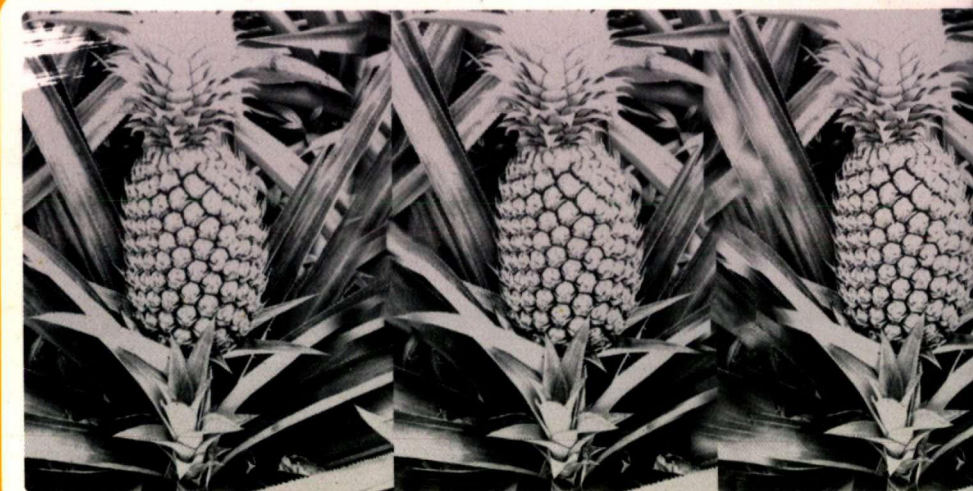


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A STUDY ON VALUE CHAIN OF PINEAPPLE AND BANANA IN SRI LANKA

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Research Report No: 145

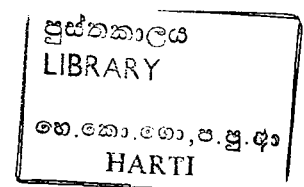


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FOREWORD

The importance of fruit sector and value chain of fruits has emerged with the changing agricultural environment in the rural sector as a result of rural to urban migration and the changing food habits and needs of the consumers. This research was conducted to improve techniques to increase production by focusing consumer needs. In addition, this research has been concentrated on other areas such as processing, environmental and social costs, health impacts and indigenous knowledge.

An integral component of the value chain is the agricultural supply chain, because in a value chain marketing system all the stakeholders such as farmers, suppliers and processors work closely to produce specific goods to satisfy consumers demand. Two major fruit crops; pineapple and banana were selected for this analysis because they are important for both local and export market. A number of interesting value chain issues have arisen in connection with the distribution of agricultural foods.

This study reveals that there are many traders involved in the marketing system. But the way they handle the crop and the services provided by them vary according to the needs of the final consumer. The gross margin between the wholesale price and the retail price of banana is very wide due to 10 percent wastage and the price reduction with the over ripening of fruits. Therefore it is necessary to implement a program to address problems in harvesting and post harvest activities including training in proper handling techniques, grading and standardization and pack house operations. The pineapple marketing system of course is also well organized and almost all the large scale producers link with the exporters and they follow the required standards.

My sincere thanks go to the research team consisting of Mrs. C.P. Hathurusinghe, Head/MFPAD, Research Fellow and Research Officers, Mrs. Roshini Rambukwella, Mrs. Ruvini Vidanapathirana and Mr. T.G. Somaratne for undertaking this research.

Mr. Lalith Kantha Jayasekara
Director

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Our gratitude is expressed to the members of Research and Training Committee for their valuable comments. A special note of appreciation is goes Prof. S.M.P. Senanayake, Professor of Economics/University of Colombo for the subject matter editing. We also wish to thank Dr. L.P.Rupasena, Deputy Director/Research and Dr. T.A. Dharmarathne, Head/MFPAD for their support. We would also like extend our gratitude to Prof. W.I. Siriweera for final editing of the report.

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C.P. Hathurusinghe
Ruwini Vidanapathirana
T.G. Somarathne
Roshini Rambukwella

ABSTRACT

Many researchers have studied the supply chain management of fruits and vegetables. But studies on value chains are very limited. Kaplinsky (2000, 121) defines the value chain as 'the full range of activities which are required to bring a product or service from conception, through the intermediary phases of production, delivery to final consumers, and final disposal after use.' The competitiveness of the private sector depends on how well the market is organized and whether it maximizes productivity along the entire chain of activities, from inputs of raw materials to marketing of final products. This study will deepen the understanding of the characteristics and inefficiencies of pineapple and banana value chains.

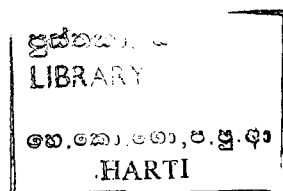
Some of the issues identified throughout the analysis require policy as well as public sector action. In addition many challenges faced by the sector can be addressed directly by the private sector and/or in partnership with the Government. Several well-known international organizations, government ministries and universities have started agriculture-related activities in Sri Lanka. Successful local agribusinesses serve as models and could provide short-term technical experts. Internationally recognized private companies engaged in export of banana, use proper techniques for maintenance of crop, harvesting, packaging and handling to fulfill the needed quality. Large scale pineapple and banana growers and traders have their own storage and packing facilities, but the facilities vary widely in technical and management qualities.

The growers try to increase the weight of pineapple and banana and this affects badly the ripened fruit. This could result in high moisture in pineapple and damaged skin in banana. Most of the small scale banana farmers sell their harvest at the nearest collecting centre, *pola* or to the mobile collectors. Immediately after selling banana, the way of handling by the labourers damages the bottom of the bunch. It is necessary to consider post harvest damages and significant improvements to product quality, product presentation, and reduction of loss.

Processing companies face problems with insufficient raw material supply, lack of credit facilities, high labour cost, high price of quality packing material and especially high price of fresh fruits. It is necessary to strengthen public-private dialogue to produce healthy seedlings to satisfy farmer needs and implement a plant distribution programme with varieties that are in demand in target markets. For the development of the selected fruits it is necessary to strengthen public-private dialogue to persuade a medium and long term strategic vision and plan for expanding the current market base of these fruits. These objectives can be fulfilled by building trust among various players along the value chain.

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CHAPTER ONE

Introduction

1.1 Introduction

The importance of value chain analysis has emerged with the changing agricultural environment in the rural sector as a result of rural to urban migration and the changing food habits and needs of the consumers. This research was conducted with a view to improve techniques of increasing production by focusing on consumer needs. In addition, this research has concentrated on other areas such as processing, environmental and social costs, health impacts and indigenous knowledge.

Value chain analysis (VCA) is a method for accounting and presenting the value that is created in a product or service as it is transformed from raw inputs to a final product consumed by end users (World Bank). Value chain analysis facilitates an improved understanding of competitive challenges, helps in the identification of relationships and coordination mechanisms, and assists in understanding how chain actors deal with powers and who governs or influences the chain. Developing value chains is often about improving access to markets and ensuring a more efficient product flow so that all actors in that chain benefit.

An integral component of the value chain is the agricultural supply chain, because in a value chain marketing system all the stakeholders such as farmers, suppliers and processors work closely to produce the specific goods to satisfy the consumer demand. Therefore in this system farmers are linked to consumers' needs. On the other hand consumers are linked to the needs of farmers through flow of information regarding orders, consumer preferences and so on. It is important that both consumers and processors are made aware of factors limiting production, as much as farmers and other producers are made aware of consumer requirements. The market "Pull" is based on integrated transactions and information. Consumers purchase products that are produced according to their preferences. The farmer becomes the core link in producing the products that the consumers desire. Under this approach all stakeholders engaged in continuous innovation can benefit. As a result, the returns to farmers can be increased and thereby living standards also can be improved.

Value chain analysis (VCA) typically involves identifying and mapping the relationships of four types of features: (i) the activities performed during each stage of processing; (ii) the value of inputs, processing time and outputs. (iii) the spatial relationships of the activities such as distance and logistics; and (iv) the structure of economic agents, such as the supplier, the producer, the processor, the wholesaler and the retailer. Value chains can become complex when they reflect multi-stage production systems with multiple types of firms operating in different locations in one country or multiple countries around the world (FAO, 2007).



In the value chain approach failures in sourcing, manufacturing and delivery in the marketing system can be identified. Under this approach the researchers will be able to recognize the key public policies such as regulations related to trade, taxes, licensing and standards, institutional and infrastructure factors and underlying constraints in the business environment. These factors will have a significant impact on the competitiveness. Market based value chain identifies the priority areas to reform the industry and helps to redesign policies for solutions within the specific environment.

Three main areas such as product market issues, factor market issues and market related issues come out in the value chain approach. Product market issues cover trade policy, competitiveness, price distortions, subsidies, licensing, product standards, customs, logistics, property rights and trade regulations. Factor market issues are wages, capital charges, utility market issues, labour market rigidities, land price and zoning. Market related issues cover market diversification, research and development, product diversification and supplier linkages, (FIAS, 2007).

Agriculture can be a major driver of growth and development in Sri Lanka because agriculture offers food security, income diversification, increased national productivity and creation of new jobs. To achieve these, agriculture should also be aimed at agribusiness. In the past as well as in the present many of the stakeholders have not really been pursuing agriculture as a business. There are many challenges such as low yields and low quality of yields, limited access to credit, and limited facilities for storage and processing to take the agriculture as a viable business to its final destination that is the market. Commercial agriculture is the best way to achieve the goals in agriculture.

In commercial agriculture, it is necessary to link the producers to critical value chain institutions to achieve their maximum capacity. This effort ultimately will provide market for agricultural commodities. Then the stakeholders will think about the aspects of the value chain. This is production, transport, processing, storage and supply management. When all these activities are integrated, it is called market-oriented approach or the value-chain approach.

The stakeholders in this sector lose their earnings due to post harvest losses. To overcome these problems proper processing is needed. The income of farmers cannot be increased by mere production. They can earn more from value addition. When the stakeholder adds value through agro industrialization, he will reap the full benefit of the investment. Also the buyers look for better grades of what they produce, and the allied issues of packaging and the rest will come in. Virtually, this is the value chain - production, storage, processing, packaging and marketing.

In the past, increased production, processing, and marketing of fruits and vegetables had changed the status of stakeholders to some extent. It is understood that there is a potential to enhance the incomes of small farmers and create employment for rural and urban poor in the country, and also to provide nutritional benefits to poor consumers. By expanding the sector it will create new opportunities for the rural and urban poor in all

aspects of the commodity chains of high value crops, from production, through processing, transport and marketing, to consumption.

In order to generate improvements in the supply or quality of any product, one needs to consider all aspects of the range of steps in the chain from production to consumption, including both opportunities and constraints, and the demand and supply of necessary products and services.

Taking a value chain approach to economic development and poverty reduction involves addressing the major constraints and opportunities faced by farmers and producers, processors, traders and other businesses at multiple levels and points along a given value chain. This will inevitably include a wide range of activities such as ensuring access to the full range of necessary inputs, facilitating access to cheaper or better inputs, strengthening the delivery of business and financial services, enabling the flow of information, facilitating improved market access, or increasing access to higher-value markets or value-added products. Hence a value chain is a connected string of companies, groups and other players working together to satisfy market demands for a particular product or group of products.

The value chain approach is used mainly to private sector development and the main goal is to accelerate economic growth and poverty reduction. Many countries use a participatory, stakeholder-driven approach to make use of opportunities for investment and growth in industries with high levels of micro and small enterprise involvement.

The value chain approach analyzes the firms in a market chain and the relationships among the stakeholders from input suppliers to final consumers or buyers. It analyzes the factors influencing industry performance, including access to and the requirements of end markets; the legal, regulatory and policy environment; coordination between firms in the industry; and the level and quality of support services. Relationships among firms in an industry can facilitate production and marketing efficiencies and enable the flow of information, learning, resources and benefits.

The value chains in this sector are very complicated. Under this sector there are many crops cultivated and marketed. The most popular fruits in the country are banana, pineapple, mango and papaw. Cultivated extent of all these crops have fluctuated mainly according to the prevailing prices, and availability of quality planting materials and weather conditions. Demand of these crops has changed due to many reasons mainly the price and the quality. During the last few years fruit sector had gained a prominent place because of the changing food habits in the urban sector and access to export markets and demand created by the processing industry.

As far as the processing industry and exports are concerned very limited quantity of crops had gained this opportunity. Some of them have undergone for processing. Some of them are supplied to the local market and others for export. Therefore to understand the value chains clearly, two crops were selected namely banana and pineapple. These two crops are produced to the domestic as well as export market in raw and processed forms. The

present situation of these crops is explained and the importance of these crops in the sector is discussed below.

1.2 Background

Extent and Production of Banana and Pineapple had increased during the last two decades and they were stable during the period 1995 to 2009. Nearly 50 percent of the production of banana comes from Kurunegala, Ratnapura and Moneragala districts. The production of banana has declined since 2006 because in UdaWalawa area farmers had reconverted the banana lands to paddy lands with the availability of low cost fertilizer for paddy. Pineapple production is mainly concentrated in Gampaha and Kurunegala districts amounting to about 76 percent of the total production. The highest cultivated extent of pineapple was reported in Kurunegala District followed by Gampaha. The cultivated extent in Kurunegala has declined gradually while that in Gampaha has increased with fluctuations. The demand for pineapple has increased from importing countries and the prices also have increased. Hence the growers in Gampaha district cultivated pineapple in almost all available lands. As a result the leasing charges of land also have increased. The domestic consumption of pineapple is very low compared to banana. According to the Department of Agriculture there is a potential to cultivate both crops in some other districts too.

Table 1.1: Extent and Production of Banana and Pineapple

Year	Banana		Pineapple	
	Extent (ha)	Production ('000 bunches)	Extent (ha)	Production ('000 fruits)
2000	48,686	33,617	4,603	34,603
2001	45,809	30,575	4,832	42,594
2002	47,850	31,719	4,800	42,432
2003	49,677	32,997	4,825	40,716
2004	50,376	33,750	5,188	48,065
2005	51,147	34,083	5,257	48,721
2006	48,856	31,528	4,963	47,640
2007	49,421	32,419	4,778	44,421
2008	47,682	33,121	4,962	43,480
2009	48,044	31,982	4,782	41,289
2000-2009 Change %	-1.3	-4.9	3.9	19.3

Source: Department of Census and Statistics of Sri Lanka

Table 1.2: Major Producing Districts of Banana and Pineapple

Year	Location	Extent (ha)	Production ('000 bunches)	As a % of Total Production
Banana				
2008	Kurunegala	8,362	6,414	19
	Ratnapura	5,705	5,199	16
	Moneragala	4,927	4,327	13
2009	Kurunegala	8,289	6,434	20
	Ratnapura	5,877	4,835	15
	Moneragala	4,603	3,811	12
Pineapple				
			(‘000 fruits)	
2008	Gampaha	1,780	15,142	35
	Kurunagala	1,636	17,325	40
2009	Gampaha	1,739	14,920	36
	Kurunagala	1,627	17,277	42

Source: Department of Census and Statistics of Sri Lanka

In early 1990s the exported quantity of banana was less than 5 mt per year. The most of the supplies were exported to the Maldives and the United Kingdom. Exported quantity of banana had increased sharply since 2005 and it had increased tremendously in 2008. From 2004 to 2008 it has increased from 25 to 1751mt. and Cavendish type banana had a higher demand in Europe, USA and Japan markets. This was mainly due to the production of Cavendish variety by the CIC and exported to Europe, USA and Japan. Mauritius type fresh pineapple had also gained a good market in Dubai and Europe. Matured but not ripened pineapple is exported to Dubai and ripened pineapple is exported to Europe.

Table 1.3: Exports of Banana and Pineapple

Year	Banana		Pineapple			
	Quantity (mt)	Value (Rs.'000)	Fresh (mt)	Juice (mt)	Dried (mt)	Preserved (mt)
2000	3	677	2,400	43	0	38
2001	36	2,169	2,314	112	0	186
2002	7	1,002	2,575	23	0	188
2003	6	1,747	2,523	10	766	90
2004	25	5,007	2,717	0	721	216
2005	45	13,623	1,682	0	434	100
2006	58	11,227	1,752	4	251	159
2007	855	51,568	1,513	108	217	134
2008	1,751	87,558	1,488	12	334	463

Source: Sri Lanka Customs

According to the Export Development Board there are 127 registered fresh fruit exporters and out of them pineapple is exported by only 29 firms and banana is exported by only 06

companies. There are 31 and 46 canned fruit and dried fruit exporters respectively. In the domestic processing industry MD, KIST, KVC, Alli and Edinborough take the leading role.

Table 1.4: Registered Exporters of Fruits

Type of Product	Number of Exporters
Fresh Fruits	127
Canned fruits	31
Dried fruits	46
Pineapple	29
Banana	06

Source: Sri Lanka Export Development Board

Domestic demand for banana varies according to the consumer preference (taste) and the price. The highest demand is for Ambul variety both in urban and rural sectors and also in the lower and upper income groups due to lower price compared to that of other varieties. The consumption of kolikuttu and ambun is high in the upper income groups.

Since 1990 the producer prices of banana have increased gradually and annual averages have increased considerably during the last two decades. The producer prices of both Mauritius and kiwi pineapples have increased considerably during the last two decades and the demand is fairly high for Mauritius type fresh fruits.

There are three marketing channels for banana and four marketing channels for pineapple which were identified according to the market surveys conducted by the Marketing Food Policy and Agribusiness Division of the HARTI.

1.3 Problem

Value chain analysis for this sector is lacking in Sri Lanka. The marketing process from farm-gate level to retail must convey information not only about prices but also must ensure the reliability at distribution network. As the distance between the farmer and the consumer widens, the level of credibility becomes more difficult to establish. Therefore, a number of interesting value chain issues have arisen in connection with the distribution of agricultural foods.

1.4 Objective

The main purpose of the study is to identify ways to improve competitiveness through three strategies: producing and delivering goods and services more efficiently; differentiating products through processing, improving quality standards, branding; and exploiting new market demand.

More specific objectives are:

1. To identify specific varieties with high value domestic and export potential,

2. To identify the actors for each step of production and marketing using the value chain approach,
3. To identify key input suppliers including technology and services,
4. To identify productivity issues at farm level,
5. To identify current market outlets and alternatives,
6. To analyze the factors affecting performance of the value chains,
7. To analyze the roles and relationships of actors in the industry for implementation of the interventions,
8. To make recommendations that will be useful for the policymakers to economic development through the income growth of rural poor and stakeholders in agricultural sector.

1.5 Methodology

The fruit sector is very wide and consists of many different sub sectors. Hence the secondary data was collected and analyzed to select the most important crops. Accordingly two major sub sectors were selected:

- Fresh fruits for local market and export market
- Processed fruits for both local and export market

Value chains were mapped for key product lines. The channel mapping methodology was used to analyze the value chain because this is a process of tracing a product flow through an entire channel from the point of product conception to the point of consumption. This process highlights the underlying patterns of inputs, constraints and competitive advantages that a producer has. It also traces the path of all value-adding and non value adding activities associated with the production of a commodity and estimated approximate costs involved at each stage.

More traditional methods of product and market analysis isolate operational costs along various stages of production. The methodology employed in this study is a much more comprehensive tool; particularly it takes into account an entire range of activities and inputs associated with a product. Supply channels with potential to be developed into fully fledged value chains were identified. Based on the identified supply channels an end market study was done to understand market requirements and critical success factors. By using it as a departure point the authors mapped all the functions, actors involved and their interrelationships downstream the chain. Apart from understanding the primary private sector actors, also the secondary actors to the chain who are the support institutions (public, donor, projects) that could work together in supporting the chain were analyzed. The critical services to be delivered by them and their relevance and sustainability were also identified.

CHAPTER TWO

Overview of the Pineapple and Banana Sector

2.1 Overview of the Pineapple Sector

2.1.1 Introduction

Pineapples (*Ananas comosus* L.) belong to family Bromeliaceae originate from tropical South America (native to Southern Brazil and Paraguay). They are still cultivated there by the low-land population, who have integrated fruit cultivation into their agro forestry systems in a variety of ways. The varieties differ greatly in both taste and shape. Each variety also has local types. All pineapples are self-sterile and mostly free of seeds. The seeds are therefore only inseminated via external sources. Pineapple is a xerophytes, and can survive long dry periods. Rainwater, mist and dew are collected by the leaves and stored. Organically grown pineapples are found in Burundi, Cameroon, Columbia, Ghana, Guinea, Honduras, India, Sri Lanka, Togo, Uganda and USA. Pineapples are eaten fresh or processed into dried fruits, juice and as canned fruits.

Pineapples are actually not just one fruit but a composite of many flowers whose individual fruitlets fuse together around a central core. Each fruitlet can be identified by an "eye," the rough spiny marking on the pineapple's surface. The fibrous flesh of pineapple is yellow in color and has a vibrant tropical flavor that balances the tastes of sweet and tart. The area closer to the base of the fruit has more sugar content and therefore a sweeter taste and more tender texture. The enzyme *bromelain* is one of its most important health-promoting compounds.

Varieties:

Most popular	—	Smooth Cayenne ('Sarawak' or 'Kew')
Other acceptable	—	Queen, Red Spanish, Mauritius
Less popular	—	Abacaxis, Sugar loaf

Table 2.1: Commercial Varieties Growing in Sri Lanka

Characters	Kew	Mauritius
1. Presence of spines in leaves	No	Yes
2. Quality of flesh	Very Good	Excellent
3. Canning quality	Very Good	Fair
4. Fruit Yield	High	Average
5. Fruit weight (kg)	2.5 - 4	1.2 - 2
6. Shape of the fruit	Cylindrical	Conical
7. Color of the ripen fruit	Yellow with green mottling	Golden yellow
8. Flavor and aroma	Pleasant	Excellent
9. Wilt resistance	Susceptible	Moderately susceptible
10. Drought resistance	Moderately resistant	Resistant
11. Farmer preference	Medium	High
12. Cultivated extent	Very low (5%)	Very high (95%)

Source: Department of Agriculture

Mauritius

This is also known as 'European Pine', 'Malacca Queen', 'Red Ceylon' and 'Red Malacca'. It is one of the 2 leading pineapple cultivars in Sri Lanka; also important in India. The leaves are dark green with broad red central stripe and red spines on the margins. The fruit is small, yellow when ripening, has a thin core and very sweet flesh. It is sold fresh and also utilized for juice.

