Output Traceability and Performance of Horticultural Firms in Kenya

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Boniface Muli Kingoto [1*], Dr. Noor Ishmael Shale [2], Dr. Elizabeth Wachiuri [3]

[1*] PhD Scholar: Jomo Kenyatta University of Agriculture and Technology, Kenya

[2'3] Lecturer: Jomo Kenyatta University of Agriculture and Technology, Kenya

Abstract

Purpose: This study therefore sought to examine the effect of output traceability on performance of Horticultural Firms in Kenya. The study was anchored on the theory of constraints.

Methodology: This study adopted a cross-sectional survey research design. The target population was 3,290 heads procurement, quality assurance, production, information and communication technology as well as marketing departments from 658 registered Horticultural firms in Kenya. The sample size was determined using Slovin's Formula and stratified random sampling in the selection of 355 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 semi-structured questionnaires. A pilot test was conducted to assess the validity and reliability of the research instrument. The semi-structured questionnaires generated qualitative and quantitative data. Thematic analysis was used to analyse qualitative data and the results will be presented in a prose form. Descriptive as well as inferential statistics were used in analysing quantitative data with the help of SPSS version 28.0 statistical software. Descriptive statistics comprised of frequency distribution, percentages, standard deviation and mean. Inferential statistics included correlation analysis and linear regression analysis.

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

Unique Contribution to Theory, Policy and Practice: This study extends the theory of constraints to traceability practices in the horticultural sector, offering valuable insights for enhancing firm performance. It also provides actionable recommendations for horticultural firms and policymakers to adopt traceability systems, improving efficiency, competitiveness, and growth.

Keywords: *Output Traceability, Performance, Horticultural Firms, Customer Satisfaction*

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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.

This strategy enhances transparency, ensures product quality, and reduces risks, helping businesses meet sustainability demands and stay competitive (Schuitemaker & Xu, 2020; Gupta & Boyd, 2018). Traceability enables firms to adapt effectively, boosting performance while addressing global challenges in quality assurance and shifting market dynamics. The components of supply chain traceability include product traceability, process traceability, input traceability and output traceability.

Output traceability refers to the process of tracking and documenting the movement and transformation of products or materials through a supply chain, ensuring that every output, from raw materials to final products, is traceable at each stage (Cai & Yang, 2019). This practice is crucial in industries like agriculture, food, and pharmaceuticals, where product safety, quality assurance, and regulatory compliance are vital. By employing systems such as barcodes, RFID, and digital records, businesses can enhance transparency, reduce risks, and improve accountability (Gupta & Boyd, 2018; Schuitemaker & Xu, 2020). In addition, output traceability supports sustainability by verifying product origins and ensuring adherence to ethical and environmental standards, thereby strengthening consumer trust and market competitiveness (Bae & Cho, 2019). Key elements of out traceability include movement tracking, which records the flow of goods, quality assurance, which ensures product standards are maintained, and feedback tracing, which gathers insights from end-users to improve processes (Masudin, Ramadhani & Restuputri, 2021). These indicators enable businesses to monitor performance, maintain consistency, and swiftly address any issues in the product lifecycle.

Output traceability in the horticultural industry is essential for ensuring food safety, quality, and sustainability across multiple countries. In the United States, initiatives like the Food Safety Modernization Act and organic certification programs require traceability from production to distribution, tracking ingredient origins and production methods (Maharjan & Kato, 2023; Hallak & Tacsir, 2022). In India, the Food Safety and Standards Authority (FSSAI) enforces traceability, capturing data on raw material origins, production processes, and distribution channels (Hinkes & Peter, 2020). Similarly, in Ghana, traceability systems are implemented in the horticultural sector and cocoa industry to monitor product journeys and promote responsible sourcing (Osei-Amponsah et al., 2019). In Kenya, organizations like the Fresh Produce Exporters Association of Kenya (FPEAK), Kenya Flower Council (KFC), and Kenya Horticultural Council

(KHC) have adopted traceability systems to track products from farms to export markets, ensuring product quality and compliance (FPEAK, 2021; KFC, 2021). Additionally, in Ethiopia, traceability systems in the coffee and textile industries help maintain quality and enhance global competitiveness (Amare, 2022; Mulugeta & Teshome, 2023). Across these countries, technologies such as RFID, blockchain, and barcoding are crucial for improving transparency, reducing risks, and boosting competitiveness in the global market.

