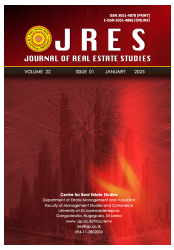

Available online at https://journals.sjp.ac.lk

JOURNAL OF REAL ESTATE STUDIES

ISSN 3051-4878 [PRINT] | E-ISSN 3051-4886 [ONLINE]

Factors Influencing Cinnamon Production: Insights from the Karandeniya Divisional Secretariat area in Galle District

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ABSTRACT

The spice industry is a major economic driver in Sri Lanka, with cinnamon playing a significant role in the country's foreign exchange balance. Despite a steady increase in the area cultivated with cinnamon from 2015 to 2020, production levels have not shown comparable growth. The Galle District, which includes the Karandeniya Divisional Secretariat, accounts for over 35% of the total cinnamon cultivation area in Sri Lanka. However, not all plantations in this region are equally productive, highlighting a disparity between cultivated area and yield. This research is original as it addresses a knowledge and geographical gap in understanding the factors influencing cinnamon production in Sri Lanka, particularly in the Karandeniya Divisional Secretariat area. Primary data were collected from 50 cinnamon cultivators using purposive sampling and a self-administered questionnaire, while secondary data were sourced from the resource profile published by the Karandeniya Divisional Secretariat. Data analysis was conducted using correlation and multiple linear regression analyses via IBM SPSS Statistics 20.0 software. The correlation analysis revealed that logistical and infrastructure-related factors, Policy and institutional factors and operational and managerial factors had a significant positive relationship with average annual cinnamon harvest per acre at the 0.01 significance level. The multiple linear regression analysis confirmed that logistical and infrastructural factors, policy and institutional factors, and operational and managerial factors significantly impacted the average annual harvest per acre. These findings indicate the importance of addressing these three key factors in policy development to enhance the productivity and sustainability of the cinnamon sector in Sri Lanka. The study emphasizes the need for targeted interventions in logistical and infrastructure improvements, better operational and managerial practices, and more supportive policy frameworks to boost cinnamon production and maximize its economic benefits.

ARTICLE INFO

Article History:

Received 20th November 2024
Revised 29th December 2024
Accepted 24th January 2025

Keywords:

Cinnamon Cultivation and Productivity, Logistical and Infrastructure-related Factors, Policy and Institutional Factors, Operational and Managerial Factors.

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Doi: 10.31357/jres.v22i1.7918

1. INTRODUCTION

Sri Lanka is the world's largest exporter of true cinnamon, also known as "Ceylon Cinnamon," which has a unique chemical composition and distinct characteristics that set it apart from cassia cinnamon, commonly produced by other countries. Cinnamon is a primary export spice of Sri Lanka, contributing significantly to the country's foreign exchange balance. The Galle District, particularly the Karandeniya Divisional Secretariat, represents more than 35% of the total cinnamon cultivation area in Sri Lanka, making it a key region for cinnamon production. However, not all plantations in this region are equally productive, with approximately 9.21% of the cultivated land being unproductive (Sugathadasa et al., 2021). Despite its global significance and regional importance, the industry faces several challenges.

Although the area under cinnamon cultivation has steadily expanded from 2015 to 2020, production levels have fluctuated rather than shown consistent growth (Institute of Policy Studies of Sri Lanka, 2017). Production per hectare has declined over the past five years, with a 12% decrease in 2019/20 compared to 2018/19. Furthermore, the cinnamon industry lacks formal employment data, making it difficult to assess workforce trends and overall sector performance. These inconsistencies in productivity highlight underlying issues within the supply chain and production processes that must be addressed to ensure the industry's sustainable growth. Identifying the factors influencing cinnamon production is essential for maintaining a stable supply and enhancing the sector's contribution to Sri Lanka's economy.

This study aims to evaluate the impact of various factors affecting cinnamon production in the Karandeniya area. While previous studies have explored general agricultural challenges, limited research has specifically examined the factors influencing cinnamon production in this region. Given that cinnamon accounts for 2% of Sri Lanka's total merchandise exports (Kumari Fonseka et al., 2018), understanding and managing these production challenges is critical. This research fills an important knowledge and geographical gap by analysing the production dynamics in Karandeniya and providing insights for improving industry performance. The findings will support stakeholders, including growers, processors, policymakers, and investors, in making informed decisions to enhance the sustainability and growth of Sri Lanka's cinnamon industry.

2. LITERATURE REVIEW

2.1 Ceylon Cinnamon

The global cinnamon market is divided into two main categories: Ceylon cinnamon and Cassia cinnamon. Ceylon cinnamon, which is derived from the "Cinnamomum Zeylanicum Blume" plant native to Sri Lanka, accounts for 85% of the world's production (Song et al., 2020). Studies have shown that Ceylon cinnamon is superior to cassia cinnamon in terms of quality. In the global market, Ceylon cinnamon is more commonly used than Cassia cinnamon due to its lighter and brighter tones. Cassia cinnamon, on the other hand, has a stronger and hotter flavour (Tridge, 2025)

Sri Lanka is the largest producer and exporter of true cinnamon, accounting for a significant portion of the world's (Institution of Policy Studies of Sri Lanka, 2017; Kumari Fonseka et al., 2018; Sugathadasa et al., 2021). The export of cinnamon from Sri Lanka has a long history, dating back to before the 15th century. During the Dutch colonial period in the 15th century, cinnamon was commercially cultivated in the southern region of Sri Lanka (Kumari Fonseka et al., 2018). Cinnamon is usually sold in the form of quills and is also exported in the form of

quelling, feathers, and chip (Song et al., 2020)

