RESEARCH REPORT

Hector Kobbekaduwa Agrarian Research and Training Institute

EVALUATION OF THE EFFECTS OF ECONOMIC CRISIS ON FRUITS AND VEGETABLE SECTOR: PRODUCTION AND MARKETING

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HARTI

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FOREWORD

The economic crisis of 2022 - 2023 period marked a pivotal moment for Sri Lanka's agricultural landscape, fundamentally altering the dynamics of fruit and vegetable production and marketing systems that have sustained our nation for generations. The agricultural sector, which serves as the backbone of rural livelihoods and food security, faced unprecedented challenges that tested the resilience of our farming communities and supply chains.

This study provides crucial insights into how the economic upheaval transformed agricultural practices, market structures, and farmer decision-making processes. The research encompasses critical crops including beans, brinjal, banana, and papaya, offering a detailed analysis of how cultivation patterns, production methods, and marketing channels evolved under crisis conditions. More importantly, it presents evidence-based policy recommendations that can guide our agricultural sector toward greater resilience and sustainability. The findings reveal not merely statistics of decline, but stories of adaptation, resilience, and strategic responses by farmers who confronted soaring input costs, supply shortages, and market uncertainties with remarkable ingenuity.

I trust that this study will serve as an invaluable resource for policymakers, agricultural practitioners, researchers, and development partners committed to strengthening Sri Lanka's agricultural sector.

Prof. A.L. Sandika
Director/Chief Executive Officer

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EXECUTIVE SUMMARY

The economic crisis in early 2022 significantly impacted Sri Lanka's agricultural sector, particularly the fruit and vegetable supply chains. Increased production costs led to smaller cultivation areas, lower yields, and changes in farming practices. This disruption affected both supply and demand, unsettling market equilibrium was disrupted. This study by the Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI) examines the crisis's impact on crops such as beans, brinjal, banana, and papaya, comparing current conditions with pre-crisis levels and proposing targeted policy measures.

The crisis sharply drove up the cost of essential production inputs, notably seeds, agro-chemicals, and labour intensifying the financial burden on farmers. Cultivated acreage plummeted, with beans by 30%, brinjal by 25%, banana (embul) by 45%, banana (kolikuttu) by 60%, and papaya by 20%. Despite these challenges, less than 5% of farmers completely abandoned cultivation. The steep rise in input costs, coupled with the scarcity of high-quality seeds and fertilizers, worsened the decline. Crops that depend on imported seeds faced acute shortages, further straining production efforts.

In banana sector, COVID-19 restrictions had disrupted local seedling supply chains, and the abandonment of some banana cultivars further compounded the shortage of healthy seedlings for replanting. The demand for tissue-cultured banana plants, vital for maintaining crop health, far outstripped supply, highlighting the urgent need for expand tissue culture capacity to meet farmers' needs.

Under mounting financial pressures, farmers increasingly turned to family labour instead of hired labour, particularly for labor-intensive crops like bananas, where the labour costs constituted a significant portion of the overall expenses. Additionally, the frequency and quantity of fertilizer application decreased by 10-45% across all crops. These adjustments led to reductions in crop quality and yield, particularly in high-input varieties. For instance, embul bananas experienced a 45-65% reduction in bunch weight, while papaya fruits lost approximately 15% of their average weight. To mitigate rising fertilizer costs, banana farmers shifted from high-input varieties like kolikuttu to more resilient, low-input varieties such as seeni kesel as a strategy to cope with rising fertilizer costs.

The escalation in the cost of agrochemicals, particularly for disease management in crops like brinjal, placed additional strain on farmers. For example, the cost of a recommended fungicide for brinjal increased to RS. 40,000 for a 130 ml bottle. Faced with this steep increase, many farmers resorted to reduced or alternative pest control methods, resorted to crop quality and yield. Faced with this steep increase, many farmers resorted to reduced or alternative pest control methods, affecting crop quality and yield.

Despite the crisis, the primary marketing channels for fruits and vegetables remained stable; however, transaction volumes dropped by 15-40%, with banana sales experiencing the steepest decline. Farmers responded by diversifying their sales channels, distributing smaller quantities to various buyers, including wholesale outlets, village collectors, and value-addition companies. While this strategy helped farmers maintain cash flow, this strategy reduced levels.

In the export-oriented fruit-processing sector, factories that typically purchase lower-quality fruits faced increased electricity costs, threatening their competitiveness in the global market. Currently, these facilities work with a relatively small number of farmers, and their operations are constrained by limited demand and rising operational costs. However, export-focused factories play a vital role in stabilizing prices for farmers by absorbing grade-two fruits, especially when domestic demand is inconsistent.

The study's analysis of market margins before and after the crisis revealed mixed impacts across the supply chain. Farmers' margins for most crops, except bananas, improved slightly, ranging from 4.4% to 10% due to increased retail prices. In contrast, retailer margins dropped by 2.5% to 19.5% in most crops, except for papaya. Wholesalers, however, saw their margins increase between 2.7% and 29.4%.

A price integration analysis indicated that farmgate and retail prices for bananas remained stable post-crisis, while price variability in other crops showed mixed patterns. For example, retail price variability increased for for brinjal and banana but decreased for beans and papaya. Notably, embul banana farmers faced the most significant losses, as farmgate prices remained relatively stable while retail prices soared.

To address the crisis's adverse effects, the study recommends policy interventions:

i. **Quality and Price Regulation**: Implement strict controls on the pricing and quality of imported seeds, fertilizers, and agro-chemicals. Additionally, enforce measures to eliminate unauthorized agro-chemicals that have proliferated in some areas, like Anuradhapura.

ii. **Promotion of Good Agricultural Practices (GAP)**: Expand the adoption of GAP to help farmers reduce agro-chemical costs and boost productivity. For instance, GAP beans farmers in Nuwara Eliya incurred 50% lower production costs than their non-GAP counterparts, illustrating GAP's potential to sustain agriculture during crises.

iii. **Enhanced Export Capacity**: Boosting fruit-based product exports offers a strategic way to offset the high cost of imported inputs. This approach involves identifying export opportunities, supporting local entrepreneurs, and fostering partnerships with international buyers. Establishing a

knowledge hub for exporters could further strengthen Sri Lanka's competitiveness in global markets.

iv. **Infrastructure and Resources for Seedling Production**: Invest in government institutions responsible for seedling production, such as the Fruit Research Institute and the Grain Legume and Oil Crops Research and Development Centre to expand their capacity. This would help meet the growing demand for tissue-cultured banana plants and other essential seedlings, supporting sustainable crop production.

v. **Local Standards for Tissue Culture Labouratories**: Developing standards in line with international practices for private tissue culture labouratories could increase the availability and quality of tissue-cultured plants, addressing supply shortages more sustainably.

vi. **Improved Quality Control in Traditional Channels**: Since 75% of commodities, flow through traditional channels, enhancing quality control, at key entry points, is crucial. This would help reduce post-harvest losses and improve quality in the domestic market, especially through better handling and transportation practices at the Dedicated Economic Centers (DECs).

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LIST OF ABBREVIATIONS

ADF	-	Augmented Dickey-Fuller
AI	-	Agricultural Instructor
ANOVA	-	Analysis of variance
ARDA	-	Agriculture Research and Development Assistant
ASC	-	Agrarian Services Centers
BC	-	Before Crisis
BOP	-	Balance of Payment
CBSL	-	Central Bank of Sri Lanka
CV	-	Coefficient of Variance
DEC	-	Dedicated Economic Centers
DOA	-	Department of Agriculture
FAO	-	Food and Agriculture Organization
FGD	-	Focused Group Discussions
GAP	-	Good Agricultural Practices
GDP	-	Gross Domestic Product
HARTI	-	Hector Kobbekaduwa Agrarian Research and Training Institute
HIES	-	Household Income and Expenditure Survey
HORDI	-	Horticulture Research and Development Institute
IARS	-	Institute of Agricultural Technology and Rural Sciences
IMF	-	International Monetary Fund
KII	-	Key informant Interviews
KPSS	-	Kwiatkowski–Phillips–Schmidt–Shin
MOP	-	Muriate of Potash
RDB	-	Regional Development Bank
TSP	-	Triple Super Phosphate
UNCTAD	-	United Nations Conference on Trade and Development
UNIDO	-	United Nations Industrial Development Organization
VCA	-	Value Chain Analysis
WFP	-	World Food Programme

CHAPTER ONE

Introduction

1.1 Brief Account of Fruit and Vegetable Sector in Sri Lanka - Production and Consumption

The importance of the fruit and vegetable farming sector in Sri Lanka cannot be overstated, as it is a major contributor to the country's economy in terms of food and nutritional security, income generation, and employment opportunities. The country's agro-biodiversity, 46 agro-climatic zones, allows for the cultivation of over 550 food crops throughout the year. In 2020, the agricultural sector contributed 8.36 percent to the country's GDP, an increase from 7.54 percent in the previous year (CBSL, 2020).

Agriculture employs 29 percent of the total labour force in Sri Lanka. Within the agricultural sector, the vegetable production sub-sector is the second largest after paddy cultivation. Despite the challenges posed by the COVID-19 pandemic in 2020, the total area under vegetable cultivation was 82,126 hectares, producing 1,068,245 metric tons (Department of Agriculture, 2021). The vegetable sector also contributed to the country's net foreign exchange earnings in 2020, generating export earnings of RS. 124.508 million (Department of Agriculture, 2021).

The seasonal nature of vegetable production results in wide variations in significant variations in availability throughout the year. In Sri Lanka, the main growing season, known as *maha*, accounts for 60% of the annual production and extends from mid-October to the end of December, with peak harvesting occurring between February and March. The other growing season, *yala*, typically experiences peak harvesting from August to September. Vegetable prices tend to be lowest during peak harvesting periods and highest just before and after these periods (Champika, 2016).

As a result, vegetable prices are typically higher in December, January, May, June, and July than the corresponding annual average prices. Despite the availability of fresh vegetables, the reported consumption of 110.37 g per day by Sri Lankans has remained relatively unchanged over the past ten decade (112/g per day in 2012) and continues to fall below the recommended daily intake of 200 g per day (Ministry of Health, 2021). This low consumption is primarily attributed to the limited purchasing power of the poorer segment of society during lean periods (Jayawardena et al., 2012).

In 2020, the total area dedicated to fruit cultivation in Sri Lanka was 117,244 hectares, producing 1,381,674 metric tons according to the Department of Agriculture (2021). However, with a few exceptions, fruit cultivation in Sri Lanka is primarily carried out by small-scale, semi-commercial, or subsistence farms, with over 60 varieties of underutilized fruit crops grown in rural home gardens or wild areas (Dahanayake, 2015). The export earnings from fresh and dried fruits in 2020 amounted to 4,317.312 million Sri Lankan rupees, with an export volume of 31,945 metric tons. However,

with an import bill of 8,607.642 million Sri Lankan rupees in the same year, the fruit sector remained a net importer to the economy (Department of Agriculture, 2021).

Over time, the primary market for Sri Lanka's fruit exports has shifted from Europe to the Middle East, with the unit value per product generally declining. Nonetheless, the increase in quantity supplied has offset the low-price premium. Notably, the contribution of fruit exports to the country's merchandise exports has been increasing, reaching 0.35% in 2016, indicating industry expansion within the country.

The Sri Lankan Ministry of Health's Food-based Dietary Guidelines for 2021 recommends a daily intake of 200 grams comprising five different types of fresh fruits per person. Despite national-level efforts to expand fruit cultivation and encourage the consumption of fresh fruits, the reported per capita intake of fresh fruits remains far below the recommended average daily intake, standing at 88.2 grams (Udari, Perera, & Wickramasinghe, 2019). Given that fruits and vegetables are vital for a healthy diet due to their rich content of vitamins, minerals, and antioxidants, ensuring adequate intake of safe and nutritious fruits could play a significant role in achieving food and nutrition security in the country, particularly amid the current economic crisis.

1.2 Supply Chain Characteristics of Fruits and Vegetables

Fruits and vegetables are highly perishable and have a short shelf life, making supply chain management critical for both cost control and maintaining the quality of produce (Veena and Venkatesha, 2011). To preserve the freshness of these items until they reach the consumer, proper transportation, handling, and storage facilities are essential.

In developed countries, the supply chains for fruits and vegetables are well integrated and managed through centralized systems. This includes grading and packaging of commodities at collection centers, with low quality, diseased, and damaged produce sorted out before entering the main supply chain. Properly packed commodities are then transported in specialized vehicles designed for horticultural transportation, with the cold chain maintained throughout the system.

Food losses are a significant concern for both developing and industrialized countries. In developing countries, more than 40% of food losses occur at post-harvest and processing stages, including transportation. In industrialized countries, however, more than 40% of food losses occur at retail and consumer levels (FAO, undated) (Figure 1.1).

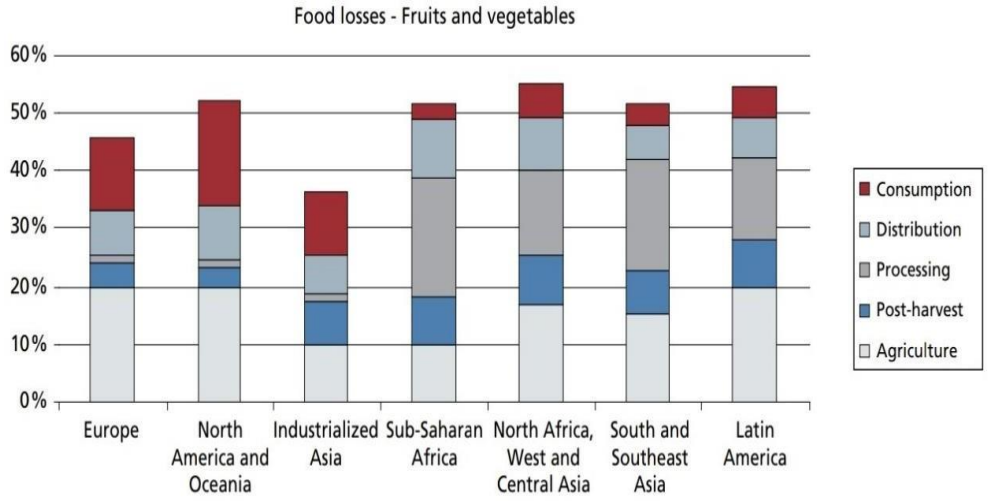
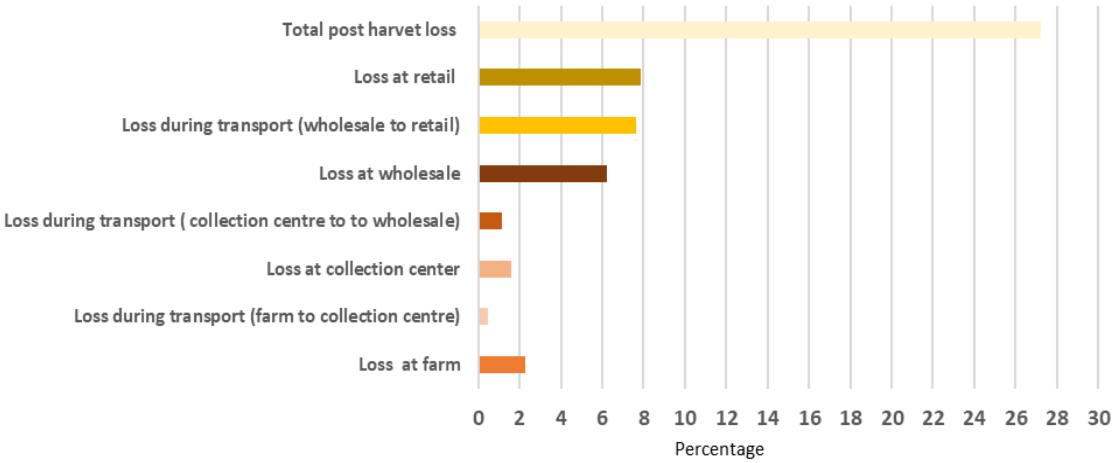


Figure 1.1: Food Losses in Supply Chain by Regions (FAO, Undated)

Within the fruits and vegetables commodity group, losses in agricultural production dominate in all three industrialized regions, primarily due to post-harvest grading based on quality standards set by industries and retailers. Waste at the consumer level is also substantial in all three regions, with 15-30% of purchased produce discarded by mass. In developing regions, losses in agricultural production dominate the entire food supply chain. Losses during post-harvest and distribution stages are severe, mainly due to the deterioration of perishable crops in warm and humid climates, inadequate transportation infrastructure, in many developing countries, and seasonal surpluses that become unsaleable.



Source: Kamalakkannan *et al*, 2022.

Figure 1.2: Post Harvest Losses at Different Stages of Supply Channel

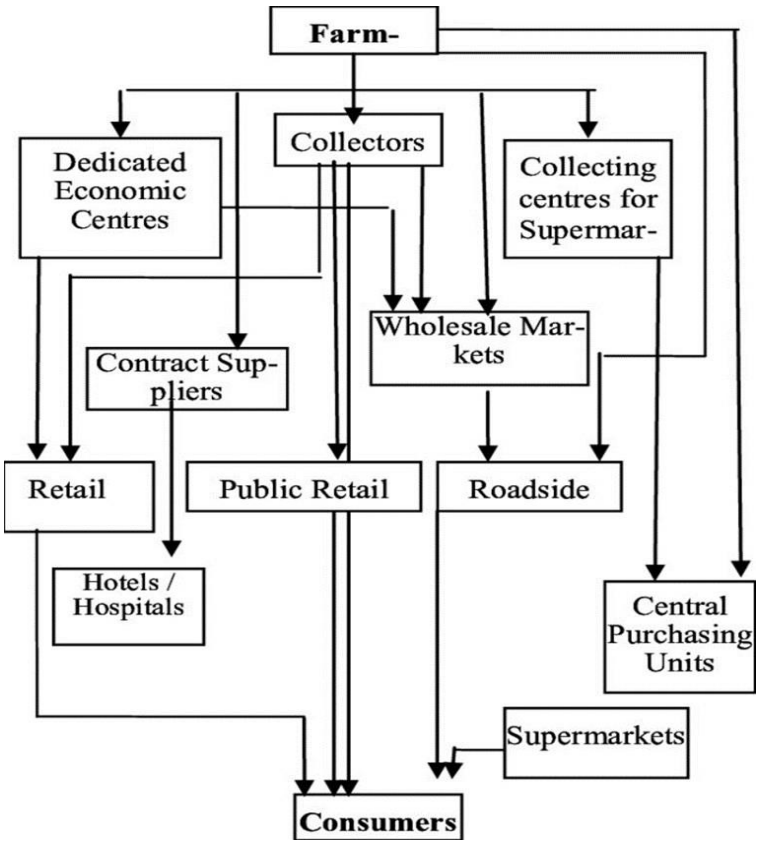
A recent study conducted to examine the postharvest operations (up to retail level, excluding consumption losses) of the primary supply chains of the sour banana variety (*ambul*) in Sri Lanka revealed that total postharvest losses of 27.23%, with the most substantial losses occurring at the retail stage (7.89%), followed by transportation from wholesale to retail (7.61%) and wholesale stage (6.22%) (Kamalakkannan *et al*, 2022). (Figure 1.2). Thus, it can be anticipated that total post-

harvest losses including those at the consumption would range from 35% - 40%, within the farmer - collection center - wholesaler- retailer channel.

1.3 Marketing Channels and Supply Chain Characteristic of Fruits and Vegetables in Sri Lanka

The fragmented and less integrated nature of the Sri Lanka's fruits and vegetable supply chain has led to the involvement of multiple players with diverse interests. The supply chain comprises farmers, local traders, transporters, processors, and retailers, each performing different functions. Intermediaries play a vital role in transferring ownership, facilitating movement, maintaining quantity and quality, ensuring payment to sellers, and delivering commodities to the buyers (Halder and Pati, 2011). Therefore, linkage and integration among the various players are essential for the effective and profitable operation of the entire supply chain. Figure 1.3 illustrates the marketing channels used to move vegetables from producers to end consumers.

In Sri Lanka, over 90% of food supply and distribution is managed by the private sector, with traditional market channels, i.e., selling through dedicated economic centers and collectors, dominating the supply chain, accounting for nearly 95% of total vegetable sales.



Source: Vidanapathirana, Priyadarshana and Rambukwella, 2011

Figure 1.3: Types of Fruits and Vegetable Marketing Channels in Sri Lanka

In Sri Lanka, approximately 70% - 75% of fruits and vegetables pass through dedicated economic centers (DECs) before being transported to regional wholesale markets (Figure 1.3). From there, commodities are directly supplied to consuming areas. Currently, there are nine DECs in Sri Lanka: Dambulla, Thambuththegama, Nuwara Eliya, Katugasthota, Keppetipola, Veyangoda, Embilipitiya, Meegoda, and Norochcholai (Puttalam) (HARTI, 2023).

Perishable commodities such as fruits and vegetables, which cannot be stored and have varying quality standards, are more likely to pass through dedicated economic centers, where inspection, grading, and pricing are conducted on the spot.

The chain of intermediaries begins with the village-level collecting agents, with the most common marketing channel being the farmer-collector-wholesaler-retailer-consumer system. Typically, farmers sell their produce to vegetable collectors or send it to commission agents at the wholesale markets through transporting agents. However, commission agents often quote prices lower than those at the wholesale market, potentially leading to farmer exploitation (Perera et al., 2004).

However, a significant portion of temperate vegetables grown in hill areas are directly sent by farmers to commission agents in the Peliyagoda market in Colombo through organized transporters. Meanwhile, collectors purchase tropical vegetables from farmers at weekly fairs (*pola*) to sell them to the same market.

In the traditional vegetable supply chain, quality signals are not communicated to farmers, and they are compensated solely based the weight of the produce, without consideration for its quality. This practice has led farmers to prioritize increasing the weight of their produce, sometimes resorting to unethical methods such as placing stones and inferior quality vegetables in the middle of the sacks of vegetables (Rupasena et al., 1999; Perera et al., 2004). Subsequently, transporting agents tightly pack vegetables in *polysac* bags or net bags and overload them in transport vehicles, resulting in substantial wastage of vegetables (Rupasena et al., 2001).

Wholesaling in the vegetable supply chain facilitates the economic function of buying and selling, allowing the forces of supply and demand to converge and establish a single price for a commodity. However, the lack of integration and linkage between the various players in the supply chain has led to inefficiencies and reduced profitability for farmers and other intermediaries. To enhance the effectiveness and profitability of the entire supply chain, it is crucial to establish better linkages and integration among the players involved in the vegetable supply chain in Sri Lanka.

1.4 The Problem Statement

In the Sri Lankan context, rising production costs of commercially grown fruits and vegetables could lead to various production changes, including reduced cultivation extent, decreased yield, lower cropping intensity per season, complete abandonment of cultivation, and a shift to low-input crops. Changes in the market

chain may also occur, such as a threefold increase in transport costs, making neighbouring markets more favourable than distant ones. This situation could result in frequent shortages of some products and frequent oversupply of others, causing significant price disparities across regions. Additionally, the market margins for producers, collectors, wholesalers, and retailers could significantly deviate from normal levels, while smaller transaction volumes and shrinking profits may force some actors out of the supply chains.

On the demand side, food inflation rates have steadily increased since the second quarter of 2020, making nutritious food increasingly unaffordable for the lower-income group. According to a report by WFP in September 2022, approximately 6.7 million people in Sri Lanka lack access to an adequate diet, and 5.3 million are reducing their daily meals. Additionally, more than 60% of families are turning to cheaper and less nutritious food (WFP, 2022). The prevailing economic crisis is believed to have exacerbated supply chain issues in less populated rural areas. Supply chain disruptions, coupled with shorter food miles, might result in reduced availability of some varieties in rural markets. Affordability issues may have also worsened due to job losses in the informal sector.

A crisis can affect market equilibrium in various ways, depending on the type and severity of the crisis. Some possible scenarios include: Shift in supply: As mentioned earlier, a crisis can disrupt the supply chain, leading to a decrease in the supply of goods, particularly for non-essential products (Baldwin & Tomiura, 2020). This can shift the supply curve to the left, resulting in a higher equilibrium price and a lower equilibrium quantity Shift in demand: A crisis can also affect purchasing power, consumer preferences, and behaviour, leading to a shift in demand, often resulting in lower demand than usual (Raza, Siddiqui, & Hussain, 2020). This can shift the demand curve to the left, causing both a 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, reduce access to credit and disrupt transportation, leading to a decrease in supply. At the same time, consumers may face lower purchasing power and reduce their demand. 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 try to re-adjust and reposition to a new equilibrium. On the supply side, suppliers (farmers in this case) may seek alternatives for high-cost inputs, adjust their production processes, and reduce costs. This reconfiguration of supply chains, aims to build more resilience in operations, and may involve investing in new technologies to adapt to 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 product availability. According to a study published in the *Journal of Retailing*, consumers may start looking for

cheaper alternatives, switch to more readily available products, or postpone purchases until the situation improve (Grewal, Iyer, & Levy, 2020).

These adjustments by both supply and demand forces can lead to changes in market equilibrium, including shifts in the supply or demand curve, alterations in prices and quantities, and adjustments in the allocation of resources.

Therefore, this economic crisis calls for a broader study of the fruit and vegetable sector to understand the current challenges and propose effective mitigation strategies. Over time, as 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, though this equilibrium may differ from the pre-crisis one. Measures of market integration can indicate whether the market is still readjusting and repositioning or if it is in the process of reaching a new equilibrium. However, research efforts on measuring the effects of the economic crisis on the supply and demand forces of fruits and vegetables in Sri Lanka have been limited. Therefore, this research aims to examine the impact of economic crisis on fruit and vegetable supply chains to mitigate the potential adverse effects on both the supply and demand sides.

1.4.1 Research Questions

I. What is the percentage change in the cultivated area of selected fruits and vegetables before and during the crisis?

II. What is the percentage change in the production and marketable surplus of selected fruits and vegetables before and during the crisis?

III. What is the percentage change in the cost of cultivation before and during the crisis?

IV. How have the margins of farmers, wholesalers, and retailers changed compared to the pre-crisis situation?

V. How has the change in margins affected the stability of the supply chain?

VI. Have prices in the producing areas and consuming areas become integrated or disintegrated due to the economic crisis?

1.5 Objective

The main objective of this study is to assess the impact of the economic crisis on the production and marketing of fruits and vegetables.

Specific Objectives

To achieve the intended purpose of the research, the study would have the following specific objectives:

i. To evaluate the changes in fruit and vegetable production resulting from the economic crisis.

ii. To assess changes in the supply chains of fruit and vegetables by comparing their current status to pre-crisis situation.

iii. To propose policy implications that can help mitigate the anticipated negative impacts of the economic crisis on fruit and vegetable supply chains.

CHAPTER TWO

Literature Review and Conceptual Framework

2.1 Impact of Foreign Exchange Crisis on Sri Lanka

In the Sri Lankan context, numerous economists contend that the foreign exchange crisis was driven by a prolonged negative balance of payments (BOP), the economic impact of the COVID-19 pandemic (2020–2021), a heavy foreign debt burden, a decline in the tourism sector, and the significant reduction in remittances (Bhowmick, 2022; Kataria, Manur, & Pradhan, 2022; IMF Press Release, 2022).

Economies experiencing both a fiscal deficit and a current account deficit are referred as twin deficit economies. Sri Lanka's BOP has consistently recorded a deficit, with the trade balance ranging from -$6 billion to -$9.7 billion from 2011 to 2020, indicating a growing trend in deficits over the years (Bhowmick, 2022). The twin deficits phenomenon intensified Sri Lanka's dependence on foreign debt, with the country needing to repay $7 billion in 2022 alone.

The downturn in the tourism sector, initially triggered by the Easter bomb attack in 2019, and subsequently exacerbated by the COVID-19 pandemic, had a significant impact on the Sri Lankan economy, causing both short-term and long-term negative effects. The imposition of travel restrictions and lockdowns led to a drastic decline in the number of tourists visiting Sri Lanka, resulting in substantial revenue losses.

According to the Central Bank of Sri Lanka, the country's tourism earnings have declined by 66% in 2020 compared to the previous year (CBSL, 2020). Real GDP contracted by 3.6% in 2020, due to a combination of factors, including the loss of tourism revenue, reduced remittances and the implementation of necessary lockdown measures. COVID-19 pandemic also adversely affected other sectors of the economy, such as manufacturing, agriculture, and services. Lockdown measures and supply chain disruptions led to a decline in manufacturing activities, while the loss of income and heightened uncertainty caused by the pandemic resulted in decreased consumer spending, further impacting the services sector.

