VALUE CHAIN ANALYSIS OF PINEAPPLE IN ERNAKULAM DISTRICT

By

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(2018-11-124)

DEPARTMENT OF AGRICULTURAL ECONOMICS

COLLEGE OF HORTICULTURE

VELLANIKKARA THRISSUR – 680656

KERALA, INDIA

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DECLARATION

I, hereby declare that this thesis entitled **"VALUE CHAIN ANALYSIS OF PINEAPPLE IN ERNAKULAM DISTRICT"** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Vellanikkara, **Apeksha K. Rai**

09-10-2020 **(2018-11-124)**

CERTIFICATE

Certified that this thesis entitled **"VALUE CHAIN ANALYSIS OF PINEAPPLE IN ERNAKULAM DISTRICT"** is a bonafide record of research work done independently by **Ms. Apeksha K. Rai (2018-11-124**) under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, associateship, fellowship to her.

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ABBREVIATIONS

BCR	-	Benefit Cost Ratio
CCA		Commodity Chain Analysis
CGR	-	Compound Growth Rate
CV	-	Coefficient of Variation
DEA	-	Data Envelopment Analysis
DMU	-	Decision Making Units
MFC	-	Marginal Factor Cost
MVP	-	Marginal Value Product
OLS	-	Ordinary Least Square
SD	-	Standard Deviation
TE	-	Triennium Endings
VCD	-	Value Chain Development
VSM	-	Value stream mapping

Introduction

1. Introduction

In India, over the past few decades mainly after the economic reforms of 1990s the agricultural system has undergone rapid transformations. In India, the advent of unified agriculture is considered as one among the greatest observable market sensations along with supply and value chains. Horticultural crops are considered as high value crops since besides creating employment opportunities, it is also important for the farming community in rising their income.

In the country, fruits and vegetables account for almost 90 per cent of total horticultural production. India is the second major producer of fruits and vegetables in the world and is the leader in several horticultural crops. During 2017-18, the area under horticultural crops was 25.43 million hectares and the production was estimated to be 311.71 million tonnes (GOI, 2018). Fruits are nature's ideal gift to mankind. Production and consumption of high quality fruits allow us to sustain a healthy, balanced daily diet. From 2004-05 to 2017-18, the overall production increased from 51 million tonnes to 97.5 million tonnes. Fruits alone contributed 31.2 per cent in total share of horticultural crops (GOI, 2018).

The entire world has become a single global market in the present era and there exists a competition in the market. With the varying agricultural environment in rural sector, the significance and value chain in fruit segment has developed because of countryside to urban migration and shift in food lifestyles and essentials of buyers. With the emerging competition for quality products unbeatable prices and consumer satisfaction, businesses need to be repeatedly assessed for the value they bring into the firm. Agriculture has the potential to provide nutritional security but so far it has failed to provide it. Value addition is one of the important elements of nutritional security. Value addition in agriculture is necessary for the profitability of the farmers and other weaker sections of the society. It is necessary to provide consumers with healthy, quality and branded food, to reduce post-harvest losses, to reduce imports and to increase exports, to encourage the

growth of subsidiary industries, to reduce marketing risks, to encourage crop diversification and to increase farmers' financial stability.

Pineapple

Pineapple (*Ananus comosus*) is a pleasing edible tropical produce with excellent moistness, exciting flavour and enormous fitness aids from the family Bromeliaceae. It is a rich source of Vitamin A, B and C and also contains a large number of vital nutrients for human health with less fat and cholesterol. It is also a good source of Vitamin B_1, Vitamin B_6, Copper and dietary fiber. Enzymes present in pineapple helps in treating rheumatoid arthritis and speedy repair of tissues caused by wounds, diabetic pustules and common surgical treatment. It is considered as an outstanding cerebral cleanser since it fights against memory loss, sadness and melancholy (depression). It can be used to produce food articles such as jelly, squash, jam, pickle, candy, *etc*., which not only provide remunerative prices for the farming community in a sustainable manner but also create employment opportunities for the unemployed rural community. Considering the economic value of the fruit, the Indian Government has endorsed one out of ten Agricultural Export Zones (AEZs) for pineapple for the all-round growth of pineapple producing areas (Joy, 2013).

Around the world, pineapple displays increasing demand, over the years. The major pineapple producing countries are Brazil, Thailand, Philippines, Costa Rica, China, India and Indonesia. After Banana and Citrus, Pineapple is considered as the third most significant tropical fruit worldwide. Globally 50 per cent of pineapple is traded as fruit, 30 per cent as preserved product and 20 per cent as essence. Fresh pineapple has registered 100 per cent rise in the world trade over the last decade (Joy, 2013).

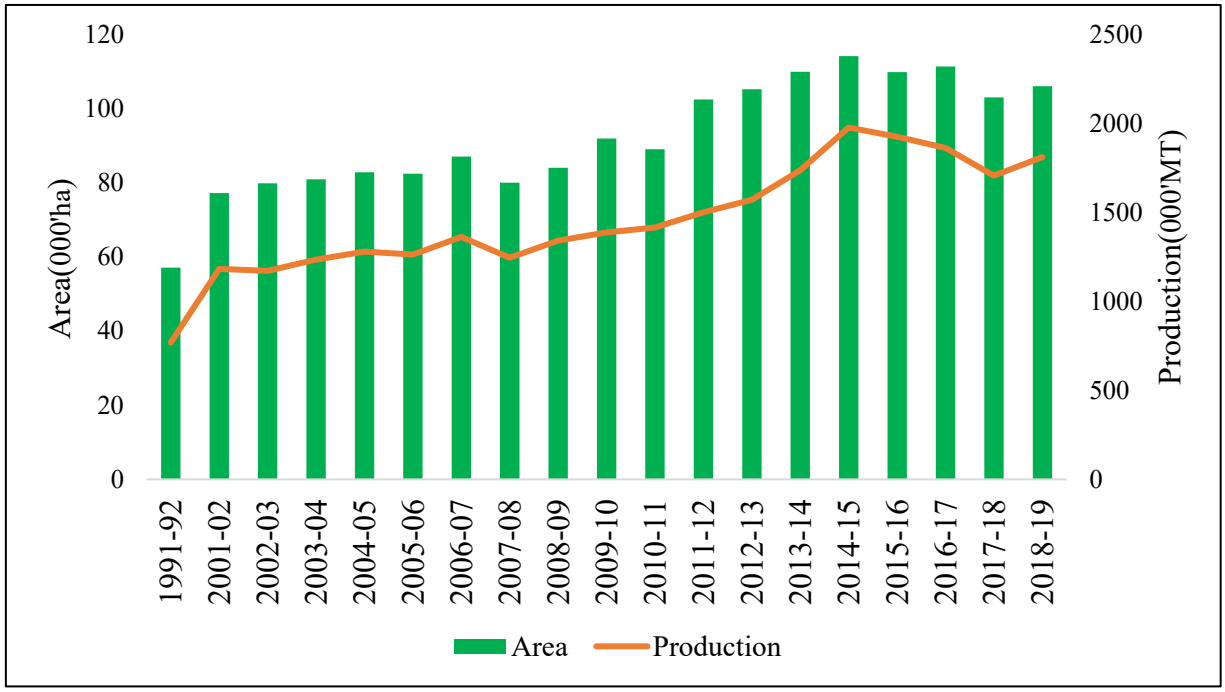
Indian scenario

India ranked third with an area of 106 thousand hectares and sixth in pineapple production in the world which accounts for eight per cent share in total pineapple production. Production of pineapple has increased from 768.5 thousand metric tonnes to

1810 thousand metric tonnes since 1991-92 to 2018-19 as depicted in the Figure 1.1 (GOI, 2018).

Pineapple is grown mainly in North-Eastern states like Manipur, Tripura, Arunachal Pradesh, Mizoram, Meghalaya, West Bengal, Assam, and Nagaland. Also in Southern states like Kerala, Karnataka and partially in Goa, Orissa and in the coastline belt in Tamil Nadu. West Bengal is the leading producer even though Assam reported the highest area under cultivation. Karnataka, Telangana and Maharashtra are the three states that reported the highest productivity (GOI, 2018). Generally, as compared with the world productivity of 22.58 t/ha, India reported low productivity of 16.00 t/ha. The two important pineapple varieties grown in India are 'Kew' and 'Mauritius' (Joy, 2013). The major importers of pineapple from India are Nepal, Maldives, United Arab Emirates, Saudi Arabia, Kazakhstan, Oman, Bahrain, Bangladesh, Zambia, Pakistan and Qatar (APEDA, 2018).

Figure 1.1: Area and production of Pineapple (1991-92 to 2018-19) in India.



Source: Horticultural Statistics at a Glance, 2018-19

Kerala scenario

In Kerala, about 69.72 thousand metric tonnes of pineapple were produced from an area of 8.22 thousand hectares with a productivity range of 8.49 t/ha (GOI, 2018). Congenial humid climate helps pineapple cultivation in the state. The best grade Mauritius pineapple is from Kerala. It is identified as the finest in quality, sugariness and has noble flavour hence the demand for fresh fruits not only confined to India but also in foreign markets.

Ernakulam, Kottayam, Pathanamthitta and lower elevation of Idukki are considered as the major pineapple producing districts in Kerala. More than 60 per cent of area in pineapple cultivation was contributed by Ernakulam alone. In the district, pineapple cultivation mainly concentrated within and outside Vazhakulam (Pineapple city). From Vazhakulam the fruit is marketed to all the Southern and most of the Northern states of India and is identified as the biggest pineapple market in India. Pineapple is cultivated in coconut and rubber plantation mainly as an intercrop. This will give additional income in fetching remunerative price in the International market to the farmer during the period when no income is earned from rubber/coconut. The variety mostly preferred for cultivation is Mauritius (locally known as Kannara/Vazhakulam pineapple) because of huge internal market and export potential. For more than 50 years, pineapple has been commercially cultivated. In 2009, under Agricultural and Horticultural products, the Vazhakulam pineapple has been listed with Geographical Indication (GI). GI tag is helping in fetching remunerative price in the International market.

Kerala offers exclusive advantage for the production of Mauritius grade. The growing export demand has compelled Kerala's pineapple growers to emphasis on the globally accepted MD2 variety due to its better suitability for processing and extended shelf life, compared to the traditional Mauritius grades. For export purpose, sea shipment protocol has been developed. It is ideal for table purpose, hence Mauritius variety has got higher consumer demand and other varieties are suitable for processing. Some factors are

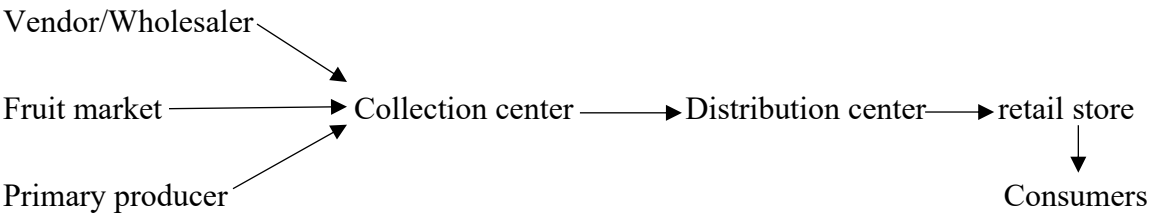
significantly contributing towards wider expansion of pineapple in the state and few among them are

1. Well-structured Pineapple Growers' Association
2. Developmental and technical upkeep from Kerala Agricultural University and Pineapple Research Station
3. Formation of Kerala Pineapple Mission
4. Industry support from Vazhakulam Agro and Fruit Processing Company (NAPCL)
5. GI registration
6. Vazhakulam market and VFPCK markets
7. Local availability of planting material
8. Knowledge towards pineapple cultivation, *etc*.

Value chain

From the producer, before reaching final consumer most of the products change hands. Value is added at every stage of the process such as input providers, farmers, traders, processors, transporters, bulk suppliers, venders, stores, distribution or market place of the product, *etc*. Thus value chain is defined as the complete range of activities involved in moving a product or service from input suppliers to the end users. Value chain analysis is a valuable instrument to understand what generates the maximum potential value to the produce.

Value chain flow -



(Kumar, 2014)

To describe how value adds along the chain of operations and what leads to final product or service, Michel Porter advocated the idea of value chain for the first time in 1985. He categorized value chain activities into two groups, primary and secondary activities

1. Primary activities: Activities that directly involve in production and distribution of a products

2. Supporting activities: Activities that are not directly involved in production but increase effectiveness and thereby increase efficiency.

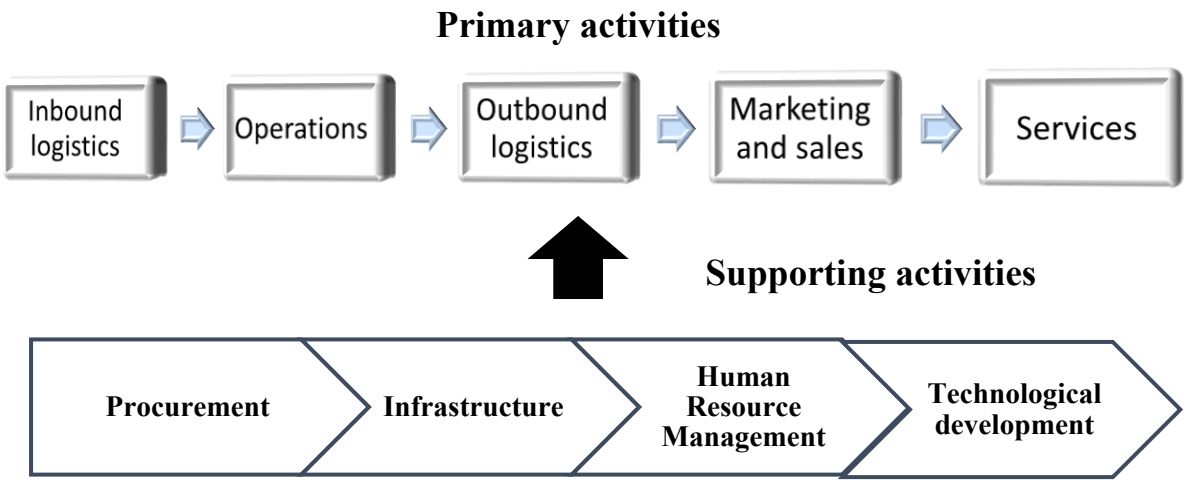


Figure 1.2: Porter's value chain

FAO conducted a sequence of value-added chain studies within India and outside countries to study the influence of value chain on growers who are the chunk of producing a definite quality of produce. Efficiency in production is a crucial condition for successful penetration into global markets. With the growing division of labour and distribution of production components, systematic competitiveness becomes increasingly important. Understanding the dynamic elements within the whole value chain is inevitable to make an entry into the global market.

In this perspective, an important area of study is to assess production performance and how existing marketing arrangements for pineapple in Kerala are adding value to the produce. Keeping this background in view, the present study "Value chain analysis of Pineapple in Ernakulam district" was done with the objectives given below:

1. To prepare the value chain map of Pineapple in Ernakulam district
2. To assess the value chain production system; evaluate their technical efficiency; to identify the institutional and infrastructural issues that affect the competitiveness of the selected value chain and
3. To propose interventions for upgrading the Pineapple value chain

Scope of the study

There exists scope for increasing productivity in all pineapple producing zones of India by adopting improved cultivation practices. Besides production, equal emphasis on provision of ideal marketing facilities are also important. Wide variations in prices and wastage due to improper handling and lack of value addition results in income variability of farmers. The present study would suggest the importance of adopting improved pineapple production system and various stakeholders involved in the Pineapple value chain in Ernakulam district. The growth rate, costs and returns in pineapple cultivation, resource productivity and efficiency on pineapple farms, marketing concepts like marketing efficiency, price spread were calculated and the physical flow of Pineapple within and outside the state were analyzed. The constraints faced by the growers in pineapple production and marketing were also studied. Opportunities and interventions have been suggested for upgrading the Pineapple value chain.

The study helped to identify the existing value chain of Pineapple in Muvattupuzha and Pampakkuda blocks of Ernakulam district and the role played by each actor in the chain. The findings would create a good impact on building value chain perceptions so as to ensure sustainable livelihood to pineapple growers.

Limitations of the study

The study was carried out by an individual researcher and confined only to the Ernakulam district during the year 2019-20. The results from this study were made on the basis of inference drawn from data collected from Pineapple farmers and other players involved in the value chain. During primary data collection, errors aroused from entry and loss of data due to Covid-19 were also encountered. The practice of maintaining records on the cost of cultivation was not predominant among the growers, the responses were drawn from their memory. The conclusions drawn from the primary data are for a very short period, hence the recommendations provided cannot be stretched. Hence the results of the study are subject to these limitations. However, efforts have been made to minimize the errors wherever possible.

Presentation of the thesis

The study entitled "Value chain analysis of Pineapple in Ernakulam district" has been presented under five chapters. The introduction chapter gives in brief the importance of Pineapple production in India and Kerala followed by scope and restrictions of the study. Explanation about the results of the earlier research in the related work has been given in the review of literature chapter. Methodology used in data collection and data analysis have been presented and discussed in the third chapter. The fourth chapter explains about the major findings of the research work. The overall view of the major implications of the research work has been given in the last chapter. The list of referred books, journals and web sites have been presented in the reference section.

Review of Literature

2. REVIEW OF LITERATURE

Review of literature is the organized summary of the study which is conducted on a particular focused subject. It not only summarizes the background but also framework of the research. In significance to the present research, an effort was made to examine the literature of earlier research study. The reviews were collected, classified and offered under the different subheadings given below:

2.1. VALUE CHAIN CONCEPTS

Gereffi (1994) described global value chain as along four dimensions: their input-output structure, their geographical coverage, their governance structure and their institutional framework in which the chain operates.

Kaplinsky and Morris (2002) gave the definition for value chain as the complete range of activities which are essential to carry a product or service from origin, through the

different stages of farming which includes a mixture of physical transformation and the input of various producer services, delivery to end users and final disposal after use.

Hobbs *et al.* (2000) defined the value chain as the specific form of supply chain. The supply chain applies to the entire vertical chain of operations, which contains from farm production through manufacturing, distribution and retailing to the customer. They differentiated value chain from supply chain as the chain players who prepared to work together , have a long term strategic vision, , directed by demand and great level of faith in one another that enable better safety in industry and that eases the expansion of mutual goals and objectives results in mutual commitment to regulate product quality.

Fold and Gough (2008) reported that to support the processing segment, the capability of the value chain were governed by how successfully the value addition will fulfill with the nature of the demand and also on the consumer preference, which is considered as the key driver of changes in value chains.

Presutti and Mawhinney (2009) in their modern value chain model reported that supply chain is considered as the key element of value chain but not same, which contains all of the Porter model's primary activities. Value chain includes governance, community values and the discipline of supply chain administration. The integration of these activities into the contemporary model's supply chain aspect offers some important elements for the success of the value chain.

United Nations Industrial Development Organization defined value chain analysis as the method of splitting a chain into its component parts for better understanding of its construction and operations. At each step, participants in the research were identified and their activities and relations were differentiated. Leadership to control chain and promote and reinforce chain formation were evaluated. Value-added actions in the chain were identified and additional cost were allocated to each of these operations. And also it was said that to identify problems and prospects to improve the participation of particular

players in the complete chain it is important to analyse the movement of goods, data and funding through the different stages of the chain (UNIDO, 2009).

Trienekens (2011) suggested three key elements for a secure analysis of value chain. They were linkage structure, horizontal and vertical market channel relationships and value addition. It relates to any business chain's main strategic objective; and governance, covering institutional structures among value chain actors. In value chain business atmosphere, these components were regarded as fixed, where the focus has been kept on markets, capital, infrastructure and institutions.

The World Business Council of Sustainable Development has given the definition for value chain as the complete life sequence of a product or services which includes finding of raw material, production, feeding and disposal/reusing processes (WBCSD, 2011).

Dunn (2014) defined value chain as a vertical linkage or a network between various independent business organizations, which involves processing, packaging, storage, transport and distribution.

2.2. SIGNIFICANCE OF PINEAPPLE

Saraswat (1997) piloted a study on organization of cultivation and marketing of Apple in Kirari village of Himachal Pradesh. It was observed that compound growth rate of area under apple in Himachal Pradesh increased at the rate of 4.71 per cent per year and the production increased from 1966-67 to 1990-91 at the rate of 8.34 per cent per year. The study also revealed that the average productivity of apple orchard per hectare was 1285 standard boxes of each 18 kg.

Keerthi (2008) conducted a study on pineapple area, production and productivity in Shimoga district of Karnataka from 1994 to 2004. Analysis has shown that Karnataka state reported a positive growth of 0.43, 17.76 and 17.27 per cent in area, production and productivity respectively. Whereas, Shimoga district reported a growth rate of 3.95 per

cent in area. Production and productivity showed 5.29 and 1.31 per cent growth rate respectively.

Hemalatha and Anbuselvi (2013) reviewed that pineapple fruit exhibits high moisture, high sugars, soluble solid content, ascorbic acid and low crude fiber. Because of all these reasons it could be consumed as additional nutritional fruit for good personal health. Also it is an outstanding source of minerals and Vitamins. About 16.2 per cent of daily requirement of Vitamin C can be obtained from one healthy ripe pineapple.

Hosain *et al*. (2015) reported that global market demand for pineapple has been expanded rapidly. It is one of the common fruit in Bangladesh and other countries around the world. It contains a good number of beneficial elements for living health such as different vital nutrients, starches, crude fiber, moisture and various minerals.

Hossain (2016) reviewed that pineapple has abundant health aids and provides growers, businesspersons and consumers with an economic potential. Pineapple quality varies due to growing climate, technique of cultivation, time of harvesting, storage and facilities for transport. In the growing countries, the prospect of pineapple farming was bright because of increased consumption and export potential in the world market. He added that to increase the revenue and sustain pineapple quality from creation to marketing stage, broad research should be undertaken with improved novel technologies. To gain better economic returns farmers must pay due attention to adopt all recommended locality-based cultivation practices. And also added that better processing technology, distribution and storage processes will increase the availability and accessibility of fruits and fruit products.

Shivakumar (2016) in his study reviewed that fruits and vegetables are appropriate fields of consideration in Indian farming. Fruit and vegetables can deliver farmers with two to four time higher income and compared to cereals it uses 40 -80 per cent lesser amount of water. For India, China's apple success case can be a valuable example. In ten years, China's processed apple exports increased from US $ 50 million to over US $ 1.4 billion.

2.3 VALUE CHAIN MAPPING

The term commodity chain analysis (CCA) refers to the group of economic mediators that directly contribute to the identification of the final product. Thus the chain incorporates complete series of operations that begin with the resources or an intermediary product, increases value after several stages of transformation and ends in sale of one or more final products at the level of the consumer (Bockel and Tallec, 2005).

Norton and Fearne (2009) enlightened the concepts related to sustainable value stream mapping (SVCM) or value chain assessment. They clearly explained how the methodology can be applied by emphasizing the significance of relations and dissemination of information among food merchants and producers in London. SVSM is an analytical system that initiated in lean manufacturing with the purpose of removing inefficient actions and decreasing production lead time.

Bolwig *et al*. (2010) analysed the significance of value chain map and according to them, it is important to know how actors and activities are related vertically and to recognize the horizontal dimensions, i.e. the relationship between actors at the same chain level.

Rieple and Singh (2010) analysed the various activities in India's organic cotton value chain to understand where and how value is added at each stage. By use of many techniques and technologies most manufacturing stages requires the conversion of a cotton plant into a fabric and then to an ultimate item of clothing. From cotton production to its eventual sale as clothing includes series of events and prices achieved at each stage of this chain were studied.

Value chain linkages are differentiated into vertical and horizontal linkages. Vertical connections are the commercial relationships that brings the product up through the value chain (Dunn, 2014). Horizontal linkages bind actors in the value chain doing the same thing.

Legesse (2014) outlined the methods used in value chain mapping. After clearly identifying the point of entry of a value chain of a particular commodity, mapping of value chain is carried out using input-output relations, the physical movement of products along the line, stream of services, skills and consultants, employment, destination of sales in terms of wholesalers, number of buyers, concentration of sales among major consumers, and also import and export.

Pauline and Ajjan (2014) in their study on mapping the value chain of banana in India, has found that the South Indian markets were highly complex with many intermediaries. Each stakeholder in a value chain was found to work in isolation. Some new strategies that to be planned in future days were listed and few among them are information collaboration, fiscal movement administration, equalization of supply-demand, collective prediction, information distribution, good flow, synchronization. The fragmentation in the value chain has been reported as the reason for high market transaction cost and less price realization by the farmers.

The value chain map offers an easily digestible way of understanding the production and sales processes by explaining the dynamics of the industrial system and its value chain in a simple form (Kerr and Roos, 2015).

Stein and Barron (2017) defined value chain linkages as the networks or relations which links diverse activities of the value chain and which enables the product to move from creation to the consumption stage.

2.4. VALUE CHAIN PRODUCTION SYSTEMS

Anic and Nusinovic (2005) assessed the performance of value chain in apple in Croatia. They defined the necessary circumstances for generating value addition and they identified the inefficiencies in the Croatian apple chain. They suggested that value addition can be increased with the use of advanced technologies, equipment's and high-value

manufactured goods and also by financing in processing businesses and organized infrastructure.

Saili *et al*. (2005) conducted a research on elements disturbing the output of pineapple farmers in Kampung region of Meranek, Malaysia. They regressed production (output) in their study against a number of factors including labour, practice of pineapple cultivation, land, knowledge, and farm record keeping. The average yield per hectare was 35-60 tonnes and the average annual income was ₹ 308700. Their focus was on qualitative (education, race, gender, status, number of farmers children involved in pineapple farming, pineapple cultivation practice, and farm recording) factors that influenced the output against most of the variables quantified.

Ekelund *et al*. (2008) focused on the quality principle as described in the value chain by market actors. Researchers found that retailers first rated product by price, then by demand, volume and product source, while wholesalers identified buyers' quality. Performance came second after demand, followed by quantity and quality, in their ranking of the value of different buying criteria. They also found that customers want freshness and source-related quality products.