Statement of the Problem

The horticultural sector in Kenya plays a key role in economic development as it contributes about 26% of the agricultural GDP, which is the main pillar of the national economy (Horticultural Crops Directorate, 2022). Despite the growth of the sector in the last 10 years, the sector has been experiencing challenges such as increased competition in the export market, increase in foreign exchange rate, climatic change and the changing needs of the consumers (Fresh Produce Exporters Association of Kenya, 2022). To remain competitive in the horticultural export market, horticultural firms in Kenya have in the last one decade been adopting various elements of supply chain traceability including output traceability. Masudin et al. (2021) indicate that output traceability leads to an improvement in supply chain performance.

Despite the growth of the sector, the performance of Horticultural Firms in Kenya has been fluctuating for the last five years (Wawire et al., 2018). An Agricultural Sector Survey by the Central Bank of Kenya (2023) revealed that earnings in horticultural industry in Kenya declined by 8.23% from Ksh. 144. billion in 2020 to Ksh. 133 billion in 2021, which decreased by 10.59% in 2022 to Ksh. 120.3 billion and 10.39% in 2023 to Ksh. 107.8 billion. The Horticultural Crops Directorate (2023) indicates that customer satisfaction in the horticultural industry increased from 85.3% in 2019 to 89.1% in 2020, but decreased to 86.2% in 2021, decreased to 81.3% in 2022 and 78.9% in 2023. Fresh Produce Exporters Association of Kenya (2022) observed that the return on assets among horticultural firms in Kenya decreased from 13.9% in 2019 to 12.0% in 2020, 11.6% in 2021 and 11.3% in 2022. In addition, Dae and Wamugo (2022) found that return on investments in the horticulture industry declined from 21.6% in 2019 to 19.2% in 2020, which increased to 20.0% in 2021, but decreased to 18.5% in 2022 and 17.9% in 2023. The Fresh Produce Exporters Association of Kenya (2022) also indicates that the average market share of horticultural firms in 2019 was 26.21%, but it dropped sharply to 12.69% in 2020, increased to 18.72% in 2021, increased to 32.78% in 2022, but decreased to 26.76% in 2023. It is therefore important to examine output traceability and performance of horticultural firms in Kenya.

Various studies have been conducted on supply chain and performance of firms. For instance, Onyango (2022) examined the impact of output traceability on the Performance of Public Health Facilities in Kisumu County; and Maitri and Hurburgh (2019) examined the framework for implementing output traceability system in the bulk grain supply chain. However, Onyango (2022) study was limited to performance of public health facilities in Kisumu County while Maitri and Hurburgh (2019) study was not specific to any region or sector. In addition, Onyango

(2022) used a descriptive research design while Maitri and Hurburgh (2019) utilized systematic review of literature. Therefore, previous studies have been conducted in different sectors and have used different methodologies. In addition, these studies did not show how output traceability affects performance of Horticultural Firms, and this is what necessitated the research.

The null hypothesis in this study was;

H₀: Output traceability does not significantly affect performance of horticultural firms in Kenya

Literature Review

Theoretical Review

One theory that explains output traceability is the Theory of Constraints (TOC), which was introduced by Goldratt (1984). This theory emphasizes the importance of identifying and managing constraints in a production system to improve overall system performance. According to Goldratt (1984), the TOC is based on the premise that every production system has at least one constraint that limits the output of the system. The goal of the TOC is to identify and manage these constraints in a systematic way to increase the throughput, or the rate at which the system generates profit (Gupta & Boyd, 2018).

The TOC is comprised of five focusing steps, which are designed to identify and manage constraints in a production system. The first step is to identify the system's constraint, which is often the bottleneck in the production process (Kuppaeva, 2022). The second step is to exploit the constraint by maximizing its output and reducing its downtime. The third step is to subordinate everything else to the constraint by ensuring that all other production activities support the operation of the constraint. The fourth step is to elevate the constraint by investing in additional resources or technology to increase its capacity. Finally, the fifth step is to repeat the process by identifying and managing the next constraint in the system (Ray & Sanyal, 2020).

