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Research Article

Assessing Economic Crisis Impacts on Sri Lanka's Banana Sector

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ABSTRACT:
The economic crisis in Sri Lanka since the first quarter of 2022 has significantly impacted the banana (*Musa sp*.) sector, which is vital in terms of both consumption, and exports. This study aims to assess the potential impacts on the sector and suggest mitigation strategies. Market margins, price variation (CV), difference in mean retail and farmgate prices and vertical integration between farmgate and retail prices were analyzed for pre-and post-crisis scenarios. The main banana variety, *ambul*, witnessed a 45% decrease in cultivated acreage, leading to a shift from hired to family labour. There has been a transition from high-input responsive, high-risk varieties (such as *kolikuttu*) to low-input responsive, resilient varieties like *seeni kesel* as a measure of avoiding high fertilizer cost. Meanwhile, crisis induced low fertilizer application resulted in 45% decrease in bunch weight. While the main marketing channels remained unchanged, sales volume and vendors involvement has decreased by 40%. Post-crisis, farmers' and retailers' margins dropped by 9.7% and 19.5%, respectively, while wholesalers' margins witnessed an increase of 29.4%. Furthermore, CV has increased by 11.4% and 14% for retail and farmgate prices during the crisis. Though the retail prices were significantly higher than pre-crisis levels, farmgate prices did not see a significant increase. Thus, farmers suffered the most negative impact due to the economic crisis. In conclusion, the economic crisis severely impacted the banana sector, with reduced acreage, labour shifts, decreased sales, and altered market margins.

KEYWORDS: Economic crisis; Banana; Sri Lanka; Market margins; ANOVA

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INTRODUCTION

By May 2022, the Sri Lankan government unilaterally ceased debt repayments and declared bankruptcy as an emergency measure. Researchers argue that there were several avenues through which the impact of the economic crisis transmitted to the country's agriculture sector and food security.

One major area affected was the interest rates. Following the declaration of bankruptcy, the IMF sought to control inflation by reducing the money supply. Consequently, interest rates rose to 30% in the last quarter of 2020. According to the Central Bank of Sri Lanka's Annual Report for 2020, the average interest rate on agricultural term loans provided by licensed commercial banks was approximately 10%. (CBSL, 2020). Additionally, the average interest rate on agricultural overdraft facilities was around 12%. Prior to the economic crisis, Agrarian banks (*Govijana* banks) offered agricultural credits with an average interest rate of roughly 8%. However, after the economic crisis, interest rates increased significantly to 12% in *Govijana* banks, and up to 21% in other banks.

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On May 6, 2021, the Sri Lankan government imposed a ban on the import of chemical fertilizers. The government's objective was to create an opportunity for local and international consumers to obtain toxin-free agricultural products, as well as to reduce import bills and cut down public expenditure on subsidies to manage the escalating deficit in the government budget (Weerahewa, & Dayananda, 2023; International Monetary Fund, 2022; Young, 2022; Weerahewa, Senaratne, & Babu, 2021; Kataria, Manur, & Pradhan, 2022). The sudden change in agricultural policy to convert to organic agriculture by banning importation of agricultural inputs such as inorganic fertilizer and agrochemicals has had a significant negative impact on agricultural productivity and yield (Koralagama & Udugama, 2022).

Meantime the removal of fuel subsidies, combined with the devaluation of the SL rupee, (CBSL, 2022) has caused the prices of petrol (92) and diesel (auto) to increase nearly threefold by November 2022 compared to January 2022. Moreover, the electricity tariff has increased by an average of 75% since August 2020 (Bhowmick, 2022). Meanwhile, prices of essential inputs for commercial vegetable cultivation, such as inorganic fertilizers (e.g., urea), have increased from Rs. 3050.00/50kg in 2021 to Rs. 29,000.00/50kg by October 2022 (News Wire, 2022). Prices of other variable inputs, such as pesticides, weedicides, and agricultural machinery parts, have also increased by almost 250% According to a survey conducted by HARTI in August-September 2022, there was a 21 percent reduction in vegetable land extent under cultivation and a 57 percent reduction in average vegetable yield per acre in the 2022 Maha season (HARTI, 2022). The ban was lifted in November 2021 in the midst of an economic crisis, preventing the importation of fertilizer for the 2021/2022 main cultivation season. The compounded effect of income loss due to lack of agricultural inputs and the threefold rise in the cost of production in 2022 was expected to lead to a range of production fluctuations that could alter the supply in both the short and long run.

Furthermore, the crisis induced fuel shortages significantly disrupted functionality of the agricultural markets due to the unavailability of fuel for transportation. Subsequently, the high cost of fuel continued to pose a barrier to the smooth transportation of perishable horticultural produce at frequent intervals. As a result, markets appeared to be less integrated, with reports of oversupply of commodities from surrounding areas and shortages of commodities supplied from distant producing areas. Additionally, high to medium supply chain resilient risks and abnormal price behaviours were repeatedly observed in the Northern and Eastern provinces amid fuel price hikes, as reported by the World Food Program in September and October 2022 (WFP, 2022).

The economic crisis has resulted in changes in food patterns, particularly in commodity purchasing and food consumption. A food security survey conducted by HARTI in the last quarter of 2022 covering 17 districts with 1,584 respondents revealed that 91% of the respondents experienced negative changes in their buying behaviour. It further shows that 86% of respondents reduced the number of food items cooked for a meal, while 76% changed the usual food items they used for cooking into inferior substitutes (Samantha *et al,* 2022). These negative changes in food affordability and accessibility status are expected to worsen nutrition indicators, particularly among low-income populations.

