranges. In addition to descriptive statistics, inferential statistics were

utilized to make broader inferences about the population from the sample data. Techniques such as correlation and regression analysis were employed to explore and quantify the relationships between variables and test research hypothesis. The regression model that was used to test is shown below:

$$y = \alpha + \beta_1 x_1 + \varepsilon$$

Where,

Y = Performance of Horticultural Firms in Kenya

α = Constant

β_1= the slope representing degree of change in independent variable by one unit variable.

X_1 = Consumer Tracking Traceability; and

ε = error term

Key assumptions of regression models and their testing methods ensure robust and accurate analysis. Linearity, which posits a direct relationship between independent and dependent variables, was assessed using scatterplots to visually confirm straight-line trends. Normality of residuals was tested through skewness, kurtosis, Shapiro-Wilk, and Kolmogorov-Smirnov tests, supplemented by histograms and normal probability plots. Heteroscedasticity, reflecting unequal variance in error terms, was checked using the White General Test, with p-values indicating potential issues. Autocorrelation, the dependence among residuals, was tested using the Durbin-Watson statistic, where values between 1.5 and 2.5 signaled independence. Addressing these assumptions ensures credible regression outcomes.

FINDINGS AND DISCUSSIONS

The sample size for this study included 256 heads of procurement, head of production, head of finance and head of administration from registered horticultural firms in Kenya. Out of these, 221 questionnaires were returned, reflecting a high response rate of 86.5%. However, 2 of the returned questionnaires were deemed unusable due to incomplete responses or other issues, reducing the total number of usable questionnaires to 221. This results in a usability rate of 85.92%. The high response and usability rates suggest strong participation and engagement from the targeted department heads within the horticultural firms, ensuring that the data collected is both reliable and representative of the intended population.

Latwal (2020) indicates that a response rate of 50% is considered sufficient for effective analysis, a rate of 60% is viewed as good, and anything 70% or higher is deemed excellent. The study achieved a notable response rate of 86.48%, which significantly exceeds these benchmarks. This high response rate not only indicates that the level of participation was more than adequate but also reflects a strong engagement from the respondents. Furthermore, with 85.92% of the returned questionnaires deemed usable, the reliability of the collected data is enhanced, reinforcing the strength and credibility of the study's findings. This robust engagement and high usability underscore the effectiveness of the data collection process.

Table 2: Response Rate

Responses	No.	Percentages
Administered questionnaires	256	100%
Returned	221	86.48%
Unusable questionnaires	35	0.56%
Usable questionnaires	221	85.92%

Consumer Tracking Traceability

The respondents were asked to indicate their level of agreement with various statements on consumer tracking and traceability practices in horticultural firms in Kenya. The results were as shown in Table 3. The respondents strongly agreed that firms conduct thorough investigations to identify the causes of consumer complaints or product issues, with a mean of 4.610 (SD=0.732). This indicates that horticultural firms take consumer complaints seriously and engage in systematic problem identification. Closely related, the respondents agreed that corrective actions are implemented based on findings from root cause analysis to prevent recurrence (mean=4.534, SD=0.733), highlighting the firms' commitment to continuous improvement in product quality and service delivery. The respondents also agreed that documentation of consumer requirements is effectively maintained and monitored for compliance (mean=4.340, SD=0.910) and that products supplied to consumers consistently meet the agreed quality and safety requirements (mean=4.320, SD=0.805). These findings suggest that horticultural firms emphasize adherence to consumer specifications and quality standards, which is critical for building trust and brand reputation.

With a mean of 4.142 (SD=0.984), the respondents agreed that firms consistently verify the identity of consumers before product delivery, reflecting the importance placed on accurate delivery and traceability. In addition, firms were perceived to ensure compliance with regulatory standards throughout the consumer distribution process (mean=4.098, SD=1.036), indicating alignment with industry regulations. Moderate agreement was reported regarding the use of consumer feedback for accurate tracking of product usage (mean=3.880, SD=0.926) and the effectiveness of methods used to confirm that products reach the intended consumers (mean=3.825, SD=1.081). This shows that while firms are generally effective in tracking and traceability, there may be room for improvement in feedback integration and delivery verification processes. Finally, respondents agreed that data from consumer tracking is used to continuously improve product quality and delivery processes (mean=4.009, SD=0.983), demonstrating that the information collected is leveraged for organizational learning and process enhancement.

