ECONOMIC ANALYSIS OF PRODUCTION, MARKETING AND PRICE BEHAVIOR OF TAPIOCA

By

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(2016-11-057)

THESIS

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KERALA, INDIA

2018

DECLARATION

I, hereby declare that the thesis entitled **"Economic analysis of production, marketing and price behavior of tapioca"** is a bonafide record of research done by me during the course of research and that it has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

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Introduction

1. INTRODUCTION

Tuber crops are one of the most important food crops of tropics. Root and tuber crops provide a significant part of the world's food supply, and are also a key source of animal feed and industrial products. On a global basis, approximately 45 per cent of root and tuber crop production is consumed as food, and the remaining used as animal feed or for industrial processing of products such as starch, distilled spirits, and a range of minor products. Among tuber crops tapioca is the largest source of carbohydrates and is the third-largest source of food carbohydrates in the tropics, after rice and maize.

Cassava (*Manihot esculenta* Crantz) commonly known as tapioca in India, is a staple food crop cultivated in several developing countries. It is a crop of food security as it contains high levels of carbohydrates. In India tapioca has been cultivated since mid 1870s. The crop has been introduced into India by the Portuguese when they landed in the Malabar region, presently the part of Kerala state during the 17th century, from Brazil (Edison *et.al.,*2005). Tapioca is consumed either directly as cooked tubers or as the products prepared from tapioca. Tapioca is mostly used for human consumption in the African continent and in the South America. By virtue of its diversified uses, it has become a commercial crop. Industrial utilization of tapioca is prominent in Thailand, Indonesia, Vietnam, and India in the form of starch, sago, dried chips, and flour.

GLOBAL SCENARIO

Among the tropical root and tuber crops, tapioca stands first in terms of area and production globally. It is staple food for people living in several tropical countries of South America and Africa, like Brazil, Nigeria and Ghana. Globally tapioca is grown in an area of 30.51 million hectare producing 277.1 million tonnes with a productivity of 10.95 tonnes per hectare. The share of different countries in global tapioca production as presented in Fig.1.1 showed that African countries contribute to more than half of the total world production of tapioca, followed by Asia, Latin America and Caribbean. Nigeria is the largest producer of tapioca with an overall production of 57.1 million tonnes followed by Thailand (31.1 million tonnes) and Brazil (21.1 million tonnes) (FAO 2016).

Among the tapioca growing countries Asian countries have the highest productivity which is more than the world average productivity. Indonesia, Thailand, Vietnam and India are the major countries growing tapioca in Asia. India plays a significant role in the world tapioca scenario due to its highest productivity in the world (27.92t/ha.) and is cultivated in an area of 240,000 ha producing 8.1 million tonnes.

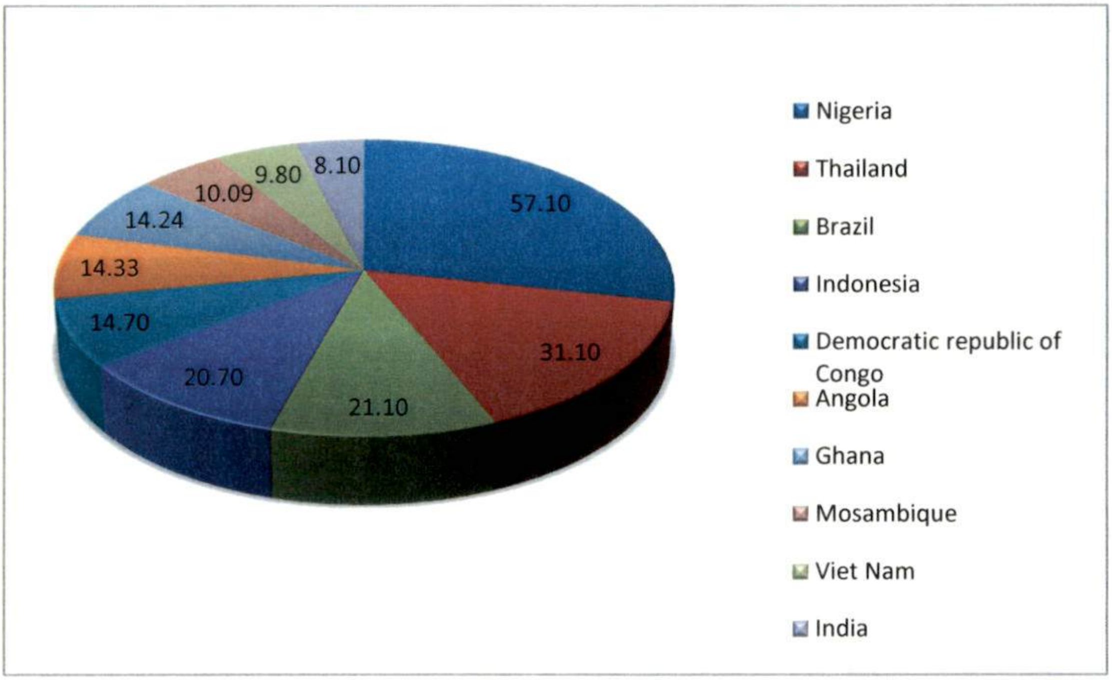


Figure 1.1 Share of different nations in global tapioca production (in million tonnes)

INDIAN SCENARIO

India is the tenth largest producer of tapioca with production of 8.10 million tonnes from an area of 2.17 lakh hectares. India acquires its significance in global tapioca economy due to highest productivity in the world (37.33 t/ha). In India, tapioca cultivation is mainly concentrated in Kerala, Tamil Nadu, Andhra Pradesh, Nagaland, Meghalaya, and Assam. Tamil Nadu has the largest area and production, followed by Kerala and Andhra Pradesh (Table I.1) In Tamil Nadu and Andhra Pradesh, tapioca is grown under open conditions whereas in Kerala more than 40 per cent of tapioca is grown as a mixed crop. In Tamil Nadu 40 percent of the tapioca is intercropped with short-duration crops like cowpea, black gram, groundnut and vegetables. The mixed cropping system practiced in these states provides the much needed additional income to the small and marginal farmers. Southern states have highest productivity owing to favourable climatic conditions.

Table 1.1 Area, production and productivity of tapioca in major producing states of India

States	**Area (000'ha)**	**Production (000' metric tonnes)**	**Productivity (tonnes/ha)**
Tamil Nadu	109.56	4205.82	38.38
Kerala	72.47	2637.20	36.39
Andhra Pradesh	16.45	329.02	20.00
Nagaland	6.00	50.00	8.33
Assam	4.48	38.31	8.55
Karnataka	1.00	12.90	12.90
Total (including others)	216.66	8076.00	37.33

Source: Agricultural statistics, 2015-16, Government of Kerala

The district wise area, production and productivity of tapioca as presented in Table.1.2 revealed that more than half of the area under tapioca in Kerala is concentrated in two districts *viz.*, Thiruvananthapuram and Kollam. Predominance of low yielding planting material, deficient rain fall, decreasing area and changing cropping patterns has brought down the production. However, one of the most distressing features of the tapioca economy of Kerala during the past two decades was the stagnant and slow movements in the prices of tapioca and reduced demand of the produce among people which affect its future prospects.

Table 1.2 District-wise area, production and productivity of tapioca

Districts	**Area (ha)**	**Production (000' metric tonnes)**	**Productivity (tonnes/ha)**
Thiruvananthapuram	23922	3925.10	16.40
Kollam	24065	5561.40	23.11
Pathanamthitta	7614	1862.65	24.46
Kottayam	7426	2241.30	30.18
Idukki	7806	2497.74	31.99
Malappuram	6947	1763.44	25384

Source: Agricultural Statistics, 2015-16, Government of Kerala

Though the area under tapioca and its production does not occupy an important position in the Indian agricultural economy, it is important in the two states where production is mainly concentrated viz., Kerala and Tamil Nadu. It is true that Kerala has tremendous progress in the research field of tuber crops but is not reflected in the area expansion and production. As a subsidiary crop of high calorific value and a source of starch in textile industries the crop assumes unique importance. Tapioca has a broad spectrum of diversified use. It is used as a staple food crop in many of the countries. However a significant part is transformed into animal feed and a considerable portion is used for industrial purpose and starch production. The starch extracted from tapioca tubers are mainly used in textile industry.

The area under tapioca in Kerala was showing a declining trend from the eighties which has resulted in stagnant production. Though the crop has tremendous potential in the food basket as well as in the industrial sector, farmers are shifting to other crops. In the above scenario, an understanding of the economics and marketing aspects of tapioca is very essential. This will help in proper planning which inturn makes production more attractive and profitable. A study on economics of production, marketing and price behaviour of tapioca would appear very significant in this context.

In the above background, the present study entitled "Economic analysis of production, marketing and price behavior of tapioca" was taken up with the following objectives

- To analyze the trend in area, production and productivity of tapioca in Kerala
- To study the price behaviour tapioca in major markets of Kerala
- To estimate costs and returns in tapioca cultivation
- To evaluate the resource use efficiency of tapioca production
- To study the marketing costs and margins

Scope of the study

Kerala occupied second position in both area and production of tapioca in the country for many years. However, the state is gradually losing its supremacy in tapioca economy of the country even though it has the highest productivity. Its share in area as well as production of tapioca in the country is declining over time and tapioca growers are going through a crisis situation due to the price fluctuations. The present study would help in identifying the reasons for declining area and production of tapioca in Kerala and help to put forth suggestions for enhancing production. This would also help to identify the factors contributing towards individual farm efficiency and suggest suitable policy for improving the efficiency.

Limitations of the study

The study was based on both primary and secondary data. Primary data is very important in social science perspective. Credibility of the data given by the respondent is very essential regard. Many of the farmers (sample respondents) does not have the habit of record keeping which makes the accuracy of data dependent on their memory so the collected data can be subjected to recall bias. Another limitation is regarding the secondary data. Secondary data collected from different sources may be different from each other and efforts were taken to choose the credible source among them. However efforts were made to minimize errors and make the available data as authenticate as possible.

Plan of thesis

The study entitled 'Economic analysis of production, marketing and price behavior of tapioca' has been presented in five chapters'. The First chapter deals with introduction, in which the statement of problem, objectives, scope and the limitations of the study. Second chapter includes the review of related literatures in the light of the present study. Third chapter describes 'materials and methods adopted for conducting the present study. The results and discussion are presented in the fourth chapter and fifth chapter includes summary and conclusion followed by 'reference, abstracts and appendices.'

Review of literature

2. REVIEW OF LITERATURE

A comprehensive review of literature will be able to provide a background to understand the research problem. In this chapter few past studies have been reviewed and discussed which are important in the context of present study. The review is presented in four sections as follows.