Shape - Tapering towards crown
 Size - 1.2 - 2.25 kg
 Colour - Golden Yellow flesh
 Taste & texture - Dual taste & fibrous

Kew

This is the leading pineapple variety in the world. Also known as 'Smooth Cayenne' or 'Cayenne', 'Cayena Lisa' in Spanish (in India, Sri Lanka, Malaysia and Thailand as 'Sarawak' or 'Kew'). Leaves are free from spines except for the needle at the leaf tip.

This variety is of greatest importance worldwide mainly for processing industries on Juices, slices, pieces, cubes etc.

Shape - cylindrical, shallow eyes, orange rind
 Size - 1.8 to 4.5 kg
 Colour - Skin deep yellow when ripe. Flesh is pale Yellow
 Taste & - low fiber, juicy, mildly acidic flavor

Nutritional factors

Food Value Per 100 g of Edible Portion (Pineapple, raw, all varieties)

Elements	Amount	Elements	Amount
Total Calories	48 kcal	Vitamin B12	0 mcg
Total Fat	0.11 g	Folate	15 mcg
Saturated Fatty Acids	0 g	Vitamin A	56 IU
Monounsaturated Fatty Acids	0.01 g	Vitamin E	0.01 mg
Polyunsaturated Fatty Acids	0.04 g	Vitamin K	0.69 µg
Cholesterol	0 mg	Folic Acid	0 mcg
Sodium	1 mg	Calcium	13 mg
Total Carbohydrates	12.63 g	Iron	0.28 mg
Dietary Fiber	1.39 g	Magnesium	12 mg
Sugars	9.26 g	Phosphorus	8 mg
Protein	0.54 g	Potassium	115 mg
Water	86.45 g	Sodium	1 mg
Vitamin C	36.2 mg	Zinc	0.1 mg
Riboflavin	0.03 mg	Copper	0.09 mg
Niacin	0.48 mg	Manganese	1.17 mg
Pantothenic Acid	0.2 mg	Selenium	0.1 mcg
Vitamin B6	0.1 mg		

Source: Department of Agriculture

2.1.2 Extent and Production of Pineapple in Sri Lanka

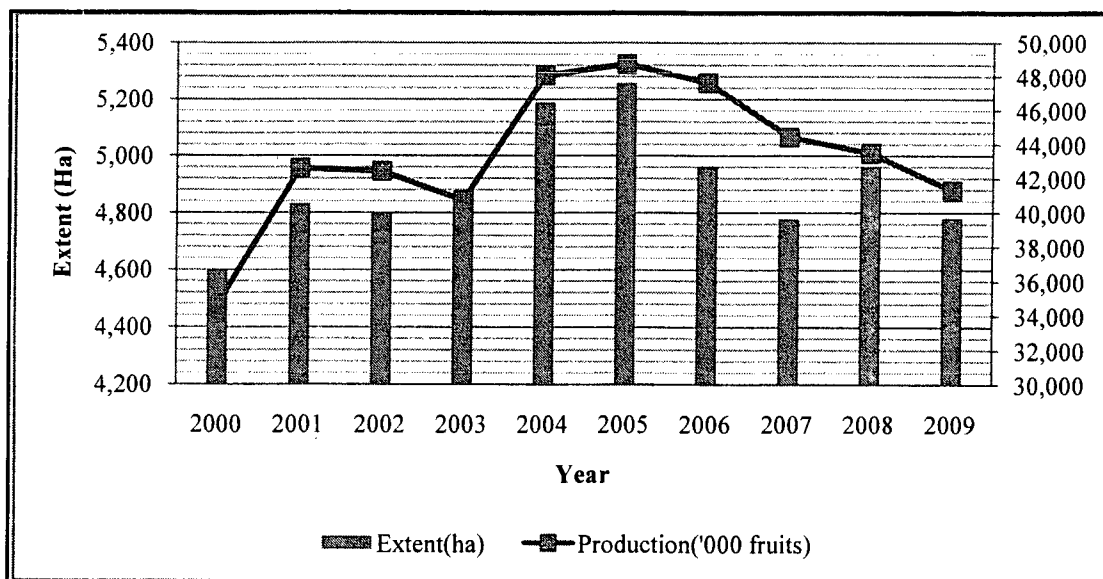
Pineapples are mainly grown in Gampaha, Kurunegala, Badulla, Puttalam, Moneragala and Colombo districts. Out of these Kurunegala and Gampaha districts contribute about 76 percent of the total production.

Table 2.2: Extent and Production of Pineapple in Sri Lanka

Year	Extent (ha)	Production ('000 fruits)	Production (mt)
2000	4,603	34,603	43,254
2001	4,832	42,594	53,243
2002	4,800	42,432	53,040
2003	4,825	40,716	50,895
2004	5,188	48,065	60,081
2005	5,257	48,721	60,901
2006	4,963	47,640	59,550
2007	4,778	44,421	55,526
2008	4,962	43,480	54,350
2009	4,782	41,289	51,611

Source: Department of Census and Statistics

Figure 2.1: Extent and Production of Pineapple 2000-2009



Source: Department of Census and Statistics

According to the table 2.2 and figure 1, the extent and production of pineapple had increased by nearly 4 percent and 19 percent respectively from 2000 to 2009. During the period 2004 and 2005 the cultivated extent and production had increased sharply as a result of the higher prices received by the farmers in previous years. With the increased production the open market prices had dropped sharply and most of the growers removed the plants from the lands. As a result the prices had increased gradually and the available supply was directed to the export market.

Table 2.3: Suitable Climatic Zones for Pineapple Cultivation in Sri Lanka

Wet Zone	WL1	WL2	WL3
Rainfall	>100"	>75"	>60"
Soil	Red yellow Podsolic	Red yellow Podsolic	Red yellow podsolic
Major growing Areas	Hiniduma, Ratnapura, Morawaka, Agalawatta, Bombuwela	Kegalla, Pelmadulla, Warakapola Polgahawela Mapalana Nakiadeniya	Walpita, Mirigama, Veyangoda, Mahara

Source: Department of Agriculture

2.1.3 Aspects of Cultivation

2.1.3.1 Site Requirement

Pineapples as a plant of the first storey of a secondary forest eco-system prefer semi-shadowed conditions. Under the full strength of the solar radiation, the fruits can develop sun-burns, especially when they stand out to one side and are no longer protected by the crown. For good harvests, 1000–1500 mm of rainfall is necessary (600 mm and 2500 mm being the outer limits). Pineapples prefer stable temperatures. Temperatures under 20°C can lead to metabolic disturbances and chlorotic discolouring. Therefore away from equatorial regions, pineapples are generally planted only up to heights below 700 m. In warmer, wetter regions (near the equator) the growth period up to harvesting is 14-16 months, in cooler regions 18-20 months. Pineapples react very sensitively to stagnant water, and sites must therefore be well drained. Planting in depressions where stagnant water can accumulate should be avoided, pineapples otherwise place relatively few demands on soil type and fertility. Irrigation is only necessary when long dry periods occur, but basin irrigation should be avoided. Due to their relatively low requirements, pineapples can be planted in degraded soil when the appropriate measures are taken, and can help to gradually improve the soil to a normal state.

2.1.3.2 Seedlings

Pineapples are vegetatively propagated by lateral shoots. The best ones to use are the suckers at the base of the trunk. The slips that form underneath the fruits are more numerous and can be used, yet these only begin to shoot during the second year. Only totally healthy and if possible large shoots should be chosen (ca. 400-500 g in weight are best), in order to ensure a uniform crop.

2.1.3.3 Method of Planting and Cultivation Systems

Planting and cultivating systems are clearly explained by the extension officers of Department of Agriculture to growers. Most of the farmers practice these methods and cultivate 5000 plants per acre.

Seedlings requirement and Field planting:

1. method Single row method
2. Double row

Table 2.4: Single Row Method

Spacing between plants within row (cm)	Spacing between rows (m)	Plants / acre	Economic lifespan
30x30	2x2	6,500	6
40x40	2x2	5,000	7
50x50	2x2	4,000	8

Source: Department of Agriculture

Table 2.5: Double Row Method

Spacing between plants within row (cm)	Spacing between rows (m)	Plants / acre	Economic lifespan (years)
30x30	1x1	16,500	4 ¼
50x50	1x1	10,000	6
30x30	1.25x1.25	14,000	5
50x50	1.25x1.25	8,600	6
30x30	1.5x1.5	12,700	5
50x50	1.5x1.5	7,600	7

Source: Department of Agriculture

2.1.3.4 Fertilizer Requirement and Management

Almost all the growers apply fertilizer to the pineapple plantations. Two months after planting first application of fertilizer is done. The second fertilizer application is done five months after planting. Most common and highly demanded fertilizer is coconut fertilizer distributed by Baur's Company and it costs Rs.2600- Rs.2750 per 50kg in 2010. Urea is also available at Rs.2600 per 50kg and farmers mix coconut fertilizer and urea by the ratio of 2:1. This quantity is enough for 500 plants. Some of the growers apply pineapple formula also. For that they mix 50kg coconut fertilizer to 1kg pineapple formula. Pineapple formula costs Rs.650 per 5kg.

2.1.3.5 Flower Induction

To avoid uneven flowering of pineapple and to attain uniform maturity and also to control the time of harvest and to reduce the picking cost the growers use Ethrel hormone. At the flowering stage that is 8 or 8 ½ months after planting, almost all the growers apply Ethrel for flowering. The plants should have reached the 30-35 leaves stage to induce flowering. Normally the hormone application can be done to about 3,000 plants out of 5,000 plants in one acre land because all the plants are not matured evenly due to many reasons. The hormone application for the rest of the plants takes another 1 ½ months. At this time the flowers can be seen from the earlier hormone applied plants. Hence the hormone application needed plants can be identified easily. Ethrel, or the more recently developed Ethephon, application causes all the fruits to mature and ripen simultaneously.

Some of the growers use liquid hormones to the crowns of the plants in the flowering stage too. The names of chemicals are Agri master, pop master, Royal super etc. Some of the farmers use Albert solution and it costs Rs.250 per 500g. They mix 1 tea spoon to 1 liter water. Harcross product costs Rs.990 per 100ml, while Ethrel was available at Rs.790 per 100ml in the market in 2010 and it had a good demand. Thrill distributed by CIC costs Rs.450 per 50ml and demand for this product was low because the fruits are not even sized after its application. In addition, chemicals were sprayed for mealy bug threat. The cost for Propenofox was Rs.995 per 400ml and Clorifydox was Rs.570 per 400ml in 2010. For spraying it 16 Litres were needed for 400 plants. For the mixture

200ml of Propenofox is used for 45gallon can and 300ml of Clorifydox is used for 45 gallons can. Some of the farmers apply Ethephon or plant fix chemicals. According to the farmers when they apply plant fix hormone, the fruit becomes large and heavy but very limited shoots come out from the plant.

The fruit comes out 45 days after application of hormones. And it takes about another 2 ½ months to mature. This means about 4 months and 15 days are needed to flowering and to reach maturity. In the last stage the eyes in the fruit skin looks mature with dark blackish colour outer skin. After harvesting the matured fruits take about 4-5 days to ripe.

2.1.3.6 Weed Management

For weed control, farmers use Dyron chemical before the first application of fertilizer and the second application of fertilizer. The cost for Dyron is Rs.1750 per kg in 2010 and it needs about 2kgs for the acre.

2.1.3.7 Harvesting

For good flavour, pineapples should be harvested when the fruit begins to turn to yellow in colour at the stalk end. If the produce destined for long term storage or voyage time it should be placed under refrigeration as soon as possible. Picking is normally done by separating the fruit from the stalk with a sharp knife trimming it to 1 to 3 cm. Harvested fruits are not exposed to sun light. Some of the fruits are harvested at the maximum maturity stage before ripening. Fruits are handled with extreme care to prevent damages and to retain export quality. Before packing, fruits are cleaned and cut and the surface of fruit stalk is covered with a chemical called carbendersim to prevent the fungal infections.

Pineapple Crop Management Chart

Multiple Crop Management Chart																																	
Month	1				2				3				4				5				6				7				8				
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1st Crop	P							W	F												W	F											
2nd Phase																																	

Month	9				10				11				12				13				14				15				16				
Week	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
1st Crop	Ho																			H	H	H											
2nd Phase						Ho																								H	H		

Source: Field Survey

*P- Planting, W-Weeding, F- Fertilizer application, Ho- Hormone application, H- Harvesting

2.1.4 Export of Pineapple from Sri Lanka

Pineapple is the third largest agricultural product after tea and coconut which has a demand in export market. But Sri Lanka is not in a position to meet the growing demand. Sri Lankan pineapple has penetrated into the Pakistan after the implementation of the Pakistan-Sri Lanka Free Trade Agreement with effect from June 2005. Major markets for pineapple are the EU, the USA and Japan. From Sri Lanka, pineapples are exported in the form of either fresh, juice, dried or preserved (canned). Out of the total production, only 3-4 percent is exported. As shown in the table 2.6, the export of fresh pineapple has decreased over the years, whereas export of preserved pineapple has shown a significant improvement and the quantity of exports has increased from 38mt in 2000 to 394mt in 2009. Export of dehydrated pineapple products has commenced in 2003 and the quantity of exports has shown a decreasing trend over the last few years.

During the period of 2000 -2009 peak production was reported in 2005 while the highest quantity of exports was reported in 2004. Both the production (by -54%) and exported quantity of dried pineapple (by -88%) had declined sharply except for exports of preserved pineapple (by 82%).

Pineapple is mainly exported to the U.A.E., the Maldives and Germany. Exports to Germany were significant from 2006 onwards and it shows that there is a growing export market in Europe.

Table 2.6: Quantity and Value of Different Pineapple Products Exported from Sri Lanka

Year	Fresh (mt)	Value (Rs.000)	Juice (mt)	Value (Rs.000)	Dried (mt)	Value (Rs.000)	Preserved (mt)	Value (Rs.000)
2000	2,400	107,843	43	6078	0	0	38	9,793
2001	2,314	165,185	112	13322	0	0	186	24,079
2002	2,575	156,485	23	2478	0	0	188	34,263
2003	2,523	131,654	10	1211	766	65,406	90	15,392
2004	2,717	171,965	0	11	721	65,129	216	38,045
2005	1,682	142,684	0	0	434	67,715	100	16,377
2006	1,752	148,284	4	615	251	104,823	159	36,797
2007	1,513	190,298	108	23131	217	114,448	134	40,430
2008	1,488	188,909	12	1857	334	220,485	463	111,995
2009	1,254	139,149	31	7089	84	55,072	394	97,181

Source: Department of Customs

Figure 2.2: Production and Exported Quantities of Fresh and Processed Pineapple

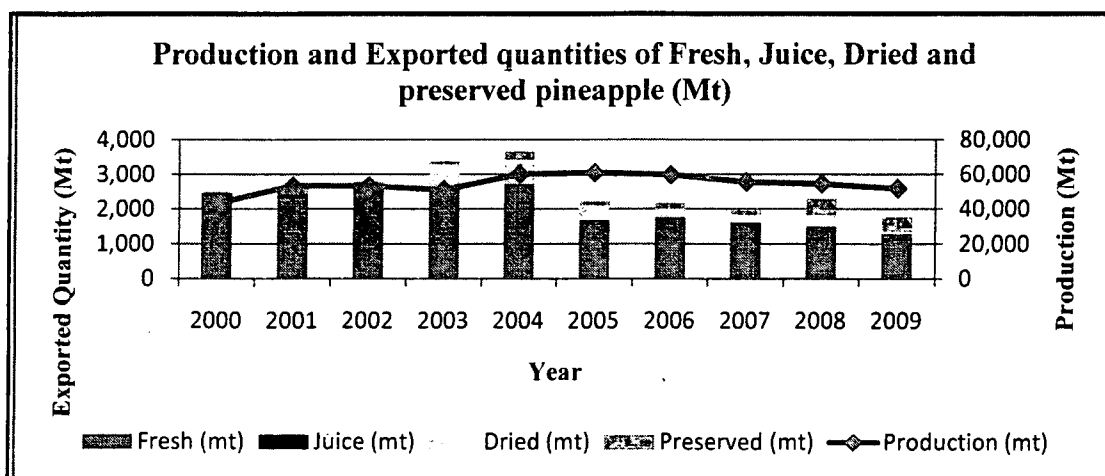


Figure 2.3: Exported Quantities of Pineapple by Countries

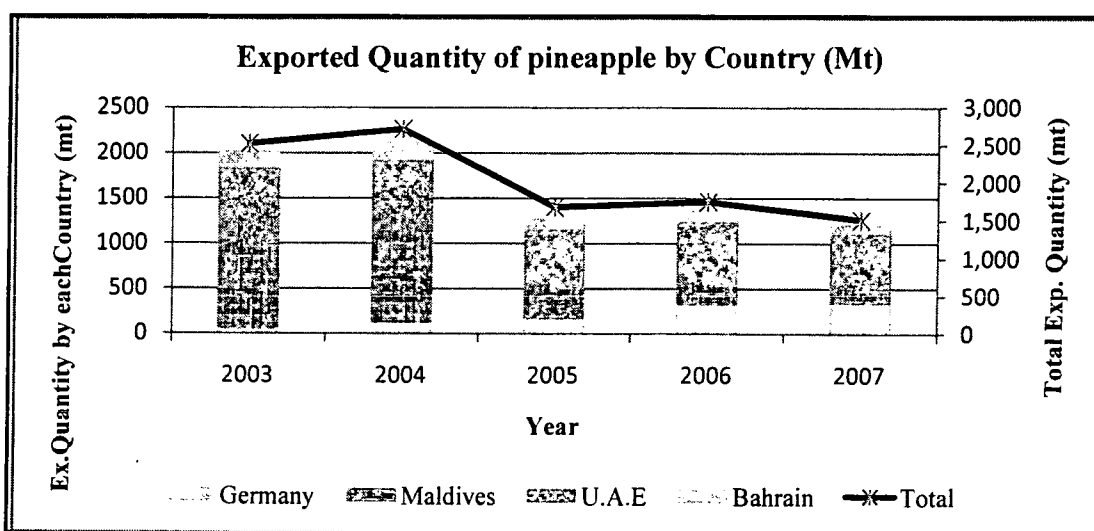


Table 2.7: Export of Pineapple by Countries

Country	2003		2004		2005		2006		2007	
	Qty (mt)	Value ('000 Rs.)	Qty (mt)	Value ('000 Rs.)	Qty (mt)	Value ('000 Rs.)	Qty (mt)	Value ('000 Rs.)	Qty (mt)	Value ('000 Rs.)
Germany	51	6,187	124	38,205	167	38,383	324	57,173	342	89,236
Maldives	939	53,327	1,015	60,792	381	21,859	252	14,622	160	12,364
U.A.E	842	21,884	782	24,450	611	26,226	666	38,442	605	39,948
Bahrain	187	7,218	203	12,171	121	4,777	129	5,787	104	6,941
Total	2,523	131,653	2,717	171,965	1,679	142,684	1,752	148,284	1,513	190,298

Source: Department of Customs

2.2 Overview of the Banana Sector

2.2.1 Introduction

Origin of banana was Southwest Asia. *Musa accuminata* and *Musa balbesiana* were the ordinary wild species and modern varieties have been formed with mixing these two species. Banana originated in the Indo-Malaysian region and botanically named as *Musa acuminata*, belongs to family *Musaceae*. Cavendish, ambul, kolikuttu, seeni, rathambala and ambun are the most popular varieties growing in the country and can be grown all over the island.

Banana (*Musa spp.*) is the most widely cultivated and consumed fruit in Sri Lanka. It is also an attractive perennial fruit crop for farmers as it gives economic gains throughout the year. Currently, nearly 60,000 ha (20,000ha and 40,000ha in wet zone and dry + intermediate zones respectively) of land is under banana cultivation in Sri Lanka. It covers about 54 percent of the total fruit lands. 13,000ha are use to cultivate plantain (for curries) and other 47,000ha lands use as fruit banana. Annual banana production is around 780,000mt and average yield is 13mt/ha. Out of the total production only around 5 percent is exported. In crop production banana takes the 4th place in the world and as a fruit crop it takes the 2nd place in the world.

Banana (*Musa sp.*) is the most popular fruit globally, the fourth most widely consumed crop by humans; after rice, wheat, and corn. In sub-Saharan Africa, especially East Africa, millions of people depend on different types of banana as a staple food and a source of livelihood. In the East African region, Uganda is the world's second leading producer after India, harvesting 10 million metric tons annually with an estimated value of US\$ 1.7 billion. The five largest exporters are Ecuador, the Philippines, Costa Rica, Colombia and Guatemala. Over 80 percent of the world banana trade is controlled by five companies.

Like most tropical fruits, bananas are highly perishable, which need efficient harvesting, packing and transportation systems. Bananas for export are shipped green in refrigerated vessels that prevent them from ripening before arrival. Once they reach the destination they are ripened in special facilities. World banana exports were projected to be about 14.5mt in 2010 that is about 20 percent higher than the average of base period 1998-2000.

Nutritional Value in 100g of banana

Nutrients	Quantity	Nutrients	Quantity
Energy	116.0	Iron	0.9mg
Protein	1.2g	Carotene	78.0ug
Fat	0.3g	Thiamine	50.0ug
Carbohydrates	27.2g	Riboflavin	80.0
Calcium	17.0g	Vat. C	7.0
Phosphorus	36.0mg		

Source: Department of Agriculture

2.2.2 Harvesting and Handling

Banana bunches are harvested with a curved knife when the fruits are about 75 percent matured, fully developed and the upper hands change in to light green and the flower remnants (styles) are off the tips. Generally, this stage is reached 75 to 80 days after the opening of the first hand.