FAO (2007) and Hathurusinghe *et al*. (2011), reviewed that value chain analysis (VCA) naturally includes finding and drawing the relations of four types of factors: (i) every activities performed during processing; (ii) the value of resources, processing period and products, (iii) the operations such as transportation and distance, (iv) the organization of market mediators like distributors, producers, processors, wholesalers and retailers. If value chains reflects multi-stage production methods with companies locating in several nations around the world, then value chain becomes a complex process.

Keerthi (2008) in his study observed the efficiency of key inputs used in the production of pineapple. The Cobb-Douglas function was used to assess the resource productivity in pineapple farming. The variable inputs were classified into five sets, which include labour, planting materials, fertilizers, weedicides, and growth hormones and per

hectare pineapple yield was considered as dependable variable. The regression co-efficient for fertilizers and planting materials were found to be positive, which specified that with further application of these two resources in the production process yield can be increased progressively.

Miah (2013) made an attempt to examine the value chain of rice in Jamalpur district and discovered that after disposing their production for family consumption, gift and kind payment to relatives and seed, farmers earned ₹ 8545/hectare. The most of the farmers failed to realize value adding opportunities due to constraints like high marketing expenses, poor transportation system, lack of market information, *etc*.

Adegbite *et al.* (2014) in their study by using Policy Analysis Matrix (PAM) discovered that in pineapple production 58.3 per cent of the growers used sucker method while 46.2 per cent used crown method which are privately and socially profitable. But sucker technique are having higher competitiveness than crown technique.

Jomy (2015), found that the net income received from pineapple orchard during the first, second and third year of cultivation was ₹ 44519/ha, ₹ 70605/ha and ₹ 52983/ha respectively and predicted that net returns resulted in the higher income generation mainly because of large scale cultivation, high density planting, increased output and reduced cost of production .

Singh *et al*. (2016) reported that the investment in pineapple orchard has been found a cost-effective business. During summer season at eight per cent discount rate the net present worth, internal returns rate and benefit-cost relation value reported as ₹ 24857.80, 32.53% and 1.23, respectively and for winter season it has been reported as ₹ 10454.44, 67.33% and 1.24, respectively.

Aoudji *et al*. (2017) in their study in Southern Benin has identified processed pineapple products which were accessible in the market and it includes juice, dried pineapple, jam, syrup, and low alcoholic beverage like cocktail. Some brews (juice, syrup and cocktails) were the most common and most consumed pineapple-based products.

Viable price, willingness to buy an indigenous beverage, natural and therapeutic beverage were the driving forces that influenced the consumers in buying.

2.5. COST AND RETURNS IN PINEAPPLE CULTIVATION

Islam (1998) conducted a study in Madhupur Thana of Tangail district on pineapple production. He presented the relative profitability of rising pineapple under small, medium and large farmers. He found that average net returns of pineapple per hectare under small, medium and large farmers were ₹ 27186.75, ₹ 28553.25 and ₹ 31866.50 respectively.

Padmini (2002) calculated the expenses incurred in pineapple farming and conjointly geared towards the issues tackled by farmers in Kerala. Within the initial year the expenses incurred for minor farmers in the production of one tonne of fruit was ₹ 4280, and ₹ 3992 for medium farmers and ₹ 3992 for big farmers. During the second year, the expenses was ₹ 2526, ₹ 2362 and ₹ 2248 for small, medium and big farmers respectively. Similarly for the third year, the expenses estimated to ₹ 1248, ₹1097 for medium farmers and ₹ 1033 for small, medium and big farmers respectively.

The returns from pineapple cultivation estimated to ₹ 19077/ha, ₹ 26964/ha and ₹ 26202/ha for small, medium and big farmers respectively within initial year. Within the second year the returns estimated to ₹ 97905, ₹ 101100 and ₹ 107450 for small, medium and big farmers respectively. In the third year return estimated to ₹ 121955, ₹ 124900 and ₹ 128925 for small, medium and big farmers respectively. The study identified some most important issues tackled by the pineapple producers and they were high value of chemical and bio-fertilizers, shortage of economic help, high wage rate, insufficiency of fertile land *etc.*

Chakraborty and Bera, (2008) conducted a study in Darjeeling district to analyse costs and returns obtained from pineapple farm. They estimated per acre total cost, total return and net returns on Cost C as ₹ 119104.23, ₹ 149750.62 and ₹ 30646.30 respectively. With good marketing and processing activities the crop created tremendous employment

prospects both directly and indirectly. It helped pineapple producers to get reasonable market prices for their output.

Keerthi (2008) conducted study on production of pineapple in Shimoga district and estimated the total establishment cost and maintenance cost as ₹ 214464.40ha^{-1}and ₹ 71876.89ha^{-1} respectively. The returns obtained was ₹ 533155.26ha^{-1} from average yield of 66 tonnes.

Hasan *et al.* (2010) made a study on pineapple cultivation and analysed that, pineapple with intercropping increases the income of the farmer. They identified some widely used intercrops in pineapple field and they were ginger, jackfruits, aroids (plants of the family Araceae), turmeric, *etc*. Socio-economic factors like education level, land holding pattern, annual income, awareness and attitude towards pineapple cultivation contributed positively toward farm income. Also suggested that by growing intercrops with all recommended cultivation practices can help farmer-producer in getting a better economic return.

Alam (2018) conducted a study on mango supply chain and value chain analysis and revealed that potential for farmers to grow mango fruit was high, while the post-harvest losses and existence of middlemen were found to be maximum, farmers were not well organized, fair price for farmers was uncertain and are dominated by middlemen which reduced the farmers income. The result showed that the cost and returns share of mango farmers found to be 1.69: 1. The mango farmers contributed only 22.35 per cent to total added value, while for traders and retailers it was 23.29 per cent and 54.36 per cent respectively. And the study also suggested that by linking farmers, market intermediaries can be reduced and awareness on food safety issues can be created among farmers and traders.

Ryambi (2019) calculated the NPV for pineapple orchard and it was ₹ 36149.10 for small, ₹ 35752.68 for medium, ₹ 43232.27 for the large and the overall was ₹ 38378.03. As compared to small and medium farms the NPV was observed to be high in large

category farm and the reason projected was may be because of proper use of available inputs and improved managing practices at large farms.

2.8. PINEAPPLE IN THE STUDY AREA

Jose (1993) in his study reported that, in Muvattupuzha block, good marketing facility is available for pineapple and fruits are sold in open market through cooperative societies. The study also underlined the prospective of pineapple as an intercrop in rubber and coconut plantations in the block.

Ravi (2009) out looked that with commissioning of the combined pack house at Nadakkara near Muvattupuzha, India can be identified in the global market for fresh farm pineapple. Nadakkara Agro Processing Company Limited (NAPCL) acquires pineapple directly from the growers at fixed price based on pre-agreement. This helped the farmers in getting remunerative prices for their produce even when price fall in market price due to market glut. Pineapple growers of the region holds 70 per cent share of company and the state government owns the rest.

Joy (2013) reported that Vazhakulam region is known for pineapple cultivation over fifty years which has been grown on large scale. The area is perfectly suitable for pineapple cultivation. Vazhakulam is regarded as India's largest pineapple market. From this market fruits are traded to some South and North Indian states.

Stara (2014) mapped the value chain of Vazhakulam pineapple in Muvattupuzha block of Ernakulam district. Input provision, cultivation, procurement, trading or processing and marketing are found to be the core processes in the pineapple value chain.

2.9. INSTITUTIONAL AND INFRASTRUCTURAL ISSUES AFFECTING COMPETITIVENESS

Sikka *et al*. (2008) reported that because of post-harvest losses, lack of elementary and itemized infrastructure such as pre-cooling, storage, reefer vans, cool chains, maturing

compartments, *etc*., around 30 to 40 per cent of fruits and vegetables were unused in Punjab. There were lack of connection between development, research and global consumerism. They found that precision farming technology in various agro-climatic regions would bring rapid improvements in the value chain and also suggested that significant improvement could be made with the sophisticated resource chain, the implementation and transfer of novel equipment's.

Famogbiele (2013) reviewed that technological and institutional constraints reflected a wider problem of poor support for farmers with agricultural extensions. Farmers including pineapple producers found it difficult to make reasonable progress in their production activities when the extension service was performed below expectations. On the other hand, insufficient or poor funding was the biggest limiting factor for agricultural development in Nigeria.

Harou *et al*. (2015) conducted a study to compare the growers who never cultivated pineapple were superior or worse than growers who decided to take pineapple cultivation later in relation to their closed ones and the result was analysed using two stage least square model which estimated that the growers who adopted cultivation earlier showed greater welfare than one who adopted later or never.

Murthy and Kumar (2015) carried a study to report the gap on some problems related to value chain efficiency, technology implementation, challenges and opportunities for improving the maize value chain actors in transmission of modern know-hows and other market facilities. The study discovered that the adoption of high yield hybrid seeds by farmers, the implementation of enhanced farm technology, increased income through value addition and food security has been increased. New opportunities need to be explored through the introduction of suitable technologies for farming populations. The marketing linkages between maize productions have been extremely weak and need to be strengthened

Putri *et al*. (2015) recommended value addition of cocoa as the remedy for weak competitiveness of Indonesia cocoa industry besides the abundant production of cocoa beans. The value addition was low in the country and products which could be derived from cocoa like cocoa powder, cocoa paste, cocoa cake, cocoa butter and cocoa liquor could further strengthen industry and economy as a whole.

Mani *et al*. (2018) observed that due to various infrastructural and organizational constraints the development of Kiwi value chain remained as a challenge. The major constraints causing inefficiency were lack of reliable data on production, non-availability of research and extension provision, lack of systematized marketing and post-harvest infrastructure, lack of credit support, *etc.* They suggested the development of 'Kiwi Producers Groups (KPGs)' for the upscale of kiwi production which is a committed enquiry center for kiwi, and adequate credit availability to growers.

2.10. CONSTRAINTS AND INTERVENTIONS IN VALUE CHAIN

Achuonjei *et al*. (2002) in their research entitled Ghana sustainable horticultural export chain, described the most significant constraints in the logistics sector with regard to the production of pineapple, poor infrastructure, poor quality means of transport used, lower product quality due to lack of refrigeration facilities, export volumes being too low and the freight cost were also being too high.

Manoharan *et al.* (2003) conducted constraint analysis in milk production in Pondicherry union territory by farmers. The opinion of the farmers were scrutinized by the Garrett's a ranking technique with the formula. In terms of Garrett's mean score arranged in decreasing order of importance; the first five constraints in dairy farming were high feed cost, low selling price of milk, high outlay, infertility issues and low yield/returns.

United Nations Conference on Trade and Development conducted a series of study on value chain and found that due to organizational deficiencies, such as shortage of quality products and poor dependability, with the concession major corporations were averted to

cooperate with local producers. Native dealers' availability and reliability is the prime element of involvement in value chains centered on companies / private companies (UNCTAD, 2006).

Ouma and Jagwe (2010) conducted a study on banana value chain in Central Africa with an objective of identifying constraints and opportunities through two main survey. The study area lack or has minimum involvement in regional markets or domestic high-value chains like supermarkets. It has been shown that rural population involvement in high-value markets has strong impacts on poverty reduction, since such chains are related to profitable product prices. Also suggested that by promoting semi-industrial production of medium to large scale through collective action and coordinated advertising will theoretically have a high impact on the welfare of consumers. The results also revealed that poor flow of information within the value chain made easy for intermediaries to exploit poor rural producers who often lack market information.

Krishna *et al.* (2011) attributed that, turmeric production is a labour intensive operation which involves 38 percent of the total cost of farming and found that majority of the farmers use mother rhizome retrieval technique, which helps in reducing the cost of production. In-order to reduce the logistic costs and capture upstream and downstream profit margin, the production side actors looked to upscale their activities to decrease the number of mediators between the markets.

Patil (2012) recognized different constraints at each stages of raisin value chain. The problems encountered by grower, merchants, vendors were seasonality of crop, water and power. shortage, high outlays, high transportation cost, variability in selling price, increased storage cost, less variety of grapes for conversion of raisin, lack of promotion activities and presence of very few number of cold storage units.

Baruwa (2013) identified most widespread constraints pineapple production in Osun State, Nigeria. They were non-availability of high quality planting materials

(valuable genotypes and free of pathogens), low keeping quality, low sale price, lack of credit facilities and plant diseases.

Kumar (2013) in his study on value chain analysis of pepper identified some missing links in the value chain of black pepper between the players. At village level trader acts as a commission agent between growers and consumers. At the producer level, non-accessibility of marketing tools was considered as the main constraint.

Olainka (2013) in his study on economics of pineapple farming in Osun state, Nigeria identified constrains in pineapple production, such as shortage of high quality planting. materials, high fruit perishability, low price, lack of availability to credit, and plant diseases like heart rot.

Negi and Anand (2015) in their study related to supply chain of fruits and vegetables in India indicates that there exist innumerable constraints that lead to maximum incompetence, causing in fruit and vegetables loss and waste. Few among them were inadequate supply chain management, lack of cold chain facilities and food processing.

Nadhika and Krishnankutty (2017) conducted a study on stakeholder analysis of mango and found that among the different stakeholders involved in the chain, collection agents, traders and mandiwalas were seen to dominate the scenario. But, the growers, consumers and development personnel found to have more influence on chain. The study also suggested some potential ways to achieve the strategic options through enhancing added value and product development, promoting product branding, educating farmers on competitiveness building and increasing export potential by addressing quality parameters.

Dennis and Okpeke (2018) in their study on pineapple prospects and constraints identified non-availability of improved planting materials as the most serious (83.3%) constraint in pineapple production. And other problems including; fruit perishability(73.3%), less fruit price(55%), high labour charge (46.7%), non-availability of credits(43.3%), inadequate land holding (36.7%), rodent outbreak (30%), climate change

and diseases, lack of value addition and storage facilities(21.7%) and increased transportation cost (16.7%).

Some major recommendations suggested to overcome above constraints and they were the administration must come forward to increase pre-cooling storage facilities to reduce fruit wastage and improved varieties of pineapple (high yielding) should be make available of to augment farmer's production. In addition, agricultural price support programs should be revived and research should be promoted.

Chengappa *et al*. (2019) in their study on coffee value chain emphasized some of the tasks handled in the value chain and they discovered the prospect of conservation-based operations. Potentially feasible and accessible technology should be given to a number of stakeholders especially for small producers. Preservation-focused brand was possibly providing potentials to large scale fragmented environment through collaboration across the various value chains, incorporating simple and cost effective ecotourism-based operations. They also suggested that broad-based marking policy should be adopted in integration with sustainability principles with institutional support.

Methodology

3. METHODOLOGY

Appropriate research design is important for systematic assessment of research objectives. Methodology is the general strategy of study that specifies how to conduct research and describes the techniques to be used in it. The methodology followed to conduct the study in order to fulfill the objectives, *i.e*. to prepare the value chain map of pineapple in Ernakulam district, to assess the value chain production system; evaluate their technical efficiency; to identify the institutional and infrastructural issues that affect the competitiveness of the selected value chain, and to propose interventions for upgrading the Pineapple value chain are given in this chapter. This chapter deals with the methodology used in the study, including study area, sampling procedure, method of data collection and the different tools used for analysis. This chapter has been presented under following heads:

3.1 Types of data

3.2 Data sources

3.3 Period of study

3.4 Area of study

3.5 Sampling design

3.6 Analysis of data

3.1 TYPES OF DATA

The current study was on the basis of primary and secondary data. The primary data was collected by conducting a survey and the secondary data related to pineapple area, production, productivity were collected from publications of Directorate of Economics and Statistics, Government of Kerala (GOK), to analyze the growth and to determine the magnitude and direction of growth determinants. To assess the value chain production system and technical efficiency, primary data from selected farmers of Ernakulam district

on land holdings, farm and non-farm income, crop and input details, credit details, cost of cultivation, yield and returns and marketing details were collected. To evaluate the marketing efficiency, institutional and infrastructural issues, data were collected from other value chain actors like processors, traders, transporters and consumers.

3.2 SOURCES OF DATA

The secondary data related to pineapple, *i.e*. area, production and productivity in India from 1990 to 2018 and for the Kerala state from 1995 to 2018, were collected from Horticultural Statistics at a Glance, Ministry of Agriculture and Directorate of Economics and Statistics, Government of Kerala. Primary data related to the study were gathered by interviewing farmers, traders, processors, transporters and consumers of pineapple.

3.3 PERIOD OF STUDY

Secondary data pertaining to pineapple area, production and productivity for India was collected for the period 1990 to 2018 and for the Kerala state from 1995 to 2018. The primary data collection was carried out from January 2020 to March 2020.

3.4 AREA OF STUDY

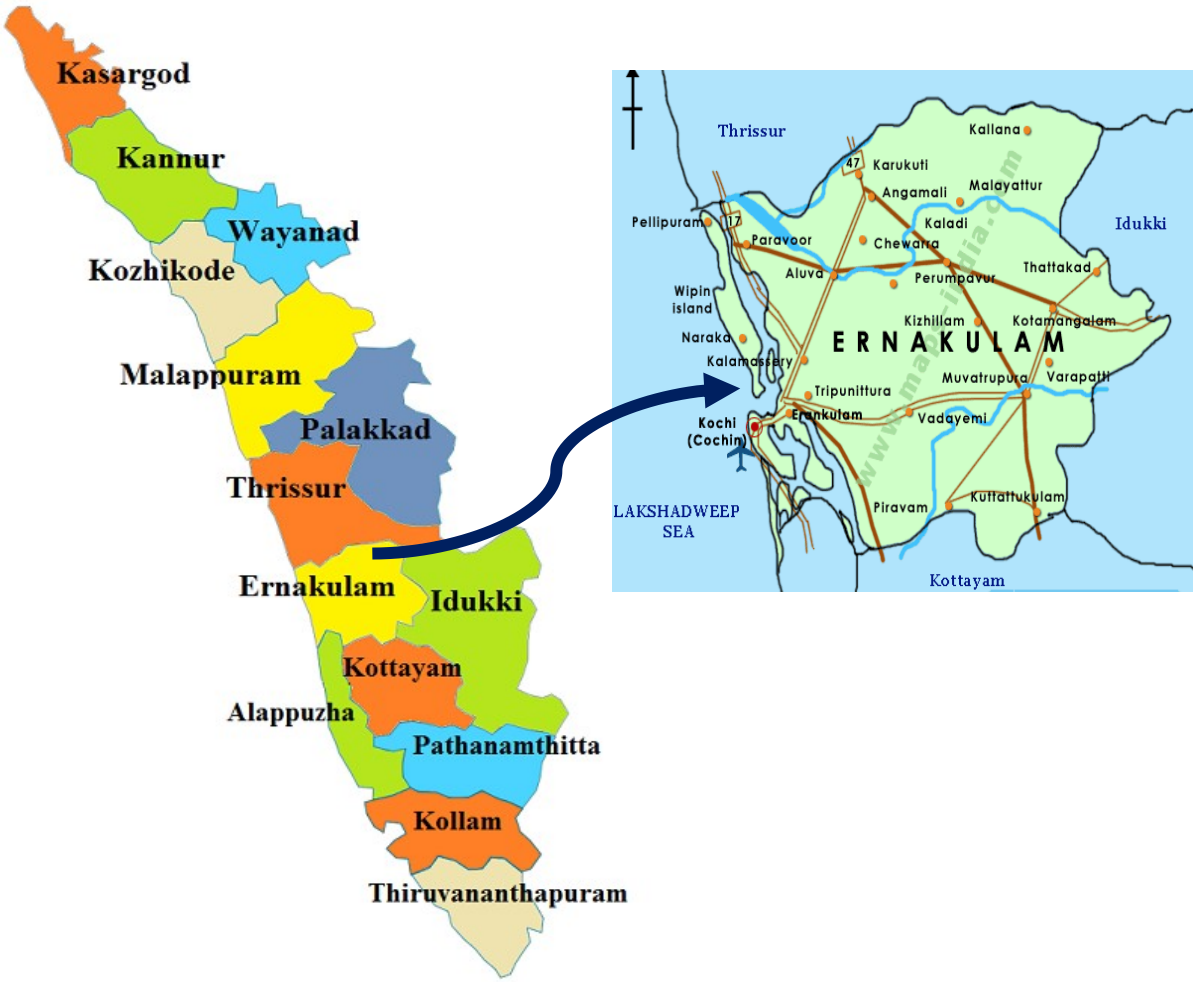
The study was confined to Ernakulam district in Kerala state. The State Greater Cochin, the biggest metropolitan province belongs to Ernakulam District. It is recognized as the commercial capital of state and premier revenue providing district in the state. It is the third most populous district and hosts the peak number of overseas and domestic tourists in Kerala. In the present study, value chain of pineapple crop has been analysed to have a deeper insights into the production system, cost, marketing channels, value chain performance, competitiveness and constraints existing in the chain.

3.4.1 Ernakulam district

Ernakulam district occupies the Central part of Kerala state and its headquarters is located at Kakkanad, a suburb of Kochi city. According to the census of 2011, 9.82 per

cent of the total population of Kerala state exists in this district. The district has 95.68 per cent literacy and population density of 1069 inhabitants per square kilo meter.

Figure 3.1: Map presenting the study area – Ernakulam district



3.4.1.1 Location

The Ernakulam district is situated between 9 ° 42'N and 10° 18'N latitudes and 76° 12'E and 76 ° 36'E longitudes. The boundaries of the district are the Arabian Sea in the West and Idukki district in the East. To the North, Thrissur district and Alappuzha and Kottayam in the South. The district is located on the Western Coastal Plains of India covering an area of 305826 hectares. Cochin International airport is located at

Nedumbasheri village in Angamaly, in the northern part of the district. Ernakulam is one of the most connected districts in the state owing the international airport, waterways, railways, and road ways.

3.4.1.2 Land utilization pattern

The Table 3.1 depicts the land utilization pattern in Ernakulam district for the year 2017-18. The overall cropped area was to the extent of 164596 hectares and the net sown area was 148295 hectares constituting around for 48.48 per cent of the total geographical area. Forest land accounted for 23.09 per cent of the total geographical area while the cultivable waste land was only 4.91 per cent. The land utilized for non-agricultural uses was 14.79 per cent of the total area.

Table 3.1: Land utilization pattern of Ernakulam district in 2017-18

Land use	Area (ha)	Percentage to total geographical area
Total geographical area	305826	NA
Forest	70617	23.09
Land laid to non-agricultural use	45256	14.79
Barren & uncultivable land	349	0.11
Current fallow	7999	2.61
Cultivable waste	15040	4.91
Water Logged Area	290	0.9
Net area sown	148295	48.48
Area sowed more than once	16300.65	5.33
Others	17980	5.87
Total cropped Area	**164596**	**53.82**

Source: Agricultural Statistics, 2017-18. Directorate of Economics and Statistics, Government of Kerala.

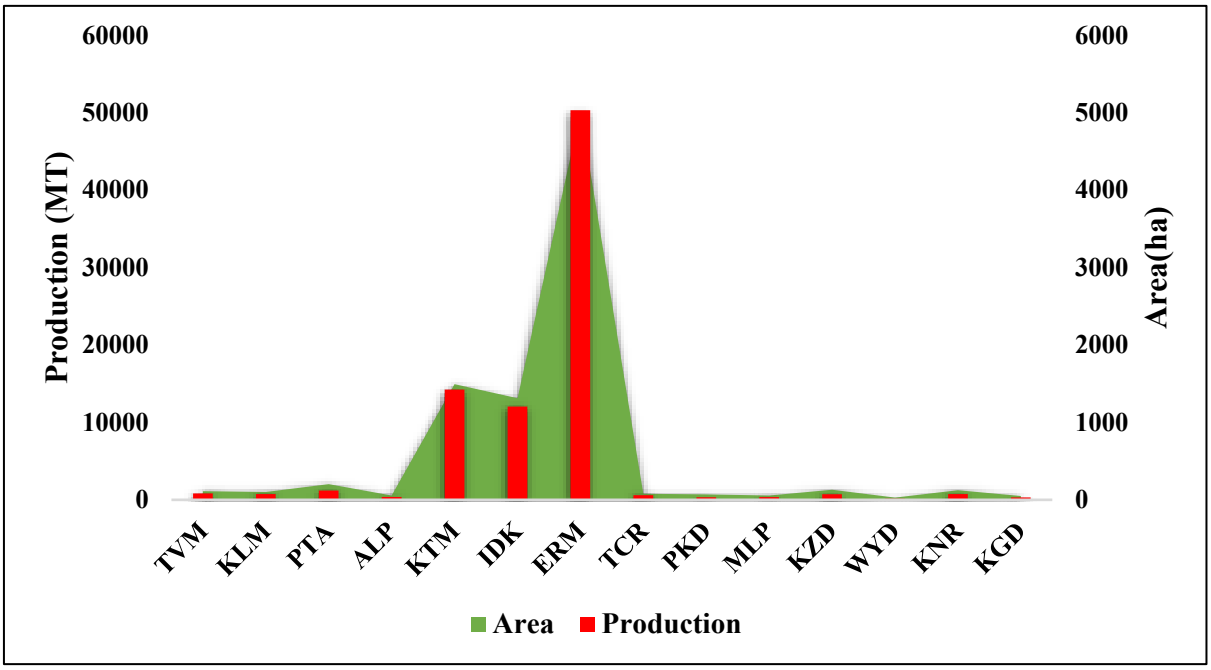
3.4.1.3 Topography and Climate

The district is separated into three distinct areas-coastal, midland and plateau comprising respectively of seacoast, plains and mountains and forests. Twenty per cent of overall area constitutes coastal area and the bare land fall under midland. Island group with natural irrigation conveniences by backwoods and waterways. A part of the Western Ghats forms the hilly or eastern portion. The humid climate reported in the district generally falls inside the eco-region of wet forests on the Malabar Coast. However, eco-region of humid deciduous forests on the South West Ghats fall under plateaus.