2.1 Trend and growth rate in area, production and productivity

2.2 Price behaviour

2.3 Economics of production.

2.4 Marketing channels and price spread

2.5 Constraints in production and marketing

2.1 TREND AND GROWTH RATE IN AREA, PRODUCTION AND PRODUCTIVITY

Chatterji (1966) examined the agricultural growth in India during 1950-1963, and he opined that the most appropriate tool to measure agricultural growth is linear trend fitting. This method would overcome any effect due to seasonal and cyclical variation. He estimated the growth rates of important cereals, pulses and non-food crops using linear model.

Dandekar (1980) found that it is more suitable to use log linear forms over the linear form while working out the compound growth rates for the series of agricultural production as a whole. In their effort to examine the trends in area, production and productivity of sugarcane in Uttar Pradesh during the period 1950-51 to 1974-75 Lal and Singh (1981) found that the area. Production, productivity of sugarcane in different regions increased significantly.

Kannan and Pushpangathan (1988) in the study on agricultural performance in Kerala during the year 1962-63 to 1985-86 used kinked exponential function and second degree exponential function to find out the growth rates of area , production and productivity of important crops in Kerala. They found that agriculture production in Kerala during the period of study showed stagnation

Elsamma and Asan (1989) in a study on analysis of changes in area, production, productivity of cassava in Kerala found that the total volume of change in cassava area and production between 1975-76 to 1986-87 for the state amounted to a reduction to the extent of about 41 per cent and 39 per cent respectively while productivity shoot up by 3.51 per cent. Trends showed that the area production declined but the productivity has been on increase.

Thomas *et al.,* (1991) analysed the performance of tapioca in Kerala during the period 1960-61 to 1986-87. Trend in area, production, and productivity and output response behaviour of tapioca in the state were examined. Semi logarithmic model of the form log Y = a + bt was used for estimating trends in area, production and productivity. The analysis was carried out by fitting semi logarithmic functions to the index numbers of the area, production and productivity for the entire period. The entire period of 27 years was divided into three phases viz. from 1960-61 to 1969-70, from 1970-71 to 1979-80 and from 1980-81 to 1986-87 and function was fitted to study inter decadal growth. From the results obtained, it was interpreted that acreage under tapioca during 1960-61 to 1986-87 showed a declining trend. But the positive growth rate of productivity had offset the negative impact of area. The results indicated that moderately high growth rate of area, production and yield took place during sixties. Trend analysis for the period of eighties revealed that the effect of technology had very little impact on production.

Biradar and Annamalai (1992) estimated the pattern of trend in area, production and productivity of sweet potato in different states of India from 1966-67 to 1977-78. They used exponential function of Y= ab^t to fit the time series data to find compound growth rates of area, production and productivity. The results of their study revealed that there was an increase in area, production and productivity of the crop by 15.3, 22.5, 6.4 percent respectively between the years.

Jeromi and Ramanathan (1993) made an attempt to examine the growth and instability of world pepper market during the period 1975 to 1990 and the export performance of Indian pepper with respect to growth, direction, competitive position and terms of trade. The study found that during the first half of eighties India's export performance has substantially improved but it has declined since 1987-88. India's export direction showed that the share of market economies has declined over the year.

The compound growth rate in area, production and productivity of pepper for the period from 1956-57 to 1989-90 was examined by Babu et al. (1996) by fitting the functions of the type $Y=AB^t$. The results revealed that over the years, pepper area increased by 0.97 per cent and production by 0.92 per cent per annum where as the productivity declined by 0.07 per cent per annum. Variability analysis revealed that growth in pepper production was accompanied by instability in production caused by instability in both area and productivity.

Grover *et al.* (1996) in their study to find the performance of agro processing industries in Haryana state during the period 1966-67 to 1994-95, opined that the compound growth rates of production, employment and capital has been significantly increased in most of the agro-industries.

An attempt was made by Shende *et al.,* (1998) to examine the trend in production export and import of rice in the country. In their study the compound growth rates were calculated for production, quantity, values of export and import with respect to India and world by fitting exponential function. When they compared the rice production in India with world they found that it was almost same and highly significant at one per cent level.

Divya (2003) made an attempt to analyse the market behaviour of important spices of Kerala. The growth rates were worked out using different growth models during 1971-2000. The results revealed that there was a significant and positive growth in area, production and productivity of pepper and ginger. But in the case of cardamom and turmeric, growth in production and productivity was significant and positive while in area it was negative though insignificant.

Srinivas (2005) in his study on cassava marketing system in India emphasized that in Kerala, area under the crop is declining year after year as the importance of cassava in the food basket of the people of Kerala has been declining. It is the need of the hour on the part of the State Govt. to encourage potential entrepreneurs and industrialists to start industries to produce diverse value added products from cassava.

Edison *et.al.,* (2006) in their study to analyse the status of cassava in India, categorized the entire period of study (1967-68 to 2001-02) into five phases (Phase I- 1967-68 to 1976-77, Phase II- 1976-77 to 1985-86 , Phase III-1985-86 to 1996-97, Phase IV- 1996-97 to 2001-02 and Phase V- 1967-68 to 2001-02) based on the values of coefficient of determination of the exponential trend lines. The study revealed that there was a positive significant growth rate per cent for area, production and productivity of cassava during the first period. The area showed a significant negative growth rate per cent during second and third period, which resulted in negative growth rate for the entire study period and it was found to be -0.78 per cent. The production and productivity remained positive throughout the period.

In their report on commodity profile of tapioca, Thomas *et.al.*, (2015) revealed that area under tapioca in India was showing a decreasing trend from TE 1982-83 to TE 2013-14. The triennium averages of area decreased from 3.15 lakh hectares in TE 1982-83 to 2.2 lakh ha in TE 2013-14, while the production increased by about 25 lakh tonnes. The productivity in the country increased from 17443 kg per hectare in TE 1982-83 to 36400 kg per hectare TE 2013-14. They also reported that the reduction in area in India was mainly attributed to reduction in area under tapioca in Kerala, because the share of Kerala state in area under tapioca has declined from about 57 per cent to 33 per cent between TE 1992-93 and TE 2013-14.

2.2 PRICE BEHAVIOUR

Kahlon and Tyaagi (1953) reported that agriculture prices have a tendency to display wider inter-year and intra year fluctuations. They also revealed that these price fluctuations of agricultural commodities are more than proportionate to the change in the agricultural production.

Kulkarni (1963) studied the relationship between market arrivals and price of groundnut in three regulated markets of Maharashtra from September 1949 to August 1959.They had analysed the weekly price data and the results revealed that the per cent rate of marketing in the "rapid marketing period" had a positive relationship with "price prospects" so that when the price prospects were favourable, the produce was marketed at more than usual rapid rate.

In an attempt to study the price behaviour using the tools of classical time series analysis Croxton et al.,(1979); and Enders, (1995), assumed that it is possible to decompose any time series into four components viz., trend, seasonal, cyclical and irregular components.

Baharumshah and Habibullah (1994) employed the cointegration technique to analyse the long run relationship between weekly pepper prices in six different markets in Malaysia for the period 1986-91. The empirical findings of the study indicated that regional pepper markets in Malaysia were highly co-integrated and the price of pepper, tended to move uniformly across spatial markets indicating competitive pricing behaviour.

Srinivas (2005) analysed the nature of trend in prices of tapioca and tapioca products. The prices of tapioca starch and sago were deseasonalised separately in order to remove the short period seasonal effects. Separate regression analysis was carried out to examine the influence of starch and sago prices on the price of tapioca and the results showed that the prices of starch and sago were influencing the price of tapioca.

Babu *et al.*, (2009) studied secular trend, seasonal, cyclical and irregular components in the prices of coconut and coconut products like copra and coconut oil in India using the techniques of classical time series analysis.. The prices showed an increasing secular trend and there were visible seasonal variations. It was found that the wide spread irregular fluctuations in prices resulted in higher price fluctuations. The domestic prices of copra and coconut oil were found to be higher than the corresponding international prices and were well integrated among themselves and with the international markets.

In their attempt to study the price behavior of black pepper using time series approach Jayasree *et al.*, (2011) found that the prices of black pepper did not exhibit any specific trend where as it showed pronounced cyclical as well as random variations in the domestic market. The trend analysis was carried out using the Ordinary Least Squares method, ratio to moving average and residue methods were used to compute the seasonal index and cyclical components respectively.

In her study on price behaviour of turmeric Jyothi (2011) found that the monthly average price of turmeric in Kochi, Nizamabad and Erode were cointegrated.

She used ADF unit root test to test the stationarity of price of turmeric, and Johansen's multiple cointegration analysis was used to estimate the cointegration between the markets.

Jayasree (2012) analyzed the price behaviour of cassava in Kerala during the period from January 1999 to June 2011and estimated that the growth in cassava prices was slow, but with high instability of 36.97%. There were random effects in the price-but it oscillated more or less evenly around the mean value of 100, indicating that random factors were evenly occurring in cassava trading. She also reported that the shelf life of cassava tubers is too short, product development and diversification through processing and value addition is suggested to overcome the adverse seasonal and cyclical price movements

Mvodo and Liang (2012) studied production and marketing factors affecting the price of cassava. The study using multivariate regression analysis reported that the size of the farm, the availability and adoption of improved planting material play critical role in the root production

Borkar (2015) in her study on "Modeling and forecasting time series data of coconut production in India", examined the yearly coconut production for a period from 1950-51 to 2012-13. Autocorrelation and partial autocorrelation functions were computed for the data and the Box Jenkins ARIMA methodology has been used for forecasting. ARIMA (1,0,0) was found to be appropriate for coconut production forecasting for seven leading years.

Bhawani *et al.* (2016) after analyzing the trend, seasonal, cyclical and irregular variations in prices of chillies found an increasing trend which was also found to be statistically significant at five per cent level. The highest seasonal index was computed for the month of December (108.52), while the lowest seasonal index of 95.52 was recorded for February. Only one cycle which had lasted for four years was observed for prices of black pepper. It was also reported that the irregular fluctuations did not exhibit any definite periodicity in recurrence.

2.3 ECONOMICS OF PRODUCTION

In their study on economics of sweet potato cultivation in three districts of Kerala (Palakkad, Malappuram and Kasargode) Pal and Ramanathan (1989) opined that the cost of cultivation in Palakkad and Malappuram was Rs. 5500 per hectare where it was around 6700 per hectare in Kasargode due to the application of higher quantity of manures and fertilizers as compared to other districts. Average tuber yield in Kasargode was around 13 tonnnes as against 11 tonnes per hectare in Palakkad and Malappuram. The cost of production of tuber per kilogram in the three districts was estimated to be 50-51 paise per kilogram.