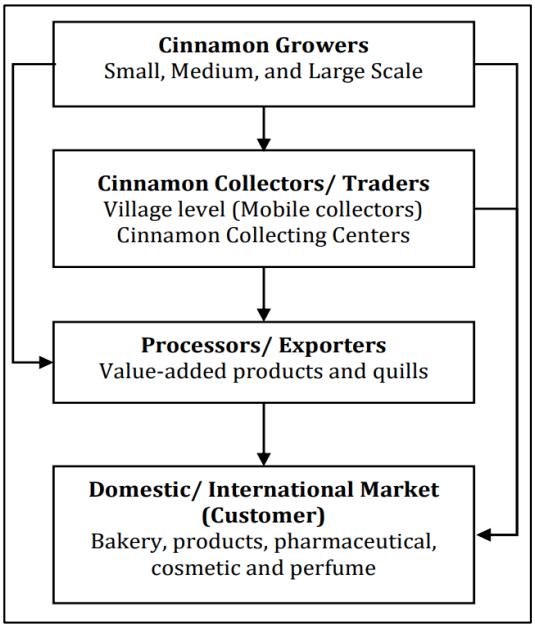
Cinnamon is a plant that thrives in diverse tropical conditions and can grow in almost all types of soils. In Sri Lanka, systematic cultivation of cinnamon covers an area of 77,489 acres (31,359 ha) in the wet and intermediate zones of the island. According to the Institution of Policy Studies of Sri Lanka, 2017, cinnamon cultivation is mainly concentrated in four districts - Galle, Matara, Kalutara, and Ratnapura - which account for 90% of the total cultivation. Out of these, Galle and Matara districts alone account for 70% of the cultivation area. Currently, the Southern province is the primary contributor to domestic cinnamon production and export. The cultivation of cinnamon is primarily carried out by smallholders (Wijesundara, 2019), and the industry provides a livelihood to about 350,000 families in the districts of Galle, Matara, Hambantota, Ratnapura, and Kalutara (Kumari Fonseka et al., 2018; Song et al., 2020; Sugathadasa et al., 2021).

Cinnamon trees typically reach a height of 5 to 6 meters. Sri Lanka has eight species of cinnamon. According to (Tridge, 2025), Ceylon cinnamon is classified into four different grades - from A to H. Among these, C2, C3, and C4 are the most popular varieties due to the prevalence of trees producing them. C-grade cinnamon tends to have higher production levels compared to the others due to the prevailing climatic and soil conditions in Sri Lanka. The Alba variety is the highest quality option within the C and A grades. As the grade number increases, the quality of the cinnamon is deemed to be better. For instance, C5 is the highest grade, while C1 is the lowest grade within the category. These days, cinnamon is widely utilized worldwide in bakery goods, medications, and cosmetics (Institute of Policy Studies of Sri Lanka, 2017).

2.2 Cinnamon Supply Chain in Sri Lanka

The supply chain of a product encompasses all aspects, starting from its origin to the final delivery to end customers. It includes all individuals, organizations, resources, activities, technologies, and other related factors involved in the process. Accordingly, Cinnamon related experts are; trainers, advisory officer, skilled & un-skilled laborers, cultivators, collectors, suppliers (nurseries, fertilizer, chemicals, machineries etc.), retailers and exporter etc. The value chain of cinnamon is a complex process involving numerous agents at various stages. The following illustrations depict the supply chain structure of the cinnamon industry in Sri Lanka (Sugathadasa et al., 2021).

Figure 1: Supply Chain Structure of Cinnamon

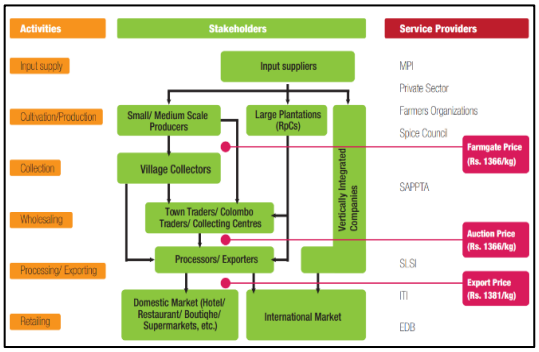


Source: Sugathadasa, et al. (2021)

Smallholders are the main cultivators of cinnamon, large-scale growers and local plantation companies also participate in the process. The Department of Census and Statistics (2014) states that smallholdings dominate the cinnamon cultivation

industry, accounting for 89% of the total cultivated extent. According to Sugathadasa, et al., (2021), illustrated above Figure 1 main actors of the cinnamon value chain are Growers, Collectors, Processors, Exporters and end Customers. The Spice Council Sri Lanka (2016) has developed a broader cinnamon value chain than Sugathadasa, et al., (2021) and it is as follows.

Figure 2: Schematic Illustration of Cinnamon Value Chain Map

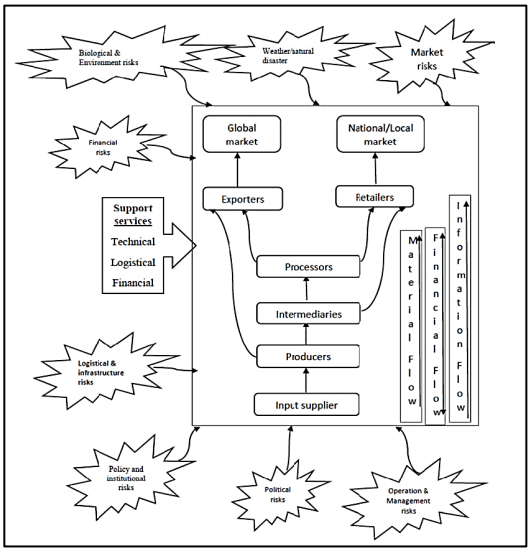


Sources: Institution of Policy Studies of Sri Lanka, (2017)