3.4.2 Descriptions of the selected Panchayats

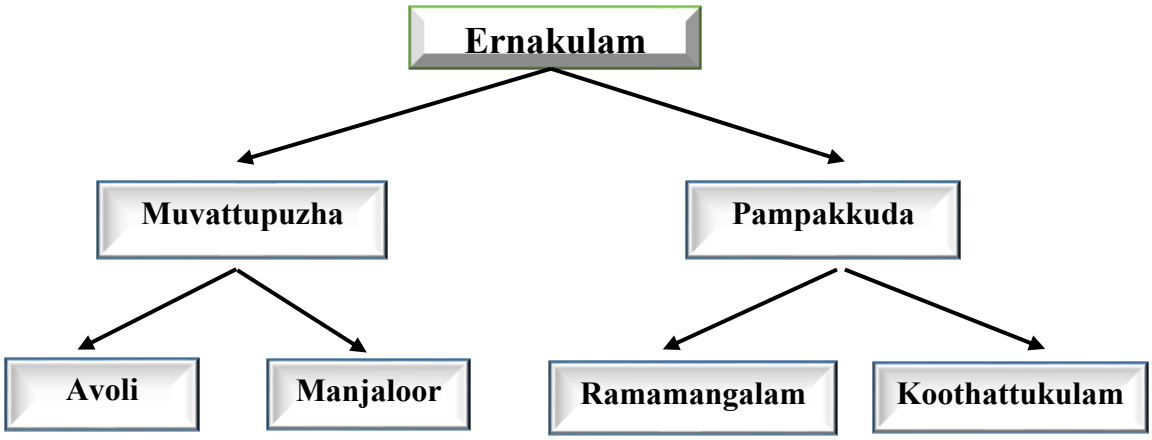
Ernakulam district alone accounts for 60 per cent of overall pineapple production in the state. Contribution of Ernakulam towards area and production of pineapple (2017-18) has been presented in the Figure 3.2 and block-wise classification of study area has been presented in Figure 3.3. Two blocks having the highest pineapple production in Ernakulam district *viz.*, Muvattupuzha and Pampakkuda were taken for the study. Then from each of the considered blocks, two Panchayats having highest area under pineapple cultivation viz., Avoli and Manjaloor Panchayats from Muvattupuzha block and Ramamangalam and Koothattukulam Panchayats from Pampakkuda block were selected for the study.

Figure 3.2: Area and production of Pineapple (2017-18) in Kerala



Source: Horticulture at a Glance, 2017-18

Figure 3.3: Block-wise classification of study area



3.4.2.1 Panchayat-wise distribution of area

Distribution of area in Muvattupuzha and Pampakkuda blocks has been presented in Table 3.2. It was found that almost 80 per cent of total area in Avoli Panchayat was dry

land. Only 16 per cent of total area in Manjaloor Panchayat was found to be under wetland. In Pampakkuda block, 72 per cent of total area in Ramamangalam Panchayat was dry land whereas, 20 per cent of total area in Koothattukulam Panchayat was wetland.

Table 3.2: Panchayat-wise area according to type of land in the study area

Blocks	Panchayats	Area in cents		
		Wetland	Dry land	Total
Muvattupuzha	Avoli	91769 (20.11)	364643 (79.89)	456412 (100)
	Manjaloor	89490 (16.03)	468701 (83.97)	558191 (100)
Pampakkuda	Ramamangalam	151534 (27.84)	392813 (72.16)	544434 (100)
	Koothattukulam	116333 (20.35)	455408 (79.65)	571741 (100)

Source: Panchayat Level Statistics, 2011, Government of Kerala

Note: Figures in parentheses indicates per cent to area in total area

3.5 SAMPLING DESIGN

The current study is centered on both primary and secondary data. Ernakulam district was selected for primary data collection, which accounts for the maximum pineapple production in Kerala state. Two blocks with the highest pineapple production were selected for the study. Four Panchayats, two from each block having maximum area under pineapple cultivation were selected. The list of farmers were obtained from the Krishibhavan of the respective Panchayat. From each of the selected Panchayat, twenty farmers were taken randomly, constituting a sample number of eighty. In addition, data were collected from ten processors, five traders, five transporters and twenty consumers.

Time series data on the area, production and productivity of pineapple in India and Kerala were collected from Directorate of Economics and Statistics, Government of Kerala and Horticulture at a Glance, Government of India.

3.5.1 Collection of data

Primary data was collected by means of a different set of pre-verified and structured interview schedule, from eighty pineapple growers, ten processors, five traders, five transporters and twenty consumers. Details were collected on the socio economic profile of the farmers, income, and value chain production systems, marketing channels, prices, post-harvest activities, constraints and suggestion for better marketing of produce. Secondary data was collected from various published and unpublished sources.

3.6 ANALYSES OF DATA

3.6.1. Commodity Chain Analysis (CCA) approach

The technique of separating and presenting the method of production is referred as commodity chain. Analysis of the commodity chain helps the researcher to define the relationships within the network of agricultural or agro-food systems between the various stages of transition, whether those relationships are linear, complementary or sequential (Bockel and Tallec, 2005). It helps to study commodity chain and analyses commodity flow. Construction of the commodity chain includes following four steps:

1. The identification of value chain functions: It follows the product downstream from input supply to the final market through various marketing and processing functions. This describes upstream the key suppliers of inputs and services that are feeding into output.

2. The identification of players in the chain: The actors who actively participated in the value chain process were identified.

3. Identification of the value chain facilitators: After the identification of events and players in the chain, different facilitators/ service providers in the value chain process were identified.

4. Constructing a diagrammatic representation (flowchart) for a commodity chain / Mapping of chain: The facts enclosed in above steps can also be signified in a product flow chart. It includes

    a. Any activities connected with supply of inputs and different stages of processing and transport have been included in the chain
    b. The players (actors/agents), carrying out the functions and facilitators involved in the process
    c. The products concerned in the chain

3.6.2 Socio economic profile of the respondents – Descriptive statistics

The averages and percentages were considered to assess the socio-economic variables including the age, education, experience in farming, land holding pattern, occupation, income of the respondents, area under pineapple cultivation, land holding pattern (marginal/small/large), organizational membership and credit details.

3.6.3 Estimation of Growth rates

Trends in pineapple area, production and productivity in India and Kerala were analysed by using the time series data collected from publications of Horticultural Statistics, Ministry of Agriculture and from Directorate of Economics and Statistics, Government of Kerala. The compound annual growth rates were worked out by fitting exponential function of form,

$$\mathbf{Y_t = a\, b^t}$$

Where, Y_t : Area or production or productivity of pineapple

a : Constant

b : Regression coefficient

t : Number of years

Taking logarithms on both the sides,

$\ln Y_t = \ln a + t \ln b$

$Y_t' = A + B$

Where, $Y_t' = \ln Y_t$,

$A = \ln a$

$B = \ln b$

Compound Growth Rate of a variable is the rate of change per unit time, usually a year. The technique of Ordinary Least Square (OLS) was considered to evaluate the co-efficient (b). Compound Annual Growth Rate in percentages was calculated using the relationships,

Compound Annual Growth Rate (CAGR) = (Antilog B-1) × 100

Coefficient of variation

To understand the variation in area, production and productivity variations over the years, coefficient of variation (CV) was worked by using the given formula.

$$CV = \frac{\text{Standard deviation (SD)}}{\text{Mean}} \text{ X } 100$$

$$SD = \sqrt{\frac{1}{n}\sum(X - \text{x})2}$$

$$\text{Mean} = \frac{\sum X_i}{n}$$

Where, $\sum X_i$ = Sum of observations

n = Total number of observations

3.6.4 Cost concepts

The cost concepts proposed by Commission on Agriculture Cost and Prices (CACP), Government of India for farm managing studies are cost A_1, A_2, B_1, B_2, C_1, C_2, C_3 (CSO, 2008). Costs are calculated by following certain cost concepts. These cost concepts and items of the cost included in the present study are given below:

i. Cost A_1 consists of:

1. Hired human labour cost
2. Hired machine power cost
3. Suckers cost
4. Manures cost
5. Fertilizers cost
6. Plant protection chemicals cost
7. Weedicides cost
8. Irrigation cost
9. Land revenue
10. Depreciation on farm implements and farm buildings
11. Interest on working capital
12. Miscellaneous expenditures

ii. Cost A_2 = Cost A_1 + Rent given for leased in land

iii. Cost B = Cost A_2 + Interest on owned fixed capital assets(excluding land)

iv. Cost C = Cost B + Imputed value of family labour

Benefit-cost ratio

Benefit-cost ratio is a concept of profitability, in which higher value indicates more returns per rupee of cost spent. It is calculated using the formula given below:

$$\text{Benefit-cost ratio (BCR)} = \frac{\text{Gross returns}}{\text{Total cost}}$$

3.6.5 Production function analysis

To study the effect of independent variables on the outcome variable in pineapple farming Cobb-Douglas production function was used. From this function elasticity for each input coefficient can be obtained.

The functional form of Cobb-Douglas production function for pineapple cultivation in Ernakulam district was given as

$$Y = a\, X_1^{b1}\, X_2^{b2}\, X_3^{b3}\, X_4^{b4} e^{\mu}$$

The ordinary least square (OLS) approach was used for the estimation of Cobb-Douglas function after converting it to log-linear form and it was given as

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + \mu$$

Where,

Y = Total yield (quintals/ ha)

X_1 = Hired human labour (man days/ ha)

X_2 = Plant density (suckers/ ha)

X_3 = Chemical fertilizers (kg/ ha)

X_4 = Hormones (L/ ha)

μ = Random error

Returns to scale

The above production function estimates the elasticity of each inputs utilized in the production function. The relative change in yield resulting from a unit relative increase in all the resources measures the total elasticity of production. If the sum of coefficients is greater than one, it indicates an increasing returns to scale and if it is less than one, it indicates decreasing returns to scale. However, if it is equal to one, the function is said to exhibit constant returns to scale.

3.6.6 Data Envelopment Analysis (DEA)

Careful examination of farm precise technical efficiency and resource specific allocative efficiency is necessary with given level of resources under the prevailing condition and with given technology, which will increases the capability of the producers to attain maximum crop productivity. One of the major objective of the study was to analyse the technical efficiency in pineapple cultivation in the study area. Technical efficiency is defined as the maximum output obtained from a set of available resources (Hazarika and Subramanian, 1999). Allocative efficiency is defined as the capability of farm to maximize revenue/yield by equating the marginal revenue products of resources to their respective marginal cost (Farell, 1957).

The efficiency estimates in this study are carried out by data envelopment analysis (DEA) using DEAP software. It is a nonparametric and mathematical method that compares performance efficiency and benchmarking of decision-making units (DMUs). It was originally developed by Charnes *et al*. (1978). Efficiency measures like technical, scale, allocative and cost efficiency can be calculated through this technique.

Efficiency in DEA can be given as weighted sum of yield produced over weighted sum of resources used as given below:

$$\mathbf{h_o\ (u, v) = \sum_r u_r\ y_{ro} / \sum_r v_i\ x_{io}}$$

u_r : Weight assumed for yield , r = 1, 2, 3….,s

v_i : Weight assumed for resources, i = 1, 2. 3, 4…,m

The amount of inputs utilization and the amount of output to be produced are x_{yj} and y_{rj}, respectively, where x_{yj} and y_{rj} are non-negative values. The relative efficiency of DMU_j has been measured by the following mathematical equation:

$$h_0 = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}}$$

Subjected to,

$$h_0 = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \leq 1$$

$$\mathbf{u_r,\ v_i} \geq 0$$

Where, h_o = Efficiency score

Y = Yield (kg/ha)

X_1 = Labour (mandays/ha)

X_2 = Plant density (suckers/ha)

X_3 = Chemical fertilizers (kg/ha)

X_4 = Hormones (L/ha)

u,v = Constant

The relative efficiency score equal to 1 indicates that DMUs are relative efficient, while the relative efficiency value below 1 illustrates that DMUs are relative ineffective (Khek and Naenna, 2015). To calculate scale efficiency, technical efficiency (TE) was considered at constant returns to scale (CRS) and variable returns to scale (VRS). It ranges from zero to one.

$$\text{Scale efficiency} = \frac{\text{TE at CRS}}{\text{TE at VRS}}$$

3.6.7 Analysis of value chain performance

Marketing margin is the finest tool to evaluate performance of market. It is calculated by considering difference between purchase and sale prices. Producer share in consumer rupee is worked out by taking ratio of producers' price and consumers' price and expressed in percentage.

Marketing Channel

It is the path through which the agricultural commodity move from the producers to the consumers through various intermediaries.

Marketing Cost

It is the costs incurred by the producers and other intermediaries to perform various functions in the marketing channel.

Marketing Margin

It is the profit earned by the market intermediaries in moving the commodity from producers to consumer while performing various market functions.

$$\textbf{Percent margin of middleman} = \frac{(\textbf{Sales price} - \textbf{Purchase price})}{(\textbf{Marketing cost})} \boldsymbol{X\ 100}$$

Price spread

Price spread can be defined as the difference between the price paid by the consumer and price received by the farmer.

Price spread = ***(Consumer price- Net price of producer)***

Producer's share in consumer's rupee

It is the price received by the farmer expressed as a percentage of retail price *i.e.* price paid by the consumer

$$\mathbf{Ps = \frac{Pf}{Pr} X\ 100}$$

Where, Ps = Producer's share

Pf = Price received by the farmer

Pr = Retail price paid by the consumer

Marketing efficiency

Marketing efficiency is defined as ratio of market output to market input. It was measured using the formula specified by Acharya and Agarwal (2001), consumer price and marketing cost per kg of pineapple are taken into account to estimate the marketing efficiency. The higher ratio indicates higher efficiency and vice-versa.

$$\mathbf{E = (O / I) X\ 100}$$

Where E - Marketing efficiency

O - Output of marketing system

(Difference between consumer and producer price)

I - Marketing cost

Degree of value addition

Value addition is the difference between the price of the product and the cost involved in producing it. The addition of value can increase either the product's price or value. The magnitude or the percentage rise in value of the good is referred as "the Degree of value addition" on that product.

3.6.8 Rank frequency method

It is the distribution of size by rank, descending order of size. Raw data are ranked based on the frequency. Also known as rank-frequency distribution. It was used to rank enhancing and constraining factors affecting the value chain competitiveness. Factors were ranked based on the frequency. Factor containing highest frequency will get rank one and so on. Factor with less frequency will get last rank.

3.6.9 Garrett Ranking technique

Constraints can be measured using the Kendall's Coefficient of Concordance; the Garrett ranking technique and sometimes the direct scoring method. However the Garrett ranking technique is preferred because the scorings given to each constraint ranked is then weighted through conversions, by the use of formula. It is also easier to use.

Garrett Ranking method was employed to rank the constraints faced by the respondents. The limitations were identified through pilot survey and review of literature. According to this method, respondents were asked to give rank for all the constraints. The outcomes of given ranks were changed into score with the help of given formula:

$$\textbf{Percent Position} = \frac{\mathbf{100\ (\ Rij\ -\ 0.5)}}{\boldsymbol{Nj}}$$

Where ,

R_{ij} = rank given for the ith constraint by jth respondent

N_j = total number of constraints ranked by jth respondent

With the help of Garrett's Table, the percent position calculated is decoded into scores (Garrett and Woodworth, 1971). The total value of the scores and the mean score values are determined by considering the scores of every single person given for each factor. The factors having the maximum mean value is identified as the most serious constraint (Dhanavandan, 2016).

Results and Discussion

4. RESULTS AND DISCUSSION

To accomplish the objectives of the research work, the collected data was analysed and inferred. In this chapter, the results of the analysis were clearly presented and meaningful conclusions were drawn using suitable analytical tools under the headings given below:

4.1 Socio-economic profile of Pineapple farmers

4.2 Growth rate of area, production and productivity of Pineapple

4.3 Value chain mapping

4.4 Economics of Pineapple cultivation

4.5 Production function analysis

4.6 Efficiency measures in Pineapple cultivation

4.7 Marketing channels, marketing cost, marketing margin and price spread in Pineapple value chain

4.8 Marketing efficiency, producer's share in consumer's rupee and Degree of value addition

4.9 Physical flow of Pineapple

4.10 Institutional and infrastructural issues in the competitiveness of Pineapple value chain

4.11 Constraints in production and marketing of Pineapple

4.12 Interventions for upgrading the Pineapple value chain

4.1. SOCIO ECONOMIC PROFILE OF PINEAPPLE FARMERS

This study was based on the data obtained from the survey of 80 pineapple farmers. The two blocks selected for the study were Muvattupuzha and Pampakkuda from Ernakulam district since these blocks reported highest pineapple production. From each block, fourty respondents were selected randomly. The list of farmers were collected from

the respective Krishibhavans. The primary data collected from pineapple farmers comprises information on various personal and professional characteristics such as age, education status, annual income, income sources, land holding pattern, area under pineapple cultivation, experience in farming, organizational membership and credit sources. The details of the analysis of data from the respondents were given below.

4.1.1. Age

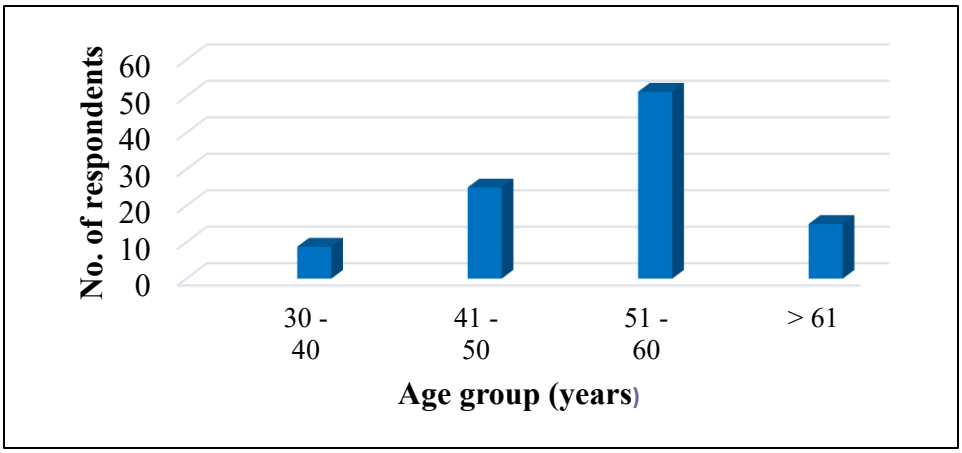
The respondent farmers were distributed on the basis of different age groups and were classified into five categories and has been presented in the Table 4.1 and Figure 4.1. It is clear that among 80 respondents, 8.75 per cent of the respondents belongs to the age group of 30 to 40 years, 25 per cent belongs to 41 to 50 years, 51.25 per cent belongs to 51 to 60 years and 15 per cent of farmers were above 61 years. So, majority of pineapple farmers fall under the age group of 51 to 60 years, indicating that in the study area old age farmers were involved in pineapple cultivation. This shows that the respondents have relatively high experience in pineapple farming.

Table 4.1: Age-wise distribution of respondents

Age group	Number of respondents
30 - 40	7(8.75)
41 - 50	20(25)
51 - 60	41(51.25)
> 61 years	12(15)
Total	80 (100)

Note: Figures in parentheses indicate percentage to total

Figure 4.1: Age-wise distribution of respondents



4.1.2 Education

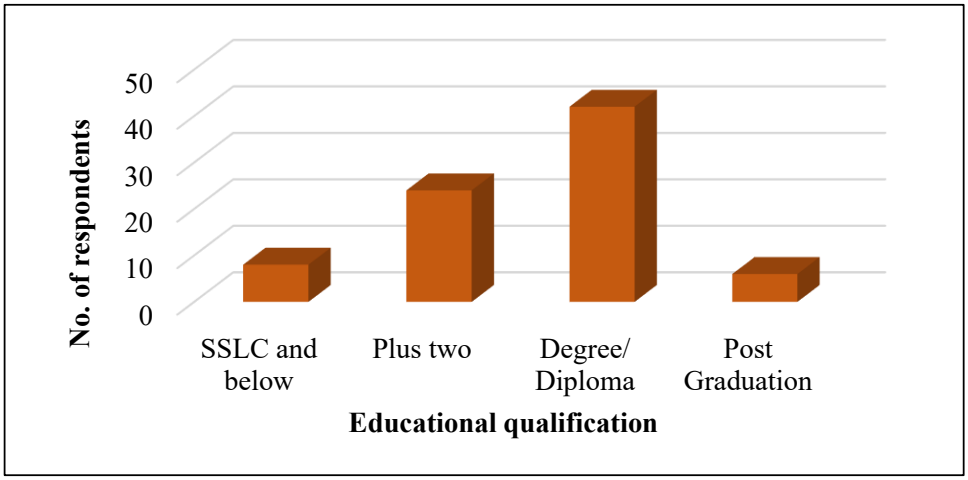
Table 4.2 and Figure 4.2 depicts the educational qualification of the sample pineapple farmers and their categorization into four groups. It was observed that majority of the farmers with the education criterion Degree/diploma (52.5 per cent) were mostly interested in agriculture in the study area. The percentage share of respondents with the qualification of SSLC and beneath were relatively smaller, about 10 per cent. Farmers with Post Graduation (7.5) qualification were also engaged in pineapple farming.

Table 4.2: Education status of respondent

Education status	Number of respondents
SSLC and below	8 (10)
Plus two	24(30)
Degree/ Diploma	42(52.5)
Post-Graduation	6 (7.5)
Total	80 (100)

Note: Figures in parentheses indicate percentage to total respondents

Figure 4.2: Education status of respondents



4.1.3 Annual income

The classification of sample farmers based on annual income has been given in the Table 4.3. From the table it is clear that 88.75 per cent of the respondents earn an income of more than ₹ 2 Lakh, 8.75 per cent farmers earn an income between ₹ 1.5 to 2 Lakh and 2.5 per cent farmers earn an income between ₹ 1 to 1.5 Lakh. From this, we can infer that pineapple farming was remunerative business in the study area.

Table 4.3: Annual income of respondents

Income group (₹)	Number of respondents
1 – 1.5 Lakh	2 (2.5)
1.5 – 2 Lakh	7 (8.75)
> 2 Lakh	71 (88.75)
Total	80 (100)

Note: Figures in parentheses indicate percentage to total respondents

4.1.4 Income sources

Based on the occupation, the sources of income of the respondent was classified into two groups which has been presented in the Table 4.4. It was found that 58.75 per cent of the respondents depended on farm income and remaining 41.25 per cent of respondents depended on other business like managing retail units, trading activities, *etc.,* along with the farm income.

Table 4.4: Income sources of respondents

Occupation	Number of respondents
Farm income	47 (58.75)
Farm + Non-farm income	33 (41.25)
Total	80 (100)

Note: Figures in parentheses indicate percentage to total respondents

4.1.5 Land holding pattern

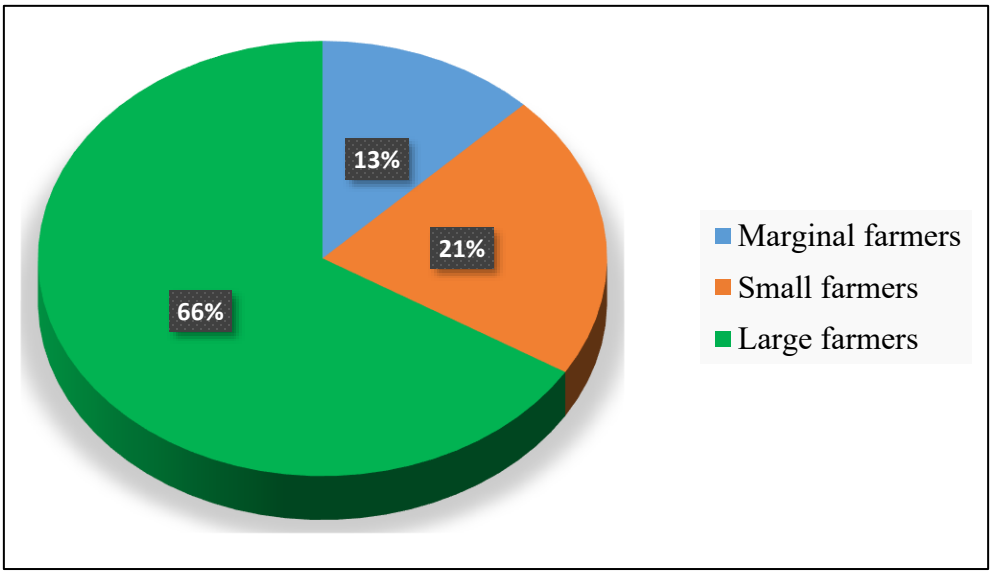
On the basis of area under cultivation, sample farmers were classified into marginal, small and large farmers which has been presented in the Table 4.5 and Figure 4.3. It indicates that 12.5 per cent of the respondents are marginal farmers with the land holding size below one hectare followed by 21.5 per cent of farmers who fall under small farmers' category with 1-2 hectares and 66.25 per cent of farmers fall under large farmers' category with land holdings more than two hectares.

Table 4.5: Distribution of respondents based on land holding pattern

Size of land holding(ha)	Number of respondents
Marginal farmers (<1 ha)	10 (12.5)
Small farmers (1-2 ha)	17 (21.25)
Large farmers (>2ha)	53 (66.25)
Total	80 (100)

Note: Figures in parentheses indicate percentage to total respondents

Figure 4.3: Distribution of respondents based on land holding pattern



4.1.7 Area under Pineapple cultivation

Based on area under pineapple cultivation, land was categorized into leased land and owned land as shown in the Table 4.6. Among 80 respondents, 94 per cent farmers

cultivate pineapple in leased land and 6 per cent in owned land. The average lease amount paid was ₹ 139916 $ha^{-1}y^{-1}$.

Table 4.7: Distribution based on area under Pineapple cultivation

Type of land	Number of respondents
Leased land	75 (94)
Owned land	5 (06)
Total	80 (100)

Note: Figures in parentheses indicate percentage to total respondents

4.1.7 Experience in pineapple farming

Based on years of experience in pineapple farming, respondents were classified into four categories as shown in the Table 4.7. Among the 80 respondents, 18.75 per cent of farmers had an experience to 10 years. About 32.5 per cent farmers fall under the group of 11-20 years of experience, 38.75 per cent fall under the group 21-30 years' experience and around 10 per cent of farmers were with more than 30 years of experience.

