The Maize Value-Chain

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FOREWORD

Maize, next to rice. That sums up the importance of the crop and indicates the long and wide policy-gaze related to it. It is an integral part of all strategies related to food security, feed security, nutritional security and enhanced income to the growers.

Given constraints, especially factors which mere domestic policy transformation has no control over, an area that requires greater attention is the maize value chain where tweaking and alleviating glitches, small and large, is necessary to enhance productivity and efficiency.

This study traces the process from farm to maize-based industries in order to obtain the social and economic factors that compromise efficiency. It points out areas which require policy-intervention and offer recommendations to improve value chain competitiveness.

It is a study limited in scope, given constraints generated by the Covid-19 pandemic, but nevertheless has covered sufficient ground to extract key issues that need to be addressed so that the sector could move towards achieving its full potential. Indeed, it is to the credit of the research team, that all the nodes in the value-chain have been inspected, so to speak, and the play of relevant social, economic and other factors noted in detail. It is an important paper which deserves perusal by all stakeholders and could spur greater and more nuanced effort by relevant state agencies.

Malinda Seneviratne
Director/Chief Executive Officer

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EXECUTIVE SUMMARY

Maize is considered to be the second most important food crop grown in Sri Lanka next to the staple, rice—in terms of extent cultivated, foreign exchange involved in imports and agro-industrial utilization. Maize has assumed importance as an input to the growing livestock feed industry, especially for the poultry sector, accounting for approximately 60 percent of raw material inputs. The consumption of maize-based food items such as locally produced ready-mix cereals (Thriposha and Samaposha), have increased during the past few years. Despite the significant increase in demand, only 60 percent of the total requirement is locally produced.

Insufficiencies related to feed production has been one of the major problems faced by the poultry industries over the last few years. The overall objective of this study, which uses both primary and secondary data, was to conduct a comprehensive value chain analysis of maize to provide recommendations for intervention with a view to improving competitiveness. Multi stage random sampling techniques were applied for primary data collection from two major producing districts, Monaragala and Anuradhapura. A total of 80 maize farmers and 20 collectors were interviewed using a structured questionnaire and key informant interviews held using semi structured questionnaires with traders, feed manufacturers and food processors and officers attached to relevant institutions. For value chain analysis UNIDO's systematic approach to agro-value chain analysis was followed.

The study revealed that the majority of maize farmers (69%) have used encroached forest lands (chena) for cultivation. More than 95 percent of the farmers have mostly used imported hybrid seeds (Jet 999, Jet 99 and Pacific varieties), considering the advantages. Maize seeds are mainly imported in July, August, September, and October targeting cultivation in the *Maha* season. The price of imported seeds varied between Rs.7,000 and 9,000 per 5kg bag whereas the price of local hybrid seeds was Rs.800.00/kg. Seed rate was 20kg/ha for local varieties whereas it was 13-17kg/ha for imported seeds in both districts. Local maize seeds are produced at government seed farms and by contract farmers island wide and recorded a production of about 112,158kg of seeds in 2020. Badra (OPV seed) was the most produced local seed in Sri Lanka. Only two hybrid varieties of maize are currently being produced.

Plant maintenance cost is the highest component in cost of production in both districts—36 percent in Anuradhapura and 29 percent in Monaragala on average. The average price received by farmers in Monaragala and Anuradhapura districts were Rs.74.00/kg and Rs.70.00/kg respectively in the 2020/21 *Maha* season. Total revenue per acre were on average recorded as Rs.128,978 and Rs.122,713 in Monaragala and Anuradhapura districts respectively. Therefore, the average gross margin or profit per acre is Rs.52,495 in Anuradhapura and Rs.68,885 in Monaragala. On average, 47 percent (Anuradhapura) and 40 percent (Monaragala) of the total variable cost is related to labour, which is to be expected given that maize is a labour-intensive crop. The majority of the maize farmers in both districts have used family and shared labour

for most of the crop production activities—71 percent in Anuradhapura and 76 percent in Monaragala district.

It was revealed that farmers sold their produce to the collecting centres of traders (46%) and to village level collectors (33%) who operate on behalf of traders or who work as independent collectors and perform as wholesalers to sell maize to outside buyers. Farmers were satisfied (83%) with the price they received during the 2020/21 *Maha* season when the prices were much higher compared to the previous season, which was also higher than the minimum support price announced by the government following import restriction imposed to create a greater demand for local maize. Crop damage caused by pest attacks (fall-army-worm), unavailability of chemical fertilizers and agrochemicals to commence new cultivation in the 2021/22 *Maha* season, high fluctuation of producer price within the season due to high demand for grains due to the ban on imports, damage caused by wild animals, lack of lands and ownership issues due to the Forest Department acquiring state lands formerly used by farmers lands, the high price of imported seeds and high input costs were the main problems faced by farmers.

A market survey was conducted to analyze the marketing margins for the 2020/21 *Maha* season and this data was compared with that of the 2019/20 Maha season. Farmers' gross margin was recorded as 34 to 41 percent and this was greater than what they received in the 2019/20 *Maha* season (20-21%). Farmer's share was the highest among the value chain actors. This increased share of rewards by farmers will be an incentive to expand the cultivation of maize. Collectors' selling price was recorded as Rs.74.00-78.00/kg. Hence, the gross margin for collectors was recorded as 4-4.5 percent and it has decreased compared to the net margin, they obtained in the 2019/20 *Maha* season (5-8%). Traders sold maize at Rs.88.00-98.00/kg for feed/food manufacturers in the 2020-2021 period. Therefore, a traders' gross margin was recorded as 16-20 percent, which was greater than the margin observed in the 2019-2020 period (13-15%). Hence, in the value addition of maize, the highest margin was retained by the farmers.

Maize has a lot of long-term potential in the feed and food industry. There are several opportunities in all its sub sectors such as seed, farm mechanization, processed food, animal feed and storage. It has enormous potential to be a key component in the provision of food, feed and nutritional security while enhancing the incomes of cultivators and therefore it is advisable to design strategies to catalyze greater productivity and efficiency in the value chain. As maize production is profitable it has a great potential for expansion as a cash crop in both the *Maha* and *Yala* seasons. It is important to increase the extent of cultivation in the *Yala* season and improve productivity in the *Maha* season with the following interventions in production and marketing at farmers' level: improving the access to quality farm inputs (hybrid seeds, fertilizers), facilitating credit access to farmers and encouraging more contract farming. It is important to encourage and promote smallholder out-grower models which have had success in other countries. It is also important to invest more on local

maize breeding and agronomic research. Another area that needs attention is the exploration and facilitation of land consolidation especially areas left fallow.

Sri Lanka imports maize-based products such as corn flakes, corn flour and corn starch. The utilization of maize for food processing is at a low level compared to the feed sector. Given the demand in Sri Lanka for value-added products, stepping into value-addition has great potential. Hence, there is a need to encourage farmers to grow better quality corn. The relevant industries need to work with farmers adopting Foreword Sale Contracts as direct farmer linkages with companies can help develop better procurement arrangements to ensure quality in food processing.

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LIST OF ABBREVIATIONS

ASC	Agrarian Service Centers
BP	Buying Price
CIF	Cost, Insurance and Freight
COP	Cost of Production
DAPH	Department of Animal Production and Health
DCS	Department of Census and Statistics
FAO	Food and Agriculture Organization
FSC	Forward Sales Contracts
GM	Gross Margins
HARTI	Hector Kobbekaduwa Agrarian Research and Training Institute
KII	key informant interviews
OPV	Open Pollinated Varieties
SLCARP	Sri Lanka Council for Agriculture Research Policy
SP	Selling Price
SPMC	Seed and Plant Material Centre
TR	Total Revenue
TVC	Total Variable Cost
UNIDO	United Nations Industrial Development Organization
VC	Value Chain
VCA	Value Chain Analysis
WFP	World Food Programme

CHAPTER ONE

Introduction

1.1 Background Information

Maize or Corn (*Zea mays* L.) is the most important cereal in the world after wheat and rice. It possesses high nutritive value and is important as a coarse grain. Further, maize is an easily grown crop, and its cultivation has been popular among farmers as a cost-effective crop with limited fertilizer use. Maize is considered to be the second most important food crop grown in Sri Lanka next to the staple diet of rice. It is widely used in both food and feed industries. Among the major annual upland crops grown by small-scale farmers, maize has received increased attention in recent years due to increased local demand with the expansion of the animal feed industry. It has become the most important feed grain due to its efficient conversion of dry substances to meat, milk and egg compared to other grains. It is grown in the Dry and Intermediate Zones mainly as rainfed cultivation during the *Maha* season. Maize is very successfully cultivated in the districts of Moneragala (40%) and Anuradhapura (26%), considering the average production recorded during last five-year period (2016-2020) (Annex Table 2). In addition, maize is cultivated in such districts as Badulla, Ampara and Kurunegala (DCS, 2020).

During last ten-year period, maize production in the country has increased, and yielded compelling success with the adoption of hybrid seeds that have significantly increased smallholder maize production (FAOSTAT, 2020). Total maize production in 2020 was about 313,520 mt, cultivated on 78,249 ha with an average yield of 3.8 t/ha (DCS, 2020). In the 2020/21 *Maha* season, about 113,077 ha were cultivated, and a reported 15,181 ha were damaged due to the fall armyworm attack, as well as drought and floods (DOA, Crop forecast 2020/21 *Maha*). The total maize output is estimated to be 432,127 mt. However, the country's requirement is estimated as 550,000 mt annually, to completely satisfy the poultry demand for maize, nationally (DAPH, 2020). Therefore, the balance requirement of 236,478 mt of maize has to be imported to fulfil the needs of the poultry sector, even if all locally produced maize is used for poultry feed production (DAPH, 2020). Only 60 percent of the total requirement is locally produced. The rest is met by imports, recorded as 103,537 mt in 2019, at a value of Rs. 5,237 million. The USA, China, and Brazil supply 64 percent of the world's maize demand. Maize-based products such as cornflakes, corn oil, and corn starch are popular in urban areas and most of these products are imported to Sri Lanka. Maize as an ingredient for the feed industry was mainly imported from Romania, India, Ukraine and Pakistan during the last 2 years (Dept. of Customs, 2019). However, in 2020, the government has taken a decision to stop imports of maize, and after that there were no imports of maize.

Maize and soya beans are the raw materials used in the largest quantities for the production of Thriposha, amounting to 66 percent and 30 percent respectively. The number of Thriposha beneficiaries living countrywide including pregnant mothers, breast-feeding mothers and infants amount to approximately a million and

accordingly, the monthly requirement of Thriposha finished food is approximately 1,500 mt. This equals to an annual requirement of 18,000 metric tons. The approximate annual requirement of maize to meet this demand is 15,000 mt. Plenty Food Ltd (Samaposha) prepares different types of cereal products using maize as an essential ingredient, such as breakfast cereals, energy cereals, Nutriline cereals, and cereal bars. Samaposha is made of corn, rice, soya and green gram, and contains Vitamins A, B, E, minerals and thiamine that provide much needed, balanced nutrition to the nation's children, helping to make them healthier in mind and body. The farmer is assured of a guaranteed minimum price based on prevailing market rates, while the company is assured of receiving high-quality produce for the manufacture of Samaposha.

The Ministry of Agriculture has taken steps to ensure a guaranteed price for maize in order to boost the local production of the cereal grain. Accordingly, the Ministry has set a certified price of 52 rupees for a kilogram of maize. In addition, the government will bear 50 percent of the cost that maize farmers spend for the seeds. The Agrarian Insurance Board of Sri Lanka provides crop damage insurance free for maize farmers. In case of cultivation damage, Rs. 40,000 per acre or Rs. 100,000 per hectare is paid as claim benefits. Further, a compulsory insurance scheme for paddy, soya, potato, maize, big onion and chillies was implemented according to the 2018 budget proposals. The government allocated Rs. 250 million as compensation for farms affected by the fall armyworm, and Rs. 40,000 per acre was paid to affected farms.

1.2 Statement of the Problem

Maize has assumed importance as an input to the growing livestock-feed industry, especially for the poultry sector. Maize accounts for approximately 60 per cent of raw material inputs for the poultry-feed sector. Current corn prices are on the rise, and have increased from Rs.52/- to Rs.70/-. Since the local production of maize ends in May, traders tend to hike up prices on local stocks to capitalize on high demand. Also, the prices of imported maize are high due to an increasing trend for prices in the global market, coupled with the tax imposed on maize imports. As maize is one of the main ingredients in poultry feed, feed cost has also shown an increasing trend over the years (DAPH, 2020).

With Sri Lanka spending approximately US$50 million annually to import maize, the country's import of maize is a huge drain on Sri Lanka's foreign exchange. The required maize is imported by third parties on licenses issued by the government, which could also lead to corruption and favouritism.

For the year 2021, a minimum of 550,000 mt of maize was required for poultry feed. Therefore, the balance requirement of 236,478 mt of maize had to be imported to fulfil the needs of the poultry sector, even if all of the locally produced maize was to be used for poultry feed production. The demand of maize for animal feed production is in rise with the growth of the poultry sector as well as with the latest development of dairy industry—especially the mega farms with imported cattle. Though a special commodity levy of Rs. 10.00 is imposed on maize to discourage importation, the

country is still failing to produce the required quantity locally. Therefore, encouragement of maize cultivation and introducing of technology to increase production efficiency is essential to assure the sustainability of poultry production.

In addition to its utilization as an ingredient for poultry feed, the consumption of maize-based food items like locally produced ready-mix cereals (Thriposha and Samaposha), popcorns and boiled maize cobs have increased during the past few years. As a result, the local demand for maize has significantly increased during the past few years.

The maize sector in Sri Lanka offers several investment opportunities to ensure food security, feed security, nutritional security, and enhanced income to maize growers in the country. Therefore, the question still remains as to why necessary steps are not taken to encourage the local maize industry and introduce new methods to enhance productivity, which in turn could serve to boost both the local maize industry as well as the poultry industry.

1.3 Significance of the Study

The government's new policy document, "Vistas of Prosperity and Splendour", emphasizes the importance of increasing domestic animal feed production, to save millions of dollars of foreign exchange presently used to import such items into the country. Further, it has emphasized the development of systems to promote the cultivation and production of dried chillies, maize, soya, green grams and cowpea, onions and potatoes in the country by enabling the substitution of their imports with domestic production, to achieve a foreign exchange saving of about USD 500 million.

Analysis of the value chains of principle crops, and identify the potential development areas is one of the research priorities on "National Research Priorities on Socio-economics and Policy Analysis, 2017-2021" (SLCARP, 2017). The development of agricultural value chain (VC) is one of the priority investment areas of the Agriculture Modernization Project.

Government and donor agencies increasingly use a VC approach as part of their development and poverty reduction strategies and interventions. Developing VCs is widely considered to be a suitable approach to inducing growth in rural areas, increasing marketed food surpluses, and enhancing rural livelihoods.

1.4 Research Objectives

1.4.1 Overall Objective

The overall objective of this study is to conduct a comprehensive value-chain analysis of maize to provide recommendations to be implemented by the stakeholders to improve maize value-chain competitiveness.

1.4.2 Research Specific Objectives

1. To examine existing practices adopted by different actors in the supply chain for the production and marketing of maize
2. To analyse economic performance (cost of production, margins, cost and returns) of different actors along the supply chain
3. To identify key policy initiatives needed to upgrade and enhance the efficiency of the maize value chain in the country

1.5 Limitations of the Study

It was initially designed to conduct a detailed value chain analysis of maize by collecting primary data from all the value chain actors from farm-to-industry through a questionnaire survey, in depth interviews and key informant discussions. Accordingly, set of attributes and variables were designed to obtain comprehensive information. However, due to travel restrictions and time to time lockdown situations in the country with prevailed COVID-19 pandemic, the study could not covered the anticipated field survey to do a comprehensive questionnaire survey for each actors in the value chain. We had to reduce the sample size of farmers and interviews were conducted over the telephone. Though the study was planned to interview an adequate sample of collectors, traders and feed/food manufacturers, due to constraints faced with field survey we were able to gather data and information from only few such players. It was unable to collect other in-depth data as expected specially information needed for economic analysis as planned. This was the major limitation of the study which has been affected to quality and output and achieve originally designed objectives of the study. Hence, this study has covered mainly the production and marketing aspects of maize at farmers' level.

CHAPTER TWO

Literature Review

2.1 Introduction

The purpose of this chapter is to review previous studies, which are related with the present study. Research studies on maize value chain in Sri Lanka have been limited. This chapter reviews related literature organized according to the study objectives. The review is based on the concept of the value-chain approach and analysis of maize value chain. The review is presented and discussed below.

2.2 Theoretical Framework

2.2.1 Basic Concepts and Definitions of Value Chain

The agricultural value-chain concept has been used since the beginning of the millennium, primarily by those working in agricultural development in under developing countries. The term value chain was first popularized by Michael Porter in 1985, who used it to illustrate how companies could achieve what he called "competitive advantage" by adding value within their organization. Subsequently the term was adopted for agricultural development purposes, and has now become very much in vogue among those working in this field. Value chain development has become a key approach in both research and policy fields, with an increasing number of bilateral and multilateral aid organizations using it to guide their development interventions.

Kaplinsky and Morris, (2001) defined the food value chain as the full range of farms and firms and their successive coordinated value-adding activities that produce particular raw agricultural materials and transform them into particular food products that are sold to final consumers and disposed of after use. It helps to identify challenges faced along different segments of the value chain and the opportunities to help meet the challenges and enhance the value chain's upgrading and development.

The United Nations Industrial Development Organization (UNIDO) in 2009 describes a value chain as the entire range of activities that are undertaken to bring a product from the initial input-supply stage, through the various phases of handling, processing, storage, packing to its final market destination, including its disposal after use. As products move successively through the various stages, transactions take place between multiple chain stakeholders, money changes hands, information is exchanged and value is progressively added. Hence, a value chain is a system of interdependent activities.

In the context of food production, the activities of a value chain include farm production, trade and support to get food commodities to the end consumer (e.g. transport, processing). The value chain analysis (VCA) extends traditional supply chain analysis by identifying values at each stage of the chain. It is called a value chain

because at each stage of the supply chain, value is being added to the product or service as it is being transformed (WFP, 2010).

Agricultural value chains link urban consumption with rural production. Value chain analysis has gained considerable importance in recent years because of the need to assess the key sources of cost efficiency or the lack of it along the value-chain of the commodity in order to come up with appropriate policy interventions aimed at raising overall value-chain efficiency (Mango, et al., 2018).

