PROCESSED FRUIT AND VEGETABLEINDUSTRY IN SRI LANKA:
POTENTIALS, BARRIERS AND PROSPECTS

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FOREWORD

The growing market for processed fruit and vegetable products has the potential to simultaneously improve nutrition and reduce postharvest losses. Sri Lanka has the ability to manufacture processed fruit and vegetable products for both local and international markets since Sri Lanka is endowed with a vast array of exquisite and extremely different tropical fruit and vegetable varieties.

This study explores the present situation, processing potentials, and constraints for the locally processed fruit and vegetable sector. Further, the findings covered processing potentials, barriers, the marketing system, and consumer demand for locally processed fruit and vegetables. Hence, it is my expectation that the findings and recommendations derived from this study will be helpful for the enhancement of the processed fruit and vegetable industry in Sri Lanka.

I would urge decision-makers, the international community, academia, and civil society to regard this study not as the end point of an analytical endeavor but as the starting point for a dialogue on strategic policy decisions and processes aimed at further improving the Sri Lankan processed fruit and vegetable industry.

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

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EXECUTIVE SUMMARY

Sri Lanka has great potential for processing foods for domestic and export markets because of the abundance of highly diverse, delectable, and variety of tropical fruits and vegetables. Hence this study was conducted to analyze the present situation, processing potentials, constraints, marketing system, and consumer preference to assess the prospects of developing the locally processed fruit and vegetable sector.

Both primary and secondary data were collected. Purposive sampling was employed in the sample selection of processors and traders, while multistage random sampling was employed in the sample selection of consumers. Pre-tested structured questionnaires were used for collecting data from 30 processors, 30 traders, and 384 consumers in Colombo, Gampaha, and Kandy districts. Key informant interviews and case studies were also conducted to obtain further information on the sector. Descriptive analysis, compound growth rate analysis, instability analysis, and constraint-facing index were applied to the data analysis.

The country's processed fruit and vegetable exports appear to have experienced positive growth from 2011 to 2021. Most (93.33%) processors were willing to expand their production capacity. A regular customer base, high demand for special products, and a regular supplier base for raw materials were key strengths identified. Most processors (57%) sell their products to local and export markets. Approximately 172 local and 110 imported processed fruit and vegetable brands are available in the domestic market. Dehydrated fruit and vegetable products have the highest potential in domestic and export markets. The Middle East, Europe, America, Oceania, and Asia are the most potential export regions for Sri Lankan processed fruit and vegetables. According to the constraint-facing index results, issues pertaining to the production process rank highest among the challenges faced by fruit and vegetable processors. In order to enable processors to access either the domestic and export markets, it is necessary for the administrative and institutional infrastructures, together with the legal framework, to be continuously developed.

Preference of family members (68.23%) and convenience (48.44%) were the major reasons for householders to consume processed fruits and vegetables. Beliefs that not appropriate for some diseases (69.27%) and lack of safety due to the addition of preservatives, artificial colourants, and flavours (66.93%) were the main reasons for refusal of certain types of processed fruit and vegetable products by the community. Therefore, developing products with zero or minimum levels of artificial compounds and low sugar content is imperative for promoting processed fruit and vegetable consumption in Sri Lanka. Further, the processors should move more towards consumer-oriented product development with innovations to attract the entire community, local and worldwide to market their products and establish the fame of Sri Lankan processed fruit and vegetable brands worldwide.

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ABBREVIATIONS

BOI	–	Board of Investment
BRC	–	British Retail Consortium
CAGR	–	Compound Annual Growth Rate
CDVI	–	Cuddy Della Valle Instability Index
CFI	–	Constraint Facing Index
CU	–	Control Union
CV	–	Coefficient of Variation
EDB	–	Export Development Board
EU	–	European Union
FDA	–	Food and Drug Administration
FRDI	–	Fruit Research and Development Institute
FRU	–	Food Research Unit
GHP	–	Good Hygiene Practices
GMP	–	Good Manufacturing Process
HACCP	–	Hazard Analysis Critical Control Point
ICS	–	Internal Control System
IDB	–	Industrial Development Board
ITC	–	International Trade Center
ITI	–	Industrial Technology Institute
LFVPPEA	–	Lanka Fruit and Vegetable Producers, Processors and Exporters Association
LMRB	–	Lanka Market Research Bureau
MOI	–	Ministry of Industry
NIPHM	–	National Institute of Post-Harvest Management
SED	–	Small Enterprise Development
SLFPA	–	Sri Lanka Food Processors Association
SLSI	–	Sri Lanka Standards Institute
SME	–	Small and Medium Enterprise
TBT	–	Technical Barriers to Trade
UKAS	–	United Kingdom Accreditation Service
USDA	–	United States Department of Agriculture
WTO	–	World Trade Organization

CHAPTER ONE

Introduction

Fruits and vegetables (F and V) play a significant role in human nutrition as a source of vitamins, minerals, and dietary fiber (Mintesnot, 2016). Most of these are highly perishable commodities with a few days or hours of shelf life. Some of them are only grown in particular regions of the world, often for very short seasons, and transportation as fresh commodities to distant markets may result in tremendous postharvest losses. Storage and processing technologies have been used over centuries to transform these perishable commodities into safe, delicious, and stable products. As stated by Chakraborty *et al.,* (2021), with increasing urbanization, rise in middle-class purchasing power, change in food habits, nuclear family structure, increasing women's empowerment, and limiting the practice of making processed products in households, the demand has been increasing for factory-made processed fruit and vegetable products across the world.

1.1 Fruit and Vegetable Processing

Fruit and vegetable processing is the transformation of raw fruits and vegetables into new products different from their initial fresh stage, terminating the natural living processes of a plant. Mostly these transformations are carried out in a food processing facility. Fruit and vegetable processing comprises extracting juice, canning, preserving, and freezing or dehydrating. However, trimming, peeling, cutting, washing, grading, sorting, and packaging are part of the preparation, and not processing, and the need for covering or not covering a trimmed or cut produce is a requirement of the standard (UN, 2016). Further, according to Chakraborty *et al.,* (2021), fruit and vegetable processing is the application of specific methods to prepare food products methodically through preservation for an extended period, packaging, storage, and distribution to guarantee that a variety of such are available all year long, which improves food consumption and nutritional standards, especially in times when food is scarce. These operations, however, may change the texture and flavour of the produce.

1.2 Global Fruit and Vegetable Processing Industry

The global processed fruit and vegetable industry in 2022 has been over US $ 320 billion, with the fruit sector accounting for $ 120 billion which is predicted to expand to more than US $ 585 billion by 2032 at a compound annual growth rate of 5.5% (Ahuja and Malkani, 2022). The fruit and vegetable processing sector worldwide has gradually expanded as a result of favourable consumer trends around the world. The global fruit and vegetable processing industry is expected to grow at an annualized rate of 3.4%, reaching US $ 359.3 billion over the five years leading up to 2026. As reported by Kanda (2021), the global processed fruit and vegetable industry comprises 43.3% of frozen fruits and vegetables, 27.3 % canned vegetables, 12.6% canned fruits,

and 16.8% other products (jams, jellies, dried fruits and vegetables, fruit preserves, and other miscellaneous products).

As stated by Kanda (2021), the processed fruit and vegetable industry's success in developed nations such as Europe and North America has the biggest impact on the industry's overall performance. The fruit and vegetable processing industry is predicted to rise in the coming years as revenue growth is increasingly driven by the performance in developing nations. The rapid growth of industries in emerging countries, particularly China, has fueled an increase in such firms on a world-wide scale, as many small businesses seek to capitalize on a growing potential across developing countries.

United States, Germany, Spain, United Kingdom, France, and Japan are the world's major importers of processed fruit and vegetable goods. Japan imports a substantial amount of processed fruit and vegetables because of its modest domestic fruit and vegetable processing industry. Different countries tend to generate different processed fruit and vegetables based on factors such as soil composition, climatic conditions, and regional preferences. For instance, large quantities of canned peaches are exported from Greece, China, and Chile due to the large quantity of production in these countries. Similarly, major proportion of canned tomatoes originate from Italy and Spain. The largest exporting nations of processed fruits and vegetables are Spain, Germany, China and USA (Kanda, 2021). As extracted from ITC trade map (2023), Europe is the largest market for processed fruit and vegetables in the world absorbing a portion of global supplies higher than any other country in the continent. In 2023, European imports of processed fruits and vegetables represented 42% of global imports in value, followed by Asia (30%), North America (19%), Latin America and the Caribbean (4%), Africa (3%), and Oceania (2%).

1.3 Fruit and Vegetable Processing Industry in Sri Lanka

Sri Lanka has the potential to produce processed fruit and vegetable products for both domestic and export markets since highly diverse and delectable tropical fruit and vegetable varieties are abundant. According to the National Export Strategy of Sri Lanka 2018-2022, the processed food and beverages industry is flourishing, diversifying, and gearing to its next level. Sri Lanka’s potential to develop exports in fresh and processed fruit products is enormous because of the high diversity of climatic zones appropriate for growing crops year-round, (Department of National Planning, 2019). The product categories such as processed vegetables, fruits, concentrates, and juices, have been identified to develop and promote in the overseas markets. Further, these product categories have shown rapid growth during the past decade. High-quality canned fruit juices such as pineapple juice in light syrup, sliced pineapples, pieces, chunks, and mixed fruits packed in glass jars/tins are some of the most demanded products from Sri Lanka. Passion fruit, mango, papaya, pineapple, anoda, and mixed fruit juices have a high potential in the tropical fruit juice market because of the unique tropical flavours unmatched by other suppliers. Further, gherkin preserved in brine or vinegar has also become a noteworthy high-demand

product. As stated by the Export Development Board (2022 a) Sri Lanka earned US $ 17.96 million from processed fruits, vegetables, and juices exports in 2021. Meanwhile, Sri Lanka imported 125,939 metric tons of processed fruits and vegetables amounting to Rs. 10,363 million in 2021 (Ministry of Industries, 2022).

1.4 Problem Statement

Agriculture is the most common livelihood of Sri Lankans, and almost 80 different cultivars of fruits and vegetables are grown in varied agroclimatic areas. Sri Lanka produces about 710,000 tons of vegetables and 540,000 tons of fruits annually (Export Development Board, 2022 b). Fruits and vegetables abundantly grown in Sri Lanka are used either for direct consumption or processing into secondary products for the consumer market. More than 96% of the fruits and vegetables produced in the country are locally consumed as fresh products without any value addition. Less than 4% of the total fruit and vegetable production undergo some form of value addition for export, processing, or local marketing through supermarkets (Esham *et al.,* 2006). Processed vegetables, fruits, concentrates, and juices have shown rapid growth during the past decade, and hence they have been identified to develop and promote in the overseas markets (Export Development Board, 2022a). Tomato, chili, and gherkin are the major vegetables used for processing, mainly to produce chutney, pickles, sauce, and gherkin in brine and vinegar, while pineapple, mango, melon, papaya, and passion fruit are the major fruits used in the fruit processing industry to produce ready to serve beverages, squash, and jam.

Fruit and vegetable cultivation is seasonal depending on the northeast and southwest rains in Sri Lanka. The two seasons of cultivation, namely the *Maha* extend from October to April and the *Yala* from May to September. Large quantities of produce are then available in all parts of the country but it has been estimated that 20-30% of the country's production goes to waste each year due to losses caused by several factors along the post-harvest chain in addition to problems associated with poor production technology, lack of markets, and underdevelopment of the processing and export industry (Esham and Usami, 2006). During seasons of glut, large quantities of fruits and vegetables perish at distant cultivation sites as the supply rapidly exceeds the demand and poor distribution facilities for immediate dispersion. Although producer prices fall very low consumers in urban areas will not benefit as they are often compelled to pay high prices for the poor quality, often deteriorating produce that reaches the urban markets. This situation is even more serious in the off-season when large-scale consumers, fruit and vegetable processing industries, hotels, and catering establishments experience considerable difficulties obtaining their raw material requirements. Therefore, the expansion in the production and processing of the fresh fruit and vegetable sector including the minimization of postharvest losses needs serious attention because the majority of fruit and vegetables could be utilized properly curtailing wastage, especially during peak harvest season and enhancing domestic or international markets by appropriate value addition processes. Further, as stated by Chakraborty *et al.,* (2021), new ‘advanced’ processing methods that ensure retaining health, nutritional properties, and other quality attributes of fruit and

vegetable products offer great opportunities for the growth of the fruit and vegetable industry.

As stated in Hawassi (2006), existing literature (Commonwealth Secretariat,1997; Dietz *et al.,* 2000; Nyagori, 2001) indicates that low demand for products processed compared to imported processed products is one of the most crucial factors contributing to the poor performance of most of the agro-processing firms in a country. Consequently, the country continues to import such items as fruit juices, canned tomatoes, and, sauces, although a surplus of the natural raw materials is seasonally produced. Sri Lanka has imported 125,939 metric tons of processed fruits and vegetables amounting to Rs. 10,363 million in 2021 (Ministry of Industries, 2022). The import of processed fruits and vegetables to Sri Lanka indicates, that there is a demand in Sri Lanka. However, processing fruits and vegetables locally is justifiable not only because of demand but also the presence of raw materials and indeed the agroecological characteristics that favour the production of a variety of such almost throughout the year. Given this, the development of the fruit and vegetable processing industry contributes to reducing wastage while providing additional income for farmers (Hawassi, 2006). According to available literature, a few attempts have been made to study the local and international market potentials for locally processed fruits and vegetables in Sri Lanka. Furthermore, there is a lack of consumption data for processed fruits and vegetables that could be used to inform policy initiatives.

1.5 Significance of the Study

The fruit and vegetable processing sector is one of the core food processing segments in Sri Lanka. Its development is critically important to the expansion and diversification of the agricultural sector in Sri Lanka. Such activities would reduce the seasonality of consumption of a range of processed food, minimize post-harvest losses, and increase the profitability and sustainability of production systems besides their impact on increasing farm income, rural employment, and foreign exchange earnings and reduction in marketing risks (Roy and Ojha, 2012; Geetanjli, 2017; Ojha, 2018). From time to time, various internal and external shocks have affected negatively on agro-food trade in Sri Lanka. It is important to promptly analyze the potentials and constraints regarding the fruit and vegetable processing sector in Sri Lanka. Further, it is timely and important to find the strategies undertaken by the fruit and vegetable processors in Sri Lanka to minimize the adverse effects of the crisis and food security. Only a limited number of studies have been conducted on the processed fruit and vegetable industry in Sri Lanka (Hathurusinghe *et al.,* 2012; Edirisinghe, 2016; Bandaranayake *et al.,* 2016, Vidanapathirana *et al.,* 2020; Rathnayake and De Silva, 2022) and none has extensively studied the existing value chains in terms of local and foreign perspectives, marketing structure, potentials, constraints, and consumer perception. Further, only a limited number of studies analyzed the export market of processed fruit products (Dissanayake *et al.,* 2022) and no study analyzed the processed vegetable exports from Sri Lanka. Perera *et al.,* (2015) in their study titled “Fruit and Vegetable Export Growth, Instability, and Diversification” strongly

emphasized the need for further research into processed fruit and vegetable export products and the market situation in Sri Lanka. Subsequently, Sarfo *et al.,* (2023) with more data-driven evidence on fruit and vegetable processing and their outcomes also recommended further research to achieve better nutrition and food security within the country. Further, Sarfo *et al.,* (2023) also suggested further research into processed fruit and vegetable consumption in urban areas where processed food consumption is prevalent.

Moreover, research on processing and value addition is one of the main national researches thrust areas identified by the National Committee on Postharvest Technology and Human Nutrition (SLCARP, 2017). Therefore, it is of timely importance to analyze the present situation, processing potentials, constraints, marketing system, and consumer perception related to the locally processed fruit and vegetable sector.

1.6 Research Questions

1. What are the different varieties of fruits and vegetables processed in the area selected for the study?
2. Are processing firms able to utilize their capacities throughout the year?
3. What are the marketing channels for processed fruits and vegetables?
4. What types of processed fruits and vegetables are prevalent or dominant in the market?
5. What are the potentials, prospects, and barriers of the processed fruit and vegetable sector in Sri Lanka?
6. How processed fruit and vegetable firms cope during crises?
7. How to spark and promote processing, marketing, and demand for locally processed fruits and vegetables in the current situation?

1.7 Objectives

1.7.1 Main Objective

Analyze the prevailing status, processing potentials, constraints, marketing system, and consumer demand in the local processed fruit and vegetable sector to recommend policy measures to enhance the processed fruit and vegetable industry in Sri Lanka.

1.7.2 Specific Objectives

1. Examine the characteristics and structure of the processed fruit and vegetable industry in Sri Lanka.
2. Examine the processed fruit and vegetable marketing system to identify constraints for marketing locally processed fruits and vegetables.
3. Analyze the consumption pattern and consumer preference for processed fruit and vegetables.

4. Identify the potentials and barriers in the processed fruit and vegetable sector in Sri Lanka.
5. Recommend policy measures to enhance the processed fruit and vegetable industry in Sri Lanka.

1.8 Organization of the Report

The report consists of nine chapters. The introductory chapter provides the background and objectives of this study. The second chapter reviews the literature of past studies on the processed fruit and vegetable sector. The third chapter is devoted to the conceptual framework and the fourth describes the research methodology and study locations. Chapter five deals with the characteristics and structure of the Sri Lankan processed fruit and vegetable industry. Chapters six, seven, and eight present the results and discussion of the study. The final chapter comprises the conclusion and recommendations.

CHAPTER TWO

Literature Review

The global fruit and vegetable processing industry includes all businesses that transform fresh fruits and vegetables to develop a value-added food product for human consumption. This industry has steadily grown due to favourable consumer trends.

This chapter reviews the literature related to the research objectives specified in the previous chapter under three categories: market structure and value chains of processed fruit and vegetables, consumption patterns and consumer perception of processed fruit and vegetables, and potentials and challenges of the processed fruit and vegetable industry. It is followed by a discussion of research gaps.

2.1 Market Structure and Value Chains of Processed Fruit and Vegetables

The value chains are a concept that incorporates a product's production, distribution, and consumption process focusing on value addition at each step. The value chain in the processed fruit and vegetable industry includes all of the activities that take place from farm to end product. Understanding how value is created at each stage and how various stakeholders contribute to the final product reaching the consumer is made easier with the help of the value chain approach. Value chain analysis identifies inefficiencies, streamlines, procedures, and guarantees the safety and quality of processed fruits and vegetables.

Marketing channels of processed fruits and vegetables are similar to other agricultural commodities. Farmers are the primary producers, influencing the quality and quantity of the produce. Processors transform raw produce into processed goods using various technologies adhering to safety standards. Packaging companies provide materials and expertise to ensure sustainability while distributors and logistic providers guarantee efficient movement. Retailers with marketing strategies, drive demand for healthy, convenient, and sustainable products. Ultimately, consumers, as the end-users substantially influence the entire value chain by demanding healthy, convenient, and sustainable products according to their preferences (Fernandez-Stark *et al.,* 2011). The production, processing, and distribution of products are facilitated by a complex web of relationships, activities, and processes that are part of the value chain dynamics in the processed fruits and vegetables industry. Coordination between various stakeholders, such as farmers, processors, distributors, and retailers, is necessary in these dynamics. The complexity of the supply chain is influenced by elements such as seasonality, perishability, and international sourcing. According to Fernandez-Stark *et al.,* (2011), fruit and vegetable processing is prohibitively expensive at low crop output levels. Therefore, low-income developing countries face difficulties upgrading the processing segment of value chains. These countries need to obtain competence during the production stage to boost output to the stage where they progress to the fruit and vegetable processing in the value chain.

Bandaranayake *et al.,* (2016) investigated the availability of processed fruit items in 30 supermarkets in the Kurunegala district and found 24 processed fruit species. Apples, dates, and pomegranates were imported, while strawberries were both local and imported. Twelve different product varieties were offered.

Dissanayake *et al.,* (2022) studied main processed fruit exports from 2010 to 2020. In this study growth patterns and instability of processed fruit exports were analyzed in terms of quantity and value. However, according to past literature, it appears that the emphasis given to export market analysis of processed fruit and vegetables has been scant in Sri Lanka.

Vidanapathirana *et al.,* (2020), conducted a value chain analysis of fresh and processed pineapples in Sri Lanka and found when value addition, raw material cost has been the highest component for dehydrated pineapple (76%) and canned products (39%). Rathnayake and De Silva (2022) categorized the Sri Lankan mango value chain into three, traditional, modern, and export as other developing countries in the region. According to them these chains significantly differ in their dynamics in terms of product, volume flow, postharvest chain management practices (cleaning, grading, and packing), level of quality, value creation, financial and information flows, and further in value chain profile's structure, actors and end markets.

2.2 Consumption Patterns and Consumer Perception of Processed Fruit and Vegetables

Sijtsema *et al.,* (2012), assessed the consumption and consumer perception of processed fruits in Western Balkan countries and revealed that people in these countries consume more fruit juice than jams and dried fruits. The main factors preventing the consumption of processed fruits have been the price, preference for fresh fruits, and the absence of habitual consumption of processed fruit products. Based on these observations Sijtsema *et al.,* (2012), recommended the strategy, to focus on the needs and wants of the customer (consumer-oriented product development) and adopt novel methods for fruit processing.

Bandaranayake *et al.,* (2016), conducted a study in Sri Lanka, to find the processed fruit products available in the market and to assess the urban consumers' perception of highly demanded processed fruit products such as jam, cordial, juice, pickle, and chutney. According to this study, advertising was the least important consideration for customers when purchasing chosen processed fruits. Their main concerns were flavour, fruit species, price, and package size. The study further revealed that convenience was the main reason for consuming processed fruit items and the main deterrent to purchasing such has been the perception of inadequate safety.

Song *et al.,* (2020), studied consumers' perceptions and attitudes towards non-thermally processed fruit and vegetable products in young (18-30 years) and middle-aged (45-60 years) consumers in selected European countries and found that lack of basic knowledge and trust among consumers as the main obstacle to their acceptance.

They viewed consumer-oriented communication and education as essential to enhance social awareness and trust in consuming non-thermally processed fruit and vegetable products.

Tarancon *et al.,* (2021), following a study on consumer perception of situational appropriateness for fresh, dehydrated, and fresh-cut fruits revealed that people preferred dehydrated fruits as an ingredient or as a healthy snack while fresh-cut fruits for school lunch boxes or for immediate consumption.

Ajisola *et al.,* (2021), examined the extent to which fresh citrus fruits are substituted by processed fruit among Oyo State customers to find the factors influencing choices between the two categories. According to them the main factors that influenced the consumer preference for processed citrus fruits have been convenience, price, and nutritional content despite the belief among the majority that processed citrus may have negative inferences on health, suggesting why respondents preferred fresh citrus fruits to processed ones.

Sarfo *et al.,* (2023), evaluated the knowledge, attitude, and practices towards fruit and vegetable processing and consumption among rural women in East Africa and revealed that a vast majority preferred minimally processed fruits and vegetables as such were good for the body. Among these rural women, 55% believed that highly processed fruits and vegetables were not good for the body. Among the respondents, 85% viewed that post-harvest losses of fruits or vegetables can be reduced by employing varied processing techniques and have shown interest in participating in training programmes on fruit and vegetable processing techniques. Further, most women indicated willingness to accept and consume newly processed fruit or vegetable products such as dried fruits and vegetables and fruit juices.

2.3 Potentials and Challenges of Processed Fruit Vegetable Industry

According to Export Development Board, (2022 a) of Sri Lanka, adherence to international quality standards such as HACCP, ISO 9000 and 22000, HALAAL, Kosher, and Organic, availability of assistance to find markets, availability of skilled and cost-effective labour, development of new product varieties, creation of job opportunities for youngsters, collaboration with International food processors associations, unique quality, taste and flavour are notable strengths of processed fruit and vegetable export industry in Sri Lanka. The industry has the potential for further expansion utilizing the resources available in the country and to develop or increase exports to ethnic markets such as the Middle East, Australia, the United Kingdom, Canada, and the USA.

Sri Lanka is known for its diverse range of fruits and vegetables due to its favourable climate and fertile land and hence fruits and vegetables hold an important place in the country's agricultural sector and international trade. Consequently, the Export Development Board, (2023) has been promoting exports of processed fruits and vegetables over a long period. The demand for Sri Lankan processed fruits and

vegetables is growing in international markets due to their quality, flavour, and adherence to international food safety standards. Processed fruits and vegetables have been identified as a sector with a high potential for world trade because of the rising demand from end users for value-added goods.

Sri Lanka's fruit and vegetable processing sector is placing high emphasis on mangoes and pineapples though there are few processed versions available for many other species including banana and several other seasonal fruits such as rambutan (*Nephelium lappaceum*), mangosteen (*Garcinia mangostana*), avocado (*Persea americana*), and durian (*Durio zibethinus*). Bandaranayake *et al.,* (2016), have proposed feasible processed forms for a few fruit species, considering their availability and attractiveness in the global market.

The challenges and weaknesses of the fruit and vegetable value chains in Sri Lanka identified by Venkatprahlad and Wijeratnam, as quoted by Dissanayake *et al.,* 2022, read as inadequate supply of raw material, year-on-year price increase, climate change, poor adoption of good agricultural practices (GAPs), good manufacturing practices (GMPs), and sanitary and phytosanitary (SPS) measures, lack of good-quality planting material, and processing facilities not on par with new-age processing technologies.

According to Vidanapathirana *et al.,* (2020), problems associated with pineapple processing are the high price of raw materials during the off-season, lack of sorting and grading practices, high cost of inputs such as labour and electricity, and limited credit facilities. Lack of refrigerated transport, storage, and handling facilities has also been a serious issue in the Sri Lankan fruit supply chain (Gamage *et al.,* 2020).

According to the Export Development Board, (2022a), lack of research and development facilities, over-dependence on existing markets, high cost of investment, lack of technology transfer programmes, high cost of production, inadequate supply of raw material against the demand, limited government involvement, difficulties faced by small and medium entrepreneurs (SME's) for obtaining loans, and non-availability of proper machinery and high technologies in the country are serious constraints for development of the processed fruit and vegetable export industry in Sri Lanka.

2.4 Research Gap

Previous studies on the processed fruit and vegetable industry in Sri Lanka are limited and a few studies analyzed the marketing channels and value chains of the processed fruit industry (ADB, 2017; Vithanapathirana *et al.,* 2020; Rathnayake and De Silva, 2022). No emphasis has been placed on the marketing channels of the processed vegetable industry. Further, only a limited number of studies were carried out on the export market of processed fruit products (Dissanayake *et al.,* 2022), and almost none on processed vegetable exports.

World literature provides significant evidence on the world consumption patterns and consumer perceptions of processed fruit and vegetable products (Sijtsema *et al.,* 2012; Song *et al.,* 2020; Tarancon *et al.,* 2021; Ajisola *et al.,* 2021; Sarfo *et al.,* 2023). However, just one study was conducted in Sri Lanka to assess the availability of processed fruit products and identify urban consumers' perceptions of processed fruit consumption (Bandaranayake *et al.,* 2016). So far, no recent studies on the consumers' perception of processed fruit and vegetable products in Sri Lanka. However, there are a few studies on the processed fruit industry (Hathurusinghe, 2012; Gamage *et al.,* 2020; Vidanapathirana *et al.,* 2020) but none on the challenges faced by vegetable processors in the country. Given this research gap, the current study was conducted to assess the prevailing status, marketing system, existing value chains, potentials, and bottlenecks in the local processed fruit and vegetable sector to suggest policy measures to enhance the fruit and vegetable industry in Sri Lanka. The conceptual framework for the proposed study is described in the proceeding chapter.

CHAPTER THREE

Conceptual Framework

The food processing industry is rapidly evolving to meet the world's population of over 9.7 billion, demanding a 70% increase in food production by 2050, primarily utilizing fruits and vegetables (Salim *et al.,* 2017 as quoted by Bisht *et al.,* 2023). Consumers are in quest of processed fruits and vegetables due to their nutritional value and health benefits. Fruit and vegetable manufacturers highlight the nutritional contents of their products through clear labeling and marketing strategies. Health trends such as plant-based diets, environmental concerns, and health consciousness drive the demand for innovative processed products, including processed fruits and vegetables in vegetarian and vegan options (Moura and Vialta, 2022). The theoretical framework proposed for the current study is drawn from existing studies that focus on the processed fruits and vegetables industry aligning with the objectives identified.

3.1 Global Trends in Processed Fruit and Vegetable Consumption

The worldwide consumption of processed fruits and vegetables has increased dramatically in recent years, a trend linked to the intricate interactions among several factors that shape consumer preferences. Customers are searching for more convenient and nutrient-dense food products since there is a discernible trend in the current environment towards healthier food options. Historical trends indicate a strong rise in customer demand for fruits and vegetables that have been lightly processed and are ready to eat. This is related to both the hectic lifestyles of the modern world and the growing awareness of the health benefits of plant-based food products. Internationalization of the food industry has also facilitated the blending of diverse culinary traditions and preferences influencing a range of options available for consumption of processed fruits and vegetables. Urbanization, emphasis on sustainability, and growing disposable incomes have all impacted consumer preferences. People are becoming more conscious of how their food choices influence the environment, driving the demand for processed fruits and vegetables that are produced ethically and sustainably. The enduring nature of global buying habits shows the depth of innovation and adaptation the industry needs to meet the shifting consumer preferences. As stated by Moura and Vialta, (2022), new consumer desires and prevailing trends will continue to drive the development of novel functional foods and cutting-edge food processing technologies. As a result, there are plenty of opportunities for innovation and the growth of the fruit and vegetable processing industry.

3.2 Value Chain and Distribution Channels

The value chains of processed fruits and vegetables involve a complex network of activities from cultivation to delivery. Climate, soil quality, and farming practices often affect the product's quality. Processed fruits and vegetables are sold to end consumers through a well-organized marketing infrastructure involving company-owned outlets,

distributors, wholesalers, retailers, and exporters similar to other factory-made food products. Brand establishment and brand image in the market play an important role in processed fruit and vegetable products. These processed products are transported to distribution centers and retail outlets to disperse in domestic or export markets. Recently, direct-to-consumer channels, including e-commerce, have become more efficient, allowing consumers to access a diverse range of processed fruits and vegetables from home. The processed fruit and vegetable market's dynamics evolve due to technological advancements, consumer preferences, and sustainable practices. According to Gjokaj *et al.,* (2017), a well-optimized supply chain ensures timely, cost-effective, and high-quality products.

3.3 Potentials and Challenges of Processed Fruit and Vegetable Industry

The processed fruit and vegetable industry has great potential in several areas, contributing significantly to consumer-related, nutritional, and economic factors. An important benefit is that processing methods such as canning, freezing, and drying can increase shelf life. Further food waste is minimized, long-distance transportation is made easier, and increases the availability of products outside of seasonal fluctuations (Parfitt *et al.,* 2010). According to Sarfo *et al.,* (2023). Further adhering to various processing techniques such as drying, freezing, boiling, and canning increases the shelf life of fruits and vegetables. Processed fruits and vegetables guarantee the availability of items all year round with a steady supply of tasty food to the satisfaction of varied customer groups.

Furthermore, as stated by Rickman *et al.,* (2007) processing techniques such as dehydration and freezing, preserve vital nutrients in fruits and vegetables, guaranteeing that processed foods have a nutritional value equal to that of fresh produce. Thus, the fruit and vegetable industry can benefit from the growing consumer interest in health and wellness by providing processed foods that satisfy dietary trends, nutritional preferences, and the expanding market for functional foods.

Despite the great potential of the processed fruit and vegetable industry for safeguarding world food security, it faces several obstacles that could compromise its long-term viability and prosperity. Though processing results in a loss of nutritional content (Rickman *et al.,* 2007) it can also be a vehicle to improve the nutritional value of food products ensuring adequate nutrition and health (Jaenicke and Virchow, 2013). This presents a challenge for creative solutions to preserve and improve the nutritional value of processed foods. According to Rickman *et al.,* (2007), there is competition from fresh produce because some consumers believe it is healthier than processed foods. Developing safe and sustainable packaging for fruits and vegetables is another challenge for fruit and vegetable processors (Chen *et al.,* 2021). To surmount hindrances and realize its complete potential, the processed fruit and vegetable sector needs to leverage the knowledge of scholars and professionals in the field to implement inventive tactics and eco-friendly methods.