The Theory of Constraints (TOC) has gained recognition as a powerful methodology for identifying and managing bottlenecks in processes. However, like any management theory, it has faced criticism from various quarters. Critics argue that TOC oversimplifies complex systems and processes by focusing primarily on identifying and managing bottlenecks (Gupta & Boyd, 2018). They argue that it may overlook other important factors and interdependencies within the system that can impact performance (Li *et al.,* 2019). Critics contend that TOC's narrow focus on bottlenecks may result in neglecting other critical aspects of process improvement and optimization. In addition, critics argue that TOC may limit organizations' ability to adapt to changing circumstances and dynamic environments. By focusing on managing and exploiting the identified constraint, TOC may hinder the flexibility and agility required to respond to shifting market demands, technological advancements, or competitive pressures (Gupta & Boyd, 2018).

The Theory of Constraints (TOC) was used to explain the effect of output traceability on the performance of Horticultural Firms in Kenya. The Theory of Constraints (TOC) emphasizes identifying and addressing bottlenecks within a system to improve overall performance. In the

context of horticultural firms, output traceability plays a crucial role in this process by enabling real-time tracking of products from cultivation to distribution. This traceability allows firms to identify constraints in key areas such as production, storage, or distribution channels (Mishra & Kumar, 2021). By pinpointing these bottlenecks, firms can focus efforts on resolving them, leading to a more efficient flow of products through the supply chain. Furthermore, output traceability provides firms with valuable data about product movement, shelf life, and market demand, which can be leveraged to optimize production processes and reduce lead times. This data-driven approach improves overall efficiency and helps firms better align production with market needs (Ray & Sanyal, 2020). In line with TOC principles, horticultural firms can streamline operations and maximize throughput, ultimately enhancing their competitiveness and performance.

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 output traceability. The dependent variable was performance of Horticultural Firms in Kenya. Figure 1 shows the relationship between the independent variable and the dependent variable.
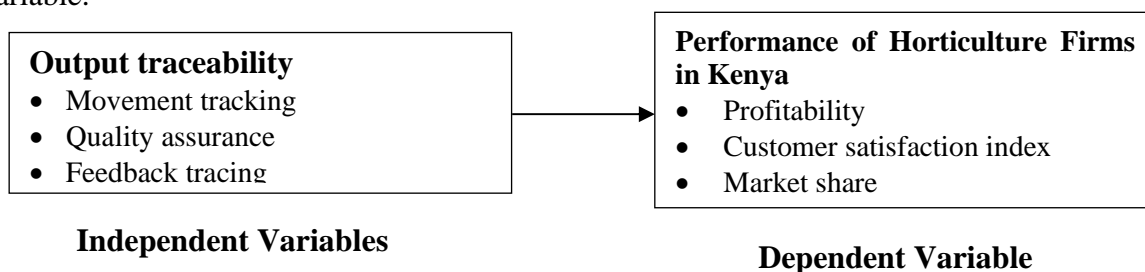
Output traceability
- Movement tracking
- Quality assurance
- Feedback tracing

Performance of Horticulture Firms in Kenya
- Profitability
- Customer satisfaction index
- Market share

Independent Variables

Dependent Variable

Figure 1: Conceptual Framework

Empirical Review

A study conducted by Othman and Hamid (2017) on output traceability and firm performance in Malaysia, targeted manufacturing firms. The study used a sample of 266 companies and data was collected using a questionnaire. The study found that output traceability had a positive and significant effect on firm performance. Output traceability systems enabled targeted manufacturing firms to ensure product quality and compliance with regulatory standards. By accurately tracing and documenting the production processes, firms demonstrated adherence to quality standards and meet regulatory requirements. Improved quality assurance and compliance positively impact firm performance by reducing defects, recalls, and regulatory penalties. Malaysia has regulations and standards governing various industries. Output traceability enhances supply chain visibility by providing real-time information about the movement of products. This enables firms to identify bottlenecks, optimize distribution, and reduce lead times. Output traceability helps manufacturing firms comply with these regulations, reducing the risk of non-compliance-related penalties.

In a study conducted by Wang and Li (2019), on the relationship between output traceability and organizational performance, the target population was comprised of Chinese food manufacturing companies. The study used a sample of 204 companies and data was collected through a questionnaire. The study found a positive relationship between output traceability and performance, indicating that output traceability had a significant effect on the performance of the food manufacturing companies. Output traceability allows companies to track and monitor the quality of their products throughout the manufacturing process. By implementing traceability systems, Chinese food manufacturing companies identify and address quality issues promptly, leading to improved product quality. Enhanced quality control positively influences organizational performance by reducing defects, minimizing customer complaints, and maintaining brand reputation.