As per the above Figure No. 2. the Cinnamon value chain is the broader value chain as it is categorized into Activities, Stakeholders and Service Providers of the Cinnamon Industry. Rural and local level hoarders are intermediaries involved in the collection phase of the cinnamon supply chain. Cinnamon processing is mainly done by exporters to suit the needs of their foreign buyers. Cinnamon producers encounter a range of obstacles, including a shortage of skilled labor, high costs for labor and planting materials, and fluctuating market prices. Similarly, collectors face problems such as expensive transportation, inadequate hygiene practices, and intense competition. At the exporter level, the key challenges are sourcing high-quality products, maintaining quality standards at a high cost, and dealing with market concentration (Institution of Policy Studies of Sri Lanka, 2017).

2.3 Model Related to the Supply Chain factors in Agricultural Sector

Figure 3: Structure of agricultural Supply Chain & Potential Sources of Risk in Ghana



Sources: Yeboah et al. (2014)

Yeboah et al. (2014) developed a model for identifying agricultural supply chain risks based on their study in Ghana, categorizing risks into eight key areas: biological and environmental risks, weather/natural disaster risks, market risks, financial risks, logistical and infrastructure risks, policy and institutional risks, political risks, and operational and management risks. Given the complexity of agricultural supply chains, these risk factors are likely to be relevant to the cinnamon industry in Sri Lanka as well. This study applies these risk factors to assess their impact on cinnamon production in Sri Lanka, providing insights into the challenges faced by the industry and identifying critical areas for intervention to enhance production efficiency and sustainability.

2.4. Factors affecting Cinnamon Production in Sri Lanka.

Based on the previous studies and model identified factors affecting cinnamon production in Sri Lanka are given below.

Weather/ Natural Disasters Related Factors

The agricultural supply chain is often affected by seasonal deficits and weather-related risks, such as heavy rainfall, temperature changes, hailstorms, and strong winds. These weather-related risks can cause reduced yields, impacting product quality and disrupting product flow (Nyamah et al., 2017). The average annual cinnamon harvest is significantly influenced by various weather and natural disaster-related factors, particularly rainfall patterns and climate variability. Cinnamon, primarily harvested from the bark of the Cinnamomum species, is typically collected during the rainy season, which spans from September to February in regions like Kerinci, Indonesia. This timing is crucial as the moisture content in the bark during the rainy season facilitates easier peeling, thus enhancing the efficiency of the harvest process (Menggala et al., 2019). Moreover, the sustainability of cinnamon harvesting practices is closely tied to environmental conditions. The application of Good Agricultural Practices (GAP) and technological innovations in cultivation can mitigate some adverse effects of climate variability. These practices include using certified varieties and optimizing post-harvest processes to improve product quality (Izhar & Hendri, 2022).

Based on the above discussion below hypothesis is stated.

H1: Weather and Natural Disaster-related factors have a significant impact on the average annual cinnamon harvest per acre.

Biological and Environmental Related Factors

Biological factors play a major role in determining harvest of cinnamon. For instance, the presence of pests and diseases can severely impact cinnamon production. Research indicates that cinnamon is susceptible to various pests and diseases, which can hinder its growth and reduce harvest significantly (Khan et al., 2020). Specifically, rough bark disease and leaf spot diseases have been reported to cause substantial yield losses among cinnamon growers, particularly in regions like Sri Lanka (Azad et al., 2019). The agricultural supply chain is significantly affected by biological and environmental risks that have diverse impacts. In the short term, these risks are location-specific, but they can have repercussions throughout the entire supply chain indicate that biological risks are mainly associated with gene expression disorders and diseases (Yeboah et al., 2014). The emergence of certain plant pests or animal diseases can limit access to international markets not only for affected farmers and companies but for the entire agricultural supply chain. They can also affect decision-making processes, productivity, and market options on a systemic level (Nyamah et al., 2017). And also, the genetic variabilities affect the cinnamon harvest (Madhushika & Bulugahapitiya, 2022) .

Environmental factors, including soil quality, climate conditions, and water availability, are equally important in determining cinnamon yields. Research has demonstrated that soil moisture content and nutrient availability significantly influence the growth and productivity of cinnamon plants (Darmadi et al., 2024). Based on the above discussion below hypothesis is stated.

H2: Biological and Environmental Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres

Markert Related Factors

The average annual cinnamon harvest is influenced by a multitude of market-related factors, including demand dynamics, value chain improvements, and export competitiveness. As a high-value commodity, cinnamon's market potential is

significant, with various parts of the Cinnamomum tree being utilized in industries such as pharmaceuticals and perfumery (Menggala et al., 2019). According to (Nyamah et al., 2017), demand risks in the agricultural sector result from various factors, such as fluctuations in demand affecting local or international input/output prices, changes in market demands for quantity and/or quality attributes, food safety requirements, timing of product delivery, and supply chain reputation and dependability. Supply-related risks refer to various events that affect a supplier's ongoing existence, such as product capacity limitations, quality issues, technical changes, and product design changes (Yeboah et al., 2014). Based on the above discussion below hypothesis is stated.

H3: Market Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres.

Logistical and Infrastructure Related Factors

Increasingly, agricultural supply chains are vulnerable to risks associated with supply and infrastructure, which impact the availability of goods and services, energy and information, and time (Yeboah, et al., 2014). The failure of supply can have a ripple effect throughout the agricultural supply chain, potentially affecting product quality (Nyamah et al., 2017). Thus, effective supplies and technologies are critical success factors for both manufacturers and retailers involved in the agricultural sector. This seasonal harvesting is crucial as it aligns with the physiological state of the trees, which can enhance the quality of the bark harvested. Furthermore, the economic incentive to harvest more cinnamon during periods of high market prices can lead to unsustainable practices if not managed properly (Menggala et al., 2019). Moreover, the interaction between planting material and spatial arrangement can influence the number of harvestable stems, thereby affecting overall yield (Aluthgamage et al., 2023). Based on the above discussion below hypothesis is stated.