Conceptual Framework

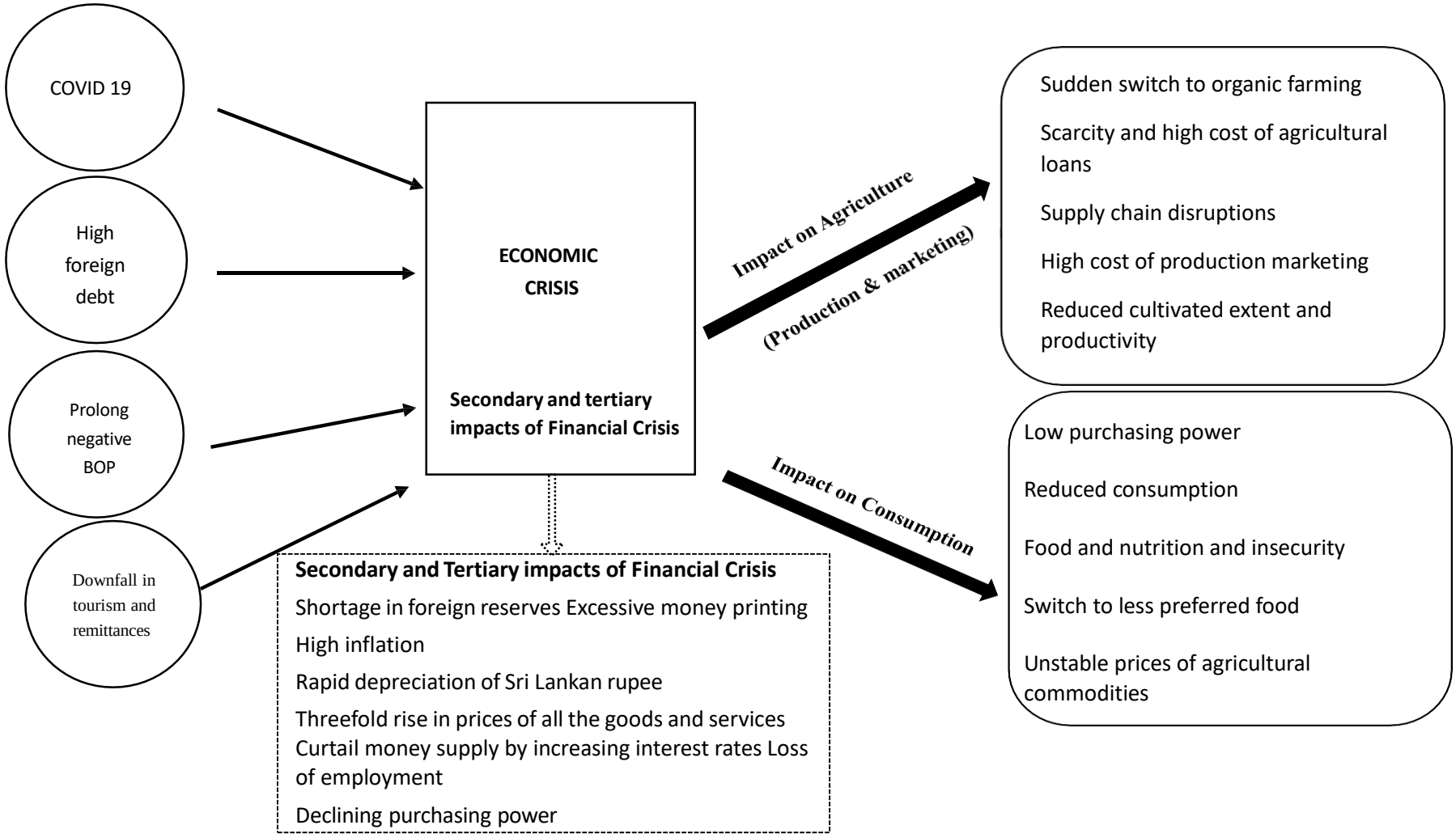


Figure 2.1: How was the Financial Crisis Translated into an Economic Crisis and How Did It Affect the Agriculture Sector?

The pandemic also impacted the country's fiscal position, as the government was compelled to increase spending on healthcare and economic stimulus measures while facing a decline in revenue. The country's debt-to-GDP (nominal) ratio, which was already elevated before the pandemic, increased further, exceeding 100% due to these factors (International Monetary Fund, 2022). Overall, the COVID-19 pandemic had a profound effect on the Sri Lankan economy, leading to a decline in economic growth, job losses, and an increase in poverty levels.

Sri Lanka has struggled to maintain its foreign reserves and domestic income over the past two years. In response, the government resorted to printing money to cover domestic expenses, resulting in a total money supply (Mo) of RS. 588 billion in the first quarter of 2022. However, this approach generated inflationary pressure on the economy. The Sri Lankan rupee (SLR) also depreciated by 44% against the US dollar from March to May 2022, causing a continuous increase in the prices of goods and services during that period, as reported by the Central Bank in 2022.

Meanwhile, the country was obligated to pay at least US$ 78 million in April 2022 as part of the US$ 7 billion due that year to avert bankruptcy (Sardar, 2022). By May 2022, the reserves had plummeted to less than US$ 50 million. Faced with such dire circumstances, the Sri Lankan government unilaterally stopped debt repayments and declared bankruptcy as an emergency measure.

After declaring bankruptcy, Sri Lanka lost access to foreign credit and sought an IMF bailout. The IMF stipulated the implementation of economic stabilization policies with immediate effect (International Monetary Fund, 2022). One of the primary policies was to reduce inflation by contracting the money supply. As a result, interest rates surged to 30% in the last quarter of 2020.

The steep increase in interest rates made borrowing more expensive for businesses, hindering their ability to invest in new projects, expand operations, or undertake capital expenditures. Higher borrowing costs also discouraged businesses from seeking loans or investment. Additionally, high interest rates increased the cost of existing loans used to finance equipment or inventory. Consequently, many businesses scaled back operations, leading to widespread unemployment, while remaining employees faced pay cuts

On May 6, 2021, the Sri Lankan government imposed a ban on the import of chemical fertilizers. The objective was to promote the production of toxin-free agricultural products for local and international markets, while simultaneously reducing import bills and cutting 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).

However, by the time the ban was lifted, global fertilizer prices had quadrupled compared to May 2021 (Bhowmik, 2022). The abrupt shift in agricultural policy

aimed at converting to organic agriculture by banning importation of agricultural inputs such as inorganic fertilizers and agrochemicals had a significant impact on agricultural productivity and yield (Koralagama & Udugama, 2022).

Meanwhile, the removal of fuel subsidies, combined with the devaluation of the Sri Lankan rupee, led to nearly a threefold increase in the prices of Petrol (92) and Diesel (auto) by November 2022 compared to January 2022. Moreover, the electricity tariff rose by an average of 75% since August 2020 (Bhowmick, 2022).

In the meantime, the prices of essential inputs for commercial vegetable cultivation, such as inorganic fertilizers (e.g., urea), surged from RS. 3,050/50kg in 2021 to RS. 29,000/50kg by October 2022 (News Wire, 2022). The prices of other variable inputs, such as pesticides, weedicides, and agricultural machinery parts, also increased by nearly 250%.

According to a survey conducted by HARTI in August-September 2022, there was a 21% reduction in the extent of vegetable land under cultivation and a 57% reduction in average vegetable yield per acre in the 2022 *maha* season (HARTI, 2022). Although the fertilizer ban was lifted in November 2021 amidst the ongoing economic crisis, it was too late to secure adequate fertilizer supplies for the 2021/2022 *maha* season.

The combined impact of income loss due to lack of agricultural inputs and the threefold rise in the cost of production in 2022 caused a significant production fluctuations, affecting the supply in both the short and long term (Figure 2.1).

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, Govijana banks offered agricultural credits at an average interest rate of roughly 8%. However, aftermath of the economic crisis, interest rates increased significantly, with rates now standing at 12% in Govijana banks, and up to 21% in other banks.

This threefold increase in agricultural inputs, combined with a scarcity of resources and the high cost of agricultural credits, has made it extremely difficult for smallholders to continue cultivation as they did before.

The economic crisis from April to July 2020, combined with fuel shortages, severely disrupted agricultural markets due to the unavailability of fuel for transportation. Subsequently, the high cost of fuel continued to hinder the efficient transportation of perishable horticultural produce at frequent intervals. As a result, markets became less integrated, with reports of oversupply of commodities from surrounding areas and shortages of commodities supplied from more distant producing areas.

Furthermore, high to medium levels of supply chain resilient risks and abnormal price behaviour were consistently observed in the Northern and Eastern provinces amid fuel price hikes, as reported by the World Food Programme in September and October 2022 (WFP, 2022).

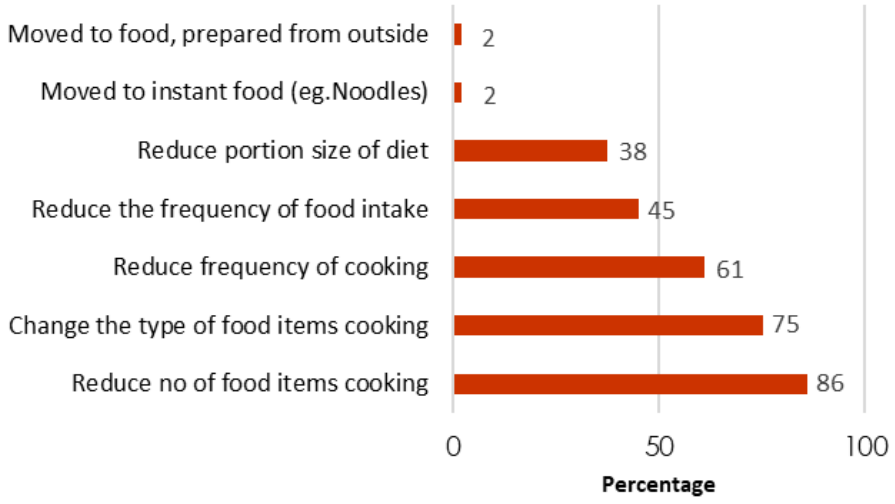
2.2 Alterations in Consumption and Likely Impact on Nutrition

Nutrition-related issues, particularly the affordability of protein and micronutrient - rich foods like fruits and fresh vegetables, have been a significant challenge among the rural poor in Sri Lanka even before the economic crisis. According to the 2019 report of WHO on childhood malnutrition, severe stunting and severe wasting among children under five years of age are more prevalent in the rural areas compared to the urban sector (WHO, 2019).

To address this issue, the National Food Production Programme in Sri Lanka promoted home gardening of fruits and vegetables among rural populations during 2016-2018. The programme aimed to increase access to and the affordability of fresh fruits and vegetables by utilizing the larger land extent of homesteads.

The economic crisis has led to significant changes in food patterns, particularly in commodity purchasing and food consumption. A food security survey conducted by Samanta *et al*. in the last quarter of 2022, covering 17 districts and involving 1,584 respondents revealed that 91% of the respondents experienced negative changes in their buying behaviour. According to the survey, 86% of respondents reduced the number of food items cooked for a meal, while 76% substituted their usual food items with inferior alternatives (Figure 2.2).

These negative changes in food affordability and accessibility are expected to worsen nutrition indicators, particularly among low-income populations.



Source: Samantha *et al*, 2022

Figure 2.2: Changes in Food Purchasing and Food Consumption Pattern

2.3 Research Gap Revealed from the Literature Review

While several studies and reports have analysed the broader impacts of Sri Lanka's economic crisis on agriculture, there is limited research specifically focusing on the fruit and vegetable sector—particularly in terms of both production and marketing dynamics. Existing literature has largely addressed the general consequences of policy shifts, such as the fertilizer ban and the removal of fuel subsidies, but there remains a significant gap in understanding how these factors have uniquely affected fruit and vegetable farmers, supply chains, and market behaviour.

Moreover, while some studies have explored macro-economic effects such as inflation, currency depreciation, and interest rate hikes, there is insufficient research on how these economic pressures translate into on-the-ground challenges for smallholder fruit and vegetable producers. The specific impacts on input availability, cost of cultivation, financial accessibility, and transportation constraints remain underexplored.

Another critical gap lies in the analysis of market integration and price volatility within the fruit and vegetable sector. Reports indicate that supply chain disruptions have led to regional imbalances, with oversupply in some areas and shortages in others. However, empirical studies on market inefficiencies and price transmission mechanisms remain scarce. Understanding these dynamics is crucial for stabilizing the sector and ensuring both farmer profitability and consumer affordability. Additionally, limited research has examined the shifting consumption patterns caused by economic hardship. While surveys indicate that households have altered their food purchasing behaviour, there is little data on how these changes specifically affect the small-scale producers.

Addressing these research gaps is essential for designing targeted interventions that can enhance the resilience of Sri Lanka's fruit and vegetable sector amidst economic instability. This study aims to fill this void by providing a comprehensive evaluation of the economic crisis's impact on fruit and vegetable production, marketing, and consumption patterns. By offering empirical evidence, the study will contribute to guide policy formulation and developing effective recovery strategies for the sector.

2.4 Conceptual Framework for Agricultural Value Chain Analysis

The production, processing, and distribution of agricultural products are increasingly being organized into value chains. These chains involve flows of inputs, products, financial and information resources among farmers, processors, retailers, and other economic actors. Value chains do not follow a deterministic process, but rather adapt and respond to local conditions, policy and institutional environment, market power, and consumer preferences, among other factors (Kirimi, et al., 2011). The objective of value chain analysis, therefore, is to examine the organization and behaviour of all participants in the value chain, diagnose the constraints and challenges they face, and identify public actions that may improve the value chain's performance, thereby contributing to national policy objectives.

Value chain analysis involves:

- Identifying the outline of the chain and the position of the various economic agents within it– those who contribute to the production, transformation and marketing of a specific product;
- Identifying the roles and functions of these agents, including those who perform multiple roles within the value chain;
- Grouping agents into categories that are homogeneous from an economic, technical and/or socio-economic analysis perspective;
- Showing interactions among agents, demonstrating how each participant engages with others within the chain;
- Quantifying the flows corresponding to the activities of the actors both in physical and monetary terms, to assess the scale and value of operations;
- Mapping key policies and institutions along the value chain that influence its functioning, including regulatory and support structures; and
- Establishing key drivers, trends, and issues that affect the value chain and its actors, providing insights into potential challenges and opportunities for improvement.

An agricultural value chain concept explained is an economic unit of analysis for a particular commodity or group of commodities, encompassing a meaningful grouping of economic activities that are linked vertically by market relationships. The emphasis is placed on the relationships between networks of input suppliers, producers, traders, processors and distributors (UNCTAD, 2000). This approach developed by Kaplinsky and Morris (2001) as well as the guidelines develop by UNIDO (2009) is illustrated below.

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 encompass all the activities of the supply chain. Since this study primarily focuses on the fresh fruit and vegetable supply to the domestic market, the supply chain aspects within the value chain mapping developed by Kaplinsky and Morris (2001), along with the guidelines established by the UNIDO (2009) will be extensively used to map and analyse the process.

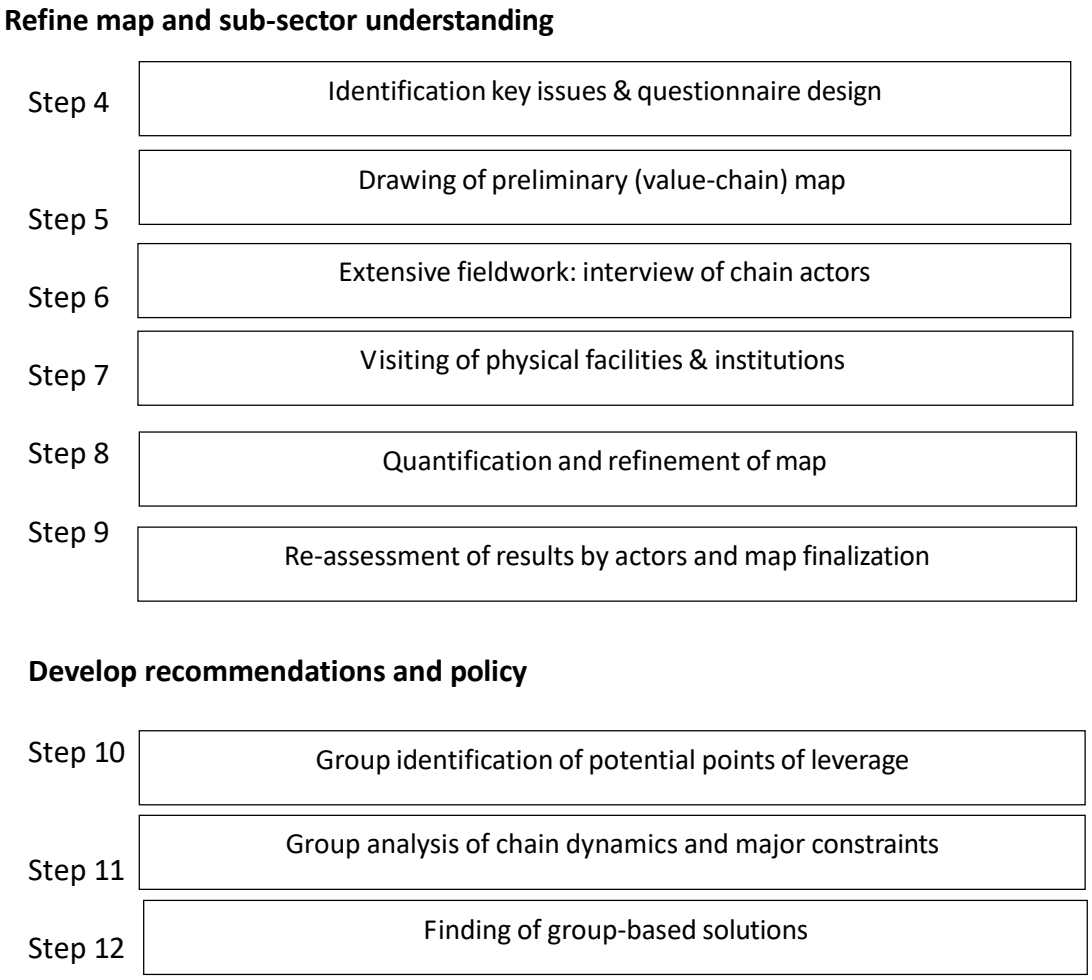


Figure 2.3: Approach Developed by Kaplinsky and Morris (2001) and the Guidelines Developed by the UNIDO (2009)

CHAPTER THREE

Methodology

Based on the per capita consumption data in HIES report for 2019 (Department of Census and statistics - 2019) two main vegetables and two main fruits was selected for the supply chain analysis and analysis of production alterations

Vegetables: Beans and Brinjal were selected to represent up country and low country vegetables
Fruits: Banana and Papaya were selected to represent the fruits

Methods of Data Collection
Both primary and secondary data were collected to achieve the research objectives. Focus Group Discussions (FGDs) served as the main tool for primary data collection. Additionally, Key Informant Interviews were conducted to gather further insights.

3.1 To Evaluate the Alterations in Production

3.1.1 Sampling Technique, Study Locations and the Sample Size

The study employed a stratified cluster sampling technique to draw the sample. All the commercial level small and medium scale farmers cultivating the specified horticultural crops were considered the study population for the assessment.

In the first stratum, the two main districts each crop (except for banana, for which three districts were selected. In the next stratum, 5 - 10 Agrarian Services Divisions (ASCs) that reported the highest number of farmers in each district was selected with each ASC division serving as a cluster.

Subsequently, seven to ten focused group discussions (FGDs) were conducted in selected villages in each ASC division, using pre-tested focus group guidelines to collect primary data on changes in cultivation due to economic crisis (Table 3.1). Each focused group comprised of 10 - 12 farmers. Additionally, quantitative data such as cultivated extent, production, marketable surplus and income were collected from individual farmers participating in the FGDs.

Additionally, two dominant input suppliers of seeds, fertilizers and agro-chemicals for each selected crops were also interviewed to gather information on the status of agriculture input sector.

A separate set of key informant interviews were conducted with the officials of the Horticultural Research and Development Institute (HORDI) under the Department of Agriculture, Agricultural Instructors (AIs) operating each ASC division, Agricultural Research and Development Assistants (ARDAs) operating in each ASC division and the private sector companies operating in each ASC division.

Table 3.1: Sample Distribution

Crop	District	ACS Division/Village	No. of FGDs
Beans	Badulla	Dawuldhena, Walahamulla, Boralanda, Thalubululanda, Karagahawela, and Etampitiya	6
	Nuwara Eliya	Okadagala, Rikillagaskada, Bulugahapitiya, Ampitigoda, Mandaramnuwara, Labuhenwala, Hanguranketha	7
Brinjal	Anuradhapura	Kagama, Kelemedawachchiya, Walaswewa, Siyambalangamuwa, Verunkulama, Katiyawa, Pahala Halmillewa, Siyambalagahagama, Galadivulwewa, and Jayagama	10
Banana	Monaragala	Mahagama, Nugegolayaya, Thelulla, Seenukkuwa (Kudagammana 1), Seenukkuwa (Kudagammana 2) and Kovulara villages	6
	Rathnapura	Moraketiya, Ketagalara, Gangeyaya, Hagala, and Thukama (9 Ela)	5
	Hambantota	Wediwewa, Beddewewa and 11Kanuwa	3
Papaya	Kurunegala	Ambanpola, Rambe, Nagollagama, Lunagamuwa, Maharachchimulla	5
	Anuradhapura	Thirappane, Nochiyagama, Ipalogama, Adiyagala, Thalawa, Yakalla, Kekirawa, Gambirigaswewa	8

3.1.2 Analytical Methods

1. Calculation of average land, yield, marketable surplus and income variations due to the economic crisis
2. Calculation of cost of cultivation for each crop and comparison of the values with pre-crisis period.

3.2 To Evaluate the Alterations in Supply Chain

Data and information on yield, cost of production and marketable surplus for the five horticultural crops (collected and calculated under Objective 2.1) were used as the primary data on supply. The analysis was confined to the main marketing channel for each vegetable and fruit.

Main collectors, wholesalers and retailers operating in each channel were interviewed through Key Informant Interviews (KIIs). The methodology of this study was based on the approach developed by Kaplinsky and Morris (2001) and the guidelines developed by UNIDO (2009) for Agricultural Value Chain Analyses (VCAs), as illustrated in figure 2.3.

The study applied the channel mapping methodology to analyze the value chain. This methodology involves tracing the flow of a product through an entire channel, from its conception to the end market. The smooth functioning of interactions within the vertical linkages of an agricultural value chain largely depends largely on the quality of products and services provided by horizontal linkages.

Therefore, this study mapped all horizontal linkages, such as input supplies, extension services, packing, and transportation services within selected value chains. The mapping methodology adopted in the VCA follows the steps outlined in Figure 2.3.

3.2.1 Analytical Methods

1. Margin Analysis for Considered Horticultural Produce

Margin analysis was conducted by using secondary data collected by HARTI from 19 farm-gate locations, 34 wholesale locations and 45 retail locations. Farm-gate prices in each producing area and the market prices reported at major wholesale and retail outlets in Colombo and its suburbs were considered for margin analysis. The percentage of the retail price acquired by farmers, collectors, and wholesalers was calculated as follows:

$$\text{Farmers' Margin} = \frac{\text{Farm-gate price}}{\text{Retail Price}} \times 100$$

$$\text{Whole seller's Margin} = \frac{\text{Wholesale price} - \text{Farm-gate price} \times 100}{\text{Retail Price}}$$

The impact of intermediaries on the vegetable marketing channel was assessed by analyzing the Marketing margin of the intermediaries. Market margin refers to the difference between the price paid by the ultimate consumer and the price received by the producer or farmer. It encompasses all costs associated with assembling, transporting, retailing and other marketing services, as well as the profit margins added to the farm products. (Khan *at el*. 2005).

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

The data used for the analysis came from HARTI's weekly farm-gate, wholesale and retail price data spanning from the 1st week of May 2018, to 4th week of August 2019 (before crisis = bc) and from 1st week of May 2021, to 4th week of August 2023 (after crisis = ac). The margins before the crisis (bc) were compared with the crisis (ac) to evaluate the effects of the economic crisis on the margins of farmers, collectors' wholesalers' and retailers' margins.

2. Calculation of Level of Price Variations in Different Retail Markets Before and After Crisis

The level of price stability was assessed using the coefficient of variation (CV) which measures the percentage change in the price relative to the mean price. Both weekly farm-gate prices (in major producing areas) and weekly retail price series in Colombo and the suburbs for the selected commodities from May 2018 to November 2019 (before the crisis) were compared with weekly farm-gate and retail prices from May 2022 to November 2023 (after crisis).

CV was calculated by using following formula.

$$CV = \frac{\text{Standard deviation of the prices}}{\text{Mean price of the particular horticultural commodity}} \times 100$$

Following the calculation of the CV values, ANOVA was applied to determine whether there were significant different in price variations for each commodity before and after crisis.

3. The Application of Analysis of Variance (ANOVA)

The objective of applying ANOVA is to identify whether there is a significant difference in price variations before and after the crisis for considered commodities.

Hypothesis:

i. H_o – There is no difference in farm-gate prices of the considered commodities due to the economic crisis.
   H_1 – There is a difference in farm-gate prices of the considered commodities due to the economic crisis.

ii. H_o – 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.

The data was sourced from HARTI database. Both weekly farm-gate (in major producing areas) and weekly retail price series in Colombo and suburbs for the considered commodities reported from May 2018 to August-2019 (before crisis) was compared with weekly farm-gate and retail prices from May 2022 to August 2023 (after crisis) situation was used for the analysis.

4. Evaluation of Level of Price Integration by Applying Engle and Granger Co-integration Test

The following empirical model was applied to evaluate the spatial price linkages (Goodwin and Schroeder, 1991).

$$P_t^1 = \beta_0 + P_t^2 \beta_1 + v_t \quad \text{- (1)}$$

P_t^1 and P_t^2 represent commodity prices of a homogenous good in two alternative regional markets at time t, β_0 and β_1 are parameters, and v_t is the error term

If two markets are perfectly spatially integrated, then $\beta_1 = 1$. On such occasions, price changes in one market are fully reflected in the other market. When $\beta_1 \neq 1$ ($\beta_1 < 1$ or $\beta_1 > 1$), then degree of integration is evaluated by investigating how far is the deviation of β_1 from unity

Stationarity of each series was tested using the ADF test and the KPSS test. The null hypothesis of ADF test suggests that the series has a unit root, and the alternative hypothesis is stated as the time series is stationary (Dickey and Fuller 1979)

$$P_t = \mu + \varphi P_{t-1} + \beta_1 \Delta P_{t-1} + \beta_2 \Delta P_t + \cdots + \beta_{k-1} \Delta P_{t-k+1} + \varepsilon_t \quad \text{- (2)}$$

Where P_t is price at time t at a location, ΔP_t represents change in the price and is equal to $(P_t - P_{t-1})$, μ, ϕ, β_1, β_2, β_{k-1} are parameters, k is the order of autoregressive model, and ε_t is the error term. Using the ADF test, we test the null hypothesis that $\mu = 0$ and $\phi = 1$. Under the null hypothesis, Equation (2) is a unit root autoregressive model with no drift, and the time series is non-stationary.

However, there can be instances where the ADF test cannot distinguish between a unit roots and presence of weakly stationarity. Therefore, failure to reject the null hypothesis of a unit root may not necessarily indicate existence of a unit root (Xu, 2020). To address this limitation, the KPSS test (Kwiatkowski et al., 1992), which has a null hypothesis of stationarity around a mean (or a linear trend), was applied to compliment the results of the ADF test.

Non-stationary time series variables may exhibit long-run equilibrium relationships, meaning they tend to move over time. This condition is referred to as cointegration (Engle and Granger 1987). The Engle and Granger (1987) cointegration test offers a framework for estimating and testing the presence of long run equilibrium relationships between non-stationary integrated variables.

H_0: There is no co-integration between farm gate prices reported for commodity X and retail prices
H_1: There is co-integration between farm gate prices reported for commodity X and retail prices
Engle-Granger methodology follows two-step estimation process. The first step

involves generating the residuals from the regression of the non-stationary time series. In the second step, the residuals are used to estimate a regression of first differenced residuals on the lagged residuals. If the residuals are stationary, it indicates that the series are co – integrated.

3.3 Data Analysis

For the analysis, two main approaches followed were as follows:

i. Descriptive analysis: Reviewing existing literature and analyzing, evaluating and describing the information collected through focus groups and KIIs;
ii. Quantitative analysis: Statistical analysis of secondary data (price - series) and data collected through primary sources.

CHAPTER FOUR

Effects of Economic Crisis on Beans Cultivation and Marketing

4.1 Beans Cultivation - General Description

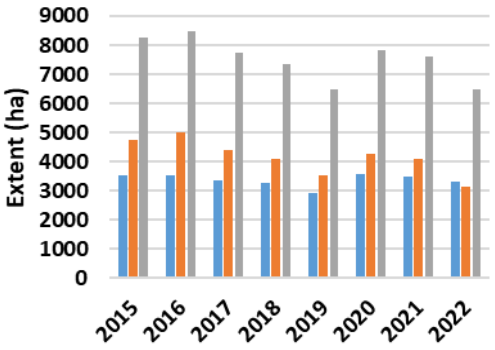
Green bean belongs to the family *Fabaceae* and Genus *Phaseolus*. It is widely cultivated in Badulla, Nuwara Eliya, Matale and Kandy Districts. Areas with high temperature (>32^{o}C) and continuous heavy rainfall are unsuitable for green bean cultivation. The temperature should be below 30^{o}C during flowering, as high temperatures adversely affect flowering and pod setting. While beans are mainly cultivated in the Up-Country Intermediate Zone, they can also be cultivated in the Up-Country Wet Zone. Bean varieties are classified into two types based on their growth habits as vine types or "pole bean" and bush types or "bush bean". Vine types are the most popular among both farmers and consumers as well. Pole bean varieties grow continuously and require support (stakes) to grow upright, producing larger pods that are lighter in colour. Bush beans typically yield less and have dark green pods. They are often cultivated as an intermediate crop between two main cropping seasons (DOA, 2025).

The Up-Country Intermediate Zone and Up-Country Wet Zone (Badulla, Nuwara Eliya, Matale and Kandy Districts) are the most suitable areas for cultivation, considering the climate and soil suitability. Red Yellow Podzolic soil with good drainage and loam or sandy loam texture is ideal for cultivation. Soils with a high clay content tend to be poorly drained, leading to root rot and blossom drop. The optimum soil pH for better growth is between 5.5-6.5. The seed requirement is 50kg/ha for vine -type beans and 75kg/ha for bush-type beans. Several insect pests can damage plants and pods during the growth period, so seed treatments or the spray application of recommended chemicals is used to control these pests. Soils should be ploughed to create fine tilth and beds should be prepared to accommodate three rows. Planting holes should be marked at the recommended spacing. No nursery is needed, as direct seeding is commonly practiced (DOA, 2025).

4.2 Trend in Cultivated Extent and Production of Beans

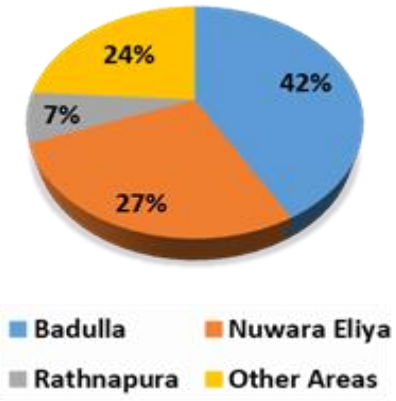
4.2.1 Cultivated Extent

According to the last eight years of data, more than 50 percent of the cultivated extent of beans was recorded in *Maha* season. As illustrated in Figure 4.1, during the last eight year's period, beans production in the country has dropped in 2019 as well in 2022.