Zhou, Pullman and Xu (2022) examined the impact of food output traceability on sustainability performance among Chinese firms. The study conducted a survey research design and focused on 450 Chinese firms. The results indicated that implementing effective food output traceability systems can encourage Chinese firms to be more transparent about their sourcing and production practices. This transparency can lead to increased accountability for environmentally harmful practices, pushing firms to adopt more sustainable methods to avoid negative consequences for their reputation and business. Traceability systems can help identify inefficiencies and waste within the supply chain. By pinpointing areas where excessive resources are used or where pollution occurs, firms can work to minimize their environmental impact by optimizing processes, reducing waste, and conserving resources.

In another study conducted by Onyango (2020) in Kenya on output traceability and firm performance, the target population was comprised of horticultural exporters. The study used a sample of 105 companies and data was collected through a structured questionnaire. The study found a positive relationship between output traceability and firm performance, indicating that firms that had implemented output traceability had a higher level of performance compared to those that had not. Output traceability enhances market access for horticultural exporters by meeting customer demands for transparency and product integrity.

Traceability systems provide information on the origin, production processes, and handling practices of horticultural products, which can be crucial for meeting regulatory requirements and building customer trust. The results indicated that many countries require proof of traceability for imported horticultural products. Implementing traceability systems can enhance exporters' access to global markets and increase export potential.

Maitri and Hurburgh (2019) examined the framework for implementing output traceability system in the bulk grain supply chain. The study adopted a systematic review of literature. The results indicated that traceability allows for rapid identification and targeted recall of contaminated or unsafe grain batches, minimizing the risk of public health crises. In addition, stakeholders gain real-time visibility into the movement of grain through the supply chain, fostering greater transparency and accountability. Also, the results indicated that providing

consumers with information about the grain's journey fosters trust in the brand's commitment to quality and safety. Data-driven insights help identify inefficiencies, reducing waste and optimizing resource utilization throughout the supply chain. Traceability enables identification of areas where resources like water, energy, and packaging can be optimized, contributing to sustainability goals.

Research Methodology

The study adopted a positivism research philosophy and a cross-sectional survey research design. A cross-sectional survey research design was adopted to collect data at a single point in time, allowing for an in-depth analysis of the relationship between output traceability and performance in horticultural firms across Kenya. 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, quality assurance, production, information and communication technology as well as marketing departments in horticultural firms in Kenya formed the unit of observation. The target population was 3,290 heads procurement, quality assurance, production, information and communication technology as well as marketing 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)

$$n = \frac{3290}{1 + (3290 * 0.05^2)} = 355$$

This study adopted stratified random sampling in the selection of 355 respondents from the target population. The strata in this study were procurement, quality assurance, production and sales and marketing departments in horticultural firms in Kenya. This sampling technique will be used because horticultural firms have distinct departments such as procurement, quality assurance, production, and sales and marketing, 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	71
Quality assurance	658	71
Marketing	658	71
Production	658	71
Information and Communication Technology	658	71
Total	**3290**	**355**

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 35 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 = Output 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.

Research Findings and Discussions

The sample size for this study included 355 heads of procurement, quality assurance, production, and marketing departments from registered horticultural firms in Kenya. Out of these, 307 questionnaires were returned, reflecting a high response rate of 86.48%. However, 2 of the returned questionnaires were deemed unusable due to incomplete responses or other issues, reducing the total number of usable questionnaires to 305. 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	355	100%
Returned	307	86.48%
Unusable questionnaires	2	0.56%
Usable questionnaires	305	85.92%

Output Traceability

The respondents were asked to indicate their level of agreement with various statements on the output traceability at horticultural firms in Kenya. As shown in Table 3, with a mean of 4.127 (SD=1.094), the respondents agreed that their feedback tracing system adequately categorizes and organizes customer feedback for analysis. Also, the respondents agreed with a mean of 4.006 (SD=0.966) that their firm consistently acknowledges and responds to customer feedback in a timely manner. Similarly, with a mean of.4.009 (SD=0.988), the respondents agreed that their firm prioritizes the consistent delivery of superior quality in its products or services. With a mean of 3.950 (SD=1.073), the respondents agreed that their firm has ensured movement tracking on all products. The respondents agreed with a mean of 3.832 (STD=1.115) with the statement indicating that all vehicles in their firm are fitted with tracking devices. The respondents also agreed with a mean of 3.744 (SD=1.164) that goods being transported are always tracked in their firm. These findings agree with Maharjan & Kato (2023) observations that movement tracking involves monitoring and recording the movement and whereabouts of individuals or objects using various technologies, such as Global Positioning System (GPS) or cellular network signals.