H4: Logistical and Infrastructure Related Factors have significant impact on-Average Annual Cinnamon Harvest Per Acres.

Policy and Institutional Factors

According to (Nyamah et al., 2017), the structure of the agriculture supply chain is greatly influenced by policy and institutional risks. Administrative barriers can impede the design and dynamic performance of the supply chain, while legal changes can be unexpected and hard to predict, leading to significant increases in transportation costs (Yeboah et al., 2014). Research has identified various risk factors in the cinnamon export industry in Sri Lanka, highlighting the importance of institutional support for smallholder producers (Sugathadasa, et al., 2021). Based on the above discussion below hypothesis is stated.

H5: Policy and Institutional Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres.

Operational and Managerial Related Factors

Effective agronomic practices play a significant role in determining cinnamon yield. For instance, the implementation of conservation agriculture techniques, such as no-till farming and cover cropping, has been shown to enhance soil health and improve crop yields across various agricultural systems (Su et al., 2021) Agricultural supply chain management involves various management and operational challenges. Human judgment and response significantly affect agricultural operations and management risks, which often result in decreased productivity, inferior product quality, and

unreliable distribution. According to (Nyamah et al., 2017), operational failures in one organization can have a ripple effect, causing losses or market access issues for multiple entities in the supply chain. Based on the above discussion below hypothesis is stated.

H6: Operational and Managerial Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres.

Average Annual Cinnamon Harvest Per Acres

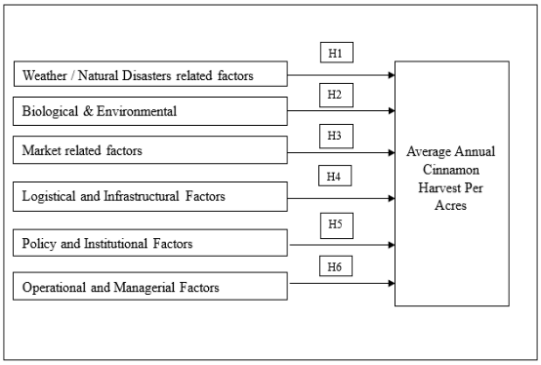
This is the dependent variable of this study. This variable influence on the various factors including logistics and infrastructure, policy and institutional frameworks and operational and managerial practices. Previous studies highlight expansion of cinnamon cultivation areas, productivity per hectare has fluctuated due to inefficiencies in the production process (Sugathadasa et al., 2021; Institute of Policy Studies of Sri Lanka, 2017). This variable use with different studies with the several variables. The Average Annual Cinnamon Harvest Per Acre is a key measure of productivity in cinnamon cultivation, influenced by environmental, agronomic, and economic factors. Climatic conditions such as temperature and rainfall play a crucial role, with studies indicating that even a 1°C temperature increase can reduce crop yields by 5%-7% (Kim & Mendelsohn, 2023).

3. METHODOLOGY

This study examined factors affecting cinnamon harvest in Sri Lanka with the special reference in Karandeniya Divisional Secretariat Division (DSD) in Galle district. This quantitative research study aims to assess the significant impact of factors identified through the literature and the model developed by Yeboah et al. (2014) on the structure of agricultural supply chains and potential sources of risk in Ghana. These factors have been adapted and applied to the context of cinnamon production in Sri Lanka to evaluate their influence on the industry's performance and sustainability. This study utilized purposive sampling technique under the non-probability sampling technique to collect the 50 cinnamon cultivators in Karandeniya DSD. This study utilized both primary and secondary sources of data. Primary data was collected through structured questionnaire and measure the constructor using five- point Likert scale. Data analysis of this study done by using SPSS software and regression analysis used to analyze the impact of factors affecting cinnamon production.

3.1 Research Model

Figure 4: Research Model



Source: Author (2024)

3.2 Operationalization

A detailed breakdown of the variables with measurement items, and sources of each variable is provided in Annexure 01.

4. DATA ANALYSIS AND DISCUSSION

4.1 Demographic Analysis

The demographic profile of this study highlights key characteristics of the sample, which consists of 50 cinnamon cultivators from the Karandeniya Divisional Secretariat in Sri Lanka. The sample collectively owns 104 acres of cinnamon cultivation, supporting 184

dependents. The majority of the sample, 66%, are male, and 88% are married. Notably, 52% of the respondents engage in cinnamon cultivation as a full-time occupation. The age distribution ranges from 26 to 63 years, with the largest group (18 cultivators) falling within the 30-40 age range. Regarding experience, 84% of cultivators have over 10 years of experience, with a significant proportion having more than 25 years of expertise. Educationally, only 12% possess degree-level qualifications, and none have formal agricultural education. Geographically, 62% of the cinnamon lands are located within a three-kilometer radius of the cultivators' residences, with the highest concentration within one kilometer.

Reliability

Reliability assesses the internal consistency of the data, ensuring that the variables produce stable and consistent results across repeated measurements (Hair et al., 2019). According to Table 1 Cronbach's alpha values of all indicators are in the range of 0.723 - 0.994. The accepted value of Cronbach's alpha is 0.7 (Hair et al., 2019). Since, Cronbach's Alpha value of the all indicators is above the accepted value, it can be stated that the collected data for this study is reliable.