Source: Department of Census and Statistics

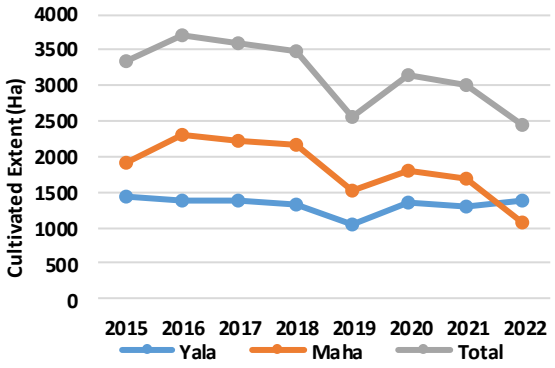
Figure 4.1: Extent of Green Beans Cultivation in Sri Lanka (2015-2022)



Source: Department of Census and Statistics

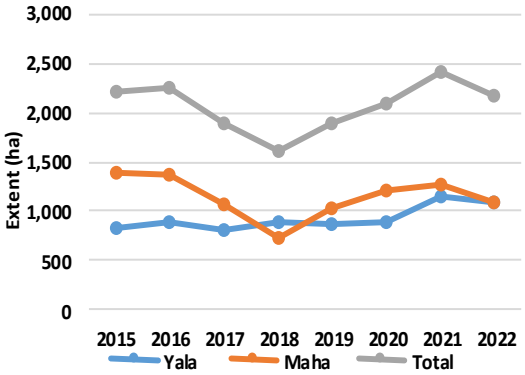
Figure 4.2: Average Extent of Green Beans Cultivation in Major Producing Areas (2015-2022)

Considering the total average cultivated extent recorded during the last eight years (2015 -2022), 42 percent of the extent under beans cultivation was recorded in the Badulla district while 27 percent in the Nuwara Eliya district (Figure 2). Figure 3 and 4 depicts the cultivated extent of beans in Nuwara Eliya and Badulla districts from 2015 to 2022. The government decision on the ban of the import of chemical fertilizers and agro chemicals to the country badly affected for the green bean cultivation resulting drop in extent cultivation as well as the production.



Source: Department of Census and Statistics

Figure 4.3: Cultivated Extent of Beans in Nuwara Eliya District (2015 -2022)



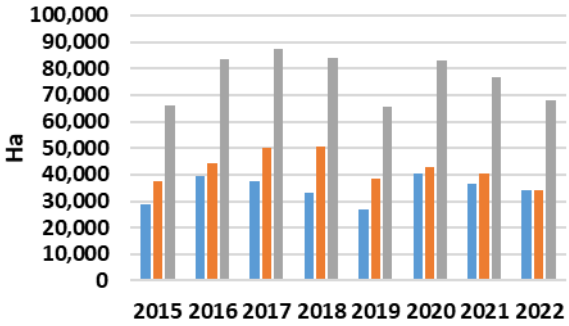
Source: Department of Census and Statistics

Figure 4.4: Cultivated Extent of Beans in Badulla District (2015 - 2022)

4.2.2 Production

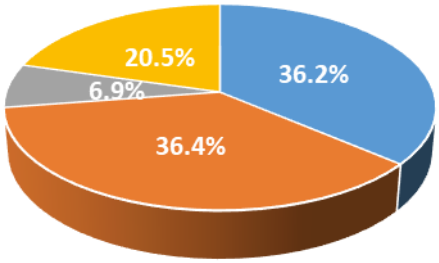
Based on the average production recorded over the last eight years (2015-2022), the Nuwara Eliya district accounted for 36.4 percent of green bean production, while the Badulla district contributed 36.2 percent. Consequently, these two districts, Badulla and Nuwara Eliya, collectively contributed 72 percent of the total green bean

production. The primary season for green bean production is identified as *Maha*, contributing more than 50 percent of the total production, specifically accounting for 58 percent.



Source: Department of Census and Statistics

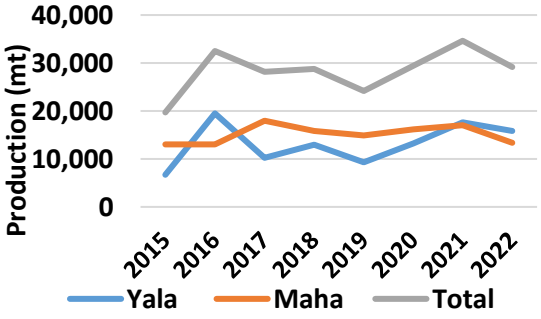
Figure 4.5: Production of Green Beans Cultivation in Sri Lanka (2015-2022)



Source: Department of Census and Statistics

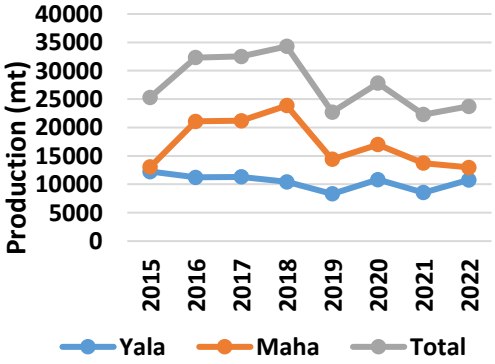
Figure 4.6: Average Production of Green Beans Cultivation in Major Producing Areas (2015-2022)

The production of green beans in Nuwara Eliya and Badulla districts during the past eight years are in figure 4.7 and 4.8. The production of green beans has dropped in 2022 due to mainly the ban of import of chemical fertilizer and agro chemicals in the country.



Source: Department of Census and Statistics

Figure 4.7: Production of Green Beans in Nuwara Eliya District (2015 -2022)

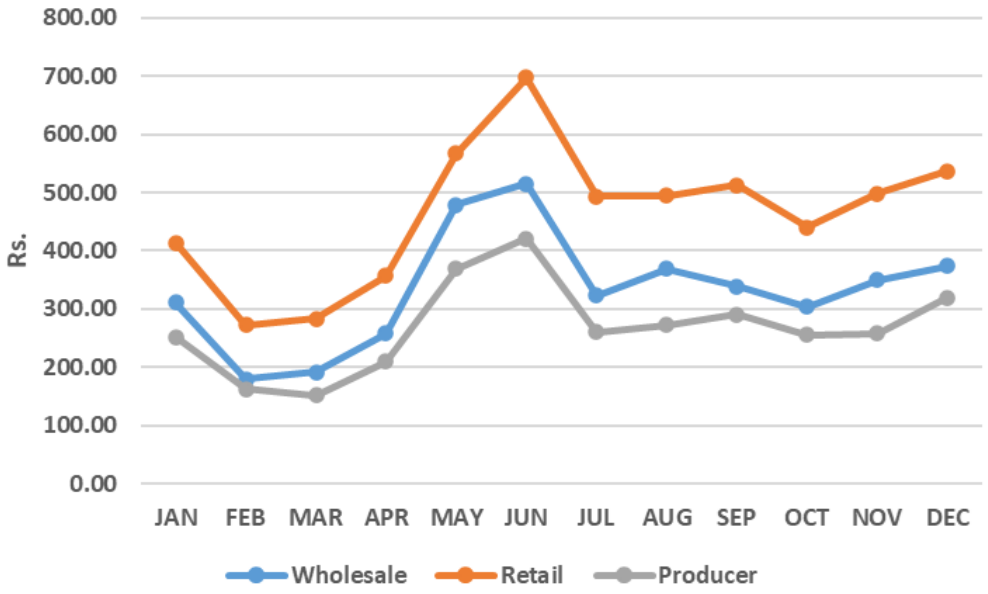


Source: Department of Census and Statistics

Figure 4.8: Production of Green Beans in Badulla District (2015 -2022)

4.3 Price Behaviour

4.3.1 Producer Price, Whole Sale Price and Retail Price of Green Beans



Source: HARTI Price Database, 2022

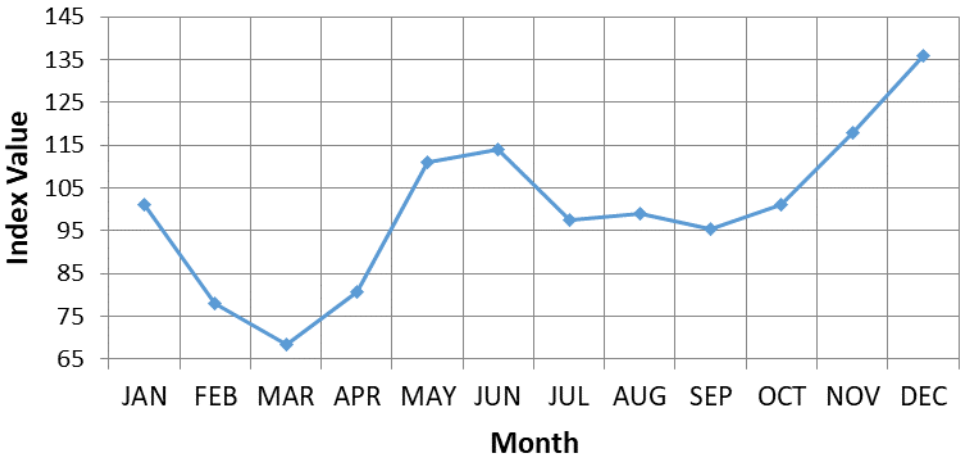
Figure 4.9: Monthly Average Producer, Wholesale & Retail Prices of Beans-2022

Figure 4.9 illustrates the price behaviour of wholesale, retail, and farm gate prices for beans in 2022. It appears that there is a distinct seasonality pattern in the bean prices, with May and June showing high prices, and February, March, and December indicating lower prices. This pattern is attributed to the harvesting seasons in April to May and September to October, which lead to increased market supply and subsequently lower prices.

The overall trend throughout 2022 suggests that bean prices remained at higher levels consistently. This is explained by shortages in fertilizer, agrochemicals, and fuel in the country, leading to a reduced supply of beans. The scarcity of these essential resources likely affected the farming process, resulting in lower yields and higher production costs, ultimately impacting the market prices.

4.3.2 Seasonal Price Index

The seasonal price index disclosed that, prices of vegetables trend upward during the months of May, June and December due to off season. The price fluctuations over the years and seasonal variation and variability of prices observed were mainly due to seasonality in production, oversupply of production.



Source: Compiled based on HARTI Retail Price Data (2018-2022)

Figure 4.10: Seasonal Price Index of Green Beans (2018 - 2022 = 100)

The annual price is set at 100, and values exceeding this level indicate insufficient supply to meet demand, while values below 100 signify an excess supply relative to market demand. There are two distinct periods when index values dip below 100: February to April and September, coinciding with the harvesting seasons of beans. Conversely, during the periods of October to January and May to June, bean prices soar, and the supply falls short of meeting market demand.

The annual price is set at 100, with values exceeding this level indicating insufficient supply to meet demand, while values below 100 signify an excess supply relative to market demand. The index values dip below 100 during two distinct periods: February to April and September, coinciding with the harvesting seasons of beans. On the other hand, during the periods of October to January and May to June, bean prices rise sharply as the supply falls short of meeting market demand.

4.4 Evaluation of the Effects of Economic Crisis

Focused Group Discussions (FGDs) were conducted in various villages across the Nuwara Eliya and Badulla districts, including Rikillagaskada, Bulugahapitiya, Ampitigoda, Mandaramnuwara, Labuhenwala, Hanguranketha in Nuwara Eliya, and Dawuldhena, Walahamulla, Boralanda, Thalubululanda, Karagahawela, and Etampitiya in Badulla. Each FGD included 10-15 farmers. Most of these farmers cultivate beans on land ranging from 0.25 to 2 acres in both districts.

In the Nuwara Eliya district, approximately 80% of the participants were male, with ages ranging from 30 to 70 years. In the Badulla district, 85% of the participants were male, with ages ranging from 25 to 70 years. Most of the farmers come from a family background in farming, relying on agriculture as their primary source of income. Their farming experience ranges from 10 to 50 years. The majority (80%) of the participants cultivate their own lands in both districts.

4.4.1 Cultivated Extent and Production of Green Beans

Beans cultivation experienced a 30% decrease in acreage in the Nuwara Eliya district and a 35% decrease in the Badulla district compared to the pre-crisis situation. However, no reports of farmers have completely abandoned farming in either district. This decline can be attributed to several factors, including a threefold increase in production costs, poor seed quality, scarcity and low quality of fertilizers and agro-chemicals, reduced sales volume, and consequently, lower profits. The poor quality of agro-chemicals led to a high prevalence of the yellow mosaic virus in the beans crop. Despite these challenges, a few unauthorized agro-chemicals were still available in both Nuwara Eliya and Badulla districts.

4.4.2 The Input – Type, Price and the Cost of Production Seed - Suppliers, Rate and Price

The majority of farmers in both districts use local seed varieties for their cultivation, as these are of comparatively good quality. The primary seed varieties cultivated in the Nuwara Eliya and Badulla districts include Capri, Malaysian, Kakulu, Lanka butter, Weera Bonchi, and Pokuru setti. Among these, Capri (in white, black, yellow, and brown varieties) accounts for 90% and Kekulu makes up 10% of the most common and popular varieties among farmers in those areas.

While the economic crisis has not significantly impacted the selection of seed varieties, seed prices have shown a twofold increase due to the economic crisis. There is a variation in the seed requirement for beans cultivation based on the variety: for vine type beans, 50kg of seed beans are required to cultivate one hectare, whereas bush-type beans require 75kg of seed beans per hectare.

4.4.3 Seed Producers

There are three major categories primarily involved in the seed supply system of beans.

i. Seed Farmers
ii. Government Sector (Seed Bean Unit-Department of Agriculture)
iii. Seed Traders/Importers

i. Seed Farmers

Seed bean farmers are predominantly situated in Elamulla, Labuhenwala, Dunukebedda, and Idampitiya villages in Mathurata, as well as the Mandaramnuwara Agrarian Service Centers in the Nuwara Eliya district. These regions are deemed highly suitable for seed bean cultivation due to their climatic conditions and area appropriateness. When selecting seed varieties, these farmers prioritize factors such as high yield, strong demand, seed germination percentage, disease resistance, and rapid drying of bean pods.

White Capri seed exhibited a comparatively higher demand, while the brown Capri seed variety reported higher yields. To produce 1 kg of seed beans, 10-12kg of fresh bean pods must be dried. Seed-producing farmers estimate the cost of seed production to be approximately RS. 1,200 - 1,500/kg. When selling seeds to a seed bean unit, they receive around RS. 1,750 - 2,000/kg, whereas selling to private traders in the field yields approximately RS. 2,500/kg. Consequently, many farmers prefer selling to private traders due to the potentially higher prices and the absence of a cumbersome quality checking process required by the Department of Agriculture (DOA). Seed bean farmers in the Nuwara Eliya district have identified several issues and provided suggestions:

a) Lack of a stable market price for seeds.
b) Delays in receiving payments from the Department of Agriculture (DOA), with payment periods extending beyond one month.
c) Insufficient seed storage facilities in ASCs, despite the establishment of two large cool storages in Mandaramnuwara and Munwatta areas under the Divisional Secretariat Office, which are not functioning effectively.
d) Scarcity of seed-preserving chemicals in the market, along with high prices and low quality

Farmers in this region assert their ability and environmental suitability to meet the country's entire seed bean requirements. They oppose the import of Malaysian bean seeds and propose DOA intervention to introduce new and improved seeds, as well as an efficient buying and payment system.

ii. Government Sector (Seed Bean Unit-Department of Agriculture).

The Seed Bean Unit was established in 1974 within the government sector to ensure an ample supply of quality seeds and planting materials. This objective is pursued through the collabourative efforts of both public and private sectors in the development of the local seed industry. The registration process commences with the selection of seed farmers and the verification of their identity. Seed farmers are registered under the Seed Act through the Seed Bean Unit and the Seed Certification Unit. However, registered farmers must sign a contract for each season if they are involved in seed production, and the number of farmers under the Seed Bean Unit fluctuates seasonally. The farmer count is determined by the required seed quantity specified by the seed production programme of the Seed & Planting Material Development Center, and the available seed stock. Typically, 150 farmers are needed for the *maha* season, and 10-15 farmers for the *yala* season to meet the required seed amount.

Seed bean farmers registered under the Seed Bean Unit must meet several requirements, including:

a) An isolation gap that varies based on the type of vegetable and class (e.g.,10 m for beans).
b) A minimum land area of 0.25 acres.

c) Registration, contract signing, and participation in awareness programmes during seed distribution to address potential issues.
d) Compliance with department instructions at specified occasions in the field.

Seeds are purchased exclusively from contracted farmers. The purchasing and selling prices are set by the Director General and the Price Amendment Board, based on the Cost of Production (COP), economic conditions, and the prevailing national situation. Payments are processed through written vouchers, typically taking around one month, subject to government cash allocation. Quality testing is conducted before purchasing, with officials visiting the farmer's location after harvesting and drying. Samples are collected and submitted for testing, and seed testing reports, for beans take approximately two weeks.

Bean seeds are typically sold through department stalls, following the standard price list maintained by the department and administered by the Gannoruwa Vegetable Seed Center. The Seed Bean Unit purchases and sells various seed varieties, including Lanka butter, Kekulu, Bandarawela kola, Kappitipola nil, and Hordi pokuru. Purchased seeds are temporarily stored in cool rooms at the Rikillagaskada center before being sent to the Peradeniya Vegetable Seed Center.

Officials in the Seed Bean Unit highlight the following problems:

i. Inadequate facilities for seed dehydration/drying
ii. Inactive seed storage/protection centers
iii. Issues with agricultural insurance
iv. Outdated warehouse facilities
v. Selling substandard seeds
vi. Non-compliance by farmers with contract terms.

iii. Seed Traders

Most private seed traders in the area primarily function as seed collectors, visiting villages to purchase seeds from local seed-producing farmers. According to these traders, the average farm gate price for seed beans in the 2021/22 *Maha* season was Rs. 2,200/kg. In the current 2022/23 *Maha* season, prices range between Rs. 2,300 and RS. 2,500/kg, varying by seed variety. White Capri seeds command higher prices than Black Capri, as per the traders' observations.

Typically, these traders procure approximately 20,000 to 25,000 kgs of bean seeds per season from local farmers. Moreover, they support their regular customer farmers by providing chemicals and fertilizers on credit. Post-collection from village-level sources, seed traders sort and grade the seeds, often rejecting 1-2 kg out of every 100 kg due to poor quality. The selected seeds undergo packing and labeling, incurring a standard cost of RS. 100/kg. Prior to packing, a chemical blend of *Eviset*, *Silo*, or *Acipate* is applied to enhance the seeds' keeping quality. For every 100 kg of seeds, a 10-gram application of this chemical is sufficient. Despite these expenses, seed traders typically retain RS. 200 – 300/kg as profit from seed sales.

In Hanguranketha, most traders supply seeds to input traders in Welimada, Nuwara Eliya, and Bandarawela for further distribution.

4.4.4 Input Suppliers of Fertilizer, Agro-chemicals and Related Issues

Before the economic crisis, the majority of farmer's practiced recommended rates for applying Urea, TSP, and MOP in their bean cultivation. They typically met around 20% to 25% of their inorganic fertilizer needs using surplus subsidized fertilizer meant for paddy cultivation. However, the application of organic matter was well below the recommended rate. Following the economic crisis and the subsequent ban on inorganic fertilizer importation, the use of organic matter surged by about 25%. Poultry manure, cow dung, and used crop residues became popular choices as organic fertilizers during planting. While some farmers produced their own organic fertilizer through composting, most sourced it from private traders.

The most favoured inorganic fertilizer among bean farmers was the mixed fertilizer, which was priced at RS. 9,000/50kg, up from RS. 5,000/50kg before the economic crisis. Approximately 40% of farmers chose unmixed fertilizer, purchasing TSP at RS. 9,000 for a 50kg bag. In the post-crisis period, farmers faced fluctuating fertilizer prices depending on their location with no fixed unit price. TSP was utilized for less than 50% of the required amount in the basal fertilizer mix due to its unavailability. Farmers expressed dissatisfaction with the quality and purity of the fertilizers available at local shops.

Yellowing leaf diseases are a common in beans, causing farmers to frequently purchase agro-chemicals based on recommendations from shop owners. However, it is strongly advised to consult qualified agricultural specialists or extension agents for accurate guidance on the proper use of agro-chemicals. Relying solely on the advice of shop owners, who may lack the necessary expertise, is not recommended.

Moreover, the cost of chemicals used to treat these diseases has doubled compared to the post-crisis period. Farmers have reported the presence of cheap, smuggled Indian brands in the market, but these often have with reduced efficacy. In the post-crisis era, farmers were compelled to make cash payments, and no discounts were offered for agro-chemicals, further adding to their financial burden. Additionally, due to the poor quality of fertilizers and agro-chemicals, many farmers have opted to reduce the extent of their cultivated lands.

Input – Labour

Both hired and family labour were used for bean cultivation. While hired labour remained sufficiently available in both districts post-crisis, bean cultivation still relied heavily on family labour. Labour is primarily needed for establishing supporting sticks for bean vanes, land preparation, and harvesting.

Following the crisis, labour charges doubled in both districts. The unit price for male labour increased by approximately Rs. 1,000 per day, while female labour costs were reported at RS. 400 per day, a significant rise from the pre-crisis period. Currently, female labour costs range from RS.800 to Rs. 1,000 per day, while male labour costs range from RS. 1,500 to 2,500 per day which includes two meals and tea.

Input – Machinery

Farmers primarily use small machines for land preparation, as large machinery cannot be used due to elevation. In addition, water pumps and agro-chemical sprayers are commonly used. Very few farmers own their land preparation machines; but most rent them. The cost of renting a machine for land preparation ranges from RS. 10,000 to RS. 15,000/ac. While farmers can find preferred types of machinery in their areas, availability is limited.

When farmers purchase or leased the machinery, they typically pay cash immediately or request a short relief period (3-4 days) based on their trustworthiness. Bean farmers face key issues in the machinery sector, including high repair costs, expensive parts, high fuel costs, and limited availability of parts. Farmers primarily use cash for machinery purchases; otherwise, they resort to pawning to obtain funds. During the early stages of the economic crisis, farmers experienced difficulties due to inadequate fuel quotas allocated to the agricultural sector.

4.5 Cost of Production and Gross Income

Crop Calendar

Farmers predominantly cultivate green beans as their main crop, supplemented by leeks, tomatoes, radishes, and cabbage. Key factors influencing crop selection include weather conditions, market prices and demand, seed availability, seed germination percentage, farmers' experience, the potential for seed production in times of bean pod market price drops, and the economic status of the farmers. In the past, farmers would base their crop selection on market prices from the previous season to predict prices for the upcoming season. However, the current scenario involves rapid price fluctuations within one to two days, leading to significant price differences. As a result, farmers find it challenging to make decisions based on historical crop prices.

Green beans are primarily cultivated during the *Maha* season, as per crop calendar provided in the following table. While the average yield varies depending on the seed type, typical yields for beans range from Rs. 15,000 to Rs.25,000 kg/hectare. Harvesting frequency is limited to 3-5 times for Malaysian-type beans and 10-15 times for other local-type beans.

Table 4.1: Planting and Harvesting Period of Beans

Season	Planting period	Harvesting period
Yala	December - February	April - May
Maha	June - July	September - October

Source: HARTI Survey Data, 2023

Cost of Production of Green Beans

The cost of cultivating beans in Badulla and Nuwara Eliya districts for the 2022/2023 *Maha* season is presented in Table 4.2 and Table 4.3. According to the data, the total cost of cultivation was Rs. 791,040 per acre in Nuwara Eliya district and RS. 884,500 per acre in Badulla district. This translates to an approximate cost of RS. 65.92/kg to produce fresh beans in Nuwara Eliya district while in Badulla district, the cost was recorded at Rs.73.70/kg. This cost is double the amount reported in the 2019/*Yala* season.

Table 4.2: Cost of Production of Green Beans – Traditional Cultivation in Nuwara Eliya District

Activity / Input	Units	Unit Price (RS.)	Cost
Land clearing	Male - 12	2,000	24,000
	Female - 4	1,500	6,000
Ploughing	12 Hours	2,000	24,000
Beds/Pits preparation	Male - 12	2,000	24,000
Weeding/ Thinning out/ Fertilizer	Female - 20	1,500	30,000
application/ Beds re-preparation	Male - 12	2,000	24,000
Irrigation	Male - 20	2,000	40,000
Fuel/ Electricity	16 L	415	6,640
Total			178,640
	Inputs		
Seeds (Hybrid/ Local)	16 kg	3,000	48,000
Slaked lime	120 kg	50	6,000
Inorganic fertilizer	600 kg	240	144,000
Organic fertilizer	1,600 kg	25	40,000
Liquid fertilizer	8 L	1,800	14,400
Agro-chemicals	Fungicide	800	60,000
		Weedicide	
	Pesticide	800	60,000
Supporting Sticks	16,000 Sticks	12	192,000
Other (Tea, Lunch)			48,000
Total			612,400
Total cost			791,040
Harvest kg/ac			12,000
Cost of production for 1 kg			65.92

Source: HARTI Survey Data, 2023

Table 4.3: Cost of Production of Green Beans – Traditional Cultivation in Badulla District

Activity / Input	Units	Unit Price (RS.)	Cost
Land clearing	Male - 12	2,000	24,000
	Female - 2	1,500	3,000
Ploughing	12 Hours	2,000	24,000
Beds/pits preparation	Male - 12	2,000	24,000
Weeding/ Thinning out/ Fertilizer	Female - 20	1,500	30,000
Application/ Beds re-preparation	Male - 12	2,000	24,000
Irrigation	Male - 20	2,000	40,000
Fuel/ Electricity	16 L	600	9,600
Total			178,600
	Inputs		
Seeds (Hybrid/ Local)	17 kg	2,700	45,900
Inorganic fertilizer	900 kg	240	216,000
Organic fertilizer	2,500 kg	80.00	200,000
Agro-chemicals	Fungicide	14,000	14,000
	Weedicide		
	Pesticide	800	60,000
Supporting Sticks	10,000 Sticks	10	100,000
Other (Tea, Lunch)			70,000
Total			705,900
Total cost			884,500
Harvest kg/ac			12,000
Cost of production for 1 kg			73.70

Source: HARTI Survey Data, 2023

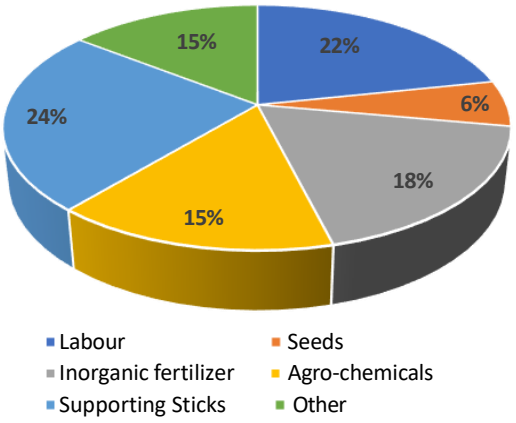
In the post - crisis scenario, the overall amount of fertilizer applied and the frequency were 25% lower than the recommended levels. Additionally, the scarcity of high-quality agro-chemicals, seeds and inorganic fertilizers has restricted farmers' harvests. The cost of production of GAP cultivation in Nuwara Eliya district is shown in Table 4.4. The total cost of cultivation under GAP was Rs. 356,720/ac, which is lower than the Rs. 434,320/ac for traditional cultivation cost. Producing one kilogram of green beans under GAP cultivation costs around Rs.30/kg, which is less than 50% of the cost of production compared to traditional cultivation.

Compared to the average farm gate price of Rs.203.69/kg reported in 2019, the post crisis average farm gate price has risen approximately fourfold, reaching Rs. 705.19/kg.

Table 4.4: Cost of Production of Green Beans – GAP Cultivation (Nuwara Eliya District)

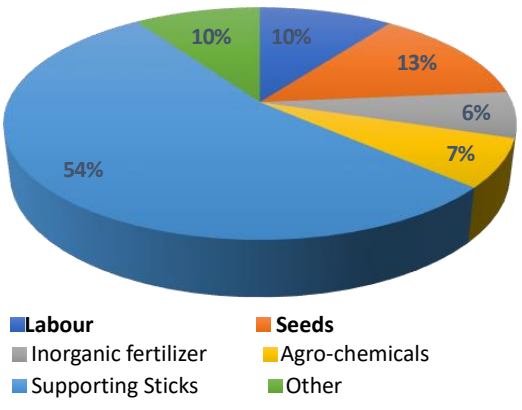
Activity / Input	Units	Unit Price (RS.)	Cost
Labour			
Land preparation, Seed planting	Male - 8	2,000	16,000
	Female - 4	1,500	6,000
Fertilizer/liquid fertilizer Application, Irrigation	Female - 4	1,500	6,000
	Male - 4	2,000	8,000
Total			36,000
Inputs			
Seeds (Hybrid/ Local)	16 kg	3,000	48,000
Inorganic fertilizer (Urea – 12 kg, MOP – 12 kg, Albert solution – 8 kg)	32 kg		22,720
Organic fertilizer			8,000
Liquid fertilizer			16,000
Agro-chemicals	Fungicide Weedicide Pesticide		24,000
Supporting Sticks	16,000 Sticks	12	192,000
Other (Tea, Lunch)			10,000
Total			320,720
Total cost			356,720
Harvest kg/ac			12,000
Cost of production for 1 kg			29.726

Source: HARTI Survey Data, 2023



Source: HARTI Survey Data, 2023

Figure 4.11: Cost Distribution of Beans Production in Traditional Farming



Source: HARTI Survey Data, 2023

Figure 4.12: Cost Distribution of Beans Production in GAP Farming

Figure 11 illustrates the major components of the total cost of cultivation under traditional cultivation. The largest cost component is the cost of supporting sticks, which accounts for 24% of the total cost. Labour costs follow closely at 22%, while inorganic fertilizers make up 18% of the total cost. Agro-chemicals account for 15% of the cost.