Table 4.7: Distribution of respondents based on experience

Experience (in years)	Number of respondents
< 10	15 (18.75)
11 - 20	26 (32.5)
21 - 30	31 (38.75)
> 30	8 (10)
Total	80 (100)

Note: Figures in parentheses indicate percentage to total respondents

4.1.8 Organizational membership

Table 4.8 presents the share of respondents' membership in various organization. About 68.75 per cent respondents hold membership in Pineapple Farmers' Association. Some farmers were traders too, about 26.25 per cent respondents were members in Pineapple Merchants' Association and 28.75 per cent in NAPCL. About 10 per cent farmers doesn't hold any membership.

Table 4.8: Distribution of respondents based on organizational membership

Organizations	Number of respondents
Pineapple Farmers' Association	55 (68.75)
Pineapple Merchants' Association	21 (26.25)
Nadukkara Agro and Processing Company Ltd. (NAPCL)	23 (28.75)
No membership	8 (10)

Note: Figures in parentheses indicate percentage to total respondents

4.1.9 Credit sources

The sources from which respondents availed loans has been presented in the Table 4.9. About 18.75 per cent of respondents availed loan from Commercial banks under different schemes. Majority of the respondents availed loan from Cooperative societies (41.25%) and 3.75 per cent dependent on traders. About 36.25 per cent of the respondents were not involved in credit activities.

Table 4.9: Distribution of respondents based on credit sources

Credit source	Number of respondents
Commercial banks	15 (18.75)
Cooperative societies	33 (41.25)
Traders	3 (3.75)
No credit	29 (36.25)
Total	80 (100)

Note: Figures in parentheses indicate percentage to total respondents

4.2. GROWTH RATE OF AREA PRODUCTION AND PRODUCTIVITY OF PINEAPPLE

4.2.1. Growth rate of area, production and productivity of Pineapple in India

In India, pineapple is showing a stable growth in area, production and productivity, even if it is cultivated in a few pockets rather than in continuous patches. Using the time series data from 1989-90 to 2018-19 in India, the growth rates for area, production and productivity of pineapple crop were calculated. The data were collected from Horticultural Statistics at a Glance, Ministry of Agriculture, Government of India. Arithmetical tools like percentage share, mean values and compound growth rates were used to show the composition of area, production and productivity values.

Triennium endings (TE) were drawn for the years (1989-2018) and presented in the Table 4.10 and Figure 4.4. During the period of TE 1994 the average area, production and productivity of pineapple increased by 21.91, 44.62 and 18.70 per cent respectively. Production showed a great variation during this period. This may be due to the appreciable climatic condition available for pineapple in India. During the period of TE 1997, area was

increased by 11.27 per cent and production was increased by a negligible amount of 0.4 per cent, but productivity was reduced by 9.69 per cent. From TE 2000 to TE 2009, the area, production and productivity exhibited an increasing trend. This was mainly because of the increased demand for pineapple both within and outside the country. The period of TE 2018, saw a decrease in area, production and productivity by 4.04, 4.61 and 0.57 per cent respectively. This was may be due to the consequence of crop specialization in numerous states. The highest production change was observed in Kerala, Tripura and Karnataka respectively. When the farmers initiated to cultivate pineapple in new/replanted rubber plantation as an intercrop, the commercial production of pineapple extended its momentum.

Table 4.10: Area, production and productivity of Pineapple in India (1990-2018)

YEAR	AREA ('000' ha)	PRODUCTION ('000'MT)	PRODUCTIVITY (kg $ha^{-1)}$
TE 1991	51.40	673.24	1306.79
TE 1994	62.67(+21.91%)	973.64(+44.62%)	1551.25(+18.70%)
TE 1997	69.74(+11.27%)	977.60(+0.40%)	1400.81(-9.69%)
TE 2000	75.94(+4.43%)	1084.30(+10.91%)	1425.99(+1.79%)
TE 2003	79.30(+8.89%)	1196.06(+10.30%)	1508.45(+5.78%)
TE 2006	84.06(+6.01%)	1301.17(+8.78%)	1547.45(+2.58%)
TE 2009	85.50(+1.46%)	1324.26(+1.77%)	1553.90(+0.41%)
TE 2012	98.86(+15.90%)	1495(+12.89%)	1515.70(-2.45%)
TE 2015	111.26(+12.54%)	1879.03(+25.68%)	1688.23(+11.38%)
TE 2018	106.76(-4.04%)	1792.3(-4.61%)	1678.60(-0.57%)

Compound growth rates of area, production and productivity of Pineapple in India has been presented in the Table 4.11. The growth rate of area of pineapple was found as 2.62 but was non-significant. The growth rate for production and productivity were found to be 3.36 and 0.72 respectively which were positive. This indicates that, India showed a positive growth rate in area, production and productivity of pineapple over the year.

Thomas (2015) studied the trends and growth rate in area, production and productivity of pineapple cultivation in India from 1961 to 2013 and the growth rate was found to be 0.3 each for area and production and 0.4 for productivity.

Table 4.11: Compound growth rates of area, production and productivity of Pineapple in India (1990-2019)

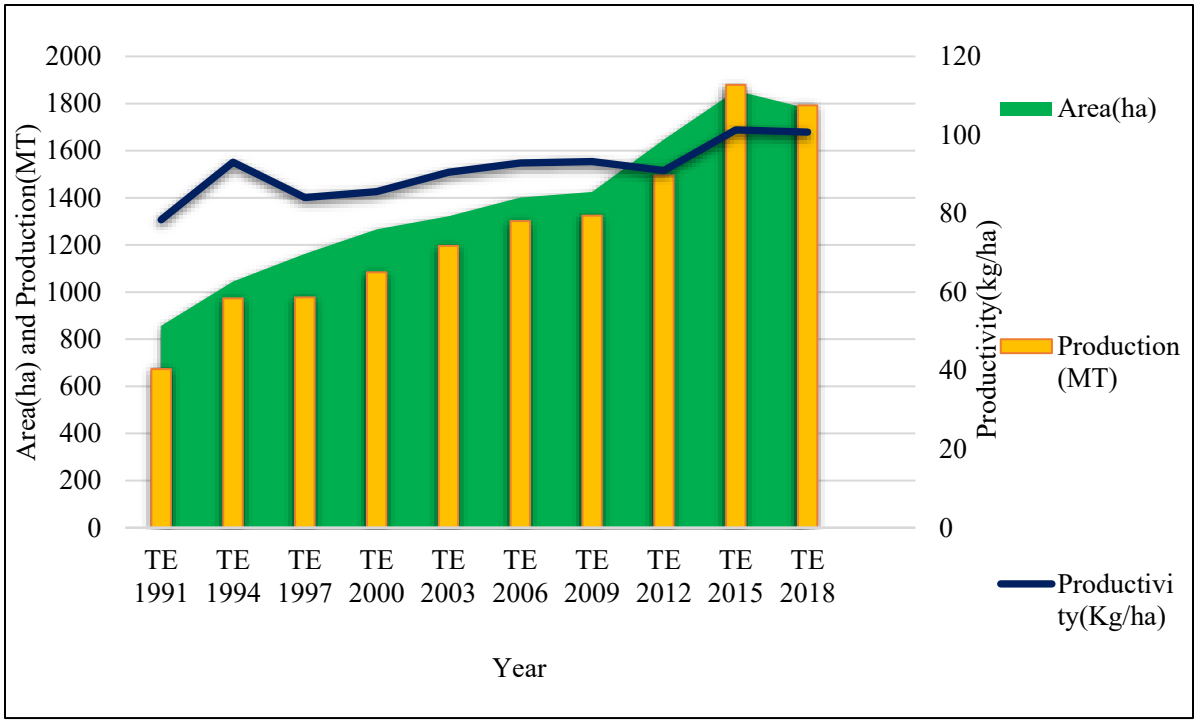
Particulars	AREA	PRODUCTION	PRODUCTIVITY
Growth rate(%)	2.62	3.36	0.72
Standard error	4.11	1.89	1.54
Significance value	1.04	0.89	0.69

Table 4.12 presents the coefficient of variation (CV) for area, production and productivity of pineapple in India from 1989 to 2018. The table indicates that area and production has larger CV than that of productivity. This specifies that discrepancy/inconsistency was more in area and production than in productivity in the country. The main causes that can be endorsed to this discrepancy may be due to pineapple cultivation requires huge human resources (labour) which has shrunken over the year.

Table 4.12: Coefficient of variation (CV) of area, production and productivity of Pineapple cultivation in India (1989 -2018)

Variable	CV
Area	22.73
Production	29.09
Productivity	8.42

Figure 4.4: Area, production and productivity of Pineapple in India (1989-2018)



Source: Horticultural Statistics at a Glance, Ministry of Agriculture

4.2.2. Growth rates of area, production and productivity of Pineapple in Kerala

In Kerala, pineapple is one among the conspicuous fruit crops in the horticulture sector. Generally Mauritius variety is suggested for commercial cultivation because of its smaller crop period (as compared to Kew and MD2), better fruit quality and long keeping

period. Using time series data from 1995-96 to 2018-19 in Kerala, trend analysis of growth rates of area, production and productivity of pineapple crop were carried for the data collected from Kerala stat, Directorate of Economics and Statistics, Government of Kerala.

Triennium endings (TE) were drawn for the years 1995-2018 and presented in the Table 4.13 and Figure 4.5. During the period of TE 2000 the average area, production and productivity of pineapple increased drastically by 15.86, 28.04 and 9.30 per cent respectively. This was mainly because pineapple cultivation was extended commercially mainly after the implementation of Kerala Horticulture Development Program (KHDP) in 1993. From TE 2006, area, production and productivity exhibited a continuous rising movement. But during the period of TE 2010 the average area, production and productivity decreased by 16.98, 19.84 and 3.16 per cent respectively. This was may be due to increased lease amount or crop diversification. Later over the years, the area under pineapple gradually decreased in Kerala which in turn led to decrease in production. But productivity fluctuated over the years. During the period TE 2018 area increased by 7.06 per cent but production and productivity were on a decline. The figures above reveals that the growth of pineapple cultivation in Kerala lies more on output enhancement than on area enlargement. The favorable condition like presence of warm and moist climate all over the year helping in widespread and growth of pineapple cultivation.

Table 4.13: Area, production and productivity of Pineapple in Kerala (1995-2018)

YEAR	AREA (ha)	PRODUCTION (MT)	PRODUCTIVI8TY (t $ha^{-1)}$
TE 1997	8383	53510.24	7.11
TE 2000	9713 (+15.86)	68512.5 (+28.04)	7.78 (+9.30)
TE 2003	11195 (+15.26)	82771.18 (+20.81)	8.15 (+4.81)
TE 2006	12647 (+12.96)	94858.02 (+14.60)	8.26 (+1.40)

TE 2009	10499 (-16.98)	76035.26 (-19.84)	8.00 (-3.16)
TE 2012	9229 (-12.09)	72792.95 (-4.26)	8.70 (+8.77)
TE 2015	7998 (-13.34)	66157.13 (-9.11)	9.11 (+4.66)
TE 2018	8563 (+7.06)	66113.88 (-0.06)	8.50 (-6.71)

Compound growth rates of area, production and productivity of pineapple in Kerala has been given in the Table 4.14. Area showed a negative growth rate which means that area under pineapple cultivation has been decreased over the years. This was may be due to the increased cost of cultivation, increased wage rate and shortage of human labour. The growth rate for production and productivity were found to be 0.25 and 0.86 respectively. Even with the negative growth rate in area, production increased slightly due to increase in productivity. This indicates that there has been an insignificant increase in the production and productivity of pineapple in Kerala over the year.

Growth rate was found to be 2.02 for area, 0.6 for production and negative growth rate of 0.7 for productivity (Thomas, 2015).

Table 4.14: Compound growth rates of area, production and productivity of Pineapple in Kerala (1995-2018)

Particulars	AREA	PRODUCTION	PRODUCTIVITY
Growth rate (%)	-0.6	0.25	0.86
Standard error	1.10	48.5	9.7
Significance value	0.21	0.63	0.003

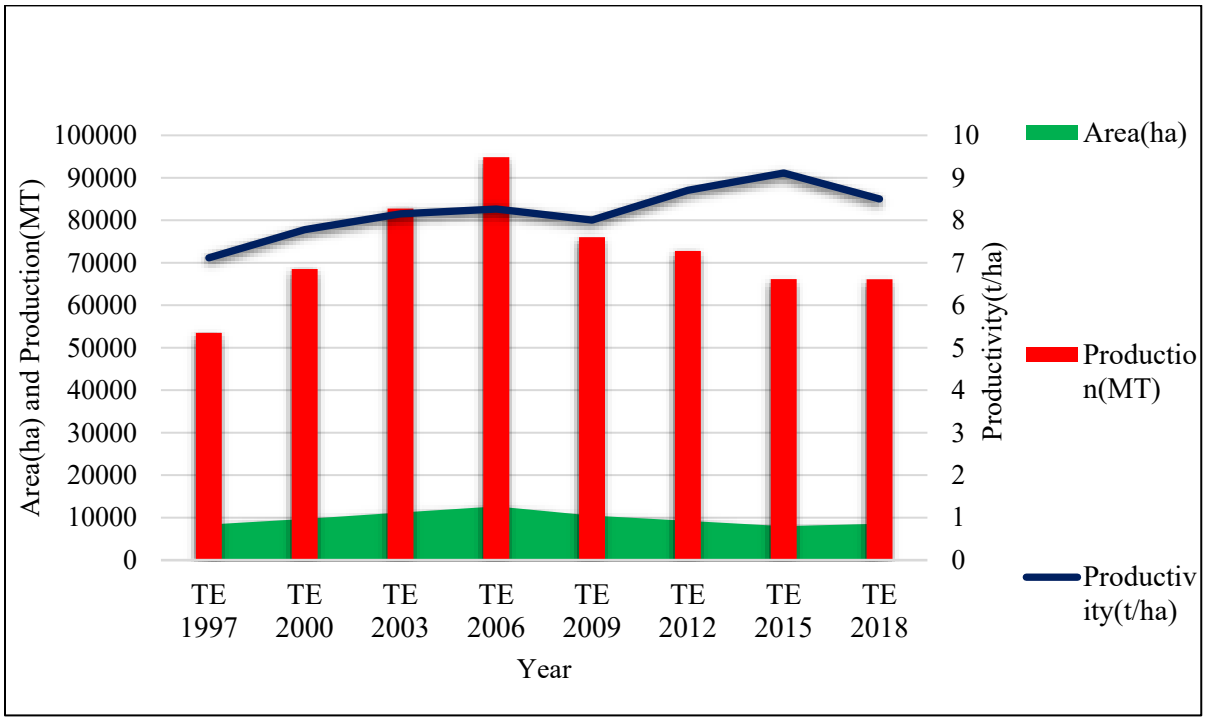
Table 4.15 presents the coefficient of variation (CV) for area, production and productivity of pineapple in India from 1995 to 2018. The table indicates that area and

production has larger CV than that of productivity. This specifies that discrepancy/inconsistency was more in area and production than in productivity in the state. The main cause that can be endorsed to this discrepancy may be because pineapple was grown mostly as intercrop with rubber and coconut plantation.

Table 4.15: Coefficient of variation (CV) of area, production and productivity of Pineapple cultivation in Kerala (1995 -2018)

Variables	CV
Area	0.16
Production	0.17
Productivity	0.10

Figure 4.5: Area, production and productivity of Pineapple in Kerala (1995-2018)



Source: Department of Economics and Statistics, Government of Kerala.

4.3. VALUE CHAIN MAPPING

From producer before reaching to final consumer, most products change hands. Value added chain is a combination of diverse hands in the movement of the produce. For creating a value chain map, value chain players and their activities has been identified in the primary step. The principal processes in the Pineapple value chain has been represented in the Figure 4.6.

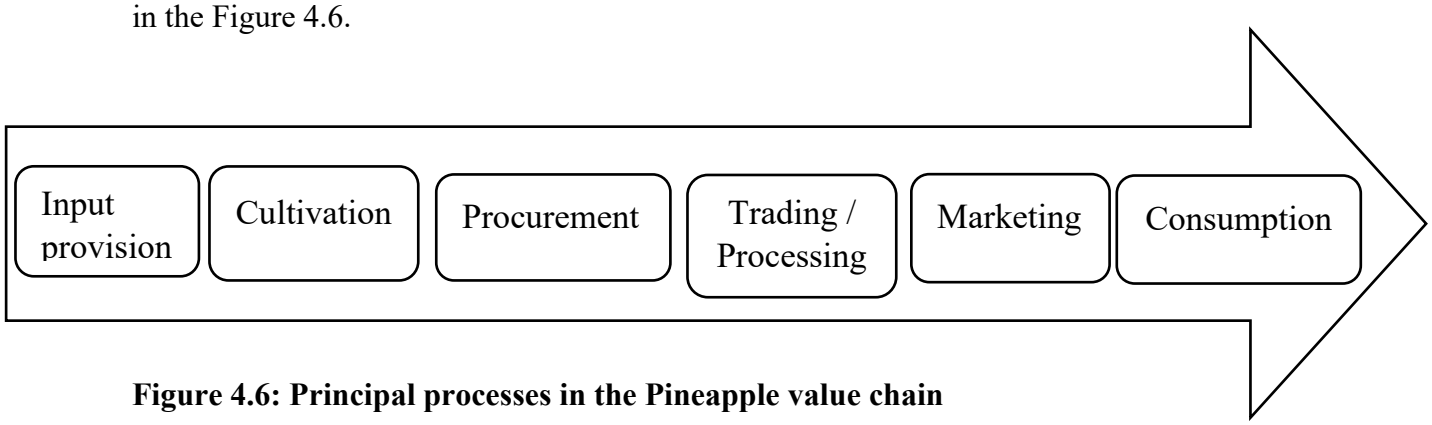


Figure 4.6: Principal processes in the Pineapple value chain

Value chain map of pineapple in the Ernakulam region of Kerala has been presented in the Figure 4.7. The map depicts the different functions, players and facilitators involved in the value chain process. The activities of the major players has been provided in consequent paragraphs. On the basis of information acknowledged from the primary study, the tentative movement of produce through various actors were positioned in the map. This was achieved through commodity chain analysis (CCA). The technique of separating and presenting the method of production is referred as commodity chain. It involves four steps which are clearly presented in the upcoming subsections.

4.3.1 Identification of major functions in the Pineapple value chain

Input supply, production, collection, wholesaling, processing, retailing and consumption were the main functions involved in the process. The major inputs used were organic manures, chemical fertilizers, suckers, implements, plant protections, *etc.* Commercial farmers produced pineapple for the purpose of selling. At the domestic level farmers conducted cleaning and grading. Small scale processing was done at native level along with market centres. Large scale commercial processing was generally done in chief

market centres and maximum of them situated in and around Muvattupuzha. Procurement, local and regional trading fall under trading activities. However, fruits may not satisfy the export requirements, much national trading was not done. Through bulk suppliers and sellers the product reaches the domestic consumers. Some traders and wholesalers were engaged in intercity movement of fruits.

4.3.2. Identification of the value chain players

Input suppliers: Farmers contacted nearest input suppliers for the supply of manure, agricultural equipment's, planting materials, chemical fertilizers, pesticides, *etc*. Krishibhavan supplies chemical fertilizers to the required farmers. Pineapple Research Station not only provides suckers of different varieties but also encourages farmers in pineapple cultivation by giving training in various new technologies developed from the research. Other input suppliers includes agro suppliers, sucker dealers, State Horticulture Mission, local dealers, *etc.*

Farmers: Farmers produced pineapple for commercial purpose since majority of the farmers were with land holdings of more than two hectares. Mauritius variety was preferred by all of the sample farmers because it has relatively higher demand due to its better taste, flavour and good keeping quality within the country.

Traders: Majority of the farmers were dependent on traders for the marketing of their produce. Traders buy from farmers and supply it to native as well as larger processors and also to the wholesalers after keeping some profit margin. In the study area some farmers were traders too since they were involved in both cultivation and trading activities. During the peak season, they marketed produce from Vazhakulam to the other cities like Bangalore, Mumbai, Chennai, Hyderabad, Delhi, Jaipur and other North-Eastern cities. Normally 3-5 tonnes capacity open vans were used by the traders during the procurement of fruits from farmers. Fruits taken to the market as and when harvest was done.

Exporters: They procured superior quality green pineapple from traders and then sent to the export market, mainly to the Gulf countries. In some cases fruits were sent to Mumbai markets and then were used for export. NAPCL involved in export of processed products.

Local processors: Are those who were involved in lower degree of processing. The products like pickles, pineapple pulp, canned pineapple slices, candy, juices, squashes, *etc*., were prepared by local processors for local supply. They procured fresh fruit directly from the farmers at low price. The processed pineapple pulp produced was used for home consumption and some sold excess quantity to the domestic markets and some to the large scale product making units.

Wholesalers: Wholesalers/ Distributors were mostly operate in the market centers who supply fresh produce to the vendors. They supply both fresh fruit as well as processed products. Some wholesalers purchased fruits directly from farmers to avoid middlemen exploitation or some bought from traders and sold to the processors or retailers.

Processors: Are regional processors who produce large quantity of processed products. Majority of them had large processing unit using modern technologies and packaging mechanisms. They bought fresh fruits either from farmers, or from traders and after processing they wholesaled products to the wholesalers or directlyto the retailers. Some processing units sold their products through sales agent to the consumer's door step. The products were branded and it includes juices, jam, jelly, squash, sweets, canned pineapple slices, pickles, *etc.*

Retailers: They were the shop operators at domestic level and deal with the grocery articles. They collected produce directly from farmers or processors or wholesalers and then to the consumers. They were the actors who gets maximum share in consumer's price.

Consumers: They were the end users in the value chain process. They purchase products according to their need by paying maximum retail price (MRP) to the product providers. From the primary survey of consumers it was found that consumer preference was more towards fresh fruits, pineapple jam, juices and squashes.

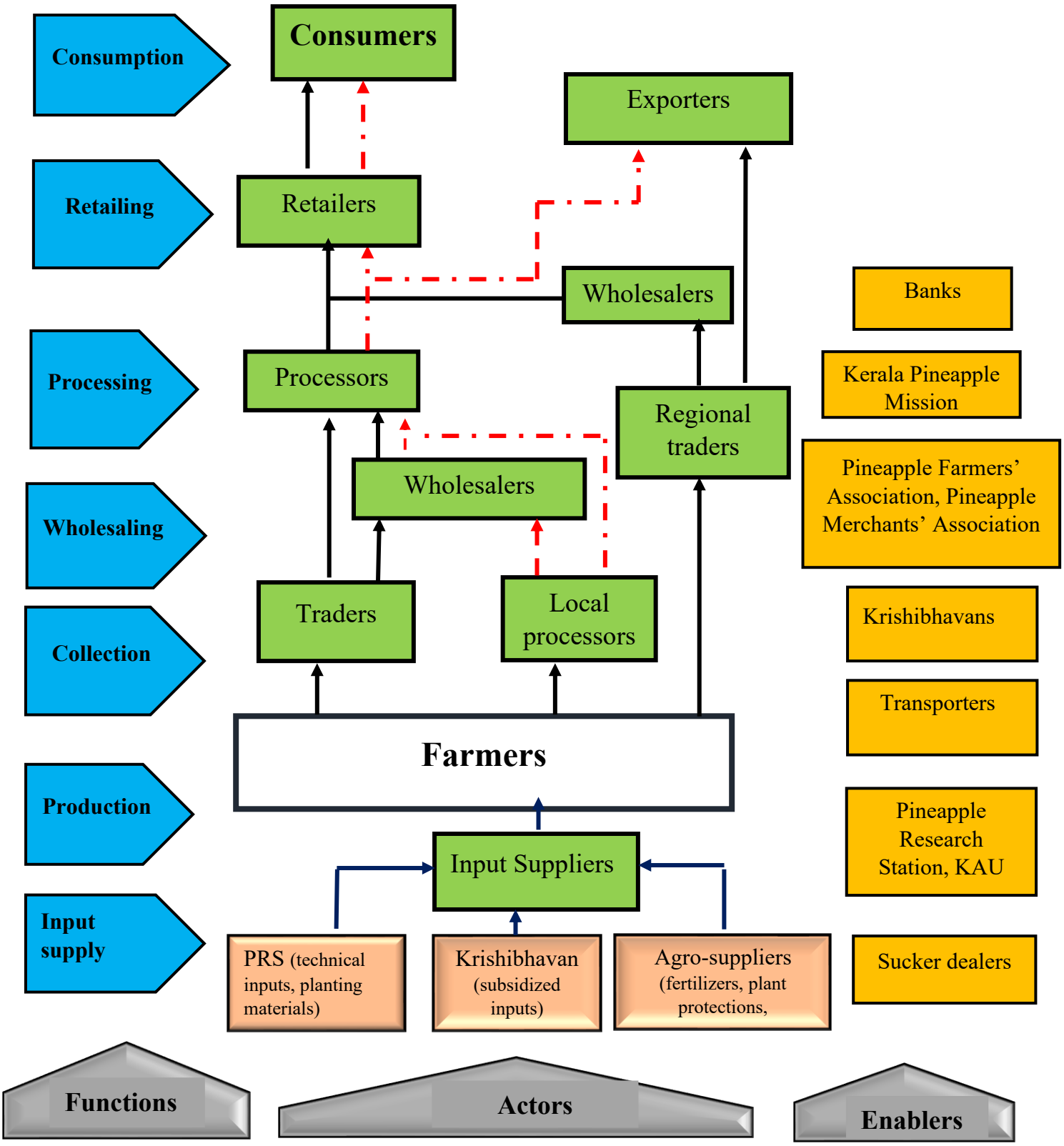
4.3.3. Identification of the value chain facilitators

They are service providers in the pineapple value chain process. The major input suppliers were input dealers, Krishibhavans, Pineapple Farmers' Association, *etc*. The principle Government agencies supporting the value chain are Pineapple Research Station, Vazhakulam, Kerala Agricultural University and Kerala Pineapple Mission which provides extension services and carry out research in pineapple farming. At trader's level, Pineapple Merchants' Association provides market information and facilitates market linkages in the study area. Transporters are the very important service providers in moving a produce/product from one place to another place. They bridge the gap between sellers and buyers. Financial institutions like Commercial banks, Cooperative banks, Regional Rural Banks, NGO's, *etc.,* were involved in financial activities.