Table 1:Reliability of indicators

Factors	Cronbach's Alpha
The impact of Weather / Natural Disasters Related factors	0.779
Biological and Environmental Related Factors	0.723
Market Related Factors	0.991
Logistical and Infrastructure Related Risk	0.886
Policy and Institutional Related Factors	0.973
Operational and Managerial Related Factors	0.994

Source: Survey Data (2024)

Validity

Construct validity was evaluated through factor analysis, ensuring that the items align with the theoretical constructs defined in the study. Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were applied to assess the adequacy of the data for factor analysis. The results presented in Table 2 show that all variables have Kaiser-Mayer-Olkin measure of sample adequacy (KMO) values greater than 0.5, indicating sufficient inter-correlation. Additionally, the Bartlett's Test of Sphericity was significant with $p < 0.05$, further indicating the validity of the factors. These tests confirm whether the identified factors meaningfully contribute to the dependent variable, Average Annual Cinnamon Harvest Per Acre.

Table 2: KMO and Bartlett's Test

Variables	Kaiser- Mayer-Olkin Measure of	Bartlett's Test of Sphericity		
		Approx. Chi-Square	df	Sig.
Weather/ Natural Disaster Related Factors	0.632	19.671	10	0.033
Biological and Environmental Factors	0.699	58.366	10	0.000
Market Related Factors	0.863	37674.675	10	0.000
Logistical and infrastructure Related Factors	0.663	215.945	10	0.000
Policy and institutional Related Factors	0.856	34385.41	10	0.000
Operational and Managerial Factors	0.821	44153.721	10	0.000

Source: Survey Data (2024)

Factor Analysis

The results of the factor analysis, as presented in Component Matrix - I (*Annexure 02*), indicate that all extracted values exceed the threshold of 0.4. This confirms that all indicators are suitable for further statistical analysis, including correlation and regression. The extraction was performed using Principal Component Analysis (PCA), yielding a single component, which suggests strong factor loadings across the dataset. These findings validate the selected variables for continued analysis.

Normality

The distribution patterns of the factors, as illustrated in Normality of the Data (*Annexure 03*), confirm that the data follows a normal distribution. The graphical representations exhibit a roughly bell-shaped curve, supporting the assumption of normality. This validation ensures the appropriateness of proceeding with further statistical analyses, such as correlation and regression.

Correlations Analysis

The correlation analysis was conducted to examine the relationship between various factors and the average annual cinnamon harvest per acres. Among these hypotheses three were accepted and others did not. The threshold value of the P= 0.05, it was found that Weather / Natural Disasters Related factors (p= 0.890), Biological and Environmental Related Factors (p=0.528) and Market Related factors (p=0.200) did not show significant relationship with the Average Annual Cinnamon Harvest Per Acre.

However, Logistical and Infrastructure Related Factors (p=0.000), Policy and Institutional Related Factors (p=0.006) and Operational and Managerial Related Factors (p=0.000) were accepted. Those hypothesis results shown in the below table 3.

Table 3: Hypothesis Testing for Correlation

Hypothesis		Sig Value (P = 0.05)	Null Hypothesis
H1	Weather and Natural Disaster-related factors have a significant impact on the average annual cinnamon harvest per acre.	.890	Reject
H2	Biological and Environmental Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres	.528	Reject
H3	Market Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres.	.200	Reject
H4	Logistical and Infrastructure Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres.	.000	Accepted
H5	Policy and Institutional Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres.	.006	Accepted
H6	Operational and Managerial Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres.	.000	Accepted

Source: Survey Data (2024)

Table 4: Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.773[a]	.598	.531	41.8153661

Source: Survey Data (2024)

Predictors: (Constant), Operational and Managerial Related Factors, Market Related Factors, Logistical and Infrastructure Related Factor, The impact of Weather / Natural Disasters Related factors, Policy and Institutional Related Factors, Biological and Environmental Related Factors.

Based on the above table 4, the R-squared value is 0.598, which indicates that these seven variables collectively explain approximately 59.8% of the variance in the average annual cinnamon harvest. Additionally, the adjusted R-squared value is 0.531, indicating that 53.1% of the variation in the dependent variable (average annual cinnamon harvest) can be attributed to the seven identified factors while holding other factors constant in this study, while the remaining 46.9% is due to other factors not included in the study.

Table 5: ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	109173.439	7	15596.206	8.920	.000[b]

a. Dependent Variable: Average annual harvest per acre

b. Predictors: (Constant), Operational and Managerial Related Factors, Market Related Factors, Financial Related Factors, Logistical and Infrastructure Related Factor, The impact of Weather / Natural Disasters Related factors, Policy and Institutional Related Factors, Biological and Environmental Related Factors

Source:(Survey Data, 2024)

The ANOVA table was used to evaluate the level of significance between various factors and the average annual cinnamon harvest. As indicated in Table 5, all factors exhibit a statistically significant relationship with the dependent variable, with p-values below the alpha threshold of 0.05. Additionally, the F-statistic value, being close to 1, reflects the model's overall fitness, suggesting that the independent variables adequately explain the variation in the dependent variable.