Figure 12 illustrates the major components of the total cost of cultivation under GAP cultivation. Under the GAP cultivation method, the cost of the supporting stick was the highest cost component and it was recorded at 54% of the total cultivation cost. Similar to traditional cultivation, the highest cost component in GAP cultivation is the cost of supporting sticks, which accounts for 54% of the total cost. The costs for agro-chemicals and inorganic fertilizers are much lower in GAP cultivation compared to traditional cultivation.

4.5.1 Insurance, Loans, and Supportive Services

During the early stages of the post-crisis situation, most surveyed vegetable farmers in both the Nuwara Eliya and Badulla districts accessed loans through various channels, including Govi Jana Bank, farming associations, and RDB. Their loan sources included agricultural loans ranging from RS. 100,000 to Rs. 150,000, Samurdhi loans ranging from RS. 50,000to RS. 500,000, and pawning, along with obtaining inputs (such as seeds) from middlemen were also common sources of financial support. It is important to note that the provision of inputs by sellers is not considered a loan; but rather a support mechanism for farmers struggling to acquire inputs for the next season.

Pawning of jewelry emerged as a popular practice among farmers to meet immediate cash needs during the planting season. However, the challenges faced by farmers in relation to loans included rising interest rates (from 8% to 12% in Govijana banks and up to 21% in other banks), long waiting periods, cumbersome documentation procedures, and the demand for guarantees. Additionally, banks showed reluctance in granting loans due to uncertainties surrounding income, primarily caused by the lack of fertilizers and agro-chemicals. Although issues related to rising interest rates for agricultural loans gradually decreased by the end of 2023, as the policy interest rates of CBSL significantly declined.

Amid the economic crisis in June 2022, the "Sarusara" loan scheme was introduced through private banks in collaboration with the Central Bank of Sri Lanka. This initiative aimed to improve the socio-economic conditions of micro and small-scale growers of seasonal crops. Notably, it became the most favorable loan scheme, offering a low-interest rate of 4% during a time of steeply rising interest rates. The maximum loan amount is set at 75% of the total cost of cultivation, with a repayment period of up to 270 days.

However, despite the potential benefits, the majority of farmers in the region were either unaware of or did not approach private banks to avail themselves of loans

through this scheme, with only a few long-term customers participating. In terms of insurance, the Agriculture Insurance Board does not have a specific scheme for upland vegetables. In crop damage occurs, farmers must maintain the field as is until claim officer's visit, which can take 2-3 months. Despite the ongoing economic crisis, these issues persist.

Farmers in this area generally lack insurance, as the previously available crop insurance system is no longer functioning efficiently, leading to delays in compensation. If crop damage occurs, farmers are required to submit a claim within 7 days to government officers (ASCs). However, due to the extended time taken for these officers to reach the fields, claims often become invalid after 2-3 months. This prolonged process significantly hampers farmers' ability to cultivate their crops within a six-month period.

4.5.2 Extension Services

Regrettably, the current extension service provided by Agriculture Instructors (AIs) is hampered by staffing limitations. The broad coverage area assigned to each AI necessitates prioritizing certain crops for extension efforts. Consequently, only a specific subset of farmer's benefits from the service, due to the AIs stretched capacity.

In such scenarios, farmers often turn to their more experienced and successful neighbours for knowledge and guidance. This reliance on peer expertise highlights a significant gap in the accessibility of extension services. Additionally, there are instances where Agricultural Instructors lack adequate and accurate information, further hindering the effectiveness of the extension service. Farmers frequently express dissatisfaction with the timeliness and quality of the extension service, claiming that they do not receive the necessary support at crucial times.

In light of these challenges, farmers earnestly hope for improved extension services delivered by Agricultural Instructors in a timely and effective manner. Their key aspiration is to gain insights into selecting high-quality inputs and acquiring practical knowledge for their proper utilization. Enhancing the outreach and reliability of extension services is crucial to addressing these concerns and ensuring that a broader spectrum of farmers can benefit from the expertise provided by Agricultural Instructors.

4.6 Market Information, Transporting and Marketing

Market Information

The information gathering process from Dambulla DEC involves direct phone calls, engaging with farmers, and contacting sellers/traders. HARTI-Mobitel 6666 is also utilized to augment data collection. This approach has remained consistent both before and after the crisis, indicating a consistent methodology.

Regarding market information, farmers seek details on market purchasing prices from collectors, DEC, and a WhatsApp group managed by Agriculture Instructors in their respective areas. The decision on when to harvest beans (pods or seeds) is often influenced by these market prices.

However, many farmers express limited interest in market information, because the farm gate price can vary significantly based on supply and quality. Some farmers contact traders at the DEC using phone numbers found on payment slips. If a trader recognizes the quality of a farmer's goods, they may consistently request supplies from that particular individual. Price information is commonly obtained through interactions with traders or fellow farmers.

While young farmers are aware of HARTI price information, they often do not utilize it in their decision-making processes. Farmers commonly emphasize that checking retail or wholesale prices is futile, as they typically have to sell their products at the best price offered by the limited options of traders.

An urgent need is identified for time series analysis of selling prices at DEC. The significant fluctuations in selling prices throughout the year pose a serious challenge for farmers. To address this, farmers should be informed and advised on the strategic timing of planting and harvesting, leveraging the accumulated price data from DEC. This proactive approach can empower farmers to make more informed decisions and navigate the volatile market conditions effectively.

Transporting Harvest to the DECs and Financial Settlements

In the Nuwara Eliya district, the predominant practice among farmers is selling their harvest to the village collector. There are lorry owners who only acts as transporter not as a collector or intermediary. Almost all the farmers had repeated engagement with a particular transporter and commission agent seller at DECs. When they opt for the Dambulla DEC, they typically use their own vehicles. A significant volume of bean harvest from Nuwara Eliya is transported to Dambulla DEC and Katugastota market. Additionally, a notable portion goes to commission agents in the Peliyagoda wholesale market. Some farmers also engage with *pola* vendors and the Rikillaskada market for selling their produce.

In the Badulla district, 50% of the bean harvest is directed to the Bandarawela market and Keppetipola DEC. Farmers usually start early in the morning, utilizing their own vehicles to sell their products to selected commission agents. Others may employ a neighboring farmer's vehicle for transportation to the DEC.

A key observation is the establishment of long-term relationships between farmers and specific transporters and commission agents at DECs. These relationships are built on trust, with transporters returning money along with the commission agents' bills on the same day of sale. Rejected harvests are also returned by the transporter, emphasizing the importance of reliability in this process.

Post-economic crisis, transport costs have surged threefold, reaching RS.300/30-40 per net bag km, compared to the previous RS.100/30-40 km. Each bag weighs 50 kg, and the cost per net bag has risen to RS.80 from RS.40. Notably, plastic trays are avoided due to space constraints and higher costs.

The commission structure for traders remains consistent, with percentages set at 5% for 100-150 kg, 10% for up to 300 kg, and 15% for quantities exceeding 300 kg. Despite economic challenges, these commission rates have remained unchanged.

In Dambulla DEC, farmers possess bargaining power due to the presence of numerous buyers. High-quality harvests enable farmers to negotiate prices and assess the willingness of commission agents to buy at higher rates. Packaging is typically done using net bags.

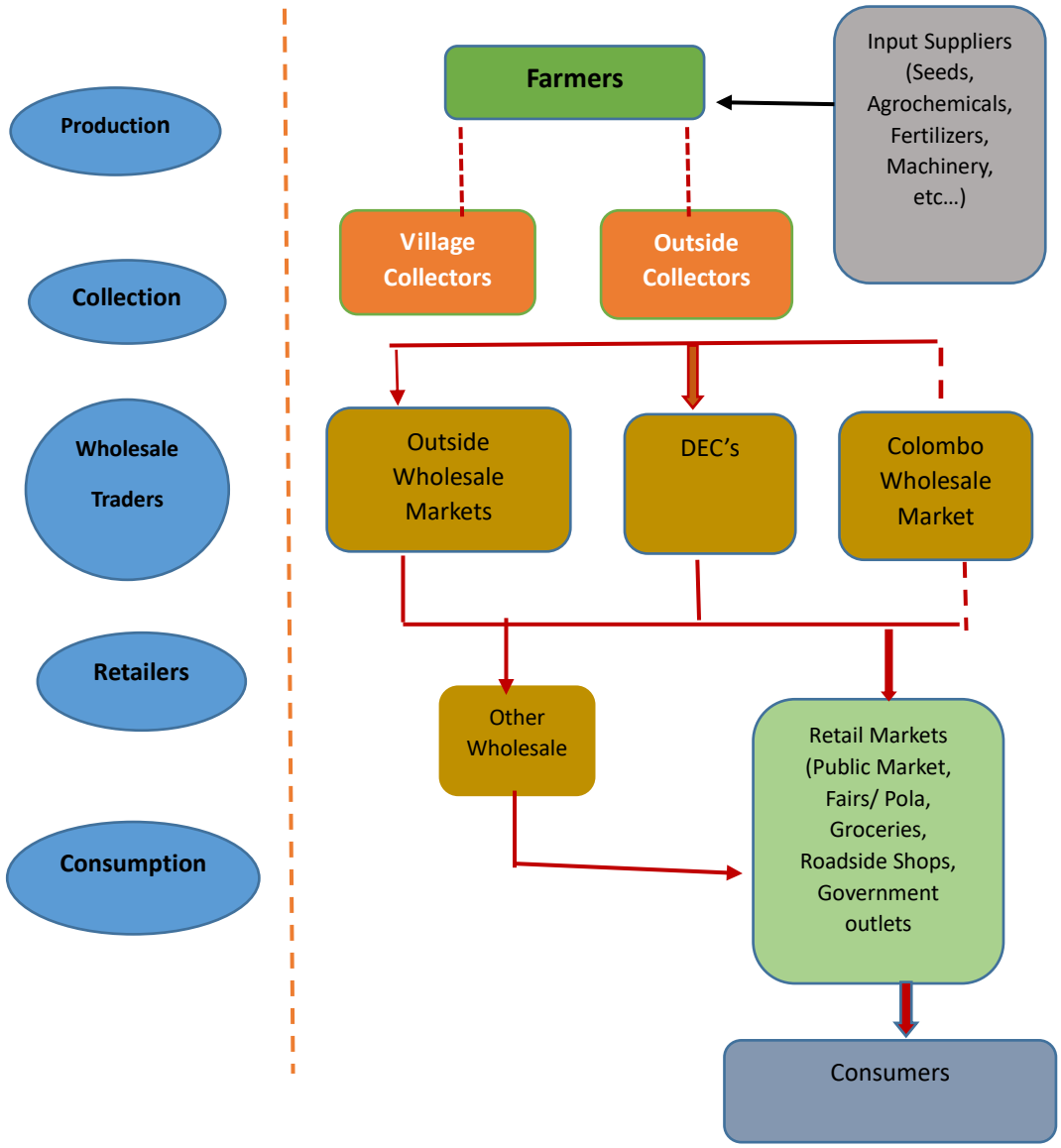
4.7 Supply Chain and Involved Intermediaries

Traditional Supply Chains of Green Beans

Figure 13 comprehensively depiction the traditional channel for beans in Nuwara Eliya and Badulla districts, elucidating the key stages of the supply chain and the major actors involved. The visual representation highlights the fluid movement of produce across different stages and interactions among actors within each segment of the supply chain. The production process initiates at the pre- production stage, encompassing input supply, and progresses through production, collection, grading and packing, processing, marketing, and consumption. The supply chain map vividly illustrates the product flow and stakeholder connections, while the network map effectively captures the primary product movements and the dynamic interplay among different actors involved in the process.

Predominantly, commission agents and large - scale private sector traders predominantly steer marketing. The intermediary chain commences with village-level collecting agents, the most common marketing channel being the farmer-assembler-wholesaler-retailer-consumer. However, the flow may diverge based on market distance, involving additional intermediaries. While the main marketing channels for beans remain consistent, a decline in the volume of sales and the number of transporters and vendors is noted.

Approximately 75% of beans produced in surveyed areas of both districts follow this traditional, non-centralized supply chain for collection, transportation, grading, and packing. The prevalent channel in both districts is Farmer-Transporter-Commission Agents at Dedicated Economic Centers (DECs)-Retailer-Consumer. During bulk harvests or high-quality off- season produce, farmers often prefer transporting the goods to the respective DECs using their own or hired vehicles. Otherwise, they enlist transporters.



Source: HARTI Survey Data, 2023

Figure 4.13: Supply Chains for Traditional Green Beans

Modern Supply Chain

Supermarkets have increasingly become stronger players in fruit and vegetable retailing. Their focus is on securing a steady flow of quality products that match the consumer preference while being competitively priced. Recognizing the importance of fresh food to attract customers, modern supply chains have significantly improved the supply and display of these products. The logistics of fresh produce are much more complicated than those of dry goods, requiring supermarket chains more time to organize. Supermarkets compete by adopting various management strategies to offer superior quality, wider choice, reduced wastage, greater value, and shorter and more effective supply chains (Abeysekera and Abeysekera, n.d.).

Modern supply chains (leading supermarket chains in the country; Cargills, Keells) have established collecting centers in major producing areas.

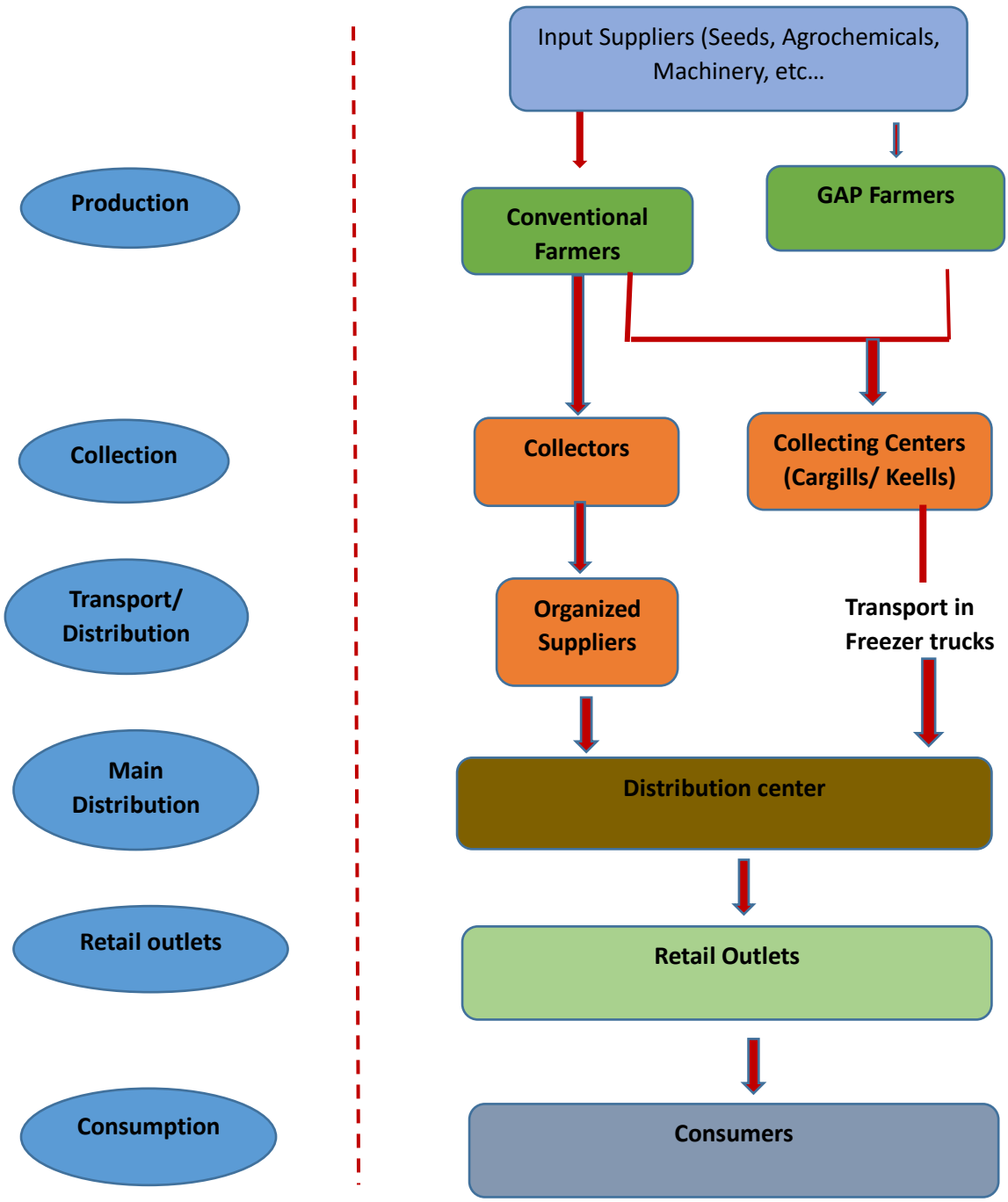
Cargills Supermarket chain collects green beans from their center at Rikillagaskada, while Keels supermarket has a collecting center at Adikarigama. Other supermarkets use specialized suppliers and collectors for procurement from local bean farmers in the area.

Supermarket vegetable requirements are conveyed to these regional vegetable collecting centers or specialized suppliers, who then issue orders to farmers and collectors. Communication between supermarkets and suppliers is mainly via telephone and mobile phones.

Supermarket employees at the collecting centers inspect, sort and grade the vegetables. Simultaneously, value-added activities such as cutting and trimming are performed. However, supermarkets do not strictly adhere to quality standards stipulated by formal certifications. Instead, they assess quality based on physical attributes such as size, colour, texture and the absence of pests and diseases. Produce that does not meet these standards is not purchased and is disposed of. Items withheld from delivery by the suppliers are typically sold in secondary markets such as traditional wholesalers (Dedicated Economic Centers), other markets and street fairs. This selection process helps farmers gain a better understanding of supermarket quality requirements.

At the collection centers, vegetables are packed in plastic crates or cardboard boxes to maintain product quality during transportation to distribution centers. Currently, only a limited number of farmers supplying to supermarket chains currently adhere to Good Agricultural Practices (GAP). Cargill's actively promotes GAP adoption by providing guidance, supervision, and subsidies to these farmers.

Currently, there are no specific quality or safety standards beyond GAP. GAP-compliant farmers adhere strictly to recommended fertilizer levels, with some applying chemicals under the guidance of relevant officers to maintain product quality, while others rely on their own expertise. For pest, weed, or disease management, GAP farmers take a proactive approach by promptly applying pesticides or other chemicals upon identifying specific issues, demonstrating a proactive approach to maintaining product integrity.



Source: HARTI Survey Data, 2023

Figure 4.14: Modern Supply Chains (Leading and Other Supermarkets) for Green Beans

4.8 Maintenance of the Quality and Safety Standards along the Traditional Supply Chain

In traditional marketing channels flow within Dedicated Economic Centers (DEC) or other wholesale markets, there are no effective measures to control product quality. Key players in this channel, including collectors and traders, show little interest in improving the quality of the products they handle. Some producers and collectors even hide rotten or immature products inside the middle of sacks to deceive buyers.

Even commission agents display minimal concern for maintaining product quality. The commodities are often sold in excessively packed sacks stacked haphazardly at the back of trucks for transportation. Unfortunately, these sacks are handled without the necessary care, as traders or their assistants may throw, step on, or rest on them at DECs or other wholesale markets. In conventional vegetable supply chains, participants often overlook produce quality.

Quality signals are not effectively communicated to farmers, who are typically remunerated based on weight, neglecting quality. Consequently, farmers are incentivized to focus solely on increasing yield weight, sometimes leading to unscrupulous practices such as adding stones and inferior-quality vegetables to the middle of the vegetable sacks to boost profits.

In contrast, modern marketing channels, particularly supermarkets emphasize purchasing reasonably higher-quality vegetables, though still within general market standards. However, their influence on farm-level practices remains limited. Supermarkets have established efficient systems with farmers, requiring produce to be delivered on the same day of harvest, usually before noon.

Farmers are advised to harvest early in the morning, clean dirty produce before transport to maintain cleanliness and reduce field heat. Clear instructions are provided on proper packing in crates and transporting in clean vehicles. The standards produce include being free from pest and diseases, undamaged, uniform in shape and color, accurately weighed and at correct maturity stage.

At the collection center, produce is cleaned again if necessary, using washing and cleaning facilities. A small amount of chlorine is added to reduce bacterial counts. The Nuwara Eliya Cargills collection center is notably equipped with a drying unit. After washing, the products are graded, dried, and packed in crates for transport to the packing center in reefer trucks. While supermarkets may not strictly adhere to formal certification standards, they emphasize quality-based attributes such as size, colour, texture, and the absence of pests and diseases.

4.9 Issues Related to Beans Production and Marketing

Farmers in both Nuwara Eliya and Badulla districts express concerns that broadly fall into two main categories: longstanding structural issues and problems induced by

the crisis. The intensity of these issues has likely fluctuated depending on the different phases of the crisis. Table 4.5 provides a detailed description of the nature of these issues and their corresponding changes during different these phases.

Table 4.5: Nature of These Issues and Their Corresponding Changes based on the Crisis Phase

Issue	Nature of the Issue		Change Depending on the Phase of the Crisis	
	Structural	Crisis Induced	Early Phase	Latter Phase
Threefold rise in price of imported seeds, fertilizers, and agro-chemicals		✓	same	same
Low quality of imported seeds, fertilizers, and agro-chemicals		✓	same	same
Availability of illegal and unauthorized agro-chemicals		✓	severe	diminishing
High cost of machinery and spare parts		✓	same	same
Unavailability of efficient and effective crop insurance system	✓		same	same
Have to repay high-interest rates for agricultural loans		✓	severe	diminishing
Insufficient fuel quota allocated for agriculture		✓	severe	No such issue
Not using proper transportation (e.g. over packing)	✓		severe	severe
Post-harvest losses at the DEC level	✓		same	same
Collectors/Transporters are reluctant to take necessary steps to preserve the quality during handling and transportation	✓		same	same

Source: HARTI Survey Data, 2023

CHAPTER FIVE

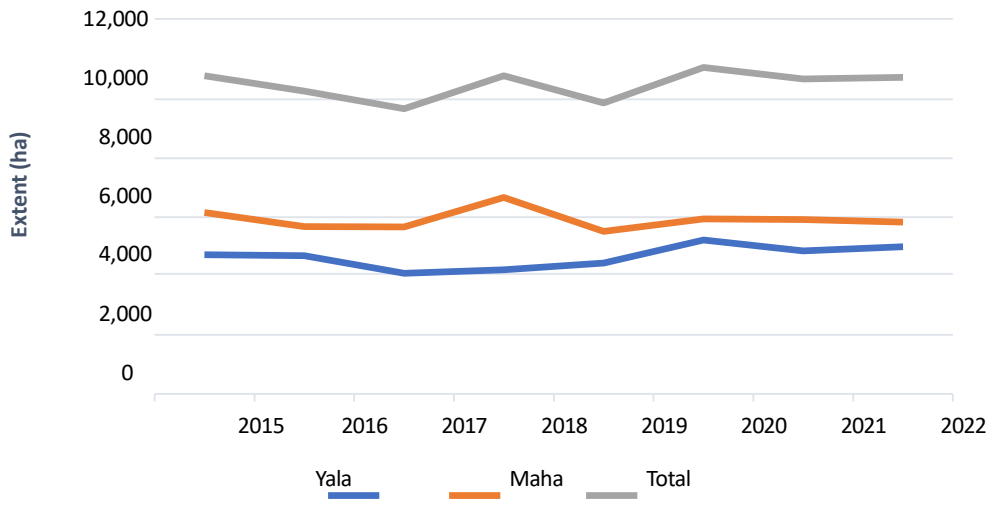
Effects of Economic Crisis on Brinjal Cultivation and Marketing

5.1 Brinjal Cultivation – General Description

Brinjal (*Solanum melongenum* L.) is a widely cultivated vegetable crop that thrives in tropical to sub-tropical climatic conditions. Among *Solanaceous* crops, it holds a prominent position, being cultivated in both greenhouses and open fields, and consumed consistently throughout the year across Asia, Africa, and sub-tropical regions. There is significant morphological variation in brinjal encompassing diverse fruit colours, shapes, and sizes. Rich in protective nutrients, brinjals are good sources of calcium, phosphorus, iron, and Vitamin-B. In Sri Lanka, brinjals are highly consumed low-country vegetables, with an average consumption of 278.72 grams per person per month. These crops can thrive at elevations of up to 1,300 meters above sea level. Despite the Department of Agriculture releasing a few brinjal varieties, traditional ones continue to be cultivated in Sri Lanka, including Amanda F1, Anjalee-F1, HORDI Lenairi 1, Thinnaweli purple, Padagoda, and SM 164.

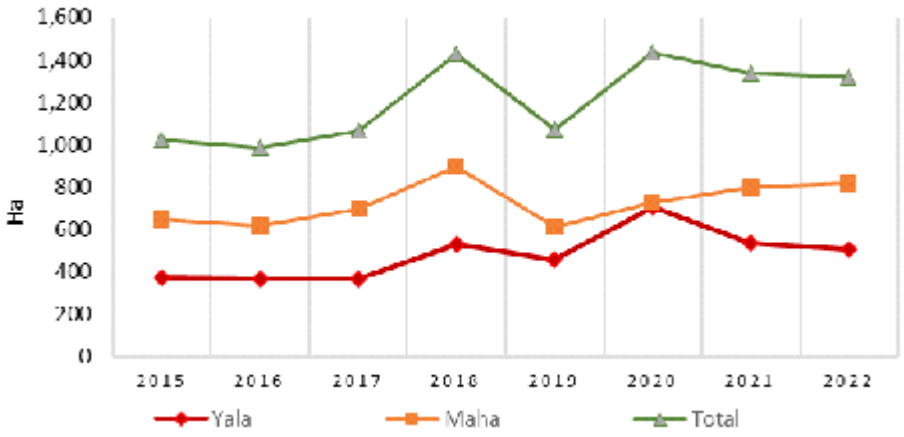
5.2 Trend in Cultivated Extent and Production of Brinjal

The major brinjal cultivation districts in Sri Lanka are Anuradhapura, Hambantota, and Badulla. By the end of 2022, the total cultivated extent spanned approximately 10,771 hectares at the end of 2022. As depicted in Figure 5.1(a), there appears to be a generally horizontal or stationary trend in brinjal cultivation extent across Sri Lanka. However, a slight increasing trend has been observed in the Anuradapura district in recent years 5.1 (b). The country witnessed a drop in brinjal production in 2019 due to drought conditions. Harvesting typically commences 10-12 weeks after planting, and fruits can be picked at 7-day intervals for up to 10-12 rounds.



Source: Department of Census and Statistics

Figure 5.1(a): Cultivated Extent of Brinjal



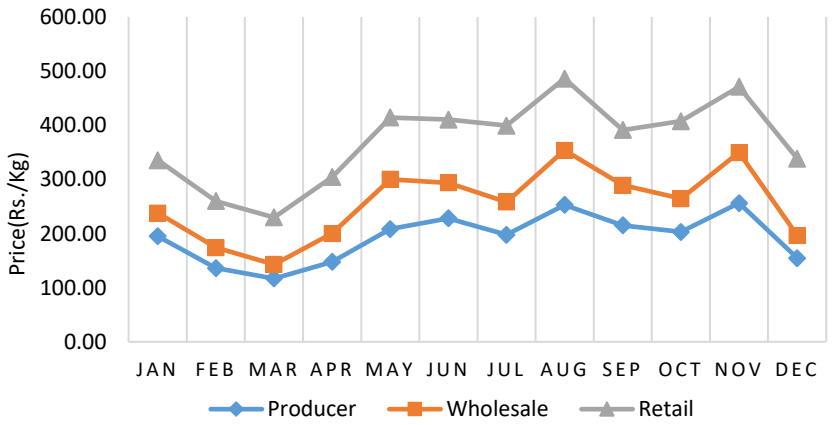
Source: Department of Census and Statistics

Figure 5.1 (b): Cultivated Extent of Brinjal in Anuradhapura District

5.3 Production

The total production of brinjal is about 128,248.8 mt with an average yield of about 10.3 t/ha (Department of Census and Statistics 2023). Harvesting can start 10-12 weeks after transplanting with fruits harvested at 7-day intervals for up to 10-12 picks. Potential yield varies by variety: open pollinated varieties yield 18-20 t/ha, and hybrids yield 30 - 40 t/ha. Brinjal is normally cultivated in both *Yala* and *Maha* seasons as a monocrop or intercrop. The production of brinjal has dropped in 2022, mainly due to the ban of import of chemical fertilizers and agro- chemicals in the country.

5.4 Price Behaviour of Brinjal



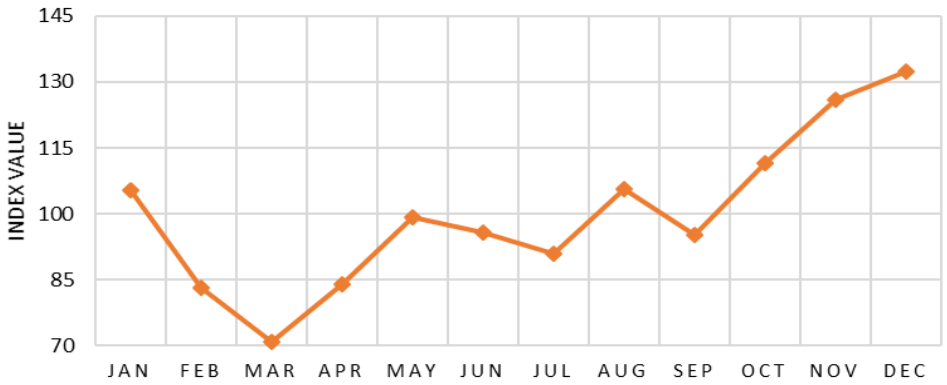
Source: Data Management Division, HARTI

Figure 5.2: Monthly Average Producer, Wholesale and Retail Prices in 2022

The above figure shows the price behaviour of wholesale, retail and farm gate prices for brinjal in 2022. Brinjal prices are greatly affected by the seasonality and depicted prices show a more a less similar distribution pattern. August and November indicate the high prices for brinjal, while prices dropped in March and December. February - April and September-October are the main harvesting seasons, for brinjal and high market supply during these times instigate low prices.