Sheela and Kunju (1990) in a study on economics of cassava based intercropping system, opined that though the inter crops reduced the yield of cassava, inter cropping at high nutrient level is less economical than the pure crop of cassava.

Sairam *et al.* (1998) compared the cost of cultivation of coconut based on the study conducted in Kasargode district under rain fed and irrigated cultivation at different growth stages of the crop with respect to three holding size classes such as marginal, small and large farmers. They reported that the total cost under irrigation was almost double to that under rain fed and the difference is because of labour charge including family labour rather than other cost components which accounts for about 60 to 70 per cent of total cost in all the stages of cultivation.

In a study on the cost-benefit analysis of cassava in southern zone of Kerala, Elsamma and Asan (1991) reported that the net return per hectare was more for small holdings having size upto 50 cents. Input productivity analysis showed constant returns to scale and labour was found to be the most significant factor influencing cassava production.

Singh *et al.*(1991) in a study on economic analysis of potato cultivation in Jaunpur district of Uttar Pradesh found that the farmers operating at higher levels of technology obtained higher levels of returns over variable cost.

Pal et al. (1992) in their study on cost of cultivation of cassava in Kerala, worked out the average cultivation cost to Rs, 5500 per hectare for the local varieties. When high yielding varieties were grown by following recommended practices, an additional cost of Rs.2180 per hectare was incurred.

In a study on economics of sweet potato cultivation in low land areas and in upland area Anantharaman *et al.,* (1993), found that in low land the yield of sweet potato was more than double the average yield of sweet potato in uplands. The efficiency of production in low land area was 3.03 against 1.40 in the up land.

Sheena (1997) conducted a study on economics of production and marketing of tuber crops in Palakkad district and she used different cost concepts to work out the cost of cultivation of different tubers like coleus, sweet potato and Tapioca. Total cost C_3 was found to be 14031 rupees per hectare in aggregate level. Cost on other items accounted for the highest share in coat A_1 followed by labour cost and material cost. She also opined that the high cost of cultivation was due to higher expenditure on labour which accounted for 58 per cent and 66 per cent for high yielding varieties and local varieties respectively. The resource use efficiency was estimated by fitting cobb- Douglas production function and labour and farmyard manure were found to be significantly contributing towards the yield.

Korikanthimath (2000) analyzed the performance and economics of replanting of small cardamom at Chattily in Kodagu District of Karnataka and found that an average yield of 749 kg/ ha of dry cardamom was obtained during five crop seasons, which was 5.35 times higher than the national average of 140 kg/ ha. It was found that the highest yield of 1775 kg/ha of dry cardamom was recorded during the second year after replanting. Out of 869.8 labour days required per hectare per year during the bearing period, the requirement for women labourers was higher. It was found that 57.8 per cent of the labour requirement was for picking only. In the total cost of cultivation, maximum share (69.45 per cent; Rs. 57,230.80/ha) was incurred for labour charges. A net income of Rs. 1,96,986.20/ha (average of five crop seasons) was obtained at a production cost of Rs. 130.97/kg of dry cardamom. The undiscounted measure of PBP was estimated as 2.15 years while the discounted cash flow measures namely, NPW and BCR were estimated as Rs.5,09,296.45 and 2.78 respectively, which clearly indicated that replanting of cardamom was an economically viable and financially feasible proposition.

In an attempt to study cost-benefit analysis of rainfed coconut cultivation using the annuity value approach Remold (2000), reported an annuity value (at 13 per cent) of Rs.28, 469 while the BCR was worked out as 1.02.

Varghese (2007) studied the economics of cardamom cultivation in Kerala, reported that the small sized farms incurred high cost of production per unit cost as compared to medium and large sized farms. This was mainly owing to the fact that small size cultivators were applying more manure and cow dung, but they obtained low yield per acre. He also suggested that government should provide a special package to support the small and marginal cardamom farmers who were continuing to cultivate the crop purely for survival.

Odomenem and Otanwa (2011) undertook a study to analyse the economics of cassava production in Benue state. The cost and return analyse reported that there is a significant cause-effect relationship between profit and the explanatory variables suggesting that as the cost of labour increases profit of the respondents decreases.

Thomas *et.al.,* (2015) in their report on commodity profile of tapioca revealed that the cost of cultivation per hectare of tapioca was doubled during the ten year period from TE 2003-04 to TE 2013-14. The major component in the cost of cultivation for tapioca was hired human labour which accounted for about 56 to 59 per cent of the total cost. The operational expenses were Rupees 57,793 in TE 2013-14.

Prashantha (2016) analysed the cost of cultivation of arecanut in Malnad and non-Malnad regions of Karnataka. The comparative study reveals that the cost of cultivation is relatively more in Malnad area than in non-Malnad area because of the high cost involved in ground preparation for plantations and expensive land levelling operations. In addition to the cost of cultivation, it was found that maintenance cost, harvesting and post-harvest expenses, storage, transportation and marketing cost were also higher in Malnad areas compared to non- Malnad area.

2.4 MARKETING CHANNELS AND PRICE SPREAD

In her study on market trend in cassava Lakshmi (1978) estimated the trend in long run and seasonal fluctuations in price of cassava. It was revealed in the study that the price was stable due to constant and stable agricultural prduction. It was also identified that the growth rates were substantially higher in all the districts.

Ojha *et. al.,* (1983) in their attempt to study the role of middleman in agricultural marketing found that the major share paid by the consumers was taken away by the middle man and the producer got only a very lower share of the price. Out of the money paid by the consumers for rice and wheat, the middle man's share accunted to 33.2 per cent and 31.5 per cent respectively. The study also revealed that most of the farmers were selling their produce through traditional means of commission agents.

To understand the interaction among prices in the spatially separated markets, market integration is used and is defined as market in which prices of products behave independantly (Monke and Petzel, 1984). A market is said to be integrated, if all the market functionaries are satisfied for their produce purchased,

Sindhu (1988) conducted a study on new thrusts in agricultural marketing in Punjab. It was found that there should be sufficient market infrastructure, proper government policies and a sound network of input supply system for marketing of agricultural commodities. The study also revealed that around 30 per cent of fruits and vegetables productin were lost due to lack of cold storage and processing facilities.

Lakshmi and Pal (1989) in their effort to study the marketed surplus and utilization pattern of cassava in Trivandrum district it was found that consumption of cassava per capita per day was different in urban (0.17 Kg) and rural areas (0.52 Kg). Fresh tubers of cassava were generally consumed and the surplus was sold in the market for Rs, 1.30 per kilogram. Some of the rural farmers converted the surplus quantity of cassava to chips.

Lakshmi and Pal (1990) conducted a study for the estimation of marketed surplus and utilization patterns of marketed surplus and the utilization patterns of cassava in three villages of Kerala viz., Perumpazhuthur, Sreekaryam., Kundara and Neyyatinkara municipal and corporation limits of Trivandrum. It was reported that per capita consumption of cassava per day per house hold were more in rural area than urban area. Fresh cassava tubers were cooked and consumed and the surplus was sold in the local markets with a retail price ranging from Rs. 1 to Rs. 1.75 per kilogram. It was also found that 70 per cent of the rural households consumed cassava in a daily basis where as in urban areas it was included in the diet once or twice a week.

In their effort to examine marketing cost, marketing margin and price spread of green and dry ginger in Himachal Pradesh revealed that by encouraging group sales through producer's cooperatives net price for producers could be ensured. It was also reported that, by increasing the competition in wholesaler's level the high margin derived by the wholesalers can be reduced

Lakshmi (1991) in her study on evaluation of marketed surplus and utilization patterns of cassava in four villages of Thiruvananthapuram district and five villages of Kollam district reported that marketed surplus from fresh tuber of cassava from Thiruvananthapuram district was 6.2 tonnes per hectare and that of Kollam district was 3.96 tonnes per hectare. In both the districts households which depends on agriculture consumed more cassava per day.

Haridose and Chandran (1996) worked out the marketing costs, margins, price spread, effect of variation in the consumer's price on the share of the producers and the retailer and the efficiency of the marketing channels of coconut. Further, they identified problems confronted in the marketing of coconut by using Garrett's Ranking Technique. The results of the study showed that the producer's share in the retailer's net price of Rs 3,015 per 1000 coconuts was Rs 2,440. The producer's share in retailer's net price was 80.93 per cent. The marketing margin and marketing efficiency of coconut were found to be Rs 170 per 1000 coconuts and 4.24 respectively. The major problems identified in marketing of coconut include the lack of finance, poor transportation facilities and deficient storage facility.

Sheena (1997) studied the economics of production and marketing of tuber crops in Palakkad district and found that marketing of tubers in that area was mainly through village traders. Marketing efficiency was worked out using marketing costs and margins and the results revealed that the highest market efficiency index was for tapioca, as the margins realized by the market intermediaries was lesser in the case of tapioca.

Acharya and Agarwal (1987) defined agricultural marketing as a process, which starts with a delusion to produce a saleable farm commodity and it involves all the aspects of marketing structure or system both functional and institutional, based on technical and economic considerations, and includes pre and post- harvest operation, assembling, grading, storage, transportation and distribution.

Obasi and Majeha (2007) analyzed the determinants of performance of tapioca products marketing in South Eastern Nigeria. Data were analyzed using ordinary least square models. This study revealed that all the markets were relatively efficient in terms of monetary input and output ratios. They also reported that socio economic and marketing facilities should be improved upon to reduce costs and enhance efficiency.

Mahesh *et al.*, (2011) in their study on innovative payment options in agricultural marketing reported that limited access to market information, low literacy level among farmers and multiple channels of distribution were detrimental to both farmers and consumers. Farmers in turn, at the end of transaction do not get correct payment for their produce and there were illegal deductions, unauthorized commission charges, delayed payment as well as payment in long term instalments even running up to next season, and unauthorized deductions in the weight of the produce while making payments to farmers. An e-tendering model with online mode of payment that would help the farmers in receiving full and prompt payment for their produce was also recommended.

Rangasamy (2011) in his study to understand various aspects of investment in agricultural marketing, market-related infrastructure and agricultural marketing system in Kerala reported that, the investment in agricultural marketing infrastructure in Kerala was very low due to lack of APMC act, reduced exports, lack of public-private subsidy schemes, ineffective state government policies, less involvement in marketing by farmers and increased involvement by traders, poor management of local self-government markets, less market development activities, lack of awareness about central government subsidy, strong trade unionism and labour problems. It was also reported that, investment in agricultural marketing infrastructure in Kerala was influenced to a large extent by processing and value addition.

Emeka and Ugwu (2014) studied the profitability of cassava production and marketing in Ondo state of Nigeria. The analysis was carried out using descriptive statistics and profitability model. It was reported that the production and marketing of cassava was profitable with every one unit invested was a return of 2.97 units.