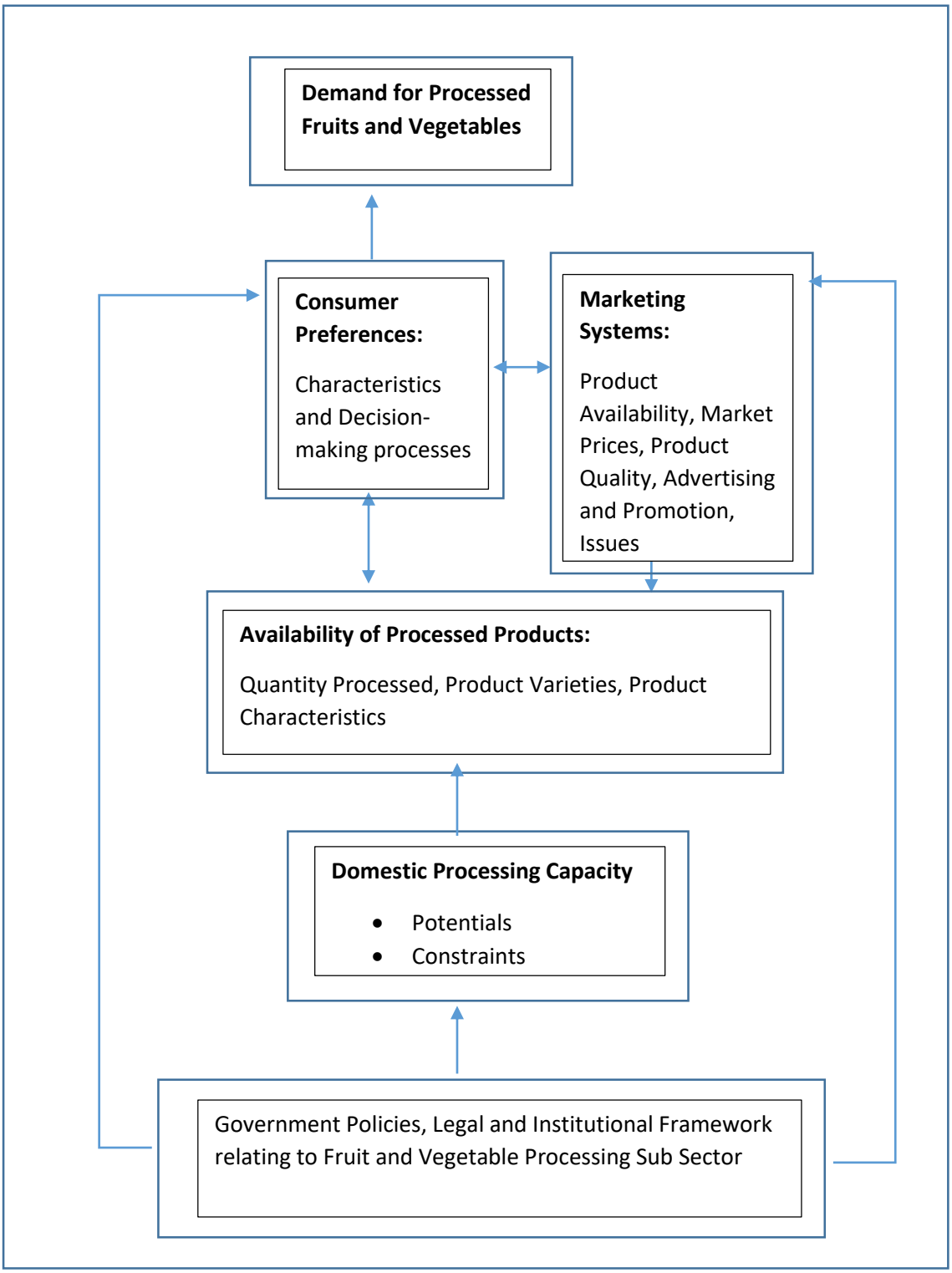
3.4 Government Regulations and Policies

The global processed fruit and vegetable market is regulated by various government policies to ensure food safety, quality, and fair-trade practices. These standards cover hygiene, labeling, packaging, and transparency. Compliance with these regulations is crucial for consumer trust and legal requirements, with stringent quality control measures enforced to monitor pesticide residues and nutritional content. Government policies, trade agreements, and tariffs can significantly influence the processed fruits and vegetables market affecting the accessibility, affordability, and cost competitiveness. Additionally, they can promote sustainability and environmentally friendly practices. Compliance with government regulations and policies is crucial for consumer perception and market accessibility. According to Thow *et al.,* (2018), the processed fruit and vegetable industry needs to remain adaptable and proactive to navigate the regulatory landscape effectively.

The conceptual framework mentioned below was designed based on the existing literature (Hawassi, 2006) and the proposed objectives of the study (Figure 3.1). The consumption of processed fruits and vegetables is determined by the consumers' preferences influenced by many interrelated factors such as the decision-making process, consumers' characteristics, and the marketing system. For this reason, factors such as prices of processed and fresh fruits and vegetables, availability of processed products, and frequency of promotion significantly affect the consumption of processed fruits and vegetables. However, the effectiveness of the marketing systems to a greater extent depends on the processing potential in terms of quantity and quality of the products, product varieties, product form, and characteristics of the processed products. Moreover, domestic processing capacity is based on processing potentials and constraints.

The conceptual framework (Figure 3.1) also assumes that government policies and legal and institutional frameworks related to agro-processing have a vital role in stimulating and promoting, the processing, marketing, and consumption of locally processed fruits and vegetables in Sri Lanka and around the world.

The intention of the present study is to collect information based on the conceptual framework presented in Figure 3.1 to analyze empirically to achieve the specified objectives of the study.



Source: Authors' Own Work Adopted from Hawassi, (2006)

Figure 3.1: Conceptual Framework

CHAPTER FOUR

Methodology

This chapter describes the data, sources of data, and analytical tools used in the current study and the analytical techniques, Compound Annual Growth Rate (CAGR), Cuddy Della Valle Instability Index (CDVI), and Constraint Facing Index (CFI) used in the data analysis.

4.1 Research Design and Data Collection

A mixed-method approach combining qualitative and quantitative techniques was applied to the to collect, collate, and analyze data in the current study.

4.2 Data Collection Methods

4.2.1 Secondary Data Collection

The study was conducted from 2011 to 2022 although the time varied according to method and data availability. Secondary data about performance indicators (number of establishments, number of employees, and output value) were obtained from the Department of Census and Statistics. Processed fruit and vegetable exports and imports data were collected from Sri Lanka Customs. In addition, secondary data were gathered from reports and databases at the Central Bank of Sri Lanka, Export Development Board, Ministry of Industries, Department of Agriculture, and affiliated institutions, research reports, and journals.

4.2.2 Primary Data Collection

The primary data were collected from primary data sources such as pre-tested structured questionnaires, key informant interviews, and case studies using different tools. Purposive sampling was employed to select samples to interview processors and traders. Multistage random sampling was applied to select the consumers to obtain information relevant to the study. Questionnaire surveys were conducted in Colombo, Gampaha, and Kandy Districts, which have the highest urban population and about 80% of the country's fruit and vegetable processing companies, supermarkets, and special outlets.

Questionnaire Survey

A pre-tested structured questionnaire was used to interview the selected processors (30), and traders (30) (supermarkets and retailers). Parallelly another questionnaire survey was conducted with consumers (384) in the selected districts with the highest urban population. The margin of error and confidence level for the credibility of information were 5% and 95% respectively.

Key Informant Interviews
Key informant interviews were conducted with officials of government and private institutions related to the processed fruit and vegetable industry in Sri Lanka.

Case Study Method
Twelve case studies were conducted with leading fruit and vegetable processors in Sri Lanka and with successful small and medium entrepreneurs in the sector. These case studies were conducted in Colombo, Gampaha, Kandy, Kurunegala, and Galle districts.

4.3 Data Analysis and Analytical Techniques

4.3.1 Objective 1: Examine the Characteristics and Structure of the Processed Fruit and Vegetable Industry in Sri Lanka.

Data Source: Primary and Secondary Data

Method: Questionnaire Survey, Key Informant Interviews, and Secondary Data Sources

Analytical Method: Descriptive Analysis, Compound Growth Rate Analysis and Instability Index

Data such as product varieties, quantity processed, main sources of raw materials, product characteristics, characteristics of processors, traders, exporters, marketed quantities (% share in local market and foreign market), major customers of processed fruits and vegetables (processors' side and traders' side), related institutes and their functions to achieve the objective. A descriptive analysis was conducted to present the data.

Table 4.1: Operationalization of the Characteristics and Structure of the Processed Fruit and Vegetable Industry in Sri Lanka (Objective 1)

Indicator	Variable	Meaning	Measurement
Processing Status			
Processing Firms	Composition of firms engaged in processing fruits and vegetables	Determine the current status of fruit and vegetable processors	Categorize fruit and vegetable processing firms by size, small, medium, and large as a percentage of the total
	Characteristics of the fruit and vegetable processing firms	Understand the characteristics of the fruit and vegetable processing firms	Characterize fruit and vegetable processing firms by region and type of products as a percentage of the total

Raw Material Supply	Main sources of raw materials available for fruit and vegetable processing	Identify the most preferred sources of raw materials for processing by main suppliers for processing	List the main sources of fresh fruits and vegetables as a percentage of the total List processors contracted with suppliers of fruits and vegetables by region as a percentage of the total
	Quantity of fruit and vegetable raw materials used for processing	Understand the fruit and vegetable raw material usage	Calculate the means of the amount of fresh fruits and vegetables processed
Production	Quantity of fruits and vegetables processed	Obtain production details of processed fruit and vegetable products	Calculate the means of quantity of fruits and vegetables processed from 2020 -2022 (in Tons) Calculate the processed fruit and vegetable production as a percentage of the total output
Product Types	Types of fruit and vegetable processed products and their specific characteristics	Identify the locally produced processed fruit and vegetable product varieties	Analyze quantitative and qualitative data of the processed fruit and vegetable produce
Expand Processing	Willingness to expand the fruit and vegetable processing capacity	Realize the processors' intention to expand the fruit and vegetable processing industry	Categorize the firm's intention to expand the fruit and vegetable industry as a percentage of the total output
Current Market Status			
Trading	Main customers for trading fruit and vegetable processors' products	Identify the main customers of fruit and vegetable processors.	Categorize main customers of processed fruits and vegetables by region as a percentage of the total
	Characteristics of processed fruit and vegetable traders	Understand the composition of processed fruit and vegetable traders	Characterize processed fruit and vegetable traders by region as a percentage of the total

	Traders' preferences for local and imported processed fruit and vegetable products	Understand the traders' preferences for local and imported processed fruit and vegetable products	Categorize traders by their preferences for local and imported processed fruits and vegetables by region as a percentage of the total Categorize traders by reasons for selling different types of processed fruit and vegetable products as a percentage of the total
	Main customers of processed fruit and vegetable traders	Identify the main customers of the processed fruit and vegetable traders	Categorize main customers of processed fruits and vegetables traders by region as a percentage of the total
Domestic Market	Types of locally processed fruits and vegetables available in the domestic market and their specific characteristics	Identify the types and characteristics of processed fruit and vegetable products available in the domestic market	Analyze quantitative and qualitative data on the processed fruits and vegetables in the domestic market
	Marketed quantities of processed fruits and vegetables	Obtain information on marketed quantities of processed fruits and vegetables available in glut and off-season	Calculate the means to the amount of locally processed fruits and vegetables supplied to the market by processors in 2022 (Tons) in the harvest season and the off-season
	Quantities of processed fruit and vegetable products supplied to the domestic market	Assess the availability of locally produced processed fruit and vegetable products in the domestic market	Categorize locally produced processed fruit and vegetable products in the domestic market as percentage of the total
Export Market	Types of locally processed fruit and vegetable products cater to the export market and their specific characteristics	Identify and characterize processed fruit and vegetable products supplied to the export market	Analyze quantitative and qualitative data to identify and characterize processed fruit and vegetable exports

	Quantities of processed fruit and vegetable products supplied to the export market	Assess the availability of locally produced processed fruit and vegetable exports	Categorize processed fruit and vegetable exports as a percentage of the total
	Composition of exporters of processed fruit and vegetable products	Identify the composition and the current status of processed fruit and vegetable exporters	Categorize the composition of processed fruit and vegetable exporters by size (small, medium and large) as a percentage of the total
	Main customers of processed fruit and vegetable exporters	Identify the main customers of processed fruit and vegetable exporters	Categorize main customers of processed fruit and vegetables importing countries as a percentage of the total
	Growth pattern of customers of processed fruit and vegetable exporters	Assess the growth pattern of processed fruit and vegetable exports by the harmonized system (HS) code.	Estimate compound annual growth rates (CAGR) of processed fruit and vegetable exports from 2011 to 2022
	Direction of the trade of processed fruit and vegetable exports	Assess the direction of processed fruit and vegetables by main destinations	Estimate compound annual growth rates (CAGR) and instability index (II) of processed fruit and vegetable exports from 2011 to 2022.
Influential Actors	Related institutes and their functions related to the export of processed fruits and vegetables exports	Identify institutes and their functions related to the export of processed fruits and vegetables	Analyze quantitative and qualitative data to identify the institutes and their functions related to the export of processed fruits and vegetables

The growth pattern and the direction of trade in the processed fruit and vegetable sector were analyzed by calculating the Compound Growth Rate Analysis and Instability Index.

Compound Annual Growth Rate Analysis

Compound annual growth rate (CAGR) measures an investment's average past performance over a long period. It is one of the most accurate ways to calculate and determine returns for individual assets, investment portfolios, and anything that can

rise or fall in value over time. CAGR was computed using different formulas to capture the average annual growth rate, considering the compounding effect, and providing a more accurate representation of the growth trend. Further, it corrects the unpredictable nature of year-by-year growth rates since it assumes the growth rate was compounded yearly.

The compound growth function was used in the current study to analyze the trend and growth pattern in exports of selected processed fruits and vegetables. The growth rates of export quantities and values for selected processed fruits and vegetables were measured using the compound growth function formula described by Parte *et al.,* 2022, mentioned below, using the secondary data pertaining to export quantity (Kg) and value (LKR MN) for selected fruits and vegetables in the period from 2011-2022 from the published data of the Department of Customs, Sri Lanka.

$$Y = ab^t e_t \quad (1)$$

Where, Y = Dependent variable for which growth rate is to be estimated (Quantity exported (Kg) & Total real export earnings (Rs. Mn))

a = Intercept

b = Regression Coefficient = (1+g), where g, is the compound growth rate

t = Time variable (years 1,2…n)

e_t = error term

The logarithmic form of the equation (1) is as follows:

$$\text{Log } Y = \log a + t \log b + \log e_t \quad (2)$$

The compound growth rate (g) in percent was calculated using the following association

$$g = (\text{antilog of } (\log b)-1) \times 100 \quad (3)$$

The significance of the coefficient was tested using the t statistic.

Instability Index

The coefficient of variation (CV) and Cuddy Della Valle Index (CDV) (1978) were used to measure the magnitude of instability in the export of processed fruits and vegetables from Sri Lanka to different countries.

Co-efficient of Variation (CV)

The coefficient of Variation is the simplest measure of instability, calculated as the standard deviation's percentage from the mean.

$$CV = (\text{Standard deviation/Mean}) * 100 \quad (4)$$

Cuddy Della Valle Instability Index (CDVI)

The Cuddy-Della Valle Index (CDVI) measures the instability in time series data with a trend. It is calculated by multiplying the coefficient of variation (CV) by the square root of one minus the adjusted R-squared value. CDVI was calculated in the current study to measure the instability in Sri Lankan processed fruit and vegetable exports and the production indicators. The CDVI is a better index to measure the instability of agricultural produce (Vilhekar *et al.,* 2022) and exports (Yeligar *et al.,* 2023).

Moreover, it adjusts the CV which overestimates the variability in time series data and detrends the series, and depicts the direction of the instability exactly.
The Cuddy-Della Valle Index is expressed as

$$CDVI = CV^{*}(\sqrt{1 - \bar{R}^2}) \quad (5)$$

Where,
CV = Coefficient of Variation
$\bar{R}^2$ = Time trend regression adjusted for its degrees of freedom
The ranges of CDVI are: Low instability, 0 to 15, Medium instability, 15 to 30, and High instability, 30 and above (Vilhekar, *et al.,* 2022).

4.3.2 Objective 2: Examine the Marketing System for Processed Fruit and Vegetable Products and Identify Constraints to Marketing Locally Processed Fruits and Vegetables

Data Source: Primary Data and Secondary Data

Methods: Questionnaire Survey and Secondary Data Sources

Analytical Methods: Descriptive Analysis
The marketing system of processed fruits and vegetables and the constraints for marketing them locally were assessed by collecting data *via* a sample of processed fruit and vegetable traders on their characteristics businesses, preferred fruit and vegetable products, and processed fruit and vegetable products available, their main customers (domestic and export), existing marketing channels, factors affecting the marketing of locally processed fruits and vegetables and marketing constraints. A descriptive analysis was performed to present data.

4.3.3 Objective 3: Analyze the Consumption Pattern and Consumer Preference of Processed Fruits and Vegetables

Data Source: Primary Data

Methods: Questionnaire Survey

Analytical Methods: Descriptive Analysis
The consumption pattern and consumer preference of processed fruits and vegetables were assessed by collecting information *via* a sample of fruit and vegetable consumers on consumption patterns, frequency of consumption, reasons for consumption, buying behaviour, willingness to consume novel products, perceived barriers of consumers and suggestions to enhance processed fruit and vegetable industry in Sri Lanka.

4.3.4 Objective 4: Identify the Potential and Barriers to Enhancing the Processed Fruit and Vegetable Industry in Sri Lanka.

Data Source: Primary Data

Methods: Questionnaire Survey, Key Informant Interviews, and Case Studies

Analytical Methods: Descriptive Analysis, SWOT Analysis, and Constraints Facing Index (CFI)

The potential and barriers to enhancing the processed fruit and vegetable industry in Sri Lanka were identified by collecting information *via* a sample of stakeholders using questionnaires, conducting interviews with key informants, analyzing case studies, performing descriptive analysis, SWOT analysis, and ranking the selected constraints by computing Constraint Facing Index (CFI).

Constraints Facing Index (CFI)

The Constraint Facing Index (CFI) is an index that evaluates and ranks the constraints identified in a study based on a scaled score (Mozahid *et al.,* 2017). In the present study constraints faced by marketing channel actors were measured by a structured questionnaire using a four-point scale asking respondents to give their opinion on 6 selected constraints, identified during the data collection period. For each constraint, score either 3, 2, 1, or 0 to indicate, high, medium, low, and not at all, respectively. The total constraint scores were then computed for each respondent by adding his scores for all the constraints and the Constraint Facing Index was:

$$CFI = (C_h \times 3) + (C_m \times 2) + (C_l \times 1) + (C_n \times 0) \quad (6)$$

Where, CFI = Constraints Facing Index; C_h = Number of respondents having high constraints; C_m = Number of respondents having medium constraints; C_l = Number of respondents having low constraints; and C_n = Number of respondents having no constraints.

This chapter describes the methods followed in the analyses of the present study. The outputs of these analytical methods will be elaborated in the next four chapters accordingly.

CHAPTER FIVE

Characteristics and Structure of the Processed Fruit and Vegetable Industry

This chapter describes the imports, exports, and market structure of the processed fruit and vegetable industry in Sri Lanka, institutes related to the industry and their functions, and the government policy and support provided to the sector.

5.1 Performance of the Fruit and Vegetable Processing Industry in Sri Lanka

The fruit and vegetable processing industry is a core segment of the food processing sector in Sri Lanka and its development is vital for expanding and diversifying the country's agro industry. The number of fruit and vegetable processing firms registered in the Sri Lanka Food Processors Association and Export Development Board by the end of 2023 were 73 and 26 respectively. The growth of fruit and vegetable processing establishments with employees 25 or more from 2015 - 2019 is presented in Table 5.1.

Table 5.1: Growth Rates of Fruit and Vegetable Processing Industries from 2015-2019 in Sri Lanka.

Year	No. of Establishments	No. of Employees	Output (Rs.)	Input (Rs.)	Value Added (Rs.)
2015	116	11,595	30,727,170,466	21,815,728,812	8,911,441,655
2016	135	13,695	46,826,515,039	33,267,659,243	13,558,855,796
2017	194	17,387	57,980,500,133	41,079,442,482	16,901,057,651
2018	102	16,637	65,076,101,733	42,407,020,914	22,669,080,819
2019	90	14,460	59,660,502,565	41,769,802,744	17,890,699,821
CAGR (percentage per annum)	**-7.60**	**6.61**	**17.94***	**16.65***	**21.05***

Note: * denotes significant 10 %

Source: Authors' Calculations based on Annual Industry Survey, Department of Census and Statistics (DCS), Issues, 2015, 2016, 2017, 2018 and 2019

The performance of the fruit and vegetable processing industries during 2015 – 2019 has shown steady growth in the number of employees, inputs, outputs, and value-added products despite the negative growth in the number of establishments.

5.2 Processed Fruit and Vegetable Imports and Exports

Sri Lanka exported 114,580 metric tons of processed fruits and vegetables worth Rs.47,184 million and imported 125,939 metric tons worth Rs.10,363 million in 2021. The main imported countries have been Pakistan, India, China, Bangladesh, and the Netherlands (Ministry of Industries, 2022). The main processed fruit export products were pineapple juice, preserved pineapple, dried banana, and dried pineapple while the main vegetable export product was gherkins. The main imported

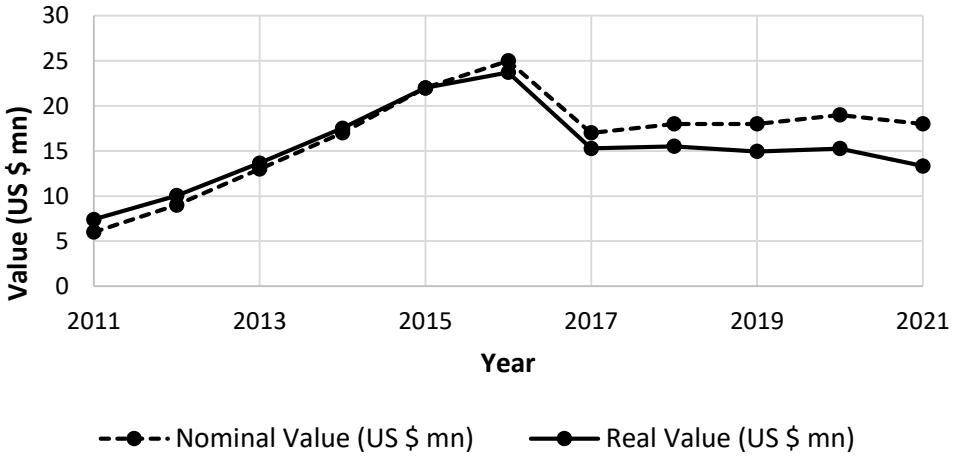
processed fruit products were dried dates, orange juice (frozen/non-frozen), dried grapes, apple juice, mango pulp, and pineapple juice and the imported processed vegetable products were tomatoes, tomato ketchup, sauces, and preserved mushrooms (Department of Agriculture, 2023).

Table 5.2: Processed Fruit and Vegetable Imports and Exports during 2019-2021 in Sri Lanka

Indicator	2019		2020		2021	
	Quantity (MT)	Value (Rs. Mn)	Quantity (MT)	Value (Rs. Mn)	Quantity (MT)	Value (Rs. Mn)
Processed fruit and vegetable imports	153,788	9,004	137,123	10,075	125,939	10,363
As a percentage of the country's total processed food imports	7.55	4.63	6.40	4.79	6.08	4.20
Processed fruit and vegetable exports	77,672	26,810	96,675	34,158	114,580	47,184
As a percentage of the country's total processed food exports	21.20	21.39	24.57	25.13	26.06	25.45

Source: Ministry of Industries, Industry Data Book, (2022); Sri Lanka Customs

5.3 Processed Fruit and Vegetable Exports Trend in Sri Lanka from 2011 – 2021



Note: GDP deflator for real value, base year =2015.
Source: Authors' Compilations based on EDB Food and Beverage Industry Capability Reports (2011-2021)

Figure 5.1: Processed Fruits and Vegetables Exports from 2011-2021 in Sri Lanka

The fruit and vegetable export values from 2011 to 2021 show a positive trend in real and nominal export value, except in 2017 and 2021 (Figure 5.1).

Table 5.3: Growth Rates and Instability of Total Processed Fruits and Vegetables Exports (2011-2021)

Indicator	Growth Rate	Instability
Export Value (Nominal)	8.83*	27.08
Export Value (Real)	3.99	30.74

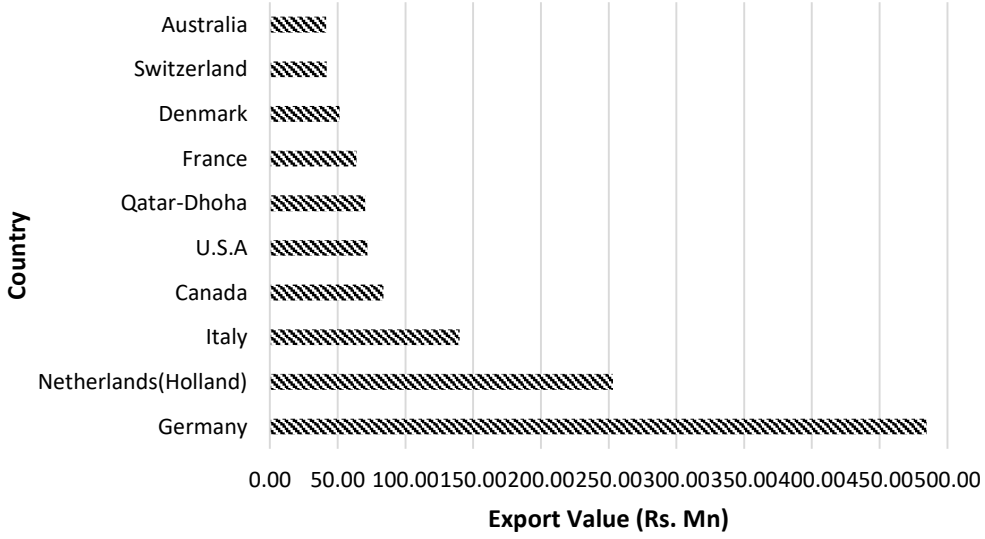
Note: *denotes significant 10 %

Source: Authors' Calculations based on EDB Food & Beverage Industry Capability Report, Multiple Issues

The results revealed that export values in terms of both real and nominal have shown positive growth rates. The export value in nominal terms shows medium instability while the export value in real terms shows high instability (Table 5.3).

5.4 Market Structure of Processed Fruit and Vegetable Exports in Sri Lanka

Main Processed Fruit Export Markets in 2022



Note: The fruits considered in this analysis are mango, pineapple, banana, passion fruit, figs, guava, oranges, grapefruit, pomelos, lemons, and lime.

Source: Authors' Compilation based on Customs Data, Sri Lanka (2022)

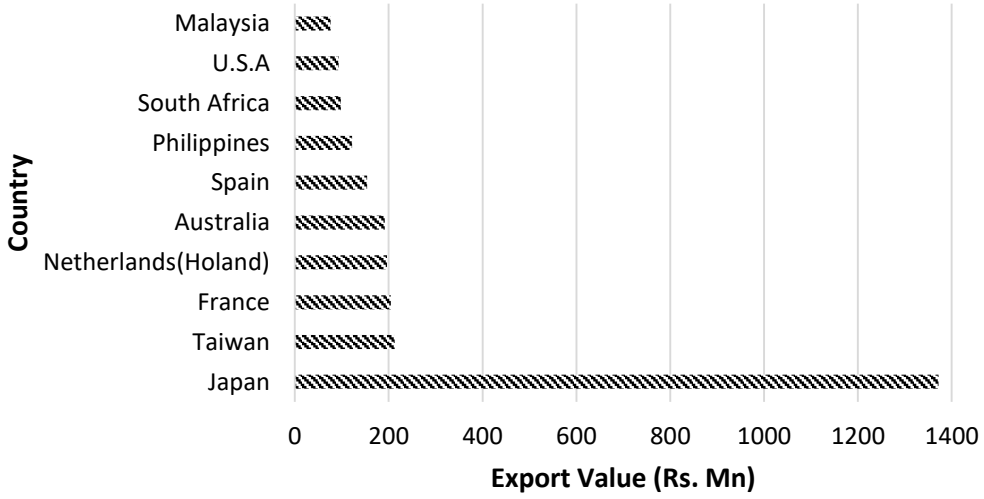
Figure 5.2: Major Markets for Sri Lanka's Processed Fruit Exports in 2022

Figure 5.2 presents Sri Lanka's main processed fruit exporting countries and the value of exports by each country in 2022. Germany, the Netherlands, Italy, Canada, the U.S.A., Qatar-Doha, France, Denmark, Switzerland, and Australia were the main

processed fruit importing countries from Sri Lanka in 2022 (Figure 5.2). Sri Lankan processed fruit exports to Germany recorded the highest (Rs. 487 million) during the year.

Main Processed Vegetable Export Markets in 2022

Figure 5.3 presents Sri Lanka's main processed vegetable exporting countries and the value of exports by each in 2022. Japan, Taiwan, France, the Netherlands, Australia, Spain, the Philippines, South Africa, the U.S.A., and Malaysia were the main processed vegetable importing countries from Sri Lanka in 2022. Sri Lankan processed vegetable exports to Japan recorded the highest value (Rs. 1372 million) in the same year. Gherkins preserved in brine or vinegar have a high demand in the export market with the main exporter being Japan followed by Australia, Taiwan, and the Netherlands.



Note: The vegetables considered in this analysis are cucumber, gherkin, tomatoes, and beans.
Source: Authors' Compilations based on Customs Data, Sri Lanka (2022)

Figure 5.3: Major Markets for Sri Lanka's Processed Vegetable Exports in 2022

5.5 Government Policies and Support for the Processed Fruit and Vegetable Industry

This section discusses the most relevant policies, acts, and strategies of the Sri Lankan government for promoting the fruit and vegetable processing industry (see Annex 1).

5.5.1 Main Policies, Acts, Strategies, and Regulations in Sri Lanka for the Fruit and Vegetable Processing Industry

National Agriculture Policy (Suggested in 2021)

The National Agriculture Policy was developed under the National Policy Framework, "*Vistas of prosperity and splendor"* (2020-2025) to transition from subsistence agriculture to demand-driven, entrepreneurial, and export-oriented agriculture with

import substitution, while raising the living and social standards of the farming community, with a special emphasis on youth in an environmentally friendly agricultural environment. In this framework, under thematic area 6, *Agri-Entrepreneurship and Markets* Policy Statement 8 "*Foster strategic collaboration among the value chain actors, especially focusing on value-added products, targeting domestic and international markets"* primarily emphasize the value addition of agricultural products.

National Industry Policy

The government's industrial policy fosters investment, joint ventures, importation for value addition, and re-exports of specific products to increase the country's most needed foreign exchange (Export Development Board, 2022a). The National Industry Policy (NaPID) was prepared and submitted to the Cabinet of Ministers and the Committee for Economic Stabilization, Revival, and Growth Enhancement in 2023 as an urgent requirement for Sri Lanka's industrial growth (Ministry of Industries, 2023).

National Export Strategy (2018-2022)

In 2018, the National Export Strategy (NES) of Sri Lanka was developed under the guidance of the Ministry of Development Strategies and International Trade and the Sri Lanka Export Development Board (EDB), with financial support from the European Union. The NES was a timely step taken to reform the export sector in Sri Lanka. It defines a detailed roadmap for faster export growth and acknowledges a need for a work plan to increase the contribution of trade to the country's economic development. The NES was developed in consensus with the entire export community with upcoming tasks and removing barriers that block the smooth progression of the export trade (Ministry of Development Strategies and International Trade, 2018). The processed food and beverage (F and B) sector is one of the six focus sectors identified in the National Export Strategy (NES).

Food Act No. 26 of 1980

Food Act No. 26 (1980) regulates and controls the manufacture, importation, sale, and distribution of food by a Food Advisory Committee by repealing the Food and Drugs Act of 1949 and providing for matters connected therewith or incidental thereto.

Regulations Related to the Processed Fruit and Vegetable Industry

- Food Act No 26 of 1980, amended the food labelling and advertising regulation, 2022
- Colour coding for sugar levels – Liquid Regulation, 2022
- Control import, labeling, and sale of genetically modified Foods Regulations 2006 – No 1456/22
- Food (Preservatives) Regulation, 2019 No. 2113/16
- Food (Additives-General) Regulations 2019 – No. 2131/2
- Food (Registration of Premises) Regulations 2019 – No. 26/1980

- Food (Colour coding for sugar, salt, and fat) Regulation 2019 – No. 26/1980
- Food (Colour coding for sugar levels) Regulations 2016- No. 1965/18
- Food (Sweeteners) Regulations 2014 – No.1905/36
- Food (Flavouring substances and flavour enhancers) Regulations 2013 – No. 1795/51
- Food (Shelf life of imported food items) Regulations 2011 No.1927/57
- Food (Shelf life of imported food items) Amended Regulations 2011 No.1927/57
- Food (Hygiene) Regulations 2011- No. 1733/47
- Food (Colouring Substances) Regulations 2006 – 1, No.472/19
- Food (Colouring Substances) Amendment Regulations 2011- No.1688/28
- Food (Packaging materials and articles) Regulation 2010 – No.1660/30
- Food (Adoption of standards) Regulation 2008- No.1838/12
- Food (Vinegar standards) Regulations 2007- No.1503/8-2007
- Food (Irradiation) Regulations 2005 – No 1420/5
- Food (labelling and advertising) Regulations 2005 – No. 1376/9
- Food (Standards) Regulations of 1989 – No. 637/18

Standards Introduced for the Processed Fruits and Vegetables Industry

There are 34 standards (SLS) introduced by the Sri Lanka Standards Institute (SLSI) for fruits and vegetables (Annex 2). The following three are compulsory for the processed fruits and vegetables industry.