4.3.4. Value chain mapping of Pineapple

Value chain map is a representation of various functions, actors and facilitators involved in the value chain of pineapple. Figure 4.7 represents diverse players functioning in the chain and flow of good in the chain. Based on the primary data collected from the actors during primary survey and also information backed up from secondary sources, the map was structured. The movement of fresh pineapple in the flowchart was represented by using a continuous arrow mark and processed products was denoted by broken line with an arrow mark.

Figure 4.7: Value chain map of Pineapple



4.4 ECONOMICS OF PINEAPPLE CULTIVATION

Economics of pineapple cultivation was carried out to assess cost involved in cultivation, returns and to understand the relative profitability of pineapple cultivation and finally helps in deriving the benefit-cost ratio.

4.4.1 Cost of cultivation

Cost of cultivation refers to overall expenditures incurred by the farmer in cultivation of one hectare farm. It was calculated by input wise cost in together with the percentage to the overall cost. A detailed cultivation cost on ABC cost measures was also worked out.

4.4.1.1 ABC cost measures

Table 4.16 depicts the ABC cost assessment of one hectare pineapple cultivation during the first year. To arrive at Cost A_1, different variable costs such as human and machine labour, suckers cost, manures and chemical fertilizers cost, plant protection chemicals, land revenue were considered. In addition to this depreciation, interest on working capital (@ 7per cent) were also considered. The Cost A_1 was estimated to ₹ 346295 ha^{-1}. Major share of Cost A_1 was contributed by cost of suckers (47.79 %). About 27 per cent change was exhibited between Cost A_1 and A_2 which discloses the fact that the farming was mainly in leased land and about 27 per cent increase of Cost C was mainly due to the lease amount. The small variation between Cost B and Cost C (0.7 %) was a sign of low or insignificant usage of family labour in pineapple cultivation. The Cost C for one hectare of pineapple cultivation estimated to ₹ 500575.

Table 4.17 provides the complete illustration about the ABC cost measures of pineapple farming during first, second and third year. This cost analysis reveals that generally about 70 per cent of overall cost comprised by the variable cost, i.e. Cost A_1 in the first year whereas 35 to 45 per cent during second and third year of cultivation.

Estimated Cost C for first, second and third year was ₹ 500575 ha^{-1}, ₹ 277742ha^{-1} and ₹ 248178ha^{-1} respectively.

Table 4.16: Cost of cultivation of Pineapple under ABC cost measures - First Year (₹/ha)

Sl. No	Items	Cost (₹/ha)	Per cent
1	Human labour	80202	23.16
2	Machine labour	41414	11.95
3	Cost of suckers	165515	47.79
4	Manures and fertilizers	46145	13.31
5	Plant protection chemicals	2877	0.84
6	Land revenue	350	0.10
7	Depreciation	401	0.11
8	Interest on working capital(@ 7 per cent)	3104	0.9
9	Miscellaneous expenses	6287	1.84
10	Cost A_1	346295	100
11	Rent paid for leased in land	139917	
12	Cost A_2	486212	
13	Interest on owned fixed capital excluding land(@ 10 per cent)	11021	
14	Cost B	497233	
15	Imputed value of family labour	3342	
16	Cost C	500575	

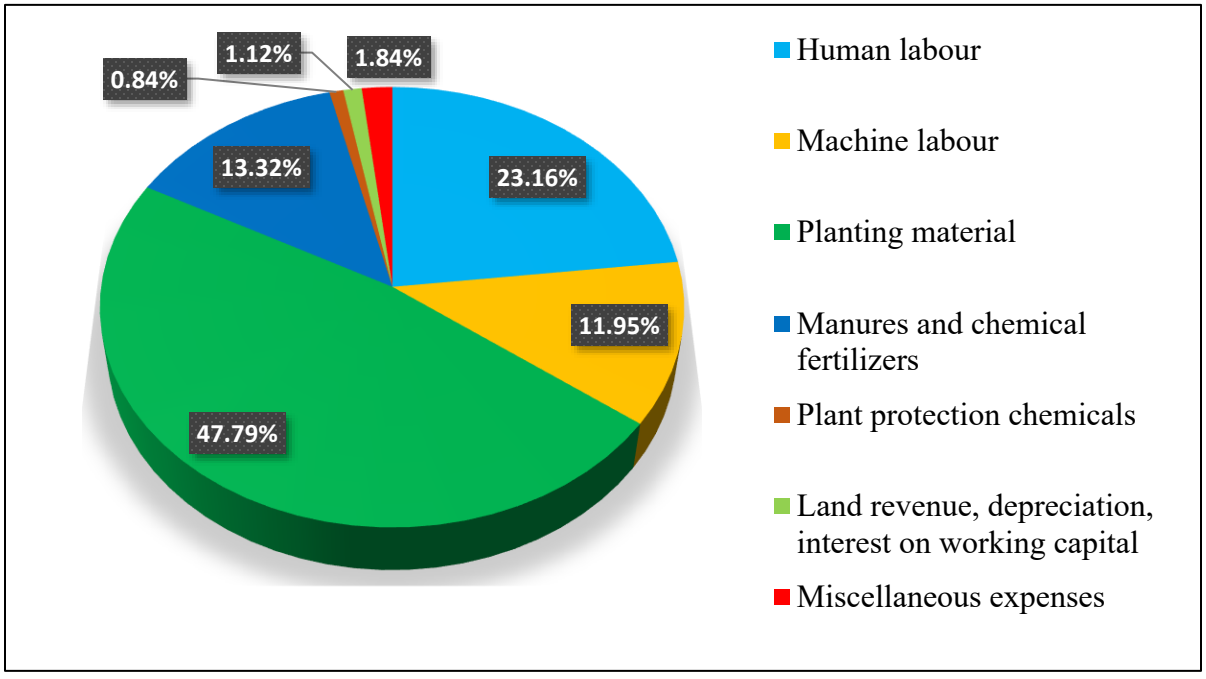
Source: Computed from primary data

Table 4.17: Costs incurred in Pineapple cultivation (₹/ha)

Cost measures	Costs (₹/ha)		
	First year	Second year	Third year
Cost A_1	346295	123462	93898
Cost A_2	486212	263379	233815
Cost B	497233	274400	244836
Cost C	500575	277742	248178

Source: Computed from primary data.

Figure 4.8: Per cent share of variable cost in Pineapple cultivation



4.4.1.2 Input wise cost in Pineapple cultivation

The major input cost incurred in pineapple cultivation includes hired human labour and machine cost, planting material, manure, chemical fertilizers cost, plant protection

chemical (pesticides, weedicides and hormones) cost, lease amount and miscellaneous expenses (irrigation, input transportation, *etc.*). Detailed input wise cost in pineapple cultivation has been given in the Table 4.18 for three years of pineapple cultivation.

In the first year among the various inputs, cost of planting material (suckers) alone contributed about 33 per cent share in the total input cost. The other major input costs were human labour cost (16.03%), machine labour cost (8.25%), manures (4.63%), chemical fertilizers cost (4.59%), lease amount (27.95%), and other expenses contributed 4.89 per cent to overall cost. The least contributed input cost was plant protection chemicals (0.58%) in the input cost. Thus the total input cost of pineapple in the first year found to be ₹ 500575 ha^{-1}.

In the second year, the cost of inputs was equal as that in the first year excluding the machine, suckers and manure cost since in the second year plant was taken as the first ratoon of the first year (parent) plant. Therefore no fresh planting was done. Hence was the same case in manure and machine cost. Constant lease amount was paid during all the years. In the second year, share of labour cost (31.86%) was increased. Later from second year, farm became thicker. Hence the additional number of labour utilized to perform different operations as compared to first year. Ratooning and earthing-up was done again after second year crop. This might be the possible cause for the sharp increase in the labour cost. The further input cost includes lease amount (50.37%), chemical fertilizers (8.26%), plant protections (1.16%) and miscellaneous expenses (8.35%). The total input cost estimated in the second year was ₹ 277742 ha^{-1}.

The second ratoon or third year crop uses all the inputs utilized in the second year. Other than lease amount (56.37%), labour cost (26.15%) contributed more towards total cost. During third year farmer reduced the use of pesticides, weedicides and irrigation because subsequently the spacing in the middle of the plants became denser. The other major input cost were chemical fertilizers (7.76%), plant protections (1.05%), and miscellaneous expenses (8.67%). The total input cost estimated in the third year was ₹ 248178 ha^{-1}.

Table 4.18: Input wise cost in Pineapple cultivation (₹/ha)

Sl. No.	Inputs	First year	Second year	Third year
1	**Human labour**	80202 (16.03)	88450 (31.86)	64880 (26.15)
2	**Machine labour**	41414 (8.27)	-	-
3	**Planting material cost**	165515 (33.06)	-	-
4	**Manure cost**	23202 (4.63)	-	-
5	**Chemical fertilizers**	22943 (4.59)	22943 (8.26)	19268 (7.76)
6	**Plant protection chemicals**	2877 (0.58)	3220 (1.16)	2600 (1.05)
7	**Lease amount**	139917 (27.95)	139917 (50.37)	139917 (56.37)
8	**Miscellaneous expenses**	24505 (4.89)	23213 (8.35)	21513 (8.67)
	Total input cost	**500575**	**277742**	**248178**

Source: Computed from primary data.

Similar findings was reported by the Thomas (2015), cost of cultivation of pineapple in Kerala was ₹ 283977 ha^{-1}, in which planting materials accounted for higher proportion followed by land rent.

Similar results were obtained at Pineapple Research Station (2016) located at Vazhakulam estimated the one hectare cost of pineapple farming and it was found to be ₹

431500, in which planting material and lease amount contributed more to the total cost (PRS, 2016).

According to the report on cultivation cost of important crops by Department of Economics and statistics, estimated to ₹ 420452 ha^{-1} of pineapple farming in which major share was contributed by seedlings/suckers cost (GOK, 2019).

4.4.2 Yield and returns from Pineapple cultivation

After the harvest fruit were categorized into grades such as Grade A, Grade B and Grade C based on fruit weight. Grade A weighs above 800g, Grade B weighs 500-800g and Grade C weighs below 500g. Fully ripped fruit greater than one kg was considered as Grade A. Superior quality fruits fall under Grade A and it priced ₹ 20 /kg. Grade B and Grade C costs on an average of ₹ 14/ kg and ₹ 7/ kg respectively (as on February, 2020).

The detailed yield and returns obtained from pineapple cultivation for three years has been presented in the Table 4.19. The average per hectare yield of pineapple in the first, second and third year was 30323 kg, 25062 kg and 15791 kg respectively. The gross returns obtained from pineapple yield during first, second and third year was ₹ 582400 ha^{-1}, ₹ 444191 ha^{-1} and ₹ 239474 ha^{-1} respectively. The additional income was obtained by selling extra suckers produced by the parent plant. Average of two suckers per plant were produced and were marketed at the rate of ₹ 5/sucker during first year, ₹ 4 and ₹ 3/sucker during second and third year respectively. The returns obtained from marketing of suckers in the first, second and third year was ₹ 140000 ha^{-1}, ₹ 192000 ha^{-1} and ₹ 144000 ha^{-1} respectively.

In the first year, the total returns obtained was worked out to ₹ 822400 ha^{-1}. Total returns in the second and third year was ₹ 636191 ha^{-1} and ₹ 383474 ha^{-1} respectively and the net returns at Cost A_1 was found to be ₹476105 ha^{-1}, ₹ 512729 ha^{-1} and ₹ 289576 ha^{-1} for first, second and third year respectively. The net returns at Cost C was estimated to ₹ 321825 ha^{-1}, ₹ 358449 ha^{-1} and ₹ 135296 ha^{-1} respectively. From the table it is clear that net returns obtained during the second year was higher than the first and third year which was mainly due to decreased input cost.

Table 4.19 Yield and returns from Pineapple cultivation

Sl. No.	Particulars	First year			Second year			Third year		
1	Grades	A	B	C	A	B	C	A	B	C
2	Total yield (kg/ha)	26831	3048	444	18174	4642	2246	7677	4160	3954
3	Returns (₹/ha)	536620	42672	3108	363481	64988	15722	153556	58240	27678
4	Gross returns (₹/ha)	582400			444191			239474		
5	Additional income (₹/ha)	240000			192000			144000		
6	Total gross returns (₹/ha)	822400			636191			383474		
7	Net returns at Cost A_1 (₹/ha)	476105			512729			289576		
8	Net returns at Cost C (₹/ha)	**321825**			**358449**			**135296**		

Das *et al*. (2016) studied the costs and returns structure of pineapple farming in Darjeeling district and estimated that total cost, returns and net return on Cost C per hectare were to the extent of ₹ 297760.57, ₹ 374376.55 and ₹ 76615.75 respectively.

4.4.3 Benefit-cost ratio for Pineapple cultivation

Benefit-cost relation is a concept of profitability, in which higher value indicates more returns per rupee of cost spent. B:C ratio at Cost A_1, A_2, B and C were computed for three years and presented in the Table 4.20. From the table we can infer that all the year B:C ratio was greater than one which means that pineapple cultivation was a profitable business. B:C ratio was high at Cost A_1 which implies that more benefits can be obtained by restricting cost to the Cost A_1, *i.e.* by cultivating pineapple in the owned land than in the leased land.

Table 4.20: Benefit-cost ratio for Pineapple cultivation

Sl. No.	Costs	B:C ratio		
		First year	Second year	Third year
1	**Cost A_1**	2.37	5.15	4.08
2	**Cost A_2**	1.69	2.41	1.64
3	**Cost B**	1.65	2.31	1.56
4	**Cost C**	1.64	2.29	1.54

Singh *et al*. (2016) reported that the investment in pineapple orchard has been found to be a cost-effective business. Benefit-cost ratio have been reported as 1.23 during summer and 1.24 during summer reason (Chakraborty and Bera, 2008).

4.5 PRODUCTION FUNCTION ANALYSIS

4.5.1 Resource productivity on Pineapple farm

To study the resource productivity on pineapple farm, a functional relationship was developed between inputs and output. Resource productivity based on production approach provides a more accurate estimation on influence of individual resources on the output. In the study this was achieved by fitting Cobb-Douglas production function.

The algebraic form of function was written as

$$Y = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} e^{\mu}$$

The above function can be adjusted into log- linear form.

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + \mu$$

Where,

Y = Total yield (quintals/ ha)

X_1 = Hired human labour (mandays/ ha)

X_2 = Plant density (suckers/ ha)

X_3 = Chemical fertilizers (kg/ ha)

X_4 = Hormones (L/ ha)

μ = Random error

In the above equation, yield was identified as dependent variable and human labour, plant density, chemical fertilizers, hormones were identified as independent variables. The co-efficient of determination (R^2) explains the deviation in the dependent variable caused by means of independent variables involved in the production function. Estimated regression value (bi) of respective inputs (Xi) gives the elasticity of production. The

regression coefficient (bi) indicates the percentage change in the yield (Y) if the input quantities (Xi) changes by one unit while all other factors remain constant at their geometric mean levels.

The estimates of the Cobb-Douglas production functions has been given in the Table 4.21. The result of Cobb-Douglas production function analysis indicated that the coefficient of determination (R^2) was 0.73. This signifies that 73 per cent of the deviation in pineapple output was due to the variation in the resources considered (*i.e.* labour, plant density, chemical fertilizers, and hormones). From the examination of production parameters of Cobb Douglas function it was clear that pineapple production was positively contributed by variable inputs like labour, plant density and hormones, whereas, fertilizers had a negative influence.

The coefficient value of labour found to be maximum (*i.e*. 1.40), which means that the magnitude of elasticity of production for labour was high compared to other independent variables. The coefficient of plant density was found to be positive and significant at 5 per cent, which indicates that increase in the number of suckers tends to increase the dependent variable *i.e.,* yield of pineapple by 0.16 quintals per hectare. The coefficient of quantity of chemical fertilizers was found to be negative, which indicated that increase in chemical fertilizers by one kg per hectare tends to decrease the yield by 0.07 quintals. The production function appears to be in the third stage of production with respect to chemical fertilizers as was indicated by the negative elasticity of production for the resource.

Table 4.21: Estimation of Cobb-Douglas production function

Sl. No	Particulars	Coefficient	t value	p value
1	**Intercept**	-0.97	-2.37	0.01
2	**Human labour (man days/ha)**	1.40	14.12	1.73

3	**Plant density (suckers /ha)**	0.16**	2.12	0.03
4	**Chemical fertilizers (kg/ha)**	-0.07**	-2.20	0.03
5	**Hormones (L/ha)**	0.08	1.82	0.07
6	$\sum \mathbf{b_i}$		1.56	
7	$\mathbf{R^2}$		0.73	

Note: ** indicates 5 per cent level of significance

From the results, it could be inferred that the variable resources like labour, plant density and hormones were the most important inputs which determines the pineapple output in the district. By increasing the usage of considered resources, the total output can be increased in the study area.

4.5.2 Returns to scale in Pineapple cultivation

From the regression analysis, the total sum of coefficient ($\sum b_i$) was 1.56 per cent, which means that unit rise in all the independent variables simultaneously increased the yield by 1.56 per cent. Increasing returns to scale was noticed in pineapple cultivation for Ernakulam district, since the estimated regression coefficient (b_i) of respective input (X_i) value was more than one.

Similar result was obtained by Rani (1995) in her study on pineapple production and marketing in Vishakhapatnam district in Andhra Pradesh where sum of elasticity found to be 1.12 showing increasing returns to scale.

4.6 EFFICIENCY MEASURES IN PINEAPPLE CULTIVATION

An effort has been made in the work to examine the efficiencies of key resources used in pineapple farming. In the present study, Data Envelopment Analysis (DEA) model was used to measure the technical efficiency, scale efficiency, cost efficiency and allocative efficiency in pineapple cultivation.

DEA is a system of mathematical programming that facilitates the determination of individual efficiency based on its output and inputs, and it matches with other units considered in the analysis. The solution to the DEA model provides relative measures for each respondent in the study. In the present study, yield was compared with inputs like labour, plant density, chemical fertilizers and hormones.

Technical efficiency is the value with which a specified set of resources utilized to produce an output. If a farm produces maximum output from the minimum amount of inputs, then it is said to be technically efficient. Technical efficiency (in percentage) distribution of pineapple farmers was estimated and presented in the Table 4.22. According to the efficiency calculated from DEA, the majority (47.5%) farmers in the study area had a technical efficiency ranging from 61 to 75 per cent and about 9 per cent growers were in range of 90 to 100 per cent. The minimum and maximum individual efficiency were found to be 33% and 98% respectively. However, the average technical efficiency from pineapple farming found to be 73 per cent, which means that output can still be increased by 27 percent with the available resources. This signifies that there were significant inefficiency in cultivation and still there exist an opportunity for returns gain through efficiency enhancement.

Table 4.22: Technical efficiency distribution of Pineapple farmers

Sl. No.	Efficiency range (%)	Frequency
1	**<50**	2 (2.5)
2	**51 - 60**	9 (11.25)
3	**61 – 75**	38 (47.5)
4	**76 - 90**	24 (30)
5	**> 90**	7 (8.75)
	Total farmers	80 (100)
	Mean technical efficiency = 73 %	

Note: Figures in parenthesis indicate percentage to total efficiency

Scale efficiency expresses whether the farm is operating at its optimal size or not. It ranges from zero to one. If scale efficiency equals to one which indicates operation of farm under optimal size. From the model, mean scale efficiency score of 0.83 was obtained which means that pineapple farm was operated below optimal size in the study area.

Allocative efficiency was computed for individual farmers. It is an output level where marginal cost (MC) equals the price (P). Clearly, it is the condition of a farm to produce a crop where marginal cost equivalents to price. From the model, the average allocative efficiency worked out to 0.91. Allocative efficiency was higher than technical efficiency which implies that the returns from pineapple cultivation can be maximized by reorganization of resources and by enhancing the technical efficiency.

Cost efficiency is the product of technical and allocative efficiency. For pineapple cultivation cost efficiency found to be 0.65. By improving the efficiency (both technical and allocative) in pineapple farming, the profit can be almost doubled in the Ernakulam district. Therefore more concerned attempts are need to expand the efficiency in pineapple farming in the study area.

Table 4.23: Efficiency measures in Pineapple cultivation

Sl. No.	Efficiency measures	Efficiency score
1	**Technical efficiency (CRS)**	0.73
2	**Technical efficiency (VRS)**	0.87
3	**Scale efficiency**	0.83
4	**Allocative efficiency**	0.91
5	**Cost efficiency**	0.65

Thomas (2015) undertook a study with a specific objective to assess the cost, return and technical efficiency in intercropped pineapple farming in Kerala. In his work, mean

technical efficiency in Kerala was estimated to 77 per cent, and he suggested that by proper utilization of available resources such as plant density, total labour (man days per hectare), manures, chemical fertilizers, pesticide and weedicides efficiency measures can improved by 23 per cent.

4.7 MARKETING CHANNELS, MARKETING COST, MARKETING MARGIN AND PRICE SPREAD IN PINEAPPLE VALUE CHAIN

Marketing channels are the paths through which produce moves from producers to final consumers. To understand the marketing characteristics of pineapple, different marketing channels were recognized and marketing cost, marketing margins and price spread were studied.

4.7.1 Marketing channels in Pineapple

4.7.1.1 Marketing channels in fresh Pineapple

Channels by which fresh pineapple were moved from the farmers to the final consumers has been represented in the Figure 4.9.

The different passages recognized in the marketing of pineapple fruit were

Channel 1 - Producers – Retailers – Consumers
Channel 2 - Producers – Wholesalers – Retailers – Consumers
Channel 3 - Producers – Traders - Wholesalers – Retailers – Consumers
Channel 4 - Producers – Vazhakulam Market – Consumers

Among these, Channel 2 and Channel 3 were identified as the commonly used channels. In Channel 1, retailers directly collect fruits from producers to avoid middlemen so that profit margin can be increased. In Channel 2, wholesalers procured fruits from producers on pre agreement which helped farmers in getting more price per unit than the traders which was then moved to the retailers and then to the consumers. Channel 3 was the longest chain identified. In this, traders collected fruits from producers and then it was

sold to the wholesalers located in and around the Muvattupuzha which was then traded to the vendors and to the customers. Last channel, *i.e*. in channel 4 producers sold their produce to the trader in the Vazhakulam market and trader himself acts as a retailer. Consumers buy fruits from such retailers since fruit costs comparatively less price from other retail shops or super markets.

4.7.1.2 Marketing channels in processed Pineapple

Marketing channels for processed pineapple products has been presented in the Figure 4.10. The channels identified for marketing of processed products were

Channel 1 – Producers – Processor – Retailers – Consumers
Channel 2 – Producers–Processors – Distributors – Retailers – Consumers
Channel 3 – Producers – Traders – Processors – Retailers – Consumers
Channel 4 – Producers – Local processors – Processors – Distributors – Consumers

Among these channels, Channel 2 and Channel 3 were most common channels. Processors collected fruits directly from farmers by setting a floor price so as to support them when price falls drastically. Channel 3 followed mostly for the distant processors *i.e.* processors belongs to the other state. In Channel 4, local processors procured fruits from producers and after processing it into pulp, it was sold to large scale product making units.

Among the various marketing channels identified, channel 3 was considered as the most preferred path for fresh pineapple and channel 2 was considered as the most preferred path for processed pineapple product from the primary survey.

The share of intermediaries in marketing of Pineapple has been presented in the Figure 4.11. Majority of the farmers (81.25%) sold their Grade A produce through traders. About 60 per cent of producers traded their Grade B and C produce through traders and 27.5 per cent through processors. From the figure we can say that farmers are dominated by traders, hence the bargaining power is very less. Many of the farmers do not have direct contact with the market companies or wholesalers or processors, so they contact traders to sell their produce.

Singh *et al.* (1990) conducted a study in North Tripura on marketing of pineapple. They recognized various marketing passages in marketing of pineapple and found that farmers- local traders – wholesalers – retailers – consumers as the most preferred channel in the process of marketing.

4.7.2 Marketing cost incurred by different market mediators

It is the costs experienced in the marketing channels by the producers and other intermediaries to perform various functions. The item wise cost incurred per kg of pineapple by intermediaries has been presented in the Table 4.24. Fruit sold at farm level, hence there was no marketing cost at producer level. On average marketing cost incurred by the trader estimated to ₹ 4/kg of pineapple. Marketing cost incurred by wholesalers or distributors was ₹ 4/kg. At processor level marketing cost worked out to ₹ 20/kg which included processing, packaging, labeling, branding, *etc.* The significant item of cost was transportation cost.

Table 4.24: Marketing cost incurred by market mediators (₹/kg)

Sl. No.	Particulars	Trader	Wholesaler /distributor	Processor
1	Transportation cost	2	2	2
2	Loading & unloading charges	1	1	1
3	Processing / value addition	1	-	15
4	Miscellaneous charges (equipment, wastage, handling charges, packaging *etc*.)	-	1	2
	Total cost	4	4	20

4.7.3 Marketing margin and price spread in the marketing of Pineapple

Marketing margin is defined as profit earned by the actors when the commodity is moved by performing various marketing functions from producers to consumers. Marketing margin and price spread for the most preferred channel for fresh fruit and processed product identified in the study region has been calculated and given in the Table 4.25.

4.7.3.1 Marketing margin and price spread in the marketing of fresh Pineapple

One of the most preferred marketing channel for the fresh fruit was Channel 3 - Producers – Traders - Wholesalers – Retailers – Consumers. Marketing margin for the trader found to be ₹ 6/kg, and for wholesalers and retailers were ₹ 4/kg and ₹ 6/kg respectively. The price spread in the channel 3 was ₹ 25/kg of which only ₹ 1 was the cost experienced by the vendor and the left over (₹ 24) was his profit.