For packing for export market, individual hands are cut from the harvested bunches. These are placed on a sheath laid out on the ground with the cut crown pointing downwards to avoid latex running on to the fruits. The hands are left for a few minutes until the latex flow slowly and thereafter a paper pad (previously soaked in TBZ fungicide) is laid over the cut surfaces. Exposure to even moderate light after harvest initiates the ripening process. Therefore to protect the fruits from light as much as possible they are sent to the packing shed.

Harvested bunches are sent to the market by the farmers and whole bunches are distributed to regional markets by the traders. Hands are detached from the bunch at the collecting center or in the pack house by the traders on request of their customers. Finally these lots are delivered to the supermarkets or hotels on request.

Banana Crop Management Chart

Month	1				2				3				4				5				6				7				8				
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Kolikuttu	P							W	F														W	F									
Embul	P							W	F														W	F									
Amban	P							W	F														W	F									

Month	9				10				11				12				13				14				15				16					
Week	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	
Kolikuttu																																		
Embul																			H	H	H			H	H	H								
Amban												W	F																		H	H		

Source: Field Survey

*P- Planting, W-Weeding, F- Fertilizer application, Ho- Hormone application, H- Harvesting

2.2.3 Packaging

For the export market delivery exporters/producers use full telescopic corrugated boxes with ventilation holes at the top and bottom only. These boxes are strong enough to protect the fruits when 10 boxes are stacked one above the other. The fruits are kept inside 150 gauge polyethylene film bag which is in the box. Then they are packed well by folding the bag preventing bruising of the fruits moving about during transport. Immediately after they are packed, boxes are transported to a cold room for storage.

For the domestic marketing most of the production is not packed properly. Banana hands are packed in the plastic crates while transporting to the super markets and hotels.

Almost all the other banana bunches are packed in a lorry and some of the traders put banana leaves as packing material in between bunches to avoid bruises. This is a low cost method for packing.

2.2.4 Delivery

Fruits are kept in the reefer trucks as quickly as possible to maintain quality. Boxes are stacked on top of another in a column with no air space between them. Normally the supplies to the local market are not transported through reefer trucks.

2.2.5 Controlled Ripening and Storage

Harvested bananas are allowed to ripen naturally at room temperature. They are not as sweet and flavorful as those ripened artificially. Post harvest ripening is expedited undesirably if bunches or hands are stored in unventilated polyethylene bags.

Bananas are generally ripened in storage rooms with 90 to 95 percent relative humidity at the beginning and later reduced to 85 percent by ventilation, and at temperatures ranging from 58° to 75°F (14.4°-23.9°C), with 2 to 3 exposures to ethylene gas at 1: 1000, or 6 hourly applications for 1 to 4 days, depending on the speed of ripening desired. The fruit must be kept cool at 56° 60°F (13.3°-15.6°C) and 80 to 85% relative humidity after removal from storage and during delivery to markets to avoid rapid spoilage.

Almost all the banana bunches are sprayed with ethylene before packing in to the trucks.

2.2.6 Labeling

The following details are presented outside the box:

- handling information
- this side up symbol
- fragile symbol
- temperature symbol with indication of temperature range
- Produce information
- bar coding
- country of origin
- produce
- net weight
- count – no of fruits in package
- packed – date of packing
- tare – tare weight in kg
- packer or dispatcher name and address or authorized code
- grower – name and address or code

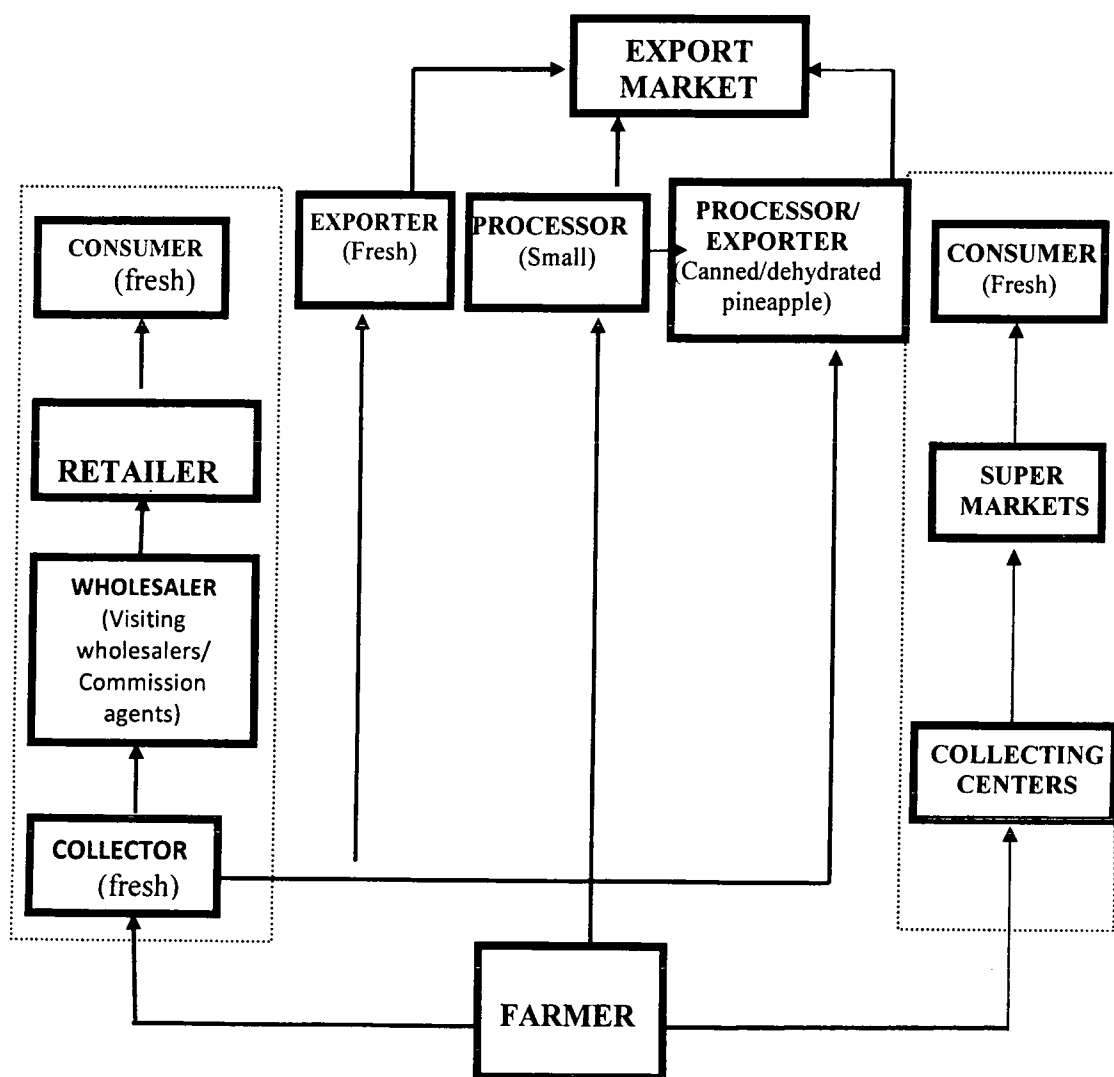
CHAPTER THREE

Value Chain Analysis for Pineapple

3.1 Introduction

The value chain concept entails the addition of value as the product progresses from input suppliers to producers to consumers. Typical value chain linkages include input supply, production, assembly, transport, storage, processing, wholesaling, retailing and utilization, with exportation included as a major stage for products destined for international markets. Value chains represent the value of each commodity as it passes along the supply chain to the final consumer. Examination of the supply and value chains can reveal important obstacles and inefficiencies in an agricultural economy.

Figure 3.1: Marketing Channels for Pineapple in Sri Lanka



Marketing channels for pineapple are very similar to those of many other agricultural commodities. There are several types of market participants such as collectors, wholesalers, retailers, exporters, processors and institutional buyers. Majority of the farmers sell their produce to collectors at field level. When fruits are purchased by them, farmers need not pack and transport the fruits. Collectors supply pineapple to commission agents in the Colombo Manning market and to hotels, restaurants and institutional buyers. Visiting wholesalers come from different parts of the country to major producing areas of pineapple and they purchase either from collectors or directly from farmers. Retailers are the final sellers. If they purchase pineapple from commission agents they have to bear the transport cost and when they buy directly from visiting wholesalers transport cost is not involved.

Only a small share of market surplus is purchased by the processors. The processors mostly purchase fruits directly from collectors and sometimes small scale processors directly buy from farmers.

Exporters mostly purchase pineapple from collectors and from large scale farmers. The exporters and the collectors have a good relationship. The collectors and farmers also have good understanding about cultivation and harvesting periods and the quantities available with them.

The main institutional buyers are hotels/restaurants, hospitals and processors. The share of this group of buyers is negligible. They buy on contract basis from suppliers who are mostly collectors. A few of them buy the fruits from commission agents.

3.2 Value Chain of Fresh Pineapple for Local Market

3.2.1 Cost of Production of Pineapple

Farmers have to clear the land before they adopt other methods of land preparation. Thereafter lands need to be ploughed and harrowed and these operations would cost about Rs.9,000/acre. Almost all the farmers constructed fences to protect plants and production from animals and thieves. It is estimated that 6 roles of barbed wire and 60 wooden posts or concrete posts are required for fencing of one acre land. 30 man days of manual labour are required for the construction of a fence. Therefore, the total cost for fencing is Rs. 63,000/acre.

Planting materials cost is around Rs.6.00-8.00 per plant. In Gampaha district a plant costs at Rs.7.00. The cost of plants varies from Rs.35,000 - Rs.40,000 per acre. The transport cost is Rs.7,500 for 5000 plants. The labour requirement for planting is 12 man days.

Most of the farmers use coconut fertilizer for pineapple cultivations. Pineapple fertilizer mixture is also used by some farmers who cultivate pineapple mainly under rubber cultivation. Most farmers mix the fertilizer. They use 6 bags of pineapple fertilizers (50kg size) for one acre. The cost for one bag is Rs. 4,000. In addition to this mixture, one bag of urea is added for 4 bags of pineapple mixture. Therefore, the total cost of fertilizer is

Rs. 28,500 per acre. Most of the farmers apply fertilizers twice a year. About 8 man-days of manual labour are needed per acre for each application of fertilizer. The other important activity is hormone application. There are two varieties of hormones. The farmers mainly use ethrel, which is more effective than plofenex. Two man-days of manual labour are required for each application of hormones.

Different categories of farmers adopt different methods of weeding. Some do only manual weeding, four times per year, which is costly and less effective, but good for the crop in the long run. Most do manual weeding twice per year and chemical weeding during the rainy season at the end of the year. Some others do chemical weeding 2-3 times per year. The second category of weeding for estimation of the cost of production has been used in the study as most of the farmers follow this method.

The next important activity is harvesting. Skilled labour is required for harvesting. With two man-days of manual labour 2000-2500 fruits could be harvested. Three man-days of manual labour are needed to harvest one acre land and another two persons are needed to collect the fruits. After the first harvest, a significant proportion of farmers maintain two suckers in one cluster and thereby expect to harvest nearly ten thousand fruits from 5000 clusters.

A significant proportion of farmers especially the large-scale farmers, rent or lease the land for cultivation. The terms of the lease could vary according to the conditions of the land. Some pay Rs.5,000 per acre per year and they have to look after the coconut plants while receiving the income from coconut trees. If so, expenditure on land rent would be compensated by the income from coconut. However, in some other cases, the farmers have to plant the coconut trees and maintain them. That involves another cost for the farmers. The land rent is considered as Rs.5,000 per acre per year for the estimation of cost of production.

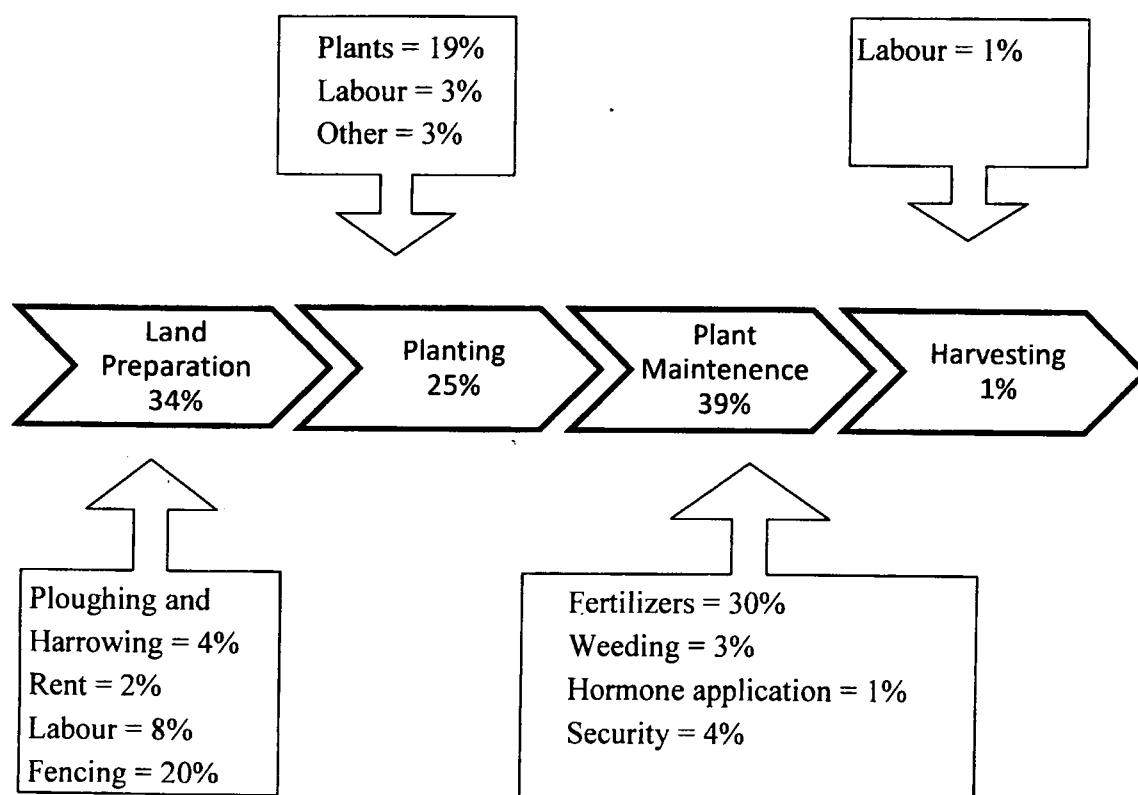
The cost of cultivation of pineapple is about Rs.200,000 per acre. But the major costs incurred for land leasing, land preparation and planting material are spread throughout the next three years. The yield also varies during this period. The average cost of production of pineapple was about Rs.20.00 per kg at the initial stage. For the growers who sell to the collectors the actual cost for the first year is about Rs.18.14 per kg because harvesting is done by the collector.

**Table 3.1: Cost of Production of Pineapple in Gampaha District (Rs/Acre)
October 2010**

Activity	Cost for Inputs (Rs/acre)	Cost for Labour (Rs/acre)	Total Cost (Rs/acre)		
			1 st Year	2 nd Year	3 rd Year
Rent			5,000		
Land Preparation			9,000		
Fencing		(21000+24000+5400)/4			
- Posts	21000				
- Barbed wire	24000	(3md * 600*3) = 5,400	12,600		
Planting					
- Plants	42000	(2md * 600) = 7,200	49,200		
- Transport			7,500		
Fertilizers					
- NPK Mixture	57,000	(8md * 600 * 2) = 9,600	62,600	62,600	
(2 times/Year)		(3md * 600) = 1,800			
Weeding					
- Diuron	4,425	(4md * 600) = 2,400	6,825	6,825	
Hormone Application					
- Ethrel	500	(2md * 600) = 1,200	1,700	1,700	
Security			8,000	8,000	
Harvesting		(5md * 600) = 3000	3,000	3,000	
Leaf cut		(3md * 600) = 1800	1,800	1,800	
Sub total	148,925				
TOTAL COST			154,225	87,925	
Average Yield (kg)			7,800	8,000	5,000
Gross Income Rs/acre)			351,000		
Cost of Production (Rs/kg)			19.77		
Average Price (Rs/kg)			45.00		

Source: Survey Data, October - 2010

Figure 3.2: Value Chain for Fresh Pineapple (On-farm) in Gampaha District



Plant maintenance is the highest cost component of the value chain for fresh pineapple, and this is driven primarily by the high cost of fertilizers and chemicals, all of which are imported.

3.2.2 Marketing Cost of Pineapple from Gampaha to Rajagiriya Retail Market

Collector's Cost

- Pineapple load per lorry = 1500 kg
- Total transport cost for the load = Rs. 3000/-
- Labour cost for loading and unloading = Rs. 2400/-

Cost for the Retailer

- Transport cost = Rs.300/- per load
- Labour cost = Rs. 10,000/- per month
- Rent = Rs. 15,000/- per month
- Other cost = Rs. 3000/- per month

Figure 3.3: Value Chain for Fresh Pineapple

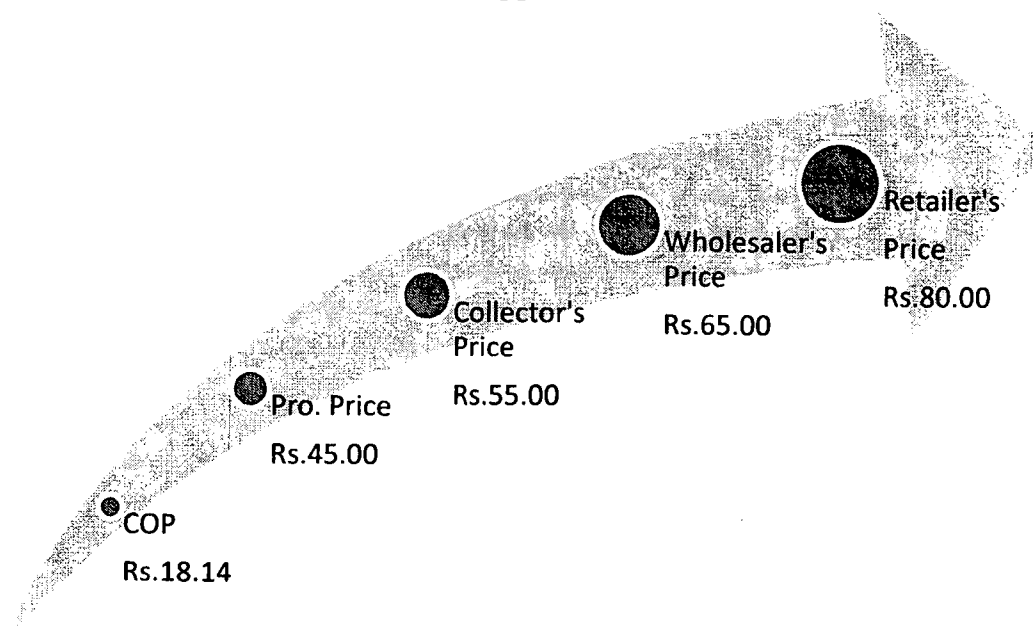
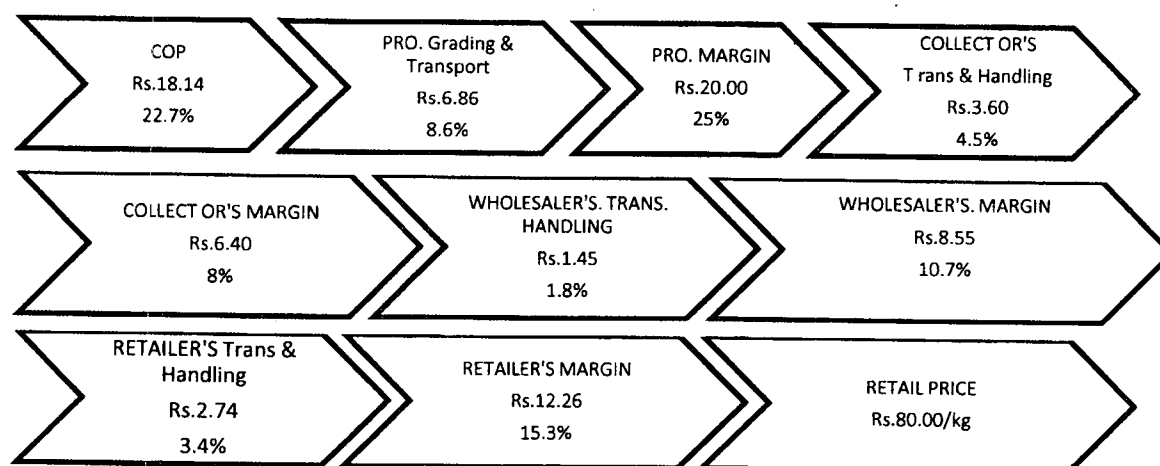


Figure 3.4: Marketing Cost for Pineapple (farmer – collector – wholesaler – retailer)



When the collectors visit the land to purchase pineapple they do harvesting as well as grading. They themselves transport the produce to the wholesalers, Exporters or directly to the retailers. Most of the time collectors pay cash at the time of purchasing. Sometimes they pay later when the grower and the trader are well known to each other and they do business regularly. During the survey period it was observed that collectors visited growers to collect pineapple because there was a shortage of pineapple in the area

and exporters were trying to obtain the crop. As a result farmers could get Rs. 65.00/kg at the farm from both collectors and wholesalers. Pineapple growers' view was that they had no selling problems because collectors visit their farms according to the need of the importers.