A crisis can impact the market equilibrium in various ways, depending on the type and severity of the crisis. Here are some possible scenarios:

Shift in supply: As mentioned earlier, a crisis can disrupt the supply chain and cause a decrease in the supply of goods: especially for non-essential products (Baldwin & Tomiura, 2020). This can shift the supply curve to the left, leading to a higher equilibrium price and a lower equilibrium quantity

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Shift in demand: A crisis can also impact the purchasing power, consumer preferences, and behaviour, leading to a shift in demand, which may result in lower demand than usual (Raza, Siddiqui, & Hussain, 2020). This can shift the demand curve to the left leading to lower equilibrium price and quantity at every price level.

Simultaneous shift in supply and demand: In some cases, both supply and demand can be affected by a crisis. For instance, an economic crisis can increase the cost of production, lower the access to credit and disrupt transportation, leading to a decrease in supply. At the same time, consumers may experience lower purchasing power and demand less. This can result in a higher equilibrium price but a lower equilibrium quantity.

During the middle phase of a crisis, both supply and demand forces tries to re-adjust and reposition to a new equilibrium. On the supply side, suppliers (farmers in this case) may try to find alternatives for high-cost inputs, adjust their production processes, and reduce costs, reconfiguring their supply chains, building more resilience in their operations, and investing in new technologies to adapt to the changing market conditions in response to the changing market conditions (Sarkis et al., 2021). On the demand side, consumers may change their purchasing behaviour and preferences in response to changes in prices and availability of goods. According to a study published in the journal of retailing, consumers may start looking for cheaper alternatives, switch to products that are more readily available, or postpone purchases until the situation improves (Grewal, Iyer, & Levy, 2020).

These adjustments by both supply and demand forces can lead to changes in the market equilibrium, such as a shift in the supply or demand curve, changes in prices and quantities, and adjustments in the allocation of resources.

Therefore, this economic crisis calls for a broader study on the agricultural commodity sector to understand the current challenges and propose effective mitigation strategies. Over time, if the crisis eases up and the economy stabilizes, the market may eventually reach a new equilibrium point where supply and demand are once again in balance, which may look different from the pre-crisis equilibrium. Measures of market integration (for e.g. between farmgate and retail markets) is an indication of whether the market is still readjusting and repositioning or if it is in the process of reaching a new equilibrium. Yet, research efforts on measuring the effects of the economic crisis on the supply and demand forces of perishable commodities in Sri Lanka have been limited. Bananas constitute the primary fruit crop in Sri Lanka, recording the highest cultivation area, consumption rate, and export value (Agstat, 2021). Consequently, this study aims to investigate the repercussions of economic crises on banana supply chains with the goal of recommending mitigation measures to potential adverse effects on the sector.

METHODS

Primary Data Analysis

Focus Group Discussions (FGDs) was applied as the main tool of primary data collection. A threefold increase in agricultural input costs, the ban on fertilizer imports, and a shortage of crude oil for agricultural machinery caused significant disruptions in the supply chain for banana. Therefore, the primary reason for conducting focus group discussions with commercial-level banana growers was to gather primary data on changes in production levels, cultivation practices, marketing, and the challenges that growers faced due to the economic crisis.

Monaragala was the main district for commercial-scale *ambul* banana cultivation. All the commercial scale banana growers in the district were treated as the sample population. The prominent banana-

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growing agrarian services centre divisions (ASC) in the district were ranked according to the number of farmers in each ASC, and ten ASC with the highest number of farmers were selected as the sample frame. Of these ten, the first four ASC with the highest number of farmers were interviewed. Farmers in the fifth-ranked area refused to participate, so the sixth-ranked one was selected instead. Altogether five focused group discussions (each comprising 10-15 farmers) were conducted in most prominent ASCs in the district.

District-wise data on cultivated area, average yield, total production, recommended fertilizer types and quantities, application frequencies, the recommended pest and disease control methods, selling prices, and average production costs per kilogram were available for the pre-crisis situation. Therefore, farmers were asked about the changes in these parameters that occurred during the crisis compared to the pre-crisis period. Following this, a series of key informant discussions were conducted with experts from each sector to validate the farmers' responses.

There were no farmer organizations specifically for banana growers; however, most banana growers were members of local paddy farmers' organizations. In areas with active paddy farmers' organizations, experienced banana growers were selected with the assistance of the organization's office-bearers. In the absence of such organizations, the local Agriculture Instructor was consulted to identify experienced banana farmers.

All discussions were conducted in the local language. During each discussion, participants were asked a series of questions based on a pre-tested questionnaire. Each group was encouraged to reach a consensus on each issue. If consensus could not be reached, the various viewpoints and the range of numerical values provided were recorded. All discussions were audio-recorded and carefully transcribed into written form.

An agricultural value chain concept explained as an economic unit of analysis of a particular commodity or group of commodities that encompasses a meaningful grouping of economic activities that are linked vertically by market relationships. The emphasis is on the relationships between networks of input suppliers, producers, traders, processors and distributors (UNCTAD, 2000). The primary distinction between a value chain and a supply chain lies in their respective focuses. While a supply chain concentrates on assembling the product and delivering it to the customer, a value chain seeks to enhance the product's worth as it progresses through the supply chain (Feller, Shunk, D., & Callarman, (2006). Generally, value chains comprise all the activities of the supply chain.