Hameedu (2014) conducted a study on the supply chain of cardamom in Kerala and reported that the farmers were not conscious about the quality of the product and marginal farmers were selling their produce, without sorting or drying to the local traders who gave them a reasonable price. The main problem in cardamom cultivation in Kerala was the absence of grading system at the producers' level. It was also found that the marginal farmers and traders were not having access to market information.

Ekpa *et.al.*,(2016) in their study on analysis of processing, marketing channels and profitability determinants of selected cassava products in Kogi state of Nigeria reported that processing and marketing activities of cassava products are prominent and profitable in the study area. They also reported that by boosting the capital base of sample respondents they can use modern processing and packaging techniques.

2.5 CONSTRAINTS IN PRODUCTION AND MARKETING

Akinnagbe (2010) conducted a study to ascertain the constraints and strategies towards improving cassava production and processing in Enugu north agricultural zone of Enugu State, Nigeria. The results showed that limited processing option, instability in government policy, difficulties of harvesting during dry season, lack of adequate technical knowledge of modern processing technique and poor access road for transportation of farm procedure and lack of finance, difficulties in obtaining credit facility, lack of collateral required to secure loan, high cost of inorganic fertilizer, high cost of agro chemicals, lack of modern processing equipment and high cost of processing were the major constraints.

Rani and Murugan (2010) conducted a study on Constraint analysis of Cassava growers and strategies for increasing production and productivity in Salem, Tamil Nadu. It was revealed from the study that, among the several constraints marketing constraints like exploitation by middle man, malpractices in Point scale fixation, lack of regulated market, low price for tubers due to fluctuations in price followed by production constraints like mosaic and tuber rot diseases, labour scarcity, un availability of quality planting materials, and lack of short duration varieties were the major constraints expressed by many of the cassava growers.

Bonsu *et.al.,(*2012) analysed the constraints and their Effects on the marketing of cassava by farmers in the Ajumaku-Enyan-Essiam District of Ghana. Simple descriptive statistics like percentages, rank score, Kendall's coefficient of concordance test and student's t-test were used in the analysis. The results show that farmers mostly sell their products to urban wholesalers, urban retailers, rural retailers and consumers, respectively. It was also found that the difficulty in harvesting during the dry season, followed by inappropriate sales measurement, bad road network and the absence of government support for cassava marketing were the major production and marketing constraints of cassava.

In their study to analyse constraints and opportunities of the Tamil Nadu industrial cassava value chain and market, Linder *et. al.,* (2017) reported that lack of regulation facilitates and severe price fluctuations along the value chain, especially for farm-gate tuber prices are the major constraints in cassava marketing. They had also reported that this price volatility impacts market demand, profitability at the producer level, and results in market structure shifts and transformation.

The literature reviewed above pertaining to different aspects is immensely useful to pursue the present research investigation. A thorough review of the earlier studies helps the researcher to employ various tools to conduct his/her study.

Methodology

3. METHODOLOGY

The methodology provides a way to endorse and understand the methods to be used when the research is to be undertaken. The present study on the "Economic analysis of production, marketing and price behaviour of tapioca" aims to examine the trend in area, production and productivity of tapioca in Kerala, study the price behaviour, estimate the costs and returns in tapioca cultivation, evaluate resource use efficiency, study the marketing cost, margins and price spread and to analyze the constraints in production and marketing This chapter gives a better understanding of how the research was performed and includes the types of data collected, tools used in the analysis of data as well as the different approaches used in the study.

3.1 TYPES OF DATA

The study is based on both Primary and secondary data. The time series data on area, production and productivity of tapioca in Kerala and India for a period of 1950-51 to 2016-17 were collected to study their trend. Monthly average prices of tapioca in various markets of Kerala were collected to evaluate the trend and price behaviour of tapioca over the period 2002 January to 2018 July. Primary data was collected from 120 selected farmers using pretested interview schedule by personal interview method.

3.2 SOURCES OF DATA

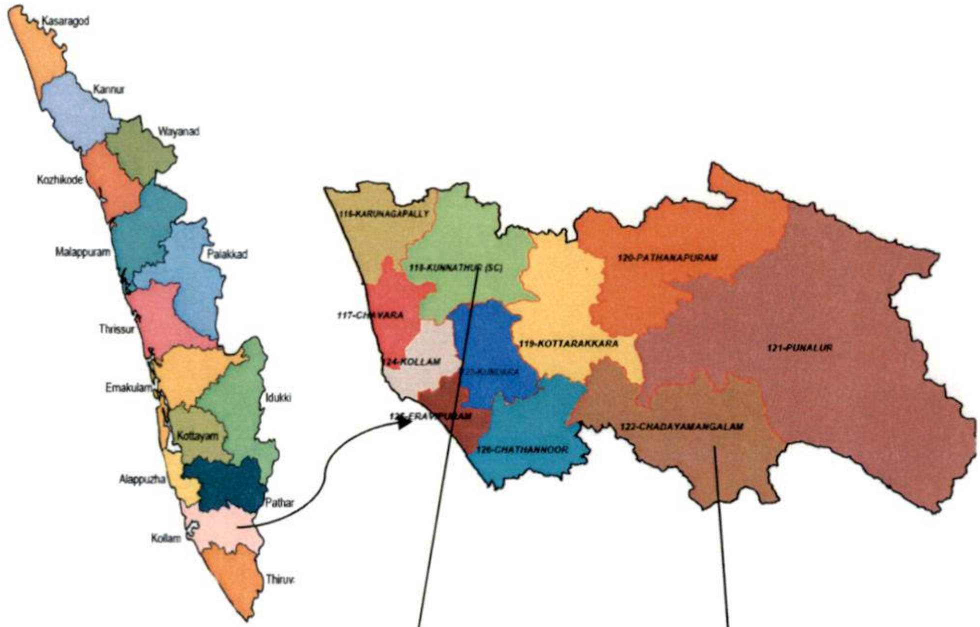
The time series data on area, production and productivity of tapioca in the major tapioca producing states in India and the major tapioca producing districts of Kerala from 1950 to 2017 were collected from various issues of Agricultural Statistics and Statistics for planning published by the Directorate of Economics and Statistics, Thiruvananthapuram. The monthly price data of tapioca in major domestic markets of Kerala were collected from Vegetable and Fruit Promotion Council Keralam (VFPCK). The main items of observation such as socio-economic features of the sample farmers, costs and returns of tapioca cultivation, marketing channels, marketing costs, marketing margin, and socio-economic constraints in production and marketing were collected from the selected farmers and market intermediaries.

3.3 PERIOD OF STUDY

Data pertaining to area, production, productivity and price of tapioca in Kerala were collected for the period from 1950 to 2017. The primary data collection was carried out during the period from February 2017 to March 2018.

3.4 AREA OF STUDY

Kerala holds the key position in tapioca cultivation where it is widely grown as a food crop. Hence, the trend and growth rate analysis were done considering the state as a whole. Kozhikode, Ernakulum and Chalai markets were selected for the study on price behavior of tapioca Two districts representing the southern (Kollam) and northern (Malappuram) part of Kerala were selected for primary data collection on economics of production, marketing channels and constraints. The details of the selected districts, Kollam and Malappuram are presented in the following section.



Sasthamcotta block

Sooranadu south Panchayat

Poruvazhy Panchayat

Chadayamangalam Block

Chadayamangalam Panchayat

Elamad Panchayat

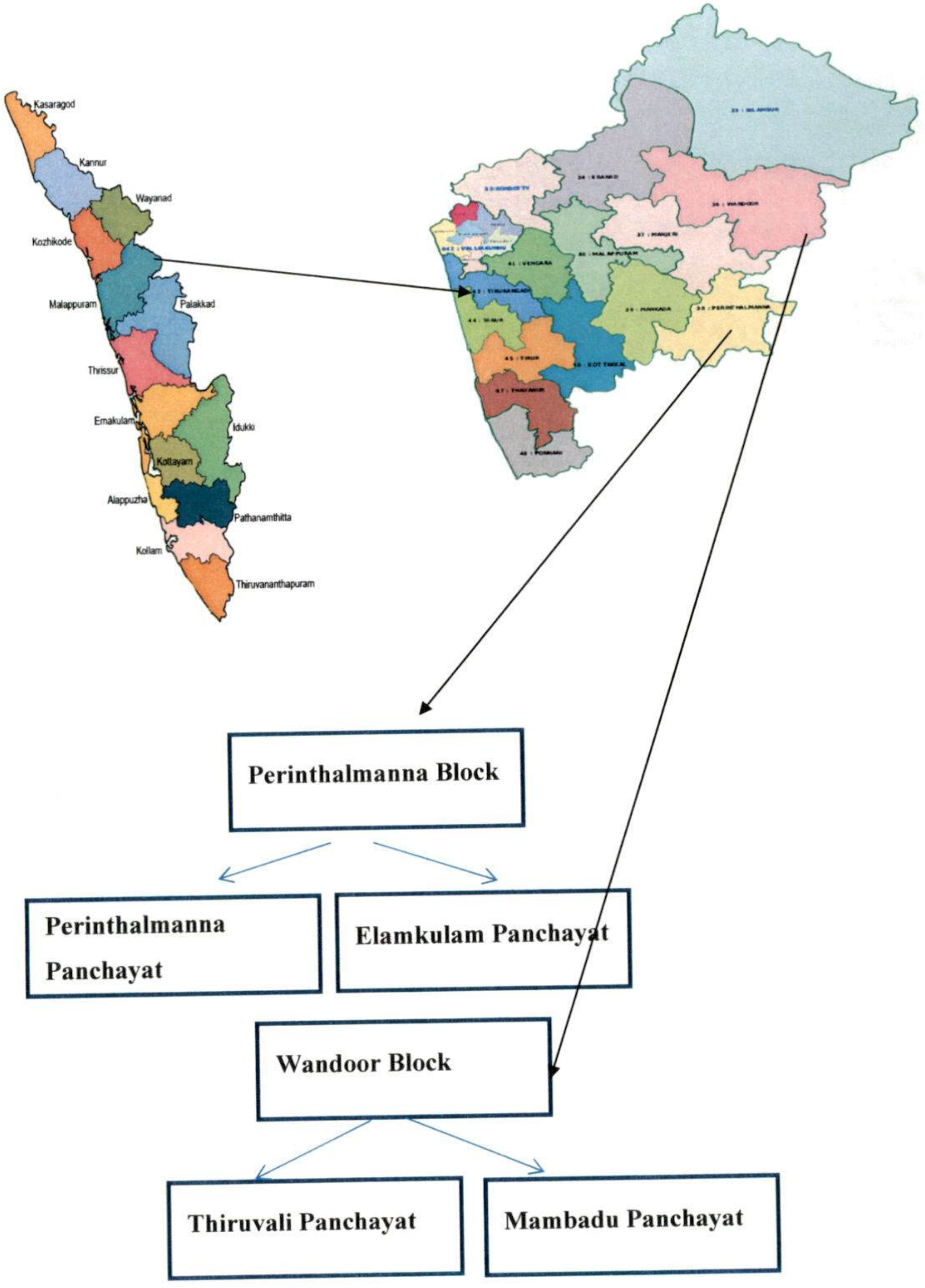


Fig 3.1 Map of study area

3.4.1 Kollam

Kollam is an old sea port city on the coast of Arabian Sea. It extends from Lakshadweep Sea to Western Ghats. Total geographical area of Kollam district is 2483 sq. km. Population density of the district is 1061 persons per sq. km. Kollam district constitute 6.41 per cent of the total geographic area of the state. The district has a prominent place in the field of agriculture. The total extent of land under cultivation is 2,18,267 hectares and the principal crops grown are paddy, tapioca, tapioca, rubber, pepper, banana, mango and cashew. About 70 per cent of the work force is engaged in agriculture. It has the largest area under tapioca cultivation which accounts for about 60 per cent of the total cropped area.