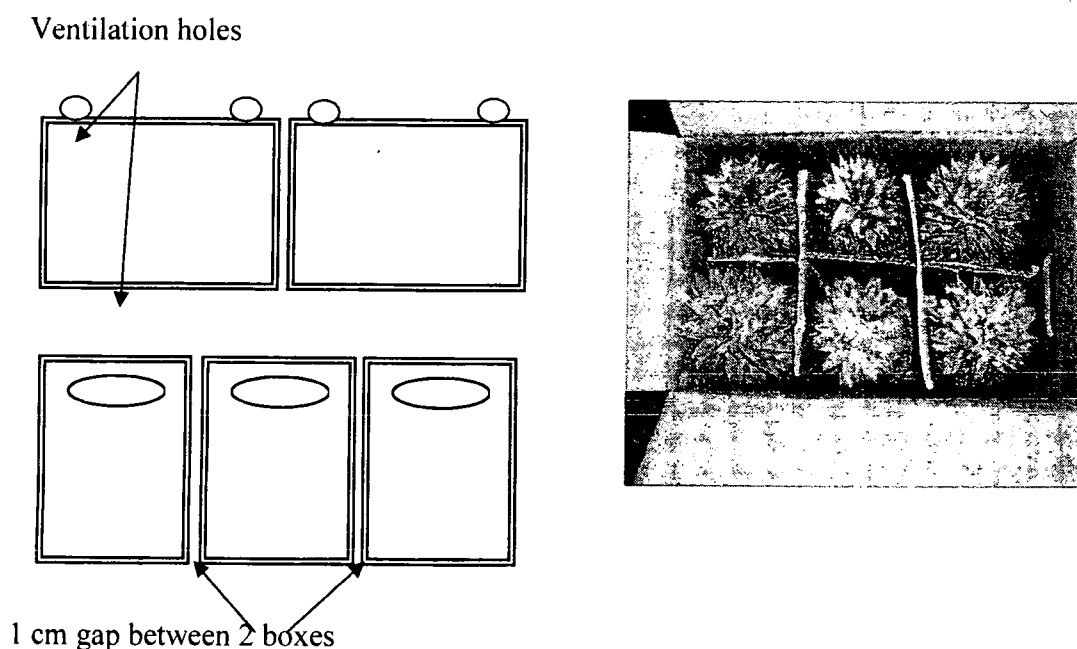
3.3 Value Chain for Fresh Pineapple Export from Sri Lanka

3.3.1 Packing and Storage

The function of packaging is to protect the fruit from mechanically and atmospherically caused damages during the transportation from producer to the market. In addition, packaging supports the sales promotion, presentation of the fruit and identification of content and its origin. Fruit can be packed either flat or upright in 12 to 15 kg cartons, with 8 to 20 fruit per pack, depending upon the grade of the fruit. Fruit between 1.2 to 1.6 kg is packed in five ply fiberboard carton of 370 mm long X 330 mm wide X 220 mm deep. Carton must be well ventilated for sea freighting. The box should be divided internally into six compartments by inter locking strong fibre board dividers. For larger luxury fruit, it is more important that the crown be protected during shipment. In order to save on freight space the larger crowns can be trimmed to a minimum prior to harvesting or before packaging for export marketing.

Top ventilation - If the boxes are to be transported in reefer containers with cold air input at the top of the container, the boxes should have ventilation holes at all four sides. The boxes should be stacked in the container leaving around 1 cm space between boxes and stacked as follows for proper ventilation.

Figure 3.5: Packing of Fresh Pineapples



Bottom ventilation – where boxes are transported in reefer containers with the cold air input is from the bottom, the boxes should have no holes on the sides but only holes on the top and bottom.

Boxes should be stacked in the container one on top of another with the bottom hole of one box directly above the top hole of the one below, so that air can be blown through them. Space between boxes and the side wall of the container should be blocked off with polystyrene, wood or laying poly sacks to encourage the air to be blown through the boxes.

Storage

After packing they should be transported as quickly as possible to a pre – cooling room. They should be stacked in the pre cooler so as to achieve maximum air circulation around each fruit so that they are cooled to 14⁰C within 12 hours after being placed in the pre - cooler. Pre - cooling is required for successful sea shipments and the temperature should be controlled between 10⁰C to 14 ⁰C during the journey, depending on the storage time required, the maturity of the fruit and the variety. Cold storage at a temperature below 4.5⁰C causes chilling injury and internal breakdown in pineapples. Mature green fruit can be safely stored at temperatures between 10 and 14⁰C. The expected life of fruit kept in the right condition is maximum of 4 weeks. The relative humidity should be high (80%-90%) to help keep the fresh appearance of the fruit.

Ethylene releasing compounds have been used for some time to stimulate uniform ripening and colouring. There is a possibility that storage life might be prolonged by dipping the fruits in a wax emulsion containing a suitable fungicide. Irradiation extends the shelf life of half- ripe pineapples by about one week.

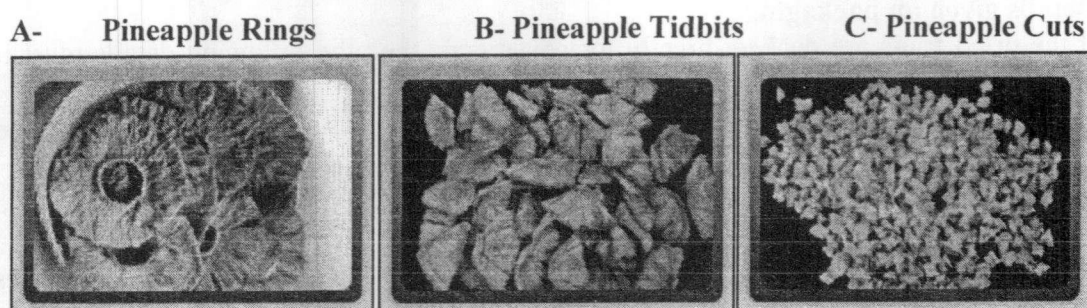
3.3.2 Labeling

- handling information
- this side up symbol
- fragile symbol
- temperature symbol with indication of temperature range
- produce information
- bar coding
- country of origin
- produce
- net weight
- count – no of fruits in package
- packed – date of packing
- tare – tare weight in kg
- packer or dispatcher name and address or authorized code
- grower – name and address or code

3.4 Value Chains for Different Types of Pineapple Products

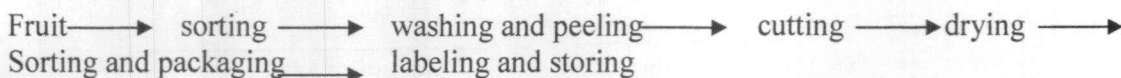
3.4.1 Dried Pineapples

Figures 3.6: Different Dehydrated Pineapple Products



3.4.1.1 Processing

Drying is the oldest method of keeping food for longer periods. It is based on the fact that micro-organisms tend to cease growing below a certain level of water content. During drying, it is important to extract the water from the fruit as carefully as possible. The most important features are a good circulation of air and not too high temperatures. The preparation stages from fresh to dried fruit are outlined below and then described in detail.



Sorting

After harvesting, the fruits are sorted as only fresh, unripe and unfermented fruits can be used for drying.

Washing and peeling

Pineapples are washed very carefully, without damaging them. Afterwards, inedible parts such as leaves, seeds, pips, heartwood and skins are removed.

Cutting and Drying the fruits

The fruits are now cut into uniform sized pieces, and laid out to dry in the air and sun in thin layers on racks, in solar dryers (drying tunnels) or drying ovens (artificial drying at 70°C).

Sorting and packaging

Before they are packed, the fruits are inspected and sorted again, to remove discoloured, skin remnants and seeds etc.

Packing and Storage

Packaging types and material

In order to be exported to Europe, the dried fruits can be packed in consumer packs, or wholesaler packs (bulk) in bags made of saleable, foils, impermeable to steam (e.g. polyethylene or polypropylene). Before sealing, a gas (e.g. nitrogen) may be added (nitrogen flushing).

Details given on packaging

If the dried fruits are packed directly for consumers, then the following details must be included on the outside of the packets:

- Product name ('trade name'): The name of the product, e.g.: Pineapple slices organically grown
- Manufacturer: Name and address of the manufacturer, importer, exporter or trader within the country of origin.
- List of contents: A list of ingredients and additions, beginning with the heaviest proportion of total weight at the time of packaging.
- Weight: Details of the total packed weight in grams
- Best before date: The 'Best before ...' details must include day, month and year; e.g. best before 30.11.2012
- Batch number

Storage

The dried fruits should be stored in dark areas at low temperatures and relative humidity. Under optimum conditions, dried fruits can be stored for up to 1 year.

Figure 3.7: Value Chain for Dehydrated Pineapples

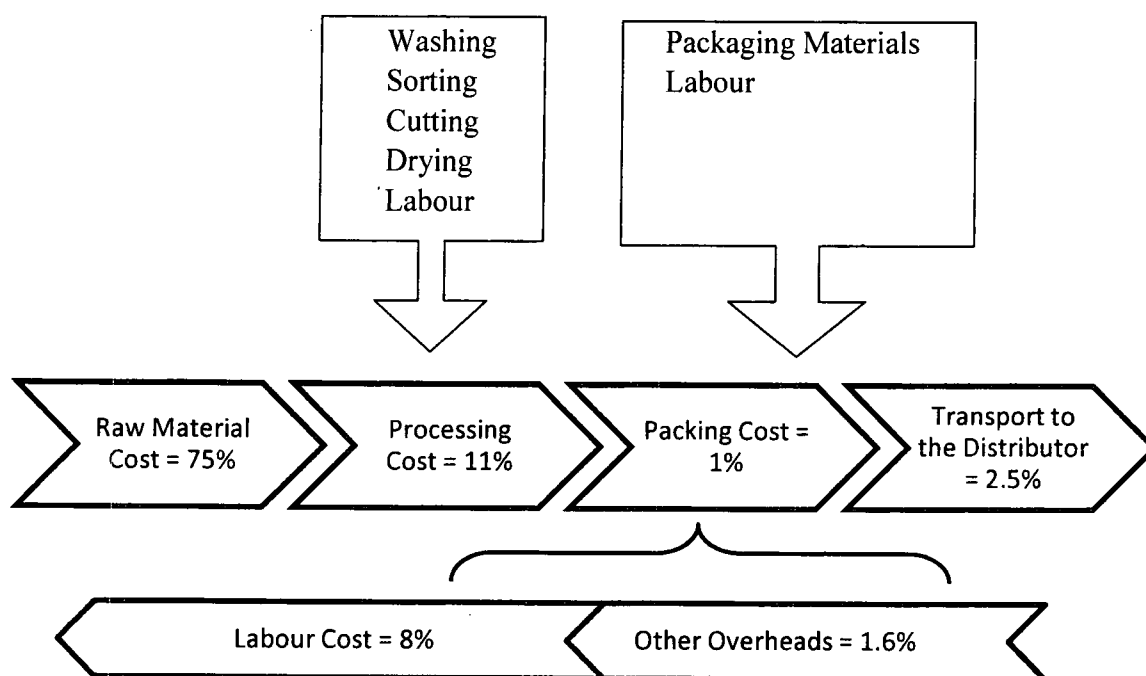


Table 3.2: Cost of Production for Dehydrated Pineapples (Rs/kg)

	Raw Material Cost	Processing Cost	Labour Cost	Packing Cost	Other Overheads	Transport Cost	Total Cost
Unit Value (Rs/kg)	900.00	130.00	100.00	16.00	20.00	30.00	1196.00
% of Total	75%	11%	8%	1%	1.6%	2.5%	100%

Source: Survey Data, October-2010

Value chain diagram for dehydrated pineapple indicates that raw material cost is the highest cost component of the value chain representing 75 percent of the total value of the production of dried pineapples followed by processing cost. About 20 kg fresh pineapples are needed to produce 1 kg of dehydrated pineapple. Processing cost is 11 percent of the total value.

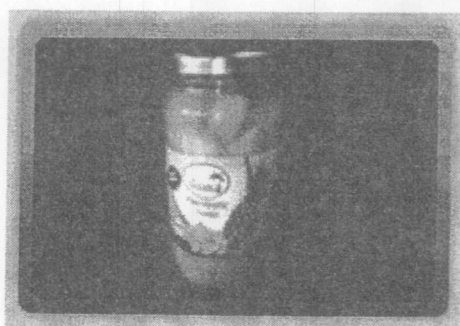
Exporting countries

Canned and dehydrated products are exported to Europe, England and China.

3.4.2 Canned Pineapples

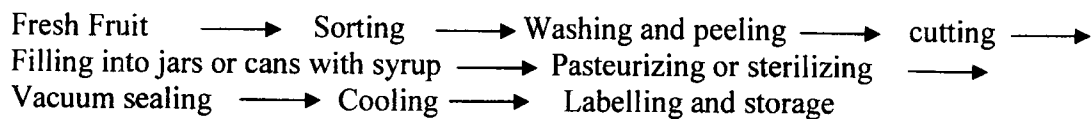
Both the pineapple pieces and the rings are canned with juice.

Figure 3.8: Pineapple Pieces in Juice & Pineapple Rings in Juice



3.4.2.1 Processing

Canned foods are products that can be stored over a long period in airtight containers (metal or glass jars). They are preserved mainly by heat treatment, during which the micro-organisms present in the fruit are significantly reduced in number, or their development restricted prevented spoiling the product. The process involved in turning fresh fruit into canned products is described schematically, and then in more detail below:



Sorting

Harvested fresh fruits are sorted because only fresh, ripe and fruits are needed for processing.

Washing and peeling

The fruits are washed very carefully without damaging the skin. This follows the procedure of removing leaves, wooden pieces, pips or seeds and peel. Peeling is often done manually with a knife. Sometimes the skin is loosened with steam and then subsequently rubbed away mechanically. Finally, the fruits are sorted again to remove any blackened pieces, bits of peeling, seeds etc.

Cutting

The peeled fruits are cut into a variety of shapes, according to type (indicated by the crosses in the table). The shape of the cut fruit must be given on the can (slices, diced, pieces etc.).

Filling in jars or cans

The cut pieces are then filled into jars or cans and covered with syrup. Additional information must be given on the can according to the sugar content of the syrup.

Vacuum sealing, pasteurizing or sterilizing

After the jars or cans have been vacuum sealed, they are either pasteurized (temperatures above 80°C) or sterilized (temperatures above 100°C).

Cooling

After the heating process, the canned fruits are first cooled to 40°C, and then subsequently down to storage temperature.

Labelling and storage

After they have been cooled, the canned fruits are labelled and stored.

Packing and Storage

Packaging type and material

For exporting to Europe, fruits are packed into single or wholesale packages (bulk) made of glass, aluminium foils or tin cans.

Details given on packaging

The label on the jar must display the following:

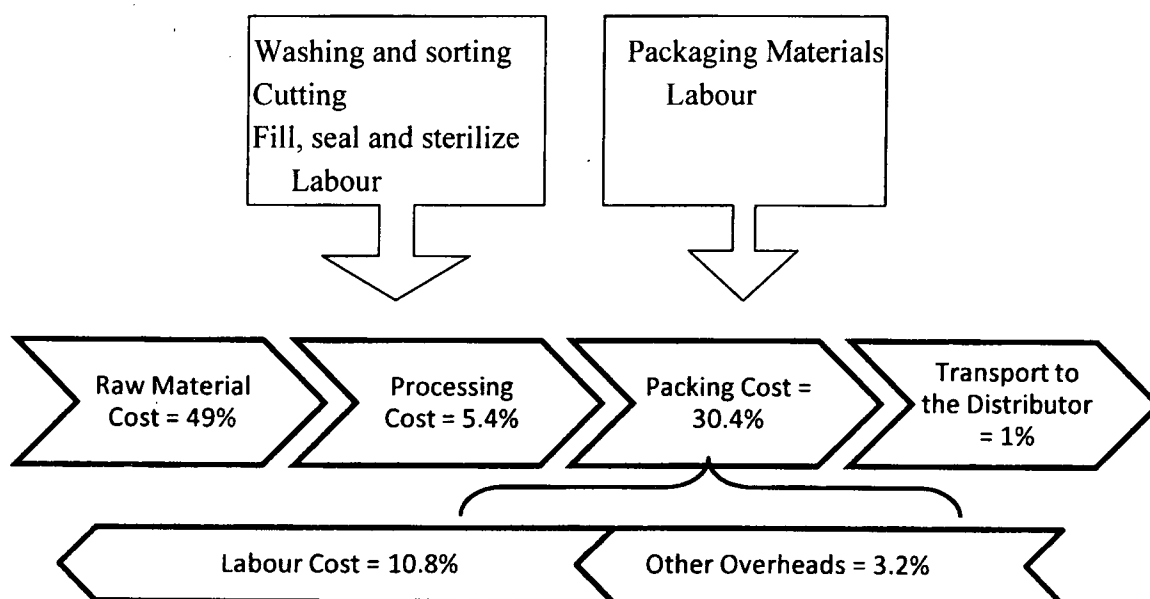
- Product name ('Trade name'): The name of the product, consisting of: Name of the fruit with or without the extra description – according to fruit content; e.g.: Pineapples in slices, lightly sugared, organically grown

- Manufacturer: Name and address of the manufacturer, importer, exporter or product trader, plus country of origin.
- List of contents: A list of ingredients
- Best before date: The 'Best before ...' details must include day, month and year; e.g. best before 30.11.2012
- Batch number

Storage

The conserved fruit (especially in jars) should be stored in dark rooms at low temperatures (max. 15°C). Under optimum conditions, conserved fruit can be stored for 1 year (when pasteurized) or 2 years (when sterilized).

Figure 3.9: Value Chain for Canned (350g Size Pineapple Pieces) Pineapple



3.4.3 Pineapple Jam

3.4.3.1 Processing

Jams are basically preparations made of fruits (jams) and various sugars that are made conservable mainly by heat treatment (boil down). The spreading consistency of these products is achieved by releasing the pectin found in the fruit pulp during the boiling process, and using this together with further pectin added to form a jellylike mass. The preparation stages from fresh fruit to jam are outlined and then described more fully below:

Fruit → sorting → washing → Peeling and sorting → pulping
 → addition of sugar → heating and boiling down →
 Addition of pectin, citric acid and spices, then renewed heating → filling into jars →
 Vacuum sealing → Pasteurizing → cooling

Sorting, washing and peeling activities are almost same as pre conditions for processing activities.

Sorting

After harvesting, the fruits are sorted, because only those that are fresh, ripe and unspoiled can be used to make jams. Jams can also be made from previously prepared, frozen fruits and pulp.

Washing

The fruit should be washed very carefully as it can be easily damaged.

Peeling and sorting

This follows the procedure of removing leaves, wooden pieces, pips or seeds and peel. Peeling is often done manually with knives, yet sometimes the skin is loosened with steam and then subsequently rubbed away mechanically. Finally, the fruits are sorted again to remove any blackened pieces, bits of peeling seeds etc.

Pulping and adding sugar

The peeled fruits are then pulped and sugar added. They might also be mixed with water or fruit juice. To make jam, at least 350g fruit per 1000g finished product must be used.

Heating and boiling

The mixture is now heated to 70-80°C and boiled down, while constantly being stirred, at 65°C until shortly before it reaches the desired consistency.

Adding citric acid, pectin and spices (optional)

If necessary or desired, citric acid, pectin and spices are added and the mixture again briefly heated to 80°C.

Filling into jars, vacuum-sealing and pasteurizing

The liquid mass is poured into jars, vacuum-sealed and pasteurized.

Cooling, labeling and storage

After the heating process, the jams are first cooled to 40°C, and then subsequently down to storage temperature, labeled, and finally stored.

Packing and Storage

Jams are usually filled into consumer-size jars with twist-off lids.

Details given on packaging

The label on the jar must display the following:

- Product name ('Trade name'): The name of the product, consisting of: Name of the fruit with or without the description about the product
- Manufacturer: Name and address of the manufacturer, importer, exporter or product trader, plus country of origin.
- List of contents: A list of ingredients and additives in the jam, beginning with the heaviest proportion of total weight at the time of packaging
- Details of the total sugar content: Total sugar content per 100 g product (measured refractometrically at 20 °C) must be represented with the words "Total sugar contentg per 100g".
- Details of fruit content: The fruit content per 100 g product must be given with the words "manufactured from....g fruit per 100g".
- Notice about cooling: The notice about storing the product in a cool place must be given with the words: "After opening, store in a cool place".
- Weight: Details of the total weight in grams
- Best before date: The 'Best before ...' details must include day, month and year; e.g. best before 30.11.2012
- Batch number

Storage

The jams should be stored in a dark, cool room at temperatures of max. 15°C. Under optimum conditions, jam may be stored for 1-2 years.

3.4.3.2 Pineapple juice

In order to manufacture pineapple juice, only fresh, non-mouldy fruits are used. After harvesting, the fruits are washed and the inedible parts removed (leaf crown, stalk etc). The following list points out various fruit-parts that cannot be used during the canning process, yet which can be used to extract juice – for this reason, a juice plant is often found side-by-side with a cannery:

- fruit flesh that is unsuitable for canning (e.g. fruits too small)
- unsuitable slices or squares
- the juice that runs away during the canning process
- the fibre-rich middle part of the fruit
- flesh left stuck to the skin

All of the edible parts of the pineapples are fed through a hammer mill or worm screw press – depending on the machinery available. The juice collected is then heated to 60°C and poured into tin cans, before being sealed, then pasteurized at a temperature of 88°C and rapidly cooled down again. In a different procedure, the pulp is heated for 2 min. up to 95°C, and then filled into tin cans (lead-free, and up to 5 kg) whilst still hot, whereby the cans are sealed while being steamed, the temperature maintained for 5 min., and then rapidly cooled down. At temperatures of around 15°C, the pulp can be stored for up to 1 year. Pulp which has been filled under antiseptic conditions (bag-in-box) can be stored for up to 1 year at room temperature.