As this study primarily focuses on the banana supply to the domestic market, the supply chain aspects within the value chain mapping developed by Kaplinsky and Morris (2001) and the guidelines established by the UNIDO (2009) was extensively used.

Secondary Data Analysis

Secondary data (price data) which was already available with the government institution (HARTI) was used for the secondary data analysis. The aim of the secondary data analysis was to calculated the crisis induced changes in market margins and price variations (in farmgate, wholesale and retail level) and compare the after-crisis situations against before crisis.

Margin Analysis for banana

Margin analysis was conducted using secondary data (weekly) collected by HARTI in the major producing district for *ambul* banana – Monaragala (farmgate prices), Colombo's main wholesale market (wholesale prices), and nine retail markets in Colombo and its suburbs (retail prices) within the main supply chain. The data series used for analysis included weekly farmgate, wholesale, and

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retail price data from the 1st week of May 2018 to the 4th week of August 2019 (before the crisis = BC), and from the 1st week of May 2021 to the 4th week of August 2023 (after the crisis = AC).

Of the retail price, which percentage is acquired by farmers, collectors, and wholesalers is calculated as follows:

$$\text{Farmers' Margin} = \frac{\text{Farmgate price}}{\text{Retail Price}} * 100$$

Middlemen impact on vegetable marketing channel was measured by considering Marketing Margin of the middlemen (wholesalers and collectors). Market margin is the difference between the price paid by the ultimate consumer and the price received by the producer or farmer. It represents all assembling, transporting, other retailing charges and profit margin added to the farm products. i.e., the cost of providing a range of marketing services, (Khan at el. 2005).

$$\text{Wholesaler's Margin} = \frac{\text{Wholesale price} - \text{Farmgate price}}{\text{Retail Price}} * 100$$

$$\text{Retailers' Margin} = \frac{\text{Retail price} - \text{Wholesale price}}{\text{Retail Price}} * 100$$

Calculation of Level of Price Variations in Different Farmgate and Retail Markets: Before and After Crisis

The level of price stability was measured by calculating coefficient of variation (CV) which indicates percentage change in the price compared to mean price.

CV was calculated by using the following formula.

$$CV = \frac{\text{Standard deviation of the prices}}{\text{Mean price of the fresh banana}} * 100$$

Following the calculation of CV values, ANOVA was applied to identify whether there is a significantly different price variation occurred before and after the crisis.

Hypothesis:

1. H_0 – There is no difference in farmgate prices of the considered commodities due to the economic crisis.
   H_1 – There is a difference in farmgate prices of the considered commodities due to the economic crisis.

2. H_0 – There is no difference in retail prices of the considered commodities due to the economic crisis.
   H_1 – There is a difference in retail prices of the considered commodities due to the economic crisis.

As the first step of statistical analysis, summary statistics (mean and standard deviation) was calculated and boxplot was created to visually examine the shape of the price distribution, its central value, and its variability across the considered years of 2018, 2019, 2022 and 2023.

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Next, different tests were conducted to see whether the data holds the assumptions of ANOVA; independently drawn samples, the experimental errors are normally distributed, equality in group variances and homogeneity of variances (homoscedasticity).

After the linear model was developed, Shapiro-Wilk test was conducted on residuals to check whether the model errors are normally distributed. The null hypothesis of shapiro test was that model errors are normally distributed. As the next step, Ramsey RESET test was performed to check whether the linear functional form is the most appropriate form or whether there exists some significant nonlinear relationship. Next, Breusch-Pagan test (bptest) was conducted to see whether the linear model's residual is homoscedastic. Null hypothesis of bptest is that the residuals have constant variance. Then, a Bartlett test was carried out to check the homogeneity of variances across all groups. Null hypothesis of the Bartlett test was that all the group variance are equal. In case of heteroskedasticity robust ANOVA test was applied in conducting ANOVA, using the Heteroscedastic robust covariance matrix.

RESULTS AND DISCUSSION

Age, experience and land use pattern

Primary data analysis revealed that the majority of farmers cultivate bananas in lands ranging from 1 to 2 acres. Approximately 95% of the participants were male, with ages ranging from 20 to 78 years. Most of the farmers come from a family background in farming and rely on agriculture as their primary source of income. Their farming experience spans from 3 to 40 years. More than 50% of the participants cultivate their own lands, while 10% cultivate lands owned by the sugar cane factory. Another 25% cultivate leased lands, and around 15% cultivate using encroached lands. Meanwhile, in the Monaragala district, the majority of banana lands were situated in uplands. Hence, farmers in this region made investments in digging agro-wells and installing irrigation systems suitable for the land.

Traditional Value Chain Analysis for Banana

1.1 Input - Planting material for banana cultivation

There were three categories of planting material producers involved

1. Self-planting material (suckers) producers
2. Commercial scale planting material (suckers) producers
3. Tissue cultured planting material producers

Banana cultivation was heavily dependent on local seedling production. There were only a few (6%) self-planting material producers in the considered district. Among the growers of *ambul* variety, 74% have accessed banana seedlings from nearby commercial-scale planting material producers, while 20% of farmers have purchased tissue-cultured seedlings (figure 1).