Value chains generally include three or more of the following: producers, processors, distributors, brokers, wholesalers, retailers and consumers. Value chain actors are those who are directly involved in handling the VC flow of goods. They work together to identify objectives, are willing to share risks and benefits, and invest time, energy and resources to make the relationship work. The value chain concept is therefore regarded as an actor-oriented approach and is considered very effective in tracing product flows, showing the value-adding stages, identifying key actors and the relationships with other actors in the chain (Schmitz, 2005).

2.3 Methodological Framework

2.3.1 Value Chain Analysis (VCA)

Value chain analysis is a method of accounting and presenting the value created in a product or service as it is transformed from raw inputs to a final product consumed by end users. Value addition includes simple tasks such as bulking, cleaning, grading, bagging/packaging, and transporting to demand centres, processing, and marketing that improve the product and attract consumers. Therefore, VCA aims to assess both goods and services along the chain, and the relative strengths and weaknesses in the links among various actors involved in the chain.

Value chain analysis is a useful analytical tool that helps understand overall trends in industrial reorganization, and identify change agents and leverage points for policy and technical interventions. It breaks the value chain into its constituent parts in order to better understand its structure and functioning. It identifies chain actors at each stage, their functions and relationships; identifies value-adding activities in the chain, and assigns costs and added value to each of those activities. It identifies the flow of goods, information and finance through the various stages of the chain. It evaluates each stage in order to detect problems or identify opportunities to improve the contribution of specific actors and the overall performance of the chain.

Value chain analysis normally shows the build-up of costs along a specific commodity chain. This can be complemented with an identification of the business service providers, and what are considered to be the main determining factors in the external policy environment. Such analysis is well suited to understanding how people in rural areas can engage, or improve their terms of engagement with trade. In general, an in-depth value-chain analysis considers the following:

- What are the economic costs along the value chain?
- Where is the most value added to the value chain?
- Who are the most important actors within the value chain?
- What is the institutional framework of the value chain?
- Where are the bottlenecks in the value chain?
- Where is there market potential for growth?
- What is the size of the sector/ chain?
- What is the potential for upgrading?
- What are the strength, weakness, opportunities and threats in each chain operators?

A VCA also helps understand the business relationships among different chain stakeholders, price formation, determination of margins, and trends in prices. The analysis of the role of the actors in the supply chain, i.e. inter alia, their access to markets and their purchasing and bargaining power, as well as the determination of their profit margins to help the analyst understand the constraints and bottlenecks to incomes they could potentially be earning from their main livelihood activity. This will in turn help to identify the need for specific interventions.

Staple-food VCA can help improve the understanding of the:

- Socio-economic and livelihoods situation of target groups;
- Production situations of target areas, and;
- Market functioning and market relationships among different chain stakeholders, including price formation, margins, trends in prices etc.

2.3.2 Value Chain Mapping

A value chain can be analyzed through mapping the chain which describes the full set of activities required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation, and the input of various producer services), and delivery to final consumers (Kaplinsky and Morris, 2001).

During value-chain analysis, value chain mapping is accomplished whereby the key value chain actors or players are identified to make clear who and how many are doing which activities, where the given activities are being done in the value chain, what the market channels are, and how the product is reaching the markets (Mitchell, et al., 2009; cited in Kamau and Nyongesa, 2017).

An actor's networking value-chain theory suggests that the value chain map should be simple, easy and clear. But the real world can be much more complex than any map because of the involvement of different actors and channels. In order to simply understand the ground situation, the map should basically describe the flow of inputs, product and information among the actors. The analysis should also recommend how to strengthen the relationship among actors (Kaplinksy and Moris, 2001). The value chain map of maize also has many channels and different integrations among the actors, either vertical or horizontal.

2.4 Review of Empirical Studies

In the Sri Lankan scenario, most studies regarding maize have focused on productivity, and controlling biotic and abiotic stresses. Only few researches have been done regarding the marketing of maize. A study of the maize contract farming system has highlighted that those farmers who have fully adopted the contract farming system have grown rich with property, experience and family assistance. Furthermore, they have earned much money by getting higher yields than non-contract farmers. A well-organized value chain, integrating producers, consumers and assured markets, are key factors for the success of the system. They also recommend the establishment of a crop insurance system and a responsible body to regulate the process (Champika and Abeywickrama, 2014).

Esham (2014) empirically analyzes the technical efficiency of smallholder maize farmers in Sri Lanka using a stochastic frontier production methodology. The study revealed that seeds, hired labour and land extent were found to positively influence maize production. The mean technical efficiency was 72%, implying that there was considerable room for improvement in maize productivity within the present state of technology. Access to hybrid maize seeds, the age of farm household head, and ownership of irrigated lowland were found to be significant factors determining production efficiency at the farm level.

Abajobir (2019) in their analysis of the maize value chain used the double hurdle model to identify factors affecting maize market participation, and the level of participation. Their results revealed that the market participation of maize was affected by extension contacts, access to market information, membership in cooperatives, yield, education and market price. The major constraints identified at market and production level were the absence of improved seeds, high costs and the late arrival of seeds, the late arrival and high costs of fertilizer, absence of information on how to use credit, insects and pest disease, shortage of land, poor linkage of actors, quality problems, lack of transportation facilities, lack of information, lack of storage, fluctuation of price, and low cost of maize were some of the constraints farmers faced in the study area.

Mango, et al., (2018), in maize value chain analysis with smallholder farmers shows they face relatively higher trader margins and intermediation costs along the value chains as a result of high transaction risks associated with agricultural input trading. Productivity is the most important factor in improving agricultural competitiveness as a basis for improving farmer returns. Among other interventions, the promotion of proven technological and institutional innovations that provide an incentive for private and public-sector investments in agricultural research and development is critical and primary to unlocking smallholder potential.

Shah, et al., (2016) in a maize value-chain analysis in Ethiopia indicates the need for strengthening business linkages at all levels of the chain to meet the seasonal fluctuation of demand for maize, as well as the inadequate infrastructure and storage

costs, which could ensure enhanced capacity of value chain actors and facilitate functional and integrated maize value chains to boost trade in maize.

Krishnamurthy and Kumar (2015) in a value chain analysis of maize in India reveals that a producer's adoption of high-yield hybrid seeds, application of improved farm technologies, and value-added products, enhanced income and food security. Maize has potential for product diversification under a new economic regime. Demand for maize is shifting from food to feed for livestock and poultry. New types of maize-based products are in demand among people in the higher income group. Maize-production marketing linkages are extremely weak and need to be strengthened. There is a need to develop mechanisms for strengthening the maize production – processing - marketing system.

Kaminski, et al., (2013), conducted a study to examine the key obstacles facing maize value-chain development and reviewed the incentives required to transform maize from a predominantly self-consumed crop into a cash commodity. Serving the needs of several growing market outlets (processed food, animal feed, breweries) in West Africa. The study found that the maize sector continues to be hampered by multiple market and institutional failures. On the marketing side, maize value-chain actors confront large seasonal price variability, and variation in supply and quality. Institutional obstacles include the lack of an effective legal system and weak commercial and market transactions, all of which limit the growth potential for the agro-processing sector.

Kirimi, et al., (2011) explained that land shrinkage, a decline of maize's share in gross farm revenue, differentiation of market concentration within smallholders, and marketing training, are major factors affecting value chain of Kenya at farm level while, government policies, raising of market margins by large-scale millers and retailers, varying accessibility of farmers to potential markets, investments in private sector, limited transportation and the performance of the assembly sector mainly affected at the middle level in value chain.

CHAPTER THREE

Methodology

3.1 Introduction

This chapter discusses the study site, target population, research design and data collection methods used in the study. It also describes how the study sample was obtained, and highlights how data was collected, analysed and presented. The research designs employed defined the research questions, variables, and the data collection methods that helped obtain information relevant to the research problem.

3.2 Conceptual Framework

Originally defined by Porter in 1985, VCA has emerged as a powerful analytical tool in development policy making and it has been widely adopted by researchers, industry and development practitioners to understand different production systems (Kaplinsky and Morris 2001). Simply, a value chain (VC) describes the full range of activities that are required to bring a product from the producer to the final consumer by going through the different phases of value addition and processing. It provides a more holistic picture of the socio-economic environment in which the VC stakeholders operate in, describes the structure of the market, traces the distribution of benefits along the chain, diagnoses the opportunities, constraints and competitive advantage of a firm/industry, and allows for the formulation of more integrated solutions.

The conceptual framework of the maize value chain is depicted in Figure 3.1 and it illustrates the stages, actors, supporters and enablers of the maize value chain, which are involved in acquiring the farm inputs required for maize production, transporting maize produce from the farm to various market destinations, processing, and maize trading to reach consumers. It is a network of horizontal and vertically integrated value chain actors that are jointly aimed towards providing products to a market.

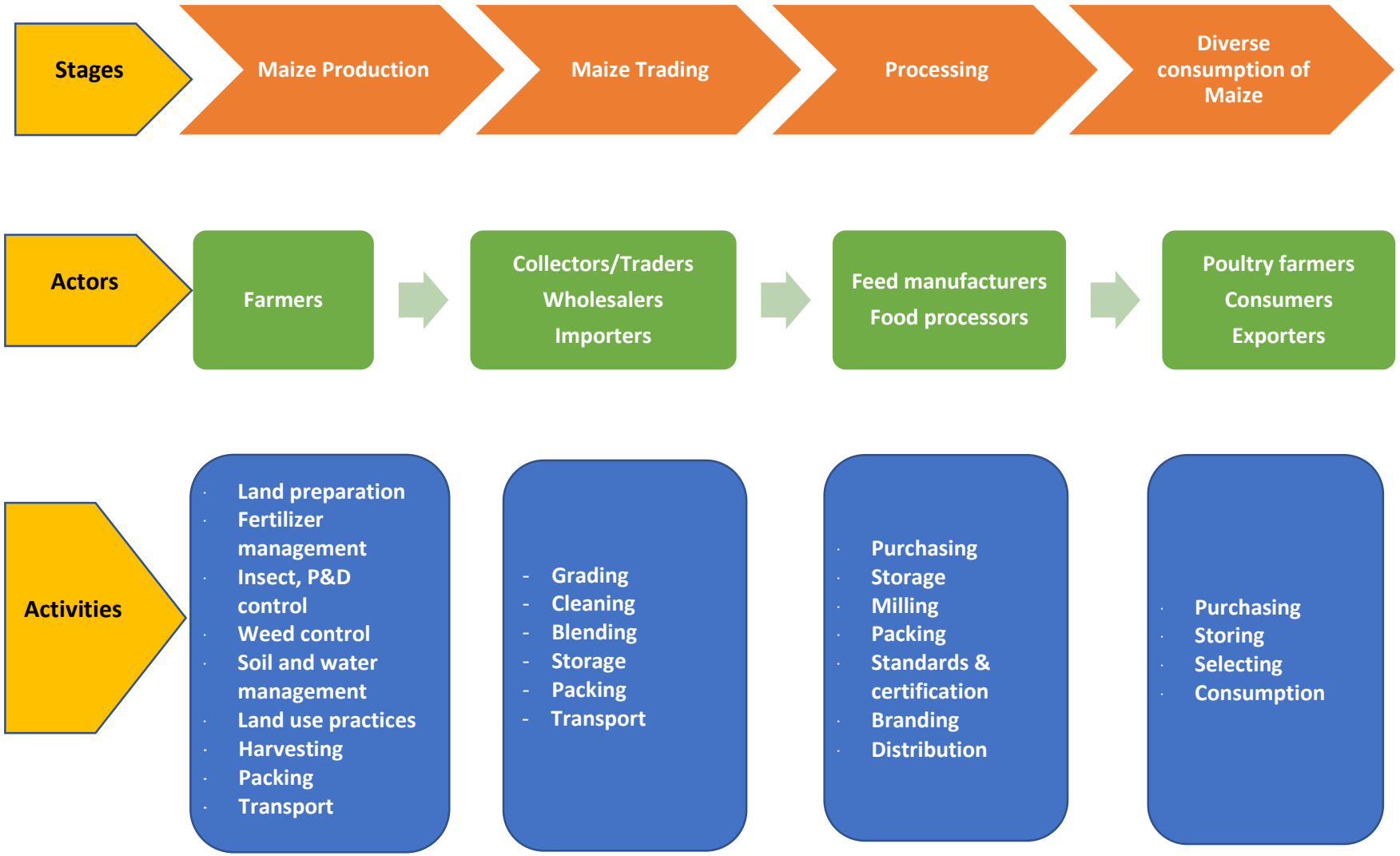


Figure 3.1: Conceptual Framework of Maize Value Chain

3.3 Study Location

According to district-wise average production data of maize from 2016-2020 in the country, the highest average production was reported in Anuradhapura and Moneragala districts (Annex Table 2). Most of the feed manufacturers are located in Kurunegala and Puttalam districts, and the food processors are located in Colombo and Gampaha districts. Hence, Anuradhapura, Moneragala, Kurunegala, Puttalam, Colombo and Gampaha districts will be selected for the field survey.

3.4 Data Collection and Sampling

3.4.1 Sample

Table 3.1 depicts the major Agrarian Service Centers (ASC) in Anuradhapura and Monaragala districts. According to the cultivated extent and production recorded in 2020/21 *Maha* season in those districts, Horowpathana, Kahatagasdigiliya and Elayapattuwa were selected from Anuradhapura district, while Siyabalanduwa, Ethimale and Dambagalle were selected from Monaragala district.

Table 3.1: Cultivated Extent and Number of Farmers in Anuradhapura and Monaragala Districts (2020/21 *Maha* season)

District	ASC Area	Cultivated Extent (ha)	Production (mt)	Number of Farmers
Anuradhapura	Horowpathana	4,291	26,822	3,750
	Kahatagasdigiliya	3,500	10,500	1,500
	Elayapattuwa	1,950	6,093	1,250
Monaragala	Siyabalanduwa	7,292	34,645	4,753
	Ethimale	6,878	34,390	4,465
	Dambagalla	4,448	17,792	2,000

Source: District Office Agriculture, 2021

The sample for this study was drawn from all the actors involved along the maize value chain as given in Table 3.2. Multi stage random sampling techniques was applied in choosing farmers for primary data collection. At the first stage, the two major producing districts of Monaragala and Anuradhapura districts were selected based on the highest average extent and production recorded during the last 5 years (2016-2020). From each district, the main ASC areas with the highest extent cultivated during the 2020/21 *Maha* season were selected. In the third stage, farmers were selected randomly for interviews from each agrarian service center. Thus, 80 maize farmers were proportionately selected according to the total number of maize farmers recorded in the 2020/21 *Maha* season in selected ASC areas.

According to the list of registered poultry feed manufacturers by the Department of Animal Production and Health, there were 41 such manufacturers in 2020. There are 5 leading food processors of maize, and 3 of them were interviewed. These feed

manufacturers and food processors have links with direct buyers and large-scale suppliers. Therefore, 2 such leading maize traders were interviewed.

Table 3.2: Sampling Frame

Actors	Categories	District	AI Division	Total No. of Farmers (2020/21 Maha)	Sample
Farmers	Independent farmers	Anuradhapura	Horowpathana	3,750	20
			Kahatagasdigiliya	1,500	10
	Out-grower farmers		Elayapattuwa	1,250	10
	Contract farmers	Monaragala	Ethimale	4,753	15
			Siyabalanduwa	4,465	15
			Dambagalle	2,000	10
					80
Collectors		Anuradhapura			10
		Monaragala			10
					20
Traders		Anuradhapura Monaragala		10	2
Feed manufacturers (Poultry)		Kurunegala Gampaha Colombo		41*	5
Food processors		Colombo Gampaha		5	2

*Registered Animal Feed Manufacturers under the provisions of Animal Feed Act No. 15 of 1986 for 2020 (DAPH)

Source: Department of Animal Production and Health, 2021
District Office of Agriculture, 2021

3.4.2 Data Collection

In this study, both primary and secondary data were collected. The study utilized a mix of quantitative and qualitative methods for data collection.

Primary Data

Primary data was collected through a mix of data collection methods: 1) questionnaire survey, 2) key informant interviews (KIIs). These methods allowed for more in-depth exploration of value chains and yielded information that facilitated deeper understanding of the constraints and opportunities in their respective value chains.

1. Key informant interviews were carried out using semi-structured questionnaires for traders, feed manufacturers and food processors.
2. Key informant interviews were conducted with the officers attached to following institutions:
    - Field Crop Research and Development Institute

- Seed and Planting Material Division
- Department of Animal Production and Health
- Department of Agriculture

3. A structured questionnaire survey was conducted for farmers.
4. Field observations
5. Market assessment

Secondary Data

Secondary data collection included a compilation of documents with relevance to the focus of the study through a desk review as well as data and information collected from the Department of Census and Statistics, Department of Agriculture, Department of Customs, Central Bank published and unpublished reports and websites. Sources of information included: journals, articles, reports, documents nationally published data sources, etc. Desk review was undertaken prior to the field work / primary data collection.

3.4.3 Research Instruments Used

Various research instruments were used to collect data for the study, and these included questionnaires for individual respondents, observation and key informants guides.

Key Informants Interview Guide

A semi-structured interview guide containing open-ended and structured questions was used to collect information from the key informants. The questions in the Key Informant interview guide aimed at verifying most of the research questions based on the objectives of the study.

Questionnaires

Questionnaires are effective for collecting information from a large sample from diverse regions. The questionnaires used in the study contained both open-ended and closed questions, and aimed to collect information from the sampled individual respondents from various maize value-chain players.

3.5 Data Analysis

Content analysis was used for analyzing the qualitative data collected, and this included labelling / coding all of the information so that similarities and differences can be recognized for the purpose of summarization. Here the aim was to make sense of the data collected and to highlight the important messages, features or findings. A quantitative analysis of the survey data collected was done using an Excel software package.

The data was collected from different categories of market participants and from different marketing functionaries. Descriptive statistics such as frequency, mean, percentage and standard deviation, were used to summarize the data and present a tabular form of market actors. For identifying the existing supply chain, a descriptive analysis was done, and for a value chain analysis, UNIDO's systematic approach to an agro-value chain analysis was followed.