Table 3: Statements on Consumer Tracking Traceability

Statements	Mean	Std Dev
Horticultural firms consistently verify the identity of consumers before product delivery.	4.142	0.984
Consumer feedback is systematically recorded to ensure accurate tracking of product usage.	3.880	0.926
The firms use effective methods to confirm that products reach the intended consumers.	3.825	1.081
Products supplied to consumers consistently meet the agreed quality and safety requirements.	4.320	0.805
Firms ensure compliance with regulatory standards throughout the consumer distribution process.	4.098	1.036
Documentation of consumer requirements is effectively maintained and monitored for compliance.	4.340	0.910
Firms conduct thorough investigations to identify the causes of consumer complaints or product issues.	4.610	0.732
Corrective actions are implemented based on findings from root cause analysis to prevent recurrence.	4.534	0.733
Data from consumer tracking is used to continuously improve product quality and delivery processes.	4.009	0.983

The respondents were requested to indicate any other issue related to Consumer tracking traceability on the performance of horticultural firms in Kenya. The respondents indicated that Consumer tracking traceability significantly enhances the performance of horticultural firms in Kenya by ensuring product quality and safety 106 (48%) of the respondents, building consumer trust 122 (55%) of the respondents, facilitating market access 71 (32%) of the respondents, improving supply chain efficiency 135 (61%) of the respondents, enabling effective risk management 152 (69%), supporting sustainability goals 141 (64%) of the respondents,, and providing valuable data for Legal decision-making 117 (53%) of the respondents. They also indicated that Consumer tracking traceability is a critical tool for achieving operational excellence 148 (67%) of the respondents, competitiveness 95 (43%) of the respondents, and long-term success in the global marketplace.

Furthermore, the respondents indicated that consumer tracking traceability is crucial for Kenyan horticultural firms to enhance market access 133 (60%) of the respondents, ensure product quality and safety 124 (66%) of the respondents, optimize supply chain efficiency 115 (52%), manage risks effectively 148 (67%) of the respondents, utilize data for Legal decision-making 113 (51%) of the respondents, comply with international standards (85%) of the respondents, promote sustainability (64%) of the respondents, and differentiate their brand in the global marketplace 175 (79%) of the respondents, embracing Consumer tracking traceability, according to the respondents, can lead to sustainable growth, profitability, and resilience in the face of dynamic market challenges. These findings is in line with the findings of Mbewe and Kalenga (2021).

Performance of Horticultural Firms in Kenya

The respondents were asked to indicate their level of agreement with various statements on the performance of horticultural firms in Kenya. The results were as shown in Table 4. The respondents agreed most strongly with the statement that marketing and distribution strategies

effectively expand the firm's market presence, with a mean of 4.443 (SD=0.914). This finding suggests that horticultural firms in Kenya prioritize marketing and distribution to strengthen their market reach. Similarly, respondents agreed with a mean of 4.463 (SD=0.915) that an increase in market share has positively influenced the overall performance of horticultural firms, which aligns with Alsharairi, Mezher and Wehbe (2020) observation that market share growth reflects shifts in consumer preferences and competitive dynamics. The respondents also agreed that the firm competes successfully against other horticultural firms in Kenya (mean=4.290, SD=1.034) and that customer service practices contribute positively to overall satisfaction (mean=4.273, SD=1.031). These findings highlight the importance of effective competitive strategies and quality customer service in driving performance. With a mean of 4.183 (SD=0.976), the respondents agreed that the firm responds promptly and effectively to customer feedback and complaints, suggesting that responsiveness enhances customer satisfaction.