3.5 Problems Faced by main Actors in the Value Chain of Pineapple

Problems Faced by Farmers

- Mostly farmers have to rent lands for the cultivation
- Unavailability of healthy suckers
- High labor cost and difficulty in finding skilled labour
- High cost of fertilizers
- Delay of payment by the exporters
- Small size fruits get much lower price compared to large size fruits after grading

Problems Faced by Retailers

- High risk of loss due to highly unstable prices
- They have to bear the cost of wastage.
- Low profit during the peak season

Problems Faced by Processors

- Affordability of price – Prices of pineapple often fluctuate. Prices are very high during off-season. This leads to high cost of production and difficulties in competing with the other exporters in the competing countries.
- Accessibility/availability
- High cost of other inputs – The costs for electricity and labour are high and these factors directly affect the profit margin.
- Poor credit facilities – Most of the small-scale operators need loans to expand the product coverage and the quality of the production. However, the credit facilities available are limited.
- Insufficient availability of packing materials – packing material such as glass containers, lids and other items are not available freely in the market. Some processors have to depend on imported items.

Problems Faced by Exporters

- High cost of good quality packing material
- Shortage of good quality fruits
- Shortage of skilled labour
- High prices of fruits during off-season
- High freight charges and air space limitations.

CHAPTER FOUR

Present Marketing System of Banana

4.1 Introduction

For this analysis many growers, traders and few processors were interviewed in Embilipitiya, Thambuthegama and Gampaha. The growers, traders and processors who are engaged in this industry were interviewed without considering the size of operation. The chain analysis is based on averaging the collected data and value chain analysis is done for three main channels of banana.

4.2 Structure of the Banana Market in Embilipitiya

A detailed study was conducted in Embilipitiya area and it was found that the *pola* is the major marketing outlet in the area. In the banana marketing system the eight *polas* take the leading role. These *polas* are located near the farming areas. Hence the farmers are able to bring their harvest as soon as harvested. Some of these *polas* sell other items also both food and non food. There are some traders who sell different types of knives which are used for banana harvesting. Therefore traders who come from outside the area bring food crops from their areas to sell to the traders in the relevant *pola*. Traders visit these wholesale banana *polas* according to the scheduled *pola* or major market days in their areas. Hence after purchasing banana, these wholesalers apply ethal to almost all banana bunches to ripen them and to sell at these *polas* or retail markets.

The major banana wholesale *polas* and their operational dates are shown below.

- | | |
|--|----------------------------|
| 1. Barawakumbuka <i>Pola</i> | Friday Morning |
| 2. Thunkama <i>Pola</i> | Thursday Morning |
| 3. Embilipitiya DEC | Tuesday & Saturday Morning |
| 4. Sooriyawewa <i>Pola</i> | Monday Morning |
| 5. Moraketiya 8 th Post <i>Pola</i> | Monday Morning |
| 6. Danduma <i>Pola</i> | Monday Morning |
| 7. Kiriibbanara <i>Pola</i> | Sunday Morning |
| 8. Hathporuwa <i>Pola</i> | Saturday Morning |

60-70 wholesalers visit Barawakumbuka *pola* from Batticaloa, Kalmune, Ampara, Colombo, Galle and Kelaniya areas. On an average about 65 lorries entered *pola* to buy banana and about 6 lorries transported banana to Pettah wholesale market and 03 lorries transported banana to Eastern area. According to the traders and farmers when traders of Eastern area come to purchase banana local farmers get higher prices. Hence farmers prefer this situation though the other wholesalers, who visit the *pola* to buy banana, dislike it. Therefore there is a good competition among buyers. According to the information collected from each *pola* it was observed that the highest number of banana sales occur in Barawakumbuka *pola*. And also both the buyers and farmers prefer the

way of handling business by the *pola* manager. The following table depicts the banana varieties supplied to each *pola* during the surveyed period.

Table 4.1: Banana Supply to each *Pola* (Bunches)

Pola	Daily Sales	Embul		Seeni		Kolikuttu	
		No.	%	No.	%	No.	%
Barawakumbuka	8,000-10,000	6,300	70	1,350	15	1,350	15
Thunkama	8,000-10,000	6,800	80	425	5	1,275	15
Embilipitiya DEC	1,000-2,500	1,400	80	88	5	263	15
Sooriyawewa	5,000-6,750	3,525	60	294	5	2,056	35
Moraketiya	3,000-4,000	2,800	80	175	5	525	15
Danduma	800-1000	720	80	45	5	135	15
Kiriibbanara	1,500-2,500	1,600	80	160	8	300	15
Hathporuwa	1,500-2,500	1,600	80	160	8	300	15

Source: Pola Managers

There are many traders and farmers who are engaged in banana business in these *polas*. The number of traders and farmers vary according to the supply and demand and the available space of the *pola*. When the supply is scarce traders visit villages to collect banana. If they go to the farm the farmer gets a higher price because both of them know that there is a scarcity in the market. Always farmers contact traders in the area as well as outside the area and find out the prevailing market prices. Accordingly they harvest their crop. Most of the interviewed farmers try to maximize their income by selling the harvest to the collectors, near by *pola*, any other *polas* in the area, or collectors in the nearest town.

At each *pola* there are many brokers engaged in this business. In Barawakumbuka *pola* there are about 60-70 brokers and most of them come from Middeniya area. Each broker earns Rs.1,000-2,000 as daily income from this *pola*. The *pola* business is over within two hours. It starts at 9.00a.m and all the banana stocks are sold within two hours. All the brokers and traders enter *pola* and wait until they are allowed to inspect the goods. Thereafter they decide the prices according to the quality of the produce. Then weighing is done and value is calculated identification is marked on the bunch and loading is done. Post harvest loss occurs at the loading time at the *pola*. Most of the labourers do not bother about post harvest losses. Therefore some of the wholesalers do the loading by themselves. Almost all the brokers visit all *polas* in the area and they buy some bunches of banana and sell at the same place to the late comers. The outstation traders also visit many *polas* in the area to collect the required quantity as well as other fruits and food crops. The opening time of *pola* is scheduled according to their convenience. The following table shows the types and number of traders engaged in this business.

Table 4.2: Types and Number of Traders in the *Pola*

<i>Pola</i>	Traders from outstations	Brokers
Barawakumbuka	100-120	20-40
Thunkama	60-80	20-30
Embilipitiya DEC	40-60	20-30
Sooriyawewa	80-100	20-30
Moraketiya	60-80	20-30

Source: Pola Managers

The highest quantity is delivered to Pettah wholesale market and suburban retail markets. Taders use the selected routes to collect fruits and sell them to the retailers at various towns. The collected supplies can be transported to consuming areas or urban areas within a shorter time period due to better road network. There are about 65 lorries that reach Embilipitiya main Banana *pola* from Colombo, Kelaniya, Galle, Kalmune and Batticaloa areas. Five main routes are covered by the traders who visit Embilipitiya. They are as follows.

Figure 4.1: Distribution of Banana from Embilipitiya

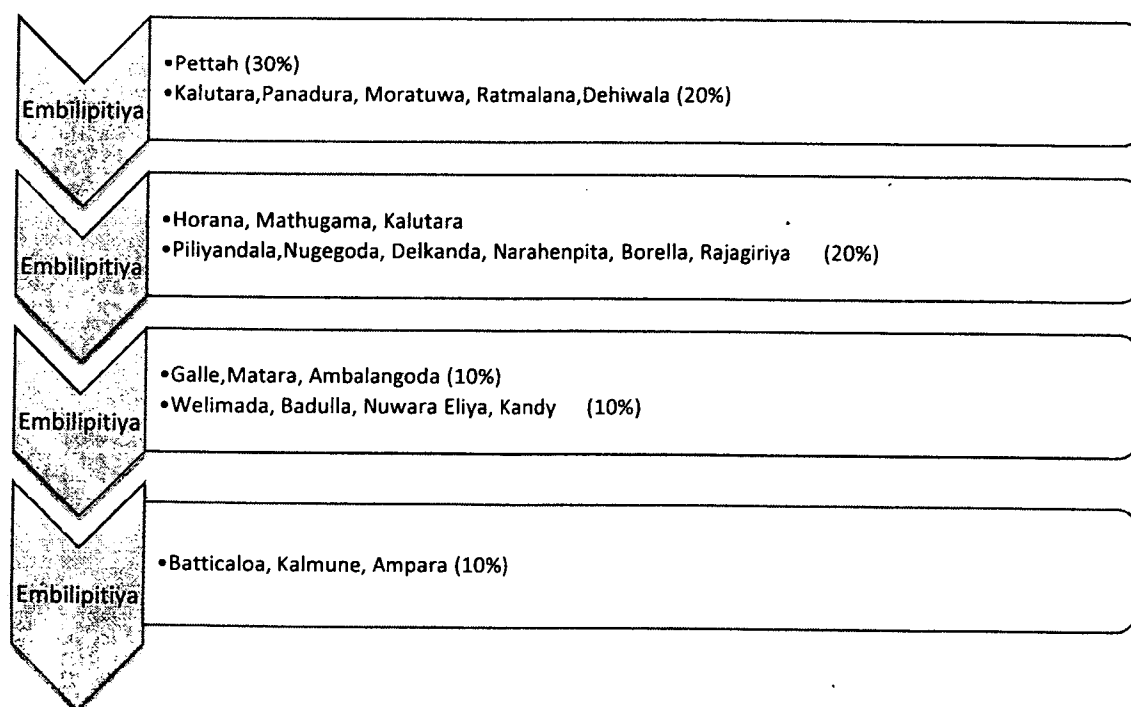


Figure 4.2: Road Map of Sri Lanka

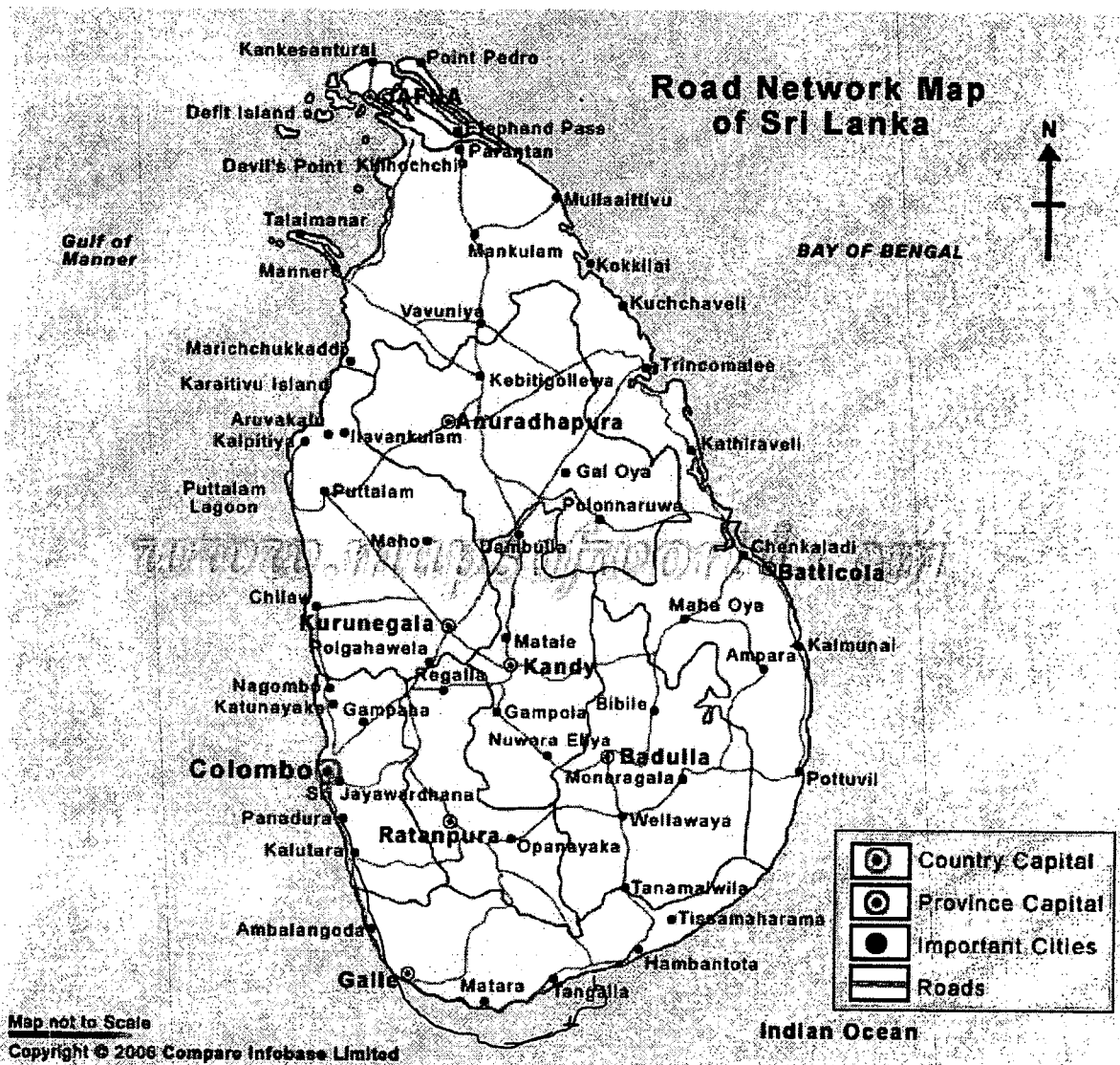
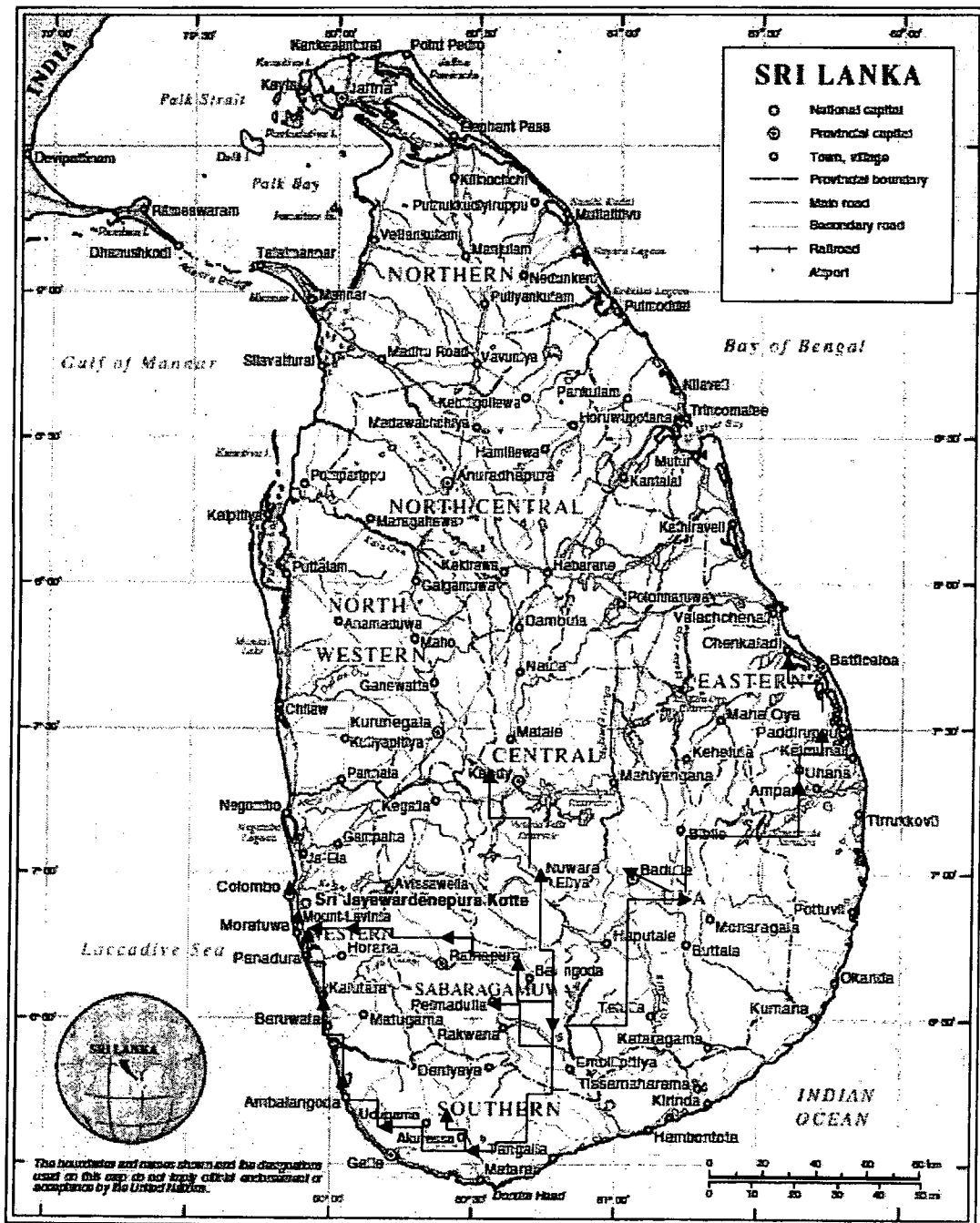
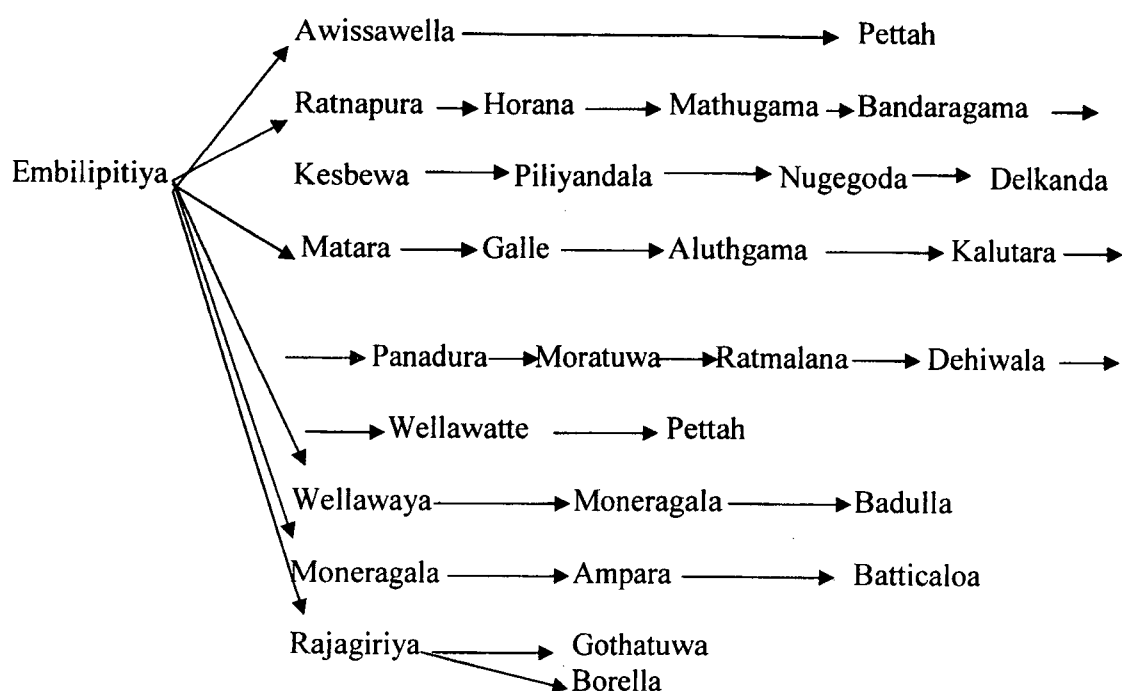


Figure 4.3: Distribution Network of Banana from Embilipitiya





The highest banana sales can be observed in Barawakumbuka *Pola* and about 8,000 – 10,000 bunches are brought by the farmers from close by villages. Out of the total supply about 70 percent is Ambul banana, 15 percent kolikuttu and 15 percent seeni banana. When the farmers bring banana they have to pay Rs.4.00 per each bunch of banana as *pola* charges. There are no charges for small size bunches of banana.

Pola charges vary according to the vehicle used for transportation. When a vehicle enter the *pola* premises large size lorry has to pay Rs.250.00, Dima Batta Rs.100.00 and two wheel tractor Rs.50.00. A labourer is paid Rs.500.00 for loading banana for a full load of lorry. Piece rate charge is also in existence in the *pola* and it is Rs.5.00 per bunch of banana. *Pola* manager collects the income to cover the value of tender, to maintain *pola* area and earn profit for his service and investment.

Some growers, traders, processors and exporters for each product were interviewed for this analysis ranging in size from small family farms and small scale processing operations up to larger farms and processing operations. The value chain analysis was based on averaging the data received and information gathered from them. It was very difficult to gather information from processors because there was a good competition in this trade.

Sri Lankan fresh fruit sector has become more important after introducing the Cavendish banana cultivation and leading world exporters have entered this market. According to the requirement of destination, fresh fruit as well as processed fruits should be produced

under the standard of HACCP. The value chain for fresh Cavendish banana was divided into five distinct areas of activities, namely harvesting, washing and sorting, drying and packing, loading and transporting to exporter.

The significant innovations identified in the transportation of Cavendish banana are refrigeration, containerization and the use of pallets. Mostly the Cavendish banana is transported through reefers. Ripening technologies are used to get a good quality product that will maintain the original taste. Refrigeration consists not only of controlling the temperature, but also the humidity and air composition while transportation. Another development has been the use of refrigerated containers. Vertical air flow has increasingly superseded horizontal air flow in reefers because it was found that the distance the refrigeration travels vertically through the shipment is shorter than horizontally.

Cartons, containers in which bananas are packed for transportation, have been modified with the size and the layout of holes. Carton size and perforations play important roles in ensuring easy air flows through and around the pallet. A new type of carton was developed and they are in 60 by 40 cm and are packed with a single layer of bananas. Dole and Del Monte are the leading export companies of banana.

According to the retailers, when an unblemished bananas are displayed consumers are willing to buy. Bananas are delicate fruits and are easily bruised in transportation and need specialized facilities for ripening. Earlier there were smoke rooms in the Pettah wholesale market for ripening. At present wholesalers and collectors use ethylene at the time they purchase banana at *pola*. An innovation that followed from the delivery of dormant bananas by lorries in *polas* is the use of ethylene to activate the ripening process. Ripening consists of the production of sugar from starch, which gives the banana a sweeter taste, the softening of tissues and the destruction of chlorophyll that turns the skin yellow.