The majority of farmers (74%) obtained banana planting materials from neighbouring farmers who commercially cultivated suckers. These farmers were initially impacted by COVID-19-related movement restrictions, followed by transportation challenges due to disruptions in the supply chain caused by the economic crisis. As a result, farmers experienced decreased profits and lacked the financial resources necessary for reinvestment. Consequently, the abandonment of the seedling production resulted in a shortage of healthy suckers available for banana growers. Furthermore, the average price of a banana sucker, produced by farmers has also risen from Rs.40.00 to Rs.80.00.

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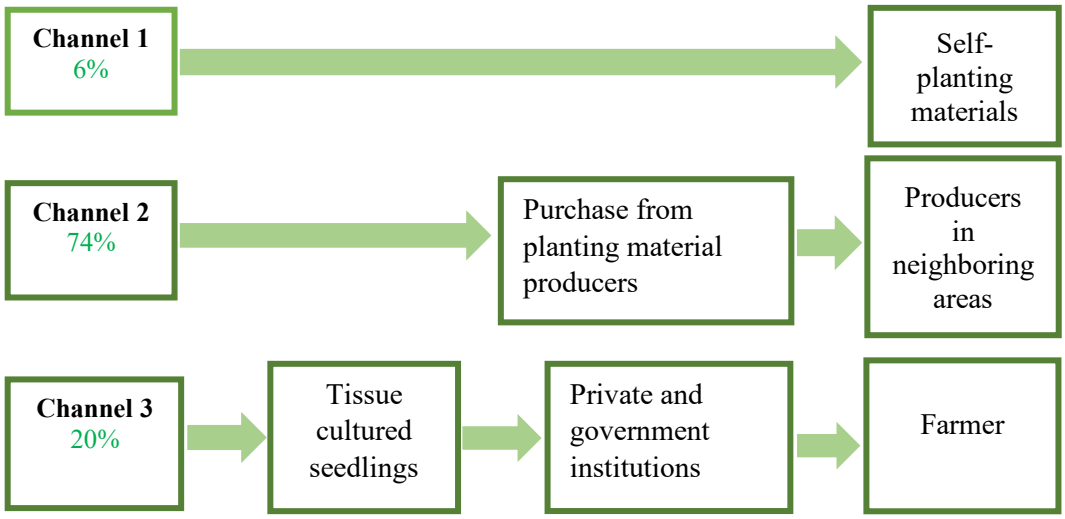

Source: HARTI survey data, 2023
Figure 1: Different supply chains of banana planting materials

The primary sources of tissue-cultured seedling production are the University of Colombo Institute of Agricultural Technology and Rural Sciences (IARS), Fruit Research and Development Institute, and a private company, specializing in tissue-cultured seedlings.

All farmers requesting tissue-cultured plants faced long waiting lists due to inadequate supply compared to demand. This has been the case even before the onset of the economic crisis. However, due to limitations in banana sucker production, the demand for tissue-cultured seedlings doubled. Despite the demand for banana seedlings in the growing season being around 1 to 1.2 million seedlings in three main producing districts, the monthly supply of tissue-cultured seedlings from the above sources is limited to 40,000-45,000. The largest supplier, IARS, provides approximately 20,000 *ambul* banana seedlings per month. Meanwhile, the cost of a tissue-cultured plant has significantly increased during the post - crisis era. A tissue-cultured *ambul* banana plant now costs Rs.120.00. This represents a price increase of 45% compared to the situation before the economic crisis.

1.2 Input - Fertilizer Application

According to the Department of Agriculture recommendations for the dry and intermediate zones, it is advised to apply organic fertilizer, two weeks before planting, with a rate of 10 kg per planting pit (DOA, 2023). However, 60% of the small-scale farmers have applied only 50% of the recommendation. As for chemical fertilizer (N: P: K mixture), the recommended quantity before planting is 225 grams per plant or clump, with a ratio of urea: TSP: MOP at 12:8:25. However, post-crisis, farmers faced a TSP scarcity, leading to a 30% reduction in the applied quantity.

Due to high fertilizer prices, most farmers have decreased both the quantity and frequency of fertilizer application for bananas. Although the recommended frequency for annual banana cultivation is 5 times, no farmer has adhered to the recommendation. The majority of farmers (75%) have applied fertilizer only 3 times, reducing the amount applied at each round by approximately 45%. The primary issues related to fertilizer application include high prices and the poor quality of locally available fertilizer.

Moreover, considering banana, there has been a transition from high-input responsive, high-risk varieties (such as *kolikuttu*) to low-input responsive, resilient varieties like *seeni kesel* as a measure of avoiding high fertilizer cost.

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1.3 Input -Input - labour

Banana cultivation showed a greater participation of male labour than female labour. With the exception of tasks such as trimming banana leaves and cleaning the fields, male labour is preferred for all other cultural practices, ranging from land preparation to harvesting. In the considered district, there was an observed increase in male labour costs ranging from 55% to 62%, compared to the pre-crisis situation. Before the crisis, 42% of banana farmers were large-scale farmers (>5ac), heavily dependent on hired labour. However, in response to the crisis, a significant number of these farmers (60%) transitioned to small-scale farming, experiencing a notable shift from hired labour to family labour

1.4 Input – Machinery

Farmers utilized four-wheel tractors for land preparation, requiring two rounds of plowing per acre. One round of rotavator and one round of disc were employed to break the clods and achieve fine tilth. Following an economic crisis, the cost of a disc round was Rs. 25,000/Ac, and a rotary round cost Rs. 23,000/Ac. This reflects a cost increase ranging from 50% to 60% across the considered three districts. Farmers utilizing machinery expressed the view that using an excavator is approximately 20% more cost-effective than manual labour. However, small-scale farmers found it challenging to secure required financial provisions for using machinery within a 1–2-day time frame.