In addition, the respondents agreed that profit margins of the firm have improved over the past few years (mean=4.173, SD=0.795), indicating growing financial performance. The respondents agreed with a mean of 4.087 (SD=0.821) that consumers are generally satisfied with the quality of horticultural products offered. This aligns with Kosgei (2020) observation that customer satisfaction increases when products meet expected standards. Moderate agreement was observed regarding the maintenance or increase of market share (mean=3.973, SD=0.981) and the effectiveness of competitive strategies in increasing market presence (mean=3.993, SD=0.992), showing that firms have made efforts to maintain competitiveness, though challenges may still exist. The respondents were moderately positive about the consistent achievement of profitability targets (mean=3.913, SD=0.974) and improvements in return on investment, indicating steady financial performance. The respondents agreed least with the statement that the firm effectively manages costs to enhance overall profitability, with a mean of 3.780 (SD=1.287), suggesting that cost management is an area that may require improvement to further enhance overall performance. Overall, the findings indicate that horticultural firms in Kenya have demonstrated strong performance in marketing, customer satisfaction, and competitive positioning, while cost management and consistent profitability remain areas for potential strategic focus.

Table 4: Statements on Performance Horticultural Firms in Kenya

	Mean	Std. Deviation
The horticultural firm consistently achieves its profitability targets.	3.913	0.974
Profit margins of the firm have improved over the past few years.	4.173	0.795
The firm effectively manages costs to enhance overall profitability.	3.780	1.287
Consumers are generally satisfied with the quality of horticultural products offered.	4.087	0.821
The firm responds promptly and effectively to customer feedback and complaints.	4.183	0.976
Customer service practices of the firm contribute positively to overall satisfaction.	4.273	1.031
The firm has maintained or increased its market share in the horticultural sector.	3.973	0.981
Marketing and distribution strategies effectively expand the firm's market presence.	4.443	0.914
The firm competes successfully against other horticultural firms in Kenya.	4.290	1.034
Competitive strategies adopted by horticultural firms have increased their market presence.	3.993	0.992
An increase in market share has positively influenced the overall performance of horticultural firms.	4.463	0.915

Figure 2 shows the declining of profitability of the horticultural firms (return on investment) for the period between 2019 and 2023. The average profitability (Return on Investment) of horticultural firms in Kenya has shown a general decline from 2019 to 2023. In 2019, the ROI was relatively high at 21.6%, but it decreased to 19.2% in 2020. Whereas there was a slight recovery to 20.0% in 2021, the downward trend continued in the subsequent years, with profitability dropping to 18.5% in 2022 and further down to 17.9% in 2023. This consistent decline in profitability over the five-year period suggests that horticultural firms in Kenya may be facing increasing challenges, such as rising operational costs, market competition, or other economic factors impacting their financial performance.

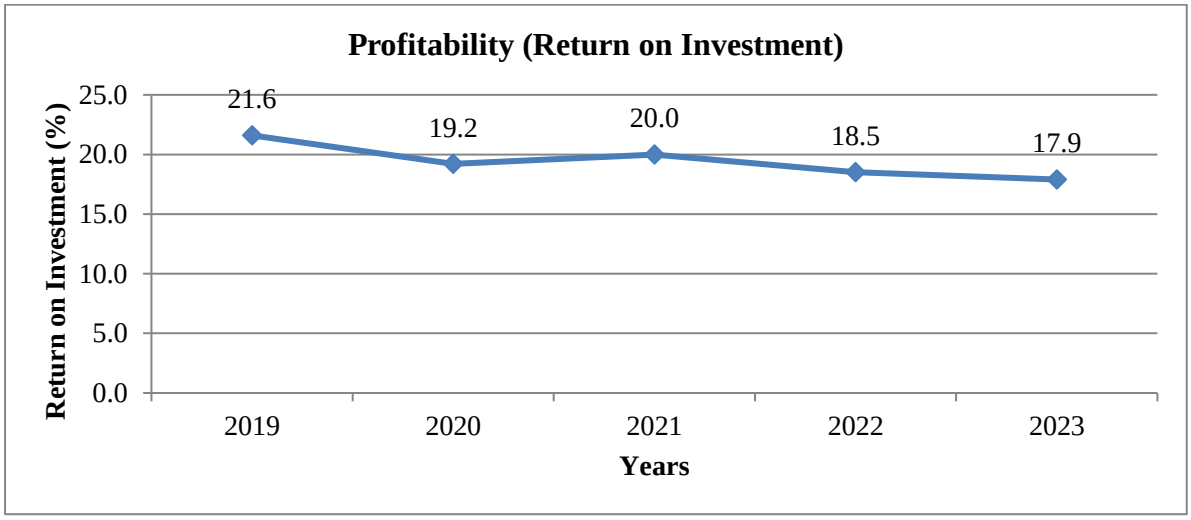

Figure 2: Trend of Profitability (Return on Investment)