Table 6: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
(Constant)		418.373	17.710		23.62	.000
Weather / Natural Disasters Related factors		5.757	8.163	.094	.705	.485
Biological and Environmental Factors		-12.374	8.362	-.203	-1.480	.146
Market Related Factors		32.433	44.397	.106	.731	.469
Logistical and Infrastructural Factors		21.365	6.975	.350	3.063	.004

Policy and Institutional Related Factors	-125.622	41.830	-.382	-3.003	.004
Operational and Managerial Factors	105.309	27.324	.444	3.854	.000

a. Dependent Variable: Average Annual Cinnamon Harvest Per Acre

Source: Survey Data (2024)

The below table shows after testing the relationship of all the factors with dependent variables and main objective checks the impact of those factors to affect the Average Annual Cinnamon Harvest per Acre. According to the below table shown weather / Natural Disasters Related factors had no impact on Average Annual Cinnamon Harvest per Acre with the p= 0.485. Biological and Environmental Factors and Market Related Factors had no impact on Average Annual Cinnamon Harvest per Acre with p values of 0.146 and 0.469 respectively. Other three factors such as Logistical and Infrastructure Related Factors, Policy and Institutional Related Factors, Operational and Managerial Related factors have impact on Average Annual Cinnamon Harvest per Acre.

Table 7: Hypothesis Testing

Hypothesis		**Sig Value (P = 0.05)**	**Null Hypothesis**
H1	Weather and Natural Disaster-related factors have a significant impact on the average annual cinnamon harvest per acre.	.890	Reject
H2	Biological and Environmental Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres	.528	Reject
H3	Market Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres.	.200	Reject
H4	Logistical and Infrastructure Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres.	.000	Accepted
H5	Policy and Institutional Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres.	.006	Accepted
H6	Operational and Managerial Related Factors have significant impact on Average Annual Cinnamon Harvest Per Acres.	.000	Accepted

Source: Survey Data (2024)

4.1 Discussion

Impact of Weather / Natural Disasters Related factors on Average Annual Cinnamon Harvest per Acre.

The results indicate that weather and natural disasters do not significantly

impact cinnamon production in Sri Lanka (ρ = 0.485). This finding contrasts with existing literature, which highlights the disruptive effects of weather-related risks, such as heavy rainfall, hailstorms, and strong winds, on agricultural yields (Yeboah et al., 2014). The lack of statistical significance in this study may suggest that farmers have adopted effective strategies to mitigate weather-related risks, such as improved cultivation techniques or the use of weather-resistant crop varieties. Future research could explore how these adaptive measures are applied in cinnamon farming.

Impact of Biological and Environmental Related Factors on Average Annual Cinnamon Harvest per Acre.

Biological and environmental factors were found to have no significant impact on cinnamon yields (ρ = 0.146). While prior studies, such as those by Azad et al., 2019; Nyamah et al., 2017; Khan et al., 2020), emphasize the detrimental effects of pests, diseases, and gene expression disorders on agricultural supply chains, the findings suggest that these risks might be less pronounced in cinnamon farming. This could be attributed to effective pest management practices or the natural resilience of cinnamon plants. Further studies are recommended to assess the specific biological and environmental challenges faced by cinnamon farmers.

Impact of Market Related Factors on Average Annual Cinnamon Harvest per Acre.

Market-related factors did not significantly impact cinnamon production (ρ = 0.469). This is somewhat unexpected, given the documented influence of market volatility, fluctuating demand, and supply constraints on agricultural output (Nyamah et al., 2017; Yeboah et al., 2014). The relatively stable demand for cinnamon in both local and international markets may help buffer producers against these risks. Additionally, established market networks might provide a level of predictability for cinnamon farmers.

Impact of Logistical and Infrastructure Related Factors on Average Annual Cinnamon Harvest per Acre.

Logistical and infrastructure-related factors were found to have a significant impact on cinnamon yields (ρ = 0.004). This aligns with the literature, which emphasizes the importance of supply chains, efficient transportation, and reliable infrastructure in agricultural productivity (Nyamah et al., 2017; Yeboah et al., 2014;Aluthgamage et al., 2023; Menggala et al., 2019). Poor logistics and inadequate storage facilities can lead to post-harvest losses and reduced product quality. Investments in improving infrastructure, such as better road networks and storage solutions, are critical for enhancing cinnamon production.

Impact of Policy and Institutional Related Factors on Average Annual Cinnamon Harvest per Acre.

Policy and institutional factors were found to significantly affect cinnamon production (ρ = 0.004). This finding is consistent with studies that highlight the role of policy frameworks in shaping agricultural supply chains (Hendricks & Singhal, 2003; Nyamah et al., 2017 ;Sugathadasa et al., 2021). Supportive policies, such as subsidies, trade agreements, and regulations promoting sustainable farming practices, can positively impact productivity. Conversely, bureaucratic barriers and unpredictable legal changes can hinder efficiency. Policymakers should focus on creating an enabling environment for cinnamon farmers to succeed.

Impact of Operational and Managerial Related Factors on Average Annual Cinnamon Harvest per Acre.

Operational and managerial factors were

highly significant (ρ = 0.000), indicating their critical role in cinnamon production. This aligns with (Nyamah et al., 2017), who noted that effective management practices are essential for mitigating risks and enhancing productivity. Poor operational practices can lead to inefficiencies, reduced product quality, and supply chain disruptions (Su et al., 2021) Training programs and capacity-building initiatives for farmers and supply chain managers could help address these challenges and improve overall performance.

5. CONCLUSION

The study provides valuable insights into the factors affecting cinnamon production in Sri Lanka. While weather, biological, and market-related factors were not found to have significant impacts, logistical and infrastructure-related factors, policy and institutional factors, and operational and managerial factors were identified as critical determinants of cinnamon yields.

These findings highlight the need for targeted interventions, such as improving infrastructure, implementing supportive policies, and enhancing management practices. Policymakers and industry stakeholders should prioritize these areas to ensure sustainable growth in the cinnamon sector. Future research should explore the interplay between these factors and investigate potential mitigation strategies for risks that were not statistically significant in this study.

The findings of this study underline the significant factors influencing cinnamon production in Sri Lanka, particularly in the Karandeniya DSD. Based on the identified drivers and challenges, the following policy recommendations are proposed to enhance the productivity and sustainability of the cinnamon industry.