- SLS 214 Compulsory - Fruit squashes, fruit syrups, fruit cordials
- SLS 729 Compulsory - Ready to serve fruit drink
- SLS 730 Compulsory - Fruit squashes concentrate, fruit syrups concentrate, fruit cordials concentrate

5.5.2 Main Institutes Related to the Processed Fruit and Vegetable Industry and Their Functions

The processed fruit and vegetable industry is an important sub-sector of the Sri Lankan economy, supported by various government, semi-government, and private institutions. The public sector institutions include the Ministry of Industries, Industrial Development Board (IDB), Export Development Board, Fruit Research and Development Institute, Department of Agriculture, Ministry of Agriculture, Industrial Technology Institute (ITI), and National Institute of Post-Harvest Management (NIPHM). Further, there are premier quality institutions such as Sri Lanka Standards Institution (SLSI) and SGS. Lanka Pvt Ltd, who is involved in the certification process. There are also well-established private sector associations such as the Lanka Fruit and Vegetable Producers, Processors and Exporters Association (LFVPPEA) and Sri Lanka Food Processors Association (SLFPA) contributing to the advancement of the processed fruit and vegetable industry. The proceeding section discusses the most relevant public, semi-government, and private organizations the processed fruit and vegetable industry.

5.5.2.1 Ministry of Industries (MOI)

Ministry of Industries, the key government ministry responsible for the processed food industry, provides the following services: Registration of fruit and vegetable processing industries, and provision of credit facilities through funds (SMILE III – Revolving Fund (RF) Loan Scheme and E-Friends II – Revolving Fund (RF) Loan Scheme), land and infrastructure, facilities through Development Divisions, inputs for industries, duty concessions for value-added goods, recommendations for entry and resident visa, support for entrepreneurship/market linkage programmes, training opportunities, laboratory and special facilitation centers, support for holding annual exhibitions/fairs facilitated by the ministry of industries, and tax incentives for exports.

5.5.2.2 Industrial Development Board (IDB)

The Industrial Development Board (IDB) is a premier state organization of the Ministry of Industries, enacted by the Industrial Development Act No.36 of 1969 to develop the Industrial Sector in Sri Lanka. The services provided by the IDB include the identification of business opportunities, improving product quality and productivity, facilitating project feasibility studies and submission of reports, managing development and consultancy services, providing business information, and developing linkages, engaging in product development, promoting innovation and new technologies, and facilitating infrastructure facilities.

Further, IDB provides facilities for testing food products to measure levels of sugar, salts, fat, the nutritional composition for labelling, determining shelf life, food spoilage, food safety, pesticide residues, heavy metals and antibiotics, and testing for SLS and other international standards (Ministry of industries, 2023).

5.5.2.3 Food Research Unit (FRU)

Food Research Unit (FRU) is a unit of the Department of Agriculture's Horticultural Crop Research and Development Institute (HORDI), primarily responsible for conducting post-harvest technology research and developing food crop products. This unit is also responsible for evaluating the quality of samples obtained through the crop enhancement programme. FRU collaborates with government, semi-government, and private sector entities to develop, transfer, and use machine technology. In addition, the unit provides facilities and supervision for undergraduate and postgraduate students to research many aspects of postharvest and food processing technologies.

5.5.2.4 Fruit Crop Research and Development Institute (FRDI)

Fruit Crop Research and Development Institute (FRDI) was first established as a Fruit Crop Research and Development Centre on 6th October 2001 at the Kananwila farm of the Department of Agriculture (DOA) with the mandate of Development and

dissemination of appropriate technologies to increase commercial fruit production in the country and improve the living standard of farmers. The main objectives of FRDI are: to provide farmers with improved fruit varieties with farmer acceptance, associated technologies for high productivity and profitability, eco-friendly plant protection technologies, methods to minimize post-harvest losses, ways to enhance value addition, quality seeds, and planting materials, and popularize and aware stakeholders on fruit crop related technologies.

5.5.2.5 Industrial Technology Institute (ITI)

Industrial Technology Institute (ITI) is a pioneer research and development institution in Sri Lanka, the successor to the Ceylon Institute of Scientific and Industrial Research (CISIR), was established in 1955 to provide technical services, conduct research and development, serve as a science information service center and provide testing facilities for quality assurance.

ITI's Contribution to Processed Fruits and Vegetables Sector

The food technology section of the ITI conducts training and workshops on key areas for stakeholders in the food industry as and when requested. These programmes also include training on fresh and processed fruits and vegetables. ITI has introduced 368 food-based technologies to date. Among them, 152 were food-based technologies for the processed fruits and vegetables industry.

The training provided by ITI to stakeholders in the food industry include;

Postharvest Technology

1. Pre and Postharvest quality management of fruits and vegetables
2. Postharvest handling of fresh produce intended for supermarkets/exports
3. Packhouse management for better quality and safe produce
4. Postharvest treatments to extend the storage life of fruits
5. Proper packaging and transportation for high-quality produce
6. Minimal processing / fresh-cut technology of fruits and vegetables
7. Safe fruit ripening technology

Fruit and Vegetable Processing Technology

1. Fruit and vegetable dehydration technology /fruit and vegetable powders
2. Osmotically dehydration technology and high sugar preservation
3. Ready to serve drinks / cordials from fruits and vegetables
4. Fruit purees / pulps /concentrates technology
5. Pickling / sauces /brining technology of perishables

Food Microbiology

1. Training on Good Manufacturing Practices (GMP) for food industry
2. Microbiological tools for food industries
3. Probiotic and prebiotics in food industry

Other training and workshops offered by the Food Technology Section

1. Food Canning and bottling technology
2. Food safety management in the food industry
3. Non-thermal processing technology for fruits and vegetables
4. Shelf-life evaluation of food, real-time method
5. Food safety and quality management
6. Food machinery and unit operations
7. Food packaging and labeling

5.5.2.6 National Institute of Post-Harvest Management (NIPHM)

The National Institute of Post-Harvest Management (NIPHM) is the main institution in Sri Lanka, to improve post-harvest technologies in rice, other grains, field crops, fruits, vegetables, and spices. The institute conducts post-harvest research, training, extension, consultancy, advisory, and other development activities.

Activities of the National Institute of Post-Harvest Management (NIPHM) related to the Fruit Processing Industry

The National Institute of Post-Harvest Management (NIPHM) conducts training programme on, banana dehydration and value addition for small and medium-scale entrepreneurs. This training covers key areas in banana processing; banana dehydration, making banana flour, producing bakery products from banana flour, and producing banana chips and snacks. NIPHM also conducts training on producing jams, jelly, and other products from banana value addition.

NIPHM actively engages in technology transfer activities to the Sri Lankan agriculture sector. Through this, many new, small, and medium-scale enterprises have been established island-wide to produce quality products for their customers. NIPHM further plans to commercialize its technologies, mainly, processed fruit and vegetable-based products, cereal-based products, and bio wax.

5.5.2.7 Export Development Board (EDB)

The Export Development Board (EDB), established in 1979 under the Sri Lanka Export Development Act No. 40, with the influence and guidance of the International Trade Center (ITC) and the United Nations Conference on Development of Trade and Tariffs (UNCTAD), is Sri Lanka's apex organization for the development and promotion of exports. There are several divisions in the EDB *viz.* Market Development Division, Export Agriculture Division, Industrial Products Division, Export Services Division, Regional Development Division, Trade Facilitation and Trade Information Division, and Policy and Strategic Planning Division. The main stakeholders of EDB are farmers, processors, exporters, government and private institutes, and international buyers and affiliated associations.

The EDB has initiated several programmes to assist export-oriented agriculture projects at the regional level. These include various awareness programmes on horticultural crops, soil testing, crop selection, crop protection, polyhouse farming, post-harvest technologies including pack houses, quality certifications, interrelated agriculture projects, and good manufacturing practices (Export Development Board, 2019).

The EDB conducts training programmes and certificate courses for exporters and potential exporters in international trade. Further, it provides export marketing support to enhance the Sri Lankan export industry through market research, advisory services, market intelligence, trade promotion, inward and outward buying and selling missions, and auxiliary services.

EDB maintains an online and offline Sri Lanka Exporters Directory, a database of Sri Lankan export products and suppliers of services and providers. It provides Sri Lankan exporters a direct path to the global markets and buyers.

5.5.2.8 Sri Lanka Standards Institute (SLSI)

Sri Lanka Standards Institution (SLSI) is the National Standards Body of Sri Lanka, established under the Bureau of Ceylon Standards Act No. 38 of 1964 and functioned under the name, Bureau of Ceylon Standards until the Act was repealed and replaced by the Sri Lanka Standards Institution Act No. 6 of 1984. SLSI functions under the Ministry of Science, Technology, and Research and is governed by a council appointed by the Minister. The stakeholders of the SLSI are the government, local and foreign organizations registered with SLSI, scientific institutions, and consumers. Functions of SLSI include formulation, revision, and amendment of national standards, product certification, system certification (ISO 9001, ISO 22000, HACCP, GMP, ISO 14001, OHSAS 18001, and SA 8000), laboratory testing services, industrial metrology and instrument calibration services, inspection of imports, quality assurance of exports, training on standardization and quality management, providing information and acting as the national inquiry point to WTO Agreement on Technical Barriers to Trade (WTO/TBT).

5.5.2.9 Lanka Fruit and Vegetable Producers, Processors and Exporters Association (LFVPPEA)

The Lanka Fruit and Vegetable Producers, Processors and Exporters Association (LFVPPEA) was established in 1986 to create a single platform for all stakeholders involved in the export supply chain of fresh and processed fruits and vegetables in Sri Lanka. At present 54 members are registered in the LFVPPEA. The mission of LFVPPEA is to increase the production of crops with high export potential through improved agricultural productivity, reduce post-harvest losses, improve the quality and safety of available produce, provide linkages between producers and buyers, and, facilitate imports and exports by easing the businesses. Over 36 years since existence, the LFVPPEA has functioned as a bridge between its members and other stakeholders

including growers, government ministries, departments, statutory authorities, commercial organizations, and international buyers by facilitating communication and sharing information. Further, LFVPPEA as a premier association in the fruit and vegetable sector influences and advocates national and international business environments, policies, tariffs, and trade agreements, favourably, on behalf of its members and the horticulture industry in Sri Lanka.

5.5.2.10 Sri Lanka Food Processors Association (SLFPA)

The Sri Lanka Food Processors Association (SLEPA) was founded in 1997 as an advocacy group for its apex body comprising small, medium, and large food processors. Its current membership is over 140 companies. The members of SLEPA are producers of food ingredients, grocery items, confectionary and bakery products, frozen foods, fruit and vegetable-based products, and beverages. Their mission is to uplift local food and beverage safety and service standards throughout the supply chain to a globally accepted level, foster innovation and collaboration within the industry by supporting services, promote global knowledge and technology transfer, lead the Sri Lankan food and beverage industry to achieve global presence and be the interface between the government, food processors and the consumer.

This chapter gave an overview and policy environment of the processed fruits and vegetables industry in Sri Lanka based on the secondary data sources, and key informant interviews. The next chapters will focus on the research findings on the potentials, constraints, marketing structure, marketing channels, and consumption patterns of processed fruits and vegetables products in Sri Lanka.

CHAPTER SIX

Fruit and Vegetable Processing in Sri Lanka

This chapter provides in-depth information on analytical findings on the processing potentials, barriers, and prospects of the processed fruit and vegetable sector in Sri Lanka based on the information collected from 30 participants, fruit and vegetable processors in the three districts, Colombo, Gampaha, and Kandy.

6.1 Fruit and Vegetable Processing in Sri Lanka

6.1.1 Socio-economic Profile of Fruit and Vegetable Processors in Sri Lanka

Information related to the socio-economic profile of fruit and vegetable processors in the sample is summarized in Table 6.1. The majority of the respondents, i.e., 66.70% in the sample were males, and half of the population were in the age group of 41 – 60 years. Around 37% of the respondents were between 20 – 40 and 13% were above 61 years. The mean age of the respondents was 47 years, indicating low participation of the younger generation in the fruit and vegetable processing industry. The level of education of about 70% of the participants was up to tertiary level possessing diplomas, degrees or post graduate degrees while others except one have studied up to GCE (A/L). A considerable proportion (33.33%) engaged in fruit and vegetable processing for more than 10 years averaging 12 years. The vast majority (90%) of the processors have participated in fruit and vegetable processing-related training programmes conducted by the government (92.59%) or private organizations (33.33%) apart from the few (10.00%) who did not participate in any such training. Almost 60% of the fruit and vegetable processors did not have membership in business associations. The others have obtained membership in the Lanka Fruit and Vegetable Producers, Processors, and Exporters Association or the Sri Lanka Food Processors Association. All processors who had membership in business associations were satisfied with the service provided by their association because of the benefits they received in areas such as awareness of international market opportunities, standards, and new technologies (63.64%), attending training and exhibitions (63.64%), and participating in organizing export promotion activities (36.36%).

Table 6.1: Socio-Economic Characteristics of Fruit and Vegetable Processors

Variable	Frequency	Percentage (%)
Gender		
Male	20	66.67
Female	10	33.33
Age (Years)		
20 - 40	11	36.67
41 - 60	15	50.00
61 and above	4	13.33
Education Level		
Up to O/L	1	3.33
Up to A/L	8	26.67
Higher Education	21	70.00
Experience (Years)		
10 years and below	20	66.67
11 - 30	7	23.33
31 - 50	2	6.67
51 and above	1	3.33
Participation in Training Programmes		
Yes	27	90.00
No	3	10.00
Membership in Business Organization		
Yes	11	36.67
No	19	63.33

Source: Authors' Compilation based on HARTI Survey, 2023

Reasons given by the fruit and vegetable processors for engaging in fruit and vegetable processing are summarized in Table 6.2. About 40% of the sample processed fruits and vegetables because of the availability of raw materials. A substantial proportion also considered this a source of additional income (33.33%) and an employment opportunity (26.67%). A considerable proportion (13.33%) also felt their processing skills and knowledge as the reason for their attraction to fruit and vegetable processing. A few processors, however, felt access to the market or business diversification as key reasons to engage in this industry. These observations tally with the findings of Hawassi (2006) in Tanzania.

Table 6.2: Key Reasons to Engage in Fruit and Vegetable Processing

Reason	Frequency	Percentage
Availability of raw fruits and vegetables	12	40.00
Source of additional income	10	33.33
Employment opportunity	8	26.67
Processing skills and knowledge acquired	4	13.33
Business investment	3	10.00
Access to market	2	6.67

Note: The total percentage of categories exceeds 100, due to multiple responses
Source: HARTI Survey, 2023

6.1.2 Description of the Fruit and Vegetable Processing Firms

A description of the fruit and vegetable processors of the sample is given in Table 6.3. About 77% of the fruit and vegetable processing firms surveyed have been operating their plants for less than 11 years with a mean of 12 years. This unanticipated result is because one company in the sample has been operating for more than 71 years.

A sole proprietorship is an unincorporated business owned by a single individual which is said to be the simplest kind of business structure. When a person enters into a partnership with another to carry out a business is collectively called a "Partnership Firm". A private company is a firm held under private ownership while a limited liability company (LLC) is a legal business entity belonging to its members. In the sample assessed 46.67% were sole proprietorships while 43.33% were private companies. The least were the partnerships (10.00%).

Table 6.3: Key Characteristics of Processed Fruit and Vegetable Firms

Variable	Frequency	Percentage (%)
No. of years in operation		
10 years and below	23	76.67
11 – 40	3	10.00
41 – 70	3	10.00
71 years and above	1	3.33
Form of ownership		
Sole proprietorship	14	46.67
Partnership	3	10.00
Private Limited Company	13	43.33
No. of employees		
Below 50	23	76.67
50 - 249	6	20.00
Above 249	1	3.33
Ownership of the company premises		
Hire	5	16.67
Own	25	83.33
Obtained quality certificates		
Yes	19	63.33
No	11	36.67

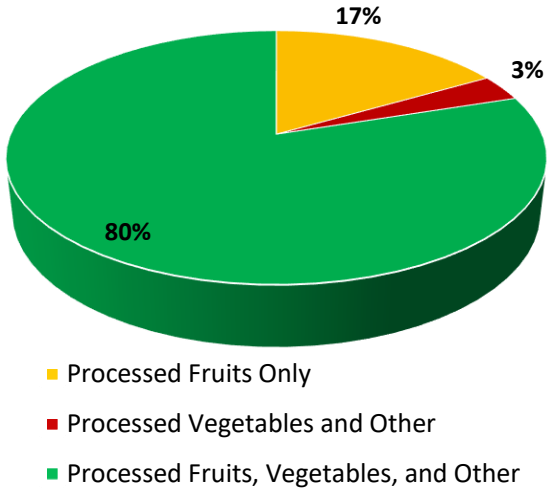
Source: Authors' Compilation based on HARTI Survey, 2023

A large percentage, 76.67% of the fruit and vegetable processing companies have less than 50 employees since they function with a minimum staff. There is only one firm in the sample with more than 250 employees. According to the survey, 83.33% of firms have factories on their land other than in hired locations. Quality standards and certifications are crucial for building trust in Sri Lankan processed fruit and vegetable products in domestic and export markets. The majority (63.33%) of surveyed processing firms have quality certifications such as Good Manufacturing Process (GMP), HACCP, ISO, SLS, FDA, EU Organic, Kosher, USDA, and BRC. Rest who still did

not obtain quality certificates mentioned their willingness to apply for at least the GMP certificate soon.

6.1.3 Classification of Processing Companies by the Type of Production

The distribution of firms in the sample according to type of production is illustrated in Figure 6.1. About 80% of processing companies process fruits, vegetables, and other products such as coconut oil, herbs, tea, and spices. There are 17% who only process fruits and 3% process vegetables and other agricultural products.

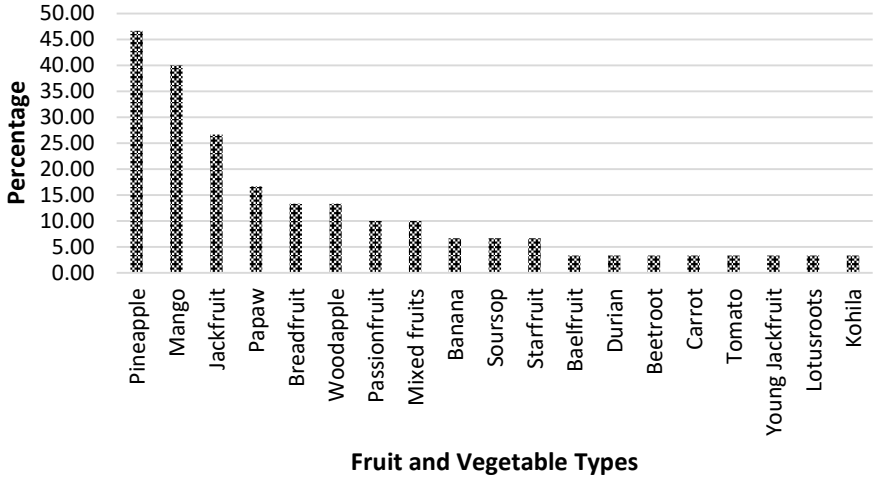


Source: HARTI Survey, 2023

Figure 6.1: Categories of Processing Firms According to the Raw Material (Fruits/Vegetable/Other) Input

6.1.3.1 Main Fruits and Vegetables Used as Raw Materials for Processing

There are 87 fruits and vegetables processed by the firms in the sample although 19 are the most frequent. Among them, pineapple (46.67%), mango (40.00%), jackfruit (26.67%), papaw (16.67%), breadfruit (13.33%), and wood apple (13.33%) are noteworthy (Figure 6.2).



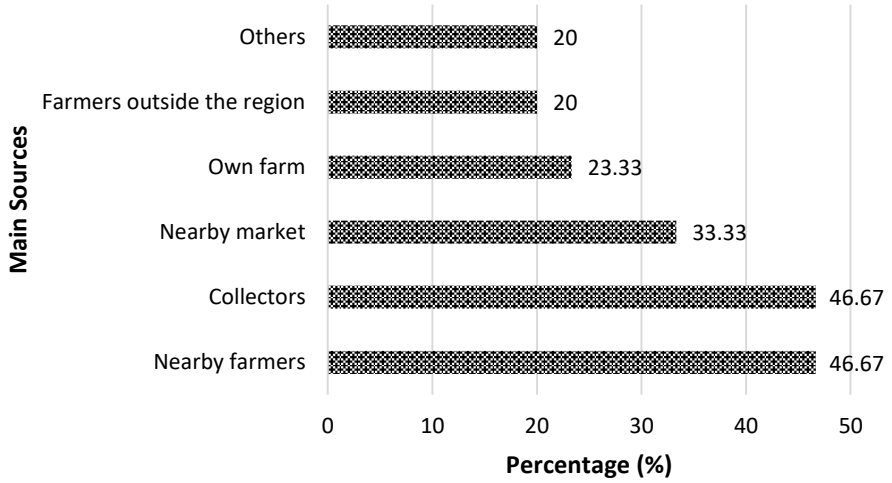
Note: Total percentage of categories exceeds 100, due to multiple responses
Source: HARTI Survey, 2023

Figure 6.2: Most Common Fruits and Vegetables Processed in Sri Lanka

6.1.3.2 Main Sources of Raw Fruits and Vegetables Available for Processing

The main sources of raw fruits and vegetables available for processing are presented in Figure 6.3. There were six main sources of raw fruits and vegetables available in the surveyed areas for processing; nearby farmers (46.67%), collectors (46.67%), nearby markets (33.33%), own farms (23.33%), farms outside the region (20%), and other (20%) such as other countries, companies, out-growers, organic certified farmer groups, and special greenhouses.

The main source of fresh fruits and vegetables depends on the variety and type. For instance, large-scale tomato processors import raw materials from India, China, and Pakistan, some small-scale processors use tomatoes from local greenhouse projects in the Gampola, Hanguranketha, and Marassana areas. Further, processors who mainly process organic products use raw materials from their organic-certified farms or other organic-certified farmer groups. Few processors indicated they maintain out-grower models, especially for pineapple, passion fruit, soursop, and mango raw material collections. Some processors buy their raw materials, especially mango from large-scale fruit exporting companies, and a few obtain dried fruit and vegetable materials from other large-scale processors.



Note: Total percentage of categories exceeds 100, due to multiple responses
Source: HARTI Survey, 2023

Figure 6.3: Main Sources of Fresh Fruits and Vegetables

Among the processing firms in the sample, the majority (73.33%) did not have contracts or written agreements with their raw material suppliers. Only eight processors (26.67%) had contracts with their raw material suppliers. Even though most processors had no contracts or written agreements with suppliers, regular supply of quality raw materials has been a key strength for their companies. All processors consulted in the survey were concerned about the quality of the raw materials purchased from different sources. They use various quality parameters; ripen stage, quality, physical appearance, weight, size, and flavour selecting raw materials before purchasing.

Based on these observations two inferences can be made; (I) there is an opportunity for processors to select the quality fruits and vegetables, and (II) fruit and vegetable processing firms maintain links with suppliers to ensure constant availability of fruits and vegetables. Both of these are vital inputs for fruit and vegetable processing because they can positively impact the industry's sustainability because the availability of raw materials for these firms depends mostly on the supply situation.

6.1.4 Production of Different Categories of Processed Fruit and Vegetables

The different categories of fruits and vegetables produced by the respondent firms include dehydrated products, fruit drinks, jams, fruit syrups, powders, desserts, sauces and pulps. The percentage production of each category is given in Table 6.4.

The most common category among the processors was dehydrated fruits and vegetables recording (53.33%). The common dehydrated food products are dehydrated vegetable mixes, fruit snacks, and mix bites. About 20% of them processed fruit drinks predominantly from strawberry, mango, pineapple, and wood apple.

About 17% of the sample produced mixed fruit jams while 13.33 % processed syrup from pineapple, mango, papaya, fruit cocktail, soursop, and rambutan. The processed food item of about 10% was powdered moringa, soursop, banana, and jackfruit powder while a similar percentage produced deserts; jack fruit watalappan, durian watalappan, and durian cupcakes. About 7% of the sample produced tomato, chili, tamarind, and mango sauces and 3% produced pulps from pineapple, mango, wood apple, passionfruit, and soursop as their main product.

Table 6.4: Main Categories of Processed Fruit and Vegetables Produced by the Companies in the Sample Assessed

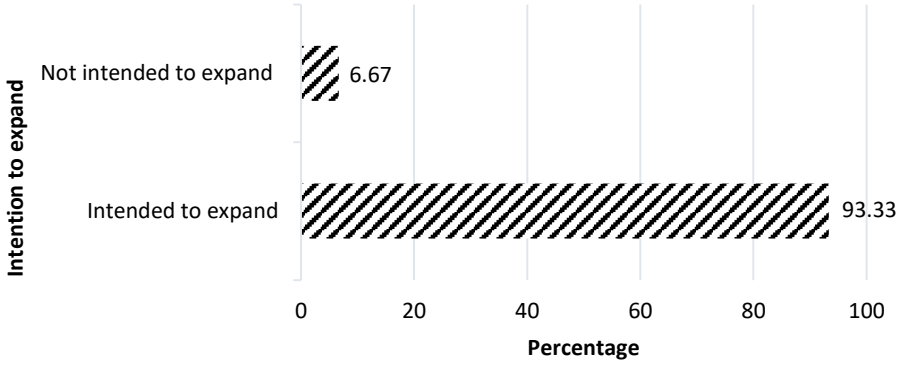
Major Products	Percentage
Dehydrated Products	53.33
Fruit Drinks	20.00
Jam	16.67
Fruit in Syrup	13.33
Powder	10.00
Deserts	10.00
Sauce	6.67
Fruit Pulp	3.33

Source: HARTI Survey, 2023

6.1.4.1 Expansion of Fruit and Vegetable Processing Capacity

Apart from the major product categories and sources of raw materials, respondents were asked to indicate actual quantities of fruits and vegetables processed during harvest and off seasons. Some of the processors, however, refused to disclose their production data. When the respondents were asked to indicate the ability to reach their optimum capacity during harvest and off seasons about 55% mentioned that their inability was due to reasons such as lack of packaging materials, insufficient market, inadequate fresh products, shortage of working capital, shortage of labour, and high energy cost.

The respondents were also asked to indicate whether they intend to expand their production. Interestingly about 93% were willing partly due to the availability of fresh produce, profit emanating from fruits and vegetable processing activities, and increased demand among consumers (Figure 6.4). Others did not show interest because they had already expanded their production capacity and some of the others suffered from a lack of credit facilities.



Source: HARTI Survey, 2023

Figure 6.4: Intention of Fruit and Vegetable Processors to Expand the Production Capacity

Specific products willing to expand: The preferences of the respondent population for product types they specifically ought to expand are detailed in Table 6.5. According to their preferences, about 53% intend to expand the production of fruit and herbal drinks and 40% dehydrated fruits and vegetables apart from a shown interest in energy porridge and jam production. Just one respondent desired to expand the production of wood apple chocolate.

Table 6.5: Preferred Processed Fruit and Vegetable Products for Future Expansion

Product	Percentage
Fruit juice (ripe jackfruit/ mango/ pineapple/ passionfruit)	26.67
Herbal drinks	26.67
Dehydrated products (mixed veggie pack/ fruit snacks/dehydrated bandum)	20.00
Powder (mango/banana/avocado seed)	20.00
Pickle (young jackfruit)	10.00
Chutney (mixed fruit)	10.00
Vegetable soup	10.00
Pulled Jackfruit with BBQ sauce/teriyaki sauce	10.00
Pulled banana blossom with BBQ sauce/teriyaki sauce	6.67
Energy porridge	3.33
Jam	3.33
Wood apple chocolate	3.33

Note: Total Percentage of Categories Exceeds 100 due to Multiple Responses
Source: HARTI Survey, 2023

6.2 Factors Affecting the Performance of Fruits and Vegetable Processors in Sri Lanka

6.2.1 Key Strengths of Fruit and Vegetable Processors in Sri Lanka

Key strengths of fruit and vegetable processing firms in Sri Lanka are presented in Table 6.6. Approximately 87% of the sample has a regular customer basis with a high demand for their products. The availability of regular supplies of raw materials for their products has been a key strength for these processing firms. About 57% of the processors noted the presence of skilled and effective labour as another key strength while around 44% also believed meeting quality standards and product certification as another key strength for their success. About 30% of the samples had their name branded. Easy access to information regarding markets and usage of new technologies were also key strengths of the respondents.

Table 6.6: Key Strengths of Fruit and Vegetable Processors in the Responded Sample

Strengths	Percentage (%)
Have regular customer basis	86.67
High demand for special products	73.33
Have a regular supplier base for raw materials	73.33
Skilled and effective labour	56.67
Maintain quality standards and certifications	43.33
Reputed company/brand name	30.00
Easy access to information regarding markets	26.67
Usage of new technology in packaging & labelling	23.33
Other (Heritage)	3.33

Note: Total percentage of categories exceeds 100, due to multiple responses
Source: HARTI Survey, 2023

6.2.2 Expectations of Fruit and Vegetable Processors to Expand their Businesses and Business-related Activities

The responses of the fruit and vegetable processors' sample on willingness to continue business and related activities are summed in Table 6.7. Approximately 90% expressed their willingness to expand their business operations. Further, a percentage of 80% participated in local and international food exhibitions, and around 67% wanted to expand the range of new products and 60% wanted to make new investments in the business.

Table 6.7: Fruit and Vegetable Processors' Expectations to Expand their Businesses and Business-related Activities

Changes	Percentage (%)
Expand business operations	90.00
Participate for local and international food exhibitions	80.00
Expand the range of new products	66.67
Make new investments in the business	60.00
Increase R&D	46.67
Increase the number of workers	16.67
Improve employment/working conditions of staff	16.67
Improve processing technology	16.67
Reduce some of the existing product lines	13.33
Hire a professional manager to run it for the processor	6.67

Note: Total percentage of categories exceeds 100, due to multiple responses
Source: HARTI Survey, 2023

6.2.3 Challenges for Fruit and Vegetable Processors in Sri Lanka

Based on the information provided by the fruit and vegetable processors in the sample and the challenges they faced for the successful operation of their activities, the constraint facing index (CFI) was computed as a tool to rank the constraints. The results are presented in Table 6.8.

Table 6.8: The Responses of Fruit and Vegetable Processors and Weights of each Rated by Constraint Facing Index (CFI)

Constraint related area	High (C_h) Weight = 3	Medium (C_m) Weight = 2	Low (C_l) Weight = 1	None (C_n) Weight = 0	CFI*	Rank
Production	12	14	2	2	66	1
Government Policies	12	10	3	5	59	2
Financial	12	8	1	9	53	3
Marketing	7	11	2	10	45	4
Export Related	9	6	2	13	41	5
Human Resource	3	6	2	19	23	6

Note: *CFI = $(3 \times C_h) + (2 \times C_m) + (1 \times C_l) + (0 \times C_n)$
Source: HARTI Survey, 2023

According to the CFI values the challenges related to the production process ranked first with a CFI score of CFI 66. Constraints related to government policies and regulations (CFI, 59), financing (CFI, 53), marketing (CFI, 45), exporting (CFI, 41), and human resources (CFI, 23) followed sequentially, ranking 2nd, 3rd, 4th, 5th, and 6th respectively.

Production-related Constraints for Processing Fruit and Vegetables in Sri Lanka

As mentioned, production-related issues were the most serious, affecting the fruit and processing industry (CFI = 66). According to the sample of 30 fruit and vegetable processing companies surveyed, costs of inputs/raw materials (71.43%) and energy (67.86%) have been the most critical. The scarcity of quality raw materials (35.71%), lack of appropriate processing technologies (21.43%), inappropriate machinery (17.86%), and underutilization of capacity (10.71%) have also been critical to a sizable extent. High labour costs and issues such as inconsistency in raw material prices, high cost of testing, lack of cold storage facilities, and frequent breakdowns have also been mentioned by a few as restraints for (Table 6.9) the smooth functioning of fruit and vegetable processing firms in the country (Table 6.9).

Table 6.9: Production-related Constraints for Fruit and Vegetable Processing in Sri Lanka

Constraint	Percentage responded to the constraint*
High cost of inputs/raw materials	71.43
High cost of energy	67.86
Scarcity of quality raw materials	35.71
Lack of appropriate processing technologies	21.43
Inappropriate machinery	17.86
Underutilization of capacity	10.71
High labour cost	7.14
Other (inconsistency in raw material prices/high cost of testing/lack of cold storage facilities)	7.14
Frequent breakdown	3.57

Note: The total percentage of categories exceeds 100, due to multiple responses. *The total number of participants who responded was 28
Source: HARTI Survey, 2023

Government Policies/Regulations-related Constraints for Processing Fruit and Vegetables in Sri Lanka

As mentioned, government policies and regulations (CFI = 59) also affect the fruit and processing industry in Sri Lanka. The fruit and vegetable processors in the sample viewed exceeding high taxes (64%) as a major constraint for running their firms profitably. Among other policy constraints, obtaining licenses/registrations (44%) and unnecessary laws imposed by the local governments (44%), lack of coordination among institutes, inadequate government assistance, and limited awareness of foreign-funded government projects (28.00%) have also been recognized as serious threats to the fruit and vegetable processing industry (Table 6.10). Very few processors mentioned the failure to protect locally processed products, especially dehydrated vegetable sachet packets, due to the importation of imported products from other countries such as India and China.