Figure 3 shows the declining of market share of the horticultural firms for the period between 2019 and 2023. The average market share of horticultural firms in Kenya experienced significant fluctuations between 2019 and 2023. In 2019, the market share was 26.21%, but it dropped sharply to 12.69% in 2020, likely due to disruptions caused by global events such as the COVID-19 pandemic. The market share recovered somewhat in 2021, increasing to 18.72%, and saw a substantial rise in 2022, reaching a peak of 32.78%. By 2023, the market share slightly decreased to 26.76%, aligning closely with the 2019 level.

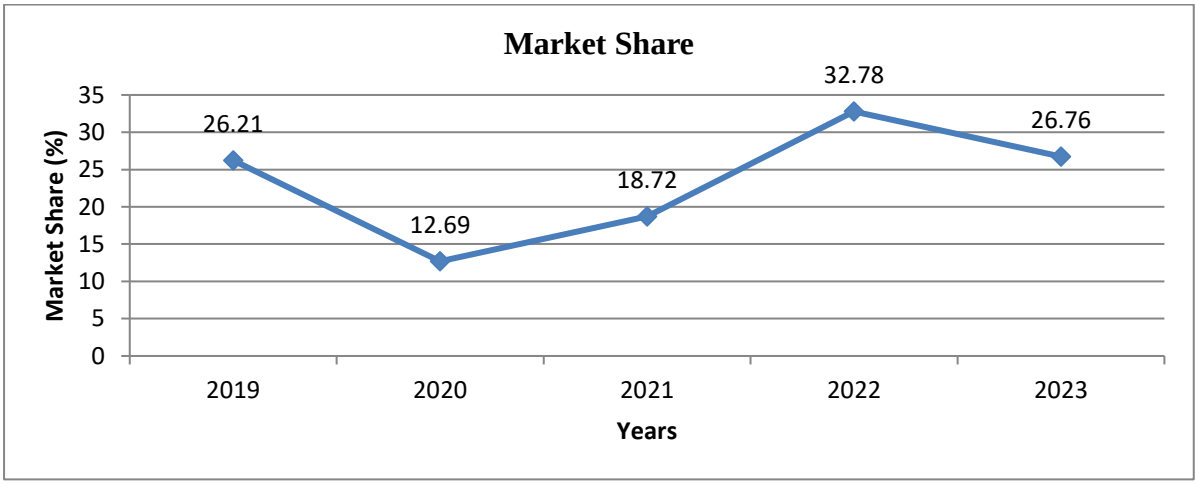

Figure 3: Trend of Market Share

Figure 4 shows the average customer satisfaction index among horticultural firms for the period between 2019 and 2023. The average customer satisfaction index of horticultural firms in Kenya displayed a fluctuating trend between 2019 and 2023. Starting at 85.3 in 2019, the satisfaction index peaked at 89.1 in 2020, indicating a high level of customer satisfaction during that year. However, from 2021 onwards, there was a gradual decline, with the index dropping to 86.2 in 2021, further down to 81.3 in 2022, and reaching its lowest point at 78.9 in 2023. These findings is in line with the findings of Mbewe and Kalenga (2021).This downward trend suggests that customer satisfaction has decreased over the years, potentially reflecting challenges or changes in the industry that may have impacted service quality or customer expectations.