Again, the respondents agreed with a mean 3.832 (SD=1.192) that their firm demonstrates a strong commitment to continuous improvement of quality assurance practices. The respondents agreed with a mean of 3.803 (SD=1.175) that in their organization, quality assurance processes are regularly reviewed and updated to align with industry best practices. These findings are in agreement with Iwamoto et al. (2021) observations that quality assurance involves evaluating and monitoring all stages of production or service delivery to identify and address any deviations or deficiencies. With a mean of 3.832 (SD=1.167), the respondents agreed their feedback tracing system is user-friendly and easy to navigate for both employees and customers. These findings agree with Hinkes & Peter (2020) observations that feedback tracing provides insights into customer satisfaction, identify areas for improvement, and effectively address customer concerns or issues.

Table 3: Statements on Output Traceability

n=305	Mean	Std. Deviation
Our firm has ensured movement tracking on all products	3.950	1.073
Goods being transported are always tracked in our firm	3.744	1.164
All vehicles in our firm are fitted with tracking devices	3.832	1.115
Our firm prioritizes the consistent delivery of superior quality in its products or services.	4.009	.988
Our firm demonstrates a strong commitment to continuous improvement of quality assurance practices.	3.832	1.192
In our organization, quality assurance processes are regularly reviewed and updated to align with industry best practices.	3.803	1.175
Our firm consistently acknowledges and responds to customer feedback in a timely manner.	4.006	.966
Our feedback tracing system adequately categorizes and organizes customer feedback for analysis.	4.127	1.094
Our feedback tracing system is user-friendly and easy to navigate for both employees and customers.	3.832	1.167
Composite Mean and Standard Deviation	**3.904**	**1.104**

The respondents were requested to indicate any other issue related to output traceability on the performance of horticultural firms in Kenya. The respondents indicated that output traceability significantly enhances the performance of horticultural firms in Kenya by ensuring product quality and safety (88%), building consumer trust (85%), facilitating market access (82%), improving supply chain efficiency (81%), enabling effective risk management (79%), supporting sustainability goals (84%), and providing valuable data for strategic decision-making (83%). They also indicated that output traceability is a critical tool for achieving operational excellence (87%), competitiveness (83%), and long-term success in the global marketplace. Furthermore, the respondents indicated that output traceability is crucial for Kenyan horticultural firms to enhance market access (80%), ensure product quality and safety (86%), optimize supply chain efficiency (82%), manage risks effectively (77%), utilize data for strategic decision-making (81%), comply with international standards (85%), promote sustainability (84%), and

differentiate their brand in the global marketplace (79%). Embracing output traceability, according to the respondents, can lead to sustainable growth, profitability, and resilience in the face of dynamic market challenges.

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 with a mean of 4.442 9 (SD=0.927) with the statement indicating that changes in market share are indicative of shifts in consumer preferences and competitive dynamics. These findings are in agreement with Alsharairi, Mezher and Wehbe (2020) observations that market share changes show shifts in consumer preferences. Similarly, with a mean of 4.423 (SD=0.925), the respondents agreed that the taste and appearance of the horticultural products reflect the high standards set by the firm. With a mean of 4.262 (SD=1.049), the respondents agreed that the taste and appearance of the horticultural products reflect the high standards set by the firm.

With a mean of 4.245 (SD=1.045), the respondents agreed that the horticultural firms offer a wide range of products and services that cater to specific needs and preferences of customers. In addition, with a mean of 4.157 (SD=0.990), the respondents agreed that they feel that the horticultural firm's offerings meet or exceed customers' expectations for the cost involved. With a mean of 4.154 (SD=0.802), the respondents agreed that return on investment in their company have been increasing in the last five years. The respondents also agreed with a mean of 4.065 (SD=0.823) with the statement indicating that the horticultural products and services offered by the firms provide good value for the price paid. These findings are in agreement with Kosgei (2020) observations that customers are more likely to be satisfied when they believe they are receiving good value for their money.