5.4.1 Seasonal Price Index of Brinjal

Price fluctuation within the year can be analyzed using seasonal price index, calculated based on five-year monthly average prices. The index values of brinjal were calculated for retail prices using monthly average prices from 2018 to 2022.



Source: Data Management Division, HARTI

Figure 5.3: Seasonal Price Index of Brinjal

The annual price is equivalent to 100, with values above this level indicating inadequate supply relative to demand, and values below 100 indicating excess supply to market demand. Overall, index values are below 100 during two periods: February to July and in September, which coincides with the harvesting of brinjal. The period of October to January shows high brinjal prices where supply is inadequate to meet the market demand (Figured 5.3).

5.5 Evaluation of the Effects of Economic Crisis

Focused group discussions (FGDs) were conducted (with 10-15 farmers in each) in villages across Kagama, Kelemedawachchiya, Walaswewa, Siyambalangamuwa, Verunkulama, Katiyawa, Pahala Halmillewa, Siyambalagahagama, Galadivulwewa, and Jayagama in the Anuradhapura district to obtain primary data. The majority of these farmers cultivate brinjal on land ranging from 0.25 to 1 acre. Approximately 95% of the participants were males, with ages ranging from 23 to 75 years. Most farmers come from a family background in farming, relying on agriculture as their primary source of income, with farming experience spanning from 10 to 50 years. The majority cultivate their own lands, while around 25% have licensed Mahaweli lands.

5.5.1 The Cultivation Extent and Production

Brinjal cultivation experienced a 20% decrease in acreage compared to the pre-crisis situation, with about 4% of farmers completely abandoned farming. This decline is attributed to a combination of factors, including a threefold increase in production costs, poor seed quality, scarcity and low quality of fertilizer and agro-chemicals, reduced sales volume, and subsequently lower profits. Approximately 40% of farmers reported issues such as reduced or no fruiting and a high incidence of damping off due to poor seed quality. The low quality of agro-chemicals contributed to a high prevalence of fruit fly infestation in brinjal. Affected fruits exhibited signs of premature rotting and increased susceptibility to secondary infections, leading to a significant decline in fruit quality, market value, and profit. Meanwhile, a few unauthorized agro-chemicals were still available in the Anuradhapura district.

5.5.2 The Input (Type, Suppliers, Price and the Cost of Production)

During the pre-crisis situation, the ratio of open-pollinated (e.g. *Lenairi, Thinnaveli*) to hybrid varieties was approximately 10% to 90%. By the time of the survey, all cultivators have transitioned from domestically available open-pollinated seeds to hybrid seeds, with 90% opting for *Raveena* and the remaining 10% choosing *Josapina* (another hybrid variety). Although this shift is not a direct result of the economic crisis, the period of rapid popularity gains for hybrid seeds coincided with the economic downturn. All imported seed supplies were private entities, namely *Onesh* Seed, *Best Seeds*, and CIC, each having their agents operating in the Anuradhapura district. The price of the *Raveena* variety was Rs. 3,000 per 10g. The harvest received from the Raveena variety was 600kg-700/acre per week. All farmers cultivated brinjal in open fields. The seed rate practiced by the farmers was 20g of seeds per 0.1 acre.

Seed Producers (Farmers)

There was one commercial level seed producer of most of the low country vegetables such as brinjal, luffa, bitter gourd, snake gourd, pumpkin, cucumber, and okra. He produces the seeds of a local open pollinated variety called *Thinnaveli*. Normally, farmers need 70g of open pollinated seeds for 0.2 acres.

Input Suppliers of Fertilizer and Agro-chemicals and Related Issues

Before the onset of the economic crisis, the majority of farmers adhered to the recommended rates when applying Urea, TSP, and MOP for their brinjal cultivation. They typically met approximately 20% - 25% of their inorganic fertilizer needs using the surplus received as subsidized fertilizer for paddy cultivation. However, the application of organic matter was below the recommended rate.

After the economic crisis and the subsequent ban on inorganic fertilizer importation, the utilization of organic matter saw an increase of approximately 25%. Poultry manure, cow dung, and used crop residues were employed as organic fertilizers during the planting stage. While some farmers produced their own organic fertilizer

(compost), the majority sourced it from private traders. 'Yar Millar,' which promotes pod development, was available at Rs.800 per 1kg. About 40% of farmers opted for unmixed fertilizer, purchasing TSP at Rs. 25,000 for a 50kg bag. Additionally, '*Nilkata*' and *'Miris pohora'* (Chili fertilizer) were applied as inorganic fertilizers. In the post-crisis period, farmers encountered varying fertilizer prices based on their locations, with no fixed unit price. While TSP was used less than 50% of the requirement in the basal fertilizer mix due to its unavailability, farmers expressed dissatisfaction with the quality and purity of the fertilizer available at local shops

Fungal diseases are commonly found in brinjal, with the rotting of pods being a frequent occurrence. When such diseases occur, farmers often purchase agro-chemicals based on the advice given by shop owners. However, it is advisable, to consult a qualified agricultural specialist or extension agent for guidance on the appropriate use of agro-chemicals, rather than relying solely on the recommendations of a shop owner who may lack the necessary expertise. The fungicide "Amistar" is normally used for treating this particular disease, with the cost of a bottle of this product is approximately RS. 40,000. This fungicide had to be applied in every 15 days and around 20 tanks is needed for 0.2 acres. Another popular fungicide used is Mancozeb. Farmers apply agro-chemicals with liquid fertilizers (Albert solution). They mentioned the availability of some cheap, smuggled Indian brands but with low efficacy. During the post crisis era, farmers had to make cash payments and received no discounts received for agro-chemicals.

Input - Labour

Brinjal cultivation was largely dependent on hired labour. In the pre-crisis era, hired labour accounted for 60%, with a slight 10% decrease post-crisis due to reduced cultivated area. After the crisis, labour usage for agro-chemical application, driven by increased disease incidence from low quality of seeds and agro-chemicals. The unit price of male labour has risen by approximately RS. 1,000 per day compared to the pre-crisis situation.

Input – Machinery

Farmers employed both two-wheel and four-wheel tractors for land preparation, with two rounds of ploughing was necessary per acre. Some farmers utilized a four-wheel tractor for ploughing, costing RS. 25,000-27,000 per acre. Alternatively, others chose to lease these machines for land preparation. On the other hand, a two-wheel tractor required 20 liters (with a maximum of 25 liters) of fuel to plough one acre. The ratio of fuel cost to machinery maintenance cost has surged to 1:3. Consequently, farmers now prefer leasing machinery to owning it. Payment for hired machinery is naturally made up - front. During the initial stages of the economic crisis, farmers suffered with an inadequate fuel quota allocated for the agricultural sector.

5.5.3 Cost of Production and Gross Income

Crop Calendar

Brinjal cultivation takes place mainly in *maha* season. The following table depicts the crop calendar of the brinjal. The first round of harvesting was obtained weeks after transplanting (transplanting is taking place when seedlings are 20-30 days old).

Table 5.1: Planting and Harvesting Period of Brinjal

Season	Planting Period	Harvesting Period
Maha	November - December	February - April
Yala	June - July	September - October

Source: HARTI Survey Data, 2023

The cost of cultivating brinjal in the Howitiyagama village in Anuradhapura district for the 2022/2023 *maha* season is presented in Table 5.2. According to the data, the total cost of cultivation was RS. 850,290 per acre, with an approximate cost of RS. 82.55 to produce one kilogram of fresh brinjal. This cost is four times higher than the RS. 20.62/kg reported in the 2019/*Yala* season.

In the post crisis scenario, the amount and frequency of fertilizer applied was 25% less than the recommended level. The level of TSP application in the basal mix was about 50% less than the recommended amount. Additionally, the scarcity of high-quality agro-chemicals, seeds and inorganic fertilizers restricted the farmers' harvest. Numerous farmers reported issues such as diminished or no fruiting, as well as a high prevalence of damping off due to low quality of seeds and agro-chemicals. After the crisis, labour usage for agrochemical application increased threefold compared to pre-crisis situation, driven by the rising incidence of disease due to the low quality of seeds and agro-chemicals.

Analyzing all these factors, it seems that, although the brinjal farmers used hybrid varieties, they could not adhere to the recommended cultivation practices to fully exploit the potential yield. As a result, the reported cost for producing one kilogram of brinjal in Anuradhapura district amounts to RS. 82.55/kg. Under optimal practices, a maximum of two years of brinjal harvest can be obtained. Many farmers have obtained normal yields for a period of 8-9 months and experienced a yield drop thereafter. Some farmers have attempted ratooning brinjal after eight months.

Compared to average farmgate price (Rs.59/kg) reported in 2019, the post crisis average farmgate price has risen approximately fourfold (Rs. 228/kg). However, despite the improvement in seed variety and technology over the span of three years, the average yield has increased marginally, by 14%, in 2023 compared to pre-crisis situation in 2019, mainly due to the issues related to inputs.

Table 5.2: Cost of Production of Brinjal

Activity / Input	Units	Unit Price (RS.)	Cost
Labour			
Bed preparation	Male - 08	2,000	16,000
Planting	Male - 02	2,000	4,000
	Female - 04	1,300	5,200
Earthing up (I)	Male - 02	2,000	8,000
	Female - 06	1,300	7,800
Earthing up (II)	Male - 02	2,000	4,000
	Female - 06	1,300	7,800
Fertilizer application	Female - 08	1,300	10,400
Agro-chemicals application	Male - 50	2,000	100,000
Watering	Male - 25	2,000	50,000
Harvesting (normally harvesting were done for 4 times /month)	Male - 96	2,000	192,000
	Female- 192	1,300	249,600
Fuel/Electricity	12L	370	4,440
Subtotal 1			659,240
Inputs			
Seeds (Hybrid)	200 g		45,000
Nilkata Fertilizer (nursery)	250g		650
Inorganic fertilizer kg (basal; urea =40, TSP =40, MOP =20)	100 kg	2,000	40,000
Round 1 = Urea	50kg		18,000
Round 2 = Yar Millar	20kg		20,000
Liquid fertilizer	12L	1,500	18,000
Agro-chemicals (pesticides and fungicides)			
Fungicides (nursery)	100g		600
Fungicides (field)	400g 800ml		18,800
Machinery (tractor)			30,000
Subtotal 2			191,050
Total cost per acre			850,290
Average yield kg/ac			10,300
Price of the Produce (Rs/kg)			228
Gross Income (RS.)			2,348,400 .
Profit (RS.)			1,498,110
Unit Cost for 1 kg			82.55

Source: HARTI Survey Data, 2023

5.5.4 Insurance, Loans, and Supportive Services

During the early phase of the post crisis situation, most of the surveyed vegetable farmers in Anuradhapura obtained loans via Farmer Organizations, Govigana Banks, Samurdhi banks (Rs. 50,000 - Rs. 500,000), and "*Maranadhara* Samithi". Pawning of jewelries was very popular to get the immediate cash needs during the planting

season. Increasing interest rates (from 8% to 12% in Govijana banks; up to 21% in other banks), long waiting periods, lengthy document procedures and the requirement of guarantees are the main issues faced by the farmers, relating to loans. Banks are also reluctant to give loans to farmers due to uncertainty of the income due to lack of fertilizer and agro-chemicals. The issues regarding rising interest rates for agricultural loans was gradually diminishing by the end of 2023, as the policy interest rates of CBSL had significantly declined.

During the midst of the economic crisis in June, 2022 "Sarusara" loan scheme, a collaborative initiative with the Central Bank of Sri Lanka, was introduced via private banks. Its aim was to improve the socio-economic conditions of micro and small-scale growers of seasonal crops. This scheme offered the most profitable interest rate (4%), during a period of alarmingly rising interest rates. The maximum loan amount was set at 75% of the total cost of cultivation, with a re-payment period extending to 270 days. However, due to the banks requesting appropriate collateral, the vast majority of farmers, with the exception of one or two long-term customers of private banks, were neither aware of nor approached private banks to obtain loans through this scheme.

The Agriculture Insurance Board does not have a specific insurance scheme for upland vegetables. If farmers face a crop damage, the field has to be left untouched until the claim officer's visit, which could take 2-3 months. These issues remained unchanged despite the economic crisis.

Extension Services

It is unfortunate that the current extension service from Agriculture Instructors (AIS) is facing a staff limitation problem. One AI has a vast area to cover, requiring them to prioritize crops for extension efforts. In such cases, it is common for farmers to seek knowledge and guidance from successful neighboring farmers who have more experience and knowledge. A few AIs who took personal interest in developing subsistent farmers to a commercial level have succeeded in areas such as Kelemedawachchiya and Werunkulama.

5.5.5 Market Information and Transporting the Final Produce

They collect information from Dambulla DEC via direct phone calls, contacting farmers and sellers/traders. Additionally, they use HARTI-Mobitel 6666 for more information. This situation has remained unchanged in both pre and post-crisis era.

Transporting Harvest to the DECs and Financial Settlements

Most farmers typically used their own vehicles (*demo batta – small lorries*) to transport their harvest to DECs (Dambulla or Thambuttegama). When going to DEC, they would need to early in the morning to sell their products to selected commission agents. The preference of the location (Dambulla or Thambuttegama) depends on the distance from the farm field to respective DEC. All the farmers in Nocchiyagama

area preferred Thambuttegama DEC while all the farmers in Kagama, Kelemedawachchiya, Walaswewa and Werunkulama preferred Dambulla DEC. Other farmers used neighbour's vehicle to transport their harvest to Dambulla DEC. There were also lorry owners who acted solely transporters, not as collectors or intermediaries.

The intermediaries in the supply chain play a critical role in transferring ownership, facilitating movement, ensuring maintenance, and preservation of quantity and quality, processing payment to the seller, and delivering the commodity to the buyer (Halder and Pati, 2011). Therefore, linkage and integration among the various players are crucial for the effective and profitable functioning of the entire value chain. Figure 5.4 explains the supply chain of traditional channel for brinjal in the Anuradhapura district.

Almost all the farmers had repeated engagement with a particular transporter and commission agent seller at DECs establishing long-term relationships for transporting and selling produce. After selling farmers' products, the transporter would return the money along with the bills (issued by the commission agents at DEC) on the same day. Rejected harvest were also returned by the transporter, highlighting the reliance on trustworthiness. Transport costs rose threefold, after the economic crisis, reaching RS.300/30 - 40 per net bag km, up from the previous Rs.100/30 - 40 km. With each bag weighing 50 kg, the cost of per net bag increased to RS.80 (previously Rs.40). Plastic trays were not used due to their larger space requirement and higher cost.

The commission for traders is 5% for 100-150, 10% for up to 300 kg and 15% for quantities beyond 300kg. The commission structure remained unchanged both before and after the crisis. In the Dambulla DEC, farmers can exercise their bargaining power, due to the large number of buyers. If the harvest is high, farmers can increase the price and assess the willingness of commission agents to buy at that price. Net bags are the usual packaging materials.

The intermediaries in the supply chain play a critical role in transferring ownership, facilitating movement, ensuring maintenance, and preservation of quantity and quality, processing payment to the seller, and delivering the commodity to the buyer (Halder and Pati, 2011). Therefore, linkage and integration among the various players are crucial for the effective and profitable functioning of the entire value chain. Figure 5.4 explains the supply chain of traditional channel for brinjal in the Anuradhapura district.

The main marketing channels for brinjal have remained unchanged. However, the volume of sales and the number of transporters and vendors involved in the marketing channel have dropped by about 20%. Approximately 75% of the brinjal produce in the surveyed areas goes through the traditional supply chain, where collection, transportation, grading and packing are not maintained by a centralized system. In the Anuradhapura district, the predominant channel for brinjal marketing

is the Farmer-Transporter-Commission Agents at District Economic Centers (DECs)-Retailer-Consumer channel. When farmers have a bulk harvest or high quality, high-value harvest in the off-season, they prefer to transport the produce to the respective DEC using their own vehicles or hired vehicles. Otherwise, they use the service of a transporter. There are no farmers with GAP certification in the traditional channel. AIs are taking initial steps to register brinjal farmers under GAP - B programme. Therefore, the quality of the final produce is difficult to assure.

5.6 Maintenance of the Quality and Safety Standards along the Traditional Supply Chain

With respect to quality and safety standards, the traditional marketing flow through Dedicated Economic Centre (DEC) or other wholesale markets does not have an established mechanism to control the quality of agricultural products. For example, some producers intentionally hide rotten or immature products intentionally in the central part of sacks in which the commodities are packed to increase weight. Even commission agents show little concern for maintaining quality. Commodities are sold in over-packed sacks piled up in the back of the lorries/trucks for transportation. With the increase in fuel prices, over-packing has become more aggravated. In addition, sacks of commodities are handled without much care. At DECs or other wholesale markets, some traders or their helpers throw, step on and take rest on the sacks, which are full of commodities. The other players (transporters and traders) in this channel do not attempt to improve the quality of the products they handle, because they do not receive any benefit from doing so. This is because the traditional supply chain is disintegrated, and players involved in a particular action do not benefit from other actions in the supply chain. Except for over packing, all the above-mentioned issues remained unchanged despite the economic crisis.

5.7 Processing and Value Addition

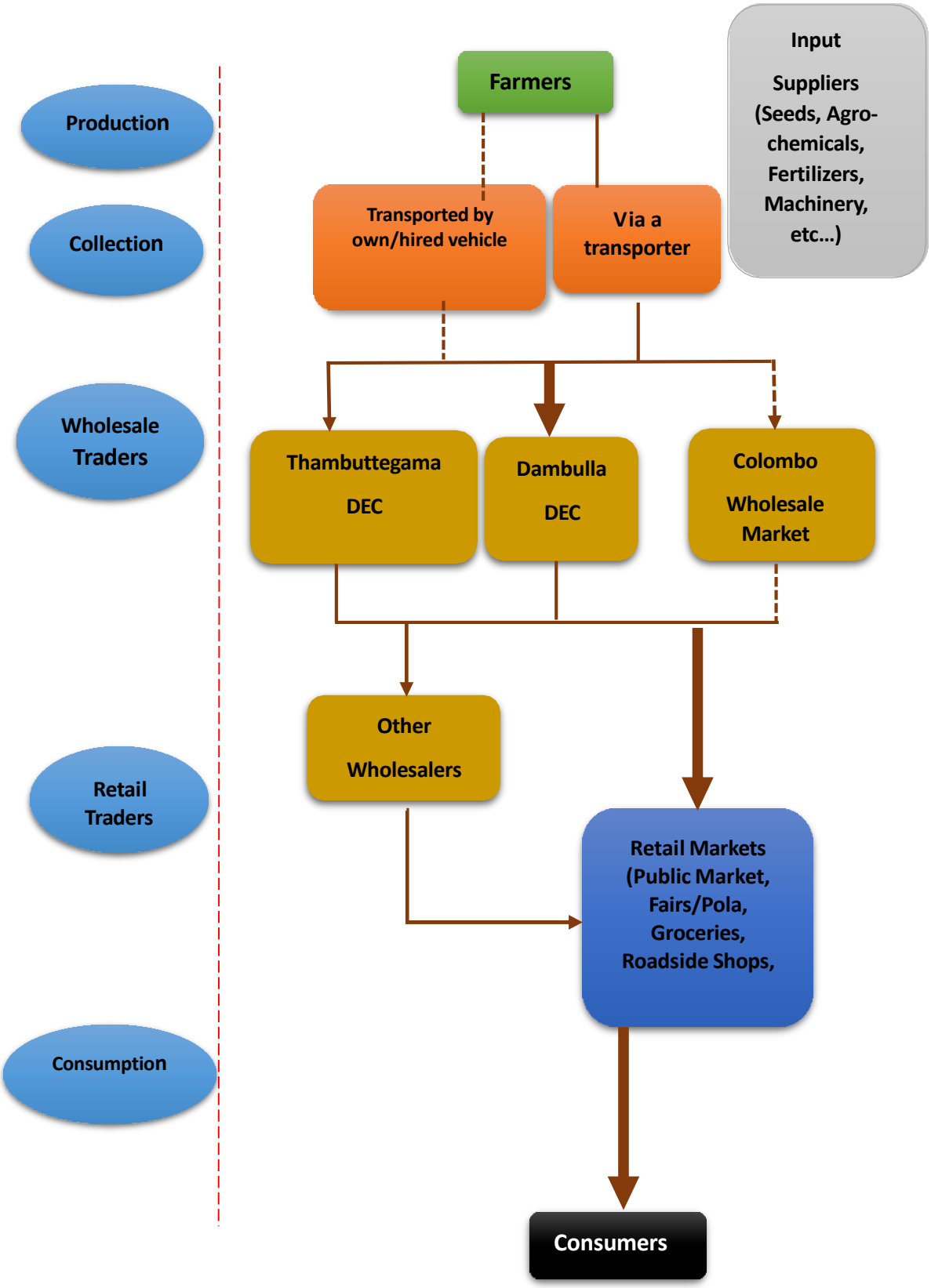
In the Anuradhapura district, there is a processor known as Rajarata Malberry Nishpadana" that currently supplies approximately 100 kilograms of dried brinjal per week to an exporter. Furthermore, they directly export dried brinjal in the form of 'gift packs' (approximately 50-60 kilograms based on demand) through a courier service, with the primary market being the United Arab Emirates. The processor has also diversified its operations by venturing into other products such as dried jackfruit, jackfruit seeds, jackfruit seed flour, dried breadfruit, dried cassava, and dried banana, aiming to mitigate risks associated with a single product focus.

According to the processor, there exists substantial potential for expanding the exportation of dried and canned brinjal. However, the expansion of operations is limited by a lack of machinery (only one electric dryer is currently in operation) and the need to convert the existing operating area into a standardized manufacturing facility.

Hence, it is advisable to support to private entrepreneurs operating in the area with upgrades to their manufacturing facilities and necessary training on quality and safety standards. This would enable them to enhance their production capacity, improve the quality, and meet safety regulations. This would enable them to enhance production capacity, improve product quality, and meet safety regulations, better positioning them to expand operations and capitalize on the export potential of dried and canned brinjal, thereby contributing to local economic growth and reducing risks for farmers in the traditional brinjal value chain.

Source: HARTI survey, 2023

Figure 5.4: Value added Pre-cuts of Brinjal



Source: HARTI survey, 2023

Figure 5.5: Traditional Supply Chain of Brinjal

5.8 Issues Related to Brinjal Production and Marketing

The concerns raised by farmers in the Anuradhapura district can be classified into two main categories: longstanding structural issues and crisis-induced problems. The intensity of both types of issues may vary depending on the crisis phase. Table 5.3 describes the nature of these issues and their corresponding changes based on the crisis phase.

Table 5.3: Nature of These Issues and Their Corresponding Changes based on the Crisis Phase

Issue	Nature of the Issue		Change Depending on the Phase of the Crisis	
	Structural	Crisis Induced	Early Phase	Latter Phase
Threefold rise in price of imported seeds, fertilizers, and agro-chemicals		✓	same	same
Low quality of imported seeds, fertilizers, and agro-chemicals		✓	same	same
Availability of illegal and unauthorized agro-chemicals		✓	severe	diminishing
High cost of machinery and spare parts		✓	same	same
Unavailability of efficient and effective crop insurance system	✓		same	same
Have to repay agricultural loans with high-interest rates		✓	severe	diminishing
Insufficient fuel quota allocated for Agriculture		✓	severe	no such issue
Not using proper transportation (e.g. over packing)	✓		severe	severe
Post-harvest losses at the DEC level	✓		same	same
Collectors/transporters are reluctant to take necessary steps to preserve the quality during handling and transportation	✓		same	same

CHAPTER SIX

Effects of Economic Crisis on Banana Cultivation and Marketing

6.1 Banana Cultivation – General Description

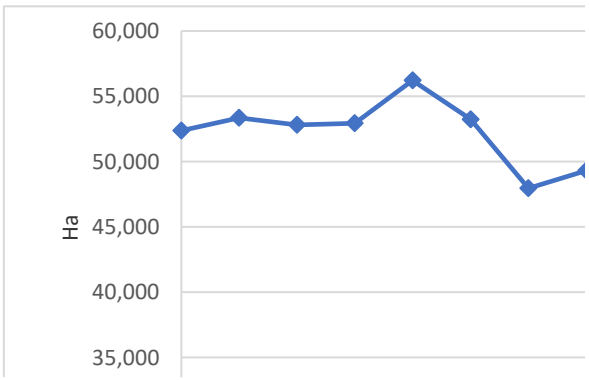
The banana (*Musa sp*.) is the most extensively grown and consumed fruit in Sri Lanka. It is a popular perennial cash fruit crop for small-scale farmers due to its ability to generate significant annual economic returns. As of 2022, banana cultivation covered 41,430 hectares of land in Sri Lanka, accounting for approximately 54% of the total fruit cultivation area.

Moreover, the annual banana production stood at around 62.09 million bunches (source: DOA, 2021). Statistical data underlines that fresh bananas constitute the highest volume of exported fruit crops, with 17,926 tons shipped in 2019 (source: DOA, 2020). Sri Lanka has a remarkable diversity of bananas, exhibiting variations in shape, colour, size, texture, and flavour, along with distinctive tree morphological characteristics.

Within the country, there are two major types of edible bananas: dessert types and cooking types, commonly referred to as bananas and plantains, respectively. Among the most popular and frequently consumed banana varieties are *ambul*, *seeni*, *kolikuttu*, *ambun*, *anamalu*, *puwalu*, *rath kesel*, *bimkesel*, and cavendish, which are consumed as fruit. Meanwhile, *alu kesel*, also known as ash plantain, serves as the preferred choice for cooking purposes. Banana cultivation has a significant presence in various Sri Lankan districts, including Moneragala, Rathnapura, Kurunegala, Hambantota, and Anuradhapura.

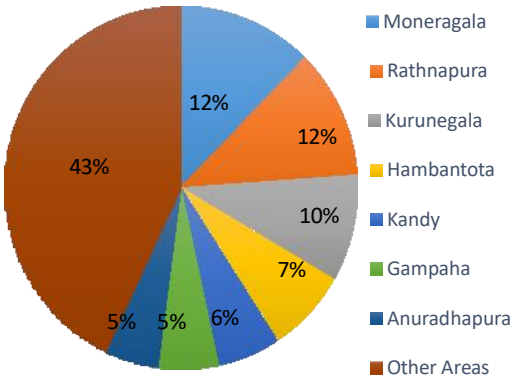
Based on data from 2010 to 2021, the largest area dedicated to banana cultivation was observed in 2014, while the smallest was recorded in 2021. The notable decline in banana cultivation in 2021 can be attributed to disruptions caused by the COVID-19 pandemic, including transportation interruptions, market distortions, and reduced demand. As depicted in Figure 6.1, over the 2010 to 2021 period, the extent of banana cultivation in the country exhibited a gradual decline, starting from 2014. This decline was primarily influenced by persistent drought conditions in 2015 and 2016, and again in 2021 due to pandemic-related challenges.

When considering the overall average cultivated area between 2010 and 2021, Moneragala, Rathnapura, Kurunegala, Hambantota, Kandy, Gampaha, and Anuradhapura emerged as the districts with the highest banana cultivation. In contrast, the remaining 18 districts collectively accounted for 43% of banana cultivation.



Source: Department of Census and Statistics, 2020.

Figure 6.1: Trend in Cultivated Extent of Banana

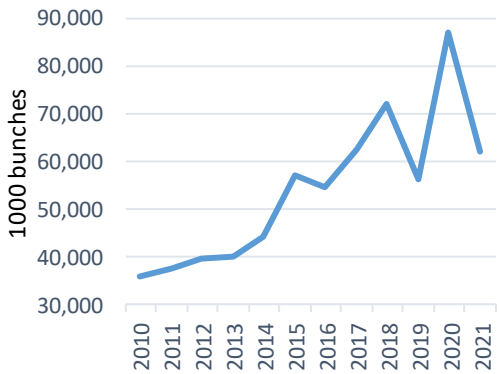


Source: Department of Census and Statistics, 2020

Figure 6.2: Average Extent of Banana Cultivation in Major Producing Areas (2010-2021)

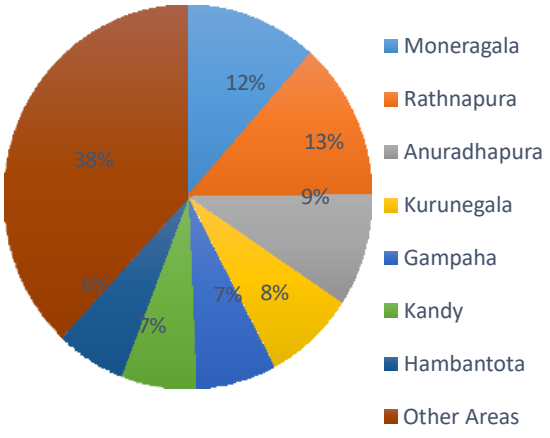
6.2 Trend in Production

Currently, in Sri Lanka, the total annual banana production stands at approximately 60,000,000 bunches, making it an appealing perennial fruit crop due to its promising economic returns. Based on banana production data, the yield has shown a gradual increase from 2010 to 2021, with the exception of 2019 an d 2021. In 2019, the decrease in banana production was attributed to curfew conditions resulting from terrorist attacks in the country, while the decline in 2021 was primarily due to the COVID-19 pandemic.



Source: Department of Census and Statistics, 2020

Figure 6.3: Trend in Production of Banana in 1,000's Bunches (2010-2021)



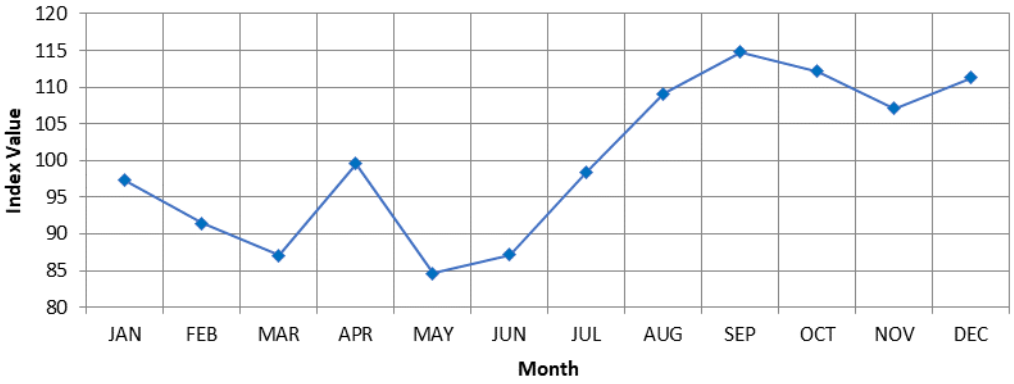
Source: Department of Census and Statistics, 2020

Figure 6.4: Production of Banana in major producing areas (2010-2021)

For a more detailed illustration, please refer to Figure 3.4. When considering the total average production recorded from 2010 to 2021, Rathnapura, Moneragala, Anuradhapura, Kurunegala, Gampaha, Kandy, and Hambantota were the districts with the highest banana production. In contrast, the remaining 18 districts collectively accounted for 38% of the production (see Figure 3.5). This underlines that major producing districts where there is commercial cultivation have higher productivity compared to remaining districts.