2. Production - Weeding, Mulching Pest and Diseases management

Farmers employed both chemical and manual weeding methods for weed control. In the chemical approach, farmers applied a broad-spectrum, systemic herbicide known as glyphosate (Glyphosate 30.5%). The price of glyphosate surged fourfold during the initial stages of the economic crisis, primarily due to scarcity following the ban. Consequently, the cost of weeding increased by approximately the same factor. In times of severe scarcity, farmers went back to either using grass cutters or manual weeding using mamoties. The manual method required approximately 8–10 man-days, costing around Rs. 20,000-23,000. For chemical weeding, cost of chemicals was Rs. 8,800.00 per acre. Farmers expressed the opinion that manual weeding is approximately twice as expensive as chemical weeding.

'Actara' (active ingredient - Thiamethoxam) was the commonly used insecticide, while 'Daconil' (active ingredient - 2,4,5,6-tetrachloroisophthalonitrile) was the most common fungicide used in pest and disease control of bananas. However, the *seeni* banana variety, widely cultivated in the surveyed area, was less susceptible to disease and drought tolerance. The main issue related to pesticides and herbicides in bananas can be identified as the high prices of these chemicals. The price increase of chemicals used in bananas is in the range of 125% - 250% compared to the pre-crisis situation.

3.1 Marketing - Market Information and Transporting

The majority of farmers (76%) had received market information via vendors in the particular *kesel pola* (village fair) situated in the area. Generally, they receive price, variety, and quality information that prevailed at the previous *kesel pola*. Large-scale farmers have established buyers who come from the eastern and central provinces. They visit the farm field and purchase the quantity they need at an agreed-upon price. Before the economic crisis, about 10% of small-scale farmers also had visiting vendors from other provinces coming to their fields and making purchases. Due to the rise in fuel prices, vendors stopped coming directly to the small-scale growers' farm fields.

Bananas, being a climacteric perishable fruit, experience relatively high postharvest losses primarily during handling and transportation in the supply chain. Despite harvesting them at the mature green stage, ripened bananas at retail shops often exhibit a poor external appearance due to significant mechanical damage caused by improper handling throughout the value chain (Kamalakkannan *et al*., 2022). Although the bunches are transported when unripe, the bruises that occur during transportation

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become apparent two to three days later, generally at the retail level. Consequently, the quality loss experienced by retailers two days after purchase is noteworthy. These factors contribute to the considerable postharvest losses of bananas in Sri Lanka, accounting for approximately 27%. According to Wasala *et al.*, 2014, this loss is primarily attributed to the lack of appropriate packaging methods for transportation from the farm gate to the consumer.

Detailed observations and field visits reveal that in the traditional distribution chain, banana bunches are bulk packed in trucks with minimal or no cushioning or lining materials. The trucks are often overfilled, and bunches are stacked in multiple layers, leading to extensive compression damage. Over pilling is more aggravated with the rise in fuel prices. Furthermore, unloading procedures at destinations lack care.

3.2 Marketing - Involved Intermediaries, Price determination and Selling in Fresh Form

The main supply chain of bananas in the surveyed area (figure 2) indicates that about 75% of the banana harvest is traded through *kesel pola*, situated in each village. Another 10% is traded via vendors visiting the farm fields. The remaining amount is sold to the wholesale shops situated in the producing areas. The amount that is sold through supermarket chains is minimal, compared to the total produce of the areas.

Depending on the price, variety, and quality information prevailing at the previous *kesel pola*, farmers decide on the number of bunches to be harvested and transported the harvested bunches to the *kesel pola* during the evening. *Kesel pola* provides balances to weigh the banana bunches. Vendors and farmers bargain on the price, and the agreed-upon price is paid on-site. Different *kesel pola* charge varying sizes of commissions. The two largest *kesel pola* in all three districts are Barawakumbuka *pola* and Sooriyawewa *pola*, which charge Rs. 20.00 per *ambul* banana bunch, regardless of the weight of the bunch. Farmers have raised concerns about the high commission, considering the average weight of a banana bunch has remained around 10 kg, especially in the post-crisis situation. The above commission has to be paid by the farmers. The majority of vendors (60%) who come to the *pola* are from the Eastern Province. The second-highest number of vendors come from the Central Province and the Western Province, each accounting for approximately 10%. As a result of the fuel price hike, the number of vendors arriving as well as the traded volume of produce at the market has significantly dropped, by 50% compared to before the crisis situation.

Processing and value addition

Though it is not a part of the traditional value chain, processing and value addition is taking place at a minor scale in Monaragala District. The two factories purchase 2nd and 3rd grade banana bunches enabling farmers to obtain higher prices for lower-quality banana bunches. During June and July of 2023, these factories purchased 2nd and 3rd grade *seeni* bananas at a price ranging from Rs. 65.00 to 70.00, which is a profitable venture compared to the price (Rs. 90.00/kg) prevailed for grade 1 *seeni* banana in the area. However, due to the relatively small daily requirement of these factories (approximately 4,000 to 5,000 kilos of bananas for each), many farmers find it challenging to access this lucrative market. Meanwhile, all the factories are struggling to stay competitive in the world market due to increasing cost of electricity during the post crisis era.