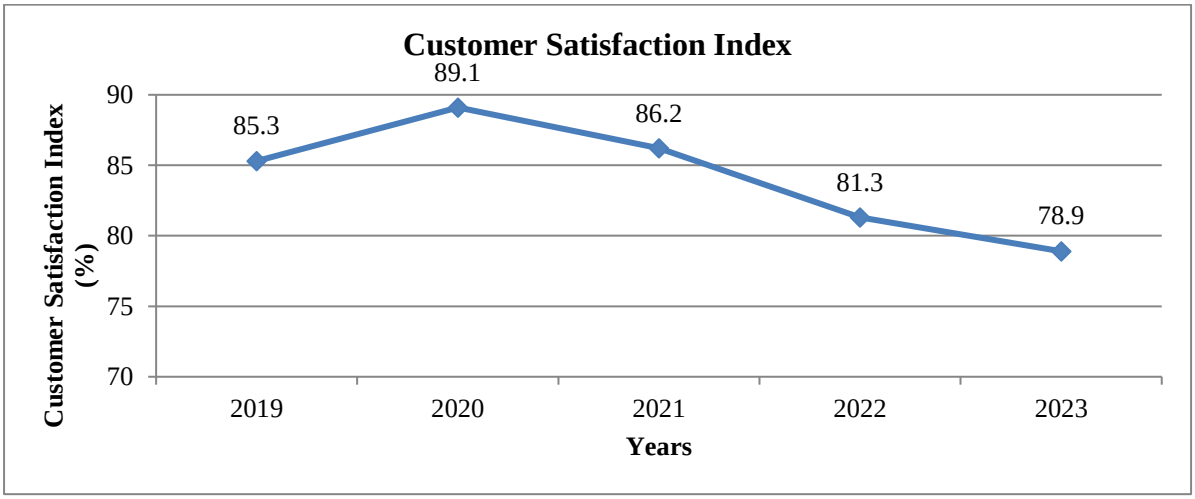

Figure 4: Trend of Customer Satisfaction Index

Correlation Analysis

Pearson correlation analysis was used to assess the strength and direction of the linear relationship between consumer tracking traceability and performance of horticultural firms in Kenya. The correlation results show that consumer tracking traceability (CTT) also shows a robust positive correlation with PHF performance ($r = 0.729$, $p < 0.001$). This correlation indicates that firms that maintain visibility and control over their products after they leave the production facility, through distribution and retail stages, tend to achieve better overall performance outcomes. By tracking outputs, such as sales distribution channels and customer feedback, horticultural firms can adapt quickly to market demands, optimize distribution strategies, and enhance customer satisfaction, ultimately contributing to higher performance levels. The findings are in concurrence with the findings of Yao and Li (2022), who observed that there is a positive relationship between Consumer tracking traceability and Firms performance.

Table 5: Correlation Coefficients

		PHFK	CTT
Performance of Horticultural Firms in Kenya (PHF)	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	221	
Consumer Tracking Traceability	Pearson Correlation	.729**	1
	Sig. (2-tailed)	.000	
	N	221	221

**. Correlation is significant at the 0.01 level (2-tailed).

Regression Analysis

Regression analysis was used to assess the strength of the relationship between consumer tracking traceability and performance of horticultural firms in Kenya. The R-squared value of 0.463 suggests that 46.3% of the variance in the performance of horticultural firms can be explained by input traceability. This indicates a moderate model fit, with the remaining 53.7% of the variance in firm performance unexplained by consumer tracking traceability alone.

Table 6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.681[a]	.463	.473	.32846

a. Predictors: (Constant), Consumer Tracking Traceability

The Analysis of Variance (ANOVA) demonstrates how well consumer tracking traceability predicts performance. Since the F-statistic (97.925) is significantly greater than the critical value of 3.94 from the F-distribution table, the regression model is highly significant. The p-value of 0.000, which is much lower than the significance level of 0.05, indicates that the model is valid for predicting the effect of consumer tracking traceability on the performance of horticultural firms in Kenya.

Table 7: Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19.818	1	19.818	97.925	.000[b]
	Residual	44.321	219	0.2024		
	Total	**64.139**	**220**			

a. Dependent Variable: Performance of Horticultural Firms in Kenya
b. Predictors: (Constant), Consumer Tracking Traceability

From the findings, regression equation was as follows;

Y=0.396+ 0.224 (Consumer Tracking Traceability)

The results reveal that consumer tracking traceability has a positive and significant effect on the performance of horticultural firms in Kenya (β = 0.224, p-value = 0.002). This coefficient suggests that improvements in consumer tracking traceability lead to a significant increase in firm performance. Specifically, for each one-unit increase in consumer tracking traceability, firm performance increases by 0.224 units. The effect is highly statistically significant (p < 0.002), which highlights the importance of effectively managing and consumer tracking traceability in achieving better performance outcomes for horticultural firms in Kenya. The findings are in line with Lesiit (2020) assertion that consumer tracking traceability has a positive effect on the performance of agricultural industry in Kenya. The findings also agree with Mukolwe and Onyango (2017) argument that consumer tracking traceability positively and significantly impact performance.