The respondents agreed with a mean of 3.967 (SD=1.006) that the growth of our market share demonstrates their effectiveness in capturing consumer interest. In addition, the respondents agreed with a mean of 3.947 (SD=0.995) that the horticultural products offered by the firms meet the quality and taste standards expected.

Also, the respondents agreed that return on assets in their firm has improved in the last five the years as shown by a mean of 3.891 (SD=0.982). With a mean of 3.744 (SD=1.307), the respondents agreed that the cost of production has been decreasing in the last five years. These findings are in agreement with Karani (2022) observations that return on assets shows how effectively the company uses its assets to generate profits.

Table 4: Statements on Performance Horticultural Firms in Kenya

n=305	Mean	Std. Deviation
Return on assets in our firm has improved in the last five the years	3.891	.982
Return on investment in our company have been increasing in the last five years	4.154	.802
The cost of production has been decreasing in the last five years	3.744	1.307
The horticultural products and services offered by the firms provide good value for the price paid.	4.065	.832
I feel that the horticultural firm's offerings meet or exceed customers' expectations for the cost involved.	4.157	.990
The horticultural firms offer a wide range of products and services that cater to specific needs and preferences of customers	4.245	1.045
The horticultural products offered by the firms meet the quality and taste standards expected.	3.947	.995
The taste and appearance of the horticultural products reflect the high standards set by the firm.	4.423	.925
Our company's market share accurately reflects our competitive standing in the industry.	4.262	1.049
The growth of our market share demonstrates our effectiveness in capturing consumer interest.	3.967	1.006
Changes in market share are indicative of shifts in consumer preferences and competitive dynamics.	4.442	.927
Composite Mean and Standard Deviation	**4.118**	**0.987**

Figure 2 shows the average 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. While 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.
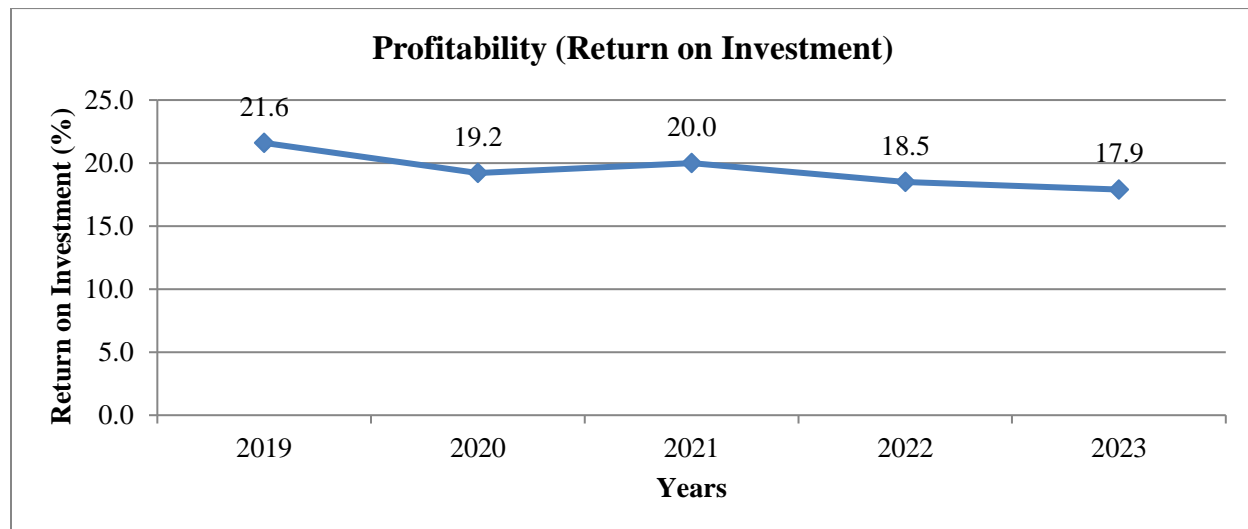

Figure 2: Trend of Profitability (Return on Investment)