3.4.1.1 Location

Kollam district lies between 8° 53' North latitude and 76° 36' East longitude. Out of the total area of 2483 Sq. Km, 336 Sq. Km falls under urban area and the remaining 2008 Sq. Km falls under rural area. It is bordered by the districts of Pathanamthitta and Alappuzha in the north, Thiruvananthapuram to the south and Tamil Nadu state to the east. The western part of the district has the presence of the Arabian Sea and has a coastal length of about 37km. As per the 2011 census, there are six taluks namely Kollam, Karunagapalli, Kunnathur, Kottarakkara and Pathanapuram, The taluks are again subdivided into 12 block Panchayats. About thirty per cent of this district is covered by the Astamudi lake, thereby making it the gateway to the backwaters of the state.

3.4.1.2 Topography climate and soil

Kollam district is characterized by an essentially tropical climate with hot and humid summer season and plenty of rainfall during the rainy season. Summer months in the district last from March to May. The maximum temperature ranges between 32 and 34° C and the minimum between 20 and 21° C. The rainy season starts during the South West monsoon which sets in the first week of June and extends up to September, while the North East monsoon extends from the second half of October. During rainy months the humidity in the district is around 90 per cent. The average rainfall varies between 1100 mm and 1500m. The district has the presence of five major soil types that is lateritic soils, brown hydromorphic soils, grayish onattukara soils, forest loam and alluvial (coastal and riverine alluvium) soils. Lateritic soils are the most predominant types of soil in the district.

3.4.1.3 Land utilization pattern

Out of the total geographical area total cropped area in the district was 67.05 per cent and the net sown area was about 53.17 per cent of the total area of the district. Forest land covered around 34.70 per cent of the total area while the cultivable waste land was only 0.67 per cent. The land not used for agricultural purpose was 11.32 per cent of the total area and the area sown more than once accounted about 13.88 per cent. The details of land utilization pattern in the district are given in Table 3.1.

The district has the presence of five major soil types that is lateritic soils, brown hydromorphic soils, grayish onattukara soils, forest loam and alluvial (coastal and riverine alluvium) soils. Lateritic soils are the most predominant types of soil in the district.

3.4.1.5 Demographic features

According to 2011 census, the district population was estimated to be 2629703 with a population density of 1056 inhabitants per Sq. Km. The population growth was recorded as 1.94 per cent over the decade 2001-2011 and the literacy rate was 93.77 per cent (male 95.83 percent and female 91.95 percent). The district has a sex ratio of 1113 females for every 1000 males.

3.4.1.6 Water resources

Kollam district is blessed with the state's largest freshwater lake namely Sasthamcotta lake. This lake satisfies most of the drinking water needs of the district. The district is endowed with another inland lake called Ashtamudi

Lake. Kallada and Ithikkara rivers are flowing through the district. From Table 3.2, it is clear that the major source of water in the district was private wells which accounted for 47.84 per cent to the total.

3.4.1.7 Description of selected Panchayats

The blocks were selected based on the area under tapioca cultivation. Two blocks having largest area under tapioca in Kollam district, i.e., Chadayamangalam and Sasthamcotta were selected for the current study. Two Panchayats where maximum tapioca cultivation was carried out *viz*., Chadayamangalam and Elamad from Chadayamangalam block and Soorandu south and Poruvazhy Panchayats from Sasthamcotta block were identified.

3.4.1.8 Cropping pattern

Cropping patterns in the selected blocks are presented in Table 3.4. It could be observed from the table that tapioca occupied the highest area among all the crops grown in both the blocks. It accounted for 27.85 per cent of the total cropped area in Chadayamangalam and 31.87 per cent in Sasthamcotta blocks

Table 3.1 Land utilization pattern of Kollam and Malappuram districts

Particulars	Kollam (Area in Ha)	Malappuram (Area in Ha)
Forest land	81438 (34.70)	103417 (29.09)
Land put to non-agricultural uses	26567 (11.32)	51678 (14.53)
Barren and uncultivable land	222 (.001)	844 (0.23)
Permanent pastures and grazing land	2 (0)	0 (0)
Land under miscellaneous tree crops	64 (.0003)	203 (0.06)
Cultivable waste land	1583 (0.67)	6048 (1.70)
Fallow other than current fallow	1804 (0.76)	5572 (1.56)
Current fallow	4457 (1.81)	8084 (2.27)
Fallow other than current fallow	1804 (0.76)	6168 (1.73)
Net area sown	124779 (53.17)	173178 (48.72)
Area sown more than once	32564 (13.88)	64682.22 (18.19)
Total cropped area	157343 (67.05)	198389.012 (55.81)
Total geographical area	251838 (100)	355446 (100)

Source: Agricultural Statistics 2016-17, Directorate of Economics and Statistics, Kerala

Table 3.2 Area under irrigation in Kollam and Malappuram

Source	Kollam (Area in Ha)	Malappuram (Area in Ha)
Government canal	1220 (31.36)	3153 (11.31)
Private canal	5 (0.12)	176 (0.63)
Government tanks	18 (0.46)	337 (1.21)
Private tanks	73 (1.87)	5418 (19.44)
Government wells	12 (0.30)	130 (0.47)
Private wells	1861 (47.84)	13106 (47.02)
Minor irrigation	0 (0)	580 (2.08)
Other sources	677 (17.4)	4018 (14.41)
Tube wells	24 (0.6)	956 (3.43)
Total	3890 (100)	27874 (100)

Source: Panchayat Level Statistics, 2010-11, Kollam, Malappuram

Table 3.3 Cropping pattern in selected blocks of Kollam and Malappuram districts

Crops	Kollam		Malappuram	
	Sasthamcotta (Area(ha))	**Chadayamangalam(Area(ha))**	**Perinthalmanna(Area(ha))**	**Wandoor(Area(ha))**
Paddy	188.6 (2.8)	160.32 (2.273)	448.18 (4.86)	252.22 (2.94)
Pepper	436.38 (6.5)	501.41 (7.109)	272.8 (2.95)	178.24(2.07)
Ginger	42.2 (0.63)	66.19 (0.938)	5.93 (0.064)	3.39 (0.039)
Turmeric	23.71 (0.35)	48 (0.681)	16.15 (0.17)	107.24(1.25)
Arecanut	193.72 (2.91)	161.36 (2.288)	1633.65(17.71)	2885.7 (33.64)
Tamarind	70.38 (1.06)	52.47 (0.744)	175.5(1.90)	91.02(1.06)
Clove	1(0.05)	1 (0.014)	0.05(0.0005)	0.29(0.003)
Nutmeg	9.14(0.013)	3.45 (0.049)	24.12(0.26)	44.03(0.51)
Jack	594. 23 (8.95)	979.79 (13.891)	905.86(9.82)	626.02(7.29)
Mango	543.16 (8.18)	625.78 (8.872)	877.49(9.51)	573.89(6.69)
Banana	490.45(7.39)	524.04 (7.42)	2024.36(21.95)	1386.8(16.17)
Plantain	386.70(5.82)	887.45 (12.58)	446.44(4.84)	332.68(3.87)
Pineapple	8.22(0.12)	19.02 (0.27)	6.05(0.065)	44.9(0.52)
Papaya	117(1.76)	160 (2.268)	174.44(1.89)	243.29(2.83)
Cashew	336.97(5.07)	192.93 (2.735)	114.9(4.8)	198.19(2.31)
Tapioca	2115.09(31.8)	1964.72 (27.854)	1096.47(11.89)	685.59(7.99)
Tubers	744.82(11.22)	368.09 (5.21)	638.72(6.92)	893.6(10.41)
Pulses	158.65(2.39)	146.52 (2.07)	124.6(1.35)	155.25(1.81)
Vegetables	109.71(1.65)	133.13 (1.88)	198.2(2.14)	214.8(2.50)
Cocoa	0.02(0.00)	0.63 (0.009)	0(0.00)	54.1(0.63)
Others	64.32(0.969)	57.32 (0.813)	38.56(0.41)	46.38(0.54)
Gross cropped area	6636.67(100.00)	7053.62 (100.00)	9221.56(100.00)	8576.14(100.00)

Source: Agricultural Statistics 2016-17, Directorate of Economics and Statistics, Note: Figures in parentheses indicate per cent to column total

3.4.2 Malappuram

Malappuram, a hilly terraced tract of Kerala situated in the northern part of the state which is commonly referred as Malabar region. The district is endowed with beautiful gifts of nature. The word Malappuram means "terraced place atop the hills". Malappuram has spread over an area of 35.50 Sq. Km. It is the third largest district in the state with population density of 1158 inhabitants per square kilometer. The district which extends from Arabian Sea to Western Ghats is blessed with abundant wild life, rivers and stream flowing to the west, forests and backwaters. Major crops cultivated in the region are paddy, areca nut, cashew nut, pepper, ginger, pulses, tapioca and rubber..

3.4.2.1 Location

Malappuram district lies between 75° to 77° East longitude and 10° to 12° North Latitude, in the geographical mark. It has all the three natural geographic divisions, lowland, midland and highland. Out of the total area of 3550 Sq. Km, 2654 Sq. Km falls under rural area and the remaining falls under urban area. Malappuram shares boarders with Kozhikode district to the west, Palakkad district to the east and Thrissur district to the south .it is a coastal district and is sharing border with Arabian Sea in the west with a coastal length of about 70 km which is 11.87 per cent of the total coastline of the state. As per the 2011 census, there are six taluks in the district namely Tirur, Ernad, Tirurangadi, Perinthalmanna, Nilambur, and Ponnani, The taluks are again subdivided into 15 block Panchayats.