4.7.3.2 Marketing margin and price spread in the marketing of processed Pineapple

The most preferred marketing channel for the processed product (pineapple concentrate) was Channel 2 - Producers – Processors – Distributors– Retailers – Consumers. To prepare one kg of pineapple concentrate on an average three fresh fruits were used. For processing purpose usually grades like B and C were used. Marketing margin for processors was ₹ 21 /kg, for distributors it was found to be ₹ 2/kg and retailers ₹ 5/kg. The price spread in the channel 6 was ₹ 51/kg of which only ₹ 1 was the cost incurred by the vendor and the left over (₹ 50) was his profit.

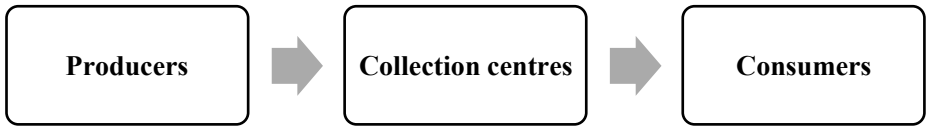
Table 4.25: Marketing cost, Marketing margin and Price spread in different channels

(₹/kg)

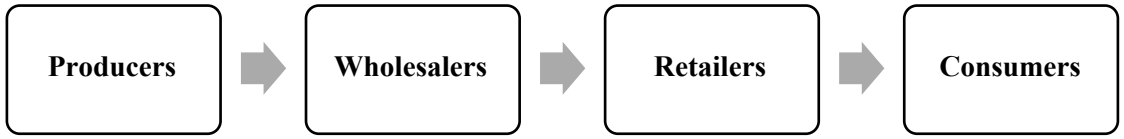
Sl. No.	Particulars	Channel III (₹)	Channel VI (₹)
1	Producer's selling price	20	12
2	Marketing cost incurred by producer	-	-
3	Net price gained by producer	20	12
4	Trader purchase price	20	-
5	Trader selling price	30	-
6	Marketing cost incurred by trader	4	-
7	Margin of trader	6	-
8	Processor purchase price	-	12
9	Marketing cost incurred by processor	-	20
10	Processor selling price	-	53
11	Margin of processor	-	21
12	Wholesaler/distributor purchase price	30	53
13	Marketing cost incurred by wholesaler/distributor	4	2
14	Wholesaler/distributor selling price	38	57
15	Margin of wholesaler	4	2
16	Retailer purchasing price	38	57
17	Marketing cost incurred by retailer	1	1
18	Retailer marketing price	45	63
19	Margin of retailer	6	5
20	Price spread	25	51

Figure 4.9: Marketing channels for fresh Pineapple

Marketing channel 1:



Marketing channel 2:



Marketing channel 3

Marketing channel 4:

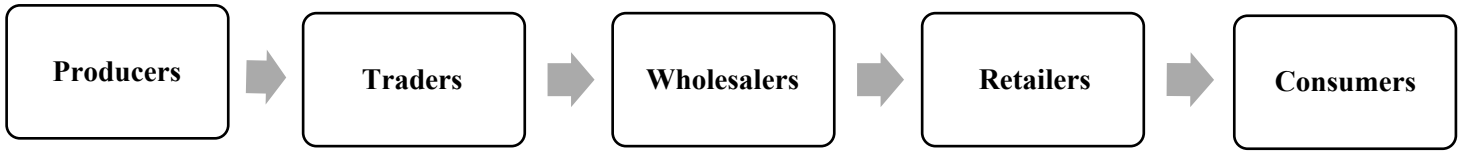
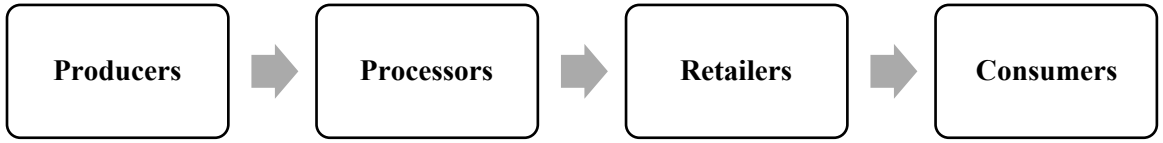


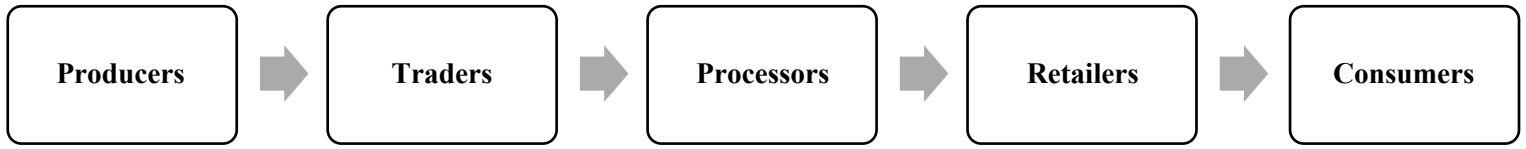
Figure 4.10: Major marketing channels for processed Pineapple:

Marketing channel 1:



Marketing channel 2:

Marketing channel 3:



Marketing channel 4:

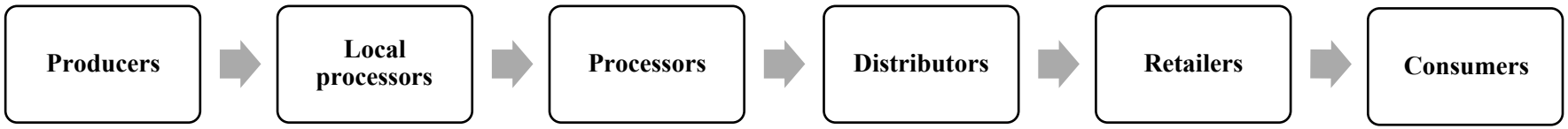
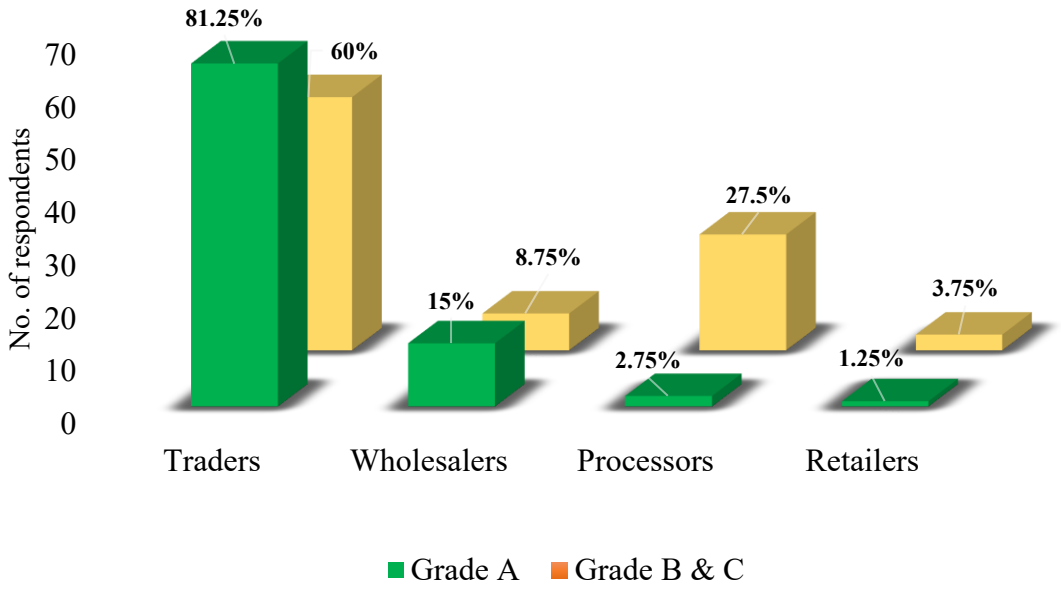


Figure 4.11: Share of intermediaries in marketing of Pineapple



4.8 MARKETING EFFICIENCY, PRODUCER'S SHARE IN CONSUMER'S PRICE AND DEGREE OF VALUE ADDITION

4.8.1 Marketing efficiency

Marketing efficiency expresses relation between market outputs to market inputs. It is the degree of market performance and it was measured by the formula proposed by Acharya and Agarwal. The output of marketing system was the difference between the consumer's price and producer's price. Marketing efficiency for the selected paths has been given in the Table 4.26. From the given table we can infer that marketing efficiency can be increased by selling the produce to the trader, *i.e*. 277% which was more than the efficiency gained by selling to the processor (222%). However, marketing efficiency can be increased by selling produce directly to the retailers (500%). Marketing efficiency can be increased by decreasing the number of intermediaries.

Marketing efficiency indicates the competitiveness of the selected value chain. Marketing efficiency for fresh pineapple was higher than the processed pineapple. Therefore, fresh pineapple value chain is more competitive than processed pineapple value chain in the study area.

4.8.2 Producer's share in consumer's price

Producer's share in consumer's price is the price received by the farmer to the retail price (price paid by the consumer) expressed in percentage. Producer's profit, producer's share and marketing efficiency in selected channel has been given in the Table 4.26. From the table it is clear that, farmers gets more profit when they sell their produce to the trader than the processors. The producer's profit and producer's share in consumer's price was more for fresh produce than processed one.

From this we can also conclude that channel with high marketing efficiency was said to have more competitiveness. When farmers sell their produce directly to retailers, they can get more profit, maximum possible producer's share in consumer's price and they can increase the marketing efficiency too.

Table 4.26: Producer's profit, producer's share and marketing efficiency in selected channel

Marketing channels	Producer's profit (₹/kg)	Producer's share (%)	Marketing Efficiency (%)
Farmers – Traders - Wholesalers – Retailers – Consumers	3.5	44.45	277
Farmers – Processor – Distributor – Retailers – Consumers	2	9.04	222
Farmers – Retailers – Consumers	13.5	75	500

Chaddha *et al.* (1998) reported that, pineapple cultivator holds very low proportion of share in the retail price, which was as small as 26 per cent in Meghalaya and 48 per cent in Kerala. This was because of the existence of large number of mediators in the marketing chain and also identified that maximum of the profit was pocketed by mediators.

4.8.3 Degree of value addition

Pineapple changes hands as it passes along the chain and the value of pineapple get varied and this process is called value addition. There is a possibility of adding a value in between the chain. The per cent rise in the value of the item referred as "the Degree of value addition" of that product.

Degree of value addition of both fresh pineapple and value added pineapple has been estimated and represented in the Figure 4.12. It differs at every stage or actors in the chain and to estimate this price of the product was taken into account. By deducting the cost from the price change margin can be obtained. The margin attained was divided by the buying price to arrive at the figure of value addition and the figure was expressed in percentage to reach at the degree of value addition of the product.

4.8.3.1 Degree of value addition for fresh Pineapple

Degree of value addition at each stage of the value chain for the fresh pineapple has been given in the Table 4.27. Since farmers do not undertake any value addition the process starts from the trading stage. At merchant stage it was 20 per cent, 13.33 per cent at wholesaler and 5.26 per cent at retailer. So it is clear from the table that, no much variation in value addition was observed in case of fresh pineapple.

4.8.3.2 Degree of value addition for processed Pineapple

The Table 4.28 gives degree of value addition at each stage of the values chain of processed pineapple. No much value addition was done at the producer level. Since processors directly procure from farmers there was no role of trader. About 150 per cent

value addition was observed at the processors stage which was maximum than any other stage followed by 3.12 per cent at distributor's level and 8.23 per cent in vendors level. Value addition was much higher processing point than other phase.

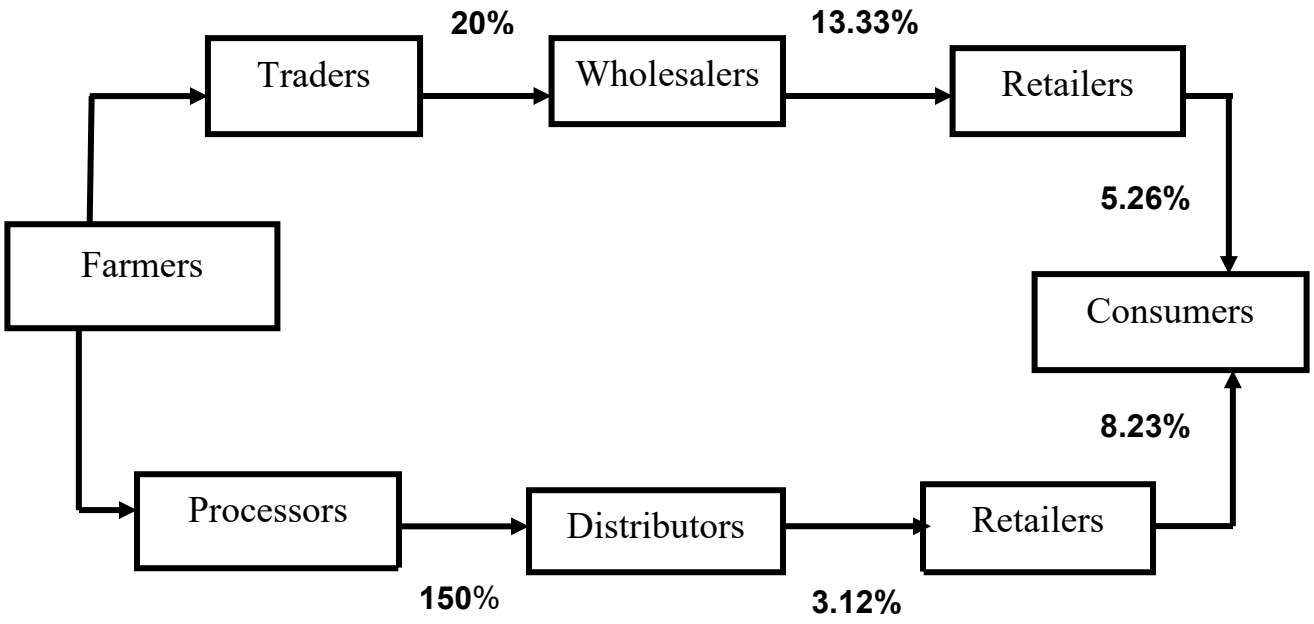
Table 4.27: Degree of value addition at each stage of the fresh Pineapple value chain (₹/kg)

Sl. No.	Particulars	Farmer	Trader	Wholesaler	Retailer	Consumer
1	Sale price	20	30	38	45	-
2	Purchase price	-	20	30	38	45
3	Price difference	-	10	8	7	-
4	Cost	-	6	4	5	-
5	Margin	-	4	4	2	-
6	Degree of value addition (%)	-	20	13.33	5.26	

Table 4.28: Degree of value addition at each stage of the fresh Pineapple value chain (₹/kg)

Sl. No.	Particulars	Farmer	Processor	Distributor	Retailer	Consumer
1	Sale price	30	160	170	189	-
2	Purchase price	-	40	160	170	189
3	Price difference	-	120	10	19	-
4	Cost	-	60	5	5	-
5	Margin	-	60	5	14	-
6	Degree of value addition (%)	-	150	3.12	8.23	-

Figure 4.12: Degree of value addition at different stages of value chain



4.9. PHYSICAL FLOW OF PINEAPPLE

4.9.1 Export of Pineapple from India

Besides one of the favorite fruit crop, pineapple is considered as one of the commercially important fruit in India. Due to its rich taste, flavour and size, Indian pineapples are consumed world-wide. The large portion of pineapple produced in India are specially exported to the Middle-Eastern countries such as UAE, Saudi Arabia, Oman, Bahrain, and Qatar. India also exports pineapple to other countries such as Nepal, Maldives, U.K, Russia, Italy, *etc.* Country wise export of pineapple from India during 2017-18 has been presented in the Figure 4.13. India exports insignificant quantity of pineapple even though it is the sixth largest producer in the world. In 2017-18, India gained around ₹ 3501.44 lakhs worth by exporting 8339.82 MT of fresh as well as dried pineapple. Middle-East countries contributed about 71 per cent to the total export value in India. Saudi Arabia, with ₹ 770.79 lakhs (1033.32 MT) grabbed the top position which contributed about 22 per cent to the total export value, but in terms of quantity, Nepal holds top position

with 3630.89 MT. Further, being grieving from many constrains, the trade value of pineapple was at its upswing from previous few years. A total of ₹ 3341.44 lakhs has increased from about ₹ 160 lakhs in 2001 to the current worth of ₹ 3501.44 lakhs. From last sixteen years India showed sharp progress in the export value. However, if we consider the international export scenario, the export quantity of pineapple from India was negligible (APEDA, 2018).

4.9.2 Export of Pineapple from Kerala

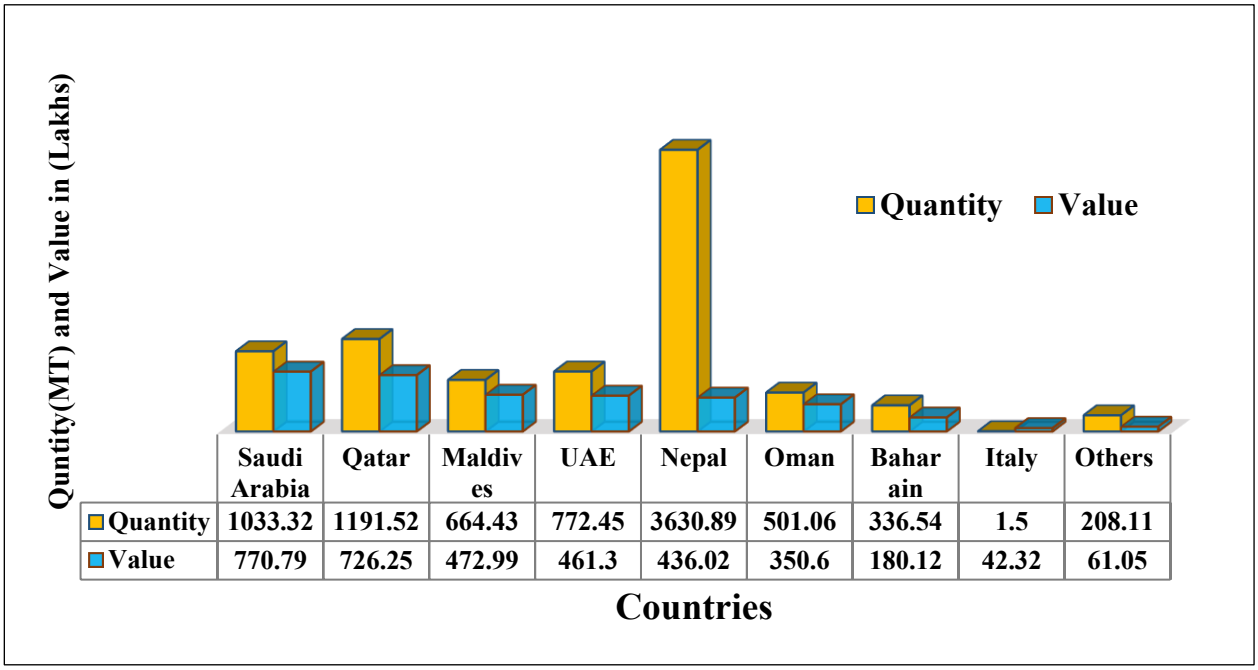
Vazhakulam pineapple is exceptional in aroma, flavor and sugariness because of its high sugar and low acidity content. Kerala contributes more towards the overall pineapple production in the country. The international trade of pineapple from state has enhanced due to GI tag, further fetching the reputational finest price in the overseas market. It was said that Mauritius variety is not suitable for processing purpose because of its shape, skin type and reduced shelf life of bout 10-12 days. It is difficult to cut and it takes more time for processing. To boost export and to meet the challenges of global competition in the WTO regime, Kerala Pineapple Growers' Association and other organizations are promoting MD2 variety pineapple for cultivation. Del Monte Scientists in Costa Rica developed a hybridized MD2 or Dinar pineapple. Due to its color, flavor, shape, shelf life and maturity MD2 is considered as the most popular variety in the national market compared to other varieties.

The rising export demand has necessitated Kerala's pineapple producers to focus on the internationally accepted MD2 variety because of its better suitability for processing and extended shelf life, compared with the traditional Mauritius fruit. Due to its long shelf-life of 30 days MD2 variety is the most preferred in the export market, while Vazhakulam pineapple has got hardly 10-12 days. The fruit characteristics such as cylindrical shape, flat eyes and thin core of MD2 variety made it the most suitable for processing and exports.

4.9.3 Physical flow of Pineapple from Kerala

In Kerala, about 69.72 thousand metric tonnes of pineapple were produced from an area of 8.22 thousand hectares with a productivity range of 8.49 t/ha (GOI, 2018). Out of overall production from Kerala, use of pineapple within and outside the state were represented through physical flow of pineapple from Kerala during 2017-18 in the Figure 4.14. Almost 90 percent of pineapple (raw/green) were transported domestically to states like Delhi, Maharashtra, Uttar Pradesh, Rajasthan, Gujarat and to all the South Indian states. Among these states 50 per cent of the share captured by Maharashtra and Delhi. Only 0.5 per cent (375 tonnes) of the overall production was exported to Gulf countries like Saudi Arabia, Qatar, Oman, UAE, *etc.* In Kerala, 8 per cent of ripe fruits were consumed out of 9.5 per cent (7125 tonnes) of total production and remaining 1.5 per cent (1425 tonnes) utilized for processing within the state. One per cent (950 tonnes) fruits were used for making concentrate and 0.5 per cent constitutes other products like jam, jelly, pickle, candy, *etc.*

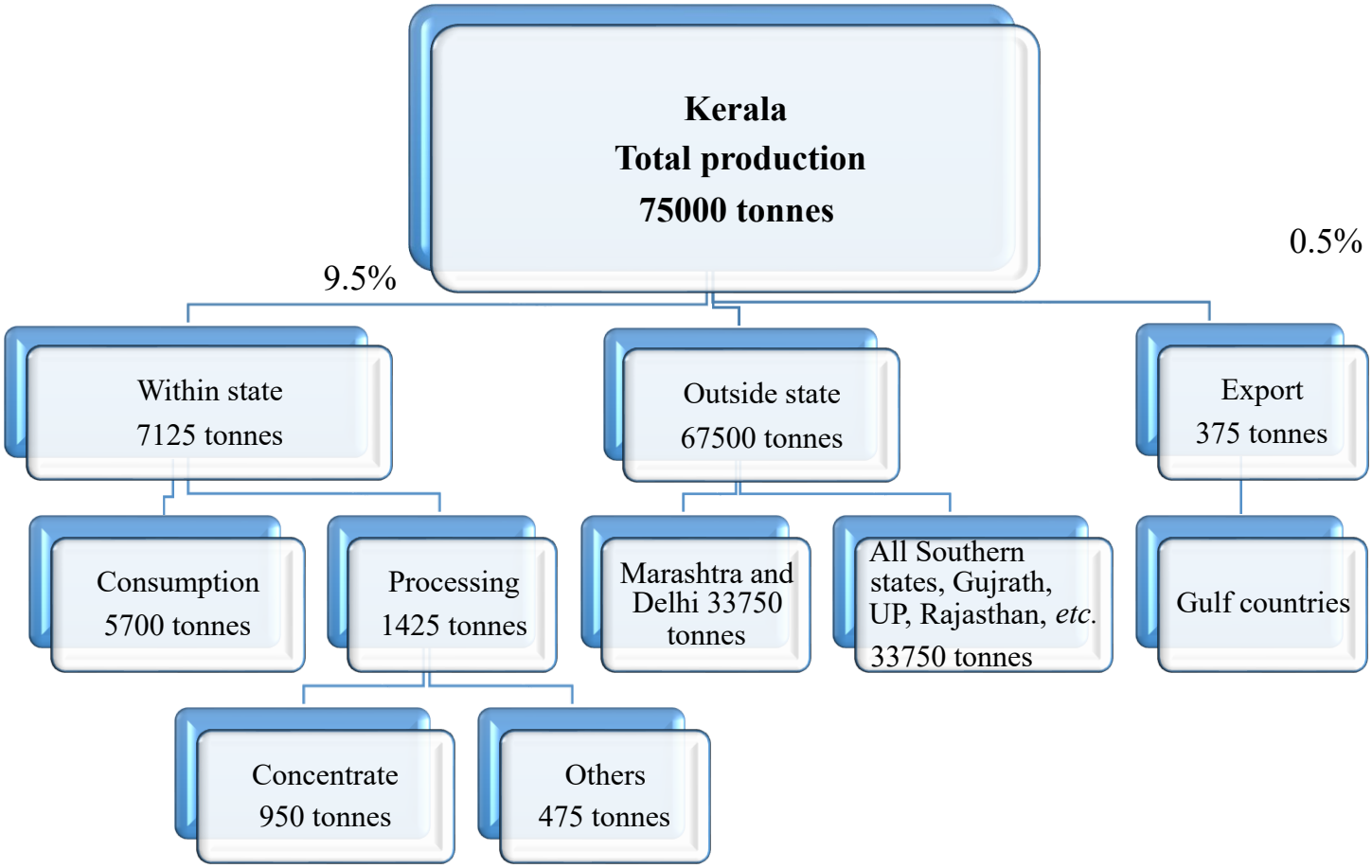
Figure 4.13: Country wise export of Pineapple from India during 2017-18



	Saudi Arabia	Qatar	Maldives	UAE	Nepal	Oman	Bahrain	Italy	Others
Quantity	1033.32	1191.52	664.43	772.45	3630.89	501.06	336.54	1.5	208.11
Value	770.79	726.25	472.99	461.3	436.02	350.6	180.12	42.32	61.05

Source: Horticultural Statistics at a Glance, Ministry of Agriculture

Figure 4.14: Physical flow of Pineapple from Kerala during 2017-18



4.10 INSTITUTIONAL AND INFRASTRUCTURAL ISSUES IN THE COMPETITIVENESS OF PINEAPPLE VALUE CHAIN

Competitiveness is defined as the set of institutes, strategies, and issues that govern the country's productivity (Porter and Schwab, 2008). This may result in surge of national income through the growth of local industries and higher incomes for farmers involved in its production (Fawole, 2008). Since it is a base for success in the native, regional and foreign market the significance of competitiveness in pineapple production cannot be

exaggerated. However, greater level of revenues were earned by the more competitive economies for their citizens. It educates stakeholders to deal with a high-quality product, to reduce costs in relative to the competitive one. Also market competition cheers producers of agricultural products to decide on the product line or services in harmony with consumer needs, quality and food security principles for the domestic market needs and export dynamism (Ivan *et al*., 2011).