5.1 Recommendations

Based on the study findings, the following recommendations are proposed to enhance the productivity and sustainability of the cinnamon industry in Sri Lanka:

1. Enhance youth engagement in cinnamon industry.

   Develop targeted programs to attract the youth population who are not occupied. This can include vocational training programs, financial incentives and awareness campaign to promote the cinnamon industry.

2. Conduct further research on determinants.
   Since logistical and infrastructure-related factors, policy and institutional factors, and operational and managerial factors were identified as critical determinants of cinnamon yields, further research should be conducted to examine these factors in detail.

3. Conduct awareness campaign on quality standards in cinnamon industry.
   Cinnamon farmers should be educated on global market trends, quality certifications and best agricultural practices to gain higher marketability.

4. Subsidized distribution of high-quality cinnamon plants.
   The Agrarian Development Board should ensure the availability of high-quality cinnamon saplings at subsidized rates. Additionally, guidance on replanting and maintenance should be provided to farmers to ensure long-term productivity and sustainability.

7. ACKNOWLEDGEMENTS

The authors acknowledge the Centre for Real Estate Studies (CRES), Department of Estate Management and Valuation, University of Sri Jayewardenepura, Sri Lanka.

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ANNEXTURES

Annexture 01 - Operationalization

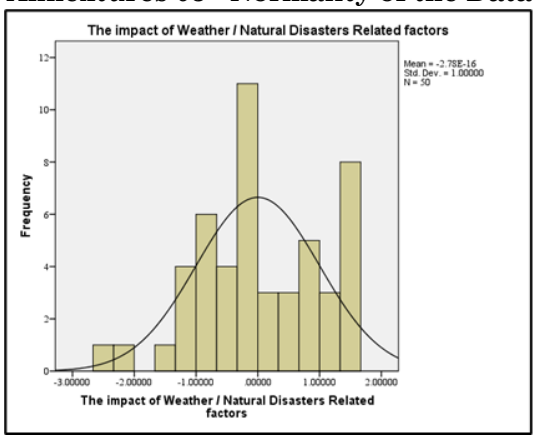
Variables	Constructors	References
The impact of Weather / Natural Disasters Related factors	Periodic deficit rainfall does not affect the cinnamon cultivation	(Yeboah et al., 2014), Institute of Policy Studies of Sri Lanka, (2017), Spice Council Sri Lanka (2016), William Hoa, Tian Zhengb, Hakan Yildizc & Srinivas Talluric (2019)
	Periodic excess rainfall does not affect the cinnamon cultivation	
	Periodic drought does not affect the cinnamon cultivation	
	Periodic Strong winds does not affect the cinnamon cultivation	
	Periodic drought does not affect the cinnamon harvest	
Biological and Environmental Related Factors	There are no continuous effects of Major pest in the Cinnamon cultivation	
	Pests do not affect the Cinnamon harvest	
	Always not subject to Major Diseases are in the cinnamon cultivation	
	There is no issue about the Soil quality of the cinnamon cultivation	
	Adequate sunlight is available during the harvesting period	
Market Related Factors	Cinnamon demand arise only from local exporters and collectors	
	The quality required for exporters are not conveyed to Cultivators clearly	
	There is no Cinnamon price administration procedure from the Government	
	Fluctuations in input price affects the cinnamon cultivation	
	Storing with care is difficult due to lack of safe space	
Logistical and Infrastructure Related Risk	Theft activities discourage Cinnamon cultivators	
	Unavailability of proper security system for Cinnamon estates discourage investments in Cinnamon cultivations	
	Increasing transport cost discourage cinnamon cultivators	
	Issues of road ways to the Cinnamon estates affects the on-time delivery of raw cinnamon to the processing centers	
	Unavailability of nearby processing centers increasing the cost of production.	
Policy and Institutional Related Factors	The recent Organic Agricultural Policy Decision affected the Cinnamon cultivation adversely	
	The agrarian office introduces new Cinnamon cultivars and provide guidance for new plantations and re-planting activities.	
	The agrarian experts of the area visit the Cinnamon Estates periodically and provide instructions for effective cinnamon cultivation.	
	The unavailability of registration system for Cinnamon cultivators causes for lack of recognition for cinnamon cultivators	
	Lack of Database about the Cinnamon Value Chain Members cause for corruption in distribution of government subsidies	
Operational and Managerial Related Factors	Unavailability of skilled labor on time, delays the Cinnamon harvesting	
	The participation of youngers are less in Cinnamon peeling and it as a risk	
	Awareness on the required quality and the standards needed for exporters	
	Re-planting the cultivation periodically	
	Instructions from agrarian office when selecting fertilizer and New Plants for the cultivation	