As with many processed fruits and vegetables, the raw material, which is fresh banana and pineapple in this study, is the highest cost component and most important component of the value chain. It was observed that usually exporters and processors purchased banana from *pola*. The fresh pineapple exporters call a number of farmers, both small and large, to obtain a price quote and quantity that can be delivered by a certain date. Most of the small scale pineapple processors in the Southern area and Embilipitiya face significant problems of obtaining good quality fresh pineapple as raw material because the variability of quality prevents them from producing a consistently high-quality product.

Small scale fruit juice processors also should follow the Sri Lanka standard (SLS) and other restrictions related to labour and chemicals. The exporters have a good knowledge about permitted chemicals that should be used in post harvest operations. Growers have a good knowledge of varieties which will give them the best return on their investment and which might be more marketable in selected markets.

Introducing new varieties and providing training will increase productivity, yields, and incomes. The researchers have introduced new ambul variety and supply suckers to the farmers who request them. Farmers pay higher prices to those suckers because their income has increased with this production. The private sector companies such as Dole, CIC and IFMA use new varieties such as Cavendish and they have used more modern technologies, which have increased yields and the ability to expand their production. But still the other banana farmers do not cultivate Cavendish. They doubt that the exporters may not purchase their produce. If it happens they are not certain whether they can sell the produce to the domestic market. Though there was no huge demand for this product, it is sold at the market at higher prices.

In this study it was observed that there was a huge distribution network of banana spread throughout the country. That helped farmers to increase their income and also all the stakeholders to earn an income. The consumers were able to purchase banana according to their taste. The traders have a good idea about consumer demand and they distribute banana accordingly. Most of the producers cultivate domestic varieties and they prefer ambul to kolikuttu because of low risk of cultivation and harvesting.

Cavendish banana cultivation was done by international companies and whole process is done under their close monitoring. Due to the prevailing high competition among them they were reluctant to divulge any information of this business. However it was understood that they were searching new lands to expand their cultivation.

CHAPTER FIVE

Value Chain Analysis for Banana

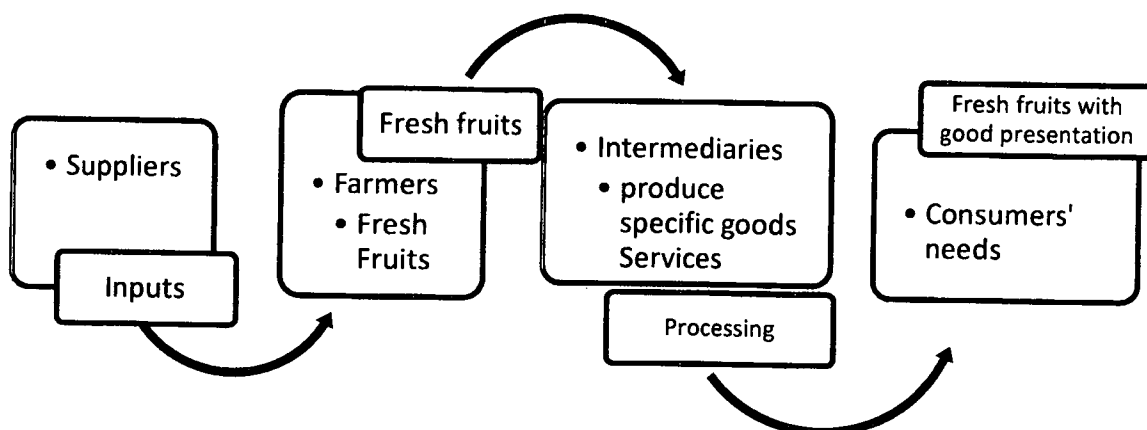
5.1 Introduction

In this chapter value chain is explained and mapped for key product lines. The channel mapping methodology is used to analyze the value chain because this is a process of tracing flow of a product through an entire channel from the point of product conception to the point of consumption. This process will highlight the underlying patterns of inputs, constraints and competitive advantages that a producer has. It will also trace the path of all value adding and non- value adding activities associated with the production of goods and approximate costs involved at each stage.

More traditional methods of product and market analysis isolate operational costs along various stages of production. The methodology employed in the study is a much more comprehensive tool, particularly as it takes into account an entire range of activities and inputs associated with a product. Identification of supply channels which have potential to be developed into fully fledged value chains was needed. Based on the identified supply channels an end market supply has been done to understand market requirements and critical success factors and by using them as a departure point we mapped all the functions, actors and their interrelationships down stream the chain. The following charts explain the supply chain, value chain and the actors and their interrelationships.

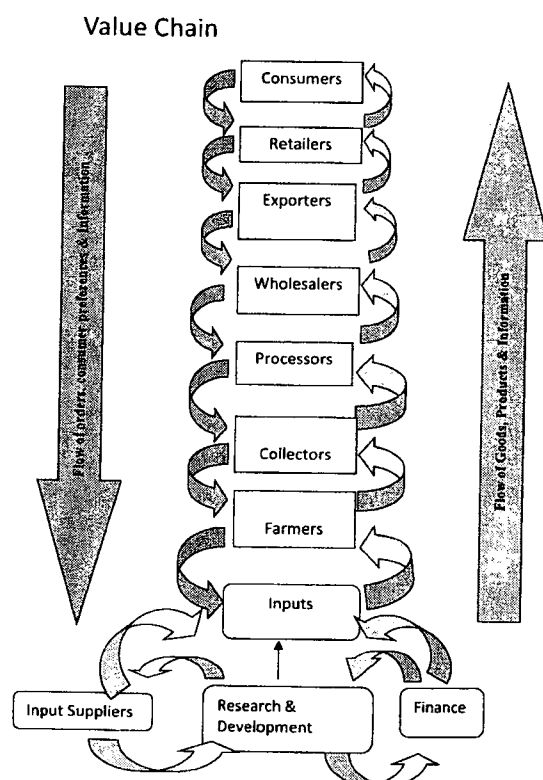
This analysis is useful to determine the importance of key individuals in driving entrepreneurship and innovation in the marketing system of fruits and also to understand the characteristics and inefficiencies of pineapple and banana value chains. The figure 5.1 shows how the entrepreneurs are engaged in this chain. Input suppliers supply input to the farmers and by using them farmers produce fresh fruits. These fresh fruits are purchased by the intermediaries who produce specific goods or give services as distributors. Finally these processed fruits and fresh fruits are distributed among retailers and consumers can purchase according to their needs.

Figure 5.1: Linkages Among Entrepreneurs



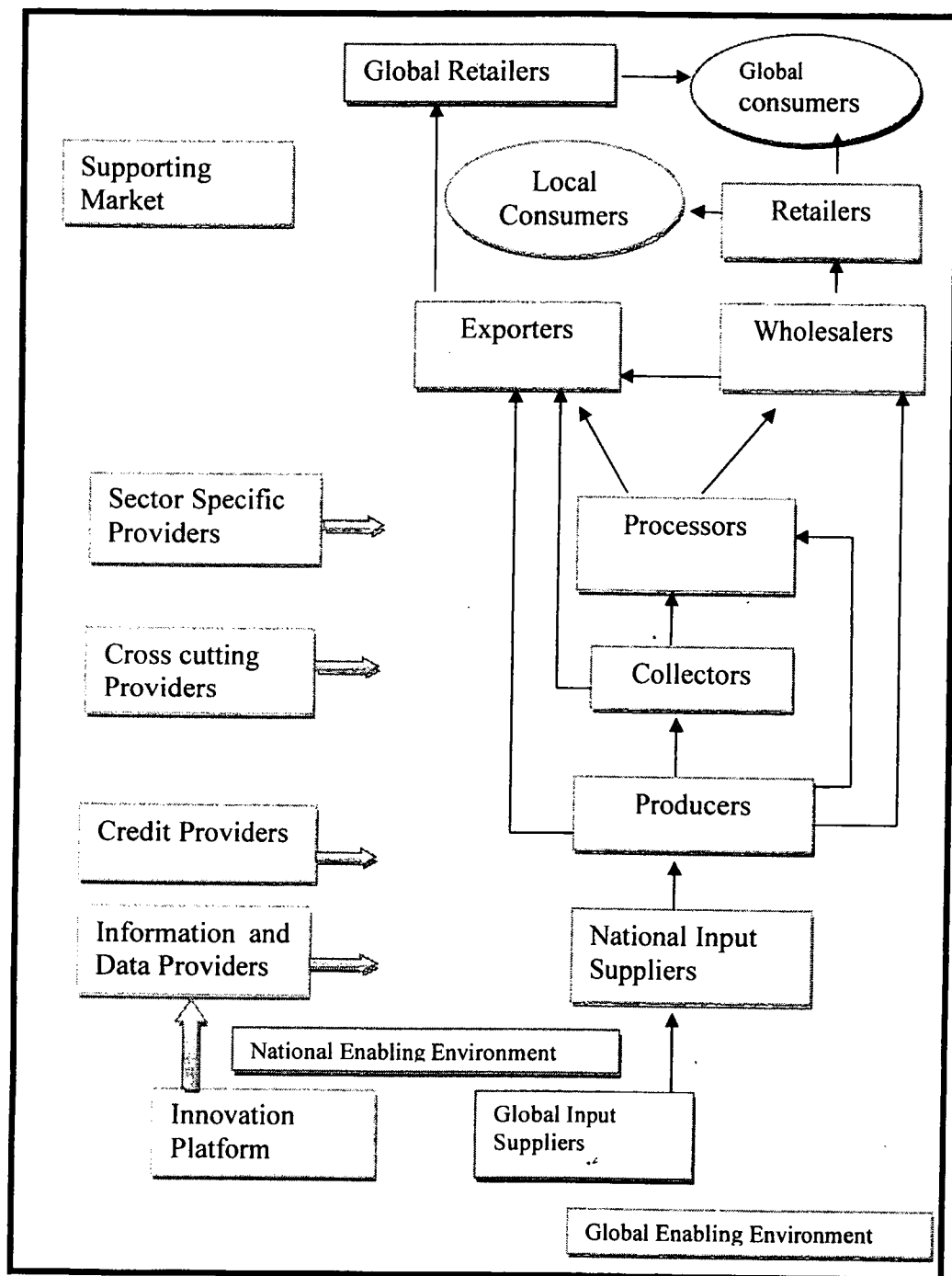
The revitalization of the fruit sector is seen as a potential drive of broad based economic growth. Increasing primary fruit production will boost the incomes of producers, processors and traders. To get a high income information should go through the supply chain to satisfy consumers and accordingly the quality of produce varies. Figure 5.2 shows how value chain proceeds.

Figure 5.2: Value Chain of Banana



The flow chart given in figure 5.3 shows how complicated the value chains are. To supply the consumer demands it is very important to collect information regarding consumer satisfaction. Then only a product can be produced to satisfy the consumer at lowest cost. There were so many stakeholders or entrepreneurs in the supply chain to provide various inputs and services.

Figure 5.3: An Overview of the Value Chain System from Suppliers to Consumers



By analyzing the available data and information the importance of these crops could be identified. But these cannot be used to analyze the value chains. Hence all the prices throughout the value chain were collected for this analysis. Several growers and processors for each product were selected according to the value chain and interviewed for this analysis, ranging in size from small family farms/ processing operations up to larger farms/ processing operations. The value chain analysis above was based on averaging the responses received from those interviewed.

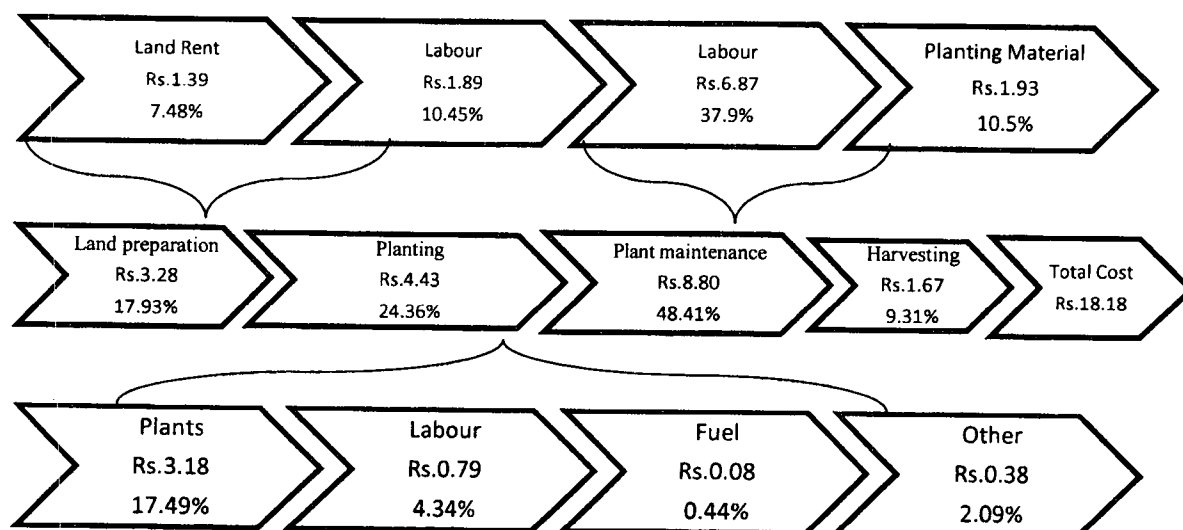
5.2 Value Chain Analysis for Fresh Kolikuttu

The value chain for fresh kolikuttu in Sri Lanka was divided in to four distinct areas. They are:

1. Land Preparation
2. Planting
3. Plant maintenance and
4. Harvesting

The total cost for these four sectors are divided according to the relevant characteristics. Out of these four areas the highest cost was incurred for plant maintenance and it was nearly half of the total cost of cultivation followed by planting. The total cost of production of Kolikuttu was Rs.18.18 per kg. Land preparation, planting, plant maintenance and harvesting were Rs.3.26, Rs. 4.43, Rs.8.80 and Rs.1.67 per kg respectively.

Figure 5.4: Value Chain of Cost of Production of Banana (Kolikuttu)



Out of the cost components of kolikuttu, the highest cost was incurred for labour, followed by plants and they were respectively 61.3 and 17.5 per cent of the total cost of

production. Fertilizer and chemicals and also land rent were about 10 percent of the cost of production.

The cost of Kolikuttu plants was 17.49% out of the total cost. Labour cost was 4.34% out of the total cost and fuel was 0.44% and other costs were 2.09 percent.

Plant maintenance was divided into two major areas such as material inputs and labour. Material input cost includes fertilizer and pesticides and it was 10.5 percent of the total cost of production. For the plant maintenance labour cost was 37.9 percent of the total cost. Harvesting cost includes only labour cost and it was 9.31 percent of the total cost.

Table 5.1: Cost Breakdown of Kolikuttu Banana Cultivation

Item	Kolikuttu					
	Rs/kg	% of Total Cost	Rs/kg	% of Main item	% of Total Cost	% of Retail Price
Land Preparation	3.28	17.9				
Land Rent			1.39	42.6	7.5	0.9
Labour			1.89	58.0	10.1	1.2
Planting	4.43	24.4				
Plants			3.18	71.8	17.5	2.0
Labour			0.79	17.8	4.3	0.5
Fuel			0.08	1.8	0.4	0.1
Other			0.38	8.6	2.1	0.2
Plant Maintenance	8.80	48.4				
Material			1.91	21.7	10.5	1.2
Labour			6.84	77.7	37.6	4.3
Fuel						
Harvesting	1.67	9.2				
Labour			1.67	100.0	9.2	1.0
Total Cost (Rs/kg)	18.18					11.4

Source: Survey data

Total production of banana was about 13200 kg per acre. Of the investment on banana cultivation the highest share goes to labour and it was 62 percent.

During the survey period the producer's, collectors', Wholesalers' and retailers' prices of kolikuttu were Rs.60.00, Rs.80.00, Rs.100.00 and Rs.160.00 per kg respectively. According to the cost breakdown the highest gross margin was kept by the retailer and it was about 33 percent of the retail price. Producers' profit margin was about 25 percent and the collectors' profit margin was about 11 percent. In the trading sector the highest investment was by the collector who visits farmers and *polas* to purchase banana. In addition, he sometimes distributes banana throughout the country and he has to wait

Figure 5.5: Value Chain of Kolikuttu (Rs/kg)



Figure 5.7: Value Chain of Kolikuttu (Rs/kg)

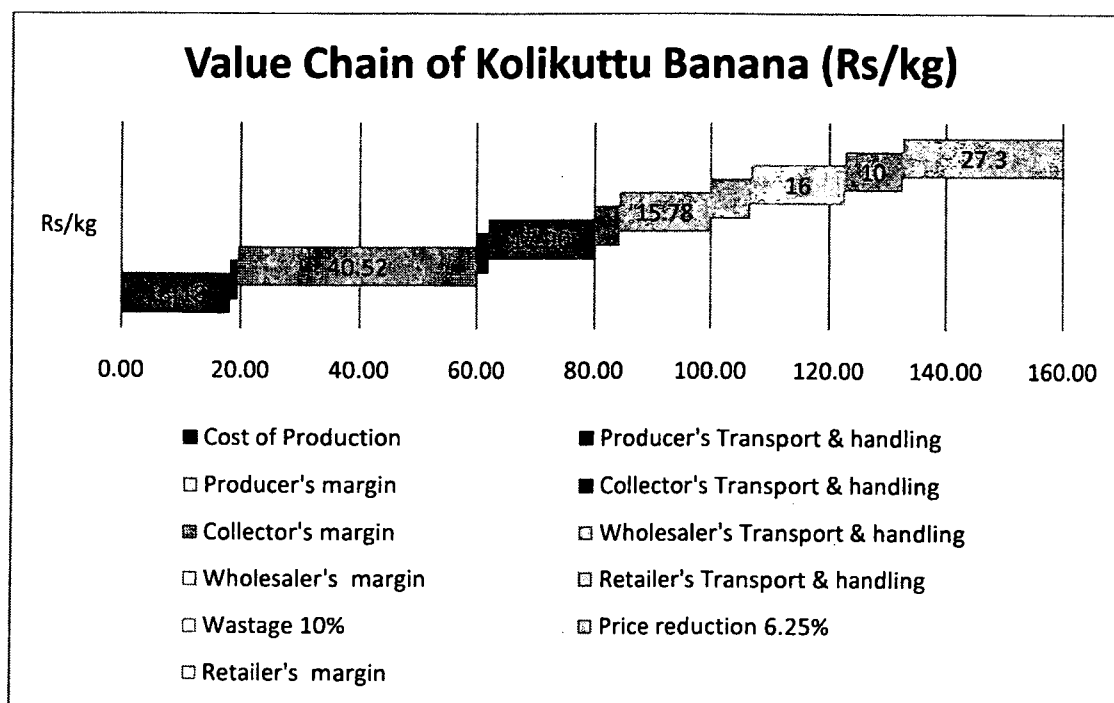


Table 5.2: Value Chain of Kolikuttu Banana

Item	Value addition (Rs/kg)	Margin as a % of retail Price
Cost of Production	18.18	11.4
Producer's Transport & handling	1.30	0.8
Producer's margin	40.52	25.3
Producer Price	60.00	
Collector's Transport & handling	2.10	1.3
Collector's margin	17.90	11.2
Collector's Price	80.00	
Wholesaler's Transport & handling	4.22	2.6
Wholesaler's margin	15.78	9.9
Wholesale Price	100.00	
Retailer's Transport & handling	6.70	4.2
Wastage 10%	16.00	10.0
Price reduction due to over ripening 6.25%	10.00	6.3
Retailer's margin	27.30	17.1
Retail Price	160.00	

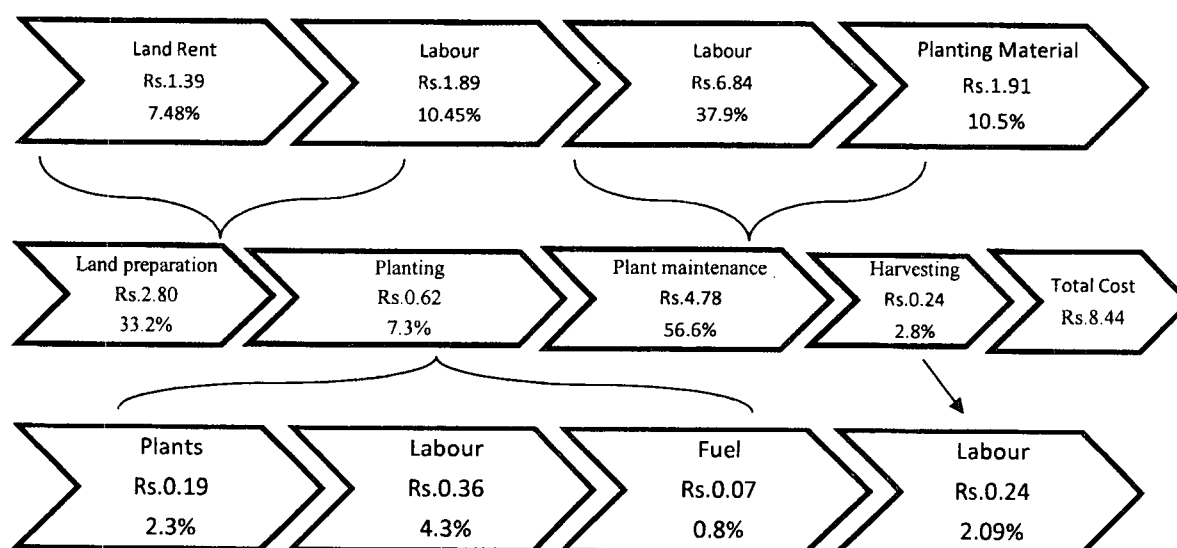
Source: Survey data

This analysis illustrates that margins of almost all the traders vary according to the services provided by those entrepreneurs. The wastage at the retail level is very high because of the ethereal application. Two days after ethereal application the skin looks deteriorated and the taste is unpalatable. As a result the demand for these fruits is comparatively low. Hence the retailers have to reduce the price by about 5- 7 percent and minimize the losses. These deteriorated fruits are collected mostly by the surrounding small scale traders who sell fruit salads and fruit juices.