Table 6.10: Government Policies/Regulations-related Constraints for Processing Fruit and Vegetables in Sri Lanka

Constraint	Percentage responded to the constraint*
Exceedingly high taxes	64.00
Difficulties in obtaining license/registration	44.00
Unnecessary by laws imposed by local government	44.00
Problems related to government institutional procedures (lack of coordination among institutes/inadequate government assistance/ limited awareness on government projects)	28.00
Failure to protect locally processed fruit and vegetable products from similar types of imported products e.g., dehydrated vegetable sachet packets	4.00

Note: Total percentage of categories exceeds 100, due to multiple responses. *The total number of participants who responded was 25

Source: HARTI Survey, 2023

Finance-related Constraints for Processing Fruit and Vegetables in Sri Lanka

As mentioned, finance-related (CFI = 53) constraints also affect the fruit and processing industry in Sri Lanka. The main finance-related constraints underscored by the fruit and vegetable processors in the sample have been high interest rates (61.90%), lack of working capital (42.86%), delayed payments (by buyers) (19.05%), lack of credit facilities (14.29%), and cost overrun (4.76%) (Table 6.11). The high interest of financial institutions has been a serious concern because this was the main source of financing for running these firms. The other finance-related constraints in the descending have been lack of working capital (42.86), delayed payments by buyers (19.05%), lack of credit facilities (14.29%), and cost overrun (4.76%).

Table 6.11: Financial Problems Faced by Fruit and Vegetable Processors

Constraint	Percentage responded to the constraint*
High interest rates	61.90
Lack of working capital	42.86
Delayed payments by buyers	19.05
Lack of credit facilities	14.29
Cost overrun	4.76

Note: Total percentage of categories exceeds 100 due to multiple responses. *The total number of participants who responded was 21.

Source: HARTI Survey, 2023

Marketing System-related Constraints for Processing Fruit and Vegetables in Sri Lanka

As revealed, marketing system-related (CFI = 45) constraints also affect the fruit and processing industry in Sri Lanka. The main marketing system-related constraints mentioned by the fruit and vegetable processors in the sample have been limited markets to sell products (60%), poor infrastructure facilities such as transport (20%),

insufficient sales promotion and advertisement (20%), high transport cost (20%), absence of attractive packaging materials (20%), various entry barriers find buyers/supermarkets (20%), lack of consumer awareness on processed fruit and vegetables (15%), poor awareness on markets (55%) and high competition in the local market (5%) (Table 6.12).

Table 6.12: Marketing System-related Constraints for Processing Fruit and Vegetables in Sri Lanka

Constraints	Percentage responded to the constraint*
Limited markets to sell products	60.00
Poor infrastructure facilities e.g., transport	20.00
Insufficient sales promotion and advertisement	20.00
High transport cost	20.00
Lack of attractive packaging materials	20.00
Entry barriers (difficulties in finding buyers/ supermarkets)	20.00
Lack of consumer awareness about processed fruit and vegetables	15.00
Lack of information on markets	5.00
High competition in the local market	5.00

Note: Total percentage of categories exceeds 100, due to multiple responses. *The total number of participants who responded was 20

Source: HARTI Survey, 2023

Export-related Constraints for Processing Fruit and Vegetables in Sri Lanka

As aforesaid, export-related (CFI = 41) constraints also affect the fruit and processing industry in Sri Lanka. Among the sample of 30 only 17 (56.67%) export their products. The main export-related constraints mentioned by the fruit and vegetable processors in the sample have been lack of government assistance (58.82%), high cost of exporting (41.18%), strong international competition 35.29%, unfavourable foreign exchange rates (23.53%), entry barriers for foreign trade (23.53), trade barriers and tariffs (17.65%), and limited information on foreign markets (17.65%) (Table 6.13).

Table 6.13: Export-related Constraints for Processing Fruit and Vegetables in Sri Lanka

Constraint	Percentage responded to the constraint*
Lack of government assistance	58.82
High cost of exporting (high transport cost)	41.18
Strong international competition	35.29
Unfavourable foreign exchange rates	23.53
Entry barriers for foreign trade	23.53
Trade barriers and tariffs	17.65
Limited information on foreign markets	17.65

Note: Total percentage of categories exceeds 100, due to multiple responses. *The total number of participants who responded was 17.

Source: HARTI Survey, 2023

Human Resource-related Constraints for Processing Fruit and Vegetables in Sri Lanka

As earlier mentioned, human resource-related (CFI = 23) constraints also affect the fruit and processing industry in Sri Lanka. The main asset of any firm is its human resources. An industry can increase its profitability and productivity, manifold if it has an appropriate number of skilled manpower. In the sample assessed, 63.64% believed lack of labour was their major human resource problem. Lack of technical know-how to run the business (9.09%) and skilled labour (9.09%) have also been human-resource-related constraints faced by the manufacturers of processed fruit and vegetables (Table 6.14).

Table 6.14: Human Resource-related Constraints for Processing Fruit and Vegetables in Sri Lanka

Constraint	Percentage responded to the constraint*
Limited labour force	63.64
Lack of technical know-how to run the business	9.09
Lack of skilled labour	9.09

Note: Total percentage of categories exceeds 100, due to multiple responses. *The total number of participants who responded was 11.

Source: HARTI Survey, 2023

Most Critical Problems, Root Causes, and Solutions: Fruit and Vegetable Processors' View

Table 6.15 summarizes the perceptions of fruit and vegetable processors in Sri Lanka on the most critical problems, root causes, and solutions for consideration in the upbringing of the industry.

Table 6.15: Most Critical Problems, Root Causes, and Solutions for the Upbringing of the Fruit and Vegetable Industry

Problem	Root Cause	Solution
Production	Low production, high cost of production	Improve proper mechanization, establish direct links with farmers, update with new technologies
Financial	Lack of finance	Introduce special loan schemes for entrepreneurs
Marketing	Difficult to find buyers, entry barriers	Create good marketplaces for processed fruit and products (digital platforms or physical)
Government policies	Administrative issues, Ineffective government laws and regulations	Improve coordination among institutes, Impose a simple tax system
Export	Complex Procedures	Relax Procedures

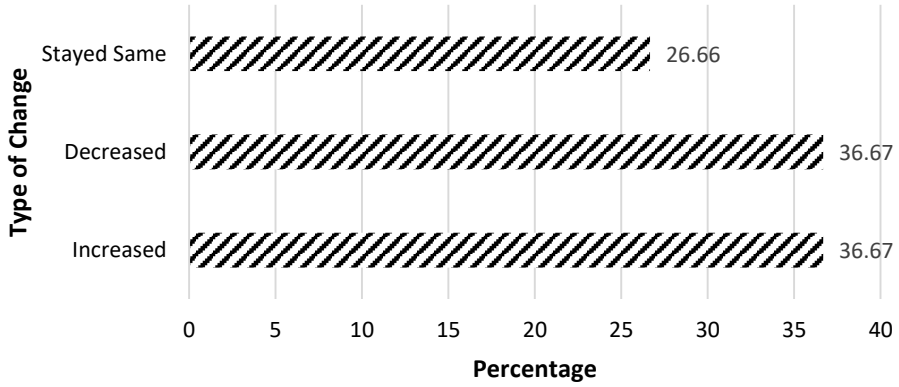
Source: HARTI Survey, 2023

Other Issues Faced by the Processed Fruit and Vegetable Industry during the Past Two Years

In addition to the aforementioned constraints, the respondents of the study were asked to comment on the issues during the past two years, they mentioned the economic crisis, pandemic, decreasing purchasing power of buyers, decreasing market demand, and ad-hoc policies implemented by the government as serious a set back to the county's processed fruit and vegetable industry.

6.2.4 Effect of Economic Crisis on the Fruit and Vegetable Processing Industry in Sri Lanka

The sample of the surveyed fruit and vegetable processors in Sri Lanka indicated changes in their sales over the last two years due to the economic crisis in 2021-2022 (Figure 6.5). Around 37% experienced a drop while a similar percentage had an increase in sales. No change was reported by the others (Figure 6.5).



Source: HARTI Survey, 2023

Figure 6.5: Change in Business Sales Movement of the Fruit and Vegetable Processors during the Crisis Period 2021-2022

A significant proportion (46.67%) of the fruit and vegetable processors in the sample started their business in the year 2020. Various factors such as the demands of buyers, the size of the company, access to finance, access to resources, export market trends, taxation, and government support, influenced the processors' decisions to increase, decrease, or maintain the production during the two years 2021-2022. Among these factors buyer's demand and export market trends were the major factors that affected the processors' decision to produce certain quantities of goods during the last two years.

The majority of the processors adopted strategies to cope with the crisis by opting to strategies such as juice freezing, storing material, reducing staff, managing costs, getting new orders, reducing package size, providing facilities to workers (transport), online marketing, and collecting raw materials from nearby farmers. During this

period about 40% of the fruit and vegetable producers in the sample approached government agencies to avail themselves of programmes/services to address their business concerns. The government institutes they sort assistance were the Small and Medium Enterprises Development Authority (50%), Agriculture Ministry (25%), Ministry of Industry and Department of Industries (25%), Department of Agriculture and Gannoruwa Food Research Unit (17%), Widatha (17%), Industrial Development Board (17%), and other institutes such as Institute of Technology Training Centre, Export Development Board, Agriculture Sector Modernization Project, Bank of Ceylon, Chamber of Commerce, Ministry of Youth, Ministry of Environment, Peoples' Bank (Graduates Entrepreneurship Spark), Sri Lanka Telecom (Helawiru programme), Department of Commerce, and Divisional Secretariats. In addition, they have also obtained benefits from trade fairs, entering supermarkets, 50%-50% facility for machinery and quality certifications (GMP), B to B platforms, and credit facilities at special interest rates.

6.3 Potentials for Processed Fruit and Vegetable Sector in Sri Lanka

6.3.1 Potential Processed Fruit and Vegetable Products for Domestic and Export Market in Sri Lanka

A list of potential processed fruit and vegetable products for the domestic and export market in Sri Lanka was prepared based on the information gathered from fruit and vegetable processors in the sample (Table 6.16 and Table 6.17). The majority of surveyed fruit and vegetable processors mentioned that dehydrated fruit and vegetable products (veggie mix, fruit snacks, and mix bites) have a high potential in both domestic (47.62%) and export (75.00%) markets.

Table 6.16: Potential Processed Fruit and Vegetable Products for Domestic Market in Sri Lanka: Processors' Insights

Product	Percentage responded
Dehydrated products (Veggie mix, mix bites, chips)	47.62
RTS Fruit drinks	28.57
Herbal drinks	23.81
Powder	23.81
Chutney	14.29
Jam	14.29
Organic	9.52
Fruit pulp	9.52
Jack flour /seed flour	9.52
Sauce	4.76

Note: Total percentage of categories exceeds 100, due to multiple responses
Source: HARTI Survey, 2023

Fruit drinks, herbal drinks, fruit and vegetable powders, chutney, jam, organic products, fruit pulp, jack flour, and sauce also have potential in domestic markets (Table 6.16) while fruit drinks, powder, frozen fruit, fruit pulp, organic products, Jam,

chutney, curry, healthy vegan, slow foods, pickles, sauce, pineapple chunks, and food supplements also have export potential in the future (Table 6.17).

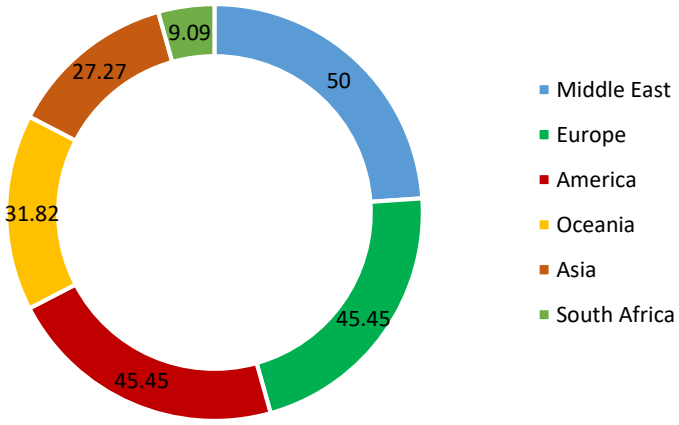
Table 6.17: Potential Processed Fruit and Vegetable Products for Export Market: Processors' Insights

Product	Percentage
Dehydrated products (Veggie mix, mix bites, chips)	75.00
RTS Fruit drinks	33.33
Powder	25.00
Frozen fruit	16.67
Fruit pulp	16.67
Organic products	12.50
Jam	12.50
Chutney	8.33
Curry	8.33
Healthy vegan	8.33
Slow foods	8.33
Pickles	8.33
Sauce	4.17
Pineapple chunks	4.17
Food supplement	4.17

Note: Total percentage of categories exceeds 100 due to multiple responses
Source: HARTI Survey, 2023

6.3.2 Future Prospects for Sri Lanka's Processed Fruit and Vegetables

Future prospects for Sri Lanka's Processed Fruit and Vegetables is shown in Figure 6.6.



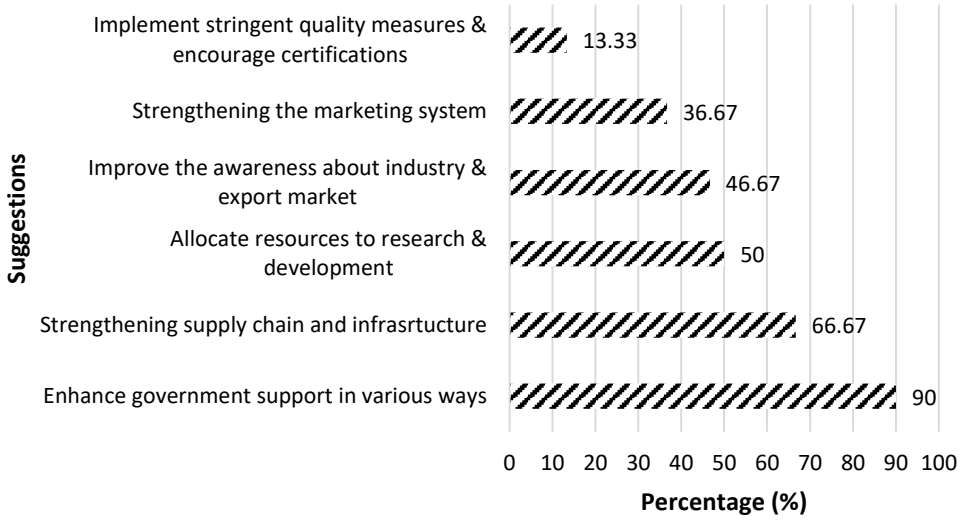
Source: Authors' Compilation based on HARTI Survey, 2023
Figure 6.6: Future Prospects for Sri Lanka's Processed Fruit and Vegetables

According to 50% of the fruit and vegetable processors in the surveyed sample, the Middle East has the highest market potential for Sri Lankan processed fruit and vegetables. Other countries with a considerable market are Europe (45.45%), America (45.45%), Oceania (31.82%), and Asia (27.27%). However, about 9% of exporters

indicated that South Africa should also be considered a potential market for Sri Lankan processed fruit and vegetables.

6.4 Fruit and Vegetable Processors' Suggestions to Improve the Industry in Sri Lanka

Suggestions made by the sample of fruit and vegetable processors who participated in the study to enhance the industry in Sri Lanka are manifold (Figure 6.7). The majority (90%) believed government support for this industry should be broadened since it is growing rapidly in various areas. Cost-effective production and exportation are vital to compete with other processed fruit and vegetable exporting countries by streamlining farmers with information and knowledge. A proper mechanism is necessary to stabilize fruit and vegetable prices. The government's intervention with stringent policies and regulatory frameworks is integral to addressing the sector's problems. Linking relevant departments and institutes to the industry is another important need for the sector's development. Banning illegal importation to protect local processors, encouraging processors by the government and other relevant authorities to boost the industry, introducing low-interest loan systems for the processing industry, and duty-free levies or concessions for acquiring machinery are also among suggestions made by the processors for upbringing the industry.



Note: Total percentage of categories exceeds 100, due to multiple responses
Source: Authors' Compilation Based on HARTI Survey, 2023

Figure 6.7: Fruit and Vegetable Processors' Suggestions to Improve the Industry in Sri Lanka

For creating an industrial culture infrastructural facilities are essential because no industrial enterprise can survive and sustain itself for long without them (Dhiman and Rani, 2011). Fruit and vegetable processors in the country are facing problems in many areas. Transportation costs and poor infrastructure facilities (40%) (Table 6.12) seriously affect the industry because the processors have to pay more for raw

materials and delivering finished products to domestic and export markets. The majority of the sample processors believe that there is a need to strengthen the fruit and vegetable supply chain and infrastructure; transportation and storage infrastructure especially facilitating cool room facilities to reduce wastage and enhancing product quality to maintain continuous supplies. Commercial cultivation of suitable varieties of fruits and vegetables is another area that needs attention to achieve higher gains. This area can be streamlined by maintaining and updating a database by identifying potential farmers, linking them with processors to guarantee reasonable prices to farmers and suppliers, and supplying quality products to domestic and export destinations.

Approximately 50% fruit and vegetable processors sampled emphasized promoting research and development to enhance agricultural practices, develop new processing technologies, and develop novel and unique value-added products capable of capturing domestic and export markets. Further, they suggested improving extension services for effectively disseminating improved technologies in fruit and vegetable cultivation, harvesting, packaging, and processing. Upgrading and modernizing processing facilities to ensure efficiency, safety, and compliance with international standards is another suggestion, made by the fruit and vegetable processors in the sample assessed.

Among respondents of the study, about 47% mentioned the importance of building awareness of the industry and prospective export markets through awareness programmes, training, and conducting business forums. About 37% also emphasized strengthening the marketing system of locally processed fruits and vegetables to enhance the industry. Making pathways for small and medium-scale processors to enter the local supermarkets, conducting market surveys, establishing online marketing platforms, identifying niche markets, and recognizing the “one village for one product’’ concept were also suggestions made by the processors sampled.

Quality standards play a significant role in promoting locally processed fruit and vegetable products to find local and export markets in the country. Implementing stringent quality control measures by encouraging processors to obtain product certifications such as GMP, GHP, HACCP, ISO, or SLS is vital in order to build trust in Sri Lankan processed fruit and vegetable products.

6.5 SWOT Analysis of Processed Fruit and Vegetable Industry in Sri Lanka

The SWOT analysis presents the industry’s internal (strengths and weaknesses) and external (opportunities and threats) environment affecting its growth and enhancement. Table 6.18 presents the four components of the SWOT analysis carried out on the fruit and vegetable sector of the country with a pretested structured questionnaire with fruit and vegetable processors sampled and key informant interviews with relevant government and private sector officials.

Table 6.18: SWOT Analysis of Processed Fruit and Vegetable Industry in Sri Lanka

Strengths	Weaknesses
1. Availability of a variety of fruits and vegetables offering a material base with a vast potential for agro-processing activities due to diverse climate conditions 2. Presence of a variety of underutilized fruits and vegetables with various functional properties 3. Advantage of having well-trained research and extension personnel 4. Ability to adhere to international and national quality standards and obtain certification 5. Availability of protocols, standards, and technologies 6. Availability of assistance to explore export markets 7. Unique flavour and characteristics of products 8. Already set demand from processors and exporters	1. Land Fragmentation limiting agricultural lands 2. Skilled labour scarcity 3. Price fluctuation of raw materials 4. Migration of skilled workers 5. Absence of well-developed value chains 6. Inadequate infrastructure facilities 7. Lack of appropriate machinery or high technologies available in competing countries 8. Lack of awareness of government's services and lapses in service delivery 9. High cost of production (wages, costs for packaging, transport, air freight, electricity, etc.) 10. Lack of quality control and testing methods in par with international standards 11. Inadequately developed linkages between research institutes and the industry 12. Minimum facilities for research and development 13. Inadequate supply of quality raw materials 14. Lack of credit facilities for SMEs
Opportunities	**Threats**
1. Development of new value-added products 2. Support from Trade Secretaries in Sri Lankan embassies in other countries 3. Rising income levels and changing consumption patterns 4. Bilateral knowledge-sharing opportunities among countries on know-how (e.g., Malaysia, Bangladesh) 5. Free trade agreements (FTA)	1. Lack of bargaining power compared to other competing countries (India, Vietnam, Thailand, China) 2. Trade barriers and regulations 3. Foreign exchange rate fluctuation 4. Changing government procedures

Source: HARTI Processors Survey, 2023 and Key Informant Interviews, 2023

CHAPTER SEVEN

Marketing Systems of Processed Fruits and Vegetables in Sri Lanka

This chapter provides detailed information and analytical findings on processed fruit and vegetable product availability in local markets, the export market status, the marketing channels, and suggestions to enhance the market in Sri Lanka.

7.1 Processed Fruit and Vegetable Products Available in the Local Market of Sri Lanka

The local and imported processed fruits and vegetables available in the country were identified by sampling some supermarkets and special outlets. Among the items detected, 110 brands were imported and 172 were local. The imported products were made of 39 fruit and 17 vegetable species and locals from 47 fruit and 36 vegetable species (Table 7.1).

Table 7.1: Processed Fruit and Vegetables Available in the Domestic Market of Sri Lanka

Imported Products (No.)	**Brands**	**110**
	Product types	Fruits - **26**
		Vegetables - **27**
	Varieties used	Fruits - **39**
		Vegetables - **17**
	Importing regions	**32**
Local Products (No.)	**Brands**	**172**
	Product types	Fruits - **27**
		Vegetables - **36**
	Varieties used	Fruits - **47**
		Vegetables - **36**

Source: HARTI Survey, 2023

The numbers of processed imported and local product types made from different fruit species, in descending order, were, mango (*Mangifera indica*; 16), strawberry (*Fragaria x ananassa*; 15), pineapple (*Ananas comosus*; 11), orange (*Citrus sinensis*; 10), mixed berries; 10, apple (*Malus domestica*; 8), lemon (*Citrus limon*; 8), lime (*Citrus aurantiifolia*; 8), dates (*Phoenix dactylifera*; 8), cherry (*Prunus avium*; 8), wood apple (*Limonia acidissima*; 7), passionfruit (*Passiflora edulis*; 7), peach (*Prunus persica*; 7), mixed fruit; 6, apricot (*Prunus armeniaca*; 6), tamarind (*Tamarindus indica*; 6), blackcurrant (*Ribes nigrum*; 6), papaya (*Carica papaya*; 6), grapes (*Vitis vinifera*; 5), mandarin (*Citrus reticulata*; 5), grapefruit (*Citrus × paradisi*; 5), pomegranate (*Punica granatum*; 5), pear (*Pyrus communis*; 5), guava (*Psidium guajava*; 4), nelli/Indian gooseberry (*Phyllanthus emblica*; 4), kiwi (*Actinidia deliciosa*; 4), watermelon (*Citrullus lanatus*; 3), ambarella (*Spondias dulcis*; 3), banana (*Musa spp*,; 3), lychee (*Litchi chinensis*; 3), soursop (*Annona muricata*; 2), rose apple (*Syzygium jambos*; 2), waraka/overripe jackfruit (*Artocarpus heterophyllus*; 2), Ceylon olive (*Elaeocarpus*

serratus; 2), bael fruit (*Aegle marmelos*; 2), goraka (*Garcinia quaesita*; 2), longan (*Dimocarpus longan*; 2); prunes/European plum (*Prunus domestica*; 2), cranberry (*Vaccinium macrocarpon*; 2), olive (*Olea europaea*; 2), and lovi-lovi/batoko plum (*Flacourtia inermis* ; 2). Avocado (*Persea americana*), bilimbi (*Averrhoa bilimbi*), figs (*Ficus carica*), raspberry (*Rubus idaeus*), durian (*Durio zibethinus*), and rambutan (*Nephelium lappaceum*) had one product each.

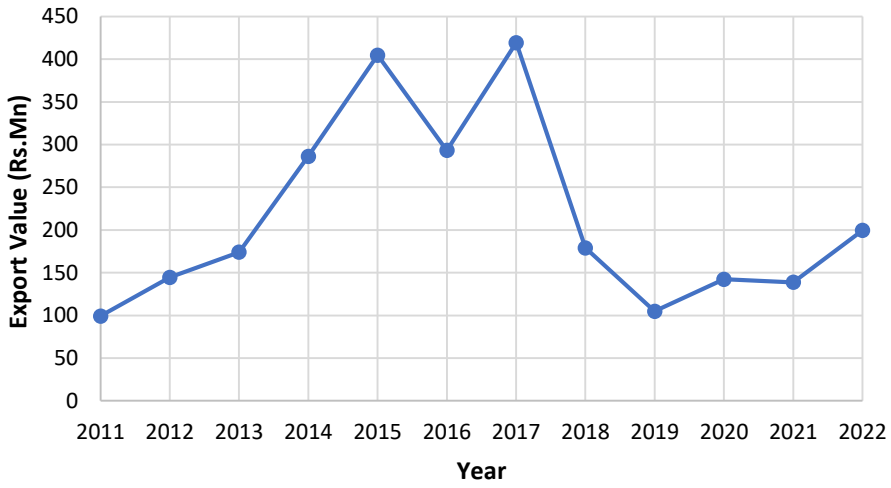
The numbers of processed imported and local product types made from different vegetable species, in descending order, were, tomato (*Solanum lycopersicum*; 16), green chili (*Capsicum annuum*; 11), corn (*Zea mays*; 8), kos/ripe jackfruit (*Artocarpus heterophyllus*; 7), moringa (*Moringa oleifera*; 7), young jackfruit (*Artocarpus heterophyllus*; 5), carrot (*Daucus carota*; 5), brinjal (*Solanum melongena*; 5), pumpkin (*Cucurbita pepo*; 4), mushroom (*Agaricus bisporus*; 4), breadfruit (*Artocarpus altilis*; 4), cassava (*Manihot esculenta*; 4), mixed vegetables, jalapeno pepper (*Capsicum annuum*; 3), bean (*Phaseolus vulgaris*; 3), paprika (*Capsicum annuum L.*; 3), sweet potato (*Ipomoea batatas*; 2); banana blossom (*Musa acuminata Colla*; 2), beetroot (*Beta vulgaris L.*; 2), gherkin (*Cucumis anguria*; 2), ash gourd (*Benincasa hispida*; 2), ash plantain (*Musa paradisiaca*; 2), rampe/pandan leaves (*Pandanus amaryllifolius*; 2), and curry leaves (*Murraya koenigii*; 2). Capsicum (*Capsicum annuum*), green peas (*Pisum sativum*), chow-chow/chayote (*Sechium edule*), kochchi (*Capsicum frutescens*), nai miris / bird chili (*Capsicum frutescens*), kohila (*Lasia spinosa*), innala (*Coleus rotundifollius*), lotus root (*Nelumbo nucifera*), radish (*Raphanus sativus*), spinach (*Spinacia oleracea L.*), bitter gourd (*Momordica charantia*), cucumber (*Cucumis sativus*), and green leafy vegetables had one product type each.

7.2 Export Market Analysis

Detailed market analyses were made on pineapple, mango, gherkins, and tomato exports using export data from 2011 to 2022. These four export-processed products were selected due to their high export market share.

7.2.1 Growth Pattern of Processed Pineapple Exports

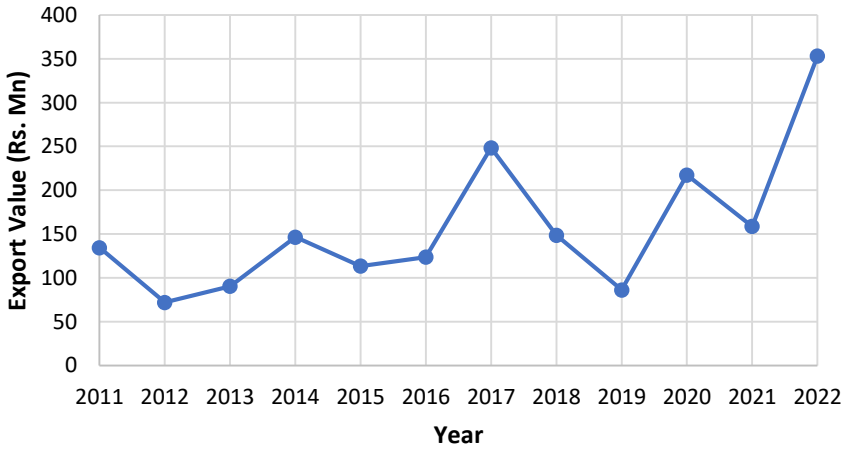
Sri Lanka's main processed pineapple exports during 2011-2022 were dried pineapples (HS 08043020), processed pineapples (HS 200820), and pineapple juice (HS 200949).



Source: Sri Lanka Custom Statistics, 2023

Figure 7.1: Dried Pineapple Export Earnings from 2011-2022

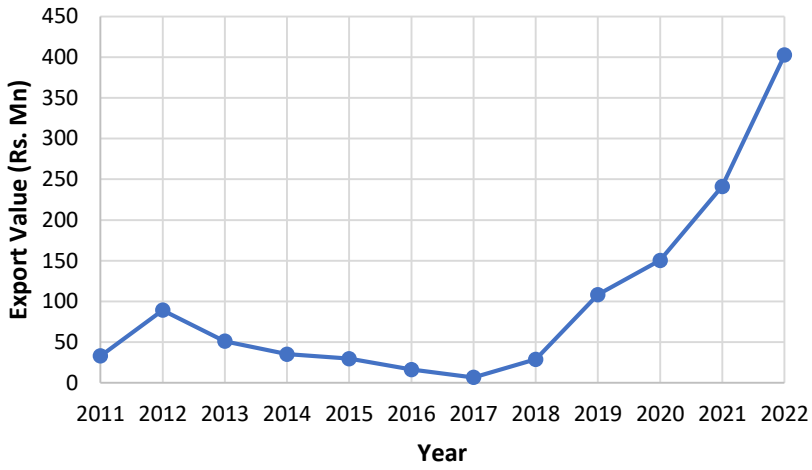
Dried pineapple (HS 08043020) exports from 2011 – 2022 showed an increasing trend in the beginning, from 2011 to 2015, decreased in 2016, and rose to a maximum in 2017. Since then, shown a decreasing trend, except for the years 2020 and 2022. The highest export value of dried pineapples was in 2017, while the lowest was in 2011 (Figure Table 7.1)



Source: Sri Lanka Custom Statistics, 2023

Figure 7.2: Processed Pineapple Export Earnings from 2011-2022

Processed pineapples (HS 200820) showed an increasing trend in export values from 2011 to 2022, except for 2012, 2015, 2018, 2019, and 2021. The highest export value of processed pineapples was in 2022 while the lowest was in 2019. (Figure 7.2).



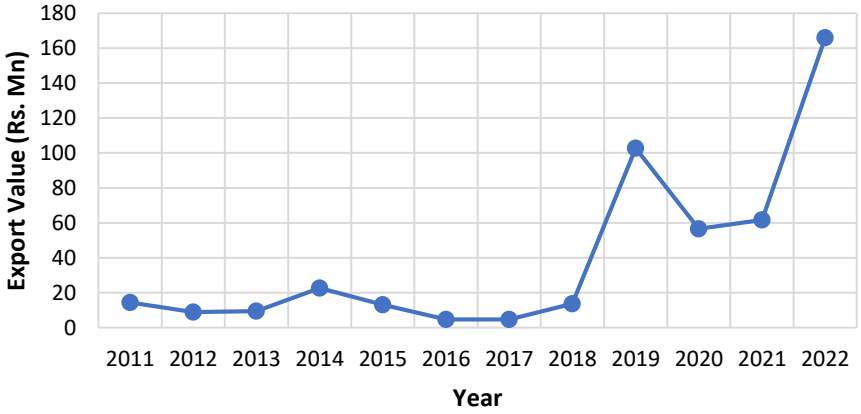
Source: Sri Lanka Custom Statistics, 2023

Figure 7.3: Processed Pineapple Juice Export Earnings from 2011-2022

The export value of pineapple juice (HS 200949) has increased from 2011 to 2012 and dropped gradually until 2017. Thereafter, it has shown an increasing trend reaching a maximum in 2022.

7.2.2 Growth Pattern of Processed Mango Exports

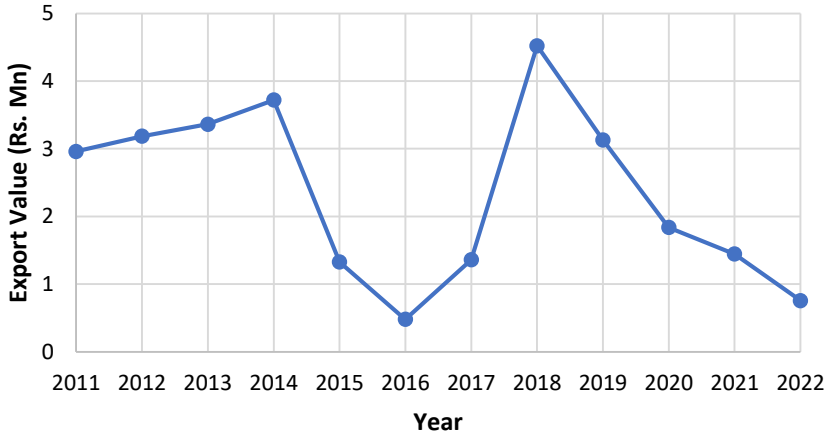
Dried mangoes (HS 08045040) and mango pulp (HS 20089910) packages weighing 3kg or more are the main processed mangoes exported from Sri Lanka.



Source: Sri Lanka Custom Statistics, 2023

Figure 7.4: Processed Dried Mango Export Earnings from 2011-2022

The export earnings from dried mangoes were relatively low during 2011 – 2018. The incomes increased from then onwards, reaching a maximum, tenfold increase by 2022 (Figure 7.4).