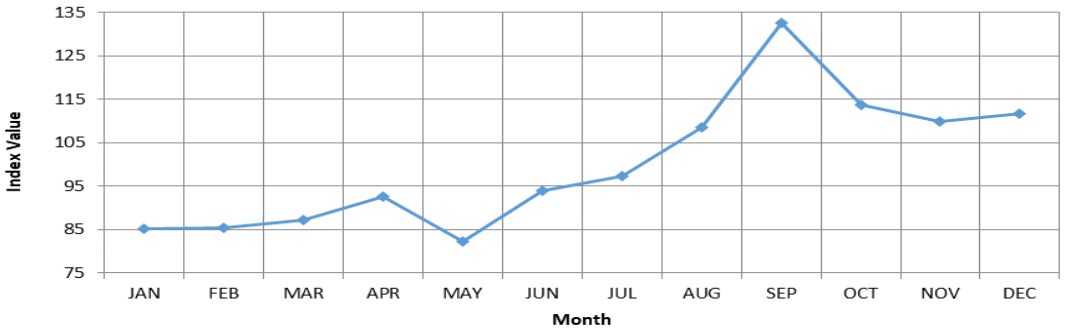
6.3 Price Behaviour

Price of banana varied for the year as illustrated in Figures 6.5, 6.6 and 6.6. According to the seasonal price index analysis, prices of all the varieties were lower from January to March. During April, prices escalated due to high demand during the Sinhala and Tamil New Year festival. In the last quarter of the year, higher prices were reported, likely because the off-season for banana production fall in November and December.



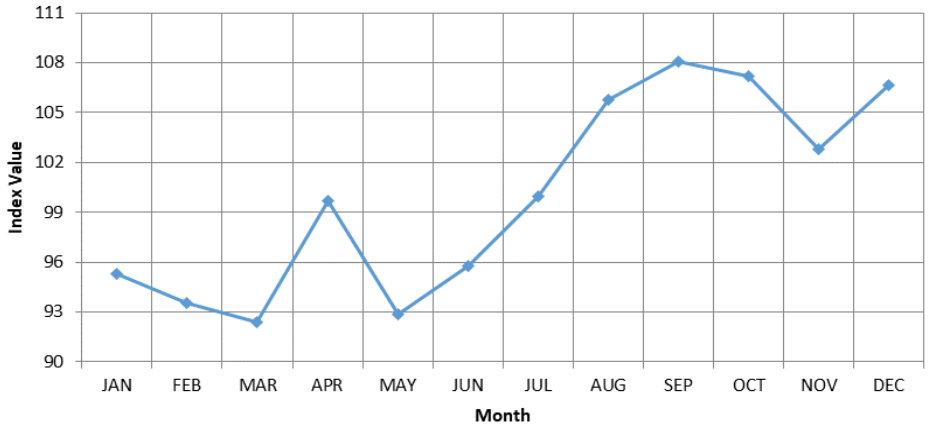
Source: Compiled based on HARTI Retail Price Data (2018-2022)

Figure 6.5: Seasonal Price Index of *Ambul* (2018-2022 =100)



Source: Compiled based on HARTI Retail Price Data (2018-2022)

Figure 6.6: Seasonal Price Index of *Kolikuttu* (2018-2022 =100)



Source: Compiled based on HARTI Retail Price Data (2018-2022)

Figure 6.7: Seasonal Price Index of *Seeni Kesel* (2018-2022 =100)

6.4 Evaluation of the Effects of Economic Crisis

Focused group discussions (FGDs) were conducted in 14 villages, including Wediwewa, Beddewewa and 11 Kanuwa Hambantota district, Mahagama, Nugegolayaya, Thelulla, Seenukkuwa (Kudagammana 1), Seenukkuwa (Kudagammana 2) and Kovulara villages in Monaragala district and Moraketiya, Ketagalara, Gangeyaya, Hagala, and Thukama (9 Ela) in Rathnapura (Embilipitiya DS division). The Monaragala district was the main focus for *ambul* cultivation, while Rathnapura and Hambantota districts was the main focus for *kolikuttu* and *seeni kesel* cultivation, respectively.

The purpose of these discussions was to gather primary data on extent, production and cultural practices compared to the pre-crisis situation. Each FGD involved 10-15 farmers. The majority of farmers cultivate bananas in land 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, with farming experience spanning from 3 to 40 years. More than 50% of the participants cultivate their own lands, while 10% cultivate lands owned by the Sevanagala sugarcane factory. Another 25% cultivate leased lands, and around 15% cultivate using encroached lands.

In the Embilipitiya DS division, nearly all the lands dedicated to banana cultivation were paddy lands irrigated by the Walawa-Mahaweli system. Similarly, in the Hambantota district, more than 70% of banana lands were either major or minor irrigated lowlands. Meanwhile, in the Monaragala district, the majority of banana lands were situated in uplands. Consequently, farmers in this region made investments in digging agro-wells and installing irrigation systems suitable for the land.

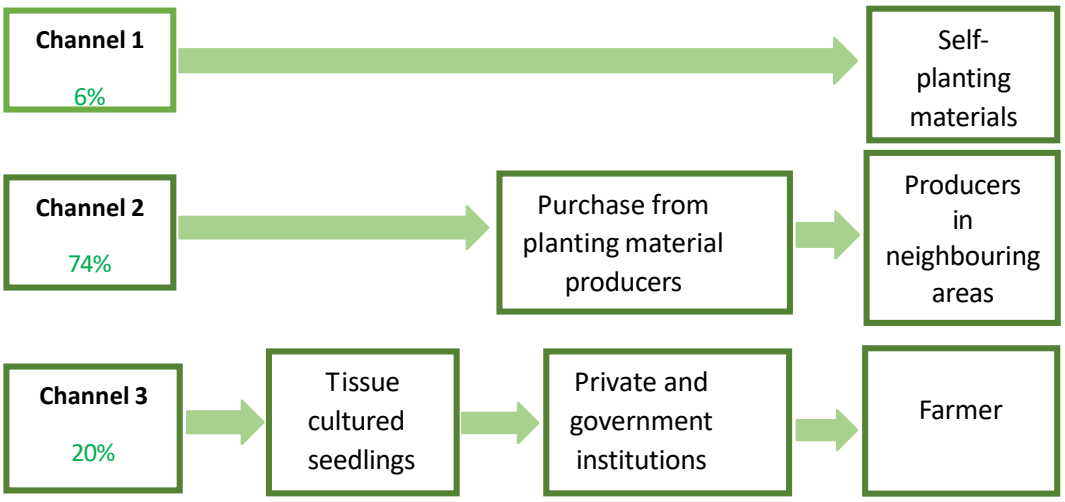
6.4.1 The Input–type, Price and the Cost

Seedling - Suppliers, Rate and Price Planting Material for Banana Cultivation
There are three categories of producers of planting material involved in the considered districts.

i. Self-planting material (suckers) producers
ii. Commercial scale planting material (suckers) producers
iii. Tissue cultured planting material producers

Only a few (6%) producers in the considered districts use self-planting material. Among the growers of *ambul* and *seeni* banana varieties, 74% have accessed banana seedlings from nearby commercial-scale planting material producers, while 20% of farmers have purchased tissue-cultured seedlings (figure 6.8). Meanwhile, almost all kolikuttu growers have opted for tissue-cultured seedlings.

Due to movement restrictions imposed by COVID-19, many commercial scales planting material producers abandoned their banana plantations, making it difficult to maintain high-quality seedlings. Consequently, it has become challenging numerous farmers to access high-quality banana seedlings when needed, negatively impacting the extent of banana cultivation. There is a high demand for tissue-cultured banana plants in all three districts, but the supply is insufficient.



Source: HARTI Survey Data, 2023

Figure 6.8: Different Supply Chains for Banana Planting Materials

The primary sources of tissue-cultured seedling production are the University of Colombo Institute of Agricultural Technology and Rural Sciences – Weligatta (IARS), Grain Legume and Oil Crops Research and Development Center (Agunakolapalassa), Fruit Research and Development Institute (Horana), and a private company in Ambalantota, specializing in tissue-cultured seedlings. IARS and Fruit Research and Development Institute (Horana) mainly produce tissue-cultured *ambul* banana

seedlings, while the Grain Legume and Oil Crops Research and Development Center primarily focuses on producing kolikuttu banana seedlings through tissue culture.

However, all farmers requesting tissue-cultured plants faces long waiting lists due to inadequate supply compared to demand. Despite the demand for banana seedlings in the growing season being around 1 to 1.2 million seedlings in these districts, the monthly supply of tissue-cultured seedlings from the above sources is limited to 40,000-45,000. The largest supplier, Weligatta IARS, provides approximately 20,000 *ambul* banana seedlings per month. Meanwhile, the cost of a tissue-cultured plant has significantly increased. A tissue-cultured *ambul* banana plant now costs Rs.120, and a tissue-cultured *kolikuttu* plant is priced at RS.160. This represents a price increase of 45% compared to the situation before the economic crisis. Additionally, the average price of a banana sucker, produced by farmers has also risen from Rs.40 to RS.80.

The spacing of plants depends on the specific variety and the cultural practices adopted by a farmer. In the case of *ambul* and *seeni* varieties, the majority of farmers adhere to the "annual method," in which only the mother plant is retained, and all suckers are either discarded or transplanted to a different field. Under this approach, 80% of farmers opt for 8 X 8 feet spacing, requiring 670 seedlings per acre. Another 15% of farmers practice the "zig-zag" method, following 8 X 6 feet spacing (8 feet between rows and 6 feet within a row), requiring 900 seedlings per acre. A small percentage (5%) of farmers opt for the perennial method, maintaining the mother plant and two seedlings, they applying 10 X 10 feet spacing, requiring 440 seedlings during the initial establishment phase.

A significant number of *kolikuttu* farmers adopt a 10 X 10 spacing, exclusively preserving the mother plant as they rely solely on tissue-cultured seedlings for subsequent cultivation rounds.

6.4.2 Input Use - Fertilizer and Agro-chemicals and Related Issues

According to the Department of Agriculture recommendations for the dry and intermediate zones, it is advised to apply organic fertilizer a rate of 10 kg per planting pit two weeks before planting. However, most 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, in the Walawa area, *Kolikuttu* farmers had applied urea: TSP: MOP at 12:8:34 rates before the economic crisis. Post-crisis, farmers faced a TSP scarcity, leading to a 30% reduction in the applied quantity. After planting, it is recommended to apply 450g of fertilizer per plant once every 2 months, with urea: TSP: MOP at 12:8:25 rates.

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, regarding 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 to avoid high fertilizer costs.

Input - labour

Banana cultivation showed 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 all districts, 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 transitioned to small-scale farming, experiencing a notable shift from hired labour to family labour (60%).

Input - Machinery

To achieve optimal outcomes in the cultivation of tissue-cultured banana plants or banana suckers for commercial production, it is crucial to adhere to precise land preparation and correct planting procedures, which are critical one-off prerequisites in banana production. Farmers utilized four-wheel tractors for land preparation, requiring two rounds of ploughing per acre, followed by one round with rotavator and one with a disc 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 three considered districts.

Subsequently, activities such as establishing a drainage system, digging planting pits, applying fertilizer, and planting were carried out. Except for 35% of farmers, the majority employed manual labour for establishing a drainage system and digging planting pits, needing approximately 25 man-days per acre. 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 timeframe.

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 reverted to either using grass cutters or manual weeding using mammoties. The manual method required approximately 8–10 man-days, costing around RS. 20,000-23,000. For chemical weeding, the cost of chemicals was RS. 8,800 per acre. Farmers expressed the opinion that manual weeding is approximately twice as expensive as chemical weeding.

Growers used mulching for soil and water retention and weed control utilizing chopped plants and dead leaves removed from the plantation as mulch around the live plants.

The main prevalent disease was Fusarium wilt/panama disease in *kolikuttu*. To avoid the disease, farmers had to rotate varieties, cultivating *kolikuttu* once every three to five years. The other common pests were banana weevils (*Cosmopolites sordidus* and *Odoiporus longicollis*) and banana aphids (*Pentalonia nigronervosa*).

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, extensively cultivated in the surveyed area, is 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.

Crop Calendar, Harvesting Practices, Average Yield and Income

The best price for bananas is received during the Sinhala and Tamil New Year season in April and the year-end festival season in December. Therefore, most farmers have cultivated the crop on at least 50% of their lands, targeting these two seasons.

Harvesting Time

Harvesting days vary depending on the type of banana and cultural practices. Fruit maturation usually occurs when the banana fruits change from green to light green, and they become less angular, assuming a more rounded shape. The ideal time for harvesting starts 12 weeks after flowering and should take place when the fruit is 90% full.

Table 6.1: Maturation Period of Banana Bunches since Flowering

Variety	Maturation Period
Ambul Banana	3 months
Seeni banana	4 months
Kolikuttu	4.5 months

Improving the Quality of Bunches

Just after the appearance of the banana bunch, it is advisable to cut off the banana flower, leaving about four inches from the last bunch. This results in a larger and reduces pest habitats. About 90% of surveyed farmers have practiced this method. Once the banana bunch has appeared, it is recommended to remove the last two hanging clusters to allow the remaining clusters to grow bigger. However, about 90% of the farmers who supply to the local market have not done this, as the last two clusters act as a 'cushion' during long-distance transport via trucks.

Application of a Cover

Banana bunches should be covered as soon as they are cut. This practice will reduce pest and disease damage and allow the bunches to have a uniform yellow colour when ripened, without spots and blemishes. However, this is not practiced by any small- scale farmer in the area. Only the two large-scale farmers have applied bags to cover the banana bunches.

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 is around 95%. This situation has not changed across pre - and post-crisis scenarios. However, the average weight of *ambul* banana 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). Consequently, the average yield from 1 acre of *ambul* banana was about 12,000 kg in the post-crisis scenario, which dropped by approximately 50% due to the economic crisis.

The average farm-gate price after the crisis (in 2023) was recorded as Rs. 67/kg, compared to the pre-crisis value of Rs. 37/kg (in 2019). Hence, the gross income during the first year of establishment was Rs. 4,444,000 in the pre-crisis situation, compared to Rs. 402,000 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

6.5 Loans, Insurance, and Supportive Services

Around 40% of the farmers obtained loans from the People's Bank, Regional Development Bank (RDB), and Farmer's Associations. The interest rate at RDB for perennial crop cultivation increased from 13% to 23% during the initial phase of the economic crisis. Consequently, the primary source of financing remained pawning of gold, as banks were somewhat hesitant to extend loans to farmers due to uncertainties about their income during the peak of the economic crisis. Notably, none of the farmers in the region had enrolled in a crop insurance scheme.

Farmers who purchased tissue-cultured plants through IARS received extension services from field officers associated with the institution. These officers visited the fields at least twice since transplanting and offered necessary advice over the phone. However, beyond these field officers, the involvement of AIs in providing extension services was minimal in the area. Most young farmers depended on advice from experienced farmers in banana cultivation.

6.6 Market Information, Transporting and Marketing

The majority of farmers receive market information via vendors in the particular *kesel pola* (banana market) situated in the area. Generally, they receive price, variety, and quality information prevailing at the *kesel pola* the day before. Two large-scale farmers have established buyers who come from the Eastern and Central Provinces, visiting the farm field and purchasing the quantity they need at an agreed-upon price. Before the economic crisis, about 10% of small-scale farmers also had vendors from other provinces visiting their fields and making purchases. Due to the rise in fuel prices, vendors stopped coming directly to the farm fields.

6.7 Traditional Supply Chain and Involved Intermediaries

The supply chain of banana in the surveyed area (figure 6.11) 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 sold through supermarket chain is minimal, compared to the total produce of the areas.

Depending on the price, variety, and quality information prevailing at the *kesel pola* the day before, 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 scales 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 commissions. The two largest *Kesel pola* in all three districts are Barawakumbuka *pola* and Sooriyawewa *pola*, which charge Rs. 30 per kolikuttu bunch and Rs. 20 per *ambul* banana bunch, regardless of the weight of the bunch.

Farmers have raised concerns about the high commission, especially considering the average weight of a banana bunch has remained around 10 kg, in the post-crisis situation. The farmers have to pay this commission. Next, vendors have to pay Rs. 1,000-RS. 1,800 per large lorry or truck and Rs 400 per Demo batta size lorry as a commission. The *pola* premises are maintained by the respective local authority (Pradeshiya Sabha).

The majority of vendors (60%) who come to the *pola* are from the Eastern Province, representing areas such as Batticaloa, Kaththankudi, and Akkaraipattu. 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 pre-crisis situation.

Source: HARTI Field Survey, 2023

Figure 6.9: Operations at a *Kesel Pola*

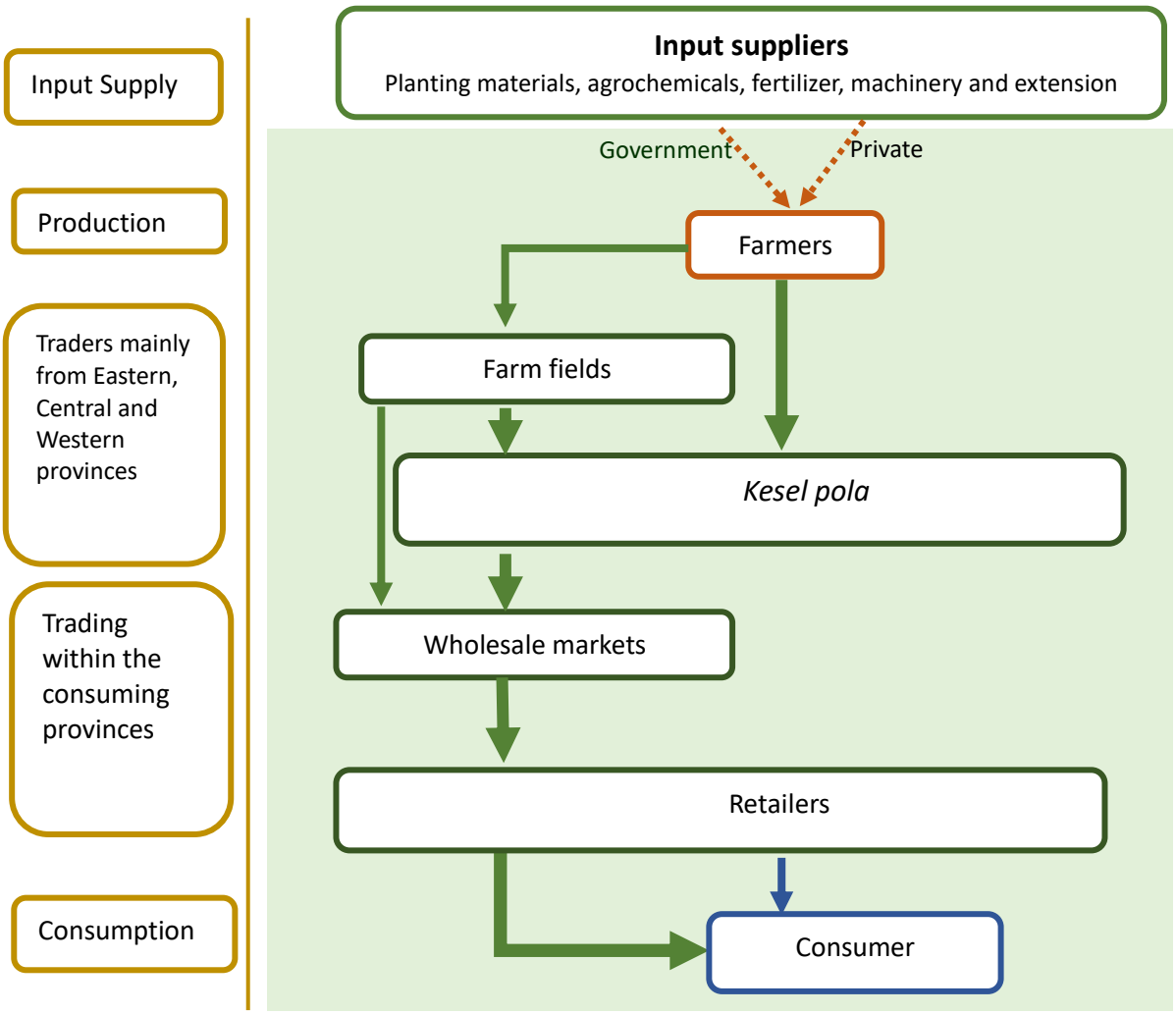
Source: HARTI Field Survey, 2023

Figure 6.10: Loaded Trucks Ready to be Transported

6.8 Maintenance of the Quality and Safety Standards

Bananas, being a climacteric perishable fruit, experience relatively high postharvest losses primarily during handling and transportation in the supply chain. Despite being harvested 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 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 Ekanayake and Bandara (2002), 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 (Figure 6. 10). Furthermore, unloading procedures at destinations lack care.



Source: HARTI Survey Data, 2023

Figure 6.11: Traditional Value Chains for Banana

6.9 Processing and Value Addition

The promotion of export-oriented fresh bananas and processed banana-related products presents a viable option to partially offset the challenges posed by the escalating prices of imported fertilizers and agro-chemicals due to the depreciation of the rupee. In Monaragala District and Hambantota District, there are three factories producing banana flour for export (sub-contracting for a supplier in Colombo). These export-oriented 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 to Rs.70/kg, which, is a profitable venture compared to the price (Rs. 90/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 kgs of bananas for each), many farmers find it challenging to access this lucrative market.

Identifying export opportunities and motivating local entrepreneurs to capitalize on them, fostering long-term agreements with foreign buyers, and introducing sustainable low-cost alternatives to address high electricity bills in factories are essential steps for uplifting the banana export sector.

Additionally, a new programme under the agricultural modernization initiative for exporting fresh bananas is underway in Monaragala, Kiriibbanara, and Hambantota - Agunakolapalassa. Around 150 *seeni* and *ambul* banana farmers in these selected areas have received seedlings and extension for plantation maintenance. The programme has promised farmers that a kilogram of fresh *seeni* and *ambul* bananas can be exported at a minimum price of Rs. 110/kg. Farmers believe that the programme, if successfully implemented, could be advantageous by offering them a fixed price for their produce.

Source: HARTI Survey Data, 2023

Figure 6.12: Banana Powder

Source: HARTI Survey Data, 2023

Figure 6.13: Dehydrated Banana Slices

6.10 Issues Related to Banana Production and Marketing

The concerns raised by banana farmers and processors in Hambantota, Monaragala and Rathnapura districts can be categorized into two main categories: longstanding structural issues and crisis-induced problems. The intensity of these issues may vary depending on the crisis phase. Table 6.2 describes the nature of these issues and their corresponding changes based on the crisis phase.

Table 6.2: Nature of These Issues and Their Corresponding Changes Based on the Crisis Phase

Issue	Nature of the Issue		Change depending on the phase of the crisis	
	Structural	Crisis Indued	Early Phase	Latter Phase
Threefold rise in price of imported, fertilizers, and agrochemicals		✓	same	same
Scarcity of tissue cultured seedlings		✓	same	same
Scarcity of healthy banana suckers		✓	severe	diminishing
High cost of machinery and spare - parts		✓	same	same
Unavailability of efficient and effective crop insurance system	✓		same	same
Have to repay high-interest rates for agricultural loans		✓	severe	diminishing
Insufficient fuel quota allocated for agriculture		✓	severe	no such issue
Not using proper transportation (e.g. over packing)	✓		severe	severe
High Post-harvest losses during transportation	✓		same	same
Collectors/ Transporters are reluctant to take necessary steps to preserve the quality during handling and transportation	✓		same	same

CHAPTER SEVEN

Effects of the Economic Crisis on Papaw Cultivation and Marketing

7.1 Papaw Cultivation – General Description

Papaw (*Carica papaya* L.) is one of the extensively grown and consumed fruits in Sri Lanka. It is a popular perennial cash fruit crop for small-scale farmers due to its potential for generating substantial annual economic income. As of 2022, papaw cultivation spanned 6,387 hectares of land in Sri Lanka, accounting for approximately 24% of the total fruit cultivation area in the country. Additionally, annual papaw production reached around 86.414 million fruits (DOA, 2022). According to statistical data, fresh papaw constituted the largest volume of exported fruit crops, with 16,075 tons shipped in 2021 (DOA, 2022).

Sri Lanka has a modest diversity of papaw, with variations in shape, colour, size, texture, and flavour, as well as distinct morphological characteristics. Compared to other fruit crops, papaw offers several advantages, including year-round fruiting, early maturity, high productivity per unit area, and diverse uses. As a result, it is widely cultivated both domestically and commercially and is regarded as having substantial potential for expansion (Saran and Choudhary, 2013).

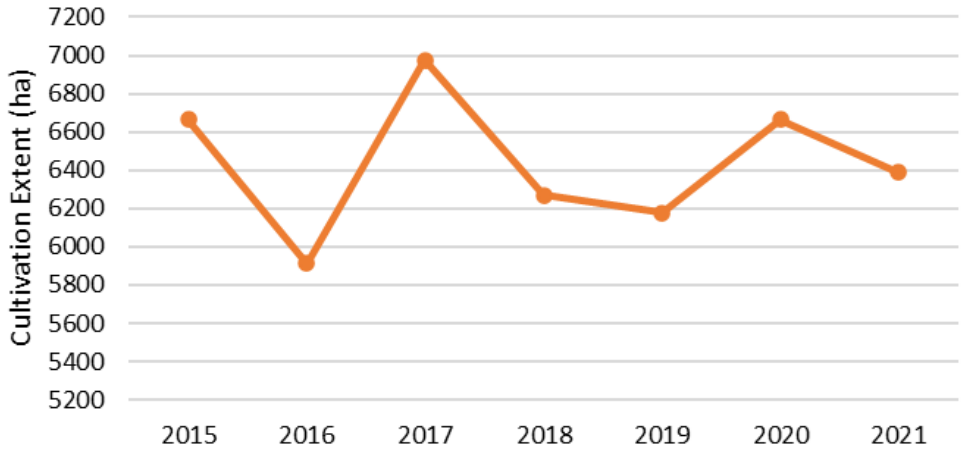
In Sri Lanka, several varieties are cultivated, including Rathna, Red Lady and Sinta, Horana papaw Hybrid and Tanin papaw. Among these, Red Lady is the most popular and widely consumed variety. Papaw cultivation is well suited to the Sri Lankan climate and is practiced in large, medium, and small-scale orchards as well as home gardens. According to the Fruit Research and Development Institute, the Horana Papaya Hybrid and Red Lady are the predominant varieties in the market. Papaw cultivation is prominent in several districts, including Anuradhapura, Moneragala, Rathnapura and Kurunegala.

7.2 Trend in Cultivated Extent

Based on data spanning from 2015 to 2021, the largest area dedicated to papaw cultivation was recorded in 2017, while the smallest was observed in 2016. The notable decline in papaw cultivation in 2021 can be attributed to disruptions caused by the COVID-19 pandemic, including transportation interruptions, market distortions, and reduced demand. The decline in papaw production has led to a decrease in the quantity of papaw available for marketing, resulting in limited supply and higher prices. This has affected not only the domestic market but also the export of fruits from Sri Lanka.

As depicted in Figure 7.1, from 2015 to 2021, the extent of banana cultivation in the country fluctuated over the years. This decline was primarily influenced by persistent

drought conditions in 2016 and 2019, and once again in 2021 due to pandemic-related challenges.



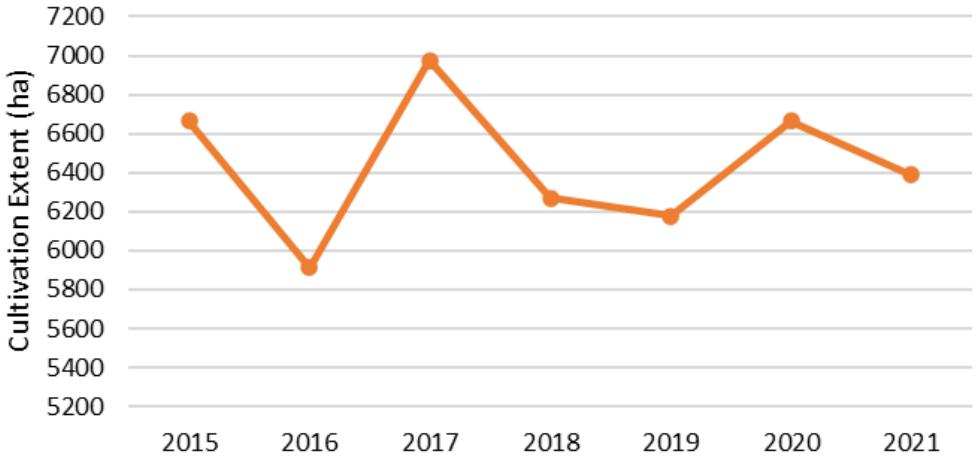
Source: Department of Census and Statistics

Figure 7.1: Trend in Cultivated Extent of Papaw (2015-2021)

When considering the overall average cultivated area between 2015 and 2021, Hambantota, Moneragala, Polonnaruwa, Kurunegala, and Anuradhapura were the districts with the highest papaw cultivation.