Figure 3 shows the average 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.
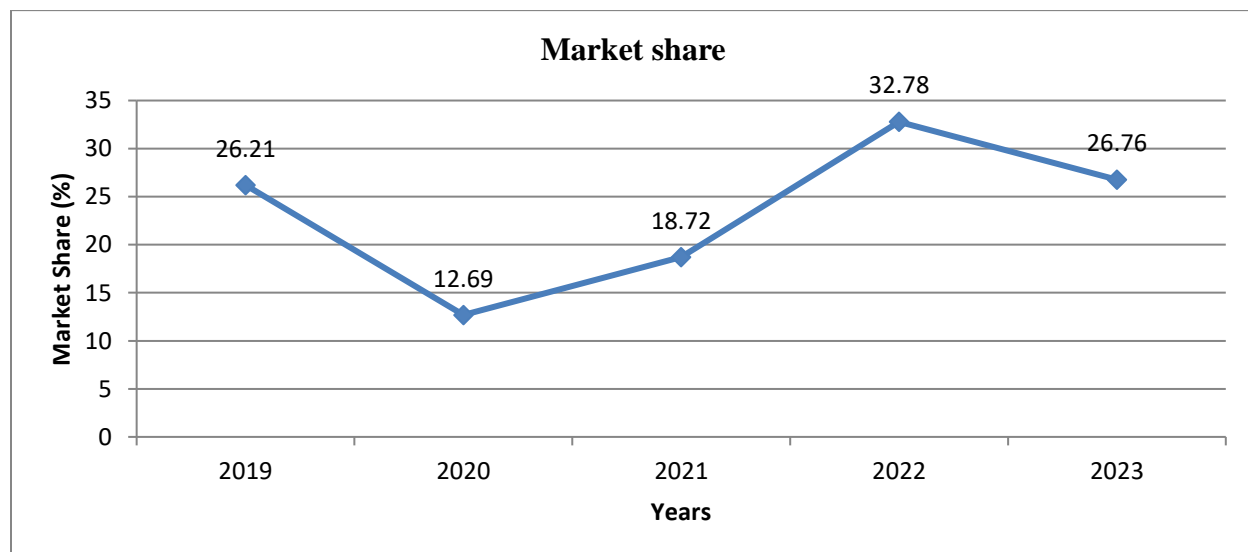

Figure 3: Trend of Market Share

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.

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.
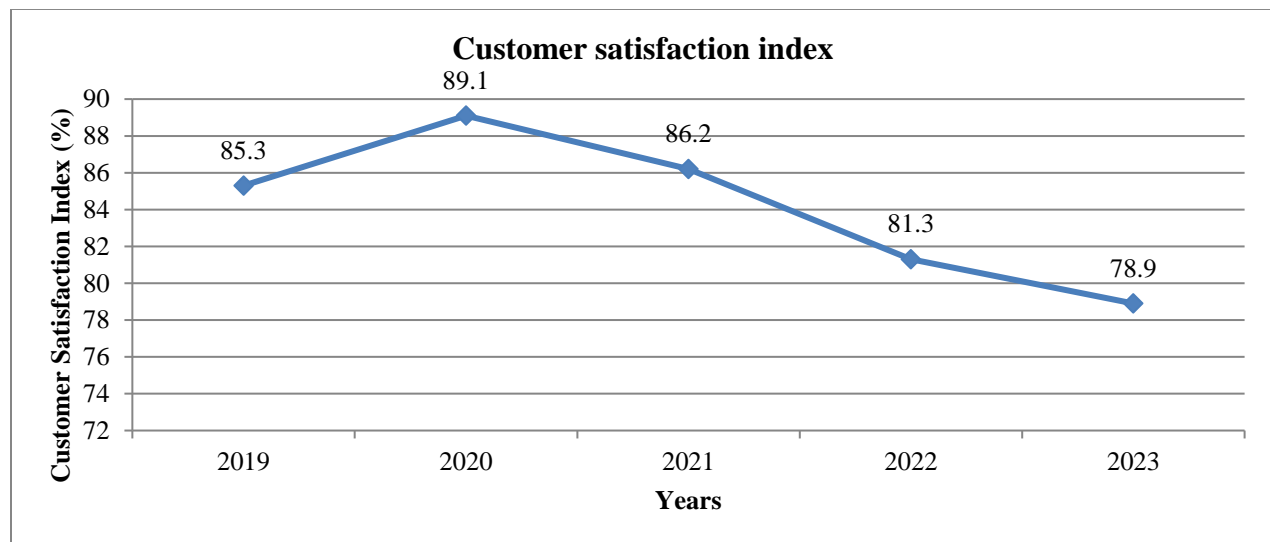

Figure 4: Trend of Customer Satisfaction Index

Correlation Analysis (Output Traceability)

Pearson correlation analysis was used to assess the strength and direction of the linear relationship between Output Traceability (OT) and performance of horticultural firms in Kenya. The correlation results show that Output Traceability (OT) has 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 Wang and Li (2019) findings that there is a positive relationship between output traceability and organizational performance.