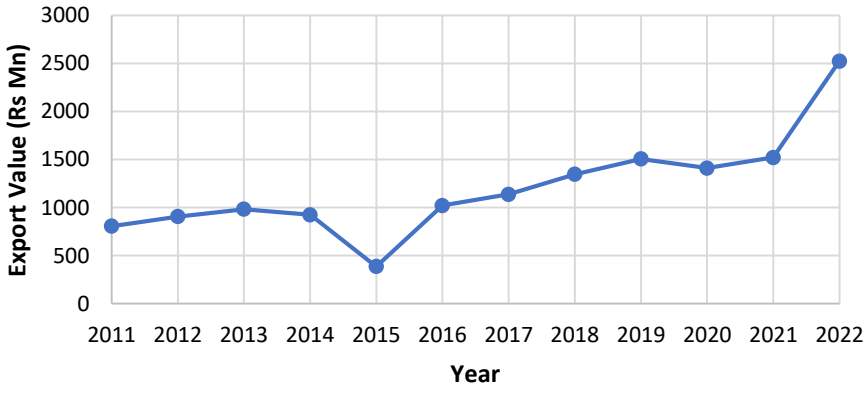
Source: Sri Lanka Custom Statistics, 2023

Figure 7.5: Processed Mango Pulp Export Earnings from 2011-2022

The export earnings from mango pulp showed an increasing trend from 2011 to 2014, a drastic drop from 2014 to 2017, a sharp increase in 2018, and a gradual drop from 2019 to 2022. The highest earning was recorded in 2018 (Figure 7.5).

7.2.3 Growth Pattern of Processed Gherkins Exports

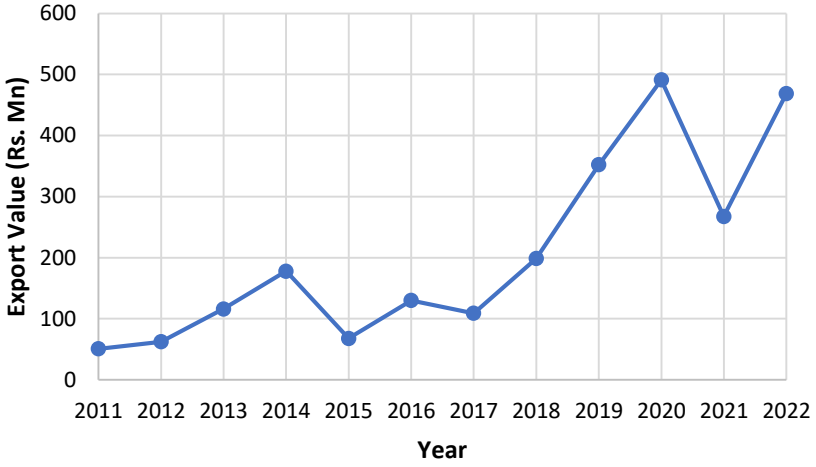
Processed gherkins are exported either preserved in vinegar or acetic acid (HS 20011020) or gherkins: provisionally preserved but not for immediate consumption (HS 07114090).



Source: Sri Lanka Custom Statistics, 2023

Figure 7.6: Processed Vinegar/Acetic Acid-Soaked Gherkins Earnings from 2011-2022

Export earnings from vinegar/acetic acid-soaked gherkins were relatively low from 2011 to 2015 and rose steadily reaching a maximum in 2022 (Figure 7.6).



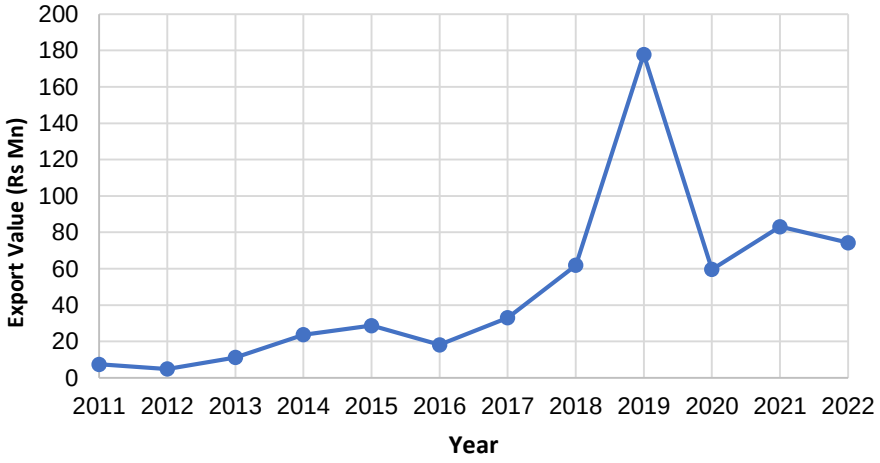
Source: Sri Lanka Custom Statistics, 2023

Figure 7.7: Processed Gherkins Earnings from 2011-2022

Export earnings from gherkins showed an increasing trend from 2011 to 2022, except years 2015, 2017, and 2021. The highest export earnings were in 2020 (Figure 7.7).

7.2.4 Growth Pattern of Processed Tomato Exports

Processed tomatoes are exported from Sri Lanka as tomato ketchup (HS 210320) and tomato juice (HS 200950).



Source: Sri Lanka Custom Statistics, 2023

Figure 7.8: Processed Tomato Ketchup Earnings from 2011-2022

Export earnings from tomatoes were relatively low from 2011 to 2018, though there was a slight increasing trend. The earnings reached a maximum in 2019 but fell drastically in 2020.

7.2.5 Growth and Instability of Major Processed Fruit and Vegetable Exports

The compound annual growth rates (CAGR) and instability indices (CDVI) of selected major processed fruit and vegetable exports from Sri Lanka are given in Table 7.2.

Table 7.2: Compound Annual Growth Rates (CAGR) and Instability Indices (II) of Selected Major Processed Fruit and Vegetable Exports (2011-2022)

Product	CAGR (%)		Instability (CDVI %) **	
	Export Quantity (MT)	Export Value Rs Mn)	Export Quantity (MT)	Export Value (Rs Mn)
Processed Pineapples				
Dried pineapples (HS 08043020)	-0.39	-6.21	40.08	55.90
Pineapples (HS 200820)	-5.88*	1.99	29.07	33.28
Pineapple juice (HS 200949)	6.47	11.65	71.66	70.46
Processed Mangoes				
Dried mangoes (HS 08045040)	23.64	18.02*	108.09	83.44
Mango pulp (HS 20089910)	-13.85	-12.94*	51.80	49.91
Processed Gherkins				
Gherkins (HS 20011020)	0.26	2.10*	19.85	14.29
Gherkins (HS 07114090)	10.60*	13.80*	237.44	28.75
Processed Tomatoes				
Tomato ketchup (HS 210320)	12.40*	19.89*	55.18	38.70

Note: * indicates the CAGR value significant at 5% ($p<0.05$); ** Indicates level of instability (CDVI, I0-15 = low instability, 15 - 30 = medium instability and ≥ 30 = high instability)

Source: Authors' calculation based on Sri Lanka Custom Statistics, 2023

Growth Rates of Major Processed Fruit and Vegetable Exports from Sri Lanka (2011-2022)

In processed pineapple products exported, the quantity of pineapple juice exported has shown a positive growth rate, and dried pineapples have a negative growth rate. The quantity and value exports have shown positive growth rates in dried mango contrasting the negative rates of mango pulp. In gherkins exported both, vinegar/acetic acid preserved products and provisionally preserved products have shown positive growth rates. The quantity and value of tomato ketchup exports have shown positive growth rates. In the comparison, the export quantity of mangoes has shown the highest positive growth rate, and the value of ketchup has shown the highest positive growth rate.

Instability of Major Processed Fruit and Vegetable Exports from Sri Lanka (2011-2022)

In processed pineapple, export quantities and values of pineapple juice were more unstable than juice and raw preparations. In mango, the dried mango form was the most unstable. Of aforementioned all processed exports, only processed gherkins (HS

20011020) have shown the medium instability in terms of both export quantity and value. However, processed gherkins (HS 07114090) have shown the highest instability in terms of export quantity. Tomato ketchup exports were highly unstable during the period of concern.

7.2.6 Destination-wise Analysis of Selected Processed Fruit and Vegetable Exports (2011 – 2022)

In here significant major importers of each processed fruit and vegetable exports were selected. These selected importers belonged to top five to ten through the period from 2011 to 2022. However, destination wise growth rates were calculated by considering the sequential data availability from 2022 to backwards. Further, in this research, a detailed destination-wise analysis was done on the dried pineapple (HS 08043020), processed pineapple (HS 200820), processed pineapple (HS 200949), dried mango (HS 08045040), processed gherkins (HS 20011020), and tomato ketchup (HS 210320) due to data availability.

Destination-wise Analysis of Processed Pineapples (2011-2022)

The main countries importing Sri Lankan dried pineapples are Germany, the USA, Japan, and the Netherlands during 2011 – 2022 (Table 7.3). The quantity and value of dried pineapple exported to the Netherlands recorded positive growth rates, 10.13%, and 14.50% respectively. The respective growth rates of exports to Germany, the USA, and Japan were negative. All major importing countries have shown high instability in the quantity and value of exports except the low instability in export of values to the Netherlands in 2011 to 2022.

Table 7.3: Destination-wise Growth Rates and Instability in the Export of Dried Pineapples (2011-2022)

Destination	Growth Rate (% per Annum)		Instability (CDVI)**	
	Quantity	Value (Rs Mn)	Quantity (MT)	Value (Rs Mn)
Germany	-12.53*	-13.08*	52.36	55.53
USA	-8.67	-5.10	81.76	99.87
Japan	-4.07	-7.22*	55.29	41.38
Netherland	10.13	14.50*	75.58	17.67
Other	18.64*	2.24	78.37	61.11

Note: * indicates the CAGR value significant at 5% ($p<0.05$); ** indicates level of instability (CDVI, 0-15 = low instability, 15- 30 = medium instability and > 30 = high instability)

Source: Authors' calculation based on Sri Lanka Custom Statistics, 2023

The main countries importing Sri Lankan processed pineapples (HS 200820) were Germany, the USA, and the Netherlands during 2020 – 2022 (Table 7.4). Only the Netherlands has shown positive growth in the quantity and value of processed pineapples. The Netherlands also had the highest rates despite the relatively high instability in both quantity and value. Conversely, Germany has shown low instability in export quantity while the USA has the lowest in export value.

Table 7.4: Destination-wise Growth Rates and Instability in the Export of Processed Pineapples (2020-2022)

Destination	Growth Rate (% per Annum)		Instability (CDVI)**	
	Quantity	Value	Quantity	Value
Netherland	260.52	301.49*	57.67	62.18
Germany	-42.57*	-35.71	7.83	14.17
USA	-87.67	-95.89	18.55	1.00
Other	1.01	-5.82	69.49	69.10

Note: * indicates the CAGR value significant at 5% (p<0.05); ** indicates level of instability (CDVI, 0-15 = low instability, 15- 30 = medium instability and > 30 = high instability)

Source: Authors' calculation based on Sri Lanka Custom Statistics, 2023

The main countries importing Sri Lankan processed pineapple juice (HS 200949) were Germany, Italy, Switzerland, and Australia during 2019 – 2022 (Table 7.5). The highest positive rates for the quantity (56.94%) and the value (48.56%) of pineapple juice were exports to Germany during the discussion period. Australia recorded the highest instability in terms of both export quantity and value. Further, Germany has shown the lowest instability in terms of quantity while Italy shown the lowest instability in terms of value.

Table 7.5: Destination-wise Growth Rates and Instability in the Export of Pineapple Juice (2019-2022)

Destination	Growth Rate (% per Annum)		Instability (CDVI)**	
	Quantity	Value	Quantity	Value
Germany	56.94*	48.56*	12.77	11.23
Italy	14.82	26.05*	28.38	9.18
Switzerland	-46.90	-39.78	47.42	32.42
Australia	-65.86	-67.66	115.00	119.87
Other	9.30	10.10	34.73	40.07

Note: * indicates the CAGR value significant at 5% (p<0.05); ** indicates level of instability (CDVI, 0-15 = low instability, 15- 30 = medium instability and > 30 = high instability)

Source: Authors' calculation based on Sri Lanka Custom Statistics, 2023

Destination-wise Analysis of Processed Mangoes (2019 -2022)

The main countries importing Sri Lankan dried mangoes were Canada, the USA, Germany, Italy, and Australia during 2019 – 2022 (Table 7.6). The growth rates of the quantity and value of dried mango exports to Canada were the highest recording 211.43% and 211.43% respectively despite being the lowest in stability recording 120.51 for quantity and 123.86 for value respectively.

Table 7.6: Destination-wise Growth Rates and Instability in the Export of Dried Mango (2019-2022)

Destination	Growth Rate (% per Annum)		Instability (CDVI)*	
	Quantity	Value	Quantity	Value
Canada	211.43	211.43	120.51	123.86
USA	-46.95	-43.39	53.67	68.81
Australia	103.60	52.04	84.59	71.02
Germany	-0.90	7.57	17.66	23.8
Italy	-3.73	-11.22	20.85	31.46
Other	66.69	49.03	94.60	51.51

Note: * indicates level of instability (CDVI, 0-15 = low instability, 15- 30 = medium instability and > 30 = high instability)

Source: Authors' calculation based on Sri Lanka Custom Statistics, 2023

Destination-wise Analysis of Processed Gherkins (2011-2022)

Sri Lanka mainly exports processed gherkins (HS 20011020) to Japan, Australia, Taiwan, Netherlands, and South Africa (Table 7.7). The rate of quantity and value of gherkins exports to the Netherlands was the highest during 2011 – 2022 recording 19.34% and 15.93% respectively. Japan and Australia have shown high instability in terms of value while Netherland has shown high instability in quantity of exports. Further, Japan shows the lowest instability in terms of quantity, while Netherland shows the lowest instability in terms of value of processed gherkin exports.

Table 7.7: Destination-wise Growth Rates and Instability in the Export of Processed Gherkins (2011-2022)

Destination	Growth Rate (% per Annum)		Instability (CDVI)**	
	Quantity	Value	Quantity	Value
Japan	0.01	2.02	14.92	31.29
Australia	-2.04	0.02	16.55	38.60
Taiwan	0.88	2.59*	17.49	27.66
Netherland	19.34*	15.93*	34.87	14.23
South Africa	0.75	2.91	19.46	24.94
Other	-2.41*	0.15	15.38	21.87

Note: * indicates the CAGR value significant at 5% ($p<0.05$); ** indicates level of instability (CDVI, 0-15 = low instability, 15- 30 = medium instability and > 30 = high instability)

Source: Authors' calculation based on Sri Lanka Custom Statistics, 2023

Destination-wise Analysis of Processed Tomato (2017-2022)

Sri Lanka mainly exports processed tomato ketchup to the Maldives, UAE, Canada, Australia, and the USA (Table 7.8). Exports of tomato ketchup from Sri Lanka to UAE exhibited the highest positive growth rates of 44.66% and 36.70% in terms of quantity and value respectively. All importing nations of processed tomato exports have shown high instability in terms of quantity. Similarly, all importing countries have shown high instability in terms of export value except Canada.

Table 7.8: Destination-wise Growth Rates and Instability in the Export of Tomato Ketchup (2017-2022)

Destination	Growth Rate (% per Annum)		Instability (CDVI)*	
	Quantity	Value	Quantity	Value
Maldives	2.49	-0.18	37.42	46.89
UAE	44.66	36.70	62.71	61.11
Canada	15.90	15.57	36.60	29.25
Australia	29.50	33.28	61.67	62.46
USA	-9.18	-10.71	45.92	32.27
Other	-16.44	-7.22	134.39	126.46

Note: * indicates level of instability (CDVI, 0-15 = low instability, 15- 30 = medium instability and > 30 = high instability)

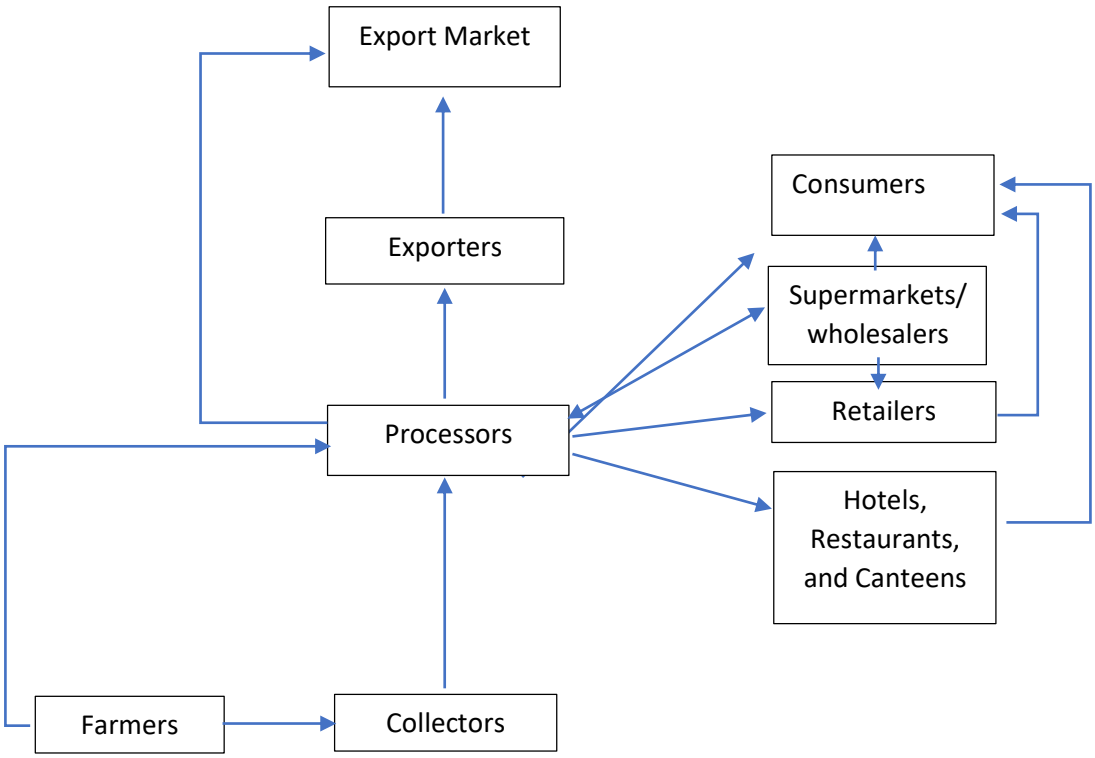
Source: Authors' calculation based on Sri Lanka Custom Statistics, 2023

7.3 Marketing Channels of Processed Fruit and Vegetable Industry in Sri Lanka

The marketing channel of processed fruits and vegetables is similar to many other processed foods (Figure 7.9) varying in marketing channel actors such as farmers, collectors, processors, supermarkets, retailers, wholesalers, hotels and restaurants, and exporters (processed fruit and vegetable).

There are four primary distribution channels for processed fruits and vegetables; general trade marketing, modern trade marketing, hotels, restaurants and canteens (ho-re-ca), and export marketing. About 57% of processors in the sample send their finished goods to domestic and export market. Majority send their products directly to export markets, while a significant proportion send their products through exporting companies.

The majority, 93.33%, of the sample surveyed trade processed fruit and vegetables imported from other countries, while all traders market domestic products. These traders, mostly (70%) sell their items directly to consumers other than retailers apart from a few selling their goods to hoteliers.



Source: HARTI Survey Data, 2023

Figure 7.9: Marketing Channel of Processed Fruit and Vegetable Products

7.4 Status of Marketing Processed Fruit and Vegetables

7.4.1 Major Customers of Processed Fruit and Vegetable: Processors' Perspective

Understanding consumers and their consumption patterns is essential for successful product marketing. Given this, processors and traders sampled were asked to mention the major customers of their products. The responses are summarized as follows:

About one third (33.33%) of the sampled processors export their entire production and 57% sell their products to domestic and international markets. The remaining companies cater only to domestic markets. Apart from major customers of finished fruit and vegetable products, processors were asked to indicate whether they had contracts with their customers. Majority (53.33%) of the processors do not have any contracts or written agreements with their customers. The others (46.67 %) have contracts with their major customers *viz*. exporters and importers (Table 7.9).

Table 7.9: Major Customers of Processed Fruit and Vegetables: Processors' Perspective

Major Customer	Percentage
Direct Exportation (Importing company, online customers in overseas)	50.00
Export Company	46.67
Supermarkets	33.33
Retailer	26.67
Hotels and Restaurants	20.00
Wholesaler	16.67
Households (Walk-in customers and online customers)	3.33

Note: Total percentage of categories exceeds 100, due to multiple responses
Source: HARTI Survey, 2023

As evident from the information summarized in Table 7.9, directly exporting forms the largest proportion of processed fruit and vegetable trade in Sri Lanka and others are; large-scale export companies (46.67%), supermarkets (33.33%), retailers (26.67%), hotels and restaurants (20.00%), and wholesalers (16.63%). Very few companies sell their products directly to households. The majority of the sample respondents mentioned seasonal changes in the demand for processed goods, especially in April and December in the domestic market, and in March, April, May, July, August, October, November, and December. For example, the number of customers for processed fruit and vegetable products such as jam, fruit juice, fruit pulp, fruit chunks, dehydrated fruits and vegetables, and sauces jumps high in April and December.

According to respondents price offered (58.62%), honesty of middleman (27.59%), product quality (20.69%), and personal ties with middlemen (13.79%) were the main decisive factors for deciding customers. Very few companies consider the sustainability of their relationship with their customers as a priority for trading.

About 43.33% of processors indicated that they have a high-end customer[1] base while 26.66 percent said that they have a regular customer base in domestic and export markets. Customer preferences for low-sugar (13.33%) products, pure organic products (10%), products with low or no addition of chemicals (10%), vegan products (6.67%), and healthy and herbal products are also noteworthy observations revealed from the study.

When the processors were asked to indicate the novelty of their products, a vast majority (93.33%) mentioned that they use diverse techniques for product development, 53.57% said they make high-quality goods and 21.43% said they produce preservative-free organic products. Focusing on unique products (17.86%), attractive products (17.86%), using novel recipes to meet client expectations (14.29%), high fruit content (7.14%), vegan products (7.14%), and products created with natural ingredients are also noteworthy.

[1] High-end customers are drawn to the quality of products rather than the price.

Processors have undertaken strategies to ensure that their products are known to customers. Advertising and promoting *via* appropriate media (60.00%), and improving product quality (46.67%) are some of the measures undertaken by processors to popularize their products. About 20% of the processors followed one or more of the above strategies. About 10% got licenses for their brands. Another few are selling their products at a reduced price.

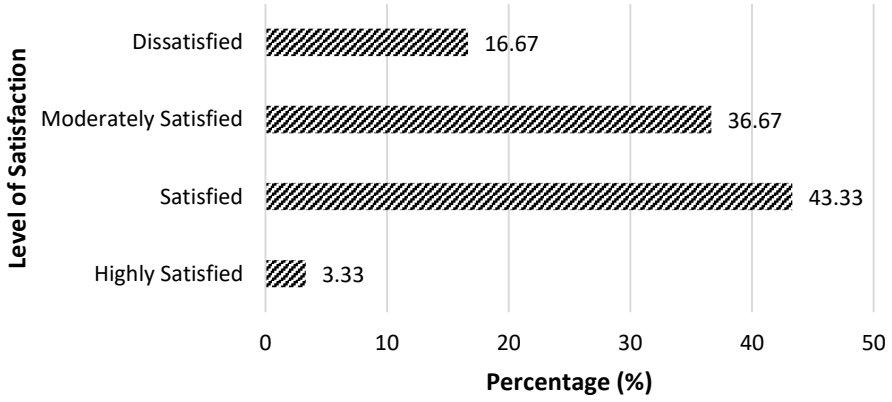
7.4.2 Major Customers of Processed Fruit and Vegetables: Traders' Perspective

Almost all the traders sell their products directly to consumers. The other way is selling to retailers (30%) except for a few who directly trade with hotels and restaurants. The traders in the study sample also emphasized seasonal variations in clientele demand, particularly in April and December.

7.4.3 Current Status of Marketing Systems and Advertising

7.4.3.1 Awareness of Prevailing Prices in the Market

Among fruit and vegetable processors questioned, a vast majority (90%), were aware of the prices of similar products they produce. However, they were satisfied with last year's market prices of their products (Figure 7.10).



Source: HARTI Survey, 2023

Figure 7.10: Satisfaction Level of Fruit and Vegetable Processors for Prevailing Prices

The most appropriate approach for processors to obtain price information on processed fruit and vegetables is to get it directly by visiting the market (78.57%). The other sources of information have been cross-checking with middlemen (32.14%), mass media (7.14%), websites (7.14%), and neighbours and friends (3.57%).

Table 7.10: Sources of Price Information on Processed Fruit and Vegetables for Fruit and Vegetable Processors

Modes of obtaining price information	Percentage (%)
Directly collecting from the market	78.57
Cross-checking with middlemen	32.14
Referring to mass media	7.14
Searching websites	7.14
Hearing from neighbours and friends	3.57

Note: Total percentage of categories exceeds 100, due to multiple responses
Source: HARTI Survey, 2023

7.4.3.2 Modes of Product Delivery by Fruit and Vegetable Processors

According to the fruit and vegetable processors in the sample, 90% of the processors deliver products to the market by themselves, while about 23% used hired transport facilities to sell their products to customers. About 20% of fruit and vegetable processors sell their products to walk-in customers, while the others opted for courier services. The processors in general were satisfied with their product delivery mechanisms' effectiveness.

7.4.3.3 Competition with Other Companies

The main competition for the country's fruit and vegetable processors was from imported processed goods and similar local products of other companies (66.67%). However, for about 33.33% of the processors the competition was not that crucial due to reasons; uniqueness, the relatively low price offered, lack of competition in the particular market, and the high demand for their goods. The processors also use various strategies such as preserving product quality (41.67%), modifying recipes to suit client needs (25%), utilizing marketing strategies (16.67%), launching new product categories (8.33%), and leveraging current market connections (8.33%) to overcome the consequences of competition.

7.4.3.4 Advertising and Promotional Campaigns by Fruit and Vegetable Processors

The majority (76.67%) of the sample of fruit and vegetable processors, advertise or promote their products through social media and websites (private/government). Most respondents who implemented promotional activities (66.67%) indicated that the volume of products marketed and awareness of products amongst customers have increased with promotional campaigns. About 23.81% of the respondents mentioned that the market volume was increased while few indicated that the impact of promotions was low in marketing their products.

7.5 Traders' Suggestions to Improve the Processed Fruit and Vegetable Industry in Sri Lanka

According to the traders' responses to the survey, the majority believe that ensuring the quality and standards of the product is the key to success in the processed fruit and vegetable industry. The importance of producing processed fruit and vegetables for niche markets with the required product attributes such as packaging, price, quality, and ready-to-eat products was also emphasized for success. Another suggestion made by the processors was to carry out processor-to-consumer programmes as in the fresh fruit and vegetable industry if demand is high for local products. Traders also believe it is worthwhile to make consumers aware by conducting consumer awareness programmes to create demand for dehydrated products such as kohila (*Lassia*), jackfruit, and mushrooms. These promotion campaigns could be effectively done by introducing samples of processed food items to participants. Another important suggestion made by the traders was to update market strategies to promote locally produced processed fruit and vegetable products. Innovations in fruit and vegetable processing and consumer-focused product development were also recommended as important strategies by the sampled traders. The traders believe the government's involvement in the processed fruit and vegetable industry is also important for enhancing Sri Lanka's processing infrastructure by reforming regulatory frameworks, addressing issues facing this industry, and introducing effective and stringent policies for developing the industry in Sri Lanka.

CHAPTER EIGHT

Consumption of Processed Fruits & Vegetables

Processed fruit and vegetables are gaining popularity as a well-rounded diet, providing a wide range of nutrients rich in fiber, vitamins, minerals, and antioxidants. Sarfo *et al.,* (2022) stated that adding certain types of processed fruits and vegetables into diets can address micronutrient deficiencies in humans. This chapter discusses motivating factors and perceived barriers to consumption, processed fruit and vegetable consumption patterns, customers' perceptions of innovations, and their propensity to consume novel processed fruits and vegetables.

8.1 Socio-Economic Profile of the Sample of Consumers Surveyed

The socio-economic profile of the consumer sample surveyed is summarized in Table 8.1. Among respondents in the sample, 73.96% were females, and nearly half (47.14%) were in the age group 41-60 with a mean age of 53. A considerable proportion of the respondents (21.35%) have qualifications above G.C.E. (A/L) either with diplomas, degrees, or post-degrees. The largest group, 43.23% have passed the G.C.E. Advanced Level, 29.43% have passed the G.C.E. Ordinary Level, 5.73% studied up to Grade 6 - 10 and a few studied up to Grade 1-5. The occupation of 83.85% of the respondents were either retired, housewives, entrepreneurs, or business owners. A small proportion was private or public sector employees (8.59%) and (7.55%) respectively.

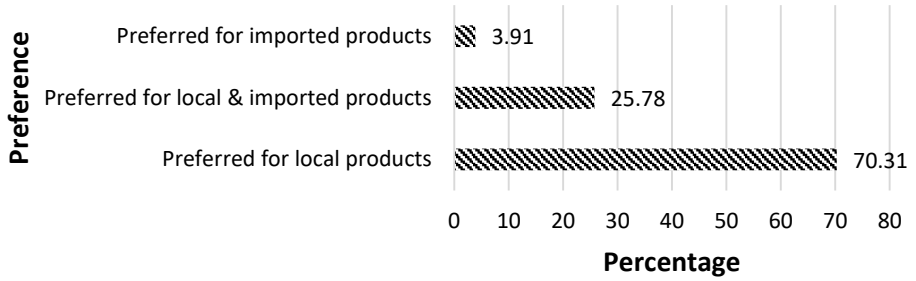
Table 8.1: Key Socio-Economic Characteristics of the Sample of Households Surveyed (N = 384)

Variable	Frequency	Percentage
Gender		
Female	284	73.96
Male	100	26.04
Age		
20 and below	4	1.04
21-40	73	19.01
41-60	181	47.14
61-80	122	31.77
81 and above	4	1.04
Education Level		
Grade 1-5	1	0.26
Grade 6-10	22	5.73
Passed O/L	113	29.43
Passed A/L	166	43.23
Higher Education	82	21.35
Occupation		
Government Sector	29	7.55
Private Sector	33	8.59
Other	322	83.85

Source: HARTI Survey, 2023

8.1.1 Householder Preferences for Processed Fruit and Vegetables Products

Householder preferences for local and imported processed fruits and vegetables are presented in Figure 8.1. About 70% of householders in the three districts sampled preferred buying locally processed fruit and vegetable products, suggesting a potential demand for these products in the domestic market. This suggestion is even more validated by the percentage (25.78%) of the group preferring local and imported processed fruit and vegetable products. Only a small percentage of householders (3.91%) singly preferred imported processed fruit and vegetable products, probably due to flavour and quality.



Source: HARTI Survey, 2023

Figure 8.1: Household Preference for Local and Imported Processed Fruit and Vegetables (%)

8.1.2 Purchasing Patterns of Processed Fruit and Vegetables

The preferred places or sources of purchasing or obtaining processed fruits and vegetables by the sample of respondents as percentages under five categories; supermarkets, homemade, retail shops, received from acquaintances (friends, relatives, etc.,) living abroad, and others are given in Table 8.2. Most households (84.00%) in the surveyed districts preferred to buy processed fruit and vegetables from supermarkets. A considerable proportion (61.00%) make processed products such as jam, chutney, pickles, and sauce in their households. Nearly half of the population (49%) preferred to purchase processed fruit and vegetables from retail shops. About 34% of the respondents consume processed fruit and vegetable products received from friends and or relatives abroad. Only a few preferred to buy these products from other sources such as special outlets and fairs (*pola*).