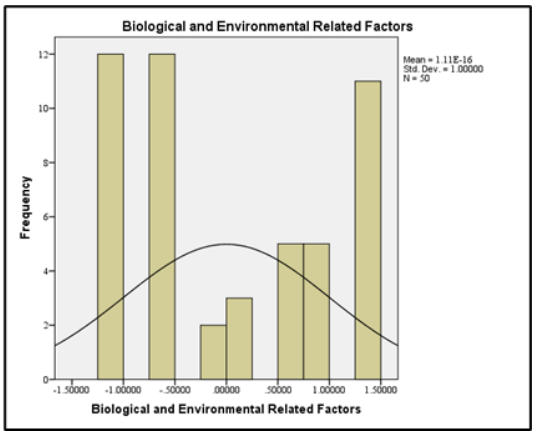
Annexture 02 - Component Matrix - I

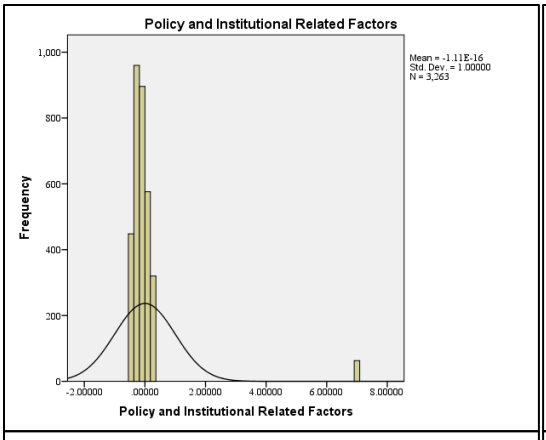
Variables	Indicators	Component 1
Weather / Natural Disasters Related factors	Periodic deficit rainfall does not affect the Cinnamon cultivation	.812
	Periodic excess rainfall does not affect the Cinnamon cultivation	.685
	Periodic drought does not affect the Cinnamon cultivation	.610
	Periodic drought does not affect the Cinnamon harvest	.542
Biological and Environmental Factors	There is no continuous effect of Major pest in the Cinnamon cultivation	.844
	Pest do not affect the Cinnamon harvest	.845
	Always not subject to Major Diseases in the Cinnamon cultivation	.643
	Adequate sunlight is available during the harvesting period	.731
Market Related Factors	Cinnamon demand arise only from local exporters and collectors	.981
	The quality required for exporters are not conveyed to Cultivators clearly	.985
	There is no Cinnamon price administration procedure from the Government	.986
	Fluctuation in input price affects the Cinnamon cultivation	.986
	Storing with care is difficult due to lack of safe space	.974
Logistical and Infrastructure Related Factor	Theft activities discourage Cinnamon cultivators	.839
	Unavailability of proper security system for Cinnamon estates discourage investments in Cinnamon cultivations	.657
	Increasing transport cost discourage cinnamon cultivators	.887
	Issues of road ways to the Cinnamon estates affects the on-time delivery of raw Cinnamon to the processing centers	.837
	Unavailability of nearby processing centers increasing the cost of production	.931
Policy and Institutional Related Factors	The recent Organic Agricultural Policy Decision affected the Cinnamon cultivation adversely	.982
	The agrarian office introduces new Cinnamon cultivars and provide guidance for new Plantations and re-planting activities	.984
	The agrarian experts of the area do not visit the Cinnamon Estates periodically and provide instructions for effective Cinnamon cultivation	.984
	The un-availability of registration system for Cinnamon cultivators causes for lack of recognition for Cinnamon cultivators	.973
	Lack of database about the Cinnamon value chain members cause for corruption in distribution of government subsidies	.885
Operational and Managerial Related Factors	Unavailability of skilled labor on time, delays the Cinnamon harvesting	.985
	The participation of youngers are less in Cinnamon Peeling and I feel it as a risk.	.985
	The quality and the standards needed for exporters	.985
	Re-planting the cultivation periodically	.991
	Instructions from agrarian office when selecting fertilizer and new Plants for the cultivation	.991

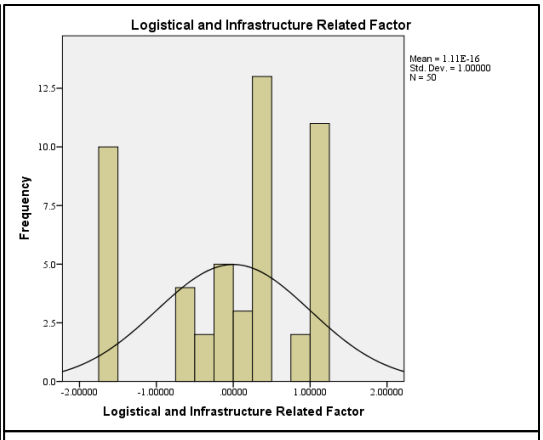
Extraction Method: Principal Component Analysis.
a. 1 components extracted.
Source: Survey Data (2024)

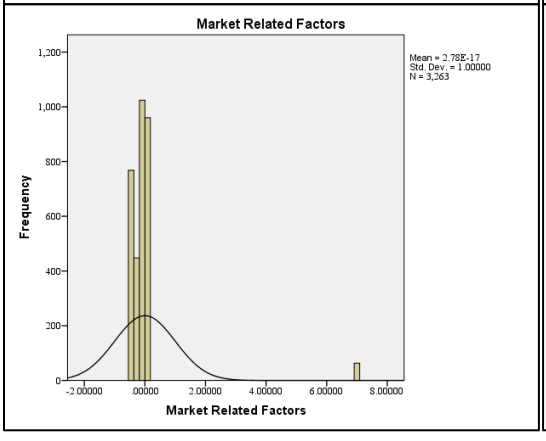
Annextures 03 - Normality of the Data

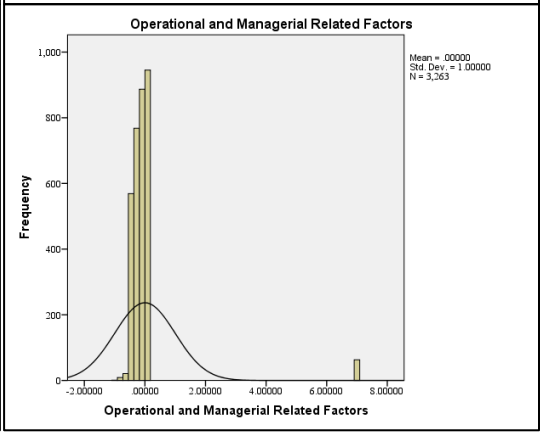












Source: Survey Data (2024)