4.10.1 Enhancing and constraining factors in competitiveness of Pineapple value chain

The factors which influenced competitiveness in value chain were identified and ranked by using rank method. The most selected factor was ranked as one and so on. The enhancing factors affecting competitiveness of pineapple value chain has been presented in Table 4.29. The major factor that encourages pineapple cultivation, marketing, processing and export were institutional support from various institutions like Pineapple Research Station, Kerala Agricultural University, Krishibhavan, NAPCL, VFPCK, *etc.* the other factors include availability of inputs, market accessibility, technological services and government policies.

Table 4.29: Enhancing factors in competitiveness of Pineapple value chain

Sl. No.	Enhancing factors	Rank
1	Institutional support	1
2	Availability of inputs	2
3	Market accessibility	3
4	Technology services	4
5	Government policies	5

Kerala has the right agro-climatic conditions for pineapple production. But over the year area and production under pineapple cultivation has been decreased. Pineapple production was constrained by planting materials, lack of know how to use new technology, post-harvest losses and other related factors combined together contributed low productivity, less quality with high costs and less competitiveness in the market. Some constraining factors affecting the competitiveness of pineapple value chain in the study area were identified and ranked which has been given in the Table 4.30.

The major factors that hindered pineapple cultivation was increased establishment cost due to increased cost of inputs and increased wage rate followed by labour availability mainly during peak season for the operations like planting, application of growth hormones and harvesting. The other constraining factors were storage facility, lease land farming, credit availability and lack of market information regarding price and arrivals.

Table 4.30: Constraining factors in competitiveness of Pineapple value chain

Sl. No.	Constraining factors	Rank
1	High establishment cost	1
2	Labour availability	2
3	Storage facility	3
4	Lease land farming	4
5	Credit availability	5
6	Lack of market information	6

Mamo (2018) conducted a study on pineapple value chain and factors affecting the producer's profitability and analysed the competitiveness in pineapple value chain. In the research area pineapple sector was highly dominated by smallholder pineapple producers and they were dominated by brokers, wholesalers and retailers. Fruit producers, collectors,

and traders were loosely connected in the value chain networks and brokers were more powerful to govern value chain than producers.

4.10.2 Institutions involved in Pineapple value chain

Many institutions are coming forward to bring competitiveness in pineapple farming, distribution, marketing and consumption. Well thought out profitable policies are networking production, handling and marketing to evolve in the global market. Major among them are discussed below:

4.10.2.1 Pineapple Research Station (PRS)

Pineapple research station (PRS) is emerging progressively and aiding as a supporting body to the pineapple cultivators of the state and the country. It is located at Vazhakulam and is the research center of Kerala Agricultural University. It was established on 2nd January 1995. Under Kerala Horticulture Development Program (KHDP), the station started as Pineapple Research Station and Pest & Disease Surveillance Unit. Later in 1997, it separated from KHDP and turned into a constituent research center under Kerala Agricultural University.

The main objective of the centre are to offer quality expertise, products and amenities to the pineapple zone, to provide research and development support and also to commence basic and realistic research in pineapple and other fruit crops of Kerala. Tissue cultured plants, saplings, rooted clippings, published materials, *etc.,* are provided through sales counter. Agriclinic and advisory, training, consultancy, quality analysis, project works for UG, PG and diploma students are also available at the station. In addition to this, for raising various fruit plants, protecting germplasm and for doing field research, free authorized land was taken as a permanent farm with considerable efforts. Station renamed as Tropical Fruit Crop Research Station (TICRS) mainly to launch sufficient substructure for advanced improvement and modification. Also it anticipated to establish a well-equipped fruit processing workrooms with FPO registration. Value added products such

as concentrate, jam, squash, *etc.,* were prepared for the proficient use of leftover fruits at the center.

The station conducted experiments on development of new varieties and various aspects of pineapple cultivation. Package of practices recommendations for the Mauritius variety is framed based on the outcomes and all the technologies developed are being transferred to the pineapple growers extensively. To boost the export of pineapple Vazhakulam pineapple has been registered in the Geographical Indication Registry. For technology transfer various modes are efficiently used, few among them are individual discussion, farm visit, phone contacts, electronic mail, websites, post, radio, TV's, newspapers, bulletins, magazines, pineapple fests, meetings, trainings, *etc.*

4.10.2.2 Pineapple Farmers' Association (PFA)

A group of pineapple farmers formed an association to tackle the problems faced during the cultivation and marketing of pineapple in 1990. Any person undertaking pineapple cultivation and belong to Kerala can be a follower of this association. At present there are more than 500 members in the association. The motto of PFA is to bond and support pineapple farmers and create consciousness about pineapple farming, marketing and related issues. It promotes marketing and value adding facilities. Also helps producers to take monetary and technical support from government and non-government institutions and banks. To the member farmers a good quality of planting materials, fertilizers, plant protection chemical, growth controllers, *etc.*, are supplied at subsidized rate. During any problems in marketing place, PFA will give assistance to farmers. It conducts seminars and meetings for farmers. Arranges classes by specialists in farming, diseases and pest control, post-harvest management, loans, *etc.* It played an enormous role in getting GI tag for Vazhakulam pineapple.

4.10.2.3 Kerala Pineapple Mission

Government of Kerala (GOK) established Kerala Pineapple Mission as a registered society in 2013. Governing council consists of 19 members to regulate administration and

management. The Minister for Agriculture, GOK is the president of the mission. The objective is to improve and civilize production, post-harvest supervision, processing, marketing, and trade which increase growth in pineapple sector. Also to augment farmer income by enabling the cultivators through contact to expertise, aids, inputs, credit and infrastructure.

4.10.2.4 Vazhakulam Agro and Fruit Processing Company

A fruit processing factory for large scale processing of pineapple, mango and other fruits, Nadukkara Agro Processing Company Limited (NAPCL) was established under Kerala Horticulture Development Program (KHDP) in the centre of Kerala's pineapple area (Nadukkara). Out of 10000 shares in total, Government of Kerala holds 51 per cent share, 30 per cent by farmer-producers and 19 per cent by Vegetable and Fruit Promotion Council Keralam (VFPCK). When price fall below threshold range, the company procures fruit directly from the farmers so as to stabilize reasonably good market price. It is having ISO/ HACCP certification and it owns a brand of pineapple juice called "JIVE". It is having the capacity to process more than 70 tonnes of pineapple per day. It provides contract processing to other private sector processors. The company provides employment to more than 100 people directly and more than 150 people indirectly. It organizes trainings and seminars for the farmers to popularize pineapple farming. To meet the challenges of world competition in the WTO reforms it is promoting MD2 variety for cultivation practices. It recently commissioned the facilities for cold storage, storing, branding and certificate tagging with a volume of 700 tonnes per day which was funded by APEDA.

4.10.2.5 Vegetable and Fruit Promotion a Council Keralam (VFPCK)

To bring about complete development in fruit and vegetable sector, Vegetable and Fruit Promotion a Council Keralam was established. It is a company with majority stake of farmers and has the Government and financial institutions. It supplies planting materials for the required farmers through Seed Processing Plant (SSP) and Krishi Business Kendra. It also supplies organic manures, bio-pesticides and bio-fertilizers. The self-help groups

formed by farmers under VFPCK trying to realize better prices for their produce and it also gives opportunity to farmers to sell their produce on their own.

4.11 CONSTRAINTS IN PRODUCTION AND MARKETING OF PINEAPPLE

Constraints in cultivation of pineapple were evaluated by gathering the opinion of the producers and market intermediaries about the challenges faced in production and a marketing of pineapple in the survey area and the same has been discussed in this section.

4.11.1. Constraints in production of Pineapple

With the help of Garrett ranking technique, the severity of identified problems were recorded. According to the rank given by the pineapple producers the scores were calculated using the formula. The constraints in production were analysed and has been given in the Table 4.31.

In the study of value chain analysis in Ernakulam district, the sample farmers rated high cost of planting material as the major constraint with the Garrett score 75.97, followed by scarcity of hired labour (67.12), high labour cost (55.66), high rent (50.7), inadequate supply of water (43.53), low yield/ returns(33.37), and pest and disease attack (25.18). Mealy bug and Heart rot of pineapple are the major pest and disease that need to be addressed effectively.

Table 4.31: Constraints in production of Pineapple

Sl. No.	Constraints	Garrett score	Rank
1	High cost of planting material our	75.97	1
2	Scarcity of hired labour	67.12	2
3	High labour cost	55.66	3
4	High rent	50.7	4

5	Inadequate supply of water	43.53	5
6	Low yield/ returns	33.37	6
7	Pest and disease attack	25.18	7

Computed from primary data

Rani (1995) conducted a study Vishakhapatnam district of Andhra Pradesh on pineapple production and marketing. She identified various constraints in pineapple production and found that 85 per cent of the farmers face the problem of inefficient technical knowledge and 74 per cent of the accounts for non-availability of good quality suckers**.**

4.11.2 Constraints in marketing of Pineapple

The constraints in marketing of pineapple has been given in the Table 4.32. It was observed that widely held respondents opined price fluctuation/ irregularity in market prices as the main problem in marketing with a Garrett score 76.3. The other problems identified were decrease in demand (63.41), high transportation cost (51.32), lack of grading facility (47), lack of value addition (29.8) and non-availability of market information (26.21). The price of fruits has been drastically fluctuated over the time. The price chart for ripe and green pineapple for last 15 years were presented in the Figure 4.15. Thus the pineapple farmers face large number of marketing related problems. To help growers in marketing of the produce there exist a need for an organization. Even with a profitability, there are lot of market space in marketing of pineapple. Hence, there is an instant need to establish marketing facility through co-operative lines or government institutions in the research area.

Table 4.32: Constraints in a marketing of Pineapple

Sl. No.	Constraints	Garrett score	Rank
1	Price fluctuation/ Unstable market prices	76.3	1
2	Decrease in demand during winter	63.41	2

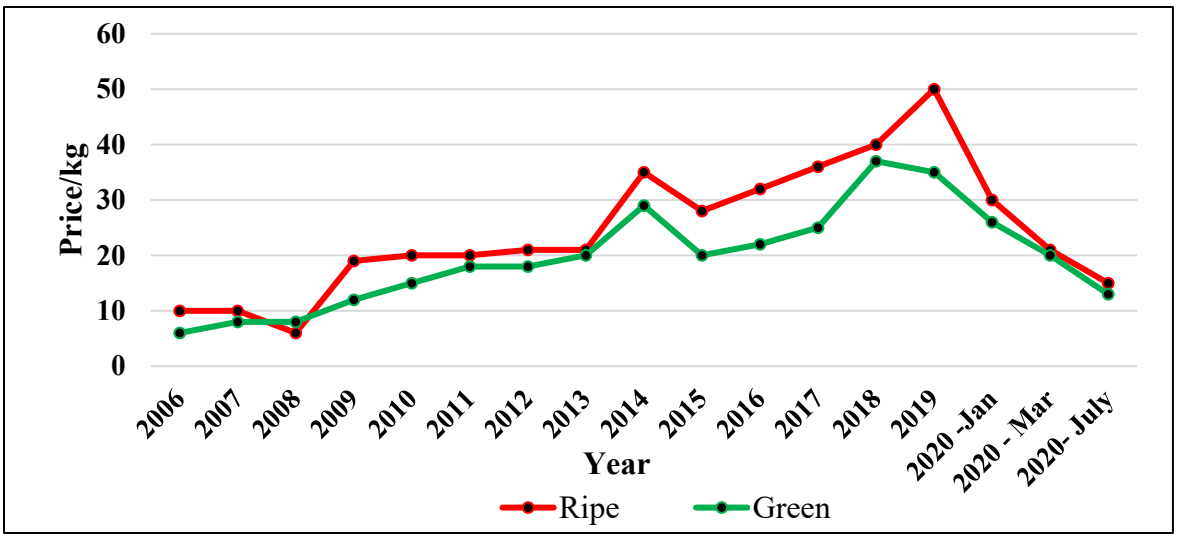
3	High transportation cost	51.32	3
4	Lack of grading facility	47	4
5	Lack of value addition	29.8	5
6	Non-availability of market information	26.21	6

Computed from primary data

Keerthi (2008) in his study on production and a marketing of pineapple in Shimoga district of Karnataka and identified problems in the marketing of pineapple such as absence of notification of commodity in the regulated market, lack of grading facility, price variation , lack of storage facility, weighment problem, and non-availability of market information. From this we can infer that problems in marketing of pineapple differ over the space. Other constraints identified are

- Unavailability of inputs on time
- Post-harvest losses
- No proper regulated markets
- Increased number of agents between farmers and consumers
- Climate change

Figure 4.15: Annual price of Pineapple in Vazhakulam market (2006-2020)



Source: vazhakulampineapple.in

4.12 INTERVENTIONS FOR UPGRADING THE PINEAPPLE VALUE CHAIN

Interventions were proposed for the constraints identified in the study area. The infrastructure and support services to facilitate the development of pineapple value chain were underdeveloped. Processing segment was at an initial stage of development and substantial upgrading and innovations are required to create value addition. Poor cooperation between value chain stakeholders presents another crucial challenge. Knowledge created, analysis carried out, initiatives planned and activities undertaken are not widely disseminated and soundly communicated. There is a mounting demand for value added pineapple with a nutritional quality around the world, but export contribution is insignificant. Therefore, there is a serious need to adopt and apply modern techniques and strategies in pineapple value chain. Some of the major interventions recommended for the pineapple value chain at various level are discussed below:

At production and output level:

- The production must be increased with the increase in processing industries
- Shift to MD_2 variety of pineapple as it has global demand due to its increased shelf-life and better processing requirement
- Good package of practices should be followed to produce export quality pineapple and intercropping should be adopted which avoids soil erosion, adds to the income and also generates employment opportunities
- Grading or value addition should be done which help in fetching good prices for the produce
- Record keeping is an important component of the successful farm business. It gives a clear indication of how business is doing financially and what needs to be changed. All actors in the value chain should be educated about the act of complete record keeping to assess their businesses from time to time

Input supply:

- Input dealers should be skilled on improved varieties and new inputs

- Supply of inputs should be made to reach farmers on time and they should reach to the farm level
- Possible irrigation facility should be given

Infrastructure:

- Market yards and storage facilities should be provided at farm level
- Collection center should be made available at farm level with suitable weighing equipment's
- Modern processing plants should be established and existing processing technique should be improved

Technical:

- In order to overcome the low productivity high yielding, fertilizer reactive, disease and pest resilient variety supported with upgraded cost effective agriculture practices should be familiarized in the farm level and required training should be given through extension agents or agri-experts
- Research work on value addition possibilities and improvement in fruit quality should be initiated

Marketing:

- To address the problem of marketing, it is recommended that producers should look for markets for their produce before producing. So that, they will not only guaranteed by a market but they will be producing specifically for a target group and so will be able to meet their requirements
- Involvement of market intermediaries should be minimized to get high producer share in consumer's a price and involvement of cooperatives in marketing arrangement should be improved
- Produce should be harvested and marketed when price hikes and bulk transportation help in reduction in transportation charge
- Market information should be provided on time
- Commercialization of new and improved pineapple products and promote export

Government policy:

- Government should keep pineapple as their priority crop
- Subsidized inputs should be provided for the needy farmer
- Saving and credit system should be established at farm level
- Awareness and policies towards organic farming can be initiated

Thus, the production and quality of fruit can be amplified along with the fruit processing industries and value chain related activities. So with this commercial crop can augment our national wealth and can create its existence felt at overseas market.

Summary and Conclusion

5. SUMMARY AND CONCLUSION

Pineapple is a significant fruit crop among the several fruits grown in India. It is rich in Vitamins, minerals, dietary fibre and with less fat and cholesterol. It is a good source of peptic enzyme Bromelin. It is mostly consumed as dessert fruit and used in processing industry for the large scale production of value added products like jam, jelly, squash, concentrates, candy, pickle, *etc.*

Pineapple exhibited increasing demand around the world. Brazil, Thailand, Philippines, Costa Rica, China, India and Indonesia are the major pineapple producing countries. India ranked third in area under cultivation and sixth position in production. In India pineapple is the most common and popular fruit because it is available throughout the year. The major pineapple producing states are West Bengal, Kerala, Karnataka, and entire North-Eastern states. India exports pineapple to Saudi Arabia, UAE, Bahrain, Oman, Nepal, Maldives, Italy, *etc.*

In Kerala, about 69.72 thousand metric tonnes of pineapple were produced from an area of 8.22 thousand hectares with a productivity range of 8.49 t/ha (GOI, 2018). Among various districts of Kerala, Ernakulam is known for pineapple cultivation. Kerala is known for the best grade Mauritius pineapple. It is identified as the finest in quality, sugariness and has noble flavour hence the demand for fresh fruits not only confined to India but also in foreign market.

Ernakulam is the major pineapple producing district in the state. More than 60 per cent of area in pineapple cultivation was contributed by Ernakulam alone. It is mainly concentrated within and outside Vazhakulam (Pineapple city). From Vazhakulam the fruit is marketed to all the Southern and most of the Northern states of India and is identified as the biggest pineapple market in India. Value addition is done at different stages of marketing. Most of the processing industries of pineapple is located in and around Muvattupuzha. To study value chain assessment of pineapple in Ernakulam district very less research works has been tried. In the light of the above fact an enquiry into the

production, value chain and marketing aspects was taken up in Ernakulam district of Kerala with a given specific objectives,

1. To prepare the value chain map of Pineapple in Ernakulam district
2. To assess the value chain production system; evaluate their technical efficiency; to identify the institutional and infrastructural issues that affect the competitiveness. of the selected value chain
3. To propose interventions for upgrading the Pineapple value chain

5.1 Sampling procedure

The current study was centered on primary and secondary data. Through personal interview method the primary data related to the study were collected from farmers, traders, processors, transporters and consumers from January 2020 to March 2020. Two blocks with the highest pineapple production from Ernakulam district were selected for the study. Four Panchayats, two from each block having maximum area under pineapple cultivation were selected. From each of the selected Panchayat, twenty farmers were selected on random basis. In addition, data was collected from ten processors, five traders, five transporters and twenty consumers. The total sample size was 120.

5.2 Analytical technique

Percentage analysis, tabular analysis, growth rates were used to evaluate the performance of pineapple production. Commodity chain analysis was used to draw the value chain map of pineapple. Cost concept was used for estimating the cost, return and B:C ratio. Cobb-Douglas production function was employed to evaluate the resource productivity on pineapple farm. Marketing aspects like marketing channel, cost, efficiency, margin, producer's share in consumer's price were estimated. Data Envelopment Analysis (DEA), a non-parametric mathematical programming tool was used to work out efficiency measures like technical, scale, allocative and cost efficiency. To rank the constrains in production and marketing of pineapple, Garrett ranking method was employed.

5.3 Major findings of the study

- The socio-economic characteristics of the respondent farmers with respect to age, education, income status, income sources, land holdings, experience in farming, area under pineapple cultivation, organizational membership and credit sources were analysed. Majority of the farmers involved in pineapple farming fall under the age group between 51-60 years (51.25 %). Majority of the respondents with the education criterion Degree/diploma (52.5 per cent) were mostly interested in agriculture in the study area and nearly 88.75 per cent of the respondents earn an income of more than two lakh annually. Farm income alone formed the major source of the income, which accounted for 58.75 per cent and remaining respondents' dependent on both farm and business. Majority of the farmers had the large land holdings and more than 94 per cent of farmers were cultivated in leased land. It was observed that majority of famers were well experienced in pineapple farming, *i.e.* about 38.75 per cent of farmers were with the experience of 21 to 30 years. About 68.75 per cent of respondents' were members in Pineapple Farmers' Association and majority of the respondents' availed credit from cooperative banks.
- Triennium endings (TE) were drawn for pineapple area, production and productivity in India from 1989 to 2018. Growth rate for area (2.62), production (3.36) and productivity 0.72) were positive. This indicates that there has been a significant increase in area, production, productivity in India over the year. In Kerala, the growth level of pineapple area, production, productivity from 1995 to 2018 were considered. Growth rate for production (0.25) and productivity (0.86) were positive and area (-0.6) was negative. This indicates that, in Kerala there has been a decline in area and significant increase in the production and productivity over the year.
- Value chain mapping was done for pineapple in Ernakulam region using commodity chain analysis. The steps involved in the process were finding of main functions in the pineapple chain, identification of the value chain actors, finding of enablers/ facilitators in the chain and finally chain was mapped by considering above steps. Input provision, production, procurement, bulk supply, processing, selling and consumption were the principal functions in pineapple value chain. Input dealers, farmers, traders, exporters, processors,

wholesalers, vendors and consumers were identified as active players in the value chain process.

- Per hectare cost of cultivation of pineapple was calculated with their percentage to the total cost. Input cost experienced in first, second, third year was estimated to ₹ 500575ha^{-1}, ₹ 277742 ha^{-1} and ₹ 248178ha^{-1} respectively. During the first year, major share of the Cost A_1 was contributed by planting material. During second and third year lease amount contributed more toward Cost A_1. Net returns at Cost A_1 were found to be ₹ 243701, ₹ 341258 and ₹ 173662/ha.
- The average yield of pineapple per hectare for three years was 30323 kg, 25062 kg and 15791 kg respectively. The total returns obtained during first year was ₹ 822400 ha^{-1}. Total returns in the second and third year was ₹ 636191 ha^{-1} and ₹ 383474 ha^{-1} respectively. The net revenue at Cost A_1 was found to be ₹476105 ha^{-1}, ₹ 512729 ha^{-1} and ₹ 289576 ha^{-1} for first, second and third year respectively. The net returns at Cost C was estimated to ₹ 321825 ha^{-1}, ₹ 358449 ha^{-1} and ₹ 135296 ha^{-1} respectively. From the table It is clear that net returns obtained during second year was higher than the first and third year which was mainly due to decrease in input cost.
- Benefit- cost ratio was computed for Cost A_1, A_2, B and C. The highest B:C ratio was reported during the second year at Cost A_1 *i.e.* 5.15. B:C ratio was high at Cost A_1 in all the year which implies that more benefits can be obtained by restricting cost to the Cost A_1, *i.e.* by cultivating pineapple in the owned land than in the leased land.
- The regression was carried out for the variables such as land in hectares(X_1), human labour in man days(X_2), suckers in numbers(X_3), chemical fertilizers in kilograms(X_4) and hormones in litres(X_5). The coefficient of multiple determination (R^2) found to be 0.73. This specifies the 73 per cent of the deviation in pineapple output was due to the variation in the used resources. The sum of coefficient ($\sum b_i$) was 1.56 and significantly deviated from the unity revealing the operation of increasing returns to scale on pineapple cultivation in the study area.
- Efficiency measures such as technical, scale, allocative and cost efficiency for pineapple farming were estimated using DEA technique. The average technical efficiency from

pineapple farming found to be 0.73 (73%) which indicates the presence of significant inefficiencies in the production and still there exist an opportunity for yield gain through efficiency enhancement and mean scale efficiency score found to be 0.83 which means that pineapple farm operated at below optimal level. The average allocative efficiency worked out to 0.91, which implied that the returns from pineapple cultivation can be maximized by reorganization of resources and by enhancing the technical efficiency.

- The most preferred marketing channel identified for fresh pineapple was Producers – Traders - Wholesalers – Retailers – Consumers and for processed pineapple/ products was Producers – Processors – Distributors – Retailers – Consumers. Marketing cost incurred by traders, wholesalers/distributors and processor from these channel were ₹4, ₹4 and ₹ 20/kg respectively.
- Producer's share in consumer's price was relatively high in fresh fruit channel than in processed pineapple. The margin obtained by the retailer was ₹ 6 per kg of fruit and that of processed pineapple was ₹ 5 per kg. But price spread observed to be more for processed pineapple than the fresh pineapple.
- Marketing efficiency of fresh pineapple was 277 % and that of processed pineapple was 222 %. But when farmers follow the channel- Farmers – Retailers – Consumers, they can gain more profit, maximum possible producer's share in consumer's price and can increase their marketing efficiency (500%). The value added at trader point was more in pineapple fruit and in processed pineapple it was more at processor stage.
- The enhancing factors affecting competitiveness of pineapple value chain were institutional support, availability of inputs, market accessibility, technological services and government policies. Constraining factors influencing competitiveness of pineapple value chain were high establishment cost, labour shortage, lack of storage facility, lease land farming, lack of credit and market information. On other hand, many institutions and infrastructures approached to bring competitiveness in pineapple farming, distribution, marketing and consumption. Few among them were Pineapple Research Station, Kerala Agricultural University, Pineapple Farmers' Association, Kerala Pineapple Mission,

Vazhakulam Agro and Fruit Processing Company (NAPCL), Vegetable and Fruit Promotion Council Keralam (VFPCK).

- The constraints expressed by majority of the farmers in pineapple production were increased cost of planting material, non-availability of adequate rented labour, high labour cost, high rent, inadequate supply of water, low yield/ returns, and pest and disease attack. Major constraints identified in pineapple marketing were price fluctuation/ unstable market prices, high transportation cost, decrease in demand during winter, lack of grading facility, lack of value addition and non-availability of market information.
- The interventions were proposed by the farmers for the constraints identified in the study area at different levels such as production and output level, input supply, infrastructure, technical, marketing and few at government level. Introduction of new crop varieties, production technologies, market information sharing system, grading and value addition at farm level is required to maximize the producer's benefit.