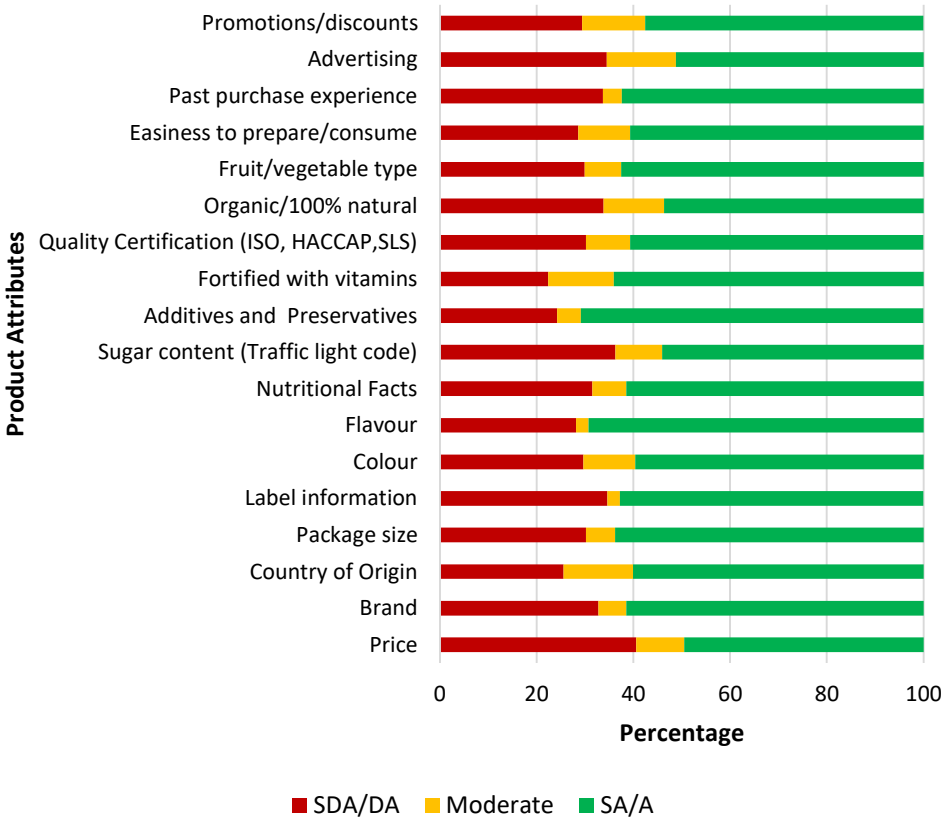
Table 8.2: Preferred Places or Sources of Purchasing or Obtaining Processed Fruits and Vegetables by the Respondents of the Study

Buying places	Frequency	Percentage
Supermarkets	323	84.00
Home-made (self-prepared)	233	61.00
Retail shops	190	49.00
Received from acquaintances (friends, relatives, etc.,) living abroad	131	34.00
Other (special outlets, fairs etc.,)	11	3.00

Note: Total percentage of categories exceeds 100, due to multiple responses
Source: HARTI Survey, 2023

8.1.3 Considerations for Buying Processed Fruit and Vegetables

According to the information collected from the sampled consumers (respondents), the considerations for buying processed fruit and vegetables are multitudinous as depicted in Figure 8.2.



Note: SDA, Strongly Disagree, DA, Disagree, SA, Strongly Agree, A, Agree
Source: HARTI Survey, 2023

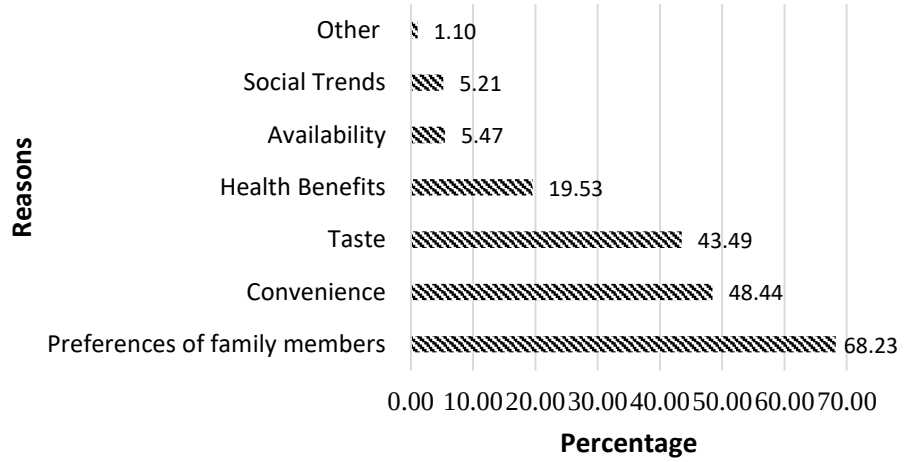
Figure 8.2: Consumer Perceptions of Processed Fruit and Vegetable Attributes in Decision-Making for Buying

More than half of the consumers agree that all the attributes mentioned in the chart influenced them to buy processed fruits and vegetables. Consumers were most concerned about additives and preservatives (70.83%). Further, they are mostly attracted to flavour (69.28%), type of fruit or vegetable (62.5%), colour (59.63%), (even, within a single product category, flavour and colour might vary depending on the species), brand (61.46%) and country of origin (60.05%) other than the pricing of the product (49.48%). The product prices change based on the package size. Therefore, the consumer attention was high on the package size (63.8%). Most consumers (62.76%) appear to be reading the label information; expiry date, nutritional composition, and quality standards before buying processed food products.

8.2 Consumption Patterns of Processed Fruit and Vegetables

8.2.1 Reasons for Consuming Processed Fruit and Vegetables by Urban Consumers

The main reasons for consuming processed fruit and vegetable products by the urban community as revealed by the information from the sample assayed are depicted in Figure 8.3. According to 68.23% of the surveyed consumers, the preference of family members was the main reason for consuming processed fruit and vegetable products. A considerable percentage, 48.44% also indicated 'convenience' as a reason for consuming processed fruit and vegetables, possibly because of the busy lifestyle of urban consumers. Taste was also a contributory factor as mentioned by 43.49% of respondents. As stated by Bandaranayake *et al.,* 2016, convenience and taste were major reasons for processed fruit consumption in urban households. About 19.53% also believe the association of health benefits was another reason for consuming processed fruit and vegetables. Therefore, the demand for processed fruits and vegetables may increase in the future because of the acceptance by urban consumers.

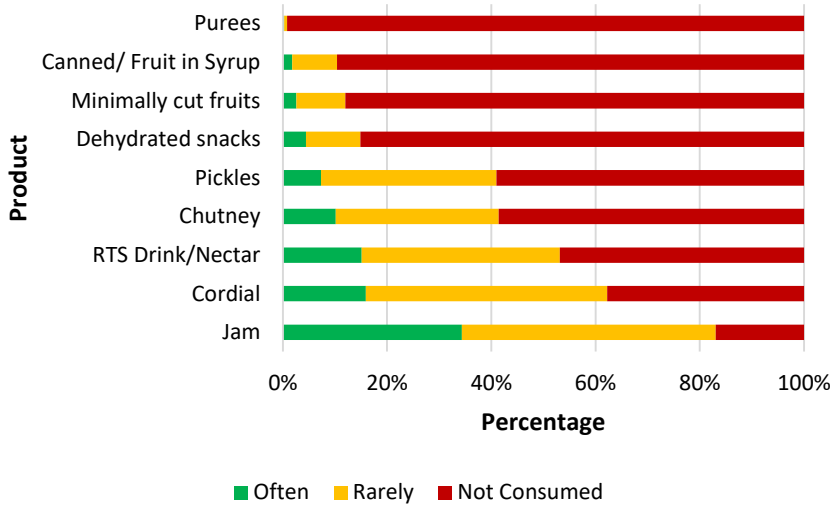


Source: Authors' compilation based on HARTI Survey, 2023

Figure 8.3: Motives for Consuming Processed Fruit and Vegetables by the Urban Community

8.2.2 Frequency of Consuming Different Types of Processed Fruits and Vegetables

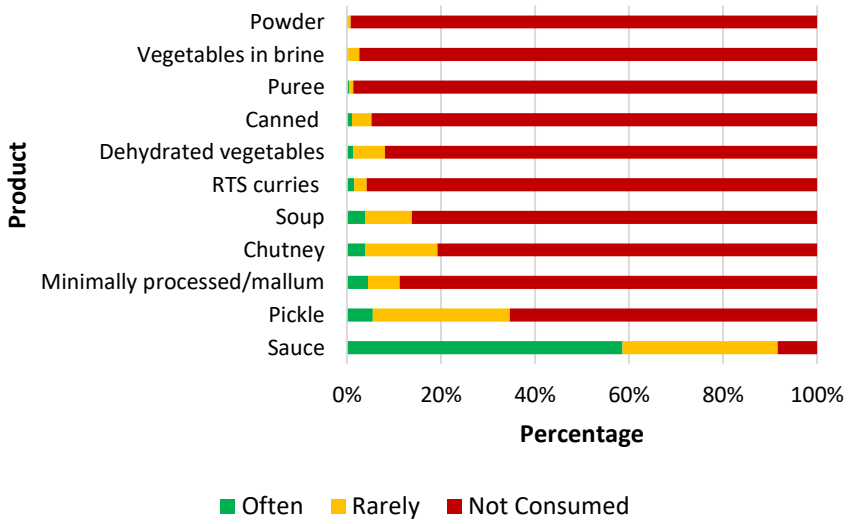
Fruit and vegetables are processed to produce different products; purees, syrups, cut products, snacks, pickles, chutney, nectar, cordial, jam, powder, soup and sauce, etc., for consumption. The consumer preferences for these different types were cataloged from the information collected from the sample of respondents (Figures 8.4 and 8.5).



Source: Authors' compilation based on HARTI Survey, 2023

Figure 8.4: Frequency of Consuming Different Types of Processed Fruits (%)

Among all processed fruit and vegetable types, the most preferred were sauces (58.59%) and jams (34.38%). The most frequently consumed sauce was tomatoes, 98.76%. The consumer preferences for jams were: mixed fruit; 57.28%, strawberry; 43.96%, wood apple; 30.96%, mango; 21.67%, and pineapple; 10.22%.



Source: Authors' compilation based on HARTI Survey, 2023

Figure 8.5: Frequency of Consuming Different Types of Processed Vegetables (%)

8.2.3 Currently Consumed Processed Fruit and Vegetables

About 21 processed fruit and vegetable product types were recently consumed by the respondents. The numbers of each type of processed fruit product are jam 18, chutney 16, drinks 15, dried snacks 15, jelly 13, pickle 13, cordial 11, nectar 10, ice cream 8, fruit in syrup 7, yoghurt 6, yoghurt drinks 4, minimally cut fruits 3, paste 2, canned 1 and, pulp 1.

The numbers of different types of fruit species processed are: mango (*Mangifera indica*) 15; pineapple (*Ananas comosus*) 10; strawberry (*Fragaria x ananassa*) 10; wood apple (*Limonia acidissima*) 9; orange (*Citrus sinensis*) 8; papaya (*Carica papaya*) 7; mixed fruit 7; apple (*Malus domestica*) 6; passionfruit (*Passiflora edulis*) 5; watermelon (*Citrullus lanatus*) 5; guava (*Psidium guajava*) 4; nelli/Indian gooseberry (*Phyllanthus emblica*) 4; grapes (*Vitis vinifera*) 4; dates (*Phoenix dactylifera*) 4; lemon (*Citrus limon*) 3; raspberry (*Rubus idaeus*) 3; roseapple (*Syzygium jambos*) 3; ambarella (*Spondias dulcis*) 3; lime (*Citrus aurantiifolia*) 2; lovi-lovi/batoko plum (*Flacourtia inermis*) 2; starfruit (*Averrhoa carambola*) 2; bilimbi (*Averrhoa bilimbi*) 2; Ceylon olive (*Elaeocarpus serratus*) 2; banana (*Musa* spp,) 2; plums (*Prunus domestica*) 2; mixed berry 2; apricot (*Prunus armeniaca*) 2; peach (*Prunus persica*) 2; cherry (*Prunus avium*) 2; and one each of Avocado (*Persea americana*), pomegranate (*Punica granatum*), blackcurrant (*Ribes nigrum*), durian (*Durio zibethinus*), waraka/overripe jackfruit (*Artocarpus heterophyllus*), bael fruit (*Aegle marmelos*), olive (*Olea europaea*), goraka (*Garcinia quaesita*), and tamarind (*Tamarindus indica*) (Annex 3).

The numbers of each type of processed vegetable product are dried vegetables 9, pickle 7, soup 6, powder/flour 5, minimally cut 4, sauce 3, canned 2, puree 1, paste 1, jam 1 vegetables in brine 1, and RTS (Ready to Serve) curries 1.

The numbers of different types of vegetable species processed are: young jackfruit (*Artocarpus heterophyllus*) 4; tomato (*Solanum lycopersicum*) 4; kos/ripe jackfruit (*Artocarpus heterophyllus*) 4; corn (*Zea mays*) 4; pumpkin (*Cucurbita pepo*) 3; green chilli (*Capsicum annuum*) 2; carrot (*Daucus carota*) 2; bean (*Phaseolus vulgaris*) 2; leeks (*Allium porrum*) 2; cabbage (*Brassica oleracea*) 2; and one each of Nai miris/ bird chili (*Capsicum frutescens*), capsicum (*Capsicum annuum*), brinjal (*Solanum melongena*), moringa (*Moringa oleifera*), bitter gourd (*Momordica charantia*), breadfruit (*Artocarpus altilis*), mushroom (*Agaricus bisporus*), long bean (*Vigna unguiculata*), kohila (*Lasia spinosa*), ladies finger (*Abelmoschus esculentus*), ash plantain (*Musa paradisiaca*), rampe/pandan leaves (*Pandanus amaryllifolius*), curry leaves (*Murraya koenigii*), and green leafy vegetables (Annex 4).

8.3 Potentials and Barriers in the Sri Lankan Processed Fruit and Vegetable Industry: Consumers' Assessment

8.3.1 Potentials of Processed Fruit and Vegetable Products

The consumers' assessment of potential processed fruit and vegetable products in different species summarized in Tables 8.3 and 8.4.

Table 8.3: The Consumers' Assessment of the Processed Fruits and Vegetables' Potential in Sri Lanka

Product	Percentage (N=81)
Seasonal fruit and vegetable products (drinks, canned products and others)	40.74
Dehydrated (dried, veggie mix, snacks and seeds)	24.69
Desserts/candy/ short eats/cookies	17.27
Flour/powder	9.88
Rare fruits/wild (dried and canned)	9.88
Herbal products/drinks/powder	8.64
Jam/pickle/chutney	7.41
Fruit cream /pulp/ frozen	2.47
Vegetable soup (powder and cubes)	2.47
Wine	1.23
Mixed vegetable butter	1.23

Note: Total percentage of categories exceeds 100, due to multiple responses
Source: Authors' compilation based on HARTI survey, 2023

Approximately 41% believe beverages and canned fruit and vegetables have the highest potential in the processing industry. In addition, dehydrated products in the dried form, snacks, seeds, and veggie mixes (24.69%), confectionary items such as desserts, candy, short eats, and cookies (17.27%), vegetable flour and powders (9.88%), products from rare fruits or wild fruits (9.88%) such as *longan/mora (Dimocarpus longan), velvet tamarind/gal siyambala (Dialium cochinchinense), and lanzone/gaduguda (Lansium domesticum)* were also seen as probable items worth of processing. Customers keen on health products (8.64%) presumed herbal products such as herbal tea in powders and bags and products made from moringa capsules have considerable potential. Further, about 7% trust jams, pickles, and chutneys made from certain fruits, biling plum (*Averrhoa bilimbi*), and raspberry as potential items for processing. In addition to processed fruits, vegetable soup, wines, and mixed vegetable butter were also thought by some as important.

Table 8.4: Proposed Processed Fruit and Vegetable Products from Potentially Important Fruit and Vegetable Species in Sri Lanka

Product	Potential fruit and vegetables species
Juice/RTS (Ready to Serve) drinks	Soursop, Pomegranate, Ceylon Olive, Guava, Ambarella, Starfruit, Mandarin, Gooseberry, Grapes, Mango, Avocado, Lime, Mora, Gaduguda, Gal Siyambala, Blackcurrant, Strawberry, Pineapple and Orange
Wine	Cashew Apple, and Carrot
Jam	Rhubarb, Strawberry, Mango, Lawulu, and Raspberry
Pickle	Lime, and Young Jackfruit
Chutney	Tamarind, Bilimbi, Ambarella, Rose apple, and Brinjal
Canned	Naminan, Pineapple, Jackfruit, Sweetcorn, and Lotus roots
Pulp	Banana, and Mango
Dehydrated Plus	Banana, Durian, Tamarind, Jackfruit, Breadfruit, Manioc, Ash plantains, Mushroom, Tomato, and Bitter gourd
Powder	Soursop, Strawberry, Orange, Beetroot, and, Carrot
Flour	Jackfruit, and Lawulu
Seeds	Pumpkin, Watermelon, Jackfruit, and Bedi Del
Herbal Products	Moringa, Soursop, and Naminan
Soup	Beetroot, Mushroom, and Mixed Vegetables
Confectionary	Banana (Kolikuttu), Jackfruit and Pumpkin
Ice cream	Durian, and Watermelon
Butter	Mixed Vegetables

Source: HARTI survey, 2023

8.3.2 Willingness of the Consumers to Purchase Different Types of Novel Processed Fruit and Vegetable Products

The consumer preferences of 30 different processed fruit and vegetable items identified in traders and processors surveys were assessed to find the willingness of the consumers to purchase these items. The list of these items is given in Annex 5.

Customer Willingness to Consume Dehydrated Fruits

Majority of the consumers (63.28%) in the surveyed districts showed reluctance to buy dehydrated fruits due to reasons such as the availability of fresh fruits, misbelief of unsuitable for people with some diseases, limited awareness, unavailability, preference for consuming fresh fruits, high price, and unaccepted by family members. A considerable proportion of consumers mentioned the probable health risks associated with adding preservatives, artificial colours, and additives as another reason for their unwillingness to consume dehydrated fruits. However, about 37% of consumers preferred buying dehydrated fruits. Branded products, superior quality, fair price, and healthy products with no addition of preservatives or additives were the consumer's preferred attributes. Convenience, taste, health benefits, and preference of family members, especially children are the major reasons for purchasing dehydrated fruit products. Moreover, a few consumers said processing

allows minimization of post-harvest losses during glut seasons to take advantage in off-seasons.

In the sample assessed, mango was the most preferred processed fruit (73.76%). Banana (64.54%), pineapple (57.45%), and papaya (47.52%) followed, while overripe jackfruit/*waraka*, strawberry, avocado, wood apple, kiwi, peach, plums, guava, apricot, ambarella, watermelon, durian, tamarind, underutilized fruits, and highly seasonal fruits (rambutan, mangosteen) have also attracted various types of consumers.

Customer Willingness to Consume Fruit Snacks

About 51% of the surveyed consumers preferred to purchase dehydrated fruit snacks especially bananas (90.72%) and papaya (47.42%). Mango, pineapple, apple, overripe jackfruit/*waraka*, orange, and watermelon were the other preferred fruit types mentioned by them. Branded goods, superior quality, fair price, and healthy local products with no addition of preservatives or additives were the consumer's preferred attributes. Convenience, taste, health benefits, and preference of family members especially, children were the main reasons for purchasing fruit snacks. However, nearly 50% of consumers dislike fruit snacks because of the availability of fresh fruits, misbeliefs of some disease associations, lack of awareness, unavailability, preference for fresh fruits, high prices, and refusal by family members. A significant proportion of sample consumers mentioned a lack of safety due to preservatives, artificial colours, and additives and doubts about processed product’s quality as other reasons for their reluctance to purchase fruit snacks.

Customer Willingness to Consume Fruit Powder

Most consumers (58.59%) in surveyed districts were reluctant to buy fruit powder due to the availability of fresh fruits, lack of awareness, preference for fresh fruits, high prices, misbeliefs of association with some diseases, and disapproval of family members. Lack of safety due to preservatives, artificial colours, and additives and doubts about processed product’s quality were the main reasons for their unwillingness to purchase fruit powder. However, a considerable proportion (41.41%) of consumers have spoken positively about fruit powders because of their convenience, taste, and health benefits. Those willing to consume fruit powders in the sample mostly preferred quality, branded goods, healthy products with no addition of preservatives or additives and sold at a fair price. Few consumers mentioned that fruit powders allow an opportunity to consume highly seasonal fruits even in off-seasons if available in local markets. The most consumer-preferred fruit powders were wood apple (87.42%), bael fruit (53.46%), and banana (40.88%). Mango, pineapple, papaya, strawberry, mixed fruit, soursop, passion fruit, ambarella, avocado, nelli/Indian gooseberry, mangosteen, rambutan, overripe jackfruit/*waraka*, orange, grapes, durian, and guava were other preferred fruit types mentioned by surveyed consumers.

Customer Willingness to Consume Jams

Most of the consumers who responded (62.24%) to the survey were willing to purchase jams, of special fruits and vegetables such as (64.85%), pumpkin (34.73%), orange (33.47%), papaya (27.20%), mulberry (27.20%), and banana (26.36%). Bael fruit, blueberry, starfruits, passionfruit, durian, nelli/Indian gooseberry, raspberry, grapes, lovi-lovi, rambutan, beetroot, mandarin, and blackberry jams were the other preferred by them. The main reasons for consumer willingness for jams were convenience, taste, and health benefits. Those who responded positively to consuming jams were particular about product attributes, brand, superior quality, fair price, and healthiness with no addition of preservatives, additives, or artificial colours. Few consumers preferred jams made of local fruits with minimum sugar content. However, 37.76% of the consumers disapproved of jams due to perceived barriers such as lack of awareness, unavailability, preferred home-made products, high prices, misbeliefs of disease association, no preference of family members, preservatives, additives or artificial colours, and doubts about processed product's quality. Few consumers mentioned that they do not favour novel types, since they prefer frequently available jams such as mixed fruit, wood apple, strawberry, mango, and pineapple.

Customer Willingness to Consume Chutneys

The majority (50.52%) of the consumers who responded to the survey were willing to purchase chutneys, and their preferred types were nelli/Indian gooseberry (76.80%), lovi-lovi (56.19%), and rose apple (31.44%). Ambarella, mango, banana, bilimbi, dates, apple, grapes, mulberry, grapefruit, chili, jackfruit, and papaya were the other preferred fruit and vegetable chutneys. These consumers buy chutneys for convenience, taste, and health benefits. The attributes of chutneys to attract consumers were branded goods, superior quality, fair price, and healthy products with no addition of preservatives, additives, or artificial colours. However, nearly 50% of the consumer sample disapproved of the consumption of chutneys because of the perceived barriers such as unavailability, preference for home-made chutneys, high prices, misbeliefs of disease association, lack of family members will, preservatives, additives, artificial colours, and doubts about processed product's quality.

Customer Willingness to Consume Fruit Bars

About 55.21% of the consumers surveyed refuse to buy dehydrated fruit bars due to perceived barriers; availability of fresh fruits, lack of awareness, preference for fresh fruits, high prices, misbeliefs of not suitable for some diseases, lack of interest in family members, limited availability, presence of preservatives, additives and artificial colourants, doubts about processed product's quality. However, 44.79% complied with consuming dehydrated fruit bars because of the attributes associated with processed foods such as branded goods, superior quality, fair price, and wellness, particularly those free of preservatives, additives, or artificial colorants. Further, convenience, taste, health benefits, and preference of family members, especially children also favour purchasing fruit bars. Few consumers indicated a preference for fruit bars made from local fruits. The most preferred fruit bars were those processed

with a mix of fruits (38.95%), watermelon (29.07%), pineapple (26.16%), mango (21.51%), and strawberry (10.47%). Consumers also prefer fruit bars made from bananas, papaya, apples, oranges, grapes, wood apple, guava, cashew, olive, avocado, blueberry, mulberry, and dates to a certain extent.

Customer Willingness to Consume Jellies Made from Natural Fruits

A vast majority (69.71%) of the surveyed sample preferred consuming jellies made from natural fruits and 95.90% of those favoured strawberry jelly over other types; apple, grapes, blueberry, pineapple, mango, papaya, orange, passion fruit, star fruit, rambutan, guava, mixed fruit, pomegranate, banana, raspberry, wood apple, overripe jackfruit/*waraka*, bael fruit, mangosteen, and watermelon. Convenience, taste, health benefits, and preference of family members, especially children were the main reasons for willingness to purchase jellies while product attributes; Branded goods, superior quality, fair price, and wellness, particularly those free of preservatives, additives, or artificial colorants were also added factors favouring jelly consumption in households. Few consumers indicated partiality to jams made from local fruits without added sugar. About 30.29% of the respondents showed reluctance to consume jellies due to high prices, no preference, misbeliefs of not suitable for some diseases, limited availability, the presence of preservatives, additives, and artificial colorants, and doubts processed product's quality.

Customer Willingness to Consume Chocolates with Fruits

The majority (67.19 %) of the respondents in the sample preferred consuming chocolates with processed fruits viz. mixed fruit or any suitable fruit (28.29%), grapes (22.48%), mango (20.93%), orange (17.05%), strawberry (16.28%), fruit and nut (16.28%), pineapple (13.57%), or plums (13.18%) with chocolate. Apple, mixed berries, bananas, dates, papaya, blackberry, ambarella, blueberry, passion fruit, black currant, pomegranate, and lime were other preferred chocolate mixed fruit varieties. Convenience, taste, health benefits, and preference of family members, especially children, were the main factors that favour consuming processed fruits with chocolates. Branded goods, superior quality, fair price, and wellness, particularly those free of preservatives, additives, or artificial colourants were also positives for attracting processed fruit and chocolate consumption. Few consumers indicated that they preferred chocolates with minimum sugar content and natural fruits. Further, a few mentioned that they buy only imported brands. However, 32.81% of the sample refused consumption of processed fruits with chocolates due to perceived barriers; limited availability, unfavoured taste, misbeliefs of not suitable for some diseases, lack of interest in family members, high prices, presence of preservatives, additives, and artificial colorants**,** and doubts about processed product's quality.

Customer Willingness to Buy Gift Packs Containing Different Types of Processed Fruits and Vegetables (e.g., Jams/Chutney in One Pack)

About 51.30% of the respondents in surveyed districts were willing to purchase gift packs containing processed fruits and vegetables because of convenience, taste, usefulness, and preference of family members. Further, customers favour buying

branded products of superior quality, exquisite, affordable, offered with discounts, and free of artificial colouration, preservatives, and additives. Nearly 50% of consumers avoided buying gift packs available in the market due to perceived barriers; availability of fresh fruits, lack of preference, and high prices. A considerable proportion of the consumers who did not purchase gift packs containing processed fruit and vegetables indicated that they might carry items that are not ideal because people's tastes might differ.

Customer Willingness to Buy Cookies Made of Fruit and Vegetable Flour

A vast majority (76.30%) sampled were willing to purchase cookies made of fruit and vegetable flour, particularly made from manioc (71.33%), fruits (70.62%) (flour/dried), dandeenala (42.32%), vegetables (6.47%), and other yams (0.68%). The most preferred fruit variety was bananas (62.80%). Convenience, taste, health benefits, and preference of family members, especially children were the main reasons for purchasing cookies made from fruits and vegetables. Branded goods, superior quality, fair price, and wellness, particularly those free of preservatives, additives, or artificial colours were the product attributes that attracted the consumers. Few consumers indicated that they preferred locally made cookies with natural fruits. However, 23.70% of the consumers refused these products due to perceived barriers; lack of awareness, nonpreferred taste, high price, and health concerns due to the addition of preservatives, additives, colouring, and doubts about processed product’s quality.

Customer Willingness to Buy Sauce Made from Fruits

About 58.07% of the respondents in the surveyed districts preferred buying sauce made from fruits, mainly because of convenience, taste, and perceived health benefits. Branded goods, superior quality, fair price, and wellness, particularly those free of preservatives, additives, or artificial colours were the preferred product attributes that attracted consumers. Few consumers indicated that they preferred sauces with local fruits, mainly those from mango (62.78%), pineapple (60.99%), tamarind (54.71%), and pomegranate (39.46%). Strawberry, mixed fruit, avocado, banana, blueberry, and starfruit were other products preferred by those who favoured purchasing fruit sauces. However, 41.93 % of the consumers did not prefer sauces that are made from fruits due to perceived barriers such as unavailability, nonpreferred taste, high price, misbeliefs of not suitable for some diseases, and lack of safety due to the addition of preservatives, additives or artificial colours, and doubts about processed product’s quality.

Customer Willingness to Buy Fruit Yoghurts

The majority (63.28%) of the respondents preferred consuming fruit yoghurts (fruit-embedded yoghurts), mainly those mixed with strawberry (79.01%), mango (73.66%), blueberry (53.91%), and dates (46.91%). Pineapple, mixed fruit, apple, banana, pomegranate, papaya, sweet tamarind, peach, kiwi, dragon fruit, wood apple, watermelon, grapes, and soursop were other fruit yoghurts preferred by those who favoured buying fruit yoghurts. Convenience, taste, health benefits, and preference of family members, especially children were the main reasons for the willingness to

purchase fruit yoghurts. Branded goods, superior quality, fair price, and wellness, particularly those free of preservatives, additives, or artificial colours were the product attributes that attracted the consumers. Few consumers indicated that they preferred yoghurts with local fruits. However, 36.72 % of the consumers in the surveyed sample rejected fruit yoghurts due to perceived barriers such as the nonpreferred taste, misbeliefs of not being suitable for some diseases, and health concerns about the addition of preservatives, additives, or artificial colours, and doubts about the processed product's quality.

Customer Willingness to Buy Fruit Yoghurt Drinks

About 58.85% of the surveyed consumers preferred consuming fruit yoghurt drinks, especially prepared by adding strawberry (77.88%), mango (72.12%), blueberry (54.42%), and dates (40.71%). Pineapple, papaya, wood apple, watermelon, apple, banana, kiwi, dragon fruit, mixed fruit, avocado, and sweet tamarind were other products mentioned by consumers who favoured buying fruit yoghurt drinks. Taste, health benefits, and preference of family members, especially children were the main reasons for the willingness to purchase yoghurt drinks including fruits. Branded goods, superior quality, fair price, availability, and wellness, particularly those free of preservatives, additives, or artificial colours were the product attributes that attracted the consumers. About 41.15% of the surveyed consumers did not show a willingness to purchase fruit yoghurt drinks for several reasons; dislike, misbeliefs that they are not suitable for some diseases, lack of safety due to the addition of preservatives, additives, or artificial colours, and doubts about the processed product's quality.

Customer Willingness to Buy Fruit Juices Made from Local Fruits

A vast majority (70.57%) of the sampled consumers preferred consuming fruit juices made from local fruits mainly those from soursop (71.96%), tamarind (62.73%), and Ceylon olive (55.72%). Mango, pineapple, apple, wood apple, passionfruit, lime, orange, avocado, watermelon, papaw, goraka (Garcinia), ambarella, mandarin, nelli, jackfruit, starfruit, bael fruit, pomegranate, and guava were other preferred sources of fruit juices mentioned by consumers who preferred to consume fruit juices. Convenience, taste, health benefits, and preference of family members were the main reasons to prefer fruit juices made from local fruits. Branded goods, superior quality, fair price, and wellness, particularly those free of preservatives, additives, or artificial colours were the product attributes that attracted the consumers. However, 29.43% of the surveyed consumers disliked fruit juices due to reasons such as the availability of fresh fruits, preference for homemade drinks, refusal by family members, misbeliefs that they are not suitable for some diseases, health concerns on adding preservatives, additives, and artificial colours and doubts about the processed product's quality.

Customer Willingness to Buy Vinegars Made from Fruits

About 57.03% of the consumers in surveyed districts did not prefer to buy fruit vinegars due to perceived barriers such as lack of awareness, high prices, misbeliefs that they are not suitable for some diseases, nonpreferred taste, dislike of family

members, unavailability, and lack of safety due to addition of preservatives, additives, and artificial colours, and doubts about the processed product's quality. However, 42.97% of the surveyed consumers preferred vinegar because of the vinegar taste and associated health benefits. In addition, the main product attributes that attracted them were branded goods, superior quality, fair price, and wellness, particularly those free of preservatives, additives, or artificial colours. The most preferred fruit vinegars were pineapple (86.67%) and apple (57.58%).

Customer Willingness to Buy Herbal Drinks Made from Fruits and Vegetables

The majority (67.19%) of the sampled consumers preferred buying herbal drinks made from fruits and vegetables. Nelli /Indian gooseberry, bael fruit, apple, cherry, berries, pears, goroka (garcinia), orange, pomegranate, starfruit, tamarind, lemon, peach, strawberry, mango, pineapple, soursop, papaya, and grapes were preferred fruit types indicated by consumers who are willing to buy herbal drinks. Few consumers also preferred herbal drinks made from underutilized fruits. The most preferred vegetable drinks were those made from curry leaves, moringa, and green leafy vegetables, e.g., gotukola. Convenience, taste, and health benefits were the main reasons for buying herbal drinks. Branded goods, superior quality, fair price, and product attributes; wellness, particularly those free of preservatives, additives, and artificial colours were the main consumer attractants. However, 32.81% of the surveyed consumers did not purchase herbal drinks due to reasons such as preference for homemade herbal drinks, family members' dislike, misbeliefs that they are not suitable for some diseases, lack of safety due to the addition of preservatives, additives, or artificial colours, and doubts about the processed product's quality.

Customer Willingness to Buy Minimally Cut or Processed Fruits or Vegetables in Packs

About 73.18 % of the consumers in surveyed districts did not buy minimally cut and packed fruits or vegetables due to perceived barriers such as the non-availability of quality products, high preference for fresh fruit and vegetables, and health concerns due to the addition of preservatives and additives, and doubts about the processed product's quality. However, 26.82 % of the surveyed consumers preferred to purchase minimally cut fruit and vegetables because of the convenience in addition to product attributes; branded goods, superior quality, fair price, freshness, and products with no addition of preservatives or additives. Most preferred minimally cut fruits were apple, papaya, mango, pineapple, watermelon, guava, starfruit, pomegranate, banana, and underutilized fruits and vegetables were tender jackfruit, ripe jackfruit, bitter gourd, banana blossom, brinjal, pumpkin, cabbage, carrot, leeks, kohila, breadfruit, mushroom, bean, cucumber, cauliflower, and capsicum.