7.3 Trend in Production

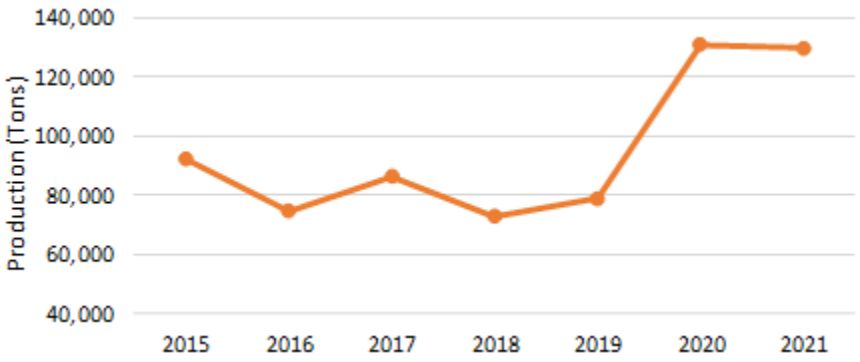
Currently, in Sri Lanka, the total annual papaw production is approximately 84,414 fruits, making it an attractive annual fruit crop due to its promising economic returns (Figure 7.2). Based on papaw production data, the yield has shown a gradual fluctuation from 2015 to 2021, except in 2020 and 2021.



Source: Department of Census and Statistics

Figure 7.2: Trend in Production Number of Papaws per Year (2015-2021)

Currently, in Sri Lanka, the total annual papaw production stands at approximately 129,621 tons, making it an appealing annual fruit crop due to its promising economic returns (Figure 7.3). The decrease in papaw production in 2019 was attributed to curfew conditions following terrorist attacks in the country, while the slight decline in 2021 was primarily due to the COVID-19 pandemic.

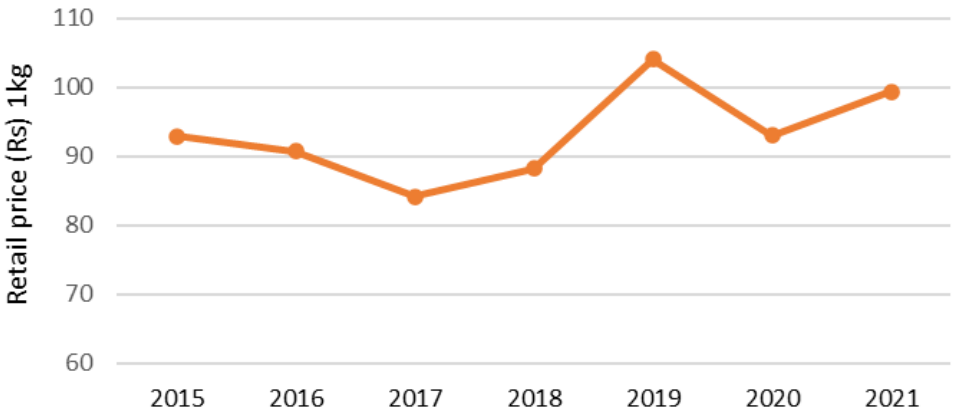


Source: Department of Census and Statistics

Figure 7.3: Trend in Production Tons of Papaws per Year (2015-2021)

7.4 Price Behaviour

Retail prices of papaw have increased in line with rising wholesale prices. Based on data from 2015 to 2021, the highest retail price of papaw was observed in 2019, while the lowest was recorded in 2017 (Figure 7.4).



Source: Department of Census and Statistics

Figure 7.4: Retail Price of One Kilogram of Papaws over Year (2015-2021)

7.5 Evaluation of the Effects of Economic Crisis

Focused Group Discussions (FGDs) were conducted with 5-10 farmers in each village across Thirappane, Yakalla, konwewa, Nochchiyagama, Gambirigaswewa, Ipalogama, and Jayagama in the Anuradhapura district to obtain primary data, with 100% male respondents. Another set of FGDs was conducted with 2-15 farmers in each village

across Rambe, Abanpola, Nagollagama, Maharachchimulla, and Dundeniya in the Kurunegala district. In this group, approximately 94% were of the participants were males, with ages ranging from 25 to 75 years.

Most farmers come from a family background in farming, relying on agriculture as their primary source of income. In the study areas, most of the farmers cultivate paddy and vegetables in addition to papaw, with common vegetables including long beans, cucumber, okra, luffa, kekiri, and pumpkin. Papaw cultivation experienced a 30% decrease on average compared to the pre-crisis situation in the study areas. However, around 10% of farmers completely abandoned farming. This decline was attributed to a combination of factors, including increased production costs, poor seed quality, scarcity and low quality of fertilizer and agro-chemicals, price hikes for these inputs reduced sales volume, and consequently, lower profits.

The majority of these farmers cultivate papaw on land ranging from 0.25 acres to 10 acres. Approximately 80% of farmers reported the low quality of agro-chemicals contributed to a high occurrence of fungal diseases in papaw. Affected fruits exhibited signs of premature rotting and increased susceptibility to secondary infections, leading to a significant decline in fruit quality, market value, and profit. Following the economic crisis the demand for Red Lady papaw declined by 40%, while the demand for Rathna papaw decreased by 35%, considering the market conditions.

7.5.1 Seedling - Suppliers, Rate and Price

The commercial-level seed producers of papaw identified by the respondents in the study areas included Onesh Private Limited, Horana Fruit Research and Development Institute (FRDI), CIC Holdings PLC, and Vega Seed Suppliers. However, more than 85% of farmers expressed dissatisfaction with the quality and the viability of the seeds provided.

In the Kurunegala district study area, the cultivated papaw varieties included Horana Papaya Hybrid, Tanin, Red Lady, Rathna, Sinta, and Sunrise. In the Anuradhapura district study area, the cultivated varieties were Red Lady, Sinta and Sunrise.

During the pre - crisis situation, in the Kurunegala district study area, the price of Horana Papaya Hybrid ranged from Rs. 4,500 to Rs. 9,000 (5g packet of seeds), the price of Tanin Papaya varied in the range of Rs. 4,500 to Rs. 5,000 (5g packet of seeds), and Red Lady varied in the range of Rs. 8,000 to Rs. 10,000 (5g packet of seeds). However, during the post-crisis situation, in the Kurunegala district study area, Horana Papaya Hybrid ranged from Rs. 10,000 to Rs. 16,500 (5g packet of seeds), the price of Tanin Papaya ranged from 13,500 to Rs. 15,000 (5g packet of seeds) and the price of Red Lady ranged from Rs. 13, 500 to Rs. 25,000 (5g packet of seeds).

During the pre-crisis period, in the Anuradhapura district study area, the price of Red Lady ranged from Rs. 15,000 to Rs. 18,000 (10g packet of seeds). During the post-crisis situation, Red Lady ranged from Rs. 23,000 to Rs. 25,000 (10g packet of seeds) in

the Anuradhapura district study area. According to papaw farmers, a 5g of seed packet contains between 365 to 390 seeds resulting in approximately 150 to 250 seedlings. The seed rate practiced by the farmers is 10g of seeds per acre, which produces around 650 to 700 seedlings.

7.5.2 Input Use - Fertilizer and Related Issues

Before the onset of the economic crisis, the majority of farmers followed the recommended application rates for urea, TSP, and MOP for papaw cultivation. They typically covered about 20% to 30% of their inorganic fertilizer needs using the surplus received as subsidized fertilizer. However, after the economic crisis and the subsequent ban on some inorganic fertilizer imports, along with the rise in fertilizer prices, 30% of fertilizer usage was reduced. This ultimately led to a decrease in production by around 20% to 40%.

The most popular inorganic fertilizer among farmers was the mixed fertilizer, priced at Rs.3,000 while other inorganic fertilizers included urea, MOP, TSP, magnesium sulfate, and potash. During the pre-crisis situation, the price of urea (50kg) ranged from Rs. 1,500 to Rs.4,000 MOP (50kg) ranged from Rs. 1,250 to Rs.3,500 and TSP (50kg) ranged from Rs. 1,350 to Rs. 3,500. However, during the post-crisis period, the price of urea (50kg) ranged from Rs. 10,000 to Rs. 12,500, MOP (50kg) ranged from Rs. 14,000 to Rs. 16,000 and TSP (50kg) ranged from Rs. 13,000 to Rs. 19,000.

Hence, it was observed that more than 85% of fertilizer prices increased after the economic crisis. Additionally, more than 90% of farmers expressed dissatisfaction with the quality and purity of the fertilizer, which were available at local shops and with suppliers.

Before the economic crisis, the price of poultry manure bags ranged between Rs. 100 to Rs. 200 and organic manure bags ranged between Rs. 200 to Rs. 300. However, after the economic crisis, poultry manure bags ranged between Rs. 500 to Rs. 600 and organic manure bags ranged between Rs. 600 to Rs. 750. According to the study, farmers revealed that they typically applied 2,500 kg of organic manure per week for Red Lady varieties and 1,500 kg for Sunrise varieties. However, with the onset of the economic crisis, farmers now apply only 500 kg per week.

7.5.3 Input Use – Argo-chemicals and Related Issues

According to the farmers, the frequently observed diseases were *Anthracnose,* Powdery Mildew and *Fusarium Wilt,* while the most common pest attack was from aphids. In the study, 80% of farmers reported the frequent occurrence of Anthracnose and Powdery Mildew. When faced with such diseases, farmers often purchase agro-chemicals based on advice from shop owners. However, it is advisable to consult a qualified agricultural specialist or extension agent for guidance on the appropriate use of agro-chemicals, rather than relying solely on recommendations from a shop owner who may lack the necessary expertise.

Most farmers used *Actara* fungicide, which provided fast elimination of sucking and chewing pests, preventing damage to crops before it started. *Actara* quickly penetrates the leaf's surface and eliminates pests within 24 hours while also providing residual control. Farmers reported using 10 to 12 tanks of *Actara* per hectare, with one tank requiring a 4g packet of *Actara.* Before the crisis, the price of a 4g packet of *Actara* ranged from Rs. 200 to Rs. 250, while after the crisis, it ranged from Rs. 400 to Rs. 450. According to the study, farmers indicated that the prices of weedicides and insecticides increased by 50% to 100% due to reduced availability within the country.

According to the farmers, they applied weedicides 7 times within one crop cycle. Generally, for one hectare of land, farmers used around 7 to 8 tanks (2 liters/tank) at a time. The cost for applying weedicides ranged between Rs. 12,000 to Rs. 15,000 before the economic crisis while after the crisis, it ranged between Rs. 45,000 to Rs. 70,000.

According to the farmers, they applied insecticides/pesticides used 250 to 300 tanks (2 liters/tank) within one crop cycle. The cost for applying insecticides/pesticides ranged between Rs. 10,000 to Rs. 15,000 before the economic crisis while after the crisis, it ranged between Rs. 35,000 to Rs. 65,000.

7.5.4 Input – Labour

Papaw cultivation was sometimes dependent on hired labour sometimes. Before the crisis, the utilization of hired labour accounted for 40%, with a slight decrease of 10% in the post-crisis period, attributed to the reduction in cultivated area. During pre-crisis period, the unit price of female labour ranged from Rs. 750 to Rs. 1,000 per day, while the unit price of male labour ranged from Rs. 1,000 to Rs. 1,500 per day. However, during post-crisis period, the unit price of female labour ranged from Rs. 1,000 to Rs. 1,300 per day, while the unit price of male labour ranged from Rs. 2,000 to Rs. 2,500 per day.

7.5.5 Input – Machinery

When preparing land (Dicks), the cost per one acre during the pre-crisis period ranged from Rs. 20,000 to Rs. 30,000, while during the post-crisis period, it ranged from Rs. 60,000 to Rs. 70,000. According to the farmers, the cost of transport during pre-crisis period ranged from Rs. 300 to Rs. 700 for 10 kilometers, while during post-crisis period, the transport cost ranged from Rs. 2,500 to Rs. 4,000.

7.5.6 Cost of Production and Harvesting

The cost of production per hectare during the pre-crisis period ranged from Rs. 200,000 to Rs. 400,000, while during post-crisis, the cost of production per hectare ranged from Rs. 500,000 to Rs. 800,000 in both Kurunegala and Anuradhapura study areas. During transportation, old newspapers were used to wrap the fruit. The cost of

1kg of newspapers during pre-crisis period ranged from Rs. 20 to Rs. 30, while during post- crisis, the cost of 1kg of papers ranged from Rs. 350 to Rs. 400 in both Kurunegala and Anuradhapura study areas.

In the Kurunegala study area, the harvesting during pre-crisis period ranged from 1.000 kg/ha to 2.500 kg/ha per week, while during post-crisis period, ranged from 500 kg/ha to 1.000 kg/ha per week. In the Anuradhapura study area, the harvesting during pre-crisis, ranged from 2,000 kg/ha to 2,500 kg/ha per week, while during post-crisis period, it ranged from 500 kg/ha to 1,200 kg/ha per week.

According to the farmers generally, they generally collected a harvest of 10,000 kg/month before the economic crisis. However, after the crisis, the monthly harvest decreased by 30%. During the economic crisis, farmers faced financial constraints that limited their ability to invest in agricultural inputs such as seeds, fertilizers, and machinery. This ultimately led to lower crop yields and reduced harvests.

7.6 Gross Income

The income per week during pre-crisis period ranged from Rs. 300,000 to Rs. 400,000, while during the post-crisis period, it ranged from Rs. 187,500 to Rs. 200,000 in the study areas. The economic crisis often results in reduced consumer purchasing power and changes in consumer behaviour. This can lead to decreased demand for agricultural products, including crops like papaw. The lower demand resulted in lower prices and reduced profitability for farmers, which discouraged them from investing in cultivation and contributed to reduced harvests.

7.7 Loans, Insurance, and Supportive Services

About 20% of the farmers obtained loans from the People's Bank, Regional Development Bank (RDB), and Farmer's Associations. The interest rate at RDB for papaw crop cultivation increased from 13% to 23% during the initial phase of the economic crisis. As a result, the primary source of financing became the pawning of gold, as banks were hesitant to extend loans to farmers due to uncertainties about their income during the peak of the economic crisis. Notably, none of the farmers in the region had enrolled in a crop insurance scheme.

7.8 Market Information, Transporting and Marketing

The majority of farmers receive market information through vendors at the local *Sathi pola* in the area. They typically gather price, variety, and quality information from the *Sathi pola* the day before. A few medium-scale farmers have established buyers from the Eastern and North-central Provinces who visit the farms and purchase the required quantities at an agreed-upon price. Before the economic crisis, about 10% of small-scale farmers also had vendors from other provinces visiting their fields to make purchases. However, due to the rise in fuel prices, vendors stopped coming directly to the farm fields.

7.9 Issues Related to Papaw Production and Marketing

The specific issues related to papaw farming in Sri Lanka are not extensively covered in the study. However, based on the current study, here are some general insights:

(i). Limited accessibility to quality seeds, fertilizers, and pesticides
(ii). Limited availability of agricultural inputs and high input costs
(iii). Damage from wild animals especially monkeys, peacocks, and elephants
(iv). Limited technical know how
(v). No guaranteed market
(vi). Water scarcity and inefficient irrigation facilities
(vii). Limited access to credit and financial services restricts farm modernization efforts

Addressing these challenges requires coordinated efforts from government agencies, agricultural extension services, research institutions, and the private sector to provide support, training, and resources to papaya farmers in Sri Lanka. Adopting sustainable farming practices, improving market access, and enhancing resilience to climate change are essential for the long-term viability of papaya farming in the country.

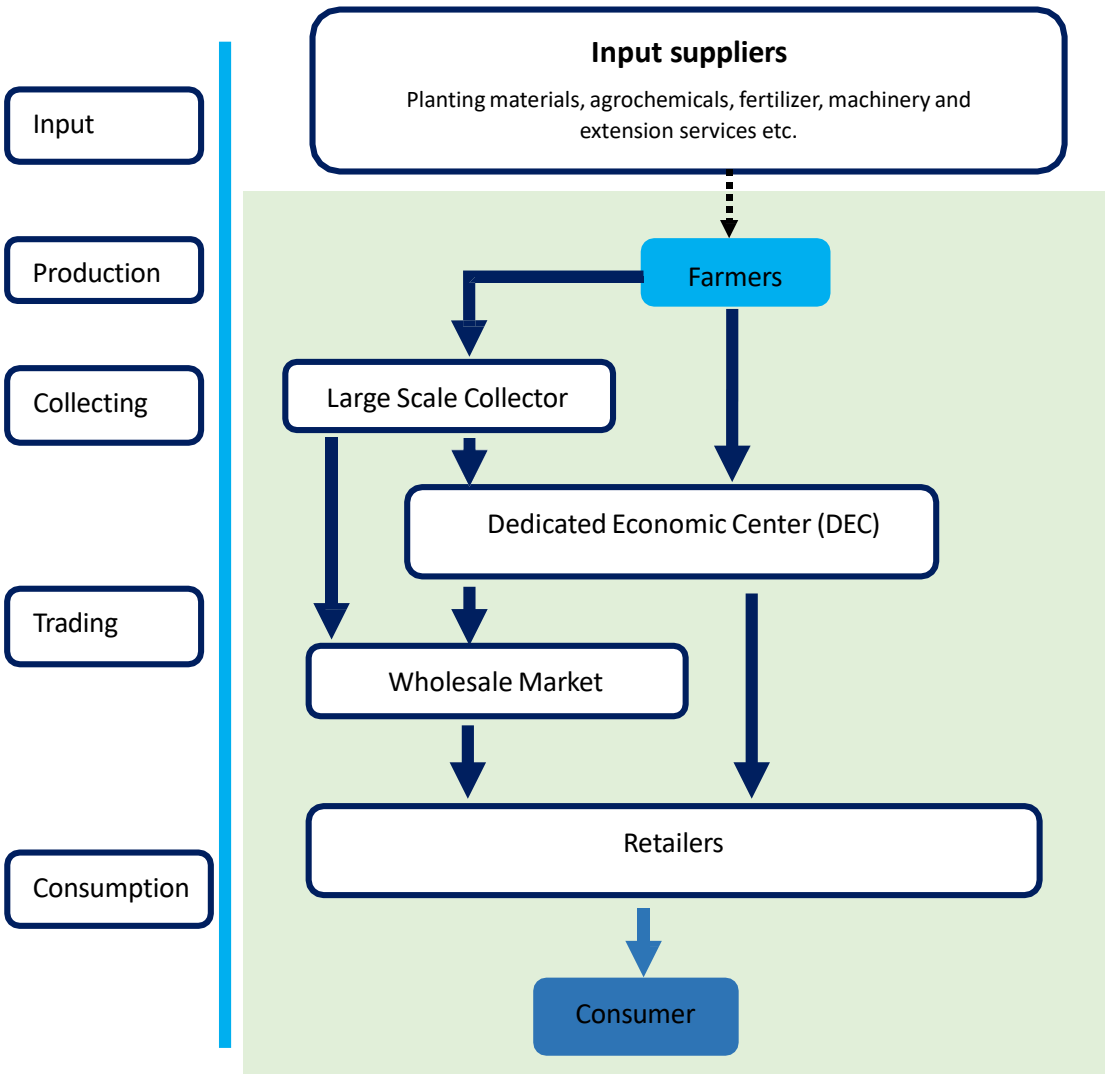
7.10 Supply Chains and Involved Intermediaries of Papaya

The major share of papaya production, around 62%, channels flow through the traditional value chain, which consists of five or more intermediaries. The diagram above shows the different channels of the papaya value chain. Among these, the most common value chain involves farmers, village level collectors and traders at the DEC. In this traditional supply chain, farmers sell their produce to the Dambulla, Thambuttegama, and Meegoda DECs.

Farmers arrange their own transport to the Dedicated Economic Centers (DECs). Those who sell directly to the DECs do so without intermediaries, dealing directly with agents at the centers. However, farmers lack strong bargaining power, which allows traders at the DECs to set the farm gate prices. In the Anuradhapura area, traditional value chain actors make minimal efforts to reduce post-harvest losses. Papaws are directly loaded into transport vehicles, with newspapers placed between them to cushion and minimize losses during transport. The produce is transported using the farmers' own vehicles or through collectors, with nearly 18% loss reported during transport.

The value chain maps (Figure 7.5) highlight the participation of diverse actors involved directly or indirectly in the value chain. Direct actors are those engaged in commercial activities within the chain, including input suppliers, producers, traders, consumers. Indirect actors provide financial or non-financial support services, such as credit agencies, business service providers, government, NGOs, cooperatives, researchers, and extension agents.

7.11 Traditional Supply Chain



Source: HARTI Survey Data, 2023

Figure 7.5: Traditional Supply Chain for Papaya

The primary stakeholders in the papaw value chain include seed and other input suppliers, farmers, traders, and consumers. Major inputs consist of planting materials, agro-chemicals, fertilizer, machinery, and extension services. Collectors are individuals who gather papaw from farmers in village markets to resell it to wholesalers and retailers. They leverage their financial resources and local knowledge to bulk papaw from the surrounding area. Collectors play an important role in the value chain, as they are familiar with surplus areas. Their trading activities include buying and assembling, repacking, sorting, transporting, and selling to wholesale markets.

Wholesalers primarily purchase papaw in large quantities from collectors and producers, more than any other intermediaries, and supply it to exporters, retailers,

and consumers. According to the study, wholesale markets serve as the main gathering points for papaw in their surrounding areas. These wholesalers have superior storage facilities, transportation, and communication access compared to other traders, which allows them to efficiently manage and distribute the produce.

Retailers play a crucial role in the papaw value chain by purchasing, transporting to retail shops, trading, displaying, and selling to consumers. They are essential partners, serving as the final link between producers and consumers. Typically, retailers buy papaw from wholesalers to sell to urban consumers, although they sometimes purchase directly from producers. Consumers prefer buying from retailers because they cater to their needs and purchasing power. Consumers, as the end-users, buy papaw for consumption. They can purchase papaw directly from producers, retailers, and wholesalers, though the majority buy from retailers. Farmers are also a significant segment of rural consumers, as they consume a portion of their own produce.

7.12 Modern Supply Chain

The modern supply chain (Figure 7.6) illustrates the different channels of the papaw value chain flow. Among them, the most common type of value chain is a farmer-village level collector-regional supermarket collecting center-central distribution center – supermarket - consumer. The primary actors in the modern value chain for papaya through supermarkets are the Keells supermarket chains. Unlike the traditional value chain, this modern chain emphasizes product quality. Farmers must register with supermarket collecting centers to sell their products through this channel.

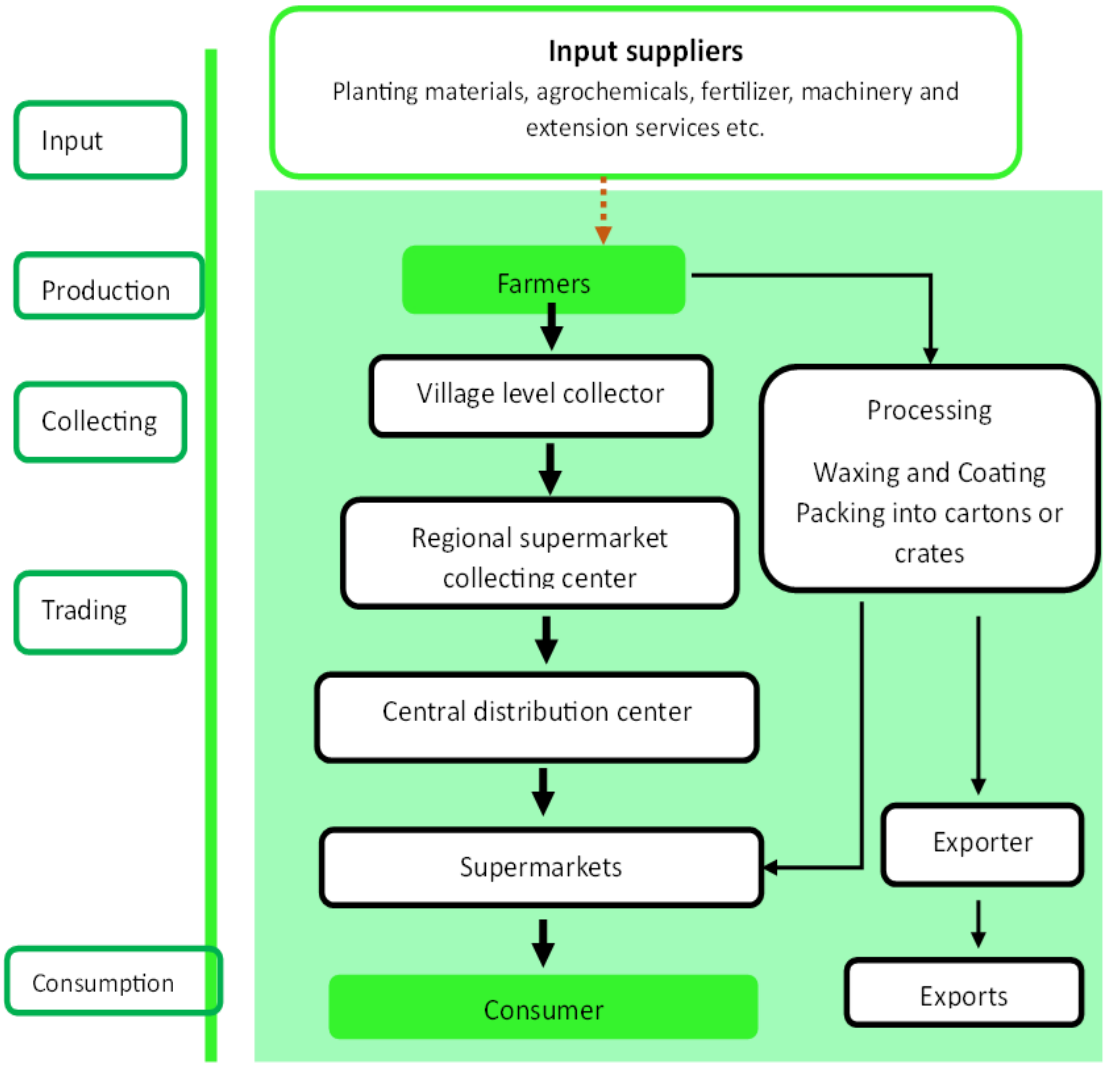
Most farmers used collectors' vehicles to transport papaya to the collecting center, while some use their own vehicles. At the collecting center, all products undergo a grading process, with lower-quality produce redirected through the traditional value chain via Dedicated Economic Centers (DECs). Farmers received pre-agreed farm gate prices, making them less susceptible to price fluctuations.

7.13 Comparison of Traditional and Modern Supply Chains

The most prevalent value chain for papaw was the traditional one, which operates through the DECs or other wholesale markets. The modern value chain is a more streamlined supply chain managed by supermarket chains and agribusiness companies. Compared to modern value chains, the traditional value chain is longer, involving five or more intermediaries between the farmer and the local consumer. In contrast, the modern value chain through supermarkets involves only 2-4 intermediaries, including the collection center, distribution center, and retail store, facilitating a more direct route from farmer to consumer.

In the modern supply chain, supermarket collection centers, such as the one at Thambuttegama, serve as focal points for quality control and consumer feedback. Farmers bring their produce to these centers, where papaws are collected daily based

on specified quality and quantity requirements. Papaws that meet these standards are purchased by the supermarket collection center, while those that do not are returned to the farmers. Farmers can sell their produce at higher prices to the supermarket collection center compared to the traditional market channel. A considerable share of papaya production (16%) is channeled through the supermarket value chain, which consists of four intermediaries.



Source: HARTI Survey Data, 2023

Figure 7.6: Modern Supply Chain of Papaw

7.14 Issues Related to Papaya Production and Marketing

The concerns raised by papaya farmers and processors in the Kurunegala and Anuradhapura districts can be classified into two main categories: longstanding structural issues and crisis-induced problems. The intensity of both types of issues may vary depending on the crisis phase. Table 7.1 outlines the nature of these issues and their corresponding changes based on the crisis phase.

Table 7.1: Nature of Issues and Their Corresponding Changes Based on the Crisis Phase

Issue	Nature of the Issue		Change Depending on the Phase of the Crisis	
	Structural	Crisis Indued	Early Phase	Latter Phase
Threefold rise in price of imported, fertilizers, and agrochemicals		✓	same	same
Scarcity of high-quality seed		✓	severe	diminishing
High cost of machinery and spare parts		✓	same	same
Unavailability of efficient and effective crop insurance system	✓		same	same
Have to repay high-interest rates for agricultural loans		✓	severe	diminishing
Insufficient fuel quota allocated for agriculture		✓	severe	No such issue
Not using proper transportation (e.g. over packing)	✓		severe	severe
Post-harvest losses throughout the supply chain	✓		same	same
Collectors/ Transporters are reluctant to take necessary steps to preserve the quality during handling and transportation	✓		same	same
Not exploited the full potential for value addition	✓		same	same

CHAPTER EIGHT

Margin Analysis

8.1 Margin Analysis for Considered Horticultural Produce

Margin analysis was conducted using secondary data collected by HARTI across 19 farmgate locations, 34 wholesale locations and 45 retail locations. The analysis considered farmgate prices in each producing area and market prices at major wholesale and retail outlets in Colombo and its Suburbs for each supply chain. The percentage share of the retail price acquired by farmers, collectors, and wholesalers was calculated as follows:

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

$$\text{Whole seller's Margin} = \frac{\text{Wholesale price – Farmgate price X 100}}{\text{Retail Price}}$$

The impact of intermediaries on the vegetable marketing channel was assessed by analyzing their marketing margin. The market margin is the difference between the price paid by the final consumer and the price received by the producer or farmer. It encompasses all costs associated with assembling, transporting, retailing and profit margins added to the farm products essentially the cost of providing a range of marketing services, (Khan *at el*. 2005).

$$\text{Retailers' Margin} = \frac{\text{Retail price – Wholesale price}}{\text{Retail Price}} \text{ X 100 Retail Price}$$

The data used for the analysis comprised HARTI's weekly farmgate, wholesale and retail price data for two periods: 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 2022 to the 4th week of August 2023 (After the crisis, AC).