Policy suggestions:

Based on the outcomes of the study, the required steps in the area of cultivation, processing and marketing of pineapple were drawn and offered as under:

1. Digital agricultural platform or Farmer Producer Organization (FPO) for marketing can be developed: This will eliminate intermediaries from the marketing system. It acts as a direct link between producers and consumers. This may serve the interest of the farmers in a better way.
2. Government tie-ups with processing companies (PPP) or processing models/schemes can be adopted to use excess quantity of fruits produced during the peak season: Excess quantity of fruits produced during the peak season can be used for processing so that large quantity of value added products can be produced which can be used for export and this will also help in price stabilization.

3. High density planting technology can be developed: Package of practices recommends 40000 plants per hectares. But farmers adopted 25000 plants per hectares, which itself posing a problem to take up intercultural operations in pineapple field. New and improved machinery or equipment's can be developed to adopt high density planting.
4. Large scale micro propagation/bioreactor technology can be developed to meet planting material requirement
5. Formulation of farmer favoured government policies: The major constraint found in marketing of pineapple was unstable prices which sometimes may lead to distress sale. Farmers are having neither storage facility nor processing. The investment for cold storage or processing unit is very high which is beyond the means of farmers. Hence suitable government policy should be formulated to provide credit facilities to take up investment/ Startups or government should come forward to provide these facilities.

PLATES

Plate 1: Pineapple Research Station, Vazhakulam

Plate 2: Vazhakulam Pineapple Market

Plate 3: Planting suckers

Plate 4 : Pineapple plants with fruits

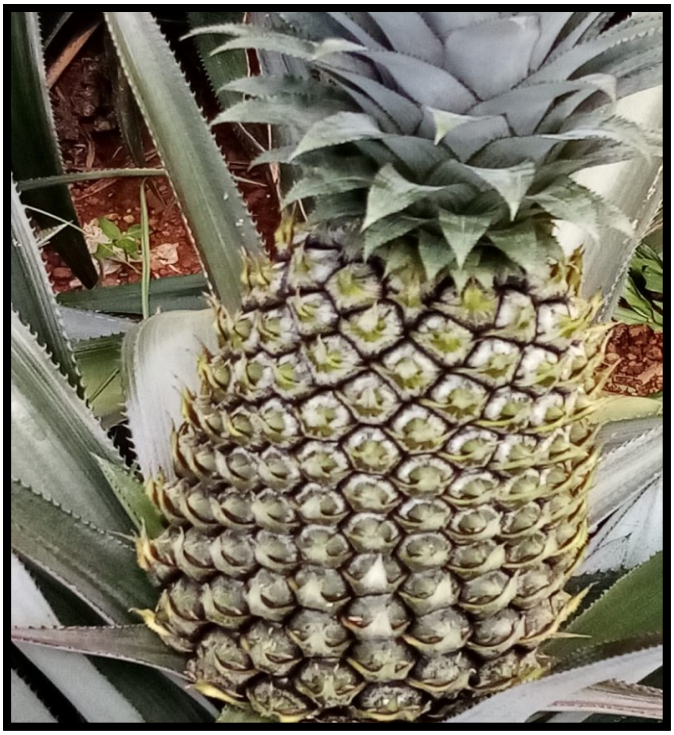


Plate 5 : Mauritius(Kannara) variety

Plate 6 : Grade A

Plate 7 : Grade B

Plate 8 : Grade C

Plate 9 : Weigh basket (50 kg)

Plate 10 : Transportation vehicle(5 tonnes capacity)

Plate 11 : Pineapple disposal at the market

Plate 12: Arranging pineapple (Crown downwards)

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Appendices

APPENDIX I

Survey Questionnaire for Farmers

Kerala Agricultural University

Value chain analysis of Pineapple in Ernakulam district

Schedule for Pineapple Farmers

Block: Panchayat: Date:

1. Socio-economic details of the farmer:

A. Name of the respondent:

B. Age :

C. Gender:

D. Address:

E. Contact number:

F. Educational qualification:

a) Below SSLC ☐ b) SSLC ☐ c) Plus Two ☐ d) Degree ☐

e) Post graduation ☐ f) Diploma ☐

Specify (If any other)……

G. Experience in farming(years):

H. Number of members in a family:

2. Income details:

A. Annual income

<50,000	50000-1 lakh	1 lakh- 1.5 lakh	1.5 lakh- 2 lakh	>2 lakh
☐	☐	☐	☐	☐

B. Source of income:

a) Farming alone ☐ b) Farming+ Business ☐ c) Farming+ Government job ☐ d) Farming+ Self employed ☐

b) Specify, if any other: _____

3. Land details:

Ownership status			**Total (Ha)**
Own land			
Leased-in			
Leased out			

Rental value of own land (leased out):

Rental value of leased-in land :

4. A. Crop details:

year	**Area (acres)**	**Number of suckers/ha**	**Quantity produced (tones/acre)**	**Yield/grade (%)**		
				A	**B**	**C**
1						
2						
3						

Other crops:

Pineapple as: a) Main crop ☐ b) Intercrop ☐

Other intercrop: if any,

B. Method of pineapple cultivation:

a) Organic ☐ b) By using chemicals ☐ c) Organic + Chemical ☐

d) Others ☐

5. <u>Input requirement details:</u>

A. Number of sucker required per acre:_____ and its price:_____

B. Sources of procurement of sucker: a) Own ☐ b) Fellow farmer ☐ c) Dealers ☐

d) Research station ☐ d) KVK ☐ e) Nursery ☐

C. Sources of irrigation:

I. a) Owned well ☐ b) Canal ☐ c) Rain water ☐ d) Bore well ☐

e) Others (specify) ☐

II. Availability of irrigation facility? a) Adequate ☐ b) Not adequate ☐

D. Other input required and its sources:

Sl. No.	Other inputs	Quantity	Unit price (₹)	Labour hours		Cost of labour/day
				Manual	Machine	
1	Land preparation					
2	Planting materials/ suckers					
3	Manures					

4	Fertilization					
5	Plant protection chemicals					
6.	Weedicides					
7	Hormones					
8	Irrigation					
9	Harvesting					
10	Others					

E. Whether you are getting any technical support? Yes ☐ / No ☐

If yes, details of support:

Sl. No.	**Name of the institution**	**Kind of support**
1	Pineapple farmers association	
2	KVK	
3	PRS(KAU)	
4	Government Institutions	
5	Farmer Producer Companies	
6	Others	

6. <u>Production details:</u>

Cultivation practice followed:

Sl. No.	Stages of pineapple cultivation	Name	Quantity	Price (₹)	Source
1	Land preparation				
2	Planting	Suckers			
3	Manuring	Compost/ FYM Fertilizers			
4	Irrigation				
5	Flower induction				
6	Plant protection				
7	Ratoon cropping				
8	Labour charges				

7. <u>Details of labour employed:</u>

A. Number of man days:

Rate/ day:

Rate/ day (skilled labour):

B. Availability of labour: a) More than adequate ☐ b) Adequate ☐ c) Less than adequate ☐

C. Skilled labour problem: Yes ☐ No ☐

D. Did you experienced any kind of loss due to: a) Pest and diseases ☐ b) Climate ☐

c). Government policy on pricing ☐ d) Labour shortage ☐

E. In case of pest and disease, specify the kind and cause of attack:

8. Yield obtained per acre:

Sl. No.		**Previous year**		**Current year**	
		Quantity	**Price/kg**	**Quantity**	**Price/kg**
1	Ripe fruit				
2	Unripe fruit				
3	Intercrop				

9. Post-harvest details:

A. Are you harvesting pineapple: a) With peduncle ☐ b) Without peduncle ☐
c) Mixed ☐

B. When will you harvest the pineapple?
a) When 25 % of the eyes get ripened ☐ b) When 50% of the eyes get ripened
c) When 75% of the eyes get ripened ☐

C. After the harvest, do you attempt any value addition to the pineapple?
a) Cleaning ☐ b) Sorting ☐ c) Grading ☐ d) All of the above ☐ e) Other ☐

D. Is that beneficial? How? What is the difference in price?

E. Are you applying any pretreatment (pre-harvest) to pineapple? Yes ☐ / No ☐
If yes, mention the chemical used for pretreatment:
Quantity: _____ Price: _____

F. Storing methods of the pineapple: a) Keeping the peduncle downwards ☐

Keeping the crown downwards ☐ c) Stacking ☐ d) Other modes ☐

G. Do you carry out the processing of pineapple at your level? Yes ☐ No ☐

a. If yes, what are they?

_____

b. If No, why?

_____

H. Problems face by you: a) Lack of infrastructure facility ☐ b) High processing cost ☐

c) Lack of technical knowledge ☐ d) Others ☐

I. What are the difficulties encountered in growing and selling pineapples?

10. Credit details:

a. Did you avail any loan, to undertake production? Yes ☐ No ☐

If yes, source:

Sl. No	Particulars	Amount	Period	Interest rate (%)
1	Financial institutions(Banks)			
2	Cooperatives			
3	SHG			
4	Money lenders			
5	Friends and relatives			
6	Others			

b. Are you a loan defaulter? Yes ☐ No ☐

11. Details of marketing:

Who are the buyers of pineapple?

Sl. No	Consumers	Quantity	Unit Price (in ₹)

1	Household consumption		
2	Individual consumer		
3	NAPCL		
4	Traders		
5	Processors		
6	Government/ Corporations		
7	Exporters		
8	Others		

12. Price details:

A. How do you fix the price for the quality pineapple you sell? a) Market price ☐

b) Supply ☐ c) Demand ☐ d) Considering all ☐ e) Cost incurred ☐

B. Unit price of pineapple (in ₹):

a) Ripe fruit:

b) Unripe fruit:

C. Whether the payment is made on spot: Yes ☐ No ☐

13. Whether the entire pineapple produced during the season is marketed? Yes ☐ No ☐

14. Whether you are getting the reasonable prices at all the levels? Yes ☐ / No ☐

15. What are the benefits from the GI registration?

_____

16. Which are the exclusive institutional support available in marketing of produce?

_____

17. Mode of transportation used for marketing of produce:

_____

18. Who will meet the cost of transportation:

Met by	Producer	Trader	Processors	Others
₹				

19. Are you satisfied while marketing the produce? Yes ☐ / No ☐

If no, why?

20. Are you a member of any association related to pineapple cultivation and marketing?

Yes ☐ / No ☐

If yes, specify the name(s)

21. What are the benefits you obtained being a member of such associations?

22. Suggestions to improve pineapple productivity:

a) At your farm:

b) In your region:

23. Rank the constraints faced in pineapple cultivation and marketing:

A. Pineapple cultivation :

Sl. No.	**Constraints**	**Rank**
1	Availability of adequate hired labour	
2	High cost of planting material	
3	High rent	
4	High labour cost	

5	Low yield/ returns	
6	Pest and disease attack	
7	Adequate supply of water	

B. Pineapple marketing

Sl. No.	**Constraints**	**Rank**
1	Price fluctuation/ Unstable market prices	
2	High transportation cost	
3	Decreasing demand	
4	Lack of grading facility	
5	Value addition	
6	Availability of market information	

APPENDIX II

Survey Questionnaire for Traders

Kerala Agricultural University

Value chain analysis of Pineapple in Ernakulam district

Schedule for Pineapple Traders

1. Name: Date:
2. Address and Ph. no. :
3. Market name:
4. No. of markets you are operating:
5. Are you single commodity trader: Yes ☐ No ☐
   If no, specify: _____
6. Varieties preferred:
7. Any variation in number of farmers year to year? Yes ☐ / No ☐
8. From where did you get the market information?

   _____
9. In which form, you are purchasing pineapple?
   a) Raw fruit ☐ b) Processed ☐
10. Do you facilitate contract farming? Yes ☐ / No ☐

    If yes:

Sl. No.	Particulars	No. of farmers	Amount / farmers
1	Financial assistance		
2	Suckers		
3	Fertilizer Pesticide		
4	Pesticides/ fungicides		
5	Growth hormones		

6	Transportation		
7	Other goodwill		

11. On what basis pineapple price is fixed?

_____

12. Do you undertake any value addition?

If yes, specify:

_____

13. What measures are taken at the time of price fall?

_____

14. Whether the supply of pineapple is adequate to meet the demand in the market?

Yes ☐ / No ☐

If no, _____

15. Mode of cash transaction:

Within what time period amount is paid to the farmers?

a) On spot ☐ b) One day ☐ c) Week ☐

16. Fruits are collected from :

Sl. No.	Particulars	Quantity	Price (in ₹)
1	Farmers		
2	Processors		
3	Others :		

17. To whom, you sell the produce?

Sl. No	Particulars	Quantity	Price (in ₹)
1	Processor		

2	Wholesalers		
3	Others :		

18. Rank important problems faced by you relate to procurement:

Sl.No.	Particulars	1	2	3	4	5
1	Lack of transportation facility					
2	High transportation cost					
3	Unavailability of labour					
4	High labour charges					
5	Others					

19. What do you do with the produce procured from farmers?

_____

20. Are you connected with retail outlet? Yes ☐ / No ☐

If yes, specify

_____

21.Who are the buyers of pineapple? a) Household ☐ b) Retailers ☐

c) Processors ☐ d) Wholesalers ☐

21. Which are the final markets for pineapple?

22. Do you have linkages with exporters? Yes ☐ / No ☐

If yes, to which country do you export? _____

23. Commission percentage:

24. Profit margin:

APPENDIX III

Survey Questionnaire for Processors

Kerala Agricultural University

Value chain analysis of Pineapple in Ernakulam district

Schedule for Pineapple Processors

Date:

1. Name of the respondent / processing unit:
2. Full address and Ph. no. :
3. Location of the unit:
4. Legal status: a) Registered ☐ b) Non registered ☐
5. Size of the unit: a) Small ☐ b) Medium ☐ c) Large ☐
6. Type of unit: a) Govt. ☐ b) Private ☐ c) Cooperative ☐
7. Do you process both pineapple and other fruits? If,
   specify_____
   Product line:_____
8. How long you have been engaged in pineapple processing? _____years
9. What are the different levels of processing that you are engaged?
   a) Making pineapple pulp ☐ b) Canning of pineapple ☐ c) Any other ☐
   _____
10. Are you getting adequate quantity of raw pineapple for processing? Yes: ☐
    No: ☐
    If yes, quantity: _____
    If no, why and what is the alternative?
    _____
    What is the shortage? _____

11. What are the prescribed specifications of fruit for processing?

_____

_____

12. How do you make payment for purchase?

a) Spot payment ☐ b) Credit ☐ c) Other (specify) ☐

13. Are you using any preservative? Yes ☐ No ☐

If yes, specifies the name, quantity and sources of supply:

14. Distribution channel of pineapple products:

Distribution channel	**Quantity**	**Price (₹)**	**Mode of receipt**	**Form of products: processed / semi processed**	**Place of sale**
Distributers					
Wholesalers					
Retailers					
Consumers					

15. Is it profitable? Yes ☐ No ☐

16. Price gap between the raw pineapple and processed pineapple:

17. Suggestions , if any to improve the value chain of pineapple:

_____

18. Constraints faced by processor:

APPENDIX IV

Survey Questionnaire for Transporters

Kerala Agricultural University

Value chain analysis of Pineapple in Ernakulam district

Schedule for Pineapple Transporters

1. Name: Date:
2. Ph. no. :
3. Address :
4. Kind of vehicle used: a) Rickshaw ☐ b) Tractor ☐ c) Truck ☐
5. Distance: a) Short ☐ b) Medium ☐ c) Long ☐
6. Maximum quantity carried:_____
7. Transportation charges collected:

Sl. No.	Particulars	Quantity	Price (₹)
1	Farmers		
2	Traders		
3	Processors		
4	Others (specify)		

8. Based on what criteria transportation cost is fixed?
   a) Distance ☐ b) Quantity ☐ c) Both ☐ d) Season ☐
9. List the problems faced by you during transportation:
10. Measures taken to avoid damage of fruit:
11. In case of damage to the produce, who will bear the loss?

APPENDIX V

Survey Questionnaire for Consumers

Kerala Agricultural University

Value chain analysis of Pineapple in Ernakulam district

Schedule for Consumers

1. Name of the respondent: Date:
2. Age :
3. Gender:
4. Address:
5. Educational qualification: a) Below SSLC ☐ b) SSLC ☐ c) Higher secondary ☐ d) Graduation ☐ e) Post graduation ☐ f) Other ☐
6. Occupation: a) Agriculture ☐ b) Govt. employee ☐ c) Business ☐ d) Others ☐
7. In what form you are consuming pineapple? Why?
   a) Semi processed
   b) Processed
   c) Raw pineapple
8. Which brand is preferred in case of processed pineapple?_____
9. Are you aware of Geographical Indication given to the Vazhakulam pineapple?
   Yes ☐ / No ☐
10. What attributes tempted you to consume pineapple?
    a) Taste ☐ b) Health benefits of pineapple ☐ c) No specific reason ☐
    d) Other (specify): ☐

11. Are you aware of variety of pineapple: a) Mauritius ☐ b) Kew ☐ c) Amrutha ☐ d) MD_2 ☐ e) Other (specify): ☐

12. Name of the variety preferred:

a) Mauritius ☐ b) Kew ☐ c) Other(specify) ☐

13. From where do you purchase pineapple and at what price?

Sources	Farm gate	Traders	Wholesalers	Retailers	Other sources
Quantity					
Price					
Frequency	Weekly ☐	Fortnightly ☐	Monthly ☐		

14. From where do you buy processed pineapple and at what price?

Sources	Processors	Wholesalers	Retailers	Bakeries	Other sources
Quantity					
Price					
Frequency	Weekly ☐	Fortnightly ☐	Monthly ☐		

15. How do you feel about the taste of raw pineapple?

a) Excellent ☐ b) Very good ☐ c) Good ☐ d) Moderate ☐ e) Not bad ☐ f) Bad ☐

16. How do you feel about the taste of processed pineapple products?

a) Excellent ☐ b) Very good ☐ c) Good ☐ d) Moderate ☐ e) Not bad ☐ f) Bad ☐

17. Most preferred value added product of pineapple: a) Jam ☐ b) Jelly ☐
    c) Squash ☐ d) Others ☐
18. Do you feel any difficulty in consuming pineapple?

    _____

19. Do you think the price of pineapple and its value added products is reasonable?
    a) Reasonable ☐ b) Not reasonable ☐
20. Has there been any increase or decrease in the consumption of pineapple its value added products?
    a) Increases ☐ b) Decreases ☐ c) No change ☐
21. How would you like to be informed about the new products?
    a) Advertisement ☐ b) Shopkeeper ☐ c) Friends and Relative ☐
    d) Exhibition and Demonstration ☐ e) Other ☐

22. Your opinion about the prices of the pineapple
23. Whether fruit is available throughout the year? Yes ☐ No ☐
24. Do you have any suggestion regarding the new product development/ product modification in existing products?

APPENDIX VI

Outlook to Pineapple marketing during Covid-19

Pandemic Covid-19 struck the pineapple growers in Kerala. The farmers who did farming on leased land with the help of bank loans faced a huge crisis as the supply chain closed and crops went waste. It was estimated that Kerala pineapple farmers stand to lose ₹ 300 cr.

James George, president of All Kerala Pineapple Farmers' Association stated the problems faced by the farmers in Kerala during Covid-19 outbreak. The peak season (March-April) for pineapple was shattered as most of the North Indian markets were closed for business and transportations were restricted. During this period in 2019, the price was hiked to ₹ 39-45/kg, but outbreak caused the price to fall below ₹ 10/kg due to delivery issue while the cost of production was at least ₹ 25/kg most of the times. The association has demanded the government to write off the interest on loans and restructure all the existing loans without interest up to two years. They also demanded a subsidy of ₹ 10 per kg for the fruit which was produced during this season and requested the land owners to reduce the lease amount and give more time to make the payments.

The Association of Agricultural Officers of Kerala and the Pineapple Farmers Association joined hands to launch a **"Pineapple Challenge"** to address the issue of large quantities of unsold harvest in the market through social media. The challenge had appealed to resident's associations, traders, voluntary bodies and other groups to place orders for the best quality on a minimum order of 100 kg at ₹ 20 per kg. This effort came as a big relief to farmers suffering from huge losses due to the nationwide lockdown. With this project around 500 tonnes of pineapple were managed to sell per day. This campaign received a good response from several organizations, so the Kerala Government decided to extend district's 'Pineapple Challenge' to entire state (The Hindu, 2020).

Outlook to Pineapple marketing during Covid-19

Government decides to extend district's 'Pineapple Challenge' to entire state

With trucks being stopped from taking loads to other states, pineapple farmers at Vazhakkulam are facing a huge crisis. However, to minimise damage, they have resorted to selling the fruit in retail | Albin Mathew

To boost exports, Kerala wants Central government to include pineapple in national crop export policy

The pineapples from Vazhakulam market have good demand in domestic and national market. (File Photo | EPS)

COVID-19 outbreak: Ahead of Vishu, Kerala farmers roll out Pineapple and Cucumber challenge

By: FE Online April 6, 2020 3:13:11 PM

COVID-19: Farmers in Kerala depending on State government to sell their produce during the lockdown

Kerala pineapple growers seek help as lockdown hits harvest

V Sajeev Kumar Updated on March 27, 2020

Corona-hit Kerala farmers go for 'pineapple-cucumber challenge'

Vandana Mohandas
APRIL 06, 2020 02:50 PM IST

Harvested pineapples being loaded to lorries at Moovattupuzha. The coronavirus lockdown has affected the year-long efforts of hapless farmers across the state who have been looking forward to Vishu, the harvest festival season, which is normally the most-anticipated sales time for them.

Easing of lockdown rules proves beneficial for Kerala's pineapple growers

Value chain analysis of Pineapple in Ernakulam district

By

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(2018-11-124)

THESIS

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Kerala Agricultural University

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ABSTRACT

Pineapple (*Ananus comosus*) is a fruit with excellent juiciness, exciting tropical flavour and enormous health benefits. It is a rich source of Vitamin A, B and C and also contains a large number of vital nutrients for human health with less fat and cholesterol. It can be used to produce a large number of value-added products like jam, jelly, squash, pickle, candy, *etc*., which not only provides remunerative prices for the farming community in a sustainable manner but also creates employment opportunities for the unemployed rural community.

The research work entitled "Value chain analysis of Pineapple in Ernakulam district" was undertaken to prepare the value chain map of Pineapple in Ernakulam district, to assess the value chain production system; evaluate their technical efficiency; to identify the institutional and infrastructural issues that affect the competitiveness of the selected value chain and to propose interventions for upgrading the Pineapple value chain.

The study area was confined to Ernakulam district of Kerala state, since it accounted for 60 per cent of the Pineapple production in the state. The sample respondents were selected from Avoli and Manjaloor Panchayats of Muvattupuzha block and Koothattukulam and Ramamangalm Panchayats of Pampakkuda block. Twenty Pineapple farmers were selected from each Panchayat at random. In addition, data was collected from ten processors, five traders, five transporters and twenty consumers using separate sets of pretested interview schedules by personal interview method. The total sample size was 120. The data analysis was done by value chain mapping (Commodity Chain Analysis), descriptive statistics, growth analysis, cost concepts, Production function analysis, Data Envelopment Analysis(DEA), marketing concepts (market cost, market margin, price spread, market efficiency), rank method and Garrett ranking technique.

The results of value chain mapping revealed that the major core processes included in the Pineapple value chain were input supply, production, collection, wholesaling, processing, retailing and consumption. The main actors who actively participated in the

value chain were input suppliers, pineapple farmers, traders, exporters, wholesalers, processors, retailers and consumers. The facilitators involved in the value chain were sucker dealers, Krishibhavans, transporters, Pineapple Research Station (PRS), Pineapple Farmers' Association (PFA), Pineapple Merchants' Association, Kerala Pineapple Mission and financial institutions.

Cost of cultivation for Mauritius variety was estimated for three years. The input cost estimated for first, second and third year was ₹ 500575, ₹ 277742 and ₹ 248188 ha^{-1} respectively. During the first year major share of the Cost A1 was contributed by planting material. During second and third year lease amount contributed more towards Cost A1. Net returns at Cost A_1 for first, second and third year were found to be ₹ 476105 ha^{-1}, ₹ 512729 ha^{-1} and ₹ 289576 ha^{-1} respectively. Second year reported higher net returns since variable cost like machine, planting material and manure cost were not considered as ratoon cropping system was followed. B:C ratio for Cost A_1, Cost A_2, Cost B and Cost C for three years were computed and it was found that Pineapple farming was profitable business in the study area and more profit can be earned by cultivating Pineapple in owned land than in leased land.

From Production function analysis, it was found that plant density significantly contributed towards the yield and increasing returns to scale (1.56) was observed for Pineapple farming in the district. Data envelopment analysis showed the efficiency of Pineapple farm with a mean technical efficiency of 0.73 in Ernakulam. Mean scale efficiency and allocative efficiency value of 0.83 and 0.91 was obtained respectively.

The marketing cost and marketing margin in fresh fruit and processed product channels were observed and found that traders and wholesalers incur maximum marketing cost in fresh Pineapple and processors in case of processed Pineapple. Traders and retailers earn more profit in fresh Pineapple whereas, processors in case of processed Pineapple channel. Producer share and marketing efficiency were found to be high for fresh Pineapple than the processed Pineapple. High cost of planting material and scarcity of hired labour were the major constraints in Pineapple production. Price fluctuation and decreasing

demand were the major constraints in Pineapple marketing. The interventions drawn to upgrade Pineapple value chain include: 1) Supply of subsidized inputs at the farm level 2) Good agricultural practices should be followed to produce cost effective and export quality Pineapple 3) Advanced and affordable technology should be made available to farmers for value addition activities 4) Market yards, storage facilities and processing plants should be established and 5) Commercialization of new and improved Pineapple products.

To conclude, the Pineapple value chain is lacking in horizontal and vertical integration among chain actors. The small producer-farmers are not able to reach the final market directly as they are dominated by the extended value chain actors and this situation made their position weak and helpless in the market with less bargaining power.