Customer Willingness to Buy Minimally Cut and Processed Leafy Vegetables (*Mallum*)

A vast majority (79.17%) of the consumers in the surveyed districts did not prefer buying minimally cut and processed leafy vegetables because of the perceived barriers such as the availability of fresh leafy vegetables of preference in the market and lack

of safety due to the addition of preservatives and additives and doubts about the processed product's quality. However, 20.83% of the consumers in the surveyed sample preferred buying minimally cut and processed leafy vegetables because of the convenience in addition to product attributes; branded goods, superior quality, fair price, freshness, and products with no addition of preservatives and additives. The most preferred green leafy vegetables were gotukola, kankun, mukunuwenna, moringa, and kathurumurunga.

Customer Willingness to Buy Dehydrated Vegetables

About 57% of the consumers in surveyed districts did not prefer to buy dehydrated vegetables due to perceived barriers; the availability of fresh vegetables, preference for fresh vegetables, high price, health concerns of adding preservatives and additives, and doubts about processed products' quality. However, a considerable proportion (43.23%) of the surveyed consumers preferred purchasing dehydrated vegetables because of convenience, taste, and health benefits. Branded goods, superior quality, fair price, freshness, and products with no addition of preservatives or additives were the preferred product attributes of dehydrated vegetables that attracted consumers. Moreover, a few consumers mentioned dehydrating vegetables minimizes post-harvest losses during glut seasons. Mostly preferred vegetables were jackfruit (78.31%), kohila (66.87%), tender jackfruit (60.84%), breadfruit (56.63%), and brinjal (50.00%). Mushrooms, cassava, sweet potato, bitter gourd, and beans were other preferred vegetable types mentioned by consumers willing to consume dehydrated vegetables.

Customer Willingness to Buy Dehydrated Vegetable Snacks (Salted/Spicy)

The majority (58.07%) of the respondents did not prefer to buy dehydrated vegetable snacks because of several reasons; availability of fresh vegetables, preference for fresh vegetables, high price, misbeliefs that they are not suitable for some diseases, and health concerns of adding preservatives and additives, and doubts about the processed products quality. However, 41.93% of the surveyed consumers preferred buying dehydrated vegetable snacks because of convenience, taste, health benefits, and preference of family members. The product's attributes that attracted consumers were branding, superior quality, fair price, freshness, and wellness, particularly those free of preservatives or additives. Carrot (32.92%), mixed vegetables (27.33%), jackfruit (26.09%), ash plantain (14.29%), and manioc (14.29%) were the most preferred vegetable types of dehydrated vegetables. Pumpkin, radish, potatoes, brinjal, bitter gourd, leeks, sweet potato, breadfruit, yams, mushroom, ambarella, kohila, broccoli, beans, beetroot, cabbage, snake gourd, dandeenala, spinach, moringa, and cucumber were other preferred types which were mentioned by the sample consumers who are willing to consume dehydrated vegetable snacks.

Customer Willingness to Buy Vegetable Mixes

A vast majority (63.28%) of the respondents in the sample of consumers did not prefer buying vegetable mixes for several reasons; availability of fresh vegetables, preference for fresh vegetables, preference for home-made mixes, high price, misbeliefs that they

are not suitable for some diseases, and lack of safety due to addition of preservatives and additives, and doubts about processed products quality. However, 36.72% of the surveyed consumers preferred buying dehydrated vegetable mixes for preparing noodles, pasta, fried rice, or biriyani. Convenience and taste were the major reasons for their willingness to buy processed vegetable mixes. Branding, superior quality, package appearance, package size, fair price, freshness, and products with no addition of preservatives or additives were the preferred product attributes that attracted the consumers.

Consumer Willingness to Buy Dehydrated Vegetables with Rice Packs

About 71 % of the surveyed consumers did not prefer purchasing dehydrated vegetables with rice packs because of perceived barriers; availability of fresh vegetables, preference for fresh vegetables and home-made products, high price, unavailability, lack of awareness, and lack of safety due to addition of preservatives and additives, doubts about processed products quality. However, 28.91% of the consumers preferred buying dehydrated vegetables with rice packs because of the convenience. Branding, superior quality, fair price, and wellness, particularly those free of preservatives or additives were the preferred product attributes that attracted the consumers.

Customer Willingness to Buy Vegetable Powders

The majority of the consumers (68.23%) in surveyed districts did not prefer buying vegetable powders because of the availability of fresh vegetables, limited awareness about the product, preference for fresh forms, high price, misbeliefs of not suitable for some diseases, and dislike of family members. Lack of safety due to the addition of preservatives, artificial colours, and additives and doubts about the processed product's quality were other reasons for their unwillingness to purchase vegetable powders. However, a considerable proportion (31.77%) preferred buying vegetable powders because of convenience, taste, and health benefits. Consumers of the sample willing to buy vegetable powders mostly preferred high-quality products at a fair price. Further, they have mentioned that they can use these vegetable powders to prepare different foods and use as a natural colouring. Pumpkins (84.43%), carrot (67.21%), and beetroot (38.52%) and to a lesser extent leeks, beans, and potatoes were the other preferred vegetable powders used by the consumers.

Consumer Willingness to Buy Processed Vegetable Soups

About 61% of the surveyed consumers did not prefer to buy processed vegetable soups because of perceived barriers; availability of fresh vegetables, unpleasant taste, preference for home-made soups, high price, and health concerns about adding preservatives and additives, and doubts about the processed products' quality. However, about 39% of the sample preferred buying processed soups because of the convenience. Branding, superior quality, fair price, and wellness, particularly those free of preservatives and additives, were consumers' preferred product attributes. A few consumers mentioned that they like processed vegetable soups made of local vegetables, preferably from carrots (75.33%), leeks (53.33%), green beans (34.67%),

cabbage (34.00%), pumpkin (33.33%), potatoes (31.33%), and any vegetable (23.33%). A small percentage also favoured artificial soups made from corn, green peas, cauliflower, mushrooms, and beetroot.

Customer Willingness to Buy Processed Vegetable Porridge

Most consumers (61.20%) in surveyed districts did not prefer to buy processed vegetable porridge because of the availability of fresh vegetables, preference for homemade porridge, high prices, misbeliefs of unsuitable for some diseases, and unfavourable preference of family members. Health concerns about adding preservatives, additives, and artificial colouring and, doubts about the processed products' quality were also reasons for the refusal to buy processed vegetable porridge formulations. However, a considerable proportion (38.80%) of the customers' sample preferred to buy processed vegetable porridge because of the convenience, taste, and health benefits. Branding, superior quality, fair price, and wellness, particularly those free of preservatives, additives, and artificial colouring were consumers' preferred product attributes. The customers mostly preferred processed porridges made from carrots (36.24%), and mixed vegetables (29.53%). A small percentage also preferred porridges processed from pumpkin (28.86%), leafy vegetables (20.13%), grains (3,36%), potatoes, leeks, cabbage, beans, kohila, curry leaves, corn, moringa, and bitter gourd.

Customer Willingness to Buy Vegetable-flavoured Pasta, Noodles, And String Hoppers

More than half of the surveyed consumers (54.17%) preferred buying vegetable-flavoured pasta, noodles, and sting hoppers made from moringa (61.06%), carrots (50.48%), and suitable vegetables (13.46%). A small proportion also favoured buying those made from pumpkin, beetroot, corn, potato, manioc, jackfruit, gotukola, leeks, spinach, cabbage, dandeenala, and leafy vegetables. Convenience, taste, health benefits, and willingness to try novel products were the reasons for buying those processed items. Branding, superior quality, fair price, and wellness, particularly those free of preservatives or additives, were consumers' preferred product attributes. A few consumers preferred brands made from local vegetables. However, a considerable proportion (45.83%) of the sample did not buy pasta, noodles, and sting hoppers because of perceived barriers; unfavourable taste, ability to use fresh produce, refusal from family members, high prices, misbeliefs of unsuitable for some diseases, presence of preservatives, additives and artificial colourants, doubts about processed products' quality.

Consumer Willingness to Buy Ready-To-Serve Curries

A vast majority (80.47%) of the consumers in surveyed districts did not prefer buying ready-to-serve curries due to perceived barriers; preference for homemade curries, unfavourable taste, high price, misbeliefs that processed foods are unsuitable for some diseases, addition of preservatives and additives, and doubts about processed food products' quality. However, 19.53% of the respondents preferred buying ready-to-serve curries made from *polos* (tender jackfruit) (85.33%), ripe jackfruit (42.67%),

and yams (34.67%). A small percentage also preferred processed curries from breadfruit, kohila, ambarella, manioc, and banana bloom (*kesel muwa*) and other preferred vegetable types. Convenience is the major reason for customer's preference for ready-to-serve curries. Branding, superior quality, fair price, and wellness, particularly those free of preservatives or additives, were consumers' preferred product attributes. Moreover, a few consumers mentioned that processing these types of products also provides an opportunity to minimize post-harvest losses during glut seasons and take advantage in off-seasons.

Consumer Willingness to Buy Varieties of Fruit and Vegetable Crunch

Most sampled consumers (73.18%) preferred buying varieties of fruit and vegetable crunch preferably from jack seeds (79.36%) and jackfruit (69.75%). A small sample also preferred manioc, banana, sweet potato, ash plantain, banana blossom, kohila, potato, and rose apple crunch. Convenience, taste, health benefits, and preference of family members (especially children) were the main reasons for their choice. Branding, superior quality, fair price, attraction, and wellness, particularly those free of preservatives, additives, and artificial colouring were consumers' preferred product attributes. About 27% of the respondents did not favour buying fruit and vegetable crunch for several reasons; unfavourable taste, misbeliefs that they are not suitable for some diseases, adding preservatives and additives, and doubts about products' quality.

Consumer Willingness to Buy Fruit and Vegetable Flour

A vast majority (75.52%) of the respondents in surveyed districts preferred buying fruit and vegetable flour of cassava (74.83%), jack seed (73.10%), jackfruit (56.55%), and sweet potatoes (44.14%). A small sample also preferred flour of lavulu / yellow sapote, potato, banana, breadfruit, and yams. Convenience, taste, and health benefits were the main reasons for their choice of fruit and vegetable flour consumption. Branding, superior quality, availability, fair price, and wellness, particularly those free of preservatives and additives were the preferred product attributes by consumers. Further, they preferred brands made of local fruits and vegetables. However, 24.48% of the respondents did not buy these flour due to perceived barriers such as unfavourable taste, less awareness, misbeliefs that they are unsuitable for some diseases, adding preservatives and additives, and doubts about processed products' quality.

Consumer Willingness to Buy Leaf Powders

Most respondents (59.11%) of the survey did not prefer buying leaf powders for several reasons; availability of fresh produce, unfavourable taste, misbeliefs that they are not suitable for those with some diseases, and addition of preservatives and additives and doubts about processed products' quality. However, a considerable proportion (40.89%) of the surveyed preferred consuming leaf powders of curry leaves (85.35%), moringa (77.71%), pandan leaves (*rampe*) (63.69%), and lemongrass (0.64%) mainly because of convenience. Branding, superior quality, healthy properties, fair

price, free of artificial colouring, additives, and preservatives were the product's attributes that attracted consumers.

8.3.3 Perceived Barriers to Buy Processed Fruit and Vegetables

The most common factors that prevent households from buying processed fruit and vegetable products were; beliefs that they are not suitable for those having some diseases such as diabetes (69.27%), concerns about the safety of adding preservatives, artificial colours, and flavours (66.93%), disapproval of the family members (36.98%), high price (26.04%) of products sold in supermarkets, especially for canned foods, information disseminating in social and mass media, especially on consuming tomato sauce (16.41%), unawareness of certain processed products (7.29%) such as jams made of guava, papaya, and banana, dehydrated products, vegetable seeds, and flour (Jack fruit flour, jack seed powder) that are currently available in Sri Lanka, negative perception on consuming processed fruit and vegetable products (1.82%), availability of fresh fruits and vegetables (1.56%) and preference for homemade foods (1.30 %). These findings agree with previous observations of many authors in existing literature (Sijtsema *et al.,* 2012; Bandaranayke *et al.,* 2016; and Ajisola, *et al.,* 2021).

Table 8.5: Perceived Barriers to Buy Processed Fruit and Vegetables

Factors that prevent buying processed fruits and vegetables	Frequency	Percentage
Beliefs of not suitable for some diseases	266	69.27
Lack of safety due to the addition of preservatives, artificial colours, and flavours	257	66.93
No preference by family members	142	36.98
High price	100	26.04
Mass media and social media news	63	16.41
Lack of awareness	28	7.29
Unavailability	16	4.17
Negative attitudes towards processed fruit and vegetables (Lack of trust /not interested)	7	1.82
Availability of fresh fruit and vegetables/ Have adequate time to prepare fresh fruit and vegetables	6	1.56
Preference for homemade processed fruit and vegetable products	5	1.30

Note: Total percentage exceeds 100 because of multiple responses
Source: Authors' compilation based on HARTI Survey, 2023

8.3.4 Consumers' Suggestions to Promote Processed Fruit and Vegetable Industry in Sri Lanka

About 56% of the consumers who participated in the survey believe there is a need to ensure the quality and standards of products sold in the markets to promote the processed fruits and vegetables industry in Sri Lanka. Among other suggestions, increasing the quality of locally processed fruit and vegetable products, non-addition or minimal addition of preservatives, additives, and artificial colouring (28.65%), and

selling homemade processed fruit and vegetable products processed with natural ingredients at a reasonable cost (8.99%) were noteworthy. The price was decisive for many (26.04%) who did not buy processed fruits and vegetables. There were many other suggestions from consumers such as producing healthy products from herbal ingredients with low sugar (8.43%), launching strong advertising programmes (3.93%) on available processed fruit and vegetable items in the country, producing processed fruits and vegetables from rare and wild species (2.25%), producing excessively during harvest and converting to non-perishables to reduce wastage and for use in the off-season (2.25%); introducing novel products and using proper packaging materials (1.12%) for promoting the processed fruit and vegetable industry in Sri Lanka. The processed fruit and vegetable consumers also emphasized the need to strengthen transportation and storage infrastructure such as cool room facilities in the country to reduce the wastage of fruits and vegetables. However, a few respondents emphasized the importance of promoting locally processed fruits and vegetables to explore the export market.

CHAPTER NINE

Conclusion and Recommendations

9.1 Conclusion

Based on the findings of this study, several key conclusions can be drawn, offering valuable insights into the processed fruit and vegetable industry in Sri Lanka.

- Pineapple (46.67%), mango (40.00%), jackfruit (26.67%), papaya (16.67%), breadfruit (13.33%), and wood apple (13.33%) were the main crops processed in the fruit and vegetable industry in Sri Lanka, the majority (53.33%) producing dehydrated products.

- A vast majority (93.33%) of processors were willing to expand their production capacity in the future. Dehydrated fruit and vegetables (veggie mix, fruit snacks, and mixed snacks) have the highest potential in both domestic (47.62%) and export (75 %) markets.

- The majority of processed fruit and vegetable exporters believe the export demand is highest in the Middle East, (50.00%) and also Europe (45.45%), America (45.45%), Oceania (31.82%), and Asia (27.27%), that could be promoted by trade representations, bilateral trade agreements, adhering to international quality standards, and enhancing exporters' knowledge on marketing and advertising.

- According to the Constraint Facing Index (CFI), production process-related problems (CFI 66) were the most critical problem faced by the processors. Therefore, a close linkage should be established between farmers and processors to guarantee reasonable prices to farmers and the supply of quality products to the domestic market or export destinations. Further, the institutional and administrative infrastructure and the legislative framework must be continuously developed to allow processors to access domestic and export markets.

- According to the majority of the surveyed consumers (68.23%), the preference of family members was the main reason for consuming processed fruit and vegetable products. A considerable proportion, 48.44% also indicated 'convenience' as a reason for consuming processed fruit and vegetables, possibly because of the busy lifestyle of urban consumers. Taste was also a contributory factor as mentioned by 43.49% of respondents. As stated by Bandaranayake *et al.,* (2016), convenience and taste were major reasons for processed fruit consumption in urban households. About 19.53% also believe the association of health benefits was another reason for consuming processed fruit and vegetables. Therefore, the demand for and acceptance for

processed F&V products among urban consumers is likely to increase in the future.

- Awareness of processed fruit and vegetables among local consumers is inadequate and needs to be addressed further to enhance the processed food industry in the country. Misbelief about the non-suitability of processed fruit and vegetables for people with some diseases e.g., diabetes (69.27%), fear of preservatives, additives, and colorants (66.93%) prevent households from buying some types of processed fruit and vegetable products in Sri Lanka is crucial for the development of the processing food industry. Processors opting to produce food items with minimal or no additives, preservatives, and artificial colorants is vital as suggested by 28.65% of the respondents. Increasing the production of healthy products with low sugar content and herbal ingredients (8.43%) was another worthy suggestion made by consumers.

- The need for processors of fruits and vegetables to adhere to accepted quality standards was another requirement suggested by the majority (55.62%) of the consumers.

- The government's role in promoting the fruit and vegetable industry was also a key requirement emphasized by the vast majority (90%) of the fruit and vegetable processors because this is a growing sector in the country with high export potential.

9.2 Recommendations

Based on the research findings, the following recommendations are proposed to enhance the growth and sustainability of the processed fruit and vegetable industry in Sri Lanka.

- Encourage commercial cultivation of suitable fruit and vegetable varieties with the potential for producing processing foods for higher gains by establishing the model; nucleus commercial farmer with an out-growers to enhance the fruit and vegetable supply for the processing industry, initially, testing for fruit and vegetable crops such as pineapple, banana, papaya, mango, tomato, and gherkin which have a high potential for producing processed foods. When applying this model, the government should provide facilities; arable lands, financial assistance, and technical support to potential farmers.

- Conduct surveys to identify in-demand fruit and vegetable products, supply chains, and infrastructure facilities for selected products to reach their fullest potential. Furthermore, measures to strengthen transportation and storage infrastructure in the value chains of the processed fruit and vegetable industry in the country.

- Establish a close linkage between farmers and processors to guarantee reasonable prices to farmers and ensure the supply of quality products to domestic and export markets. Establish and maintain a database of fruit and vegetable farmers, collectors, and processors collaboratively by the Department of Agriculture, Export Development Board, Industrial Development Board, and Department of Commerce.

- Encourage the production of processed fruits and vegetables with zero or minimum levels of artificial compounds and low sugar content to outspread the consumption.

- Introduce a quality assurance facility for processed fruit and vegetables to ensure the quality of products for local and export market consumers by establishing a quality assurance body with the initiation by the government by conducting awareness programmes, training, and monitoring programmes.

- Implement extension and training for processors to motivate the production of processed fruits and vegetables as there is an increasing demand for value-added fruit and vegetable products in the world.

- Streamline government intervention *via* various institutes such as the Department of Agriculture, Ministry of Agriculture, Industrial Technology Institute, Industrial Development Board, National Institute of Post-harvest Management, and Export Development Board to organize training and extension for processors to make quality products and channel markets, especially for exportation.

- Establish niche markets or digital platforms for promoting and marketing processed fruit and vegetable products.

- Conduct consumer awareness programmes and promotion campaigns with samples to popularize locally processed fruit and vegetable products and update existing marketing strategies to promote locally produced processed fruit and vegetable products, innovations, and the production of consumer-focused products.

- Adopt effective export promotion strategies to evolve and diversify trading processed fruit and vegetable products to find prospective markets while expanding the existing markets by commissioning trade representatives and bilateral trade agreements, meeting international quality standards, and expanding exporters' knowledge on marketing and advertising.

- Adopt an integrated approach to establish linkages among responsible and related institutes to facilitate processors' reaching domestic and export markets.

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ANNEXES

Case Studies of Large-scale Fruit and Vegetable Processing Companies

CASE STUDY 01

The Success Story of Company A Pvt. Ltd[2].

Company A Pvt. Ltd has a history of over 90 years as a leading firm in Sri Lanka, specializing in producing, distributing, and exporting natural foods. Initially established by a British Civil Servant, the company played a crucial role during World War II, providing processed food, especially fresh fruit jam, to ease food shortages of war-affected people during that time. After the war, the company continued producing goods to cater to the British population. The company established its fruit processing facility at Narahenpita, Colombo 5, by installing imported machinery from Europe. Throughout its existence, the company maintained its reputation by adhering to stringent quality control measures ensuring that all its products are of a high standard, selling under its brand name 'A[3],, pioneering the manufacturing of premium sauces, jams, cordials, chutneys, and pickles, firmly establishing as the market leader in Sri Lanka. With over 80 years of experience in the food manufacturing industry, their brand has become synonymous with 'foods of excellence' in the household and corporate sectors. The company ventured into the global market, looking beyond national borders by commencing exports in 1992. Presently their products are cherished in more than 32 countries, mainly the USA, Canada, Japan, Australia, and the Middle East.

Company A Pvt. Ltd currently has a workforce of 420 skilled labourers, mostly contracted to support their operations. The company leverages cutting-edge fruit processing machinery to meet the increasing demand for an array of flavoured jams, cordials, fruit juices, nectars, fruit creams, sauces, pickles, chutneys, and sambals, canned fruits and vegetables, pure treacle, vinegar, coconut milk, coconut cream, spices, purees, jellies, and puddings, specifically tailored to the preferences of the Asian palate. Among its impressive product lineup, the company's best-selling item was jams, which boast the highest sales volume. These jams come in various enticing flavours like pineapple, wood apple, strawberry, and orange, presented in different bottle sizes and with varying sugar levels, catering to consumers' diverse tastes. Notably, the pineapple jam is the most sought-after variety. The export demand for wood apple jam is also robust. Company A Pvt. Ltd is actively exploring avenues for diversification to capitalize on market opportunities by expanding its offerings, viz. jams, sauces, canned fruits and vegetables, cordials, pickles, and chutneys. Moreover, the company is considering venturing into organic products and items preserved in brine. As part of its forward-thinking approach, the company plans to introduce curry items; fish ambul thiyal, and other seasonally moving products to appeal to a broader consumer base cementing its position in the market.

[2] Name of the company is not exposed due to ethical consideration

[3] Brand names are not exposed due to ethical consideration

Company A Pvt. Ltd holds several certifications showing its commitment to producing high-quality foods with assured safety. These certificates include; ISO 22000 certification which is a testament to the company's adherence to the International Food Safety Management Standard ensuring that the company maintains comprehensive food safety management procedures throughout its operations, HACCP; The Hazard Analysis and Critical Control Point certification which attests the company's dedication to identifying and controlling potential hazards in food production focusing safety and hygiene of the food products, and SGS UK and UKAS Accreditation which signify the company's compliance with rigorous quality and management standards and necessary regulations for exporting food products to the United States. With these certifications the company assures that its products meet the highest industry standards, instilling confidence in consumers and clients regarding the safety and quality of their offerings.

The company does not maintain direct contact with the growers but channels them *via* collecting agents to streamline the sourcing process for collecting fruits and vegetables from the farmers. The fresh produce collected is subjected to quality tests before being processed. The processed products are distributed through four primary distribution channels; General Trade Marketing (GT), Modern Trade Marketing (MT), Export Marketing, and Hotels, Restaurants, and Canteens (Ho-Re-Ca).

The company has a substantial worldwide export market covering 32 countries with key destinations, the UK, Australia, Canada, USA, Japan, Maldives, Samoa, Norway, Sweden, and the Middle East. They are also eyeing opportunities in the Indian market for further expansion. Currently, the company holds a share of 75% in the local market and 25% in the export market. The company has diversified its products offering different sugar levels and bottle sizes, ranging from 80g to 4kg to boost their sales. The company predictably forecasts its sales and production for 3 months, adjusting prices primarily in March-April and November-December. The company requires about 800,000 pineapples as raw materials to produce around 4,000 thousand pulp units to make their products. These raw materials are sourced mainly from local farmers through contract-based agreements at prices subject to fluctuations *via* regional collectors to procure raw materials. The company imports the balance requirement, around 18 containers of tomato pulp annually from China.

The Sri Lankan products face challenges in the export market for processed passion fruit and wood apples, which have niche markets causing difficulties in selling large volumes. The company encounters production issues, including irregular and fluctuating supply of raw materials and variations in fruit quality.

The company emphasizes marketing based on its historical experience and maintaining its reputation as a provider of high-quality products. However, the sales volume is declining due to decreasing customer purchasing power in the current market and intense competition from other products. Policy-related issues such as high tax rates and documentation charges also affect the smooth functioning of the company. Exporting also faces tough competition, with high production costs and

freight charges. The company prioritizes training and development at the company level to enhance its capabilities. Despite the COVID-19 pandemic, the company managed to maintain its production levels, with export production doubling in 2023. Participation in pro-food exhibitions provided excellent opportunities for the company to expand its market presence. The company gets well-informed about its competitors' product prices by conducting market surveys and figures from LMRB surveys. However, the company was dissatisfied with last year's prices due to increased production costs and rising raw material prices. The company subcontracted certain tasks while supervising and conducting quality checks to overcome certain problems in the production process.

The company needs to consider following steps in the value chain to develop its industry: guarantee uniformity of raw materials with strict quality control measures by working closely with farmers to ensure a consistent supply of standardized raw materials leading to better product quality and lessening production issues, increase product range by conducting market research to identify new product opportunities and expand their offerings to cater to different customer preferences, develop unique and innovative products to attract a broader customer base, increase pineapple availability by strengthening relationships with growers and entering into long-term contracts for obtaining a steady and sufficient supply of raw materials to cater the demand for their bestselling product, innovating novel packaging methods by investing on research and development to create new and attractive packaging methods that are eco-friendly and eye-catching because packaging plays a vital role in attracting customers and differentiating products from competitors, powdered product development by exploring the possibility of developing some of their products in powder form offering customers products that are convenient with long shelf life for use in various applications, improve raw material quality by working closely with farmers and providing them with training and knowledge on good agriculture practices for producing high-quality fruits, establish direct links with farmers for better communication and developing partnerships for better understanding of the farmers' needs, enabling the company to offer support and incentives for consistent raw material supply, conducts programmes for farmers and emphasizing farmers the need for sustainable and reliable farming practices and employees about the requirements and standards of international markets.

CASE STUDY 02

The Success Story of Company B Pvt. Ltd[4]

The company B Pvt. Ltd. was established 30 years ago (1994), to process and export organic foods for the European Market. They are the first to export organic pineapple products to the European market (Germany). The company is a project approved by the Board of Investment of Sri Lanka (BOI) with 100% German investment.

The proprietor of this company has chosen Sri Lanka for this unique project primarily because of the delicious and distinctive flavour of the country's tropical fruits. This business was acquired by the C[5] group in 2022 with the brand name "B" for exporting coconut and other fruit products. The company processes harvested coconuts at its facility in Katunayake adhering to HACCP protocols. The fruits are processed at an automated facility in Malkaduwawa, Kurunegala. Their products undergo processing and packaging under rigorous operational methods with online analysis and procedures to retain the nutritional value and authentic flavour before being exported. They strictly follow Internal Control System (ICS) protocols to ensure the traceability of organic certification throughout the production process upholding standards of hygiene and food safety. The main export destinations of "B" products are the U.K., the U.S.A, Germany and Spain. They have also identified Japan and Dubai as potential markets. The "B" products are advertised on the website of ''C" agribusiness, social media, and international food exhibitions.

There is a high demand for the "Mauritius pineapple" and "Sri Lankan karthakolomban" mango grown in Sri Lanka over other tropical fruit varieties because they are the sweetest among all pineapples and mangoes in the world. The fruit and coconut palm growers supplying raw materials are carefully chosen from various agro-ecological zones in the country that are best suited for their cultivation with ideal climatic conditions, soils, and farming techniques. The farmers, selected for supplying raw materials are well-trained in concepts and modern organic agriculture practices, which they are compelled to integrate with their traditional cultivation techniques.

Company C's dedication to producing high-quality food with safety standards stays up to customer expectations because of the modern mechanization methods followed in food processing such as operational methods, online analysis, and procedures followed by them to prevent the nutrient content and natural flavour of the finished products before they get deteriorated. The company has a functional product range; pineapple juice to dip fruits in bottled products, organic rambutan, soursop chunks, and pineapple chunks, other fruit products dipped in mixed fruit juices, and organic mango chunks, ripe jackfruit pieces, and papaya chunks, and also dehydrated products. There are also new products in the pipeline; lotus root in a brine, dehydrated bitter gourd, okra, beet, beans, organic star fruits, organic papaya, organic

[4] Name of the company is not exposed due to ethical consideration

[5] Name of the company group is not exposed due to ethical consideration

watermelon, organic ripe jackfruits, organic dragon fruits, organic pineapple tidbits/rings, sweet banana, and organic guava.

The factory has a capacity of 8,000 jars per day for producing goods confirming the ICS procedures to ensure traceability of the organic status in the production line and maintaining the highest quality with hygienic and food safety systems. The company strictly adheres to ICS procedures for traceability when making products such as mango or mixed fruit in mixed juice.

The company's workforce receives training on personal hygiene practices to ensure international food safety standards and client requirements. They have well-trained, qualified staff members and a lab with the necessary equipment to conduct quality checks at every stage beginning with the intake of raw materials. As for quality assessments, batch-wise sampling, sample analyses, and maintaining accurate records are employed. The quality management system has been updated regularly to improve the final product's quality, safety, and legality. All the products made from premium fresh fruits are labeled with batch numbers to aid the documentation process. ISO 22000 and BRC food safety and quality management systems are adhered to maintain the whole process's quality and safety. The company's entire product range holds international EU organic certification from Control Union (CU) Certifications in the Netherlands. The company's units and processing facilities undergo thorough inspections conducted by CU Inspectors, supplemented by routine inspections by our dedicated ICS team. They maintain transparent documentation to ensure the traceability of each product from its origin to export. The ICS with its highly qualified team, diligently oversees all aspects of field operations and factory production, following well-established procedures to ensure precise traceability.

Every successful business has challenges. The main challenge for this business leader is getting orders for production when the raw materials are not available for processing. The company plans to enter the local market with its new brand "C[6]".

[6] Brand names are not exposed due to ethical consideration

Case Studies of Medium-Scale Fruit and Vegetable Processing Companies

CASE STUDY 03

The Success Story of Company D Pvt. Ltd[7]

Company D Pvt. Ltd is a prominent processed fruit and vegetable exporter in Sri Lanka with a 70% share of their products in the export market primarily the Middle East. They have strategically concentrated on serving high-end customers by making their products available at specific locations using several brands for exporting to different countries.

The origin of these products is rooted in the owner's aversion to working under someone else and his passion for agriculture and travel. The 53-year-old owner, an arts graduate with a master's degree in food science and two decades of experience in food processing, founded his business in 2005 and gained approval in 2010, currently runs his industry with 70 employees.

The product range of the company includes cinnamon powder, capsules, and oil, fruit juices made from passion fruit, soursop, watermelon, tamarind, and orange juice, king coconut water with juices, coconut-based oil, and moringa. Among the products passion fruit, and soursop are fast-moving fruit juices. The company also produces dehydrated jack fruit, *kohila,* and bitter gourd for specific orders. Currently, they also have an order for cassava powder. The company adheres to several standards of certification; ISO, Organic, FIA, ISO 22000, and HACCP offering products with a one-year shelf life with no addition of preservatives.

After years of continuous research and development (R & D) the company has recently innovated a product; coconut garlic spread. However, one of their previously introduced products Kothalahimbutu drink, failed to obtain approval from the government. The company has organized farmer groups to support its supply chain by growing passion fruit, soursop, and king coconuts for bulk purchase, processing them into pulps, and storing them until orders are received. The company always purchases raw materials with the desired quality. They allocate a significant portion of their production cost, approximately 70%, for the production and importation of packing material, e.g., glass bottles from India.

The company faces many challenges, primarily in marketing despite its notable strengths. They have not ventured into social media to advertise their products apart from a few YouTube videos. They do not closely monitor market prices, or attend local exhibitions within Sri Lanka though they are minimal. However, they showcase their products at exhibitions organized by embassies in Bahrain, Qatar, and Jordan. Furthermore, financial constraints and governmental policy issues have also posed challenges to their operations. The COVID-19 pandemic exacerbated their difficulties as the buying power of customers dwindled. They mostly sell their products during

[7] Name of the company is not exposed due to ethical consideration

the summer season, while Jaffna has a strong market presence in June, July, and August.

The company's owner envisions a better future for the industry because the young generation is turning to food supplements, especially those made from natural products. The potential for vegetable snacks holds promise, but awareness of processed fruit and vegetable products needs to be disseminated among relevant target customer bases.

CASE STUDY 04

The Success Story of Company E Pvt. Ltd[8]

Company E Pvt. Ltd is a reputed food processing company that has existed for over 40 years, producing delicious and nutritious products for the local and international markets. This was registered in 1982. The company has obtained ISO 22000:2018 quality certification. From the early days, they cultivated strawberries to sell in the local market but later on after moving to Kandy they faced problems in selling fresh strawberries to the market. As a result, their crops were largely wasted. Then as a solution, they started manufacturing jams from strawberries. By examining the details of their labels, it became evident that they are also manufacturing jams from other fruits. The company entered processing step by step and currently their main products are dehydrated fruits and vegetables. They have 150 products of categories dried vegetables, dried fruits, pickles, chutneys, sprats, jams, cordials, soups and spreads, porridge, curry paste, spices, herbal tea, and fresh fruit cordials. They mainly focus on fruit dehydration, largely mangos and pineapples, and to a certain extent papaya, watermelon, soursop, banana, and guava. carrot, cabbage, breadfruit, leeks, bitter gourd, banana blooms, kohila, rampe, curry leaves, gotu kola, lemon grass, polpala, and spinach. The company collects fruits from farmers and vegetables from collectors. Their manufacturing is done on orders for about 10% for the domestic market and 90% for exporting mainly to the United Kingdom, Japan, Germany, and the Middle East.