Table 8.1: Market Margin Analysis

Commodity	Situation	BC (2018-2019) %	AC (2022-2023) %
Beans	Farmers' Margin	52.5	58.9
	Wholesalers' Margin	10.3	13.0
	Retailers' Margin	37.2	28.1
Brinjal	Farmers' Margin	43.2	53.0
	Wholesalers' Margin	8.4	11.6
	Retailers' Margin	48.8	35.3
Papaya	Farmers' Margin	60.8	64.4
	Wholesalers' Margin	24.2	21.4
	Retailers' Margin	38.5	40.6
Banana (*Ambul*)	Farmers' Margin	36.9	27.2
	Wholesalers' Margin	13.1	42.5
	Retailers' Margin	49.9	30.4
Banana (*Kolikuttu*)	Farmers' Margin	51.1	56.8
	Wholesalers' Margin	16.0	21.1
	Retailers' Margin	33.0	22.2

*BC – Before the economic crisis *AC – After the economic crisis

The assessment of market margins before (BC) and after (AC) the crisis revealed that, except for banana (*Ambul)*, farmers experienced increased margins ranging from 4.4% to 10%. In contrast, wholesalers saw their margins rise by 2.7% to 29.4%, except for papaya, while retailers faced a margin decline of 2.5% to 19.5% (Table 8.1). If the marketing channel remains unchanged, increasing farmers' margins is typical outcome of rising retail prices.

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

Price stability was assessed using the coefficient of variation (CV) which indicates the percentage change in the price relative to mean price. Weekly farmgate prices in major producing areas and weekly retail price series in Colombo and its suburbs were analyzed. The analysis compared data from May 2018 to November - 2019 (before the crisis) with data from May 2022 to November 2023 (After crisis).

CV was calculated by using following formula.

$$CV = \frac{\text{Standard deviation of the prices} \times 100}{\text{Mean price of the particular horticultural commodity}}$$

After calculating the CV values, ANOVA was applied to determine whether price variations across different provinces differed significantly before and after crisis.

8.3 Calculation of CV values

Table 8.2: Coefficient of Variance Values

Variable	Beans	Brinjal	Banana *(embul)*	Banana *(kolikuttu)*	Papaya
Retail Prices					
Before Crisis % (2018-2019)	31.95	17.84	11.07	10.07	35.11
After Crisis % (2022-2023)	23.17	20.92 ⇧	25.50 ⇧	23.69 ⇧	23.19
Farmgate prices					
Before Crisis % (2018-2019)	46.37	38.79	22.66	26.20	62.03
After Crisis % (2022-2023)	36.25	33.42	36.58 ⇧	29.36 ⇧	39.95

Price variations, measured by the Coefficient of Variation (CV), showed mixed results between the pre-crisis and post-crisis periods. Before the crisis, papaya exhibited the highest price variation at 35%, while banana (*Kolikuttu*) had the lowest variation at 10%. However, the crisis shifted the magnitude of CV certain commodities, with banana (*Ambul*) experiencing the highest variation at 25.5%. Notably, the crisis led to increased CV in brinjal and two banana varieties, while reducing it in beans and papaya.

Similarly, for farmgate prices, papaya had the highest CV at 62% before the crisis, while banana (*Ambul*) had the lowest at 22.6%. Even after the crisis, papaya remained the most volatile, with a CV of 39.9%. The commodity with the lowest CV shifted to banana (*Kolikuttu*) at 29% after the economic crisis. As Tothova, (2011) noted, while price volatility is a typical outcome of supply disruptions amidst steady demand, heightened economic and environmental uncertainty can amplify such fluctuations. Accordingly, increased CV in retail prices was observed for three out of five commodities analyzed.

8.4 The Application of Analysis of Variance (ANOVA)

The objective of applying ANOVA is to determine whether there is a significantly different price variations before and after crisis for the selected commodities.

Hypothesis:

Ho – There is no difference in farmgate prices of the selected commodities due to the economic crisis.

H1 – There is a difference in farmgate prices of the selected commodities due to the economic crisis.

Ho – There is no difference in retail prices of the selected commodities due to the economic crisis.

H1 – There is a difference in retail prices of the selected commodities due to the economic crisis.

The data was sourced from the HARTI database. Weekly farmgate in major producing areas and weekly retail prices in Colombo and its suburbs from May 2018 to August-2019 (before crisis) were compared with weekly farmgate and retail prices from May 2022 to August 2023 (after crisis).

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

Next, various tests were conducted to check if the data met the assumptions of ANOVA: independent samples, normally distributed experimental errors, equality in group variances and homogeneity of variances (homoscedasticity).

After developing the linear model, the Shapiro-Wilk Test was conducted on the residuals to assess whether the model errors are normally distributed. The null hypothesis of the Shapiro-Wilk Test states that the model errors follow a normal distribution. Next, the Ramsey RESET Test was performed to determine whether the linear functional form is the most appropriate or if there is a significant nonlinear relationship.

Subsequently, Breusch-Pagan Test (*bptest*) was conducted to check whether the residuals of the linear model are homoscedastic. The null hypothesis of the Breusch-Pagan Test is that the residuals have constant variance. Following this, the Bartlett Test was performed to assess the homogeneity of variances across all groups, with the null hypothesis stating that all group variances are equal. In the presence of heteroscedasticity, a heteroscedasticity-robust ANOVA Test was applied, using the heteroscedasticity-robust covariance matrix.

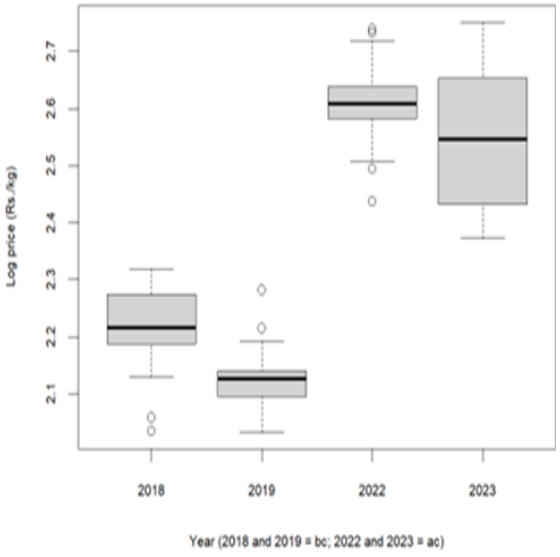


Figure 8.1: Comparing the Median Retail Prices (log) of Beans across Years

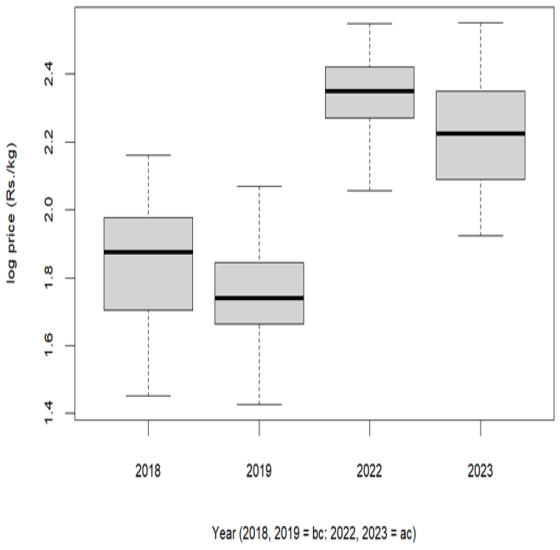


Figure 8.2: Comparing the Median Farm Gate Prices (log) of Beans across Years

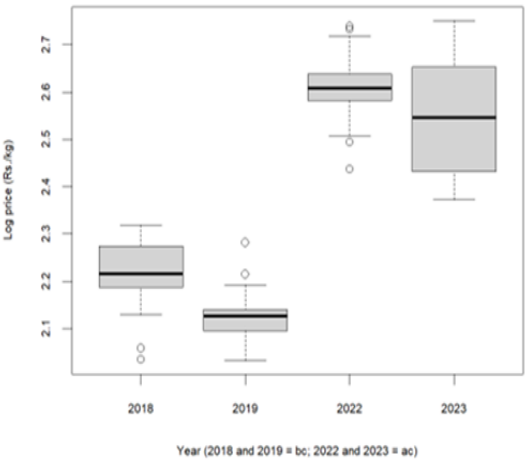


Figure 8.3: Comparing the Median Retail Prices (log) of Brinjal across Years

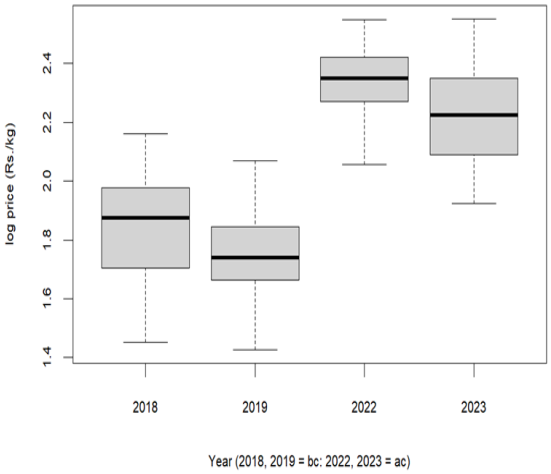


Figure 8.4: Comparing the Median Farmgate prices (log) of Brinjal across Years

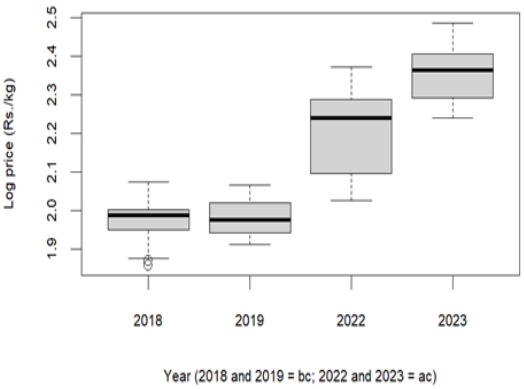


Figure 8.5: Comparing the Median Retail Prices (log) of (*Ambul*) across Years

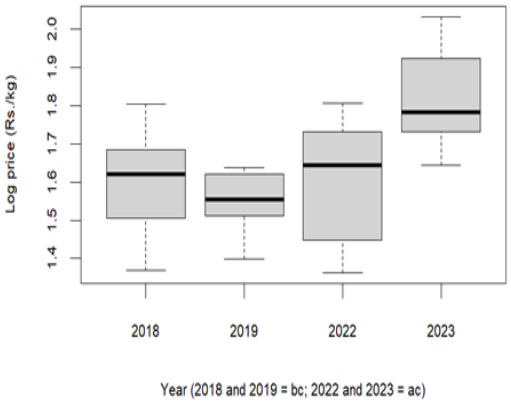


Figure 8.6: Comparing the Median Farmgate Prices (log) of Banana (*Ambul*) across Years

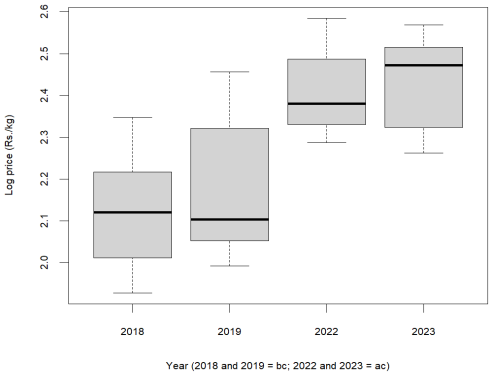


Figure 8.7: Comparing the Median Retail Prices (log) of Papaya across Years

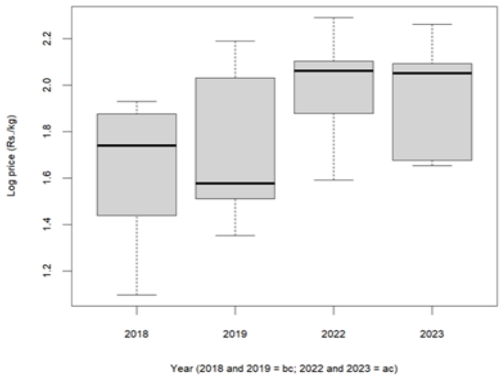


Figure 8.8: Comparing the Median Farmgate Prices (Log) of Papaya Across Years

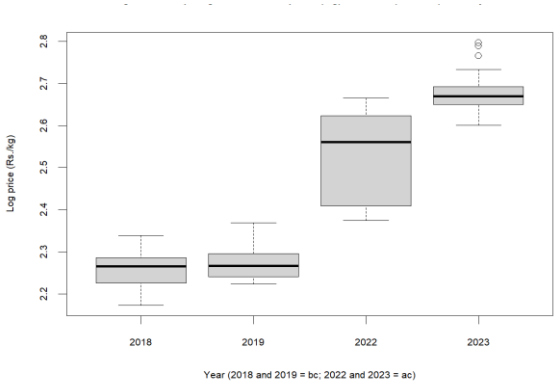


Figure 8.9: Comparing the Median Retail Prices (log) of *Kolikuttu* across Years

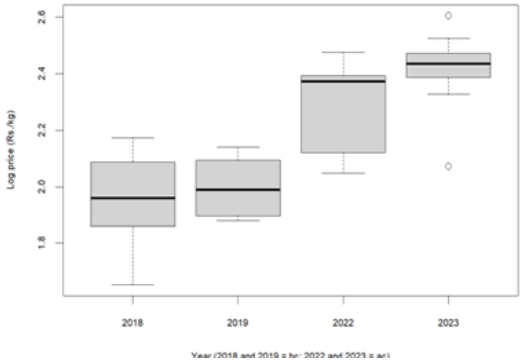


Figure 8.10: Comparing the Median Farmgate Prices (log) of *Kolikuttu* across Years

Figure 8.1 to 8.10 show that median prices in 2022 and 2023 (post crisis) were higher compared to 2018 and 2019 (pre-crisis). For banana (*Ambul*) and brinjal, both the prices and the dispersion increased in the post crisis scenario. Tukey's post-hoc test was conducted to perform pairwise comparison between the different groups and identify where those differences lie (table 8.3 - 8.7).

Table 8.3: Tukey's Pairwise Comparisons of Beans Prices

Two-way ANOVA Multiple Comparisons of Means: Tukey Contrasts	Beans Retail Prices		Beans Farmgate Prices	
	Coefficient	P value	Coefficient	P value
bc.2019 - bc.2018	-0.11435	< 0.001 ***	-0.17494	0.00139 **
ac.2022 - bc.2018	0.36819	< 0.001 ***	0.40940	< 0.001 ***
ac.2023 - bc.2018	0.27961	< 0.001 ***	0.27022	< 0.001 ***
ac.2022 - bc.2019	0.48254	< 0.001 ***	0.58435	< 0.001 ***
ac.2023 - bc.2019	0.39396	< 0.001 ***	0.44516	< 0.001 ***
ac.2023 - ac.2022	-0.08858	0.00975 **	-0.13919	0.01812 *

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05

Table 8.4: Tukey's Pairwise Comparisons of Brinjal Prices

Two-way ANOVA Multiple Comparisons of Means: Tukey Contrasts	Brinjal Retail Prices		Brinjal Farmgate Prices	
	Coefficient	P value	Coefficient	P value
bc.2019 - bc.2018	-0.09394	< 0.001 ***	-0.10135	0.0386 *
ac.2022 - bc.2018	0.39158	< 0.001 ***	0.49743	< 0.001 ***
ac.2023 - bc.2018	0.32301	< 0.001 ***	0.39241	< 0.001 ***
ac.2022 - bc.2019	0.48551	< 0.001 ***	0.59879	< 0.001 ***
ac.2023 - bc.2019	0.41694	< 0.001 ***	0.49377	< 0.001 ***
ac.2023 - ac.2022	-0.06857	0.00205 **	-0.10502	0.0298 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05

Table 8.5: 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 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05

Table 8.6: Tukey's Pairwise Comparisons of Banana (kolikuttu) Prices

Two-way ANOVA Multiple Comparisons of Means: Tukey Contrasts	Banana (*kolikuttu*) Retail Prices		Banana (*kolikuttu)* Farmgate Prices	
	coefficient	P value	coefficient	P value
bc.2019 - bc.2018	0.0156	0.435	0.03827	0.5516
ac.2022 - bc.2018	0.2661	< 0.001 ***	0.32850	< 0.001 ***
ac.2023 - bc.2018	0.4173	< 0.001 ***	0.46127	< 0.001 ***
ac.2022 - bc.2019	0.2505	< 0.001 ***	0.29023	< 0.001 ***
ac.2023 - bc.2019	0.4017	< 0.001 ***	0.42300	< 0.001 ***
ac.2023 - ac.2022	0.1511	< 0.001 ***	0.13277	< 0.001 ***

Table 8.7: Tukey's Pairwise Comparisons of Papaw Prices

Two-way ANOVA Multiple Comparisons of Means: Tukey Contrasts	Papaw Retail Prices		Papaw Farmgate Prices	
	Coefficient	P value	Coefficient	P value
bc.2019 - bc.2018	0.006005	0.958	0.08213	0.55299
ac.2022 - bc.2018	0.223806	< 0.001 ***	0.36423	< 0.001 ***
ac.2023 - bc.2018	0.378495	< 0.001 ***	0.28435	< 0.001 ***
ac.2022 - bc.2019	0.217801	< 0.001 ***	0.28211	< 0.001 ***
ac.2023 - bc.2019	0.372489	< 0.001 ***	0.20223	0.00933 **
ac.2023 - ac.2022	0.154688	< 0.001 ***	-0.07988	0.35537

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05

As shown in Tables 8.3, 8.4, 8.5, 8.6, and 8.7, the median values for each price series—retail and farmgate prices for the years 2018, 2019, 2022, and 2023 - differ significantly different at a 5% level. Additionally, all pre-crisis scenarios differ significantly from post-crisis scenarios at the 5% level.

Additionally, Figures 8.1, 8.2, 8.3, and 8.4 show that the median values after the crisis were significantly higher than the corresponding pre-crisis median values.

However, the retail and farmgate price series for banana (*Ambul*) exhibit distinct behaviours before and after the crisis. In the case of the banana (*Ambul*) retail price series, all pre-crisis versus post-crisis median values were significantly different at the 5% level. Furthermore, all post-crisis median values were significantly higher than their respective pre-crisis counterparts (see Figure 8.5). However, the 2022 farmgate price (post-crisis) was not significantly higher than the 2018 or 2019 median values (Table 8.3). This suggests that banana (*Ambul*) farmers were worse off during the economic crisis, as they did not receive higher farmgate prices despite the increase in retail prices.

For the remaining fruit varieties under consideration - banana (*Kolikuttu*) and papaya - all pre-crisis scenarios (both retail and farm gate price series) show significant differences from all post-crisis scenarios (both retail and farm gate price series) at the 5% level (see Tables 8.6 and 8.7).

Additionally, Figures 8.7, 8.8, 8.9, and 8.10 show that the median values post-crisis were significantly higher than the corresponding pre-crisis median values.

8.5 Vertical Integration of Fruits and Vegetable Markets: Pre and Post Economic Crisis Scenarios

Vertical integration, including both forward and backward integration, is a critical factor influencing the market structure and competitiveness of agricultural commodity markets (Grega, L. 2003). Analyzing the correlation between producer, wholesaler, and retailer prices offers valuable insights into the efficiency of the marketing channel and the level of market competition (Weldesenbet, 2013). Price transmission plays a key role in interconnected markets for agricultural commodities. The effective transmission of price fluctuations between different market levels - such as from retail to farmgate or vice versa—has the potential to drive agricultural development (Kharin, 2015).

Consequently, the study aims to analyze the transmission of farm-gate to retail prices during an economic crisis in Sri Lanka, with a focus on understanding how the crisis affects various agricultural commodities. Table 8.8 presents the variables used in the cointegration analysis.

Table 8.8: Variables used in Cointegration Test

Situation	Variable (weekly price series)	Time Period	Unit
Before the economic crisis (Normal situation)	Beans - Farmgate	2005-2019	Rs./Kg
	Beans - Retail	2005-2019	Rs./Kg
	Brinjal - Farmgate	2005-2019	Rs./Kg
	Brinjal - Retail	2005-2019	Rs./Kg
	Papaya - Farmgate	2005-2019	Rs./Kg
	Papaya - Retail	2005-2019	Rs./Kg
	Banana (embul) - Farmgate	2005-2019	Rs./Kg
	Banana - Retail	2005-2019	Rs./Kg
	Banana (kolikuttu) - Farmgate	2005-2019	Rs./Kg
	Banana - Retail	2005-2019	Rs./Kg
After the economic crisis (Crisis situation)	Beans - Farmgate	2022-2023	Rs./Kg
	Beans - Retail	2022-2023	Rs./Kg
	Brinjal - Farmgate	2022-2023	Rs./Kg
	Brinjal - Retail	2022-2023	Rs./Kg
	Papaya - Farmgate	2022-2023	Rs./Kg
	Papaya - Retail	2022-2023	Rs./Kg
	Banana - Farmgate	2022-2023	Rs./Kg
	Banana - Retail	2022-2023	Rs./Kg
	Banana (kolikuttu) - Farmgate	2022-2023	Rs./Kg
	Banana - Retail	2022-2023	Rs./Kg

To represent the pre-crisis situation, both farmgate and retail price series (weekly) from 2005 to 2018 was considered with each series consisting of 780 data points. The post-crisis situation was represented by the retail price series (weekly) from 2022 to 2023, comprising 104 data points.

Table 8.9: Cointegration Test Results

Situation	Variable (weekly price series)	Stationarity test on residuals	Interpretation
Before the economic crisis (Normal situation)	Beans - Farmgate vs. Beans - Retail	-10.927***	Cointegrated
	Brinjal - Farmgate vs. Brinjal - Retail	-8.256***	Cointegrated
	Papaya - Farmgate vs. Papaya - Retail	-4.097***	Cointegrated
	Banana (*Ambul*) - Farmgate vs. Banana - Retail	-3.401***	Cointegrated
	Banana (*Kolikuttu*) - Farmgate vs. Banana - Retail	-4.296***	Cointegrated
After the economic crisis (Crisis situation)	Beans - Farmgate vs. Beans -Retail	Both time series is stationary	Does not apply
	Brinjal - Farmgate vs. Brinjal -Retail		Does not apply
	Papaya - Farmgate vs. Papaya - Retail	One series is Stationary	Does not apply
	Banana (*Ambul*) - Farmgate vs. Banana - Retail	-3.401***	Cointegrated
	Banana (*Kolikuttu*) Farmgate - vs. Banana - Retail	-1.874***	Cointegrated

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05

As the first step, the farmgate and the corresponding retail price series were tested for stationarity using the KPSS Test. If either or both series are stationary, a cointegration test cannot be performed. If both series are non-stationary, the integrated order of each series is examined. If both series are integrated of the same order [e.g., I(1) or I(2)], the Engle-Granger cointegration test is conducted, and the stationarity of the residuals is tested using the KPSS test. If the residuals are stationary, the two-time series are cointegrated, indicating a long-term relationship.

As shown in table 8.9, the farmgate and the retail price series of all considered commodities were cointegrated in the pre-crisis scenario. However, , in the post-crisis scenario, only two price series met the necessary conditions to conduct the Engle-Granger cointegration test; banana (*Ambul*) - farmgate vs. banana - retail price series and the banana (*Kolikuttu*) farmgate - vs. banana (*Kolikuttu*) retail price series. Both of these series exhibited a long-term relationship, or in other words, were cointegrated with their corresponding retail price series (table 8.9).

Literature suggests that the extent of price transmission within the agricultural product supply chain affects both the market efficiency and the welfare of consumers and producers (Capps and Sherwell, 2007). Factors such as market power abuse, product perishability, distortions in price reporting, information asymmetry, and disconnections in the value chain can contribute to asymmetric price transmission in agricultural products (von Cramon-Taubadel and Meyer, 2000; Cutts and Kirsten, 2006).

The cointegration analysis revealed insufficient evidence of an economic crisis-induced value chain disconnection leading to price transmission asymmetry among the considered commodities. However, it was evident that three out of five time series did not fulfill the necessary conditions to conduct the Engle-Granger cointegration test. This could be attributed to the analysis being conducted shortly after the crisis, which resulted in a limited number of data points in each post-crisis series –each consisting of only 104 data points.

CHAPTER NINE

9.1 Discussion of the Results

All the crops under evaluation — beans, eggplant, two banana varieties (ambul and kolikuttu), and papaya — experienced a significant reduction in cultivated area due to the negative impacts induced of the crisis.

The crisis led to a threefold increase in production costs, scarcity of planting materials, poor quality inputs, decreased demand, lower sales volumes, and subsequently, reduced profits. Crops dependent on imported seeds faced shortages of both seeds and organic fertilizer at the onset of the economic downturn. Meanwhile, crops reliant on locally sourced planting materials struggled with disrupted supply chains, resulting in lower profits and insufficient funds for reinvestment, leading to shortages of healthy suckers for replanting.

The reduction in cultivated area, led to a shift from hired labour to family labour across all crops. Some large-scale fruit farmers who previously relied heavily on hired labour downsized to small-scale farming, significantly replacing hired labour with family labour.

Fertilizer application decreased noticeably across all crops, both in terms of quantity and frequency, resulting in reduced fruit weights. Additionally, farmers shifted from high-risk varieties to low-input, resilient varieties.

The sharp rise in the cost of imported seeds and agro-chemicals posed a significant challenge for all crops. However, farmers practicing GAP applied lower levels of agro-chemicals than traditional growers. For instance, in bean cultivation, GAP farmers spent approximately 20% less on agro-chemicals and inorganic fertilizers compared to traditional farmers. In the Nuwara Eliya district, the production cost of green for GAP farmers was 50% lower than that of traditional farmers.

Although the main marketing channels for the selected vegetables and fruits remained unchanged, sales volumes declined, along with the number of transporters and vendors involved in each channel, with banana experiencing the most significant drop.

In particular, fruit farmers adopted various market diversification strategies such as selling smaller quantities to different buyers, including wholesale shops, village collectors, *pola* markets, companies for value addition, and collectors from other provinces who purchased directly from the fields. Processed fruit-based export-oriented factories typically purchase grade two fruits, enabling farmers to earn higher prices for relatively lower-quality produce. However, due to the limited scale of these operations, only a small number of farmers benefit from them.

The assessment of market margins pre- and post-crisis revealed that, apart from banana, farmers experienced increased margins. Conversely, except for papaya, wholesalers also saw their margins rise, while retailers faced margin declines. When marketing channel remains relatively stable, it is common for farmers' margins to increase as retail price rises.

The analysis of market integration between retail and farmgate prices indicated that banana markets remained integrated despite the crisis.

Price variations between pre and post crisis periods showed mixed results. Retail prices for brinjal and banana fluctuated more after the crisis, while beans and papaya retail prices showed less variation compared to Pre and Post crisis. Additionally, ANOVA calculations revealed a significant difference in median retail prices before and after the crisis, with post-crisis prices notably higher. However, except for *Ambul* banana, farmgate prices followed a similar pattern. For *Ambul* banana farmgate prices, post-crisis prices were not significantly higher than pre-crisis prices. Therefore, it is evident that *Ambul* banana farmers were the most negatively impacted by the economic crisis

9.2 Conclusions

Amidst changes in production and marketing strategies, several notable alterations have emerged. These include a reduction in cultivated acreage (beans - 30%, brinjal 25%, banana - 45%-60%, papaya - 20%), a shift from hired labour to family labour (in banana - 60%), and a decreased application of fertilizers, both in terms of quantity (by 10- 45%) and frequency.

In the case of fruits, low fertilizer application has led to a decline in the weight of banana bunches by approximately 45-65% and decline in the weight of papaya fruit by around 15%. Moreover, with respect to with respect to 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*.

Low quality of imported seeds has been mentioned as a common problem by brinjal farmers, while low quality of available agro-chemicals has been mentioned by all farmers.

Whereas, among banana farmers, the shortage of high-quality planting materials (both healthy suckers and tissue cultured seedlings) has significantly impeded cultivation efforts.

The main marketing channels (traditional channel) for the considered vegetables and fruits remain unchanged. However, the volume of sales and the number of transporters and vendors involved in each marketing channel have dropped in the range of 15-40% with the highest drop recorded for banana.

The assessment of market margins before and after the crisis indicated that, apart from banana (*Ambul)*, farmers saw their margins rise between 3.6 - 9.8%, whereas, except for papaya, retailers experienced a margin decrease ranging from 9.1 to 19.5%.

An analysis of market integration between retail and farmgate prices indicated that banana markets remained integrated even after the crisis. Moreover, there was a significant difference in mean retail prices and farmgate prices, before and after the crisis, except for *Ambul* banana. Post-crisis prices were notably higher compared to pre-crisis levels.

Of all the varieties, *Ambul* banana suffered the most negative impact due to the economic crisis.

Enhancing agricultural productivity through promotion of the GAP initiative and boosting export opportunities were identified as the primary strategies to mitigate the adverse effects of rising input costs. Proposed crop specific interventions included improving access to high-quality seeds for papaya and tissue-cultured banana seedlings, adopting GAP to reduce excessive agro-chemical use in brinjal cultivation, and introducing durable alternatives for support stakes for bean plants.

9.3 Policy Implications

Urgent regulatory actions are necessary to supervise the pricing and quality standards of imported seeds, fertilizers, and agro-chemicals. Immediate steps are crucial to eliminate illegal agro-chemicals from the market.

Encouraging widespread adoption of GAP among farmers can decrease production costs, especially in agro-chemical expenses, and boost productivity to counteract rising input costs.

Promoting the export of value-added fruit products provides a viable solution to mitigate the effects of increased prices of imported inputs due to currency devaluation. This includes identifying export opportunities, incentivizing local entrepreneurs, establishing long-term contracts with international buyers, and implementing sustainable methods to address high electricity costs. Establishing a knowledge hub for commodity exporters is also essential for sharing vital information and practical experiences.

Introducing cost-effective and durable support sticks for bean farmers can effectively reduce production costs.

Expanding access to tissue-cultured plants of the *Ambul* variety, with its high fruiting percentage exceeding 95%, is crucial to prevent viral diseases. Investing in trained labour, equipment, and other resources within government banana seedling-producing institutions is vital for enhancing facilities.

Implementing local standardization procedures aligned with international standards for private tissue culture laboratories is also essential.

Given that 75% of the considered commodities are processed through traditional channels, enhancing quality control measures, especially at entry points, and addressing post-harvest losses during transportation and handling stages at the is DEC level is important.

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