Table 5: Correlation Coefficients

		PHFK	OT
Performance of Horticultural Firms in Kenya (PHF)	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	305	
Output Traceability (OT)	Pearson Correlation	.729**	1
	Sig. (2-tailed)	.000	
	N	305	305

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

Regression Analysis

Linear regression analysis was used to assess the weight of the relationship between output traceability and the performance of horticultural firms in Kenya. The r-squared value of 0.531 suggests that approximately 53.1% of the variance in the performance of horticultural firms can be explained by output traceability. This indicates a relatively strong model fit, but there remains 46.9% of the variance in firm performance that is unexplained by Output Traceability alone.

Table 6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.729[a]	.531	.530	.31014

a. Predictors: (Constant), Output Traceability

The analysis of variance shows how well Output Traceability predicts the performance of horticultural firms. Since F-calculated (343.501) is much greater than the critical value of 3.94 from the F-distribution table, the regression model is highly significant. Specifically, the p-value of 0.000 is much lower than the significance level of 0.05, indicating the model can be used in predicting the effect of output traceability on performance of horticultural firms in Kenya.

Table 7: Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33.041	1	33.041	343.501	.000[b]
	Residual	29.145	303	.096		
	Total	62.186	304			

a. Dependent Variable: Performance of Horticultural Firms in Kenya

b. Predictors: (Constant), Output Traceability

From the findings, regression equation was as follows;

Y=0.773+ 0.789 (Output Traceability)

The results show that output traceability has a positive and significant effect on performance of Horticultural Firms in Kenya (β_1=0.789, p-value=0.000). The coefficient of 0.789 suggests that improvements in Output Traceability lead to the greatest positive impact on firm performance, with each one-unit increase in Output Traceability associated with a 0.363-unit increase in firm performance.

This effect is highly statistically significant ($p < .001$), underscoring the importance of effective management and tracking of output processes in achieving better performance outcomes for horticultural firms in Kenya. The findings are in line with Zhou, Pullman and Xu (2022) findings that output traceability has a positive effect on sustainability performance among Chinese firms. The findings agree with Onyango (2020) findings that output traceability has a positive effect on firm performance of horticultural exporters.

Table 8: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.773	.161		4.793	.000
	Output Traceability	.789	.043	.729	18.534	.000

a. Dependent Variable: Performance of Horticultural Firms in Kenya

Conclusions and Recommendations

The study concludes that output traceability positively and significantly affects the performance of horticultural firms in Kenya. The findings indicated that movement tracking, quality assurance, and feedback tracing significantly affect the performance of horticultural firms. Enhancing output traceability through these practices improves operational efficiency, ensures product quality, and fosters customer trust. Effective movement tracking minimizes logistical challenges, quality assurance enhances market competitiveness, and feedback tracing facilitates continuous improvement. Collectively, these elements of output traceability drive the overall performance and sustainability of horticultural firms in competitive markets.

The study found that output traceability positively impacts the performance of horticultural firms in Kenya, highlighting the importance of enhancing these systems for further growth. Firms should focus on categorizing and organizing customer feedback to gain valuable insights into consumer preferences and improve services. Timely responses to feedback will strengthen customer relationships and loyalty, while ensuring the delivery of high-quality products will reinforce the firm's competitiveness. Additionally, the study recommends investing in robust movement tracking systems for all products and vehicles, ensuring real-time monitoring to minimize losses and improve operational efficiency. This transparency enhances customer trust and satisfaction. The study also emphasized the need for continuous improvement in quality assurance practices, with regular reviews aligned to industry best practices. Implementing a user-friendly feedback system for both employees and customers will further enhance performance and support long-term strategic goals.

Recommendations for Further Studies

The primary objective of the study was to assess how output traceability affects performance of horticultural firms in Kenya. However, the study focused on horticultural firms and therefore the findings cannot be applied to other firms in Kenya. Therefore, the study recommends that further research be conducted to assess how output traceability affects performance of other firms in Kenya. In addition, the study found that output traceability can collectively explain 53.1% of variation in performance of horticultural firms. Therefore, further studies should be conducted to determine other factors that affect performance of horticultural firms in Kenya.

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