The company's targeted market was large-scale domestic companies that use dehydrated fruit and vegetables as raw materials for their products. The company has faced problems due to uncertainties in the importation mechanism and changed its marketing strategies accordingly.

The company's strengths were: brand reputation, location, above 40 years of experience, regular customer basis, existing high demand for special products, skilled and effective labour, regular supplier base for raw materials, having their plantations, and quality standards and certifications. The barriers to the smooth functioning of the firm were: inadequate supply of quality raw materials, high energy cost (fuel and electricity), lack of market for dehydrated products, unavailability of attractive packing materials, high tax rates, trade barriers, and tariffs, lack of government assistance, restrictive rules and regulations, import restrictions, instability of input prices, high labour chargers, and certain government policies.

The company hopes to develop its business capacity by improving its packing machine facilities, finding solutions for marketing issues, scaling up its dehydrated products to reach supermarkets by producing small packs, and increasing export volume to Middle Eastern countries, Dubai, United Arab Emirates, and Qatar.

[8] Name of the company is not exposed due to ethical consideration

CASE STUDY 05

The Success Story of Company F Pvt. Ltd[9]

Company F Pvt. Ltd has been in the industry for five years producing fruit pulp to the market. Their vision was to become the leading fresh fruit and vegetable supplier in Sri Lanka. They have product quality certifications GMP, HACCP, and ISO 22000:2018. They intended to boost local agriculture with efficient and effective utilization of resources including the under-utilized land and empowering the valuable clusters who experience socio-economic hardships while contributing to increasing Sri Lanka's GDP and reducing poverty. They offer 100% natural products at a fair price to promote healthy lifestyles within and outside Sri Lanka.

A project done by the entrepreneur, when he worked at an employment agency was the basic foundation for starting this business. Initially, fresh fruit was sold to the main manufacturing companies in Sri Lanka. Due to the subsequent tax release during that period, the entrepreneur suffered a huge loss by purchasing fruit from main manufacturers of foreign countries. companies. Later, he started fruit pulp production as a value addition to fresh fruit.

The nature of his business is farming with the rural farming community, maintaining good agricultural practices, purchasing quality harvest, supplying fresh fruit and vegetables to the export market, and making natural fresh fruit pulp and supplying to the local and international markets.

The company manufactures passion fruit puree pulp, mango pulp, soursop pulp, pineapple pulp, guava pulp, passion fruit pulp, lime cubes, and wood apple cream during the harvesting season by maintaining a successful out-grower model. Their main product is mango pulp and to a certain extent pineapple, guava, lime, and wood apple collected from collectors. Passion fruit and soursop are obtained through our grower model. Ninety five percent of their products are for the domestic market. A mere 5% was exported to Dubai and Maldives. The export directly to Dubai and through exporters to Maldives. Their production is in high demand from December to April, May and August. They face less competition within Sri Lanka because of the uniqueness of the product.

The company's main target market is star-class hotels and restaurants. They also sell their products online directly to customers and to niche markets. They use unique promotion methods to promote their business for instance convincing restaurant chefs. The company has 573 farmers, covering about 400 acres of fruit cultivation for a regular supply of raw materials for daily needs. They also have a well-trained production staff who always maintain their products' quality and healthiness by following the production quality standards. The company's annual fruit harvest reaches over 200 metric tons and its yearly production capacity of fruit pulp reaches over 100 metric tons.

[9] Name of the company is not exposed due to ethical consideration

The main problems they face in their business are high energy costs, lack of storage facilities, inadequate working capacity, unavailability of attractive packing materials, high tax rates, price fluctuations of raw materials, high cost of exporting, strong international competition, unfavourable foreign exchange rates, and climate.

The company hopes to increase its export percentage and expand its product capacity annually. It plans to introduce nelli pulp, tamarind pulp, jamanaran pulp, and aloe vera pulp, which are in the testing phase. trial sessions. It expects to reduce production costs by developing storage facilities and reducing the transport cost.

Case Studies of Small-Scale Fruit and Vegetable Processing Companies

CASE STUDY 06

The Success Story of Company G[10]

This case study focuses on Company G which produces homemade processed fruit and vegetable products crafted by a team of two individuals, the owner and another lady since 2021.

The story behind this company begins with the lady partner's prior involvement in the cake business, which employed a few workers. Due to the COVID situation, her cake business suffered. At that critical juncture, she contemplated sustaining herself and her employees by expanding her business to include processed fruits and vegetables alongside the existing cake business. Today, she manages the two business ventures separately.

Although the lady holds a diploma in agriculture from Aquinas, her knowledge of processed foods was limited. By participating in a series of training programmes conducted by the Department of Agriculture (DOA) at Gannoruwa, the Industrial Development Board (IDB), and the Sri Lanka Standards Institute (SLSI) she gained adequate expertise in the processed food industry. Additionally, she continues to seek knowledge about food preservatives. She began preparing jams and chutneys, offering them to family members and friends for tasting, and from the encouraging feedback, she decided to venture into the business of producing jams.

The lady takes great pride in using natural ingredients with one food additive as a preservative to produce her processed foods though they have a relatively short shelf life, chutney 2-3 weeks, jam 6-8 months, etc. Her product range includes a variety of processed jams made from mango, mixed fruit, wood apple, strawberry, strawberry-flavored melon, orange-flavoured melon, chutneys made from mango, ambarella, tomato, and nelli and fried products made from lassia, bitter gourd, banana blossom mixed with dried fish, and chili paste with shrimps. In addition, her establishment produces cake fillings with passionfruit, blueberry, and mango.

Among the wide range of items produced by the company jams (mixed fruit, strawberry, strawberry-flavoured melon jam, wood apple, and tomato sticky) and fried items have the best demand. The raw materials for processing food items are mostly bought from Supermarkets. Strawberries are purchased from Nuwara Eliya, blueberries from the special outlet at Vauxhall Street, and tamarind from nearby areas. She pays special attention to the colour and quality of the fruits when making these purchases.

Before venturing into processed food products, she used to sell icing flowers to famous online markets. After starting the current business, she began selling

[10] Name of the company is not exposed due to ethical consideration

processed food products through the online platform. She customizes her products based on pre-orders and mostly sells them as hampers. December and April are the peak months with high demand for hampers, averaging around 50-60 per month.

The company normally takes about a week to fulfill an order. Initially, they produced 250g and 450g bottles, but later on opted for 200g bottles, believing that customers prefer smaller quantities due to reduced buying power. A 200g bottle of strawberry-flavoured melon jam is priced at Rs. 390, while a 200g mixed fruit jam bottle costs Rs. 325. Normally, 1 kg of tomato or wood apple is adequate to produce three bottles of jam. They freeze the fruit pulps and store them for use when necessary. An empty bottle costs Rs. 60, a lid Rs. 35, and an additional Rs. 18 for labeling adds to the production cost.

Apart from online platforms, the company collaborates with special marketing outlets. They avoid supermarkets because of the high margins they expect for selling goods in their shops. The company fulfills orders as they come in, with payments typically received within 45 days. When products nearing the expiry date the partners notify them a month in advance.

The company aspires to obtain the GMP certificate shortly. However, it did not intend to export its products immediately. It markets products via websites and other outlets rather than direct marketing. Nevertheless, it monitors marketing prices to ensure competitive prices. During the COVID outbreak, it adjusted prices to accommodate customers' needs.

The company continually strives to create innovative products, the most recent being cookies made from cassava flour. They foresee a growing interest in healthy diets and anticipate that dehydrated products will become increasingly popular with time. The lady also plans to improve the online methods for selling products and introduce small bouquets of homemade products to boost the processed fruit and vegetable market.

CASE STUDY 07

The Success Story of Company H Pvt. Ltd.[11]

The company H Pvt. Ltd was initially a small-scale fruit-based food processing unit established by a well-educated young lady in Kadawatha in December 2020. However, food processing operations began in late 2021 because of the quiet period due to the COVID-19 outbreak. Their products, value-added spices, and fruits, which are famous in online market platforms are now available in the open market in limited quantities. The concept of "value addition to underutilized natural forest products without adding preservatives" was born in the lady entrepreneur's mind from her educational background in forest science and the various training programmes she participated.

The company does not have permanent employees. People are hired on a daily paid basis for their work when there is an order. The products mostly produced are wood apple, surinam (pitanga) cherry, and star fruit jams. Their most popular product, the wood apple jam is prepared from blended wood apple in addition to lime pickles and garcinia paste. The fruit quality is checked by their appearance before purchasing for value addition. Usually, half-ripe fruits are selected for processing into jams by adding bee honey-based products known to be of Ayurvedic medicinal value. Their product range perfectly matches the theme they use to promote their products "*Bringing the best from the forest*" targeting health-conscious middle-class customers worldwide. These natural products have already been exported to Italy, the U.S.A., the U.K., and Dubai. The company hopes to obtain the GMP certification to expand its export capacity.

Most underutilized fruits are seasonal and the company has to find a solution to find raw materials throughout the year. As a small-scale fruit processor, the company opted for dehydrating raw materials without adding preservatives as an option for preserving seasonal fruits.

The main barriers to the company's progress are the high cost of packaging materials, production issues, limited access to loans, complexity in the exportation procedure, difficulties entering supermarket chains as small-scale processors, and dearth of technical consultations when required. According to the owner, there is a better demand for "Ready to Serve" (RTS) healthy products in the local market and organic vegan products in the European and U.S. markets.

[11] Name of the company is not exposed due to ethical consideration

CASE STUDY 08

The Success Story of Company I Pvt Ltd[12]

Company I Pvt Ltd was established three years ago gaining a reputation for its unique product, value-added durian. As the only company in the country to process durian, it works with a zero-wastage concept by utilizing every part of the fruit to produce a range of value-added products.

"We promise to make your impression even stronger" is the main theme and 'No artificial flavours', 'No colouring' and 'No Preservatives' are other slogans they use to market their products. The owner's qualification as a graduate in vocational training and his ability to innovate are the main reasons for starting his own company at his residence and later shifting to Kandy town.

There are twenty-one categories of value-added durian products; ice cream, milkshake, yogurt, pizza, mouse, watalappan, chocolate, kisses, burgers, plain juices, and seed chips made by the company. Ice cream, yoghurt, milkshakes, and pizza have been the most moving items. The company's products are mostly sold at its premises. The durian ice cream is sold at some supermarkets. Durian products only have a niche market mostly bought by the community. However, there is no competition for these products since they are unique and not produced by any other party in Sri Lanka. The strengths of this industry are the uniqueness and availability of skilled labour, loan facilities, knowledge and experience gained by personnel from industrial training and internships, and customer feedback. The main constraints to the company's progress are various government policies and regulations, unnecessary laws discouraging the processors, high tax rates, electricity costs, and the niche market. Climate change is an issue affecting the durian harvest and taste of the fruit.

The company plans to scale up durian ice cream production at the supermarket level while experimenting with improving the taste to explore the export market. They also intend to have durian plantations of their own to increase the production potential in the next five years with their long-term objective of obtaining a decent share of the export market. The countries they plan to export processed durian ice cream are New Zealand, Australia, South Korea, and Arabian countries. They also plan to expand their business on durian dehydration once they expand their processing facilities with a branch each in every district of Sri Lanka.

[12] Name of the company is not exposed due to ethical consideration

CASE STUDY 09

The Success Story of Company J Pvt Ltd[13]

Company J Pvt Ltd was established in 2022 as a small domestic industry. There was a setback at the onset of the industry due to financial problems during the COVID-affected period and the owner's father's poor health. However, with time it has developed into one of the most respected and trusted brands of dehydrated fruits and vegetables, and food supplement capsules among consumers in Sri Lanka and foreign countries. These products are meant to satisfy the changing meal patterns of people of different lifestyles in the niche market. The innovative capacity of the company's owner was the reason for this success.

The company owner was a 32-year-old lady with exceptional talents for innovation. After GCE finished GCE (Advanced Level), she completed a diploma in management studies and started working as a consultant in the banking sector before she started this business to find a solution for her low-income status, even though she didn't have previous business experience. She began her industry by buying a small dehydration machine to process bananas. The first order she got was to process 25 kg of banana chips. With time, she developed relationships with other entrepreneurs to fulfill her desire for novel products.

The Ministry of Agriculture and Small Enterprises Development Authority (SED) supported the company in several ways to bring the industry to its present status. The company mostly uses social media (Facebook) for advertising its products comprising value-added products and about 200 product categories. The lady is the leading dehydrated food product exporter in the Galle district as a large-scale producer of dehydrated fruits, vegetables, herbs, and related products. The company has attained ISO 2200 and HACCP certifications for offering custom manufacturing for over 200 products using moringa, garcinia, welpenala, cinnamon, and soursop, mainly producing dehydrated fruits and capsules, dehydrated pineapple rings, mango cubes and slices, moringa leaves, jack, papaya, and soursop, and capsules of garcinia and moringa.

The company claims that value-added products such as Jack fruit cereal, mixed fruit cube bottles, moringa capsules, lunuwila tea, and moringa tea are more profitable than others for earning foreign exchange. Their main export destinations are Japan, Switzerland, and Poland for direct and indirect marketing. The company believes that training its employees is crucial for the success and sustenance of the industry. The company makes decisions collaboratively based on their understanding and from various other sources. The factory currently has 15 employees. They get the raw materials from suppliers through a supplier chain and villagers.

[13] Name of the company is not exposed due to ethical consideration

The company gets services from the Industrial Technology Institute (ITI) to ensure the purity, safety, and spoilage of new products before releasing them to the market. The company has facilities for testing the moisture content of the products.

The company's owner claims she is a person who undertook risks to introduce new things to make a noteworthy contribution to society and the country's economy. A testimony to her creativity and risk-taking is introducing a cereal with a high percentage of jackfruit to attract children who dislike consuming jackfruit as it is.

This lady entrepreneur is a model for those interested in developing their businesses. She always has a strong internal focus and control of her business. Her ambition is to be a successful businesswoman in the future. She doesn't believe in luck or fate but in her strength and ability to stand for her success.

CASE STUDY 10

The Success Story of Company K Pvt Ltd[14]

A good entrepreneur has a way of thinking that will build a successful enterprise and discover the most appropriate ways and space to capitalize on it. The lady owner of the company K is a person of such caliber who undertakes risks and introduces new products to contribute to society and the economy. Her innovation is producing jams, cordials, and juices using Sri Lankan fruits. Her mangrove drink is one such worthy of mentioning as a great innovation.

The manufacturing unit of company K is located at Galle. Its main products are cordials made from aloe vera, star fruit, nelli, mangrove, soursop, Ceylon olives, tamarind, wood apple, passion fruit, and bael fruit. The company's owner, having seen large volumes of fruits getting wasted in the country wanted to make that an opportunity to open up a business to produce natural products without artificial preservatives. Her idea became a reality with the support she got from her husband and institutions and consulting services such as IDB, EDB, ITI, SED, Cathy Rich Embilipitiya, and Kakanadura farm. She received "The Southern Province Best Agro-Entrepreneur award in 2019 and the Best Agro-Entrepreneur award in 2011 from the Small Enterprises Development Authority (SED) for her outstanding performance in the processed food industry. She has made cordial relationships with other entrepreneurs while participating in many exhibitions organized by small enterprises in the food industry. She always believes in her inborn talent and willingness to take risks as a strength for achieving success. According to the school of entrepreneurship, she belongs to the classical school of entrepreneurship with the ability to innovate unique products such as jams, cordials, and juices from Sri Lankan fruits. She introduced jams, and cordials to the market.

The company was started with a team nearly 15 years ago considering the cost factors; labour, ingredients, and capital, economic factors; production capacity and cost factors; packaging costs for glass bottles and metal lids. During the Corona crisis, the factory had a setback and diverted to dairy products leading to a new business, producing pasteurized milk.

The company's owner believes that her innovations improve people's health by consuming natural products while creating a demand for fruit varieties. She has a vision to increase local fruit consumption and expand into the international market.

The lady owner of the company K is indeed a model to follow for those interested in venturing into the small business enterprise arena. Her determination to become an entrepreneur, desire to embark on a small-scale venture, braveness shone by taking life-changing decisions disregarding investment risks, and self-motivation to achieve set goals were the key attributes for her success. She is not a person believing fortune for success rather than her ability and that trust made her a successful entrepreneur. As a successful entrepreneur, she relied on innovations to sustain her industry.

[14] Name of the company is not exposed due to ethical consideration

CASE STUDY 11

The Success Story of Company L Pvt Ltd[15]

Entrepreneurship is a process of individuals identifying new opportunities and converting them into marketable products. The entrepreneur of company L is mindful of successfully identifying the market and discovering the most appropriate ways to capitalize on it. Accordingly, the company L was established to introduce innovative cookie varieties using local fruits and vegetables.

Entrepreneurs play an important role in a nation's economic growth by producing new and improved products and technologies enabling them to find new markets. They always think differently than ordinary people. The owner of company L is a lady who approaches problems, challenges, and failures contrary to a normal person by making proactive decisions to consolidate her position as a successful entrepreneur with a strong intuitional capacity.

The lady owner of the company has an inborn knack for innovating novel products and the will to take risks when introducing them to the market. Accordingly, she has introduced a range of dehydrated cookies from jack seed, finger millet, waraka, dandeenala, watalappan from jackfruit, and moju (dried version of classic eggplant) to the market using Thailand food processing technologies, which she has learned from a training programme. The products have been in the market since 2018. The lady also holds a diploma from the Sri Lanka Hotels School. Initially, she supplied her products to the market with the brand name J but changed to brand C, which was her son's name.

Among different patterns of innovation followed in food processing production, cookies, moju, and watalappan made from jack fruit and dandeenala (purple yam) without adding artificial flavours and colours are unique and in addition to consuming as a portion of food that help conserve jack fruit trees in particular, as a solution for addressing country's food security.

This company has been in business for 25 years starting as a small enterprise in 2019, producing dehydrated fruits and vegetables and since then their product range has increased with the addition of new products such as waraka cookies and jack fruit watalappan. The lady owner's vision is to increase the range of nutritious foods for the Sri Lankan community and introduce those into the international market. Her focus on jackfruit is commendable because many jackfruits go wasted without being consumed because people dislike eating them in the usual manner.

Jackfruit consumption is popular among people in rural but among those in urban and semi-urban areas. The company's unique product, Jackfruit flour has the potential to become a popular food ingredient in all communities. However, people usually look for products with popular brands therefore the company has to make a special effort to find a market share especially targeting the people who live in urban and semi-urban areas because they mostly prefer instant foods.

[15] Name of the company is not exposed due to ethical consideration

CASE STUDY 12

The Success Story of M Agro-Processing Centre[16]

M Agro-processing center was started in 2021 under the supervision of the former Governor of the Western Province. The project's general objectives are to provide healthy fruit and vegetable-based products to society without adding artificial colorants or flavours and to generate job opportunities for people living around the nearby areas. This newly built processing center already has GMP standards and management is working on acquiring ISO standards. This center operates under the Ministry of Agriculture, Western Province. The Industrial Development Authority is responsible for selling the products. A small sales outlet was established in the factory premises to sell the products at a discounted price.

The center produces about 45 products under dehydrated products, flour and powder, and juices and jams categories. They process foods according to the demand of the market. At present, they are not earning large profits. However, the earnings are sufficient to cover the cost of production. Considering the demands for products and the cost-effectiveness the center currently produces only 15 products. For instance, the demand for dehydrated products, mango (50g), sugar-coated mango (50g), kohila (50g), Jack fruit (250g), bitter gourd (200g), ladies fingers (100g) is low in the local market. Hence production of these products was temporarily stopped.

The products currently in demand were juices, mango, wood apple, mixed fruit, pineapple, jams, wood apple, mixed fruit, and pineapple. The center also can process spices such as turmeric powder. The center collects raw materials for its products from registered suppliers in nearby locations. But some items (e.g., tomatoes), are purchased from Dambulla Dedicated Economic Center and Manning Market. So, the center plans to build freezing facilities as a future expansion to store fruit pulp in the harvesting seasons to gain sustainability for uninterrupted production.

The center checks quality parameters; maturity stage, variety, pH value, and brix value of the raw materials and finished products to protect the quality of the final product ensuring uniformity of the products. They also check the condition of the transporting vehicles. Approximately 97% of its total goes to the local market. The products also go to Australia, Dubai, and Korea through intermediate exporters. Plans are underway to export their products, directly because their fruit juices and nectar products are gaining popularity in the international market. The demand for fruit nectar is higher for juices in the local market.

The center decides prices of products after doing a cost analysis, and market and processing surveys, especially through phone calls. The center's management knew that the world's trend is for healthy, natural, and organic dietary patterns. Hence, they are trying to produce more and more food items with functional benefits. As a result, their newest product, tamarind drink is gradually gaining a high demand in the local

[16] Name of the company is not exposed due to ethical consideration

market. Furthermore, the center directs its research and development efforts to develop soursop, king coconut, and aloe vera-based functional food products (products with health benefits) to grab the expanding market opportunities. However, this center also faces production-related issues such as high transportation, raw materials, and packing material costs.

Annex 01: National Policies and Acts Available in Processed Fruit and Vegetable Industry

National Policies/Acts/Strategies	Institutes
National Agriculture Policy (2003, 2007, 2019 & 2021) NAP 2021 (draft) Thematic Area (6) Agri-Entrepreneurship and Markets Policy Goals to be Achieved Link to SDGs Responsible Agencies. Policy Statement 8. Foster strategic collaboration among the value chain actors, especially focusing on value added products, targeting domestic and international markets	Ministry of Agriculture
National Industry Policy- (Still no approval from cabinet) The 5-year strategic plan (2023-2027) related to the industrial policy Amendment of the Industrial Promotion Act No.46 of 1990 National Policy Framework for SME development	Ministry of Industries
Food Act No. 26 of 1980 Food (Amendment) Act No.20 of 1990 Food (Amendment) Act 2011 National Nutritional Policy National Food Safety Policy (Draft)	Ministry of Health
National Export Strategy (NES) 2018-2022 Trade Policy Reforms Foreign Direct Investment Policy	Ministry of Investment Promotion Ministry of Trade
National Agricultural Research Policy & Strategy (2018-2027)	SLCARP

Source: Authors' compilation

Annex 02: SLS Standards Regarding Processed Fruit and Vegetable Industry

SLS No.	Title
SLS 209	Code of hygienic practice manufacturing of fruit and vegetable products (processed)
SLS 214	Fruit squashes, fruit syrups, fruit cordials
SLS 260	Tomato sauce
SLS 265	Jams, jellies and marmalade
SLS 266	Canned pineapple
SLS 274	Fruit juices
SLS 348	Determination of total solids in fruit juices and extracts
SLS 390	Tomato juice
SLS 399	Pickles
SLS 446	Mango chutney
SLS 536	Canned mangoes
SLS 581	Chili sauce
SLS 729	Ready to serve fruit drink
SLS 730	Fruit squashes concentrate, fruit syrups concentrate, fruit cordials concentrate
SLS 813	Mango nectar
SLS 853	Dried whole chilies
SLS 873-1	Code of hygienic practice for canned foods - Low acid canned foods
SLS 927	Passion fruit juice
SLS 945	Tomato concentrate
SLS 967	Frozen confections and freeze drinks
SLS 997	Canned mushrooms
SLS 998	Canned jackfruit (ripe)
SLS 1041	Mango juice
SLS 1324	Requirement for organic agriculture production and processing
SLS 1332-1	Methods of test for fruit and vegetable products - Fruit juice
SLS 1328	Fruit juice and nectars
SLS 1412 Part 2	Code of practice for fresh fruits and vegetables - Ready-to-eat fresh pre-cut fruits and vegetables
SLS 1572	Table apple
SLS 1584	Table mango
SLS 1611	Fruits and vegetables – physical conditions in cold stores - definitions and measurement
SLS 1612	Apples - Cold storage
SLS 1743	Chutney
SLS 1751	Specification for table grapes
SLS 1767	Requirements for induced fruit ripening

Source: Sri Lanka Standards Institute, (2024)

Annex 03: Recently Consumed Processed Fruits

Product	Fruit
Jam	Mixed Fruit, Strawberry, Wood apple, Pineapple, Mango, Blueberry, Orange, Papaya, Guava, Watermelon, Cherry, Peach, Lemon, Passionfruit, Raspberry, Apple, Apricot, Rose apple
Cordial	Wood apple, Mango, Orange, Mixed fruit, Guava, Strawberry, Passionfruit, Nelli (Indian Gooseberry), Pineapple, Blueberry, Apple
Nectar	Mixed fruit, Mango, Orange, Passion fruit, Watermelon, Wood apple, Strawberry, Apple, Nelli (Indian Gooseberry), Papaya
RTS Drinks	Passion fruit, Papaya, Mango, Watermelon, Avocado, Mixed fruit, Mango, Orange, Apple, Strawberry, Wood apple, Pineapple, Grapes, Pomegranate, Ambarella
Chutney	Mango, Orange, Mixed fruit, Grapes, Lime, Ambarella, Strawberry, Pineapple, Lovi, Starfruit, Bilimbi, Dates, Nelli (Indian Gooseberry), Guava, Ceylon Olive, Rose apple
Jelly	Strawberry, Raspberry, Grapes, Apple, Blackcurrant, Mango, Lemon, Orange, Mixed fruit, Banana, Wood apple, Pineapple, Blueberry
Pickle	Papaya, Ambarella, Pineapple, Mango, Ceylon Olive, Lovi, Nelli(Indian Gooseberry), Rose apple, Dates, Starfruit, Wood apple, Guava, Lime
Fruit in syrup	Apple, Pineapple, Strawberry, Apricot, Mixed fruit, Peach, Papaya
Powder/flour	Orange, Mango, Woodapple
Dried	Mango, Orange, Papaya, Watermelon, Lemon, Durian, Waraka (overripe jackfruit), Grapes, Plums, Pineapple, Bael fruit, Raspberry, Bilimbi, Cherry, Banana
Canned	Olive
Pulp	Mango
Paste	Goraka, Tamarind
Minimally Cut	Watermelon, Papaya, Mango
Yoghurt	Strawberry, Mango, Dates, Plums, Mixed Berry, Pineapple
Yoghurt drinks	Mango, Strawberry, Mixed Berry, Woodapple
Ice cream	Mango, Strawberry, Plums, Blueberry, Passionfruit, Pineapple, Dates, Wood apple

Source: Authors' compilation based on HARTI survey, 2023

Annex 04: Recently Consumed Processed Vegetables

Product	Vegetable
Jam	Pumpkin
Sauce	Tomato, Green Chili, Nai miris/Bird chili
Pickle	Carrot, Green chili, Beans, Capsicum, Young jackfruit, Brinjal, Leeks
Canned	Tomato, Baby corn, sweet corn
Vegetables in Brine	Corn
Powder/flour	Moringa, Curry leaves, Pumpkin, Rampe, Kos/Ripe Jackfruit Seed, Kos/Ripe Jackfruit
Dried	Bitter gourd, Kos/ Ripe Jackfruit, Young Jackfruit, Breadfruit, Mushroom, Long bean, Kohila/Lassia, Ladies finger, Ash plantain
Puree	Tomato
Paste	Tomato
Minimally Cut	Young Jackfruit, Ripe Jackfruit, Cabbage, Green leaves
RTS Curries	Young Jackfruit
Soup	Carrot, Leeks, Corn, Pumpkin, Cabbage, Beans

Source: Authors' compilation based on HARTI survey, 2023

Annex 05: Willingness to Purchase Novel Processed Fruit and Vegetable Products

Product Type		Willingness	
		Yes	No
1.	Dehydrated fruits (banana, mango, pineapple, papaya etc.)	36.72	63.28
2.	Fruit snacks (banana crisps salted/honey, papaya jujubes etc.)	50.52	49.48
3.	Fruits in powder form (wood apple, bael fruit, banana)	41.41	58.59
4.	Jam (orange, mulberry, guava, papaya, banana, pumpkin etc.)	62.24	37.76
5.	Chutneys (lovi-lovi, rose apple, nelli/gooseberry etc.)	50.52	49.48
6.	Fruit Bars (probe: like serial bars)	44.79	55.21
7.	Jellies made from natural fruits (Strawberry)	69.71	30.29
8.	Chocolates with fruits	67.19	32.81
9.	Gift packs (different types of jams/chutney in one pack)	51.30	48.70
10.	Cookies including fruit/vegetable flours (banana, manioc, dandeenala etc.)	76.30	23.70
11.	Sauces including fruits (mango, pineapple, pomegranate, tamarind etc.)	58.07	41.93
12.	Yoghurts with fruits (mango, strawberry, blueberry, dates etc.)	63.28	36.72
13.	Yoghurt drinks with fruits (mango, strawberry, blueberry, dates etc.)	58.85	41.15
14.	Fruit juices (soursop, tamarind, ceylon olive etc.)	70.57	29.43
15.	Vinegars (pineapple, apple)	42.97	57.03
16.	Herbal drinks/tea with fruits	67.19	32.81
17.	Minimally cut fruits/vegetable packs	26.82	73.18
18.	Minimally processed green leafy vegetables (Mallums)	20.83	79.17
19.	Dehydrated vegetables (Jack, tender jackfruit, brinjal, breadfruit, kohila etc.)	43.23	56.77
20.	Vegetable snacks (salted, spicy)	41.93	58.07
21.	Vegetable mixes (noodles, fried rice, biriyani)	36.72	63.28
22.	Dehydrated vegetables with rice packs	28.91	71.09
23.	Vegetables in powder form (carrot, pumpkin, beetroot etc.)	31.77	68.23
24.	Vegetable soups	39.16	60.84
25.	Vegetable porridge	38.80	61.20
26.	Vegetable flavoured pastas/noodles/ string hoppers	54.17	45.83
27.	Ready to serve curries: young jack fruit, tender jackfruit, yams	19.53	80.47
28.	Bites (jack & jack seeds)	73.18	26.82
29.	Flour (Cassava, sweet potato, jack seed, jackfruit etc.)	75.52	24.48
30.	Leaf powders (curry leaves, rampe, moringa etc.)	40.89	59.11

Source: Authors' compilation based on HARTI survey, 2023

Annex 06: Compilation of Innovative Products based on Recent Literature

Food Product	Fruit	Vegetable	Reference
1. Star fruit jelly	Star fruit		Product catalog 2023 (profood) Faculty of Agriculture, University of Ruhuna
2. Pumpkin pasta		Pumpkin	
3. Weralu spread	Ceylon olive		
4. Weralu cookies	Ceylon olive		
5. Weralu sauce (sweet and spices)	Ceylon olive		
6. Weralu jam	Ceylon olive		
7. Wine series	Ceylon olive Lovi starfruit	Beetroot Pumpkin	
8. Ugurassa lollipop	Ugurassa		
9. BB Nectar (Beetroot cordial)		Beet root and bowitiya flower extract	
10. Cassava biscuit		Cassava	
11. Cassava savory nuts		Cassava	
12. Vinegar	Lovi Fruit Star fruit		
13. Dandillow Marshmallow	Kirala	Dandila	Product catalog 2023 (profood) University of Wayamba
14. Jack fruit sausage		Jack fruit	
15. Pumpkin soup		Pumpkin	
16. Banana blossom Mallun		Banana blossom	
17. White wine from Carambola fruits		Carambola	APSURS 2022
18. Jackfruit and Mung Bean based instant healthy soup mix powder		Jack fruit, Mung bean	
19. Using jackfruit peel as a low-cost raw material in waffle cone production		Jack fruit	
20. Banana flour-based baby food	Banana		Gannoruwa, S.R.B.R.G.C (2008), Faculty of Graduate Studies, University of Sri Jayewardenepura, Sri Lanka
21. Dietary Fiber Enriched Cookies		*Avena sativa* (Oats), *Lasia spinosa* (Kohila), and Banana Blossom	University of Peradeniya –Faculty of Agriculture (2020 FAuRS proceedings
22. Sausage		Ash Plantain, Mushroom, Carrot, Oats and Chickpea Flour	

23. Instant Fried Rice and Suitable Seasoning Powder Mix		Drumstick Leaves (*Moringa oleifera L.)*	University of Peradeniya –Faculty of Agriculture (2021/2022 FAuRS proceedings
24. Instant Kola Kenda Mixture		Drumstick Leaves (*Moringa oleifera L*.), Curry Leaves, Gotukola (*Centella asiatica*), Mung Bean Flour and Unripe Banana Flour	
25. Development of Lavulu (*Pouteria campechiana*) Pulp Incorporated Drinking Yoghurt	Lavulu		
26. Nutritious and Marketable Cookie		Coconut Flour and Unripe Banana Flour	
27. Noodles		Raw Jackfruit Bulb Flour and Seed Flour	
28. Symbiotic Concentrated Type Yogurt	Wood Apple	Chickpea Flour	
29. Avocado Pulp Based Spread	Avocado		
30. Nutritious Biscuits		Pumpkin, Corn *(Zea mays*) and Soybean	
31. Ready-to-Drink Soymilk Beverage		Soybean	University of Sabaragamuwa – (2023- ICAPS SUSL proceedings)
32. Butter cake		Ash-Plantain, Corn Flour	
33. Pumpkin (*Cucurbita maxima. L*) Based Ready-To-Serve (RTS) Beverage	Pineapple	Pumpkin	

Source: Authors' compilation based on existing literature