3.4.2.2 Land utilization pattern

Out of the total geographical area total cropped area in the district was 55.81 per cent and the net sown area was about 48.72 per cent of the total area of the district. Forest land covered around 29.09 per cent of the total area while the cultivable waste land was only 1.70 per cent. The land not used for agricultural purpose was 14.53 per cent of the total area and the area sown more than once accounted about 18.19 per cent. The details of land utilization pattern in the district are given in Table 3.1

3.4.2.3 Topography and climate

Malappuram district is characterized by hot and humid climate. Summer season in extends from March to May. The temperature ranges between 30 to 20° C. The rainy season starts during the South West monsoon which sets in the first week of June and extends up to September, while the North East monsoon extends from the second half of October to first fortnight of November followed by a dry season from December to February. During rainy months the humidity in the district is around 90 per cent nearly 75 percent of the annual rains are received during this season. The average rainfall of the district is 2952mm.

3.4.2.4 Soil

According to morphological and physic-chemical properties there are four types of soils present in the district. Those are; alluvial soils that is commonly present in the soils of low lands, lateritic soils of mid and uplands, hydromorphic soils which are moderate to well drained clayey soils with high gravel content, and forest loamy soils of eastern parts of Malappuram. Lateritic soils are the most predominant types of soil in the district.

3.4.2.5 Demographic features

According to 2011 census, Malappuram is the 50^{th} most populous district among 640 Indian districts. It stands first in Kerala with an estimated population of about 4112920 and a population density of 1158 inhabitants per Sq. Km. The population growth was recorded as 13.39 per cent over the decade 2001-2011 and the literacy rate was 93.55 per cent (male 95.83 percent and female 91.95 percent). The district has a sex ratio of 1093 females for every 1000 males.

3.4.2.6 Water resources

The district is endowed with rivers and back waters. Chaliyar river, Kadalundi river, Tirur river and Bharathapuzha are the major rivers flowing through the district. Bharathapuzha,the second longest river in Kerala, flows by the southern border of the district and drains in to the sea at Ponnani.

Puthuponnani, Ponnani kayal, Poorappuzha and Kadalundi kayal are the major back water bodies in the district. From Table 3.6, it is clear that the major source of water in the district is private wells which contribute around 47.02 per cent to the total.

3.4.2.7 Description of selected Panchayats

Blocks were selected based on the area under tapioca cutivation. Two blocks having largest area under tapioca in Malappuram district, i.e., Perinthalmanna and Wandoor were selected for the current study. Two Panchayats where maximum tapioca cultivation was carried out had identified *viz.*, Perinthalmanna and Elamad from Perinthalmanna block and Thiruvali and Mambadu Panchayats from Wandoor block.

3.4.2.2 Cropping pattern

Cropping patterns in the selected blocks are presented in Table 3.4. It could be observed from the table that tapioca occupied the highest area among all the crops grown in both the blocks. It accounted for 11.89 per cent of the total cropped area in Perinthalmanna and 7.99 per cent in Wandoor blocks.

3.5. SAMPLING DESIGN

The present study was conducted in two districts representing the southern (Kollam) and northern (Malappuram) part of Kerala. Two blocks having largest area under tapioca were identified from each district. Based on the area under cultivation and the production of tapioca, Chadayamangalam and Sasthamkotta blocks were selected from kollam district. Two krishibhavans were selected randomly from each block in order to conduct the primary survey. Chadayamangalam and Elamadu krishibhavans were selected from Chadayamangalam block and Sooranadu south and Poruvazhy krishibhavans were selected from Sasthamkotta block. Two blocks selected from Malappuram district were Perinthalmanna and Wandoor.

The list of tapioca farmers was collected from Principal Agricultural office, Kollam and Malappuram respectively as well as the Krishibhavans in the respective Panchayats. Fifteen farmers were randomly selected from each Krishibhavan, making a total sample size of 120. In order to understand the costs and returns of tapioca cultivation, primary data were collected from the selected farmers using pretested interview schedule by personal interview method. The information was also collected from 30 market intermediaries (10 wholesalers and 20 retailers) making a total sample size of 150.

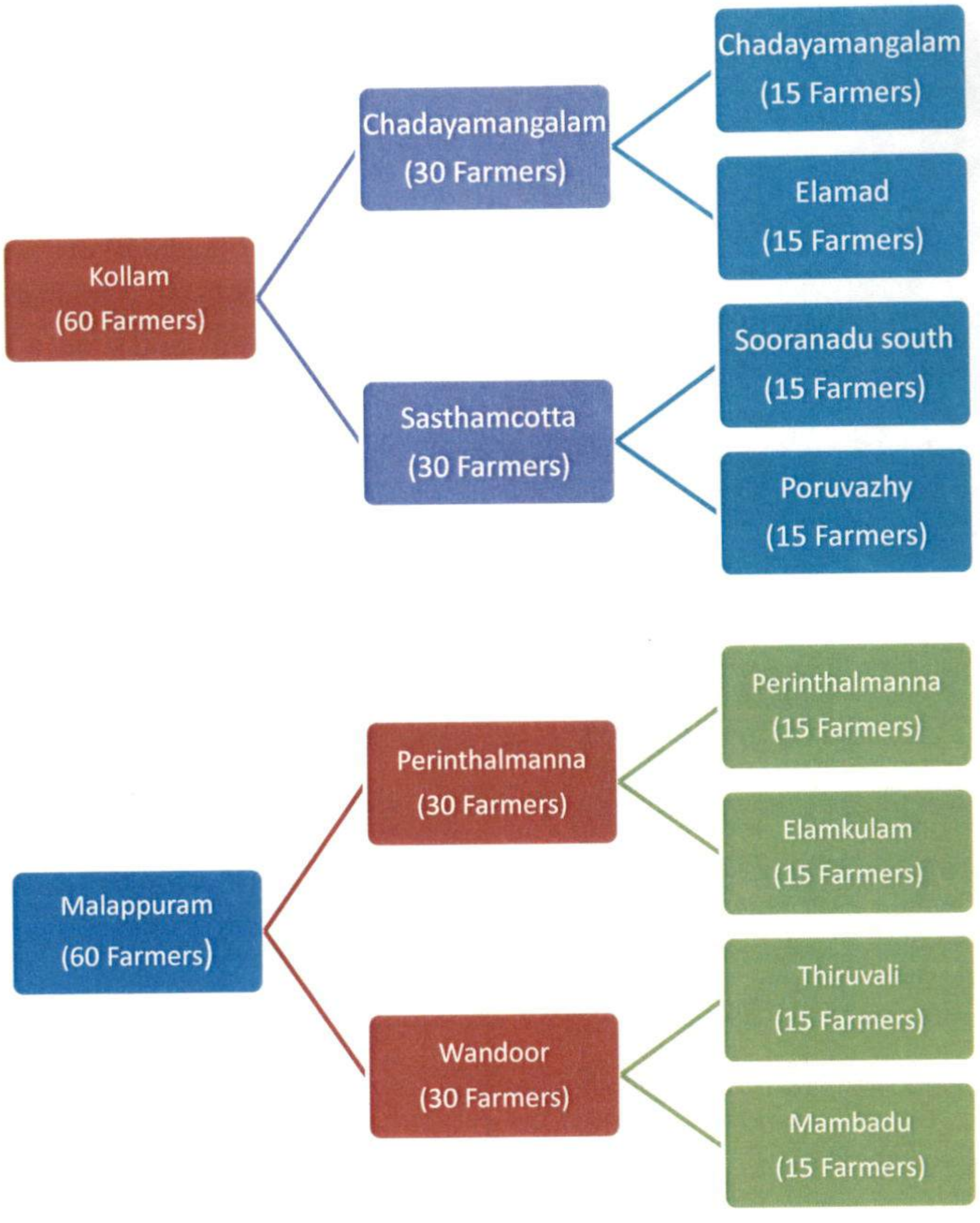


Fig. 3.2 Distribution of sample respondents

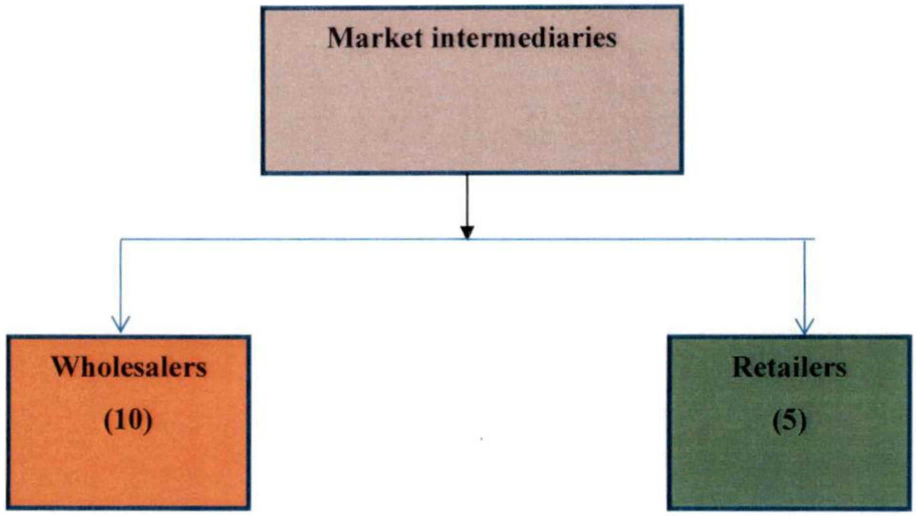


Fig. 3.3 Distribution of market intermediaries

3.5.1 Collection of data

The data regarding socio-economic profile of farmers and socio-economic constraints in production and marketing aspects were collected by personal interview of sample farmers using a well-structured interview schedule. Based on the collected details of these farmers, economics (cost and returns) of tapioca cultivation were evaluated using the cost concepts. The data regarding marketing channels, marketing cost and marketing margin were collected from the selected market intermediaries by personal interview method.

3.6 Analysis of data

Various analytical tools were used to analyze primary and secondary data which are given below

3.6.1 Primary data

The primary data collected from the sample farmers and sample market intermediaries in the study area was arranged in tabular form and expressed as averages and percentages.

3.6.2 Trend

To understand the trends in the area production and productivity of tapioca in Kerala and all- India level, a detailed trend analysis was carried out using the respective time series data for the period 1950-51 to 2016-17. Linear, growth, compound, cubic, logarithmic, sigmoid, exponential, inverse, power and logistic models were tried for fitting trends in area, production and productivity of tapioca in Kerala and in India. The best model was selected based on the adjusted R^2 , Standard Error and outlier values.