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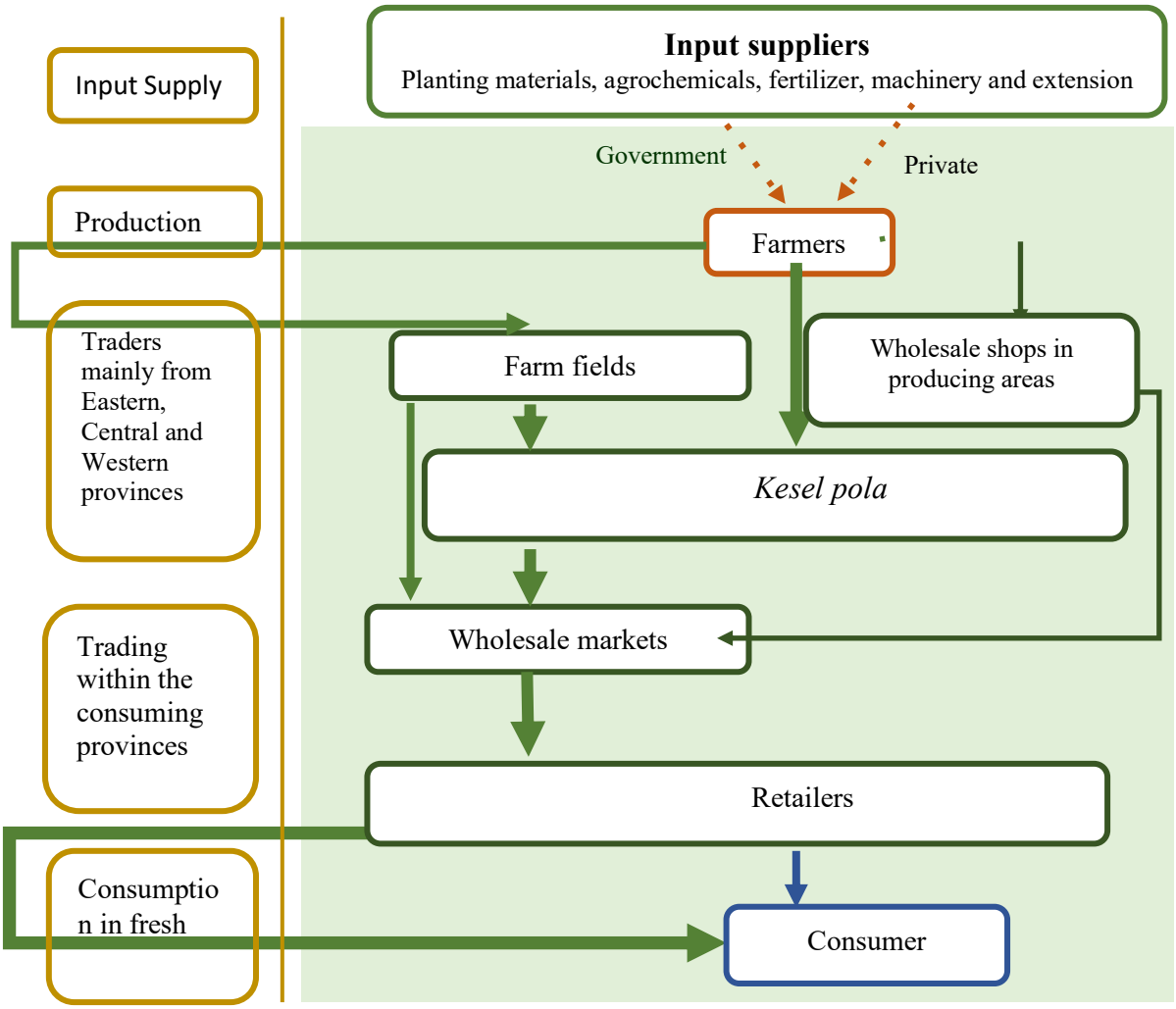

Source: HARTI survey data, 2023
Figure 2: Traditional value chains for banana

Average yield and Gross Income

Regarding *ambul* banana, the recorded fruiting percentage was around 80% when suckers were used as planting material. If tissue-cultured plants are used, the fruiting percentage was around 95%. This situation has not changed across pre - and post-crisis scenarios. However, the average weight of *ambul* banana bunch has changed compared to the pre-crisis scenario. Low fertilizer application has led to a decline in the weight of *ambul* banana bunches by approximately 45-65% (pre-crisis average weight 17-26 kg; post-crisis average weight 7-12 kg). As a result of seedling scarcity, increased prices of fertilizer, machinery, transportation and labour costs, the extent cultivated was dropped by on average 45% in Monaragala district.

Consequently, the average yield from 1 acre of *ambul* banana was about 12,000 kg in the post-crisis scenario (DOA, 2017). which dropped by approximately 50% due to the economic crisis.