Analyzing the value chain economic performance: This analysis entails measuring economic factors (marketing cost, margins, added value etc). The purpose of the economic analysis of a value chain at market prices aims to appraise revenues, costs and margins (value added and net benefits) of each activity, each agent, segments of the value chain, and the whole value chain, on the basis of prices actually paid and received by economic agents.

3.6 Statistical Tools and Techniques

Quantitative analysis such as gross margins, market margins and value addition percentage were calculated to identify the inefficiencies of each VC actor.

3.6.1 Marketing Margin of Actors

a) Absolute margin of the i^{th} actor (A_{mi}) [1]

$$A_{mi} = P_{Ri} - (P_{Pi} + C_{mi})$$

b) Percentage margin of the i^{th} actor (P_{mi}) [2]

$$P_{mi} = \frac{P_{Ri} - (P_{Pi} + C_{mi})}{P_{Ri}} \quad X\ 100$$

Where,

P_{Ri} = Total Value of receipt per unit table (sale price)

P_{Pi} = Purchase value of goods per unit (purchase price)

C_{mi} = Cost incurred on marketing per unit

3.6.2 Total Cost of Marketing

$$C = CF + C_{mi} + C_{m2} + C_{m3} + ... + C_{mn} \quad [3]$$

Where:

C = Total cost of marketing of the commodity

CF = Cost paid by the producer from the time the produce leaves the farm to when they sell it

C_{mi} = Cost incurred by the i^{th} actor in the process of buying and selling the product

Total marketing includes the costs involved in moving the product from the point of production to the point of consumption. i.e., the cost of performing various marketing functions, and the profits of various market functionaries involved in moving the produce from the point of production until it reaches the ultimate consumer.

CHAPTER FOUR

Overview of the Maize Sector

4.1 Introduction

Maize or Corn (*Zea mays* L.) is the most important cereal in the world, after wheat and rice. It belongs to the family *Poaceae*, which originated in South-Central Mexico and later introduced into other parts of America. Due to its ability to grown under different environmental conditions, maize was popularized all over the world mainly in tropics and subtropics areas and it has become one of the major grains produced in the world. Maize is a staple food for a large proportion of the population around the world, mainly in African countries. The United States produces more than 40 percent of the total world production (Ranum, et al., 2014).

Maize is considered to be the second-most important food crop grown in Sri Lanka, next to the staple diet of rice in terms of extent cultivated, the foreign exchange involved in imports, and agro-industrial utilization (Anon, 2017). It is cultivated in many districts in Sri Lanka, mainly under rain-fed conditions. It is considered primarily a dry-zone crop, and is one of the main crops cultivated in the highlands. It is cultivated as a pure as well as a mixed crop in both settled highlands and in the shifting type of agriculture practised in highlands, called *chena* (swidden). The main production season of this crop is the *Maha* season, and about 85 percent of annual production is produced during that season, which is rain fed. The *Yala* season cultivation is mainly done on paddy lands, where there is good drainage, so additional irrigation can be done.

Maize possesses high nutritive value and is important as a coarse grain. Further, maize is an easily grown crop, and its cultivation has been popular among farmers as a cost-effective crop with less pest and disease damage compared to other crops, less cost of basic inputs, more efficient use of family labour for cultivation, better adaptation to meet family food needs, lower production cost, fixed price and sales. Due to many reasons such as convenience, maize has become a very useful crop for the livelihood of the rural people in this country, and suits their lifestyle.

4.1.1 Global Scenario

Maize is widely cultivated all over the world as a major cereal. In 2019, total world production of maize was 1,148 million metric tons, produced together by 170 countries across an area of 193.7 million ha with an average productivity of 5.75 t/ha (FAOSTAT, 2020). Asia produces 32 percent of total world production. Table 4.1 shows the major producing countries in the world.

The global consumption pattern of maize is: feed – 61%, food – 17% and industry – 22%. It has attained a position of an industrial crop globally as 83% of its production in the world used in feed, starch and bio fuel industries. Further, maize is utilized directly or indirectly to produce more than 3,000 products through value addition.

Table 4.1: Global Maize Production by Countries – 2019

Country	Production (Mn. Mt)
United States of America	313.56
China, mainland	179.69
Brazil	58.52
Argentina	24.64
Mexico	22.39
India	19.47
Indonesia	16.70
Ukraine	15.65
France	14.81
Canada	11.09

Source: FAOSTAT, 2020

4.1.2 Importance of the Crop

Maize is widely used in both food and feed industries. Among the major annual upland crops grown by small-scale farmers, maize has received increased attention in recent years due to increased local demand with the expansion of animal feed industry. It has become the most important feed grain because of its efficient conversion of dry substance to meat, milk and egg compared to the other grains.

Depending on the variety, maize may contain a number of important B vitamins, folic acid, Vitamin C, and provitamin A (i.e., precursor to vitamin A). Maize is also rich in Phosphorus, Magnesium, Manganese, Zinc, Copper, Iron and Selenium, and has small amounts of Potassium and Calcium. Maize is a good source of dietary fibre and protein, while being very low in fat and sodium (salt).

Maize is the highest energy source in human consumption. It contains 342 calories per 100 grams. Eating one cup of boiled corn provides about $1/5^{th}$of a person's daily gross fibre requirement and provides $1/10^{th}$of their daily energy requirement. Maize contains important minerals, mainly Phosphorus, as well as Magnesium, Manganese, Zinc, Iron and Copper, and traces of selenium. Corn is a vitamin-rich food. Thiamin and Niacin are the main B-group vitamins found.

Different types of maize may vary in their nutritional content. Sweet corn types have more sugar, while darker yellow varieties may have more Vitamin A.

Table 4.2: Nutritive Value of Maize (per 100g of edible portion of maize)

Type of Nutrient	Composition
Carbohydrates	71.88g
Protein	8.84g
Fat	4.57g
Fibre	2.15g
Ash	2.33g
Moisture	10.23g
Phosphorus	348mg
Sodium	15.9mg
Sulphur	114mg
Riboflavin	0.1mg
Amino acids	1.78mg
Minerals	1.5g
Calcium	10mg
Iron	2.3mg
Potassium	286mg
Thiamine	0.42mg
Vitamin C	0.12mg
Magnesium	139mg
Copper	0.15mg

Source: Shah, et al., (2016)

4.1.3 Agro-ecological Requirement

Maize can be grown successfully in any part of Sri Lanka under different environmental conditions. If maize is produced for grain use, it is best suited for dry intermediate zones as dry weather is required at harvest time. But any area can be used for cultivation when used in the form of raw harvested maize or sweet corn.

In the *Maha* season the maize crop can be grown as a rain-fed crop, with supplementary irrigation when required. By establishing the crops with the onset of the rainy season, the crops can be harvested before depletion of soil moisture. The maize crop is established with the onset of the *Maha* rains that occur at the end of September or first week of October, for successful growth. The crop can then be harvested in late January or early February when there are good dry conditions. In the *Yala* season it should be established at the end of April for optimum growth.

Climate and Soil Requirement

Soils of the major proportion of the highlands of the dry zone where maize is grown are reddish-brown earths. Deep loamy soils, not highly acidic or alkaline, but rich in organic matter, are more suitable for maize cultivation and for satisfactory growth. Well-drained soils with adequate moisture supply are required for uninterrupted

growth of this crop. Its pH value should be between 5.8 and 8. This crop grows well in reddish-brown soils found in the dry and intermediate regions of Sri Lanka. However, soil drainage should be improved when cultivating in paddy lands and non-fertile brown soils. The corn plant does not grow well under water dependent conditions in the soil. Therefore, if maize is grown, it is important to pay close attention to soil drainage. It is a common occurrence on the lower slopes of the highlands in the dry zone during the heavy rains of the high season. The growth of the maize grown in those parts, then stops. Therefore, when cultivating maize, the land should be well prepared and drainage systems should be adequately prepared. This problem can be largely avoided by cultivating maize using alleys and ridges after basic landscaping.

The total water requirement of a 115-day maize crop during the dry season at MahaIlluppallama was found to be 615 mm. Maize yields decreased significantly when irrigated below the 50% depletion level of available soil moisture. The grain yield of maize, when irrigated at a 50% depletion level of available moisture, was 4,100 kg/ha, whereas at a 75% depletion level, the yield dropped to 2,226 kg/ha. Thus, in adverse weather and soil conditions, maize grown during the dry season has to be irrigated at least once every three-to-four days to prevent moisture stress (Ranaweera, et al., 2011).

Rainfall and Temperature Requirement

Maize is a warm weather crop and a temperature of 25-30˚C is ideal for the plant to grow well, so it is important to maintain good soil drainage. Paddy lands can be used for maize cultivation only if proper drainage measures are taken. In areas with cold climates, the growing season is relatively long.

4.1.4 Recommended Varieties

The Department of Agriculture (DOA) has recommended several varieties that could be harvested in a period of 3-3 1/2 months, depending on the rainfall pattern prevailing in the country. The Field Crop Research and Development Institute of DOA, had released open pollinated varieties (OPV) such as Bhadra, Ruwan, Aruna and Muthu for local cultivation. With the popularity of hybrid varieties gradually increasing, the Department of Agriculture also took steps in 2004 to release a hybrid called Sampath. Later, they introduced two more hybrid varieties named, M1H1 and M1H2. Recently, they introduced 3 hybrid varieties in 2019, with an average yield of 5.5-6.5t/ha (DOA, 2020).

Table 4.3: Recommended Varieties of Maize by the Department of Agriculture

Variety	Year of Release	Average Yield (t/ha)
Bhadra	1977	4.1 (4-6)
Ruwan	1990	4.3
Aruna	1992	4.4
Muthu	1993	5.4
Sampath (Hybrid)	2004	5-6
M1H1	2013	4.5-5.5
MIMZ Hy 3	2019	5.5-6.5
MIMZ Hy 4	2019	5.5-6.5
MIMZ Hy 5	2019	5.5-6.5

Source: Department of Agriculture, 2020

Imported Hybrid Varieties

The first hybrid maize variety tested among local farmers in 1995 was the Pacific 11 with a yield of 6 mt/ha. This variety became very popular among farmers within 3-4 years, and was later replaced by the Pacific 948 variety. In recent years, hybrid maize varieties such as Pacific, Jet 999 were introduced, and they became popular among farmers due to their high yield potential, uniform growth and ability to provide extra grains per year (Malaviarachchi, et al., 2007).

Many leading private companies importing seeds are introducing various hybrid varieties to the country. Many of these varieties are popular in India, Thailand and Indonesia. Since quality control of the varieties sold to farmers is carried out by the Field Crops Research and Development Institute of the Department of Agriculture at Mahailluppallama, it is advisable to inquire about the suitability of varieties before using new varieties.

Babycorn: Babycorn is a young finger-like unfertilized cob with one-to-three-centimetres of emerged silk preferably harvested within 1-3 days of silk emergence, depending upon the growing season. It can be eaten raw as a salad, and in the preparation of different recipes. The desirable size of babycorn is of 6 to 11 cm length and 1.0 to 1.5 cm diameter, with a regular row/ ovule arrangement. The most preferred colour by consumers / exporters is generally creamish to very light yellow. Babycorn is nutritive, and its nutritional quality is at par or even superior to some of the seasonal vegetables (Parihar, et al., 2011).

Sweet corn: Sweet corn is one of the most popular vegetables in the USA, Europe and other developed countries of the world. It is a very delicious, and a rich source of energy, vitamin C and A. It is eaten as raw, boiled or steamed green cob / grain. It is also used in the preparation of soup, salad and other recipes. Generally, sweet corn matures early. It is harvested in 70-75 days. At harvest time, the moisture is generally 70% in the grain, and sugar content varies from 11% to more than 20% (Parihar, et al.,

2011). These varieties are suitable for small-scale farmers as there is a sweet-corn market for the limited number of consumers flocking to supermarkets and other specialty stores. There is a good potential for further expansion of this crop in the future as sweet-tasting sweet corn has the potential to penetrate a large segment of the market for maize, which is currently widely sold on the road.

Popcorn: Popcorn is a common snack in many parts of the world, particularly in cities, and is liked because of its light, porous and crunchy texture. Kernels of popcorn are very small and oval / round in shape. When heated at about 1,700°C, the grains swell and burst, turning inside out. The quality of popcorn depends on the popping volume, and the minimum number of non-popcorn (Parihar, et al., 2011).

4.2 Maize Production in Sri Lanka

4.2.1 Main Producing Areas and Production Systems

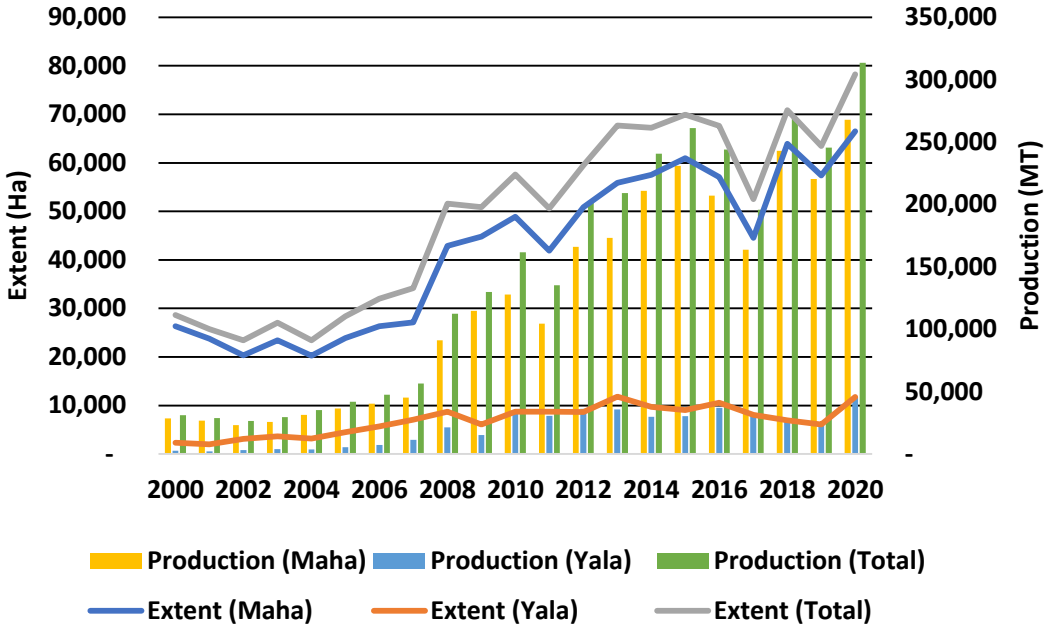
Maize can be successfully cultivated in the arid and intermediate regions of Sri Lanka, during the upland monsoon season under rain-fed conditions. These areas are more suitable for cultivation as it is essential to dry the crop well when cultivating for use as a grain crop. This cultivation can be done well under irrigation during the *Yala* season, and for maize, this cultivation can be done in any part of the country.

According to the last ten years of data, more than 80 percent of maize production comes from the *Maha* season, and *Yala* season produces only less than 20 percent. Maize is traditionally cultivated all over Sri Lanka, and hardly found in the Southwest coastal districts (Matara, Galle, Colombo, Kalutara, and Gampaha) and the Kegalle district in the mid-country. The extent of cultivation is relatively small in the Northern districts of Jaffna, Vavuniya, Mullaitivu and Mannar as well. Major maize producing districts are Anuradhapura, Monaragala, Badulla and Ampara, with the percentages respectively of 40 percent, 26 percent, 13 percent and 11 percent of the total production recorded during last 5 years, 2016-2020 (Annex Table 2 and Figure 4.2).

4.2.2 Extent

As illustrated in Figure 4.1, during the last ten-year period, maize production in the country has increased, and yielded compelling success with the adoption of hybrid seed that has significantly increased smallholder maize production. Total maize production in 2020 was about 313,520mt, cultivated on 78,249 ha with an average yield of 3.8 t/ha (DCS, 2020). The output of maize reached a bumper level as a result of record plantings, driven by the strong demand of the local feed industry, and above-average yields supported by favourable weather conditions. In the 2020/21 *Maha* season, about 113,077 ha were cultivated, reporting 15,181 ha damage due to the fall armyworm attack, drought and floods (DOA, Crop forecast 2020/21 *maha*). The total maize output is estimated to be 432,127mt. However, the country's requirement is

estimated as 550,000mt annually to completely satisfy the national poultry demand for maize.

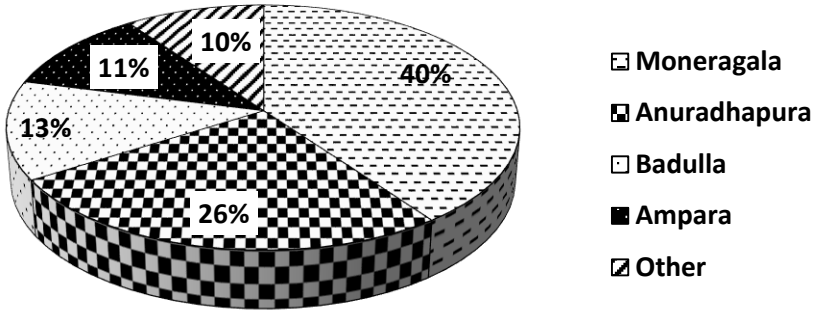


Source: Department of Census and Statistics

Figure 4.1: Extent and Production of Maize (2000-2020)

4.2.3 Production

Maize is grown in the dry and intermediate zones mainly as rain-fed cultivation during the *Maha* season. It is very successfully cultivated in the districts of Moneragala (40%) and Anuradhapura (29%), considering the average production recorded during last five-year period, 2016-2020 (Annex Table 2). In addition, maize is cultivated in such districts as Badulla (13%), Ampara (11%) and Kurunegala (DCS, 2020).



Source: Department of Census and Statistics, 2020

Figure 4.2: Average Production of Maize in Major Producing Districts (2016-2020)

4.2.4 Average Yield

Productivity levels of maize have largely remained the same over a decade. Table 4.4 illustrates the average yield of maize recorded for the period of 2010-2020. The highest average yield of 4.0 t/ha was recorded in 2020.

Table 4.4: Average Yield of Maize in Sri Lanka (2010-2020)

Year	Average Yield (t/ha)
2010	2.8
2011	2.7
2012	3.4
2013	3.1
2014	3.6
2015	3.7
2016	3.6
2017	3.7
2018	3.8
2019	3.9
2020	4.0

Source: Department of Agriculture

4.3 Marketing of Maize

4.3.1 Farm-Gate Price

Farm gate prices of maize recorded during the period of 2010-2019 are given in Table 4.5. The annual average farm-gate price of maize has risen 39 percent in that period.