5.3 Value Chain of Ambul Banana

The value chain of fresh ambul was divided into four major groups such as land preparation, planting, plant maintenance and harvesting. Land preparation cost was Rs.2.80 per kilo. Planting, plant maintenance and harvesting were Rs.0.62, Rs.4.78 and Rs.0.24 per kilo respectively. Accordingly the total production cost was Rs.8.44 per kg.

Figure 5.8: Value Chain of Cost of Production of Banana (Ambul)



In the investment on cultivation of ambul banana the highest cost was for plant maintenance and it was over 50 percent of the total cultivation cost. Nearly 90 percent of the total cost was incurred for land preparation and the maintenance of the plantation. The cost of land preparation was about 33 percent and that of plant maintenance was 56.6 percent of the total cost. The cost for planting and harvesting was about 7 and 3 percent of the total cost. Thus the cost for ambul banana plants was less than that of kolikuttu.

The highest cost involved for land preparation was for land rent followed by labour and these costs were about 20 and 13 percent of the total cost. Of the land preparation cost about 62 percent was spent for land rent and 40 percent spent for labour. About 71 percent of the plant maintenance cost was incurred for materials such as fertilizer, chemicals especially for weed control and equipment. This was about 40 percent of the total cost of cultivation and the highest cost reported for ambul banana cultivation. The

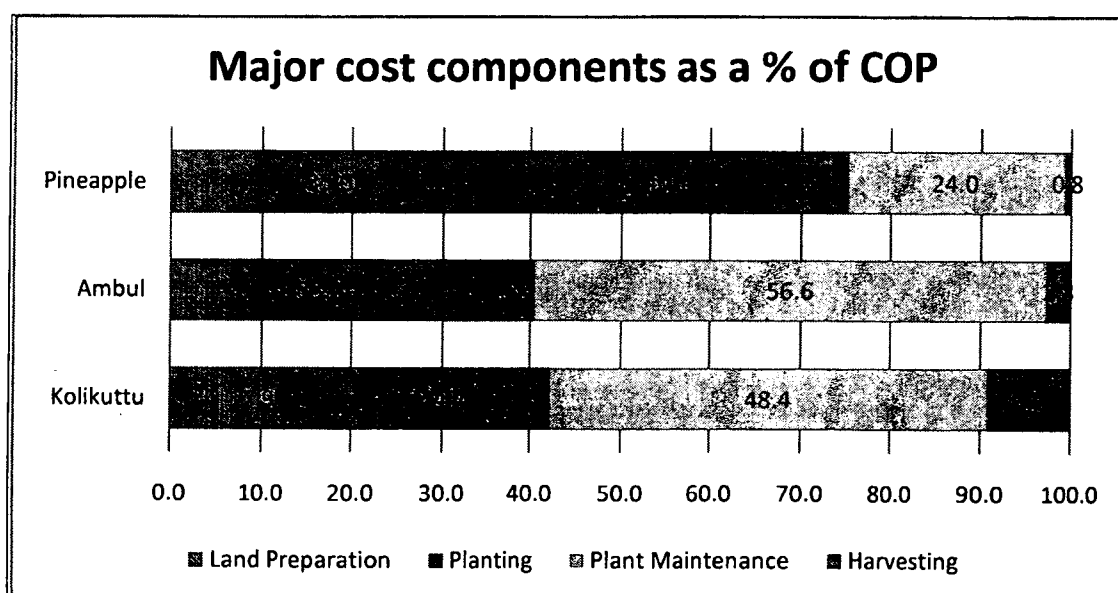
second cost component was labour and it was about 30 percent of the total cost of production. Almost all the farmers used their own labour for harvesting activities to maximize their profit margin.

Table 5.3: Cost Breakdown of Ambul Banana Cultivation

Item	Ambul					
	Rs/kg	% of Total Cost	Rs/kg	% of Main item	% of Total Cost	% of Retail Price
Land Preparation	2.80	33.2				
Land Rent			1.73	61.8	20.5	2.9
Labour			1.07	38.2	12.7	1.8
Planting	0.62	7.3				
Plants			0.19	30.6	2.3	0.3
Labour			0.36	58.1	4.3	0.6
Fuel			0.07	11.3	0.8	0.1
Other						
Plant Maintenance	4.78	56.6				
Material			3.40	71.1	40.3	5.7
Labour			0.88	18.4	10.4	1.5
Fuel			0.50	10.5	5.9	0.8
Harvesting	0.24	2.8				
Labour			0.24	100.0	2.8	0.4
Total Cost (Rs/kg)	8.44					14.1

Source: Survey data

Figure 5.9: Major Cost Components of Banana and Pineapple



The cost of production for kolikuttu cultivation is higher than for that of ambul. It was mainly due to the cost of plants. The other major cost components of cultivation were labour, fertilizer and chemicals and land rent.

Table 5.4: Major Cost Components of Banana

Item	Unit	Kolikuttu	Embul
Total Cost of Production	Rs/kg	18.18	8.44
Labour	%	61.30	30.16
Plants	%	17.50	2.25
Fertilizer & chemicals	%	10.50	40.2
Land Rent	%	10.10	20.5

Source: Survey Data

It was observed that the plant maintenance cost of banana was higher than that of pineapple. Planting cost of both kolikuttu and pineapple was higher than that of ambul.

The value chain of banana is explained as follows. The total value addition of ambul banana is about Rs.51.56 per kg. Producers' profit margin was about 18 percent and their transport and handling cost was only 01 percent of the retail price. Almost all the producers brought their produce to the nearest *pola* or sold their produce to the fruit collectors who visited their farms. As a result, their transport cost was fairly low. Some of the wholesalers in the urban areas visited farms as well as *polas* to purchase banana. They paid cash at the time they purchased banana. Both the wholesalers and collectors paid farmers when they bought the product. But they did not collect money at the time of selling because normally they distributed produce to the retailers in the early morning. They in fact received money two or three weeks later. They had maintained good relationships with the channel members and trusted each other. The channel is very clear from the farmer to the retailer. Their service to the farmers, sub wholesalers, retailers and consumers was enormous. They invested in this trade and gave the service to the marketing system for its better functioning. The wholesalers from Colombo and other outstations to Embilipitiya and Sooriyawewa areas visited almost all main *polas* to purchase banana as well as other fruits. They had a good idea about the production areas and the behaviour of farmers and other *pola* traders because they visited every week to purchase especially banana. *Pola* traders and farmers also had a good idea about the wholesalers from outstations and their demand. Both the collectors and wholesalers had to spend two days to purchase the required quantity of various types of banana. During these two days they were very busy in collecting, packing and distributing products to the required markets.

Figure 5.10: Value Chain of Ambul Banana (Rs/kg)

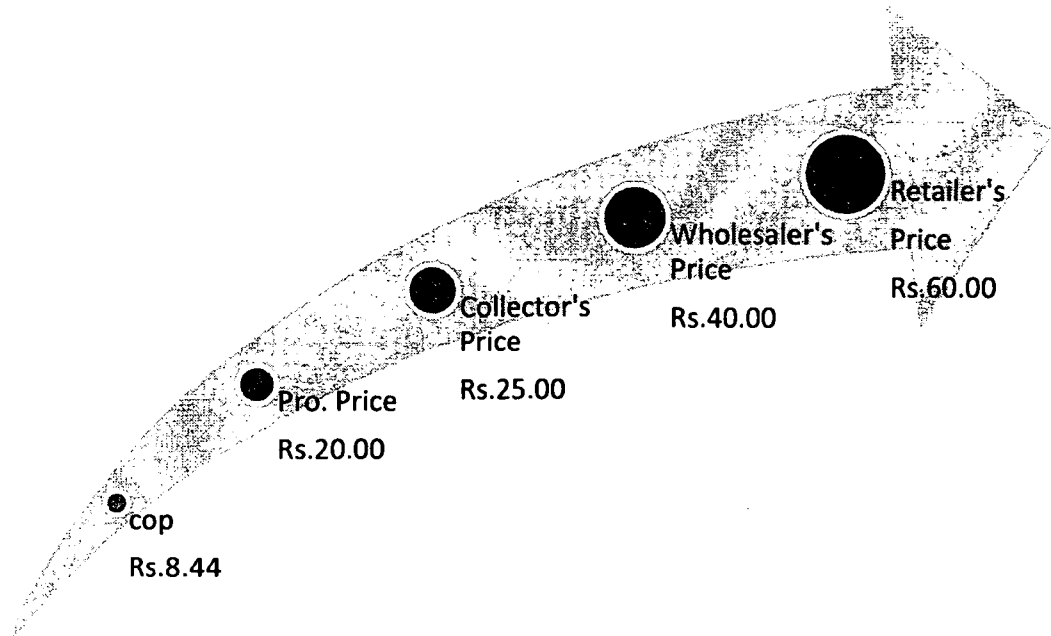


Figure 5.11: Value Chain of Ambul Banana (Rs/kg)

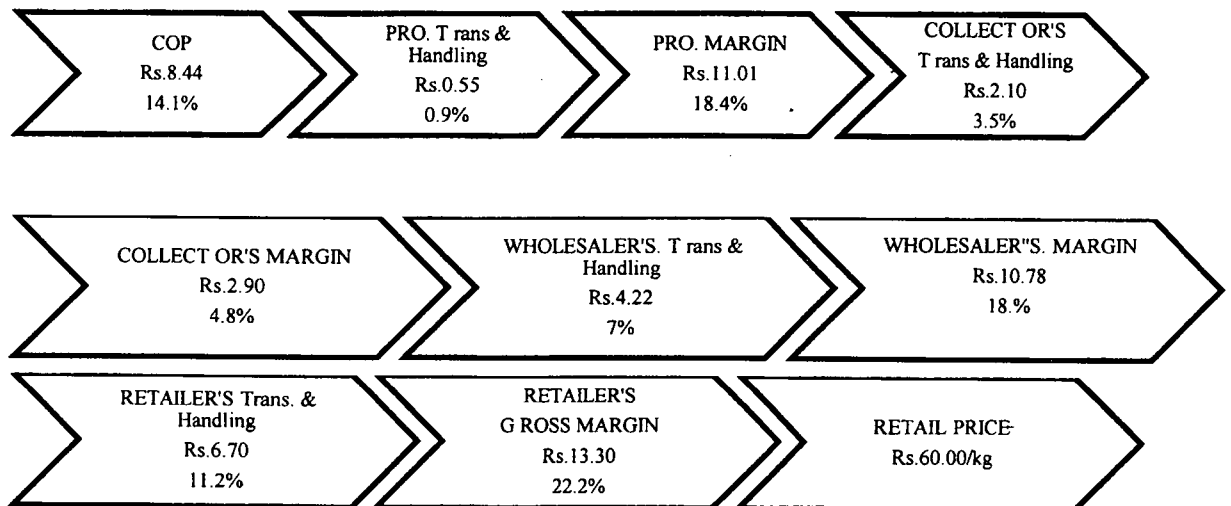
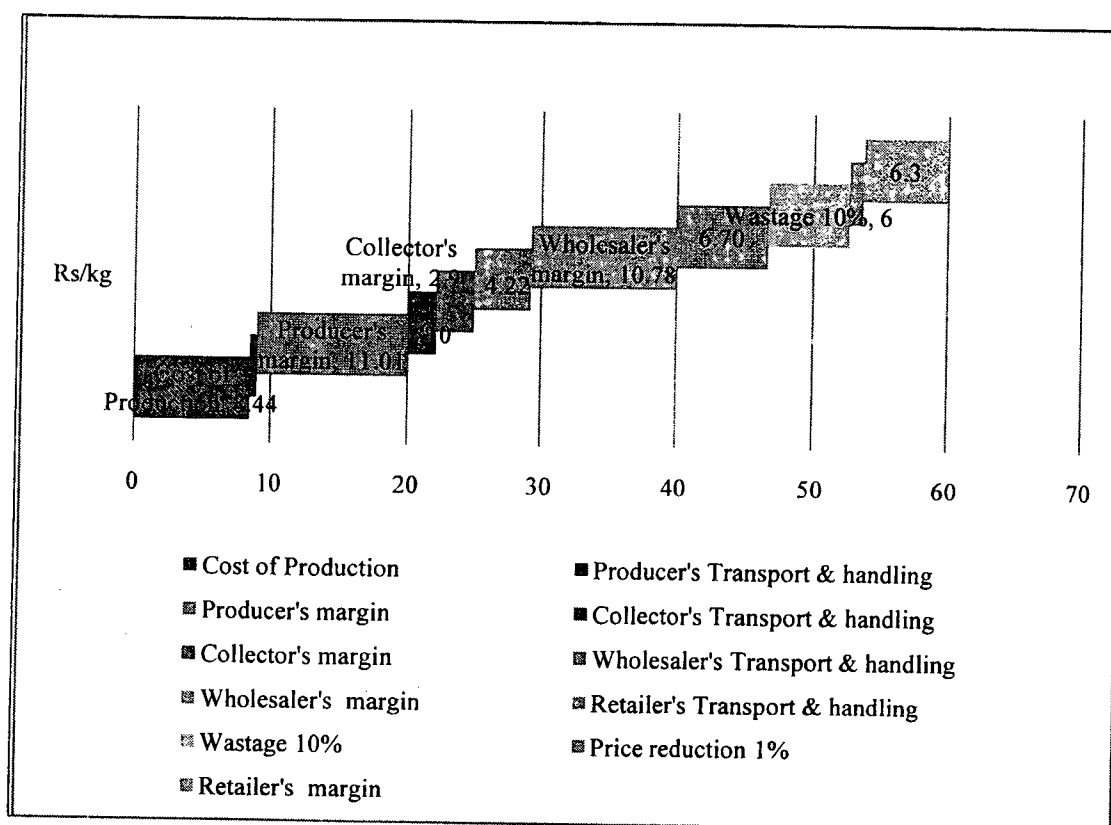


Table 5.5: Value Chain of Ambul Banana

Item	Value addition (Rs/kg)	Margin as a % of retail Price
Cost of Production	8.44	14.1
Producer's Transport & handling charges	0.55	0.9
Producer's margin	11.01	18.4
Collector's Transport & handling charges	2.10	3.5
Collector's margin	2.90	4.8
Wholesaler's Transport & handling charges	4.22	7.0
Wholesaler's margin	10.78	18.0
Retailer's Transport & handling charges	6.70	11.2
Wastage 10%	6.00	10.0
Price reduction 1%	1.00	1.7
Retailer's margin	6.30	10.5
Retail Price	60.00	100.0

Source: Survey data

Figure 5.12: Value Chain of Ambul Banana (Rs/kg)



In the value addition of banana the highest margin was kept by the retailers. This was mainly due to the high wastage. Hence some of the banana traders used to serve as collectors, wholesalers as well as retailers. As entrepreneurs they were engaged in the complete channel and maximized the profit by reducing the wastage by carefully handling. They did not apply ethereal to all the purchased produce at once and minimized the wastage.

The banana farmer's main income source was banana farming. Farmers who cultivated kolikuttu gained the highest income. In the supply to the market the supply of ambul was much higher than that of kolikuttu. Traders also kept a higher margin while they sold kolikuttu. The traders were not willing to buy naturally ripened banana from the farmers because they could be damaged while transporting with other bunches. Hence the farmers brought both matured and immature banana to the *polas*. Retailers' margin was very high because they sold these bananas the same day they purchased them to maximize the profit and to minimize the loss. If not they had to sell them at lower prices because they knew that ethylene was applied and as a result over ripening would damage the fruits. According to the retailers, consumers wished to purchase riped banana. Therefore they applied ethylene and tried to sell all the stuff as soon as possible to minimize the losses. This was not known by all the consumers.

If the consumers were willing to buy naturally riped banana, farmers had to harvest only matured banana. Sometimes the small scale farmers who had very few banana trees harvested immature banana also because of urgent cash requirements. However those bananas had a low demand and fetched low prices. When the traders purchased banana without considering the maturity they applied ethylene. This ethylene application increases the cost of products and reduces the taste. It also gives a bad smell after ripening. Therefore it is advisable to give training on both harvesting and ripening to minimize both the wastage and to improve retail prices and the quality of ripen fruits.

CHAPTER SIX

Conclusion and Suggestions

6.1 Conclusion

This detailed study was conducted in Embilipitiya area for banana cultivation and in Gampaha area for pineapple cultivation. It revealed that *pola* was the major marketing outlet in Embilipitiya area and eight *polas* take the leading role. These *polas* are located near the farming areas. Hence the farmers are able to bring their harvest as soon as they are harvested. In addition some of these *polas* sell other items, both food and non foods. There are some traders who sell different types of knives which are used for banana cultivation and harvesting. The traders who come from other areas brought food crops from their areas to sell to the traders in the relevant *pola*. Traders visit these wholesale banana *polas* to buy the required stocks on specific market days. After purchasing banana these wholesalers spray ethylene to almost all banana bunches to ripen them to sell at the *polas* or retail markets located in the other consuming areas. The collectors who purchased banana to distribute among supermarkets also apply ethylene before dispatching.

There are 60-70 wholesalers who visit Barawakumbuka *pola* from Batticaloa, Kalmunei, Ampara, Colombo, Galle and Kelaniya areas. On an average about 65 lorries entered the *pola* to buy banana and about 6 lorries transported banana to Pettah wholesale market and 03 lorries transported banana to Eastern area. When the traders of Eastern area came to purchase banana at competitive prices local farmers received higher prices.

Of all the *polas* the highest number of banana sales take place in Barawakumbuka *pola*. Both the buyers and farmers expressed satisfaction on the way of handling business by the *pola* manager.

Pineapple growers in Gampaha area keep close links with the collectors as well as exporters and they have only to cultivate and maintain the crop properly. The collectors and exporters visit the land and harvest according to the requirement. Normally for the export market, pineapples are harvested before they are matured and dark colour skins appear. For the domestic market well matured pineapples are harvested and within 04 days these are ripened. The processors as well as collectors visit farms and do harvesting and transporting to the required markets or processors.

Some of the issues identified throughout the analysis require policy as well as public sector action. In addition many challenges faced by the sector can be addressed directly by the private sector and/or in partnership with the Government. The actions required to address the issues raised throughout the analysis are presented to alleviate or reduce the negative impact on the competitiveness of pineapple and banana marketing.

Farmers want a reduction of fertilizer prices to minimize the cost of production. The cost of agro chemicals and labour has increased considerably. Crop management, harvesting, processing and packing need skilled labour. In the cultivation of banana the highest cost is incurred for plant maintenance and it was about 48 percent and 57 percent for kolikuttu and ambul respectively. The cost of planting was 24.4 percent and 7.3 percent respectively. The cost for suckers of kolikuttu was 17.5 percent of the total cost. Labour cost for kolikuttu cultivation was 61.3 percent of the total cost of cultivation.

The highest cost component for pineapple is for planting and it was 40 percent of the total cost followed by land preparation (35 percent). In the cost breakdown the highest cost was incurred for suckers (28 percent) followed by fencing (26.3 percent). Labour cost for pineapple cultivation was 22 percent of the total cost.

At present the government decision to provide fertilizer subsidy for coconut cultivation benefits the pineapple farmers because pineapple is cultivated under coconut lands and almost all the growers use coconut fertilizer for pineapple cultivations.

Several well-known international organizations, government ministries and universities have started agriculture-related activities in Sri Lanka. Successful local agribusinesses serve as models and could provide short-term technical experts. Both the universities and private sector companies already have small agricultural development programs operating within the country to work with local experts. They have engaged in the development of planting material of Ambul and Cavendish by using tissue culture technique. Farmers are willing to pay higher prices for these suckers because these plants produce higher yields, produce evenly distributed hands and are free from diseases. These bunches were sold at higher prices due to their good appearance. But assistance should also be provided beyond the agricultural production and trading firms to include support services, packing house design firms, the financial sector, and others in the value chain.

Internationally recognized private companies, which are engaged in export of banana, use proper techniques for maintenance of crop, harvesting, packaging and handling to obtain the needed quality. However other exporters also try to meet those requirements by using low cost techniques according to their practical knowledge that suits to the domestic conditions. During the survey period the producers', collectors', wholesalers' and retailers' prices of kolikuttu were Rs.60.00, Rs.80.00, Rs.100.00 and Rs.160.00 per kg respectively. According to the cost breakdown the highest margin was kept by the retailer and it was about 53 percent of the retail price. They had to keep this higher margin to minimize losses which is about 10 percent fruit loss and reduction of prices. The highest loss is due to low demand from consumers for over ripened banana. To minimize the losses these fruits are sold to fruit juice and fruit salad traders in the surrounding boutiques. The retailer's net profit margin for kolikuttu is higher than that of the wholesaler's. The wholesaler's profit margin for ambul is higher than that of the retailer's though the retail level gross margin is higher. Producers' profit margin was about 25 percent and the collectors' profit margin was about 11 percent. In the trading sector the highest investment was by the collector who visits farmers and *polas* to

purchase banana. In addition, he sometimes distributes banana throughout the country and he has to wait about two three months to collect his return from other traders. But he has to pay for the small scale producers at the moment he purchase banana. At the field level the transport and handling cost was about 01 percent and in the urban areas it was around 03 - 04 percent of the retail price. The cost in the urban area is higher mainly due to higher labour cost and higher fuel wastage incurred for distributing produce to the retail outlets.

In the value chain analysis of pineapple the highest margin of Rs.26.36/kg was obtained by the producers because the harvesting was done by the collectors or wholesalers. The collector's margin was Rs.6.42 and the wholesaler's margin was Rs.8.55/kg. They were the entrepreneurs who invested in the business. The relatively higher margin was kept by the retailers.