The average farmgate price after the crisis (in 2023) was recorded as Rs 67.00/kg, compared to the pre-crisis value of Rs 37.00/kg (in 2019) (HARTI, 2019 - 2023). Hence, the gross income during the first year of establishment was Rs 4,444,000.00 in the pre-crisis situation, compared to Rs 402,000.00 in the post-crisis similar situation. Calculations show that banana farmers were worse off by Rs 42,000 (in terms of gross income) due to the direct and indirect impacts of the economic crisis

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Assessment of market margins and coefficient of variations

The assessment of market margins before (BC) and after (AC) the crisis indicated that, post-crisis, farmers' and retailers' margins dropped by 9.7% and 19.5%, respectively, while wholesalers' margins witnessed an increase of 29.4%. If the marketing channel does not undergo radical changes, increasing farmers' margins is normal with the increased retail prices. Yet, an opposite market price behaviour is observed related to the banana farmgate prices. Table 2 indicates that both retail and farmgate and prices exhibited increased levels of variations after the economic crisis.

Table 1 – Assessment of market margins - before (BC) and after (AC) crisis

Situation		BC (2018-2019) %	AC (2022-2023) %
Banana (*Ambul*)	Farmers' Margin	36.9	27.2
	Wholesalers' Margin	13.1	42.5
	Retailers' Margin	49.9	30.4

Table 2 – Assessment of Coefficent of Variations of the prices - before (BC) and after (AC) crisis

Commodity	Banana *(ambul)*
Retail Prices	
Before Crisis (2018-2019) CV %	11.07
After Crisis (2022-2023) CV %	25.50
Farmgate prices	
Before Crisis (2018-2019) CV %	22.66
After Crisis (2022-2023) CV %	36.58

ANOVA Test Results

Figure 3 shows higher mean retail prices in 2022 and 2023 (post - crisis) compared to 2018 and 2019 (pre - crisis). On the other hand, in 2022 and 2023, higher dispersion of prices is clearly indicated compared to 2018 and 2019. However, the corresponding farmgate prices reported in 2022 is not distinctively different from the prices reported in 2018 (figure 4). Tukey's post-hoc test was conducted to compute pairwise comparisons of different groups and to point out exactly where those differences lie (table 3).

As the table 3 shows, for the retail prices, all pre-crisis versus post-crisis mean values were significantly different from each other at a 5% level. Moreover, all post-crisis mean values were significantly higher than their respective pre-crisis counterparts. Nevertheless, the 2022 farmgate price (ac) is not significantly higher than either of the pre-crisis mean values; 2018 or 2019.

Therefore, the null hypothesis (H_0) stating "there is no difference in retail prices of the considered commodities due to the economic crisis" is rejected at the 5% significance level. However, there was insufficient evidence to reject the null hypothesis (H_0) stating "there is no difference in farmgate prices of the considered commodities due to the economic crisis." It appears that during the economic crisis, banana farmgate and retail prices diverged.

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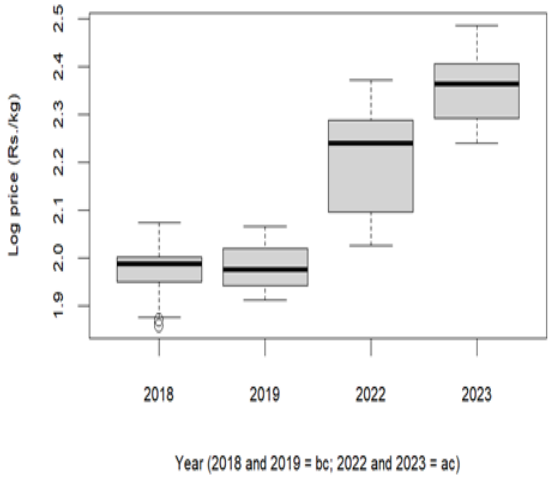

Figure 3 – Comparing the mean retail prices (log) of banana banana (*ambul*) across years

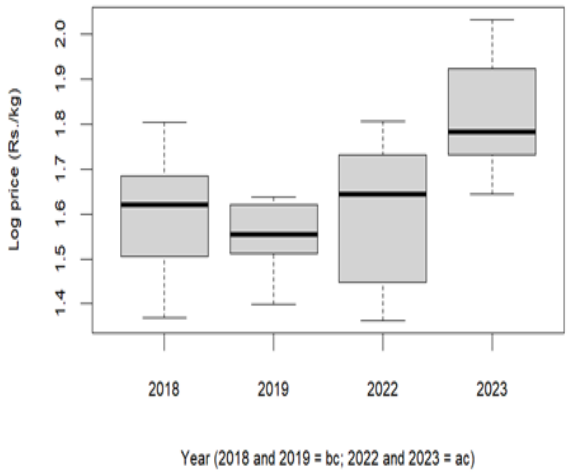

Figure 4 – Comparing the mean farmgate prices (log) of banana (*ambul*) across years

Table 3 – Tukey's pairwise comparisons of banana (*ambul*) prices

Two-way ANOVA Multiple Comparisons of Means: Tukey Contrasts	Banana (*ambul*) retail prices		Banana (*ambul*) farmgate prices	
	coefficient	P value	coefficient	P value
bc.2019 - bc.2018	0.006005	0.986	0.0129	0.863
ac.2022 - bc.2018	0.223806	< 0.001 ***	0.06075	0.164
ac.2023 - bc.2018	0.378495	< 0.001 ***	0.27444	< 0.001 ***
ac.2022 - bc.2019	0.217801	< 0.001 ***	0.04777	0.324
ac.2023 - bc.2019	0.372489	< 0.001 ***	0.26146	< 0.001 ***
ac.2023 - ac.2022	0.154688	< 0.001 ***	0.21369	< 0.001 ***

Significant at **p <.05. **p <.01. ***p <.001.*

Researchers argue that price shocks can lead to asymmetric and incomplete adjustments of retail prices in response to farmgate prices, resulting in a low correlation between retail and agricultural farmgate prices. This low correlation may stem from changes in other retailer costs that impact the retail price more significantly than the farmgate price. Additionally, it can be attributed to shock-induced retailer strategic behaviour and alternative pricing strategies beyond markup pricing. At times, the retail price of a particular product may not entirely reflect shocks, and farmgate prices may exhibit larger variations to maintain market equilibrium (Li & Sexton, 2013).