3.6.2 Growth rate analysis

The compound growth rates of area, production and productivity of tapioca in Kerala were calculated by fitting exponential function of the form,

$$Y_t = ab^t$$

Where,

Y_t : Area/production/productivity of tapioca in Kerala

a : Intercept

b : Regression coefficient

t : time period (years)

Taking logarithms on both sides,

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

$$Y_t' = A + Bt$$

Where,

Y_t' : $\ln Y_t$

A : ln a

B : ln b

Compound growth rate of a variable is a useful measure of growth over multiple time period. Ordinary Least Square (OLS) method was adopted to estimate the regression co-efficient (b). Compound Growth Rate in percentage was calculated using the formula,

$$\text{Compound Growth Rate (CGR)} = (\text{Antilog } B - 1) \times 100$$

3.6.3 Price behaviour of tapioca

The decisions of farmers, traders and consumers regarding the transactions and consumption of the commodities in the market can be influenced by price volatility. Hence the information pertaining to price behaviour in terms of trend, and variations influences the competitiveness of the good in both domestic and international markets. In this context an attempt is made to analyse the behaviour of tapioca prices so that useful policies can be formulated. The techniques of classical time series (Croxton *et al.*, 1979; Spiegel, 1992) were used to study the price behaviour of tapioca. Time series data of monthly average price of tapioca were analysed. It was estimated using a multiplicative time series model by which the time series data on price of tapioca in major markets were decomposed into different components viz., trend, seasonal, cyclical and irregular variations.

The multiplicative model is analysed using the relationship,

$$Y(t) = T \times S \times C \times I$$

Where,

Y(t) : Price of tapioca at time t

T : Secular trend

S : Seasonal variation

C : Cyclical variation

I : Irregular variation

3.6.3.1 Secular trend

Time series is a set of ordered sequence of observations collected over a period of time. Trend can be defined as the general tendency of a time series to increase or decrease over a long period of time. The trend in tapioca prices in the long run (2002 to 2018 July) in major markets of Kerala was studied by fitting suitable trend equations The following trend equations were tried and the one with high R^2 value was selected in each case.

Models attempted were as follows,

Linear trend:

$$Y_t = a + bt$$

Quadratic trend

$$Y_t = a + bt + ct^2$$

Cubic trend

$$Y_t = a + bt + ct^2 + dt^3$$

Exponential trend

$$Y_t = ab^t$$

3.6.3.2 Seasonal variation

The variation in time series data which occur within the span of a year with regular periodicity is called seasonal variation. Ratio to moving average method was used to estimate the seasonal variation in prices of tapioca in the various markets of Kerala. Since monthly prices are used, a month is referred as a season and as such there are seasonal indices for the 12 months. Twelve point centered moving average technique after eliminating other time series components such as trend, cyclical variation and irregular variation was used to estimate statistical measure of the patterns of seasonal variations in the time series and seasonal indices.

3.6.3.3 Cyclical variation

The oscillatory movements in a time series with a period of more than one year are referred as cyclical variations. They differ from seasonal variations in a sense that, they are of longer duration, usually extending a few years and are of different periodicity. Cyclic variations in the price of tapioca in major markets of Kerala were studied using multiplicative model of time series. The estimation of cyclic variations was done in three steps that are, removal of trend components, removal of seasonal effect and removal of irregular components. In first step the variations due to trend component are removed from the time series data by dividing each of the original values by the corresponding trend values and expressing the same in per cent. That is,

$$(T \times S \times C \times I) / T = S \times C \times I$$

Then such data consists of seasonal, cyclical and irregular components. The trend eliminated data for each month is divided by the corresponding seasonal index and the result is multiplied by 100 to remove the seasonal variation

$$(S \times C \times I) / S = C \times I$$

Removal of irregular variation is very difficult because it is highly entangled with cyclical movements. To get cyclic variations clearly, the data has to be smoothened by using short period moving averages.

3.6.3.4 Estimation of irregular variation

Random, unforeseen, non-recurring and sporadic fluctuations in a time series which are not attributed to seasonal, cyclical or secular factors is referred as irregular variation. Irregular variations are also referred to as residual variations. Irregular variation is estimated by dividing Y_t by estimated T_t S_t and C_t

$$I_t = Y_t / T_t S_t C_t$$

SPSS package was used for the decomposition of time series of monthly average price of tapioca into the above components.

3.6.4 Market integration and price transmission

3.6.4.1 Cointegration

Cointegration is a statistical property possessed by two or more time series which are defined by the concepts of stationarity. A stationary time series is one with constant mean and variance. In econometrics cointegration analysis is used to estimate and test stationary linear relation or cointegration relation, between non stationary time series variables. Cointegration exists between two non stationary time series if they possess the same order of integration and a linear combination (weighted average) of these series is stationary. The order of integration of a time series is given by the number of times the series must be differenced to make it stationary. Long term relationship between two or more time series variables can be theoretically expressed using cointegration. The concept of cointegration can be used to explain the correlation between the prices prevailing in two or more spatially separated markets. When markets are integrated it implies that the markets in the system operate in unison, as a single market system.

Cointegration relationships among non-stationary variables are estimated using different tools. Maximum Likelihood (ML) method of cointegration developed by Johansen in 1998 is commonly used to study specific cointegration behaviour of two or more markets which are linked together into a single economic market. There are two steps used in cointegration analysis viz.,

1) Testing for stationarity

2) Testing for cointegration

1. Testing for stationaritiy

Examining the characteristics of time series data is an important step to ensure appropriate model specification and to avoid the possibility of obtaining misleading results. This step includes tests for determining the order of integration of the variables.

The Dickey Fuller (DF) and Augmented Dickey Fuller (ADF) tests are most popularly used for unit roots. The null hypothesis for both the tests is the

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time series has a unit root or in other words, it is non-stationary. The DF test was done by running the regression of the following form,

$$\Delta P_t = \beta_1 + \delta P_{t-1} + u_t$$

Where,

$$\Delta P_t = (P_t - P_{t-1});\ Pt = \ln P_t$$

The ADF test was run with the equation,

$$\Delta Y_t = \beta_1 + \delta P_{t-1} + \sum_{i=1}^{P} \alpha_i \Delta P_{t-i} + \epsilon_t \quad (1)$$

$$\Delta Y_t = \beta_1 + \delta P_{t-1} + \beta_2 t + \sum_{i=1}^{P} \alpha_i \Delta P_{t-i} + \epsilon_t \ (2)$$

Where,

$$\Delta P_{t-1} = (P_{t-1} - P_{t-2})$$

ϵ_t for t = 1 . . . , N is assumed to be Gaussian white noise *i.e.*, $\epsilon_t \sim (0, \sigma^2)$. The equation (1) is with constant term and no trend whereas the second one (2) is with constant and trend. The number of lagged terms, 'p' is chosen to ensure that the errors are uncorrelated. In all the tests, the null hypothesis was $\delta = 0$ which implied that the time series 'Y_t' was non-stationary. In the present study, ADF tests were used to ascertain the stationarity of the price variables.

2. Testing for cointegration

Johansen's multiple co-integration procedure using stata software was employed to understand the degree of market integration among the selected markets Kozhikode, Ernakulam and Chalai. The test for finding the order of integration of each variable in the model was to establish whether the time series was non-stationary and how many times the variable needs to be differenced to result in a stationary series. However, first differencing is not an appropriate solution to the non-stationarity problem and it prevents detection of the long-run relationship that may be present in the data, *i.e.* the long-run information is lost, which is precisely the main question being addressed.

The economic interpretation of co-integration is that, if two (or more) series are linked to form an equilibrium relationship spanning the long-run, then even though the series themselves may contain stochastic trends (*i.e.,* be non-stationary) they will nevertheless move closely together over time and the difference between them will be stable (*i.e.*, stationary). The concept of co-integration mimics the existence of a long-run equilibrium to which an economic system converges over time and 'u_t' defined above can be interpreted as the disequilibrium error (*i.e.*, the distance that the system is away from equilibrium at time t).

An approach to testing for co-integration is to construct test statistics from the residuals of a cointegrating regression in levels mostly using Engle Granger and Augmented Engle Granger tests. However, in the case of a system of variables Johansen Maximum likelihood procedure (Johansen and Juselius, 1990) is the most applicable method, since it permits the existence of co-integration between the systems of variables without imposing any bias on the estimates. The Johansen test for co-integration is a multivariate unit root test which estimates the co-integrating rank 'r' in the multivariate case and is also able to estimate the parameters 'β' of these co-integrating relationships. This test procedure is most efficient because it identifies the number of co-integrating vectors between the non-stationary level variables in the context of a Vector Error Correction Model (VECM). Basically, this is a Vector Auto Regression (VAR) model in error correction form. In a system with two or more variables, a VECM, like the VAR model, treats each variable as potentially endogenous and relates the change in one variable to past equilibrium errors and to past changes in all variables in the system.

Following Johansen and Juselius (1990), the maximum likelihood method of co-integration is explained as follows:

If 'P_t' denotes (nx_1) vector of I(1) prices, then the k^{th} order vector autoregressive (VAR) representation of 'Pt' may be written as 'k'.

$P_t = \sum_{i=1} \Pi i Pt - i + \mu + \beta t + e_t (t = 1,2 \ldots\ldots t)$

The procedure for testing co-integration is based on the error correction (ECM) representation of 'Pt' given by

$\Delta P_t = \sum_{i=1}^{K-1} \acute{\Gamma} i Pt - i + \Pi i P_{t-k} + \mu + \beta t + et$

Where,

Πi = - (1- Π_1 - ...... - Πt); i= 1, 2... K-1; Π= - (1-Π_1-.... – Πk).

Each of the Π_1 is an n x n matrix of parameters; 'e_t' is an identically and independently distributed n-dimensional vector of residuals with zero mean and variance matrices. Ώe; 'μ' is a constant term and t is trend. Since, 'P_{t-k}' is I (1), but 'ΔP_t' and 'ΔP_{t-1}' variables are I (0). Equation will be balanced if Π Pt-k' is 1(0). So, it is the Π matrix that conveys information about the long run relationship among the variables in 'Pt'. The rank of Π, r, determines the number of co-integrating vectors, as it determines how many linear combinations of 'Pt' are stationary. If r = n, the prices are stationary in levels. If r = 0, no linear combination of 'Pt' is stationary. If 0 < rank (Π) = r < n, and there are n x r matrices 'ά' and 'β' such that Π = άβ, then it can be said that there are 'r' co-integrating relations among the elements of 'Pt'. The co-integrating vector 'β' has the property that 'βPt' is stationary even though 'Pt' itself is non-stationary. The matrix ά measures the strength of the co-integrating vectors in the ECM as it represents the speed of adjustment parameters. Two likelihood ratio test statistics were proposed. The null hypothesis of at most 'r' co-integrating vector against a general alternative hypothesis of 'more than r' co-integrating vectors was tested by

Trace statistic (λ-trace) = -T ∑ ln (1- λi)

The null hypothesis of r co-integrating vector against the alternative of r + 1 is tested by the maximum Eigen value statistic (λ max) = -T ln (1- λr+1).