Table 8: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	**Std. Error**	**Beta**		
1	(Constant)	.396	.093		4.258	.001
	Consumer Tracking Traceability	.224	.056	.261	4.000	.002

a. Dependent Variable: Performance of Horticultural Firms in Kenya

Conclusion

The findings conclude that consumer tracking traceability positively and significantly affects the performance of horticultural firms in Kenya. The results indicated that consumer feedback, consumer feedback management, and compliance monitoring play a crucial role in enhancing firm performance. This means that improving consumer tracking traceability (consumer feedback, feedback management, and compliance monitoring) boosts accountability and strengthens customer trust in horticultural products. There are several benefits of consumer tracking traceability for horticultural firms such as enhanced transparency and accountability: Verifying consumer identity ensures that products reach the right customers, minimizing diversion and fraud. Improved efficiency: Recording consumer feedback provides accurate insights into product usage and satisfaction, enabling firms to address gaps and enhance delivery processes. These practices lead to stronger operational effectiveness and long-term customer relationships.

Recommendations

The study found that consumer tracking traceability positively and significantly affects the performance of horticultural firms in Kenya. The study recommends that horticultural firms in Kenya should enhance their Consumer tracking traceability systems to further improve performance. Effective categorization and Firm of customer feedback helps firms gain valuable insights into consumer preferences and areas for improvement. Horticultural firms should ensure timely responses to feedback to strengthen customer relationships and build loyalty. In addition, horticultural firms should prioritize on the delivery of superior quality products or services to reinforce the firm's reputation and competitiveness in the market, thus driving growth and customer satisfaction. The study also found that firms have ensured movement tracking on all products and all vehicles in the firm are fitted with tracking devices. The study recommends that horticultural firms should invest in robust movement tracking systems for all products and vehicles. Also, the firms should ensure that vehicles are fitted with tracking devices that ensures real-time monitoring of goods during transportation, minimizing losses and enhancing operational efficiency.

This level of transparency not only aids in logistics management but also reassures customers about the safety and reliability of their orders. Horticultural firms should maintain rigorous tracking of products to ensure accountability throughout the supply chain so as to enhancing consumer trust and satisfaction. The study found that firm demonstrates a strong commitment to continuous improvement of quality assurance practices. The study recommends that horticultural firms should demonstrate a strong commitment to continuous improvement in quality assurance practices. Also, the study recommends for regular reviews and updates of quality assurance processes that align with industry best practices which ensures that the firm remains competitive. Horticultural firms should implement a user-friendly feedback tracing system for both employees and customers so as to facilitate easier navigation and enhance engagement.

Recommendations for Further Studies

The primary objective of this study was to assess how consumer tracking traceability affects the performance of horticultural firms in Kenya. However, the study focused specifically on horticultural firms, limiting the generalizability of the findings to other sectors. Therefore, further research is recommended to examine the influence of consumer tracking traceability on the performance of firms in different industries in Kenya. In addition, the study found that consumer tracking traceability explains only a portion of the variation in performance among horticultural firms. Future studies should explore other complementary factors that may affect firm performance alongside consumer tracking traceability to provide a more comprehensive understanding.

REFERENCES

Ajagbe, F. A., Olatunji, O. A., & Siyanbola, O. T. (2023). Applying the Theory of Constraints in digital supply chain optimization: Evidence from agribusiness firms in sub-Saharan Africa. *Journal of Supply Chain and Operations Management, 11*(2), 45–59.

Musau, J. K., Muturi, W., & Kamau, S. (2021). Effect of operational constraints on supply chain performance of agribusiness enterprises in Kenya. *International Journal of Business and Economic Development, 9*(3), 66–77.