Table 4.5: Producer Prices of Maize in Sri Lanka (2010-2019)

Period	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
January	40.39	38.63	45.94	36.14	34.23	42.83	43.82	53.33	42.73	51.42
February	32.32	30.26	37.20	33.55	32.76	27.94	32.30	39.19	42.98	44.76
March	30.54	32.34	35.19	29.46	30.93	29.36	35.19	45.30	44.07	46.49
April	29.89	34.68	30.19	28.91	31.73	31.64	44.41	44.81	43.51	45.85
May	32.90	37.47	32.28	29.52	31.60	34.59	38.47	43.20	45.74	48.11
June	34.31	37.37	34.64	32.13	31.11	36.65	40.01	44.33	49.52	47.63
July	34.72	38.19	32.88	27.85	33.44	35.20	38.27	44.56	43.00	48.13
August	32.49	39.58	33.37	31.70	32.67	37.40	33.40	46.05	43.87	48.46
September	32.94	51.52	33.38	30.22	35.90	38.61	32.00	43.23	44.12	47.11
October	35.60	40.61	34.55	31.03	37.92	40.32	30.42	49.50	46.01	47.86
November	37.50	52.97	34.58	32.65	41.17	37.93	42.00	49.38	46.07	43.75
December	37.63	42.32	38.88	34.60	38.00	41.71	28.75	46.00	48.70	50.71
Annual Average	**34.18**	**39.76**	**35.44**	**31.38**	**33.63**	**35.69**	**36.40**	**45.17**	**45.02**	**47.52**

Source: Department of Census and Statistics

4.3.2 International Trade

Imports

Maize is imported as a source for animal-feed production, and as seeds for crop production. Total imports of maize have increased over the years, except during the 2010-2013 period, as Sri Lanka was self-sufficient in maize production for the country. However, with imports restriction on maize in 2020, only 29,820 mt were imported. The highest quantity of imports was recorded in 2017.

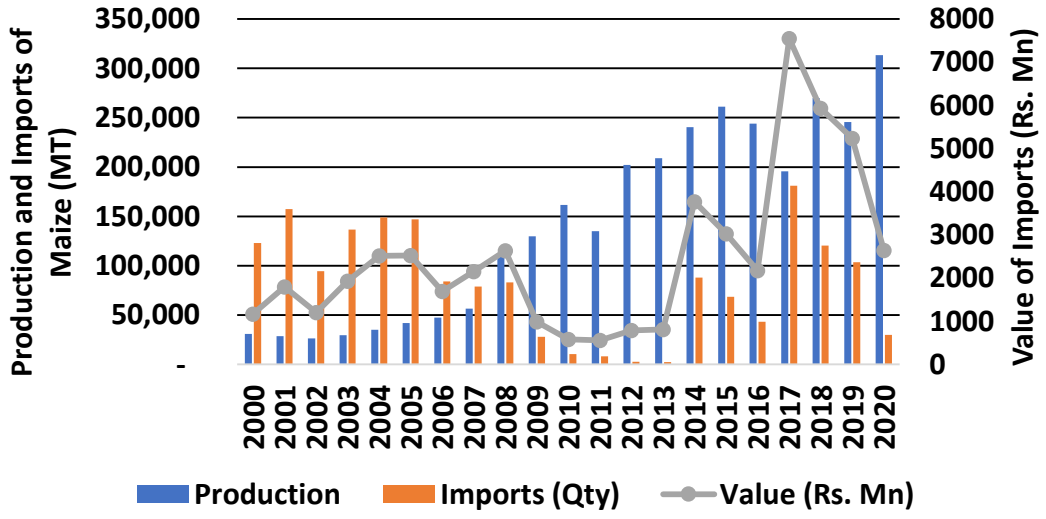
The quantity of seeds for cultivation has not shown an increasing trend, and it has ranged between 1,000-1,500 mt between the 2011-2020 period.

Table 4.6: Import Quantity and Value of Maize Seeds and Maize for Animal Feed

Year	Total Maize (Seed + Other)		Seed		Maize (Animal Feed)	
	Qty (Mt)	Value (000' Rs)	Qty (Mt)	Value (000' Rs)	Qty (Mt)	Value (000' Rs)
2006	84,044	1,694,952	349	66,900	83,695	1,628,052
2007	78,758	2,155,247	392	81,707	78,366	2,073,540
2008	83,195	2,634,178	707	164,481	82,488	2,469,697
2009	28,034	984,528	834	254,784	27,200	729,744
2010	10,506	581,557	935	297,937	9,571	283,620
2011	8,244	554,875	1,234	304,962	7,011	249,923
2012	2,782	784,537	1,778	731,593	1,005	52,991
2013	2,279	808,199	1,751	767,286	528	41,185
2014	88,138	3,766,593	1,314	629,639	86,824	3,136,954
2015	68,637	3,030,224	1,400	682,692	67,237	2,347,531
2016	43,057	2,174,654	1,112	603,130	41,946	1,571,524
2017	181,021	7,546,114	1,432	918,204	179,589	6,627,909
2018	120,568	5,936,673	1,482	1,000,137	119,087	4,936,536
2019	103,537	5,237,291	1,076	835,860	102,461	4,401,431
2020	29,820	2,638,214	1,652	1,352,743	28,168	1,285,471

Source: Department of Customs

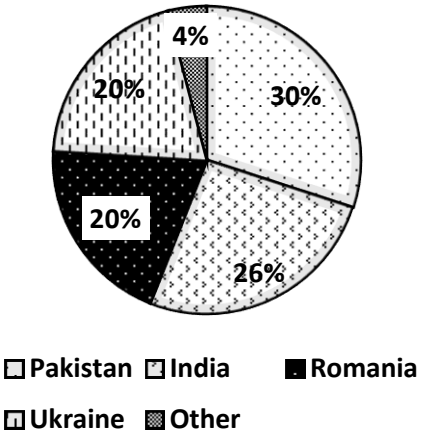
As illustrated in Figure 4.3, during the 2000-2007 period, imports were greater than local maize production, and after 2018, production increased over the years up to 2020, with Sri Lanka self-sufficient during the 2010-2013 period. The average CIF price was Rs. 819.00/kg in 2019 for imported seeds, whereas it was the Rs.46.00/kg for maize for animal feed.



Source: Department of Customs
Department of Census and Statistics

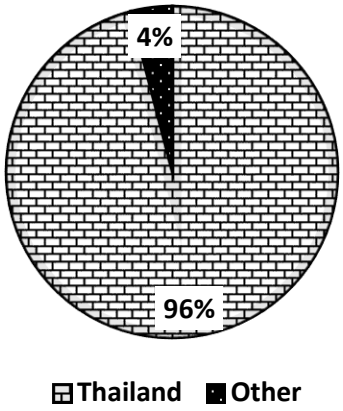
Figure 4.3: Production, Quantity and Value of Imports of Maize (2000-2020)

Considering country-wise import data recorded for 2015-2019 period, the major importing countries of maize for animal-feed production were Pakistan, India, Romania and Ukraine, which represent 96 percent of total imports. Among them an average 30 percent of the stocks were received by Pakistan, followed by India (26%), Romania (20%) and Ukraine (20%) as illustrated in Figure 4.4.



Source: Department of Customs, 2020

Figure 4.4: Country-wise Imports of Maize (Average 2015-2019)



Source: Department of Customs, 2020

Figure 4.5: Country-wise Imports of Maize Seeds (Average 2015-2020)

The majority of the stocks of maize seeds were imported from Thailand (96%), considering imports recorded for the 2015-2020 period (Figure 4.5). The rest of the stocks were mainly imported from Indonesia and South Africa.

4.4 Demand for Maize

4.4.1 Demand for Food

Sri Lankan farmers use only a small portion of maize production for their own domestic consumption. Since rice is the staple food, its availability should have an impact on maize consumption. Green-cob consumption (boiled immature cobs) as a snack is very popular among all sectors of the society. Some varieties, which are suitable for the animal feed industry, are grown for green cobs also. Roadside selling is a very popular enterprise all over the country. According to Premarathne and Samarasinghe (2020), it is estimated that about 10-20 percent of the Maha season crop (Sep.-Feb.) and 50 percent of the *Yala* season (March-August) crop are harvested as tender green cobs for direct human consumption.

Cottage-level industries, such as popcorn production, have developed recently with the introduction of popcorn varieties from other countries. Sri Lanka does not produce any popcorn variety. All stocks are imported. However, a popcorn variety is being

tested at the Field Crop Research and Development Institute, Mahailluppallama, to be released in the future. A high demand from the human food industry is another market force, which creates a favourable environment to change the production situation in the country.

4.4.2 Demand for Food-Based Industries

Thriposha Production

The state-controlled Thriphosa (high-nutrient food) Project, which produces high nutrient foods for pregnant women, mothers and children, will not be expanded in the near future. Therefore, the amount of maize needed for Thriposa (15,000 mt/year) remains unchanged. The main food-processing centre of Sri Lanka Thriposha Ltd. is situated in Kapuwatte, Ja-Ela. The main products consist of “Thriposha”, representing nearly 76 percent of total production, and “Suposha”, representing nearly 24 percent of total production at present. The composition of Thriposha is given blow:

Maize – 66%
Soyabean – 30%
Milkpowder – 3%
Vitamins – 9%
Minerals – 1%

Plenty Food (Pvt) Ltd.

The company was established in 1996 and has extensive expenses in the agriculture sector. They produce different types of products such as Samaposha and other types of cereal products for the local and export market, using maize as the main inputs required as follows:

Maize – 60%
Soyabean – 30%
Green gram – 5%
Rice – 4%
Vitamins and minerals – 1%

4.4.3 Demand for Poultry Feed

In 2020, about 865,747mt of poultry feed was produced by registered feed manufacturers in the country. The quantity of feed produced by self-mixes was 257,799mt in 2020 (DAPH, 2020). There were about 41 registered commercial feed mills operated in the country in 2020 (DAPH, 2020), producing a standard mix of feed for sale at the mill gate or being sold through their agents in depots scattered around the country.

At present, the animal feed industry is completely managed by the private sector. The commercial feed manufacturers are formally regulated. All have licenses, registration and certification obtained from the Registrar of Animal Feed. Commercial feed production and raw material importation are regulated by the Animal Feed Act No. 15 of 1986, which was amended in 2016 as the Animal Feed (Amendment) Act, No. 15 of 2016. The Registrar of Animal Feeds of the Department of Animal Production and Health (DAPH) is the licensing authority for the purposes of the Animal Feed Act.

Table 4.7: Ingredient Use in Poultry Feed Manufacturing and Feed Formula

	Ingredients	Poultry Ration
Energy	Cereals (maize, wheat, rice)	40%
	Cereal by products (rice bran, rice polish, broken rice, wheat bran/flour)	20%
Protein	Soyabean meal	20-25%
	Animal products (fish meal, meat meal, coconut meal)	5-10%
Minerals		2-3%
Additives		1-2%

Source: DAPH, 2020

It was observed that different types of feed manufacturers use different types of ingredients in the preparation of feed formulas. Self-feed mixtures use ingredients, which they can afford, to produce customized feed.

Large-scale manufacturers buy feed ingredients of maize during the peak harvesting period, storing them to be used in the lean-supply season of maize. They have silos in the processing centres to store maize. Also, they have contract farmers in major producing areas, to whom they provide credit and other inputs to farmers.

CHAPTER FIVE

Results and Discussion

5.1 Introduction

This chapter deals with the discussion and interpretation of findings from descriptive and economic analysis. The first section describes the descriptive and inferential statistics of the farmers. The second section presents value chain analysis. The third section focusses on economic performance, which includes marketing channels, costs of production, marketing costs, and margins of different actors in the value chain.

5.2 Demographic Characteristics and Socio-economic Information of Maize Farmers

The personal and socio-psychological characteristics of maize growers were studied and quantified. The variables included age, educational status, family type, experience in maize farming, social participation, farm size, area under maize cultivation, annual income, information source utilization, decision making behavior, market intelligence, market orientation, market perception, market decision, and storage facilities. A total of 80 farmers from the three ASC areas of Anuradhapura district (Horowpathana, Kahatagasdigiliya and Elayapattuwa) and three areas of Monaragala district (Siyabalanduwa, Ethimale and Dambagalla) were selected for the study. Table 5.1 represents some of the selected demographic characteristics of the sample.

5.2.1 Age

Farmers in Monaragala and Anuradhapura districts were asked to state within which age category they fell, and findings revealed that the majority (60 percent) of the maize farmers are within the age category of 40-59 years. This was recorded as 63 percent in Monaragala and 58 percent in Anuradhapura. This shows that matured people are the ones actively involved in maize agricultural activities, and therefore it is they who should be addressed to make sustainable maize value chain development interventions.

5.2.2 Educational Status

The educational status of an individual is considered as one of the most influential factors in decision-making in day-to-day life. Education is the process of bringing about desirable changes in human behaviour. Educational status is one of the factors which may influence the farmer in adopting critical technologies and effective marketing. It is generally presumed, that higher the educational level, the higher would be the rate of adoption and marketing. For an effective agricultural value chain development to be achieved, farmers should be knowledgeable, informed and innovative in their areas of operation. The distribution of respondents based on their educational status is

presented in Table 5.1. It indicates that 63 percent of the farmers obtained education up to secondary level. Only a few farmers (5%) have obtained up to a tertiary level of education. Both districts shows more or less similar results for farmers level of education.

5.2.3 Experience in Maize Cultivation

Farming experience acquired over a period of time paves the way for success in farming. Farming experience helps the farmers in making rational decisions in farm activities, and thus plays a major role in the adoption or rejection behaviour of an individual. It is a key factor in the acceptance or rejection of an innovation. The distribution of respondents according to their farming experience in maize cultivation was worked out, grouped into three categories, and presented in Table 5.1. A total of 59 percent had experience of 10-20 years in maize cultivation (55% in Monaragala; 63% in Anuradhapura).

5.2.4 Income from Farming and Maize Farming

Farmers in the Anuradhapura and Monaragala districts cultivated more than 2 acres of lands under maize cultivation in the 2020/21 *Maha* season. As the majority of them depend on farming as their main income source, they cultivate rice and other field crops in addition to maize. Considering the monthly income of farm households from overall farming activities, this ranged from Rs.25,001-50,000 for most farmers in the Anuradhapura district (59%) while it ranged from Rs.50,001-75,000 for farmers in the Monaragala district (32%). A total of 46 percent farmers reported they earned a monthly income of only less than Rs.25,000 from cultivating maize. However, there were farmers in the Monaragala districts who earned from Rs.50,001-75,000 in monthly income from maize farming alone as they had cultivated more maize lands compared to farmers in the Anuradhapura district (Table 5.1).

Table 5.1: Demographic Information of Maize Farmers in Anuradhapura and Monaragala Districts

Variables	Percentage of Farmers (%)		
	Monaragala (N=40)	Anuradhapura (N=40)	Total (N=80)
Age (Years)			
20-39	12.5	27.5	20.0
40-59	62.5	57.5	60.0
>=60	25.0	15.0	20.0
Total	**100.0**	**100.0**	**100.0**
Gender			
Male	95.0	87.5	91.3
Female	5.0	7.5	6.3
Total	**100.0**	**100.0**	**100.0**
Marital status			
Single	100.0	95	97.5
Married	0.0	5	2.5
Total	**100.0**	**100**	**100.0**
Level of education			
Primary	10.0	15.0	12.5
Secondary	85.0	80.0	82.5
Tertiary	5.0	5.0	5.0
Total	**100.0**	**100.0**	**100.0**
Year of Farming			
<10 years	22.5	17.5	20.0
10-20 years	55.0	62.5	58.8
>20 years	22.5	20.0	21.3
Total	**100.0**	**100.0**	**100.0**
Main source of income			
Farming	85.0	90.0	87.5
Non-farming	15.0	10.0	12.5
Total	**100.0**	**100.0**	**100.0**
Monthly Income (Farming)			
<25,000	7.1	7.7	7.5
25,001-50,000	25.0	59.0	43.3
50,001-75,000	32.1	12.8	17.9
75,001-100,000	21.4	12.8	13.4
>100,001	14.3	7.7	17.9
Total	**100.0**	**100.0**	**100.0**
Monthly Income (Maize farming)			
<25,000	29.6	57.9	46.2
25,001-50,000	22.2	21.1	21.5
50,001-75,000	29.6	7.9	9.2
75,001-100,000	7.4	5.3	6.2
>100,001	11.1	7.9	16.9
Total	**100.0**	**100.0**	**100.0**

Source: HARTI Survey, 2021

5.3 Land Holdings and Land Use Pattern

In both districts, the majority of maize farmers (69%) used encroached forest lands (chena) for cultivation, whereas 28 percent of farmers used their own lands. The proportion of landholding is presented in Table 5.2 below. Farmers are engaged in the production of maize both for grains and seeds, processing, transportation and sales.

Table 5.2: Ownership of Cultivated Crop Lands

Ownership of land	Percentage of Farmers (%)		
	Anuradhapura (N=40)	Monaragala (N=40)	Total (N=80)
Chena (Encroached forest lands)	70	68	69
Own	30	25	28
Leased out lands	0	2	1
Tennant	0	5	2
Total	**100**	**100**	**100**

Source: HARTI Survey, 2021

Considering the total cultivated extent of lands for maize in two districts, the majority of the farmers (45%) in the Anuradhapura district had 2-5 acres of lands, while about 47 percent farmers in the Monaragala district had 5-10 acres land. As farmers in the Monaragala district use encroached forest lands to cultivate maize, they had more lands under maize compared to farmers in the Anuradhapura district where chena lands were used for cultivation.

Table 5.3: Cultivated Extent of Maize during the Last Two Seasons (acres)

District	Season	Percentage of Farmers				Total
		Extent (acres)				
		1<=2	2<=5	5<=10	>10	
Monaragala	2020/21 Maha	-	16	47	37	100
	2019/20 Maha	-	19	41	40	100
Anuradhapura	2020/21 Maha	33	45	12	10	100
	2019/20 Maha	21	55	10	14	100
Total	**2020/21 Maha**	**18**	**32**	**28**	**22**	**100**
	2019/20 Maha	**10**	**36**	**26**	**28**	**100**

Source: HARTI Survey, 2021

5.4 Agronomy and Agricultural Practices

The maize produced in Sri Lanka go through five basic operations; 1) selection of seeds, 2) land preparation and sowing of seeds, 3) fertilization / weeding / loosening of soil, 4) plant protection and guarding to protect from wild animal damages and application of pesticide if needed, and 5) harvesting and cob shelling.