Increasing levels of spatial and vertical disintegration is common during crisis situations. Kumari, Weerahewa, & Hemachandra (2022), assessed the spatial integration of vegetable markets in Sri Lanka during the COVID-19 pandemic and found higher levels of spatial disintegration during the crisis. Before the onset of the pandemic, six out of nine regional wholesale markets were integrated with prices recorded at the main dedicated economic centre (DEC) - Dambulla, for fresh beans, carrots, tomatoes, and brinjal. However, during the pandemic, the level of integration dropped, with only prices of fresh beans in five regional markets being cointegrated with DEC – Dambulla.

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Further, Amare *et al.* (2023) conducted a study on spatial market integration during the Covid-19 pandemic in Nigeria and concluded that spatial market integration weakened substantially during the pandemic. However, they found that changes in the speed of adjustment and spatial market integration varied across different value chains over time. The study observed differential impacts of the pandemic across various value chains, as noted by Hirvonen *et al*. (2021), Mogues (2020), and Swinnen & Vos (2021). For instance, market disintegration for cereals was low and sometimes negligible, whereas for perishable commodities, it was observed to be up to fivefold higher than for storable commodities. Moreover, Amare et al. (2023) further revealed that markets with higher levels of digitization and better access to infrastructure remained relatively more resilient to food market disruptions.

Hence, the price divergence or the vertical disintegration of banana retail and farmgate prices could be a result of differences in degree of responses of retail and farmgate prices to market shocks such as decreasing quantity and quality of supply, information asymmetry, supply chain disruptions due to fuel issues and overall increase in risk associated with the marketing channel during the crisis.

IMPLICATIONS

Managerial implications

It is vital to enhance facilities by investing in trained labour, equipment, and other essential human and physical resources within government seedling – producing institutions. Moreover, implementing a local standardization procedure aligned with the international standards for private tissue culture laboratories is crucial. Since 75% of the bananas under consideration are processed through traditional channels, there is a need to enhance quality control measures (especially at the entry point) and address post-harvest losses occurring during transportation and handling stages at the *pola* markets.

It was revealed that promoting the export of banana value-added products is a viable solution to mitigate the drawbacks of increased prices of imported inputs due to the devaluation of the rupee. Identifying export prospects, motivating local entrepreneurs, fostering opportunities for establishing long term contracts with international buyers to boost demand for current industries, and implementing sustainable, cost-effective methods to address high electricity cost seems vital in the present context.

Establishing a knowledge hub for commodity exporters, offering crucial information and a platform for sharing practical experiences with newcomers to the industry in a pressing need.

CONCLUSION

The financial crisis in early 2022 in Sri Lanka led to significant shifts in agricultural commodity supply and demand. It increased production costs in bananas potentially causing reduced cultivation extent, lower yields, and changes in cropping intensity. This reduction was caused by a combination of factors: a threefold increase in production costs, scarcity of planting materials, low quality of inputs, declining demand, reduced sales volume, and consequently diminished profits. For bananas, which rely on local seedling production, COVID -19 related movement restrictions and transportation challenges resulting from the economic crisis disrupted the supply chain. Consequently, farmers faced reduced profits and lacked sufficient financial resources for reinvestment. Meanwhile, abandoning the banana crop led to a shortage of healthy suckers for replanting. Moreover, far exceeding demand for tissue-cultured banana plants than supply further aggravated the issue.

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With the reduction in cultivated extent, there was a shift from hired labour to family labour in bananas. There was 42% of banana farmers who had been a large-scale farmer (>5ac) before the crisis and who relied highly on hired labour have converted themselves to a small-scale farmer and witnessed a considerable substitution of hired labour to family labour (60%). Decreased application of fertilizers both in terms of quantity (by 10-45%) and frequency was observed. Low fertilizer application has led to a decline in the weight of (*ambul*) banana bunch by approximately 45-65%. Moreover, considering banana, there has been a transition from high-input responsive, high-risk varieties (such as *kolikuttu*) to low-input responsive, resilient varieties like *seeni kesel* as a measure of avoiding high fertilizer cost. The main marketing channels for the considered vegetables and fruits remain unchanged. Yet, the volume of sales and the number of transporters and vendors involved in each marketing channel has dropped 40%.

Market margin analysis revealed that post-crisis, farmers' and retailers' margins dropped by 9.7% and 19.5%, respectively, while wholesalers' margins witnessed an increase of 29.4%. ANOVA results indicate that post-crisis prices (prices in 2022) were not significantly higher than pre-crisis farmgate prices. This scenario implies that banana (ambul) farmers were adversely affected during the economic crisis, as they did not experience higher farmgate prices despite the rise in retail prices. Hence, there seems to be crisis-induced vertical disintegration still existing in banana markets.

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