Ngugi, P. M., & Kirima, N. W. (2023). Dynamic capabilities and digital transformation in Kenya's horticultural value chains. *African Journal of Business Management, 17*(1), 21–34.

Teece, D. J. (2021). *Dynamic capabilities and strategic management: Organizing for innovation and growth* (2nd ed.). Oxford University Press.

Wanyonyi, L. M., & Muathe, S. M. A. (2022). Integration of Theory of Constraints and digital technologies in agri-based manufacturing systems: Evidence from Kenya. *International Journal of Production Research, 60*(18), 5624–5638.

Zhou, X., & Xu, Z. (2021). Traceability in food supply chains: A systematic literature review and future research directions. *International Food and Agribusiness Management Review, 25*(2), 1–24. https://doi.org/10.22434/IFAMR2020.0065

Ali, A., & Bashir, M. (2020). Enhancing pharmaceutical supply chain traceability in Pakistan. *International Journal of Pharmaceutical Sciences*, 12(2), 78-89.

Alsharairi, M., Mezher, T., & Wehbe, N. (2020). The impact of input traceability on the performance of the Lebanese agro-food sector. *Journal of Cleaner Production*, 267, 121-143.

Amare, D. (2022). Coffee traceability in Ethiopia: A review of practices and impacts. *Journal of Coffee Research*, 35(2), 123-139.

Bhutta, M. N. M., & Ahmad, M. (2021). Secure identification, traceability and real-time tracking of agricultural food supply during transportation using internet of things. *Ieee Access*, *9*, 65660-65675

Central Bank of Kenya (2023). *Agricultural sector survey*. Retrieved from https://www.centralbank.go.ke/

Corallo, A., Latino, M. E., Menegoli, M., & Pontrandolfo, P. (2020). A systematic literature review to explore traceability and lifecycle relationship. *International Journal of Production Research*, *58*(15), 4789-4807

Devi, P. S. (2019). *Research methodology: A handbook for beginners*. New Delhi: Notion Press

Dietrich, V., & Melcher, F. (2022). Mineral raw material supply chain transparency and traceability: Does provenance matter in the supply chain? *BHM Mining and Metallurgical Monthly Journals*, *167*(12), 594-597

Eriksen, H., & Lien, A. (2020). Timber traceability and sustainability in Norway: A review. *Forestry Studies in Norway*, 78(4), 89-102

Fortuna, G., & Gaspar, P. D. (2022). Implementation of industrial traceability systems: A case study of a luxury metal pieces manufacturing company. *Processes*, *10*(11), 2444.

FPEAK. (2021). *Traceability. Fresh produce exporters association of Kenya*. Retrieved from https://fpeak.org/traceability/

Fresh Produce Exporters Association of Kenya (2022). *Update on the State of the Horticulture Industry in Kenya 2020.* Retrieved from https://fpeak.org/

Gichure, J. & Wahome, W. (2019). (2019). Extent of traceability along organic fresh produce value chains: case of kale in Nairobi, Kenya. *Organic Agriculture, 7*, 15-29.

Goldratt, E. M. (1984). *The goal: A process of ongoing improvement.* New York: North River Press.

Gupta, M.C. & Boyd, L.H. (2018). Theory of constraints: a theory for operations management. *International Journal of Operations & Production Management, 28*(10), 991-1012.

Hoque, M. Z., Akhter, N., & Chowdhury, M. S. R. (2022). Consumers' preferences for the traceability information of seafood safety. *Foods, 11*(12), 1675

Horticultural Crops Directorate (2022). *Validated report 2019-2020 - Horticultural Crops Directorate*. Retrieved from https://horticulture.agricultureauthority.go.ke/

Kafetzopoulos, D., Margariti, S., Stylios, C., Arvaniti, E., & Kafetzopoulos, P. (2024). Managing the traceability system for food supply chain performance. *International Journal of Productivity and Performance Management, 73*(2), 563-582

Karani, A.M. (2022). Effect of supply chain strategies on the performance of manufacturing firms in Kenya. *Risk Governance & Control: Financial Markets & Institutions, 6*(4), 90-112.