'λi' are the estimated Eigen values (characteristics roots) obtained from the Π matrix. T is the number of usable observations (Johansen and Juselius, 1990).The number of co-integrating vectors indicated by the tests is an important indicator of co-movement of the prices. An increase in the number of co-integration vectors implies an increase in the strength and stability of price linkages.

3.6.4.2 Granger Causality Test

Cointegration between two variables implies the existence of causality between them in at least one direction (Granger, 1980). Cointegration itself cannot be used to make inferences about the direction of causation between the variables. The Granger Causality test provides additional evidence for the presence and direction of price transmission occurring between two series. If two markets are integrated, the price in one market 'P_D' would be found to Granger-Cause the price in the other market, 'P_I' and/or vice versa. The test involves estimating the following pair of regressions

$$P_{Dt} = \sum_{i=1}^{n} \alpha i \, P_{It} - i + \sum_{j=1}^{n} \beta j \, P_{Dt-j} + u_{1t} \; (1)$$

$$P_{It} = \sum_{i=1}^{n} \lambda i \, P_{It} - i + \sum_{j=1}^{n} \delta j P_{Dt-j} + u_{2t} \; (2)$$

Unidirectional causality from 'P_{It}' to 'P_{Dt}' is indicated if the estimated coefficients on the lagged 'P_{It}' in the first regression are statistically different from zero as a group and the set of estimated coefficients in lagged 'P_{Dt}' in (2) is not statistically different from zero. Conversely, unidirectional causality from 'P_{Dt}' to 'P_{It}' exists if the set of lagged 'P_{It}' in the first regression is not statistically different from zero and the set of lagged 'P_{Dt}' coefficients in (2) are statistically different from zero. Bilateral causality is suggested when the sets of 'P_{It}' to 'P_{Dt}' coefficients are statistically different from zero in both the regressions. When the sets of both the coefficients are not statistically significant in both the regressions, independence is suggested.

3.6.5 Economics of tapioca cultivation

The cost of cultivation is the aggregate measure of total cost incurred by the farmers in the cultivation of tapioca. It is expressed on per hectare basis. Primary data collected from the sample farmers in the study area was used to estimate the economics of tapioca cultivation. Total cost was estimated by using the ABC cost concepts.

Cost A_1

Cost A_1 Gives the actual expenditure incurred in cash and kind. It includes value of hired human labour, value of manures and fertilizers, value of plant protection chemicals, interest on working capital and miscellaneous expenses.

Cost A_2

Cost A_2 consists of cost A_1 plus rent paid for leased in land. It was found that farmers do lease in land for the cultivation of tapioca

Cost B_1

Cost B_1 constitutes cost A_1 plus interest on own fixed capital.

Cost B_2

Cost B_2 is the sum of cost B_1 and rent paid for leased in land and the rental value of own land. Rental value of own land is calculated as equal to one fifth of the value of total produce.

Cost C_1

It is the sum of cost B_1 and imputed value of family labour. The cost of family labour was computed based on the prevailing wage rates paid to the hired human labour in the study area during the study period.

Cost C_2

Cost C_2 is the sum of C_1 and the managerial cost. Managerial cost is usually computed as the 10 per cent of cost C_1.

3.6.5.1 Gross income

Gross income is the total value of the produce. This was computed using the harvest price of tapioca prevailing in the study area.

3.6.5.1 Net income

Net income is the difference between the gross income and cost C_2

3.6.6 Resource use efficiency

Production function analysis will provide a sound scientific basis for input- output relationship. Estimation of economic aspect of crop production would lead the farmers to operate at the least cost and highest profit combinations. The Cobb-Douglas production functions, one of the most widely used functions in the economic analysis of the problems relating to empirical estimation in agriculture and industry was fitted to evaluate the factors influencing the tapioca production and also to examine the relative influence of these factors. Generally this function is used because elasticity coefficients could be obtained directly from the function. The production function was estimated using Ordinary Least Square (OLS) method. The estimated values of the regression coefficients were tested for statistical significance with the help of standard error value.

Model specification:

$$Y = a_0 X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4}$$

Where,

Y : Yield per ha

X_1 : Human labour (mandays/ha)

X_2 : Amount spent on manures (Rs/ha)

$X3$: Experience in farming (years)

X_4 : Amount spent on fertilizers (Rs/ha)

a_0 : Constant

b_i (i = 1, 2 . . . 5) : Coefficient

Logarithmic form of the estimated equation is,

$$\ln Y = \ln a_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X3 + b_4 \ln X4$$

3.6.6.1 Returns to scale

Returns to scale refers to the behaviour of production or returns when all the productive factors are increased or decreased simultaneously in the same ratio. In a Cobb-Douglas production function, the regression coefficients are the production elasticities of each of the variable input. Therefore the sum of regression coefficients (bi) of all the input variables provides a ready estimate of the returns to scale. If the sum of bi is not significantly different from one, it indicates constant returns to scale. If sum of 'bi' is less than one, it indicates decreasing returns to scale and if it is greater than one, increasing returns to scale is indicated.

Returns to scale = $\sum_{i=1}^{4} bi$

3.7 Marketing of Tapioca

According to the National Commission on Agriculture, agricultural marketing is a process which starts with a decision to produce a saleable farm commodity, involves all the aspects of market structure or system, both functional and institutional, based on technical and economic considerations, and includes pre and post-harvest operations, assembling, grading, storage, transportation and distribution. In the present study, marketing costs, marketing margin, price spread and marketing efficiency were estimated as explained below.

3.7.1 Market structure

Market structure refers to those organizational characteristics of a market which influence the nature of competition and pricing, and affect the conduct of business firms.

3.7.2 Marketing channel

Marketing channels are the routes through which agricultural products move from producers to consumers through different intermediaries. Intermediaries may be village merchants, brokers, traders, processors, wholesalers, commission agents, retailers *etc.*, (Acharya and Agarwal, 1987).

3.7.3 Marketing cost

Marketing costs consist of all items of expenditure incurred in transferring goods from the producer to the consumer. These are the costs incurred in performing market functions such as transporting, storing, processing, selling and other related activities.

3.7.4 Marketing margin

It is the profit of various intermediaries or middlemen involved in moving the produce from the producer to the consumer.

3.7.5 Price spread

Price spread can be defined as the difference between the price paid by the consumer and price received by the producer for an equivalent quantity of farm products. It involves various costs incurred by various intermediaries and their margins such as packaging costs, transport costs, storage costs, processing costs, capital costs *etc.*

3.7.6 Marketing efficiency

According to Kohls and Uhl (1980), marketing efficiency is the ratio of market output (satisfaction) to marketing inputs (cost of resource). The efficiency of a marketing system is measured in terms of the level or costs to the system of the inputs, to achieve a given level or quality of output level. In the present study, marketing efficiency of various channels were computed by using Shepherd's formula. Shepherd (1965) has suggested that the ratio of the total value of goods marketed to the marketing costs may be used as a measure of efficiency. Mathematically,

$$ME = \frac{V}{I}$$

Where,

ME : Marketing efficiency

V : Consumer's price

I : Total marketing cost

3.8 Constraints in production and marketing of tapioca

To identify various constraints faced by tapioca farmers, Garrett ranking technique was used. As the first step in constraint analysis, major problems faced in production and marketing were identified. The respondents were then asked to rank the identified problems and the ranks given by the sample respondents were converted into percentage using the formula,

$$Percentposition = \frac{Rij}{Nj} X100$$

Where,

Rij : Rank given to the i^{th} attribute by the j^{th} individual

Nj : Number of attributes ranked by the j^{th} individual

These percentages were converted into scores by referring to Garret's table given by Garrett and Woodworth (1969). Thus, for each factor, the scores of various respondents were added and the mean values were estimated. The mean values thus obtained for each of the attributes were arranged in descending order. The attribute with the highest mean value was considered as the most important one and the others followed in that order.

Results and Discussion

4. RESULTS AND DISCUSSION

The present study entitled "Economic analysis of production, marketing and price behaviour of tapioca" examines the trend in area, production and productivity of tapioca in India and Kerala along with price behaviour, economics, resource use efficiency, marketing costs, margins and constraints. The data collected were subjected to statistical analysis and the results are presented in this chapter under the following sections.

4.1 Trend in area, production and productivity of tapioca

4.2 Growth rates in area, production and productivity of tapioca

4.3 Price behaviour of tapioca

4.4 Socio-economic profile of the sample farmers

4.5 Economics of tapioca cultivation

4.6 Resource use efficiency of tapioca production

4.7 Marketing of tapioca

4.8 Constraints in production and marketing of tapioca

4.1 Trend in area, production and productivity of tapioca

The market supply of any crop depends on its area, production and productivity. In this segment an effort has been made to analyse the trend in growth of tapioca in India and Kerala with respect to area, production and productivity for the entire period from 1950 to 2017 and the results are discussed under two headings *viz.*, Indian scenario and Kerala scenario. To analyse the underlying patterns of growth of tapioca in national and state level the time series data on area, production and productivity were subjected to trend analysis, for this different statistical forms were tried and the model with the highest R^2 was selected as the best fit model.

4.1.1 Indian scenario

The area, production and productivity of tapioca in India from 1950-51 to 2016-17 as showed in Fig 4.1 that, during the year 2017 India has produced 4073 metric tonnes of tapioca by cultivating an area of 2.10 lakh hectares with a productivity of 19.3 metric tonnes per hectare. The area under tapioca in India increased from 2.36 lakh hectares in 1950 to a peak of 3.92 lakh hectares in 1975. Later on the area started to decline and reached its lowest (2.10 lakh hectares) in 2017. Inspite of declining area, production showed an increasing trend and reached its peak (8139.4MT) in 2014 due to the influence of increase in productivity during the period from 5.4MT to 35.7MT in 2014. There after 2014 both production and productivity declined continuously till 2017.

The results of trend analysis as given in Fig.4.2 to 4.4 revealed that, production and productivity of tapioca in India during the period 1950-51 to 2017-18 had shown an increasing trend while the area under tapioca was showing a declining trend since 1980. Though the area reduced to a great extent after eighties, the production was increasing steadily due to increased productivity. This result is on par with the findings of Thomas *et.al.*,(2015), who reported that the area under tapioca in India was showing a decreasing trend between TE 1982-83 to TE 2013-14, while the production and the productivity were increasing throughout the reference period. They also reported that the reduction in area in India was mainly attributed to reduction in area under tapioca in Kerala, because the share of Kerala state in area under tapioca has declined from about 57 per cent to 33 per cent during TE 1992-93 to TE 2013-14.

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