In the value addition of banana the highest gross margin can be seen at the retail level. At this level gross margin of kolikuttu and ambul was Rs.53.30 and Rs.13.30/kg respectively while that of pineapple was Rs.12.26/kg. The highest gross margin was obtained by the banana retailers and it was about 33 and 38 percent of the retail prices of kolikuttu and ambul banana respectively while the retailer's margin was about 17 and 10 percent respectively. Retailers' margin was very high because they had to sell these bananas the day they purchase in order to maximize the profit and to minimize losses. Otherwise they had to sell them at lower prices because they knew that ethylene was applied and as a result over ripening would damage the fruits. Of the other entrepreneurs engaged in the pineapple sector the highest margin was reported at retail level and it was over 18 percent of the retail price. The highest gross margin was gained by the pineapple producers and it was over 33 percent of the retail price. Out of these three crops the lowest gross margin was gained by the ambul producers and it was about 19 percent of the retail price.

The total value addition of ambul banana was about Rs.51.56 per kg. Producers' profit margin was about 18 percent and their transport and handling cost was only 01 percent of the retail price because almost all the producers brought their produce to the nearest *pola* or sold their produce to the fruit collectors who visited their farms. Their main income earning source was banana farming. Farmers who cultivated kolikuttu banana gained a higher income. On the supply to the market the supply of ambul was much higher than that of kolikuttu banana. Traders also kept higher margin while selling kolikuttu. Traders are not willing to buy naturally ripened banana from the farmers. Farmers brought both matured and immature banana to the *polas*. Though the consumers knew that the purchased banana is spoiled quickly they had no choices.

Large scale pineapple and banana growers and traders have their own storage and packing facilities, but the facilities vary widely in technical and management qualities. Sometimes they explore renting of cold storage space. Temperature is the single most important concern in maintaining quality of banana after harvesting. Promptly refrigerating harvested product helps retard pre-mature ripening, softening, and textural changes. The small scale farmers do not have such facilities. But it is not considered as a problem because exporters request the growers to harvest pineapple and banana

according to the needed quantity. Sometimes they themselves visit the farm and harvest the required quantity. At present most of the banana exports comprised of Cavendish variety. Domestic varieties are also exported only in small quantities.

For the domestic market, growers harvest their crop when the fruits are matured. Then the harvested fruits are supplied to the nearest wholesale market. Some of the small scale farmers sell their harvest at the nearest collecting centre or to the mobile collectors. It was observed that the way of handling banana damages the bottom of the bunch. It is necessary to present post harvest damages and significant improvements to product quality, product presentation, and reduction of loss and waste can be made through simple training and attention to proper handling in harvesting, post-harvest, transport, and storage activities. Traders should be given training and assistance in packaging and labeling and production changes.

When the growers try to increase the weight of fruits it badly affected the ripened fruit. The post harvest losses have increased due to high moisture content of pineapple fruits. With high moisture content pineapple is not tasty and this can be identified by looking at the outer skin of the fruit. When ripening, the pineapple fruit leaks juice and there is no demand for these fruits in the export market. The post harvest damages to banana also could be identified at the market with damaged skin. When the fruit is ripened outer skin of banana is cracked and opened. The traders do not wish to buy these stocks as consumer demand for those are very limited. Besides due to ethylene application ripened fruits are damaged within two days. As a result of tissue culture ambu banana trees produce large and heavy bunches. Therefore bottom two hands of the ambu bunches are damaged while loading and careless handling.

Some of the existing processing industry owners are still in the initial stage and need help in developing. Processing companies face problems with insufficient raw material supply throughout the year. Some of the fruit processors located in Southern area face environmental problems and lack of land suitable for building processing plants. These processors face problems in purchasing pineapple because the fruit grows mainly in Gampaha district. Therefore both the raw material and final product have to be transported up and down causing the additional cost to the final product. One of the main points identified in the analysis was the high cost of raw material. In the processing industry the highest cost is incurred for raw material and it was about 49 percent of the final product. The pineapple processing industry use small size pineapples to make pineapple rings, tidbits, jam and cordial. Those small size pineapples have very low demand from the consumers and those are available at low prices.

Proper packaging materials are used by exporters according to the need of the importing country. They are sturdy, capable of maintaining quality and presentable. Packaging went a long way in improving a product's image by meeting International standards and norms and certifications.

The most important key to quality maintenance of fresh fruits is careful handling. Symptoms of injuries incurred during harvesting, handling, grading, and packaging

usually are not evident until the products reach retail or consumer levels. Bruises and other mechanical damages not only reduce the quality or value and the appearance of the product but also good avenues for entry of decaying organisms. Post-harvest rots are more prevalent in fruits that are bruised or damaged than in undamaged products. Hence post-harvest disease management should be started in the field and continued throughout harvesting, handling, and marketing. Sanitation is critical, because decayed remains are an excellent source of material to spoil the other fruits.

Food safety also should begin in the field, because several outbreaks of food-borne illnesses have been traced to contamination of produce in the field. Therefore export items should be properly monitored by both the exporters and growers. The exporters have gained experience by rejecting some stocks of dried pineapple, fresh pineapple and bottled or canned items. Exporters have faced some problems by using low cost packing materials as well.

It was revealed that the global demand for fruits has increased mainly for Cavendish and pineapple. When the domestic prices increased at a higher rate exporters are reluctant to purchase and export because their profit margin declined with the stable prices in the international market.

Year round availability of a broader line of high-quality fresh produce is increasing the trade of fresh fruits. Fresh fruits represent the highest value potential to agriculture producers. But it was observed that the price of fresh pineapple does not differ much though it is exported or sold at the domestic market. Only difference is that pineapple is harvested before ripening stage for the export market. Our pineapple and Cavendish banana production is highly export oriented. In the pineapple production and marketing, growers and exporters are interconnected. Accordingly exporters are able to collect fresh pineapple throughout the year. The growers who supply pineapple to the domestic market harvest their crop on request of wholesalers in open market. They sell it to the retailers and supermarkets. These wholesalers select the fruits according to the need of the supermarkets and other contractors.

6.2 Suggestions

Strengthening public-private dialogue to pursue a medium and long term strategic vision and plan for expanding the current market base of these fruits is strongly recommended. To achieve this it is necessary to build trust among various players along the value chain.

This will help to produce healthy seedlings to satisfy farmer needs and implement a plant distribution programme with varieties that are in demand in target markets. There was a huge demand for new ambul variety which was distributed from Weligattha farm. And also farmers are willing to purchase good quality kolikuttu suckers which are in short supply at the field level.

It is recommended to improve access to short and medium term finance to develop the processing sector because many of the large scale planters are keen on establishing processing plants and need loan facilities.

Improving farmer and producer access to the latest information on international standards and types of certifications required for target markets is necessary. The growers and traders engage in this sector are aware of these requirements but the information are not freely available to others.

The supply chain should be developed and strengthened to help small farmers to link with larger producers and processors to access expanded distribution. Small scale farmers have to bring their produce to the nearest collecting center because these farmers do not have any other group marketing system to deal with larger producers or processors or exporters.

Implementing a program to address the problems in the harvesting and post harvest activities including training programs in proper handling techniques, grading and standardization and pack house operations is also recommended.

It is necessary to strengthen the sustainable capacity and access to both public and private sectors on-farm extension services to alleviate the present extension problems.

There is also a need for strengthening Research and Development capacity to develop new varieties to capture new markets and compete with the other exporting countries.

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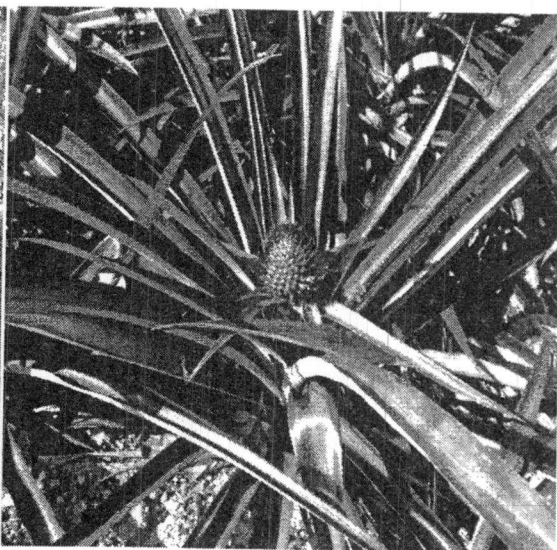
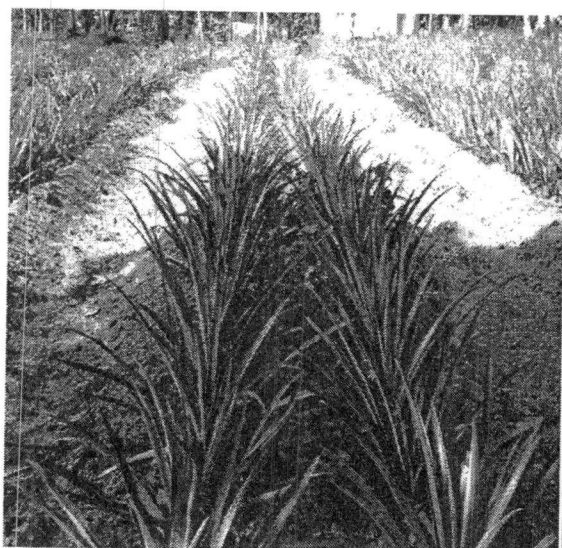
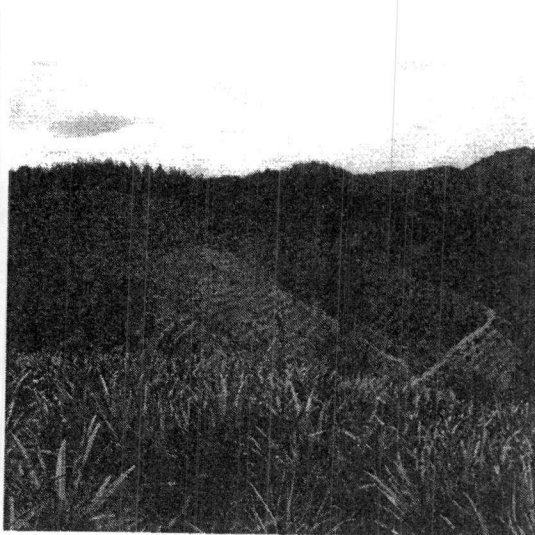
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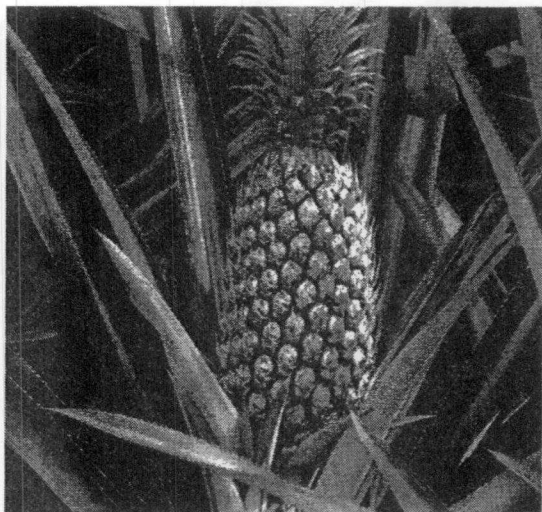
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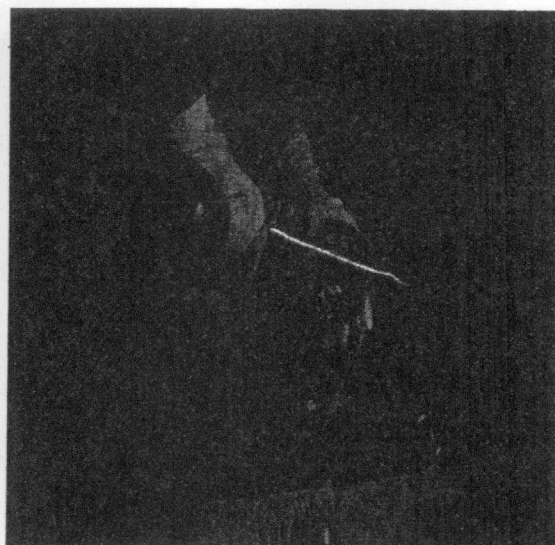
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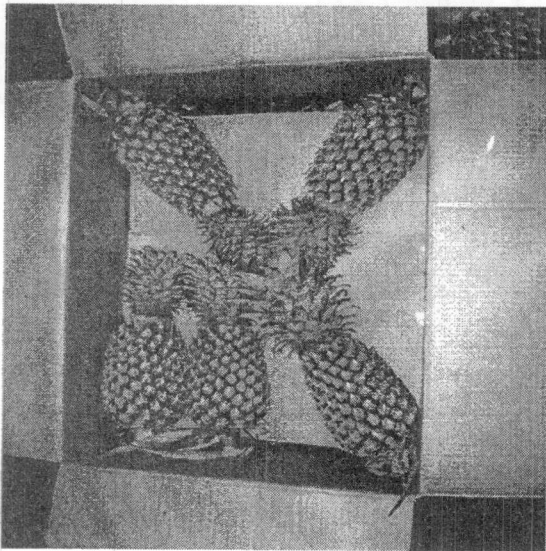
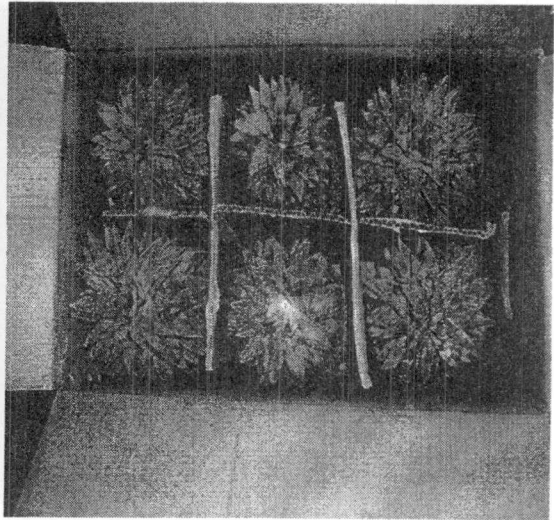
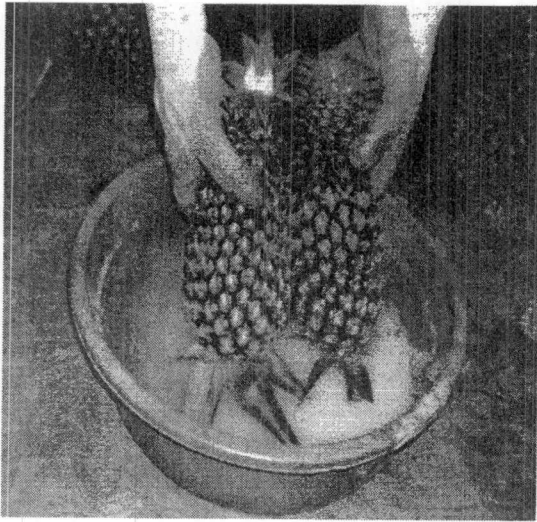
Pineapple Cultivation

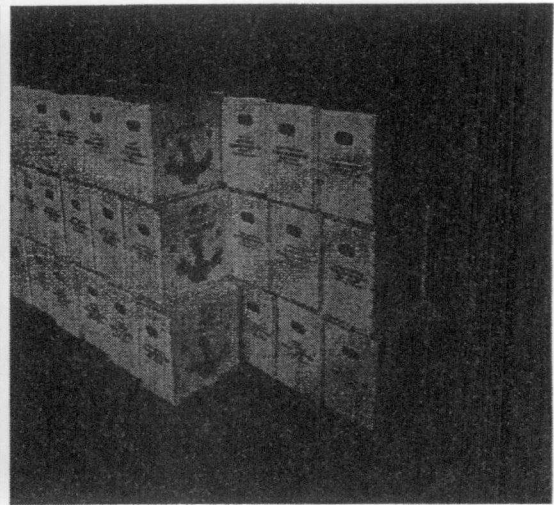
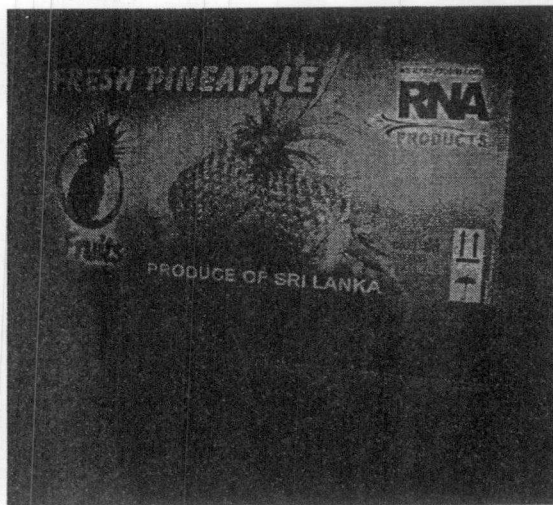




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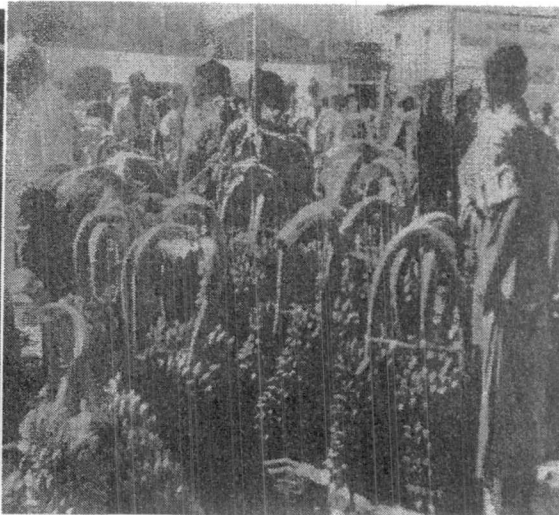






Banana Cultivation and Marketing

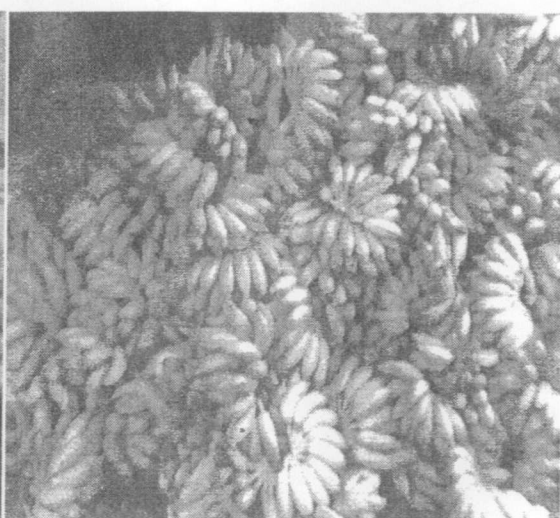
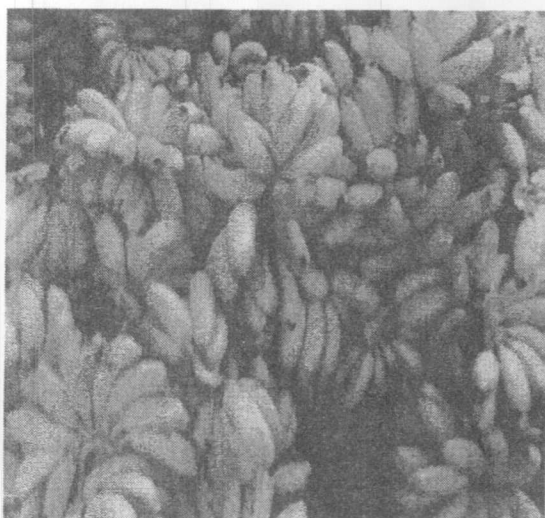
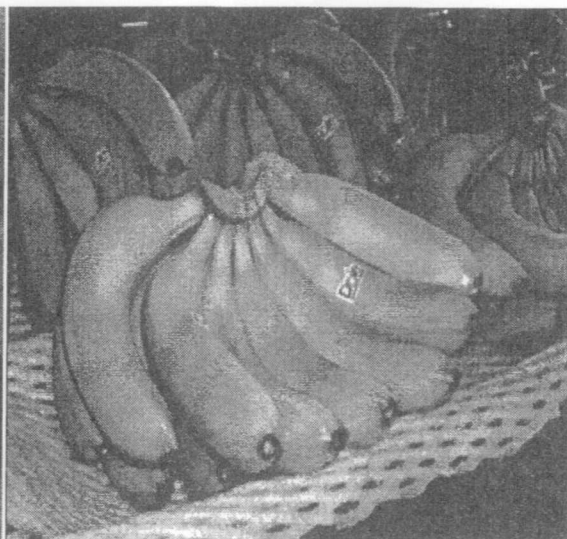
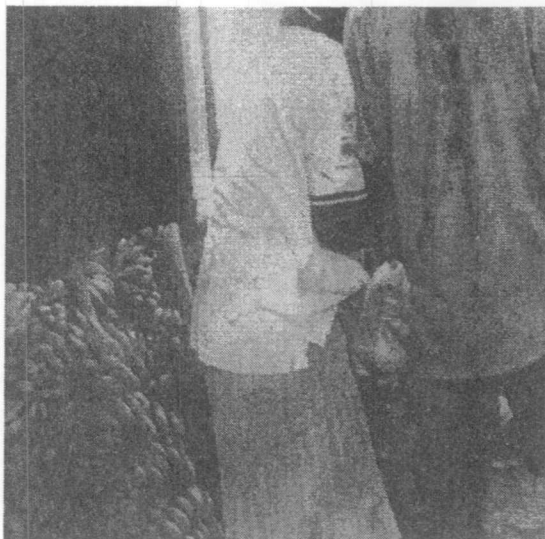




Barawakumbuka *Pola*



Etheral Application



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