5.4.1 Land Preparation

The primary objective of land preparation is to eliminate weeds, and provide an environment for the good germination and vigorous growth of seedlings. In land where shifting cultivation is practiced, minimum tillage methods, such as scraping the soil, are sufficient to get a weed-free seed bed. A blade harrow has been found to be an efficient implement for this purpose. More intensive land preparation methods must be used for continuously cropped lands to minimize weed growth. This may involve ploughing followed by one or two harrowing. Few farmers can afford this type of land preparation. Farmers do land preparation in mid-August before the rains start in the *Maha* season, with cultivation beginning in October with the onset of rain. Land preparation is mostly done in steps.

1st Step: First they remove unnecessary plants, weeds and other things using rotaries. Ploughing and harrowing is done using a disc plough. It takes 3-4 hours to prepare one-acre of land, and about 10-20 acres can be prepared within a day. The cost for this step was around Rs. 9,000 - 10,000 per acre.

2nd Step: Deep ploughing up to 45 cm is favourable for maize that have deep growth. After one month of initial land preparation, ploughing and harrowing is done using a disc plough, with 5-6 hours taken to complete one acre land. It is advisable to turn the soil with a disc plough, and crush the stones with a rotavari. The cost for this step was Rs. 4000 - 5000 per acre.

3rd Step: Finally, ridges are made using tractors to plant seeds, with 2-3 hours taken to complete one acre of land. Ridges can be made at 60cm apart for maize planting. The cost for this step of land preparation was Rs. 2000 - 3000 per acre.

5.4.2 Maize Seeds (Local / Imported)

The yield of imported seeds (10-13mt/ha) are higher than local seeds. Maize seeds are mainly imported in July, August, September, and October targeting the *Maha* cultivation of maize.

Table 5.4: Types of Maize Seeds Imports

Types of Seeds	CIF Price (US$/kg)	Selling Price
Hybrid Seeds for production of dry seeds for feed industry	3.5-4.5	Rs. 6000-7000/5kg
Hybrid Seeds for cob production	4.5-5.5	Rs. 7000-8500/5kg
Hybrid Seeds for sweet corn production	25-30	N.A.

Source: HARTI Survey, 2021

Seed-importing companies distribute seeds through dealers, and there are dealer points in major producing areas. Large-scale maize traders directly purchase seeds from companies to supply seeds to their contract farmers. The leading companies engaged in maize-seed marketing are Prima, CIC, Hayleys and DIMO.

5.4.3 Crop Establishment and Seed Rate

In the *Maha* season, these crops can be raised fed by rain as well with supplementary irrigation when there are drought periods. The *Maha* crop can be established with the *Maha* rains that occur in the latter part of September or first week of October for successful growth. The *Yala* crops should be established with the *Yala* rains that fall in latter part of April. With timely cultivation, pest problems can be reduced.

Raised-Bed Method

A raised-bed is a land configuration where irrigation is delivered through furrows, and the technology increases water-use efficiencies, and gives better crop yields, due to high fertilizer-use efficiency, reduced weed infestation and improvement in root proliferation. The irrigation water saving depends on the size of the bed-furrow system, where larger beds save more irrigation water. Using this technology, 20-30% irrigation water can be saved without any negative impact on productivity (Kumar, et al., 2013).

Activity	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Maha **Planting**												
Maha **harvesting**												
Yala **Planting**												
Yala **harvesting**												

Source: Field Information/HARTI and Department of Agriculture

Figure 5.1: Crop Calendar for Maize (Seasonal pattern of planting and harvesting)

Seeds are planted on ridges to avoid water logging in heavy rainy periods. Sufficient drains are provided to drain off excess water during rainy periods. Seeds are planted manually. Seed requirement for planting one hectare of maize is 20kg. Farmers in Monaragala and Anuradhapura have used about 6-7kg of seeds on average to cultivate one acre of land. Sometimes, it varied up to even 10kg/acre. Seeds are available in 5kg size packets, and farmers report that one packet of seeds is sufficient to plant one acre of land. The germination rate of seeds of safely packaged imported hybrids is about 95%. Therefore, it is sufficient to plant about 13kg of seeds per hectare.

Table 5.5: Seed Requirement of Maize

Variety	Seed Rate (kg/acre)	Seed Rate (kg/ha)
Ruwan*	8	20
Badra*	8	20
M1H1*	8	20
MIMZ Hy 3*	8	20
MIMZ Hy 4*	8	20
MIMZ Hy 5*	8	20
Imported Hybrids**	6-7	12.5-17

Source: * Seed and Planting Material Development Center (SPMDC), DOA
**Field Data (HARTI)

Maize seeds are produced at government seed farms, and by contract farmers countrywide for local seed production. Under both production systems, the level of production increased in 2020 compared to 2019, which shows a positive trend in local seed production. Production of seeds by the contract seed programme was higher than that produced in government seed farms for maize.

Table 5.6: Production of Local Seeds by Government Farms and Contract Growers (2015-2020)

Year	Production (kg)			Quantity Issued (kg)
	Government Farms	Contract Growers	Total	
2015	8,586	6,636	15,222	13,161
2016	16,322	20,817	37,139	20,239
2017	29,641	39,554	69,195	45,992
2018	8,526	37,242	45,768	34,244
2019	15,264	57,254	72,518	28,376
2020	38,948	73,210	112,158	49,001

Source: Seed and Planting Material Development Center (SPMDC)/DOA, 2020

Ruwan and Badra were the main OPV (Open Pollinated Varieties) seeds produced in 2019 and 2020 (DOA, 2020). Among OPV seed, Badra was the most produced seed variety. Only two hybrid varieties of maize are currently being produced.

Table 5.7: Seed Production by Varieties (2019 and 2020)

Year	Variety	Production (kg)		Seeds issued (kg)
		Basic seeds	Contract	
2019	Ruwan	n.a.	n.a.	106.8
	Badra	11,932	37,568	19,342
	M1HY1	1,222	27,899	8,489
	M1HY2	n.a.	1,141	40
2020	Ruwan	1,380	n.a.	2,253
	Badra	37,568	73,211	35,826
	M1HY1	n.a.	n.a.	10,922
	M1HY2	n.a.	n.a.	n.a.

Source: Seed and Planting Material Development Center (SPMDC)

Prices of hybrid seeds are higher than OPV seeds, and sell at Rs.800/kg, whereas OPV seeds are sold between Rs.230-280/kg (Table 5.8).

Table 5.8: Prices of Local Maize Seeds

Type of Seed	2019		2020	
	Buying price (Rs/kg)	Selling price (Rs/kg)	Buying price (Rs/kg)	Selling price (Rs/kg)
OPV Seeds	70.00-110.00	140.00-200.00	110.00-260.00	230.00-280.00
Hybrid Seeds	500.00	800.00	500.00	800.00

Source: Seed and Planting Material Development Center (SPMDC)/DOA

About 55,000-75,000 plants are required to cultivate 1 hectare of land, with 22,000-30,000 plants per acre (DOA, 2020). Accordingly, plant spacing is practiced. For maize, seeds are planted at a 60cm x 30cm spacing, with one plant per hole, or can be planted at 60cm x 60cm spacing with two plants per hole especially for tall varieties to provide more light. Planting of seeds are done manually using shared labour practices, by the majority of the farmers in both districts.

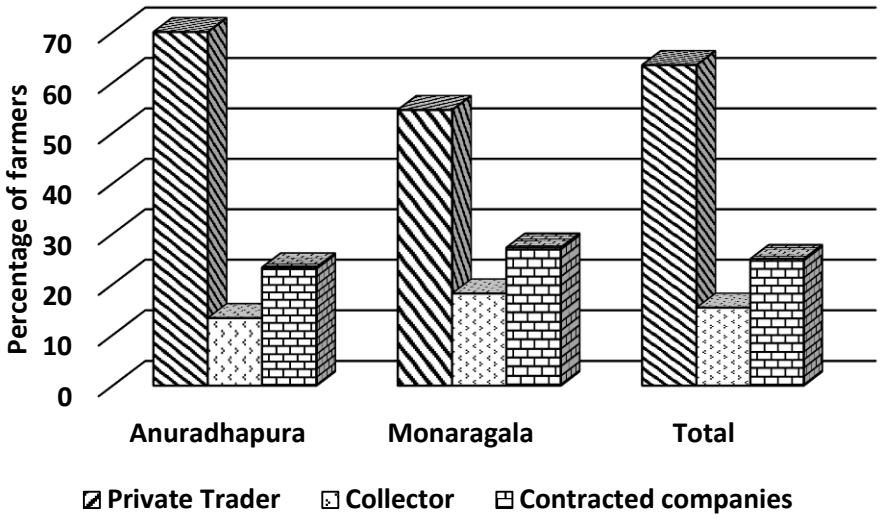
More than 95 percent of the farmers in both districts have used imported hybrid seeds. The commonly used varieties of maize are depicted in Table 5.9 below. Farmers have used Jet 999 (42.5%) and Jet 99 (30%) imported hybrid varieties mostly, revealing the same results in both districts.

Table 5.9: Types of Seeds Used by Maize Farmers in Monaragala and Anuradhapura Districts

Seed variety	Percentage of farmers		
	Anuradhapura (N=40)	Monaragala (N=40)	Total (N=80)
4311	2.5	2.5	2.5
Jet 99	25	35	30
Jet 999	45	40	42.5
Pakistan 339	7.5	7.5	7.5
Pacific	20	15	17.5
Total	**100**	**100**	**100**

Source: HARTI Survey, 2021

Farmers used seeds from private traders (63%) as their main seed source. This was recorded as 70 percent in Anuradhapura and 54 percent in Monaragala. Another 25 percent purchased seeds from extension officers of the contract companies, as they had agreed to supply seeds in forward sales agreement with the contracted farmers. About 15 percent of farmers purchased seeds from collectors, and these collectors were given the required seeds from large-scale traders in the districts. Private companies distribute imported seeds to the traders in major producing areas, and also leading maize traders purchase seeds from such companies, to distribute to farmers through village-level collectors.



Source: HARTI Survey, 2021

Figure 5.2: Seed Source

5.4.4 Fertilizer Recommendation and Application

Maize is generally grown in a shifting system of cultivation in the highlands of the dry zone, where the farmers cultivate the land for two to three seasons after clearing the forest, and then abandon it. Soils of these newly cleared lands *(chenas)* have a good supply of nutrients, and have no need for fertilizer for the first few seasons. As a result of scarcity of land for shifting cultivation, farmers in future will have to adopt a more stable type of cultivation on the rain-fed highlands. When such a system is adopted, the fertility status of the soils will decline rapidly, and use of fertilizer will be important to maintain yield levels.

Maize is an exhaustive crop, and needs a balanced supply of macro and micro-nutrients. Nitrogen is the key nutrient, and an adequate supply of Nitrogen is necessary for achieving potential yield. Hybrid maize varieties are highly responsive to fertilizers. The recommended level of fertilizer by the DOA is given in the following table.

Table 5.10: Fertilizer Recommendation

Type of Fertilizer	Kg/ha	Kg/acre
Basal dressing		
Urea	75	37
TSP	100	50
MOP	50	25
Top dressing		
Urea (Irrigated)	250	100
Urea (Rain-fed)	140	56

Source: Department of Agriculture, 2020

A basal dressing is applied when planting seeds, and after that urea is applied once or twice. A top dressing is applied after 4 weeks of planting under irrigated conditions. The recommended level is 100kg/acre. In this study it was observed that farmers in both districts applied urea 14-20 days after seeding, and again 45 days after seeding.

5.4.5 Irrigation

During dry periods, irrigation is required every 4-7 days, depending on the severity of the drought, and type of soil. During the rainy season, there is a 75% probability that rainfall alone will satisfy the water requirements of a 120-day cereal crop like maize (Panabokke and Walgama, 1974). However, during the dry season (April-August), the chances of getting a successful crop of maize under rainfed conditions are low, and the crop must be irrigated during the dry periods. Mean total rainfall for the dry season varies from 300-400 mm, most of which falls during the month of April. The dry season is also characterized by high temperatures and strong dry winds.

5.4.6 Weeding

Under shifting cultivation, farmers rarely practice weed control, as the incidence of weeds is minimal. But as the cropping frequency increases beyond two or three seasons, there is a progressive build-up of weeds. Initially, weed flora include both broad leaves and grasses, but if cultivation continues for six years or more, the grassy weeds, both perennial and annual types, become more prominent. Under irrigated condition, weed control is important especially during the first 6 weeks of planting. Farmers apply weedicides on the day of applying fertilizer. Heavy weed growth is one of the factors that reduces the yield of maize in continuously cropped lands. Yields could be reduced by about 30-40% if weeds are not controlled.

The emergence of weeds after crop establishment is inevitable, and the most common method of controlling them is by inter-row weeding. Usually, two to three weedings are required to control weeds in maize, and these weedings must be done during the first 30-40 days of crop growth. Several manually operated implements (such as the Swiss hoe, wheel hoe and three-point inter-cultivator) are found to be suitable for inter-row weeding (Ranaweera, et al., 2011).

Chemical Weed Control

A hand spray should be used for best results. When the soil is well moistened after sowing in the field before the germination, a majority of the farmers used “Cleo” weedicide. After banning the use of Glyphosate as a weedicide, Cleo-type weedicide has become the commonly used weedicides in both districts.

5.4.7 Pest and Disease Control

One of the reasons for the popularity of maize cultivation among farmers in Sri Lanka is the lower occurrence of significant pests and diseases. Root and stalk rot, and foliar diseases such as leaf blight and sheath blight, are common in maize during humid days.

Table 5.11: Types of Pests, Damages and Control Measures

Type of Insect	Damage	Control Measures
Stem borer (*Chilopartellus*)	This pest can occur from about 3 weeks after the formation of the crop to the stage of maturation of the spikes. In the early stages of damage, holes in the newly emerging leaves can be seen damaged by the larvae, and when the adult larvae damage a growing place in the plant (bud) that appears outside as a feature called dead heart.	After 3-5 weeks of Planting - Diacinon 5% GR 10-15 kg/ha - Fipronil 0.3% GR 12kg/ka
Pod borer *Helicoverpaamigera*	The larvae devour the seeds in the pods. Therefore, the pods and seeds become unfit for consumption.	After 25-35 days and 45-55 days after planting - Novaluron 10EC 10ml/10L - Ethaphenprox 10EC 15ml/10L
Koodiththa *Rhopalosiphum maidis*	These animals suck sap from the leaves, causing them to turn yellow. The sticky substance they emit is deposited on the leaves of the crop and the fungus grows on them and the leaf blade easily turns black. Therefore, plant growth is impaired. This inhibits the pollination of male flowers.	- Imidachloprid 20% SL 10ml/10L - Imidachloprid 70% WG 1.25g/10L - Thiamethoxam WG 3g/10L
Fall armyworm (Sena caterpillar) *Spodoptera frugiperda*	In the early stages of damage, small white spots can be seen on the leaves. When the damage is severe, it causes large-scale leaf tearing [?] and cracked leaves in the crop. It also damages the leaf buds. Larvae can be seen on the leaves and in the bud. Dead matter can be seen in the leaves and buds. It also enters the corncobs and eats the seeds.	- Spinotrum 25% WG 3g/10L per ha - Emamectin benzoate 5% SG 4g/10L per ha - Chlorantraniprol 200g/l SC 3g/10L per ha

Source: Department of Agriculture, 2020

5.4.8 Harvesting and Post-Harvest Handling

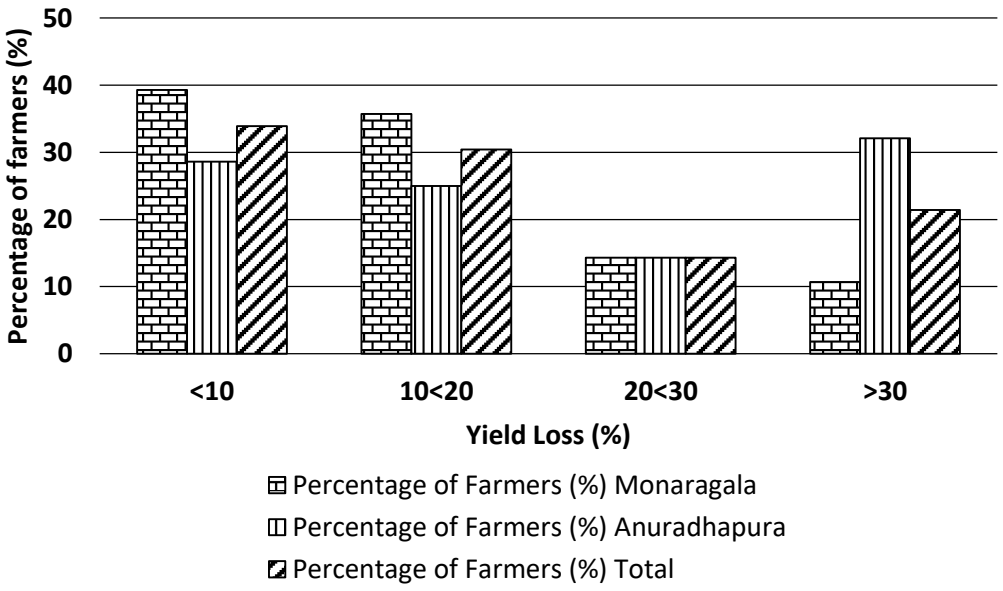
The maize crop sown for grain is harvested when the grains are nearly dry, and do not contain more than 20 percent moisture. The appearance of the plant may be misleading, particularly in the case of high-yielding hybrids, and composites whose grains are dry, while the stalk and leaves may be still green. Ears are removed from the standing crop. Harvested ears are dried in the sun before shelling. In the case of a late-sown crop, farmers prefer to harvest the whole plant and pile them, and the ears are removed later. Maize stalks are used as cattle feed or fuel. In fact, no part of the maize plant, even the cobs from which the grains have been removed, is left unused.

Crops are harvested, shelled and cleaned manually when grain moisture is low, and after physiological maturity is reached. After the harvesting process, maize requires drying for 10-15 days to reduce the moisture levels to 13%-14%. The higher the moisture level the lower the price of the produce. Seed moisture is reduced by sun drying to a safer level before shelling the seeds.

As post-harvest facilities are yet to be developed, except for seed that need special attention and storage conditions, commercial grains are disposed as quickly as possible to avoid wastage by pestilence and disease.

As per the Food and Agriculture Organization (FAO), 6% of the produce is lost due to improper storage. This could have been due to unavailability of a quality storage infrastructure, and improper fumigation during storage. In this study, it was observed that at farm level, the proper storage facilities are not available, and not rodent and fungal-attack proof, resulting in minor losses. Consequently, there is significant improvement potential for storage infrastructure. However, with the advent of organized private players (large-scale maize traders), the quality of infrastructure has improved in major producing areas.

Figure 5.3 shows the percentage of yield loss identified by farmers when growing maize in the Anuradhapura and Monaragala districts. About 64.3 percent farmers (Anuradhapura = 53.6%; Monaragala = 75%) reported that they experienced a yield-loss of less than 20 percent. Table 5.12 explains the causes raised by the farmers for crop losses. Farmers reveal that the major reason for this yield loss was due to pest and disease attacks (82%), especially due to crop damages resulting from the fall-armyworm. Other major reasons were environmental factors (43%) and damages caused by forest animals, especially elephants (33%).



Source: HARTI Survey, 2021

Figure 5.3: Reported Yield Loss at Farm Level

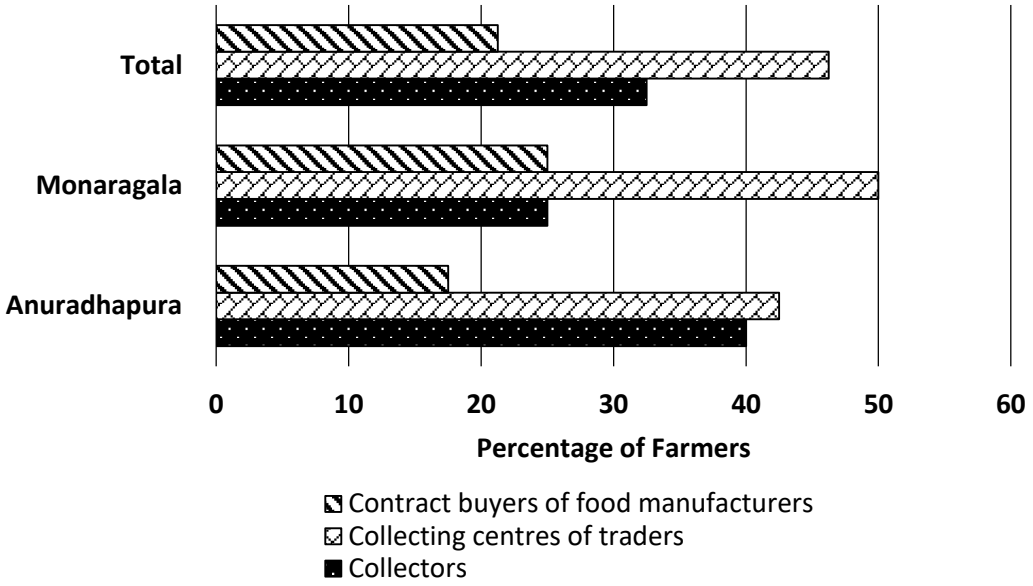
Table 5.12: Reasons for Yield Loss at Farm Level

Reasons	Monaragala		Anuradhapura		Total	
	Number	%	Number	%	Number	%
Environmental factors	22	55.0	7	21.9	29	40.3
Pest and disease attacks	32	80.0	27	84.4	59	81.9
Damage by forest animals	11	27.5	13	40.6	24	33.3
Low soil fertility	1	2.5	2	6.3	3	4.2

Note: Multiple responses were recorded
Source: HARTI Survey, 2021

5.4.9 Method of Selling

Figure 5.4 shows the share of farmers selling their maize produce to various types of buyers. The majority of the farmers reportedly sold their produce to the collecting centres of traders (46.25%), and to village level collectors (32.5%) who collect maize on behalf of traders, or to those who work as independent collectors and perform as wholesalers to sell maize to those outside buyers especially visiting from the Kurunegala area who need maize as raw material for the preparation of the self-feed mix of poultry feed.



Source: HARTI Survey, 2021

Figure 5.4: Method of Selling Practice by Maize Farmers

The majority of the farmers (83%) reported that they made their choices based on prices. About 45 percent of farmers reported that they have to sell to the buyers from whom they have obtained inputs on credit. Another reason for selecting the buyers were due to the reliability of buyers, dealing with those who could make forward sales agreements with some companies.

Table 5.13: Reasons for Selecting the Buyers

Reason	Anuradhapura		Monaragala		Total	
	Number	%	Number	%	Number	%
High Price	29	74	30	94	59	83
Reliability	15	38	10	31	25	35
Agreement	12	31	8	25	20	28
Supply of inputs on credit	10	26	22	69	32	45
Immediate payment	6	15		0	6	8
Near to Farm	3	8	1	3	4	6

Note: Multiple responses were recorded
Source: HARTI Survey, 2021

The majority of the farmers responded that they were satisfied (83%) with the prices they received during the 2020/21 *Maha* season as they were received a much higher price compared to the previous season, due to import restrictions imposed by the government to import maize, which thereby increased the demand for local maize.

Table 5.14: Farmer Satisfaction Regarding the Price Received in the 2020/21 *Maha* Season

Response	Monaragala		Anuradhapura		Total	
	Number	%	Number	%	Number	%
Yes	28	70	38	95	66	83
No	12	30	2	5	14	18
Total	**40**	**100**	**40**	**100**	**80**	**100**

Source: HARTI Survey, 2021

5.4.10 Contract Farming in Maize Cultivation

Box 1: Contract Farming Model Adopted by Private Sector in Maize Trading

The Plenty Food Co. deals with 'contract farmers' in the Anuradhapura and Monaragala districts with whom they have Forward Sales Contracts (FSC). They have farmer groups with farmer leaders, and company field officers (Extension officers) visit them and give instructions to farmers related to crop management.

Based on interviews conducted with contract farmers in Anuradhapura and Monaragala districts (30 farmers), the majority of the farmers revealed that they were satisfied with the prices they received, and the other services provided by the company. Those farmers were provided loans, seeds and other inputs, machinery (during the harvesting period) to obtain good quality products. Field officers themselves visited during the harvesting period and purchasing was done by them in a reliable manner. They have warehouses established in major producing areas to store maize. As maize is used for food production, they test for the level of aflatoxin and at stores fumigation and hygiene practices were done.

In the 2019/20 Maha season, the agreed price to purchase maize was Rs.50/kg and they were paid Rs.53/kg when purchasing. However, in the 2020/21 Maha season though the agreed price was Rs.55/kg, they were not able to collect for that price as farmers were not willing to supply as the producer price of maize had increased up to Rs.75-90/kg in the last Maha season. Also, there was high competition due to zero imports of maize.

Source: Key Informant Interviews, 2021

Table 5.15: Benefits of Contract Farming

Benefits	To producer	To contract agent
Risk	Minimizes the price risk	Minimizes the risk of raw material supplies
Price	Price stability	Price stability as per pre-agreed contract
Quality	Use of quality seed and other inputs	Get good quality produce and control on quality
Payment	Assured and regular payments through banks	Easy handling and better control on payments

Source: HARTI Survey, 2021

5.5 Value Chain Analysis

The maize value chain consists of strategic components and activities involved in the movement of raw maize from growers through the processors to the final customers. At each stage of the chain, value is added. Traders and intermediaries are the links between each stage in the chain. The maize value chain consists of a large number of activities such as growing, processing, and the marketing of feed and food products. It consists of backward and forward linkages at each stage of the value chain.

5.5.1 Value Chain Actors

In the primary processing stage, farmers and collectors practice drying, cleaning and packing of products and supply to traders. In the secondary processing stage, traders collect and store maize after cleaning, drying and quality inspections, and they deliver the required quantity for feed and food processors for tertiary processing. The secondary processing level is important in the value addition of maize, as they support farmers by offering better prices, and provide quality products for tertiary food and feed manufactures. Other countries grow maize at a large scale, and the secondary processing involves the dry and wet milling of grains, where raw maize is converted to different main and by products. These maize products obtained in secondary processing are sold in different markets. However, in this study, it was observed that feed and food manufacturers in Sri Lanka, perform milling of grain at their mills before making different food and feed products. Therefore, in the maize value chain, more physical and market value is added at the tertiary processing. Most of the actors in maize value chain appear to be independent of each other. However, there are vertical relationship and linkages in the chain.

5.5.1.1 Farmers

They are the primary producers of maize. They also perform other activities like harvesting, shelling, drying and marketing of maize. After harvesting, most of the small and marginal farmers sell at their farm gates. Most farmers sell their produce at the farm gate to get quick cash. Also, they do not have adequate storage facilities. They mainly sell to the collectors who are ready to pick the maize of any quality and standards.

Three types of farmers cultivate maize in the major producing areas: independent farmers, out-growers and contract farmers. Farmers cultivate maize on a contract basis, and receive inputs and seeds of specific maize varieties / hybrids from another party (food retailers, feed manufacturer, poultry industry, etc.). They sign Forward Sales Contract Agreements with the buying company. Out-grower farmers are supplied with seeds and other inputs by the large-scale traders, and there are no agreements between farmers and buyers.

5.5.1.2 Input Suppliers

Input suppliers do not have a direct relationship with farmers. They maintain contacts with farmer leaders in the major producing areas, and the input companies provide training for such farmer groups by conducting field demonstrations about new seeds, new agrochemicals etc. The seed companies have set up their linkages with sales agents in major producing areas, in order to sell seeds and agrochemicals to reach their targets. In addition, the companies maintain relationships with maize traders in the country, and they have collectors / assemblers in producing areas by providing seeds and credits to farmers.

5.5.1.3 Collectors

Most of the maize collectors are dependent collectors, and they are financed by the traders. They set up farmer networks in major producing areas, as they are responsible for the collection of maize. They receive commissions for procurement either from one or more maize wholesale traders. They receive money from the traders to supply the required seeds and other inputs to farmers. They receive instructions on maize prices, quantities and quality from the traders. These collectors collect maize at the farm gate, and farmers sometimes bring their harvested stocks to the collecting centres of collectors. There are no formal contracts between them, but they maintain relationships with farmers based on mutual understanding and trust.

There are independent collectors who buy maize with their own funds, store them for some period, and resell to the traders and processors. Though the collectors collect maize at the farm gate, they have to sometimes store them before supplying traders. They keep these stocks in their homes or sheds. As most of the collectors do not have appropriate storage infrastructure, they face challenges due to deterioration in the quality of the stored products, and infestation from pests.

Collectors have their own vehicles to transport stocks from farm gate to their homes, and then to the warehouses or silos of the traders, which are located in the town areas of each major producing districts. They loaded 50kg of maize in each bag, and transport about 5 tons in a tractor, or 10 tons in a lorry in one trip. The majority of the collectors do not store any of the maize grain they purchase from farmers. They sell quickly to traders mainly due to liquidity constraints. Therefore, the majority of them engage in quick-turnover operations.

5.5.1.4 Traders

Traders are the most important and influential players in the maize-marketing system of Sri Lanka. They can influence the prices to a considerable extent. Large-scale maize traders are involved in buying, drying and selling of maize to food and feed processors. Large-scale traders collect, assemble, store and transport from production zone to factories of processors. They have their own trucks for maize collection and transportation. Large-scale traders have warehouses and silos established in major producing areas. The storage duration is highly variable depending on demand and prices. Sometimes they store maize over a long period (5 to 6 months), and then sell at higher prices to the processors to take advantage of market opportunities.

Traders invest a lot in maize trading by putting up high-capacity silos to store grains. There are 4-5 leading maize traders in the country.

1. KST Evergreen (Pvt) Ltd.
2. Ceylon Agro-industries Ltd.
3. Five-star Grain Solutions (Pvt) Ltd.
4. SDK United Agri-ventures (Pvt) Ltd.

1. KST Evergreen (Pvt.) Ltd

KST Evergreen (Pvt.) Ltd., started a maize development programme under an investment promotional package. This company, situated in the Anuradhapura district where maize is grown as the main crop, engages in maize collection and processing. This is the only organization that purchases maize in cob form, and supplies it to animal-feed industries after drying. Apart from collection and processing activities, they provide quality seeds for planting mainly in the Anuradhapura district. KST Evergreen purchase a total of 140,000 Mt annually, which is 40% of the total corn requirement of Sri Lanka.

Following extension services provide by the company to farmers to achieve their targets, KST:

- Provides high quality seeds and fertilizer
- Technical advice regarding corn cultivation
- Coordinates credit facilities for farmers with banks

Figure 5.5: KST Evergreen Maize Processing and Storage Complex in Siyabalanduwa, Monaragala District

2. Five Star Grain Solutions (Pvt) LTD:

Five Star Grain is located in Siyabalanduwa, Moneragala District, with its own grain drier and elevator. This company buys, dries and sells grain required to make poultry feed. With silos they able to hold over 20,000mt of grains, to supply national demand. The total capacity of the main silos is 15,000 mt, and the warehouse can hold 25,000mt. In addition, they have bins to temporarily store grain with a total capacity of 800 mt. After collecting grain from farmers, their drying and dryer capacity is 45mt/hour. In addition to local procurement, they import maize and other grain. In 2018, over 50% of all imported grains required by local feed millers were imported by the company.

Figure 5.6: Maize Processing and Storage Complex of Five Star Grain Solution (Pvt) Ltd. in Siyabalanduwa, Monaragala District

3. SDK United Agri Ventures Pvt. Ltd.

SDK United has their own warehouses (six) in Anuradhapura, Moneragala and Colombo. In addition, they have one silo in Anuradhapura District. The company is a leading trader in maize in Sri Lanka, handling 40,000-60,000 mt annually. They collect maize from farmers in major producing areas, with a dealer network (collectors) that collects from their out-grower network to meet the required amount of maize. During the harvesting season, farmers sell their produce to these dealers of the company. The company has about 4,800 such out-grower farmers in the Anuradhapura and Moneragala Districts.

5.5.1.5 Feed Manufacturers

Feed manufacturers have a relationship with maize traders / importers to meet their grain demand. They have processing units for milling, and get their supplies from traders. They set quality standards for purchasing grain, and when buying, their agents negotiate prices based on quality requirements, which include cleanliness, absence of foreign matter, as well as absence of mold and moisture in the grain. Informal and formal contracts exist between traders and feed manufacturers.

The first step in processing feed manufacturing is the milling of grain. The main ingredients of maize and soyabean are weighed, and put in different pits from which they are taken for grinding at the first level. The graded grains are then moved to the second level of processing, where rice bran, vitamins, and minerals are added. After preparing different types of poultry feed, they are bagged and carried on conveyer belts for storage, and sent to hatcheries, individual farmers and farms, either through dealers or to be sold at the factory gate.

Maize usage in poultry feed varies according to use. In Sri Lanka, there is provision is there to use 30-60 percent of maize in broiler feed, and 30-50 per cent in layer feed (DAPH, 2020). The two types of feed processed for layers, are: powdered feed and pellet feed. There are also 3 types of processed feed as pre-starter, starter and finisher feed, for broilers.

About 41 registered commercial feed mills operated in the country in 2020 (DAPH, 2020), producing a standard mix of feed for sale at the mill gate or to sell through their agents in depots scattered around the country.

5.5.1.6 Food Manufacturers

Maize and soya bean are the raw materials used in the largest quantities for the production of Thriposha, which amounts to 66 percent and 30 percent respectively. The number of Thriposha beneficiaries living countrywide including pregnant mothers, breast-feeding mothers and infants amount to approximately a million, and accordingly, the monthly requirement of Thriposha finished food is approximately 1,500 mt. This equals an annual requirement of 18,000 metric tons. The approximate annual requirement of maize to meet this demand is 15,000 mt.

Box 2: Thriposha Production in Sri Lanka

The Thriposha Company procures maize from large-scale maize traders in the country, from local production as well as from imports done by the traders. Traders supply the required quantity of maize, and quality inspections are done before storage. Before processing, the raw materials (maize and soyabean) are cleaned to remove impurities, insect damage and broken seeds. Blending is then done, adding milk powder, vitamins and minerals, and finally, packaging. They have adequate storage facilities to store final products, and distribution is carried out afterwards. Thriposha is distributed to MOH offices countrywide, to estate residents, and 9 centers in the Department of Probation and Child Care, provided free of charge to pregnant women, lactating mothers, infant and pre-school children. In 2019, about 11,712,420kg of Thriposha and 3,717,050kg of Suposha was produced. Total annual turnover was around 15,000mt/year.

Box 3: Plenty Food (Pvt) Ltd.

Plenty Food Ltd (Samaposha) prepares different types of cereal products using maize as an essential ingredient. These include: breakfast cereals, energy cereals, Nutriline cereals and cereal bars. Samaposha is made out of corn, rice, soya and green gram and contains vitamins A, B, E, minerals and thiamine, that provide much-needed, balanced nutrition to the nation's children, helping to make them healthier in mind and body. The farmer is assured of a guaranteed minimum price based on prevailing market rates, while the company ensures they use high-quality produce for the manufacture of Samaposha.

The annual requirement of maize is around 8,000mt. They procure 90% of their maize requirement from a contracted farmer network in major producing areas. Their farmer base is about 2,000-2,500 farmers, guaranteeing fixed prices for their produce by assisting in extension and microfinancing through banks. They have 25 extension officers. The majority of the farmers were recorded in Anuradhapura district. They collect harvests from the farmer's fields according to an agreed price and agreed quality during the Maha harvesting period, storing and gradually delivering grain to the processing centers.

5.6 Marketing Channels and Product Flow

The maize value chain consists of a large number of activities: growing, processing and the marketing of processed products at different markets. Each of these links in the chain have both backward and forward linkages.

The most prominent marketing channels are as follows:

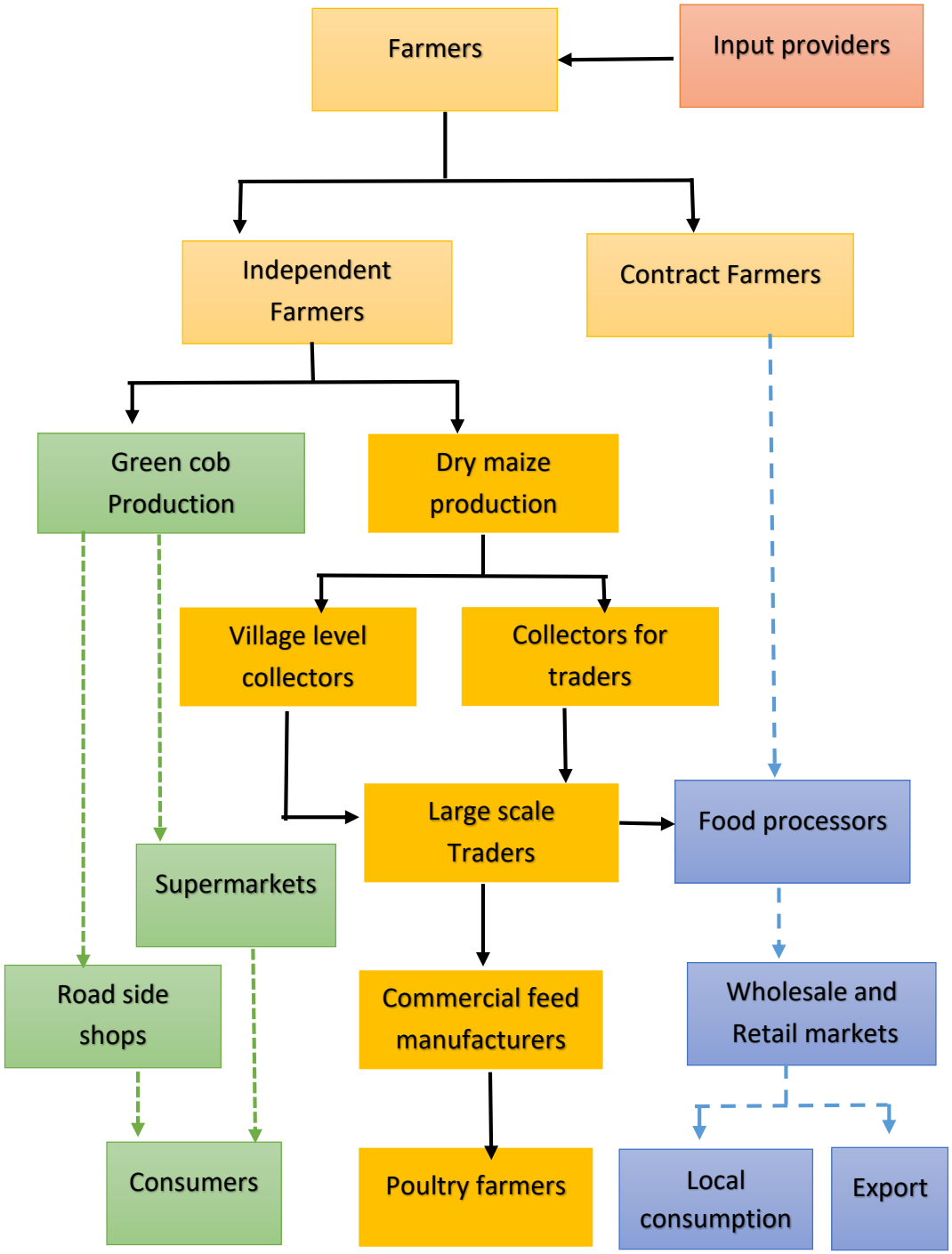
1. Poultry -feed manufacturing

- Farmers → Collectors → Large-scale Traders → Feed Manufacturers → Wholesale/Retail dealers → Commercial Poultry Farmers
- Farmers → Collectors → Small-scale Traders → Self-feed mixtures → Small and Medium Poultry Farmers

2. Food manufacturing

- Contract Farmers → Collectors of the Company / Extension Officers → Warehouses → Processing Centres → Trading → Retailing → Consumers

- Farmers → Collectors → Traders → Processing Centres → Consumers



Source: Compiled by Author, 2021

Figure 5.7: Value Chain Map for Maize in Sri Lanka

5.7 Economic Analysis

5.7.1 Cost of Production

Cost of production is an important determinant of the market value of maize. It consists of expenditures on input supply (seeds, fertilizers, agrochemicals, farm equipment, labour etc). The market value of maize for farmers is the value addition of maize at the farm level of crop production. However, more economic value is added at successive stages of the value chain. The farmer gets the market price of raw maize, which is greater than the COP. This is a positive aspect for them to expand the area of cultivation. During the 2020/21 *Maha* season, there was a significant increase in the farm gate price of maize.

The cost of production of maize in Sri Lanka can be divided into five distinct phases as: 1. Land preparation 2. Planting 3. Plant maintenance 4. Harvesting, 5. Processing and drying. Land preparation included cleaning, ploughing and harrowing. In some areas, farmers practiced 2 ploughings and harrowing using a disc plough, which commences one month after clearing land. The total average cost for land preparation was recorded as Rs.11,274/acre in Anuradhapura and Rs.14,515/acre in Monaragala.

The majority of the farmers in both districts have used imported hybrid seeds marketed by different private-sector companies, and the price ranged between Rs.6,500-9,000/5kg size packet. The seed requirement for 1ha of land is 20kg. Farmers have used 6-7kg/acre in both districts. About 22,000-30,000 plants are required to cultivate one acre. Average seed cost was recorded as Rs.9,861/acre in Anuradhapura and Rs.9,406/acre in Monaragala.

Farmers apply a mixture of Urea, TSP and MOP twice in each crop cycle, and the average cost was Rs.6,700/acre in Anuradhapura, and Rs.5,023/acre in Monaragala district in the 2020/21 *Maha* season. The total cost for fertilizer application was recorded as Rs.15,145/acre (Anuradhapura) and Rs.9,387/acre (Monaragala) on average.

Farmers used weedicides to control weeds, and the majority of them have used a “Cleo”-type weedicide, with a total cost of Rs.4,323/acre in Anuradhapura, and Rs.3,672/acre in Monaragala on average, for the application of weedicides. The most common pest type reported was the fall armyworm. The majority of the farmers used chemicals to control it, and the average cost was reported as Rs.3,028/acre (Anuradhapura) and Rs.2,092/acre (Monaragala) in the 2020/21 *Maha* season.

Plant maintenance costs are the highest cost component in the cost of production in both districts – reported as 36 percent in Anuradhapura and 29 percent in Monaragala on average. Harvesting is done manually, employing 3-5 labourers/acre after 3-4 months of planting. The majority of the farmers in both districts used “Tsunami” machine to separate seeds from the harvested cobs. Those seeds are then packed into 50kg size bags, and farmers transport them in either lorries or tractors, which cost Rs.2,500/load for short-distance transport, and Rs.3,500-4,500/load for long-distance transport.

Table 5.16: Cost of Production of Maize in Anuradhapura District (2020/21 *Maha* season)

Activity	Labour Cost			Machinery	Material	Total
	Family	Shared	Hired			
General land preparation	2,658.73					2,658.73
1st and 2nd plough with 4wt				8,615.35		8,615.35
Seeding	2,908.88	2,765.76	2,465.99		9,861.26	18,001.89
Fertilizer application	3,698.99	2,978.39	1,767.78		6,700.00	15,145.16
Weed control with weedicide	480.50		674.30		4,323.39	5,478.19
Pest & disease control	686.50		1,039.75		3,028.10	4,754.34
Harvesting & drawing	2,236.39	2,488.39	3,720.57			8,445.35
Processing with 4w thresher				4,045.33		4,045.33
Drying	1,189.06					1,189.06
Transport produce to stores	1,204.57			679.98		1,884.55
Total Cost (including family labour)	15,063.63	8,232.54	9,668.39	13,340.65	23,912.74	70,217.95
Total Cost (excluding family labour)						46,921.79
Yield and returns						
Average yield (kg/ac)						1,753.04
Price of produce (Rs/kg)						70.00
Gross income (Rs/ac)						122,712.80
Profit (Rs/ac) Inc.fam.lb						52,494.85
Profit (Rs/ac) Exc.fam.lb						75,791.01
Per Unit Cost (Rs/kg) Inc.fam.lb						40.05
Per Unit Cost (Rs/kg) Exc.fam.lb						26.77

Source: Author's Calculation, HARTI Survey Data (Sep. – Oct., 2021)

Table 5.17: Cost of Production of Maize in Monaragala District (2020/21 *Maha* season)

Activity	Labour Cost			Machinery	Material	Total
	Family	Shared	Hired			
General land preparation	2,400.00					2,400.00
1st and 2nd plough with 4wt				12,115.00		12,115.00
Seeding	2,096.19	1,883.28	592.11		9,406.96	13,978.55
Fertilizer application	1,638.52	1,490.36	1,234.42		5,023.29	9,386.59
Weed control with weedicide	415.42		735.17		3,672.30	4,822.90
Pest & disease control	252.57		649.38		2,092.02	2,993.97
Harvesting & drawing	3,481.46	2,702.42	2,519.95			8,703.82
Processing with 4w thresher				2,500.00		2,500.00
Drying	1,200.00	0.00	0.00			1,200.00
Transport produce to stores	533.00			1,459.00		1,992.00
Total Cost (including family labour)	12,017.17	6,076.07	5,731.03	16,074.00	20,194.58	60,092.84
Total Cost (excluding family labour)						41,999.61
Yield and returns						
Average yield (kg/ac)						1,742.95
Price of produce (Rs/kg)						74.00
Gross income (Rs/ac)						128,978.30
Profit (Rs/ac) Inc.fam.lb						68,885.46
Profit (Rs/ac) Exc.fam.lb						86,978.69
Per Unit Cost (Rs/kg) Inc.fam.lb						34.47
Per Unit Cost (Rs/kg) Exc.fam.lb						24.09

Source: Author's calculation, HARTI Survey Data (Sep. – Oct., 2021)

Table 5.18: Cumulative Cost and Share of Cost for Each Activity of Cost of Production in Anuradhapura District (2020/21 *Maha* Season)

Activity	Detailed Cost (Rs.)	Cumulative Cost (Rs.)	As a Percentage of Total Cost
Land preparation	Labour = 2,659/- Machinery = 8,615/-	11,274.00	16.06
Planting	Labour = 8,141/- Seeds = 9,861/-	18,002.00	25.63
Crop maintenance	Labour = 11,326/- Fertilizer = 6,700/- Weedicides = 4,323/- Pesticides = 3,028/-	25,377.00	36.14
Harvesting	Labour = 8,445/-	8,445.00	12.03
Processing, Drying and Transport	Labour = 2,394/- Machinery = 4,725/-	7,119.00	10.14
Total Cost (Rs/acre)		**70,217.00**	100.00

Source: Author's Calculation, HARTI Survey Data (Sep. – Oct., 2021)

Table 5.19: Cumulative Cost and Share of Cost for Each Activity of Cost of Production in Monaragala District (2020/21 *Maha* season)

Activity	Detailed Cost (Rs.)	Cumulative Cost (Rs.)	Share (%)
Land preparation	Labour = 2,400/- Machinery = 12,115/-	14,515.00	25.15
Planting	Labour = 4,571/- Seeds = 9,407/-	13,978.00	23.26
Crop maintenance	Labour = 6,415/- Fertilizer = 5,023/- Weedicides = 3,672/- Pesticides = 2,092/-	17,202.00	28.60
Harvesting	Labour = 8,704/-	8,704.00	14.48
Processing, Drying and Transport	Labour = 1,733/- Machinery = 3,959/-	5,692.00	9.47
Total Cost (Rs/acre)		**60,092.84**	**100.00**

Source: Author's Calculation, HARTI Survey Data (Sep. – Oct., 2021)

5.7.2 Gross Margin Analysis

Gross margin analysis is done to analyze the cost of production, total revenue and profits, and to assess break-even prices and quantities. Gross Margins (GM) provide a simple method for comparing the performance of enterprises sharing similar requirements for capital and labour. Additionally, it assists the calculation of the revenues and costs per acre, and therefore enables a comparison between different

crops. In strict terms, a GM analysis deals only with overall revenues and variable costs. Costs such as land preparation and fencing are considered as fixed costs.

The average price received by farmers in the Monaragala and Anuradhapura Districts were Rs.74.00/kg and Rs.70.00/kg respectively in the 2020/21 *Maha* season. Their average variable costs, were Rs.60,093/acre and Rs.70,218/acre, and total revenue per acre were on average recorded as Rs.128,978/- and Rs.122,713/- in Monaragala and Anuradhapura Districts respectively. Therefore, the average gross margin or profit per acre is Rs.52,495.00 in Anuradhapura, and Rs.68,885.00 in Monaragala. Average maize production was recorded as 1,753kg/acre in Anuradhapura and 1,743kg/acre in Monaragala. The break-even quantity on average was 949kg/acre in Anuradhapura and 770kg/acre in Monaragala. The average break-even price was Rs.40.00/kg/acre in Anuradhapura, and Rs.35.00/kg/acre in Monaragala.

On average, 47 percent (Anuradhapura) and 40 percent (Monaragala) of the total variable cost was related to labour. Maize cultivation is labour intensive. The majority of the maize farmers in both districts have used family and shared labour for most of the crop production activities, from input to harvesting, which was recorded as 71 percent in Anuradhapura, and 76 percent in Monaragala District.

Table 5.20: Gross Margin Analysis for Farmers in Anuradhapura and Monaragala Districts (2020/21 *Maha* season)

Revenue and Cost	Anuradhapura	Monaragala
Output (kg/acre)	Rs.1,753.00	Rs.1,743.00
Average Price (Rs/kg)	Rs.70.00	Rs.74.00
Total Revenue (TR or Gross output)	Rs.122,713.00	Rs.128,978
Total Variable Cost (TVC)	Rs.70,218.00	Rs.60,093.00
Gross Margins (TR-TVC)	Rs.52,495.00	Rs.68,885.00
Break-even Price (TVC/Production)	Rs.40.00	Rs.34.00
Break-even Quantity (TVC/Price)	948.89kg	770.42kg

Source: Author's Calculation, HARTI Survey Data (Sep. – Oct., 2021)

5.7.3 Market Margin Analysis of Maize

In the marketing of agricultural commodities, the difference between the price paid by the consumer, and price received by the producer, for an equivalent quantity of the farm produce, is often known as the farm retail-price spread or price spread. It is sometimes also known as the marketing margin. The total marketing cost includes the cost involved in moving the product from the point of production to the point of consumption, i.e., the cost of performing various marketing functions, and the profits of the various market functionaries involved in moving the produce, from the point of production until it reaches the ultimate consumer. Marketing costs, and margins incurred by the cultivator, trader and processor, were also worked out.

In this study, the marketing margins incurred by farmers, collectors and traders were worked out and presented in Figure 6.6, and it explains the total market margin, includes the costs involved in moving the product from the point of the production to industry utilization in poultry-feed production and food production (Thriposha). For this analysis, the marketing channel, which supplies maize from the Monaragala and Anuradhapura Districts to leading poultry-feed manufacturers in Colombo and Thriposha production (food), was used.

A market survey was conducted to analyze the marketing margins for the 2020/21 *Maha* season. Collectors paid Rs.70.00/kg to farmers in the Anuradhapura District, and Rs.74.00/kg to farmers in the Monaragala District, during the survey period. Hence, the farmers' gross margin was recorded as 34 to 41 percent, and this was greater than the net margin they received in the 2019/20 *Maha* season (20-31%). Collectors collect maize from farmers and transport them in lorries or tractors to the traders in their respective districts. A collector's selling price was recorded as Rs.74.00-78.00/kg. Hence, the gross margin for a collector was recorded as 4-4.5 percent, and it has decreased compared to the net margin they obtained in the 2019/20 *Maha* season (5-8%).

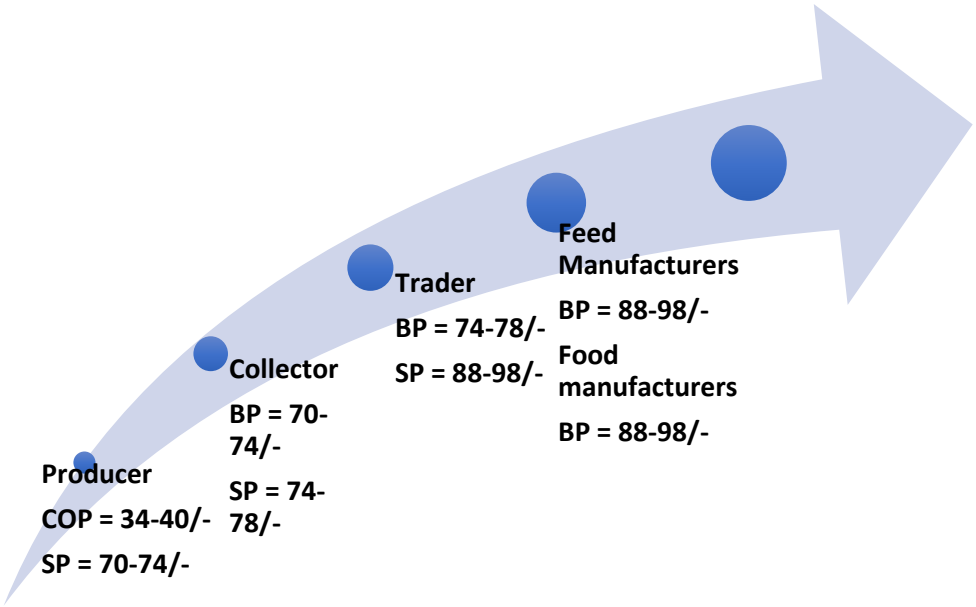
Traders have storage facilities in major producing areas, and they store maize in silos or warehouses. After purchasing they check the moisture level and for the presence of impurities. They use cleaning machines to clean the harvest before storage, and use driers to maintain the proper moisture level. After storage for some period, they deliver to feed and food manufactures in the Colombo, Gampaha, Puttalam and Kurunegala areas depending on the requirements. Traders sold maize at Rs.88.00-98.00/kg for feed/food manufacturers in the 2020-2021 period. Therefore, a traders' gross margin was recorded as 16-20 percent, which was greater than the margin observed in the 2019-2020 period (13-15%). Hence, in the value addition of maize, the highest margin was retained by the farmers.

Cost and Margins	Detailed Cost and Margins (Rs/kg)			
	2019/20 *Maha*		2020/21 *Maha*	
	Cost (Rs/kg)	%	Cost (Rs/kg)	%
Farmer				
COP	32.00[M]– 35.00[A]		34.00[M]- 40.00[A]	
Farm-gate Price	47.00[A]- 52.00[M]		70.00[A]- 74.00[M]	
Farmer's Gross Margin	12.00[A]– 20.00[M]	**20-31**	30.00[A]– 40.00[M]	**34-41**
Collector				
Collector Buying Price	47.00[A]- 52.00[M]		70.00[A]- 74.00[M]	
Selling Price	52.00-55.00		74.00-78.00	
Collector's Gross Margin	3.00-5.00	**5-8**	4.00	**4-4.50**
Trader				
Traders Buying Price	52.00-55.00		74.00-78.00	
Selling Price	60.00-65.00		88.00-98.00	
Trader's Gross Margin	8.00-10.00	**13-15**	14.00-20.00	**16-20**
Feed/Food Manufacturers				
Buying Price	60.00-65.00		88.00-98.00	

[A] – Anuradhapura; [M] - Monaragala

Source: Author's Calculation, HARTI Survey Data (Sep. – Oct., 2021)

Figure 5.8: Costs, Prices and Margins of the Maize VCA from Farm-to-Feed / Food Industry



Source: Author's Calculation, HARTI Survey Data (Sep. – Oct., 2021)

Figure 5.9: Price Flow of Maize (Farm-to-Industry) at Each Stage of Value Chain

Compound poultry-feed manufacturers in the country purchased maize from traders for Rs.88.00-98.00/kg during the survey period (April-July, 2021), as there were no imported stocks with the import ban of maize. This was higher than the price recorded in 2020 (Rs.60.00-65.00/kg). Those feed manufacturers revealed that this resulted from the increase of prices of different poultry feed manufactured (broiler feed, layer feed and breeder feed) in 2021, as maize represents 40-60 percent of the total feed cost. They expected further price increases in the coming years if the prices of maize increased further.

5.8 Constraints and Opportunities in Maize Value Chain

5.8.1 Issues Faced by Farmers

Considering the problems face by maize farmers in the Anuradhapura and Monaragala districts, 28 percent of them reported that damage by pest attacks, especially the fall armyworm during last three *Maha* seasons, was the main problem faced by them. Farmers experienced crop loss of around 20% in the 2020/21 *Maha* season on average, and it was greater than that during the previous seasons.

In the 2021/22 *Maha* season, it was observed that the farmers completed land preparation by October, and during our survey period, new cultivation had not commenced in those fields due to a lack of chemical fertilizers and agrochemicals, due to the import ban. Since they anticipated receiving chemical fertilizers for their cultivation, this issue was raised by 15 percent of the farmers.

In 2021, the producer price of maize highly fluctuated between Rs.60.00-80.00/kg in both Anuradhapura and Monaragala Districts due to the high demand created by the ban on maize imports to the country. Therefore, farmers tried to store their harvested

stocks without selling to collectors and traders, anticipating higher prices. Hence, farmers raised this problem as one of their issues.

Further, crop damage caused by forest animals, especially elephants, are other constraints experienced by maize farmers, as maize is largely grown on chena lands. With farmer interviews conducted during the survey period, the maize farmers in Siyabalanduwa, Athimale and Kotiyagala ASC areas of the Monaragala District have had to face restrictions on cultivation, due to the sudden decision taken by the Department of Forests to acquire encroached forest lands. Those farmers have cultivated maize in those encroached lands for a long period of time, and this decision badly affected farmers in such areas, and hence, about 15 percent farmers in Monaragala District pointed out this issue.

In addition to the above issues, the high price of imported seeds, losses due to unfavourable weather condition, lack of credit facilities, high input costs, and lack of proper and adequate extension facilities, were the other problems raised by the farmers in the production and marketing of maize in the 2020/21 *Maha* season.

Table 5.21: Issues Faced by Maize Farmers

	Problems	Monaragala		Anuradhapura		Total	
		Number	%	Number	%	Number	%
1.	Damage by pest attacks (Fall armyworm)	25	27	26	29	51	28
2.	Lack of chemical fertilizers and agrochemicals	15	16	12	13	27	15
3.	High price fluctuations	12	13	8	9	20	11
4.	Damage by wild animals	13	14	8	9	21	11
5.	Lack of land and ownership issues	3	3	13	15	16	9
6.	High price of imported seeds	9	10	5	6	14	8
7.	Losses due to unfavourable weather	8	9	3	3	11	6
8.	Lack of credit facilities	1	1	8	9	9	5
9.	High input costs	6	6	3	3	9	4
10.	Lack of extension facilities	2	2	3	3	5	3
	Total		**100**		**100**		**100**

Source: HARTI Survey, 2021

CHAPTER SIX

Findings, Conclusion and Recommendations

6.1 Findings

- ✓ In both districts, the majority of maize farmers (69%) have used encroached forest lands (chena) for cultivation. Considering the total cultivated extent of lands for maize in two districts, the majority of the farmers (45%) in Anuradhapura District had 2-5 acres of lands, while about 47 percent farmers in Monaragala District had 5-10 acres land. Farmers are engaged in the production of maize both for grain and seed, and in processing, transportation and sales.

- ✓ Maize seeds are mainly imported in July, August, September, and October, targeting the *Maha* cultivation of maize. The price of imported seeds varied between Rs.7,000-9,000/5kg bag and the price of local hybrid seeds was Rs.800.00/kg. The average seed cost was recorded as Rs.9,861/acre in Anuradhapura and Rs.9,406/acre in Monaragala. The seed rate was 20kg/ha (8kg/acre) for local varieties, whereas it was 13-17kg/ha (6-7kg/acre) for imported seeds in both districts. Plant density was 22,000-30,000 plants per acre. Hence, considering these advantages of imported hybrid seeds, more than 95 percent of the farmers have used them.

- ✓ *Badra* (OPV seed) was the most-produced local seed in Sri Lanka, with a quantity of 110,779kg produced at government seed farms and by contract farmers in 2020. Only two hybrid varieties of maize are currently being produced. Farmers mostly used the Jet 999, Jet 99 and Pacific varieties of imported seeds.

- ✓ The non-availability of proper storage facilities at the farmer level. This affects quality deterioration. Farmers do not have enough storage space to store bulk harvests of maize and other grain. Therefore, they are exposed to bad weather and other destructive forces.

- ✓ The majority of the farmers experienced a yield loss of less than 20 percent. A major reason for this yield loss was due to pest and disease attacks, especially due to crop damages from the fall armyworm. Other major reasons were environmental factors and damages caused by forest animals, especially elephants.

- ✓ The majority of the farmers reportedly sold their produce to the collecting centres of traders (46.2%), and to village-level collectors (32.5%) who collect maize on behalf of traders, or who work as independent collectors, and perform as wholesalers to sell maize to outside buyers.

- ✓ The majority of the farmers responded they were satisfied (83%) with the price received during the 2020/21 *Maha* season, as they received a much higher price compared to the previous season, and more than the minimum support price

announced by the government due to the import restrictions imposed by the government on imported maize, thereby increasing the demand for local maize.

- ✓ Three types of farmers cultivate maize in the major producing areas: independent farmers, out-growers and contract farmers. Farmers cultivating maize on a contract basis receive inputs and seeds of specific maize varieties / hybrids from another party (food retailers, feed manufacturer, poultry industry, etc.). They have Forward Sales Contract Agreements with the buying company. Out-grower farmers are supplied with seeds and other inputs by the large-scale traders, and there are no agreements between farmers and buyers.

- ✓ Crop damage caused by pest attacks (fall armyworm), and the unavailability of chemical fertilizers and agrochemicals to commence new cultivation in the 2021/22 Maha season, great price fluctuations of producer prices within the season due to a high demand for maize grain with the ban on imports, damage caused by forest animals, lack of land and ownership issues to cultivate due to acquisition of farmers' lands by the Forest Department from this year onwards, the high price of imported seeds, and high input costs, were the main issues faced by farmers.

- ✓ Plant maintenance costs are the highest cost component in the cost of production in both districts, which were reported as 36 percent in Anuradhapura and 29 percent in Monaragala on average.

- ✓ The average price received by farmers in Monaragala and Anuradhapura Districts was Rs.74.00/kg and Rs.70.00/kg respectively in the 2020/21 Maha season. Their average variable cost were Rs.60,093/acre and Rs.70,218/acre, and total revenue per acre were on average recorded as Rs.128,978/- and Rs.122,713/- in the Monaragala and Anuradhapura Districts respectively. Therefore, the average gross margin or profit per acre was Rs.52,495.00 in Anuradhapura, and Rs.68,885.00 in Monaragala. Average maize production was recorded as 1,753kg/acre in Anuradhapura and 1,743kg/acre in Monaragala. The break-even quantity on average was 949kg/acre in Anuradhapura and 770kg/acre in Monaragala. The average break-even price was Rs.40.00/kg/acre in Anuradhapura and Rs.35.00/kg/acre in Monaragala.

- ✓ On average, 47 percent (Anuradhapura) and 40 percent (Monaragala) of the total variable cost was related to labour. Maize cultivation is labour intensive. The majority of the maize farmers in both districts use family and shared labour for most crop production activities, from input to harvesting. It was recorded as 71 percent in Anuradhapura and 76 percent in Monaragala district.

- ✓ A market survey was conducted to analyze the marketing margins for the 2020/21 *Maha* season, compared with 2019/20 *Maha* season. A farmer's gross margin was recorded as 34 to 41 percent, and this was greater than the gross margin, they received in the 2019/20 *Maha* season (20-31%). In the value chain, the farmer's

share was the highest among the value-chain actors. This increased share of rewards by farmers will be an incentive to expand the cultivation of maize.

- ✓ A collector's selling price was recorded as Rs.74.00-78.00/kg. Hence, the gross margin for a collector was recorded as 4-4.5 percent, which decreased compared to the net margin they obtained in 2019/20 *Maha* season (5-8%). Traders sold maize at Rs.88.00-98.00/kg for feed/food manufacturers in the 2020-2021 period. Therefore, a traders' gross margin was recorded as 16-20 percent, which was greater than the margin observed in the 2019-2020 period (13-15%). Hence, in the value addition of maize, the highest margin was retained by farmers.

6.2 Conclusion

Maize is a potential crop, as a component of the long-term feed and food industry. The maize sector has several opportunities in all its subsectors such as seed, farm mechanization, processed food, animal feed, storage etc. It has enormous potential to provide food security, feed security, nutritional security, and enhanced income to maize growers. Opportunities to invest in the maize sector in Sri Lanka are visible from the strong demand for maize from the poultry feed industry.

In order to meet the incremental demand for maize in the feed industry, catalyzing greater productivity and efficiency in the value chain is required. As maize production is profitable it has a great potential for expansion as a cash crop in both the *Maha* and *Yala* seasons.

6.3 Recommendations

- Local maize production should be increased with the following interventions in production and marketing at farmers' level. With the ongoing ban on maize imports, production and productivity should be increased. It is important to increase the extent of cultivation in the *Yala* season, and productivity improvement in the *Maha* season.
  - Improve access to quality farm inputs (hybrid seeds, fertilizers)
  - Facilitate credit access
  - Encourage more contract farming: Forward Sales Contracts (FSCs) which are currently practiced at a low level should be promoted with traders, feed manufacturers and food processors
  - It is important to encourage and promote smallholder out-grower models which have had success in other countries
  - Invest more in local maize breeding and agronomic research. The government sector alone cannot strengthen technology generation due to financial constraints and there should be private-public partnership programmes in variety development (crop breeding), grain quality improvement and equipment for planting and processing.

  - Explore and facilitate land consolidation especially those left fallow. At present, the majority of the farmers in Monaragala and Anuradhapura Districts cultivate maize on encroached forest lands.
  - Promotion of "*Yaya"* cultivation is a good approach to increase production.

- Farmers should be provided with community (village-level) storage facilities. The non-availability of proper storage facilities at the farmer level affects quality deterioration. Farmers do not have enough storage space to store bulk harvests of maize and other grains.

- Training Farmers
  – Farmers are not trained in marketing systems. Proper training would improve their skills for better marketing of their produce. Training programmes are essential to enable farmers to develop more effective marketing strategies, and to negotiate more effectively with traders
  – Farmers should be trained on technical and modern management techniques

- Better Extension Facilities
  – Improve extension programmes to enable farmers to adopt improved farm technologies, and to create awareness of farmers for correct use of inputs
  - Capacity building of farmers is necessary regarding production, post-harvest management, value addition, processing and marketing. Sustainability of extension services and capacity building of farmer leaders is important.
  - A market-led extension approach is necessary to increase farmer income.

- Farmers are affected by climate changes. Therefore, it is important to implement disaster and risk-management strategies to help them become more resilient.

- Sri Lanka imports maize-based products such as cornflakes, corn flour, and corn starch, and utilization of maize for food processing is at a low level compared to the feed sector. Given the demand in Sri Lanka for value-added products, stepping into value-addition could be a possible venture to be undertaken on a large scale. Hence, the need to encourage farmers for growing better-quality corn. Industry people need to work with farmers adopting FSC as direct farmer linkages with companies could help in building a better procurement arrangement to ensure quality products for food processing.

- Secure supply of maize should be provided for potential feed mills and poultry farmers.

- It reveals that the total requirement cannot be produced locally. Therefore, policy decisions have to be taken to allow feed millers to import maize.

- Providing storage support for traders with a lack of storage facilities through leasing space in government-owned warehouses, or working with donor organizations to provide the required quality and quantity of storage.

- It is important to encourage the involvement of large-scale traders in the maize market. The participation of large traders is imperative as they create a year-round market through storage, expanding market opportunities to feed and food processors in the country.

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LIST OF APPENDICES

Annex Table 1: Extent and Production of Maize (2000-2020)

Year	Extent (ha)			Production (MT)		
	Maha	***Yala***	**Total**	***Maha***	***Yala***	**Total**
2000	26,344	2,302	28,646	28,540	2,512	31,052
2001	23,734	1,978	25,712	26,661	2,094	28,755
2002	20,329	3,084	23,413	23,244	3,173	26,417
2003	23,449	3,611	27,060	25,745	3,900	29,645
2004	20,275	3,146	23,421	31,449	3,752	35,201
2005	23,905	4,496	28,401	36,342	5,462	41,804
2006	26,310	5,692	32,002	40,376	7,145	47,521
2007	27,095	7,089	34,184	45,068	11,370	56,438
2008	42,864	8,744	51,608	91,046	21,241	112,287
2009	44,786	6,071	50,857	114,655	15,114	129,769
2010	48,887	8,731	57,618	127,761	33,933	161,694
2011	41,906	8,685	50,591	104,491	30,665	135,156
2012	50,881	8,648	59,529	165,999	36,316	202,315
2013	55,892	11,830	67,722	173,320	35,722	209,042
2014	57,525	9,694	67,219	210,886	29,702	240,588
2015	60,954	9,017	69,971	230,871	30,250	261,121
2016	57,094	10,536	67,630	207,075	36,885	243,960
2017	44,515	8,029	52,544	163,733	32,011	195,744
2018	63,926	6,969	70,895	242,935	27,106	270,041
2019	57,380	6,070	63,450	220,425	25,222	245,647
2020	66,486	11,763	78,249	267,767	45,753	313,520

Source: Department of Census and Statistics

Annex Table 2: Extent and Production of maize in Major producing districts of Sri Lanka (2016-2020)

District	Period	2016		2017		2018		2019		2020	
		Extent (Ha)	Production (Mt)	Extent (Ha)	Production (Mt)	Extent (Ha)	Production (Mt)	Extent (Ha)	Production (Mt)	Extent (Ha)	Production (Mt)
SRI LANKA	*MAHA*	57,094	207,075	44,515	163,733	63,926	242,935	57,380	220,425	66,486	267,767
	YALA	10,536	36,885	8,029	32,011	6,969	27,106	6,070	25,222	11,763	45,753
	TOTAL	67,630	243,960	52,544	195,744	70,895	270,041	63,450	245,647	78,249	313,520
MONERAGALA	*MAHA*	22,551	105,625	21,945	91,089	20,870	81,123	28,253	119,574	25,716	91,592
	YALA	629	2,461	552	2,042	650	2,215	541	2,098	968	3,447
	TOTAL	23,180	108,086	22,497	93,131	21,520	83,338	28,794	121,672	26,684	95,039
ANURADHAPURA	*MAHA*	21,066	55,825	11,920	30,635	21,752	84,773	10,272	31,206	17,697	88,794
	YALA	4,042	14,580	2,071	8,254	1,122	3,433	582	3,259	3,238	15,153
	TOTAL	25,108	70,405	13,991	38,889	22,874	88,206	10,854	34,465	20,935	103,947
BADULLA	*MAHA*	3,601	14,404	1,167	4,676	5,739	21,841	7,937	30,956	9,274	36,167
	YALA	2,527	11,136	2,475	12,537	2,613	10,450	2,749	10,996	3,973	15,890
	TOTAL	6,128	25,540	3,642	17,213	8,351	32,291	10,686	41,952	13,247	52,057
AMPARA	*MAHA*	4,525	11,991	4,297	18,370	9,356	40,972	5,434	20,683	9,512	36,283
	YALA	548	1,468	383	1,522	310	1,551	199	918	246	1,145
	TOTAL	5,073	13,459	4,680	19,892	9,666	42,523	5,633	21,601	9,758	37,428

Source: Department of Census and Statistics

Annex Table 3: Production and Imports of Maize (2000-2020)

Year	Production (MT)	Imports (MT)	Value (Rs. Mn)
2000	31,052	123,112	1163
2001	28,755	157,402	1796
2002	26,417	94,595	1206
2003	29,645	136,698	1928
2004	35,201	148,866	2519
2005	41,804	146,929	2524
2006	47,521	84,044	1695
2007	56,438	78,758	2155
2008	112,287	83,195	2634
2009	129,769	28,034	985
2010	161,694	10,506	582
2011	135,156	8,244	555
2012	202,315	2,782	785
2013	209,042	2,279	808
2014	240,588	88,138	3767
2015	261,121	68,637	3030
2016	243,960	43,057	2175
2017	195,744	181,021	7546
2018	270,041	120,568	5937
2019	245,647	103,537	5237
2020	313,520	29,820	2638

Source: Department of Customs
Department of Census and Statistics