Khan, M., Ali, S., & Mehmood, A. (2021). The impact of supply chain traceability on quality control in Pakistan's textile industry. *Textile Research Journal*, 91(7), 951-964.

Kosgei, A. K. (2020). Block chain readiness Assessment for Domestic Horticultural Traceability in Urban Kenya. *Logistics and Transportation Review, 137*, 101923.

Kuppaeva, B. T. (2022). Problems of general systems theory. *European Science Review, 13*, 21-30.

Latwal, G.S. (2020). *Research methodology.* Florida: CRC Press.

Lesiit, L. L. (2020). Block Chain Technology to enhance food traceability and safety: case study of Agriculture Industry in Kenya. *International Journal of Social Science and Humanities Research, 3*(1), 214–232.

Li, J., Wang, X., & Wang, Q. (2019). Expanding the Theory of Constraints: A Multi-Dimensional Approach to Process Improvement. *International Journal of Production Research*, 57(5), 1453-1465.

Liu, Z., Yu, Z., Zhao, J., Han, X., Li, C., Geng, N., & Yu, M. (2024). The influence of traceability label trust on consumers' traceability pork purchasing behavior: Based on the moderating effect of food safety identification. *Plos one, 9*(6), e0306041.

Mabin, V. J., & Balderstone, S. J. (2020). *The World of the Theory of Constraints: A Review of the Literature*. Routledge.

Maharjan, R. & Kato, H. (2023). Logistics and supply chain resilience of Japanese companies: Perspectives from impacts of the COVID-19 pandemic. *Logistics, 7*(2), 27-56.

Masudin, I., Ramadhani, A. & Restuputri, D.P. (2021). The effect of traceability system and managerial initiative on Indonesian food cold chain performance: A Covid-19 Pandemic perspective. *Global Journal of Flexible Systems Management, 22*, 331–356.

Mbewe, S., & Kalenga, M. (2021). Enhancing traceability in Malawi's tobacco industry: A case study. *Tobacco Industry Review*, *12*(2), 85-90.

Modgil, S. (2020). Exploring the relationship between horticultural legal framework, SCM practices and Firms performance in agri-food supply chain. *Benchmarking: An International Journal*, *27*(3), 1003-1041.

Mtimet, N., Martínez-Carrasco, L., & Bailey, A. (2016). Food safety and quality management systems in horticultural supply chains: A case study from the UK. *Food Control*, 60, 354-364.

Nilsson, S. (2022). Enhancing seafood traceability for improved sustainability in Norway. *Norwegian Journal of Aquatic Sciences*, 29(2), 50-63.

Nshimiyimana, A., Mugisha, I., & Habiyaremye, M. (2022). Enhancing coffee supply chain traceability in Rwanda: Trends and challenges. *East African Journal of Business Management*, 24(3), 90-103.

Onyango, J.O. (2022). Impact of Inventory Management Techniques on the Performance of Public Health Facilities in Kisumu County. *Journal of Pharmacy and Pharmacology, 8*(17), 438- 442.

Ray, A. & Sanyal, S.K. (2020). An improved theory of constraints. *International Journal of Accounting & Information Management*, *16*(2), 155-165.

Schuitemaker, R. & Xu, X. (2020). Product traceability in manufacturing: A technical review. *Procedia CIRP*, 93, 700-705.

Wawire, N. H., Kisaka, S. M., & Ogollah, K. (2018). Factors influencing the performance of horticultural firms in Kenya. *International Journal of Scientific and Research Publications*, 8(10), 731-737.

Xia, L., Wang, L., Xiao, R., Wang, J., & Hou , P. (2025). Blockchain and pricing strategies in supply chains considering consumer traceability preference and power structure. *International Journal of Production Research*, *1*(1), 1-20

Yao, J. & Li, J. (2022). The interrelationship between intellectual capital and firm performance: evidence from China's manufacturing sector. *Journal of Intellectual Capital*, *23*, 313-341.

Zhou, Y., Zhu, H., & Chao, Y. (2024). A Blockchain-Based Model for Traceability and Quality Management of Raw Materials in Clothing Products. *Journal of Biobased Materials and Bioenergy*, *18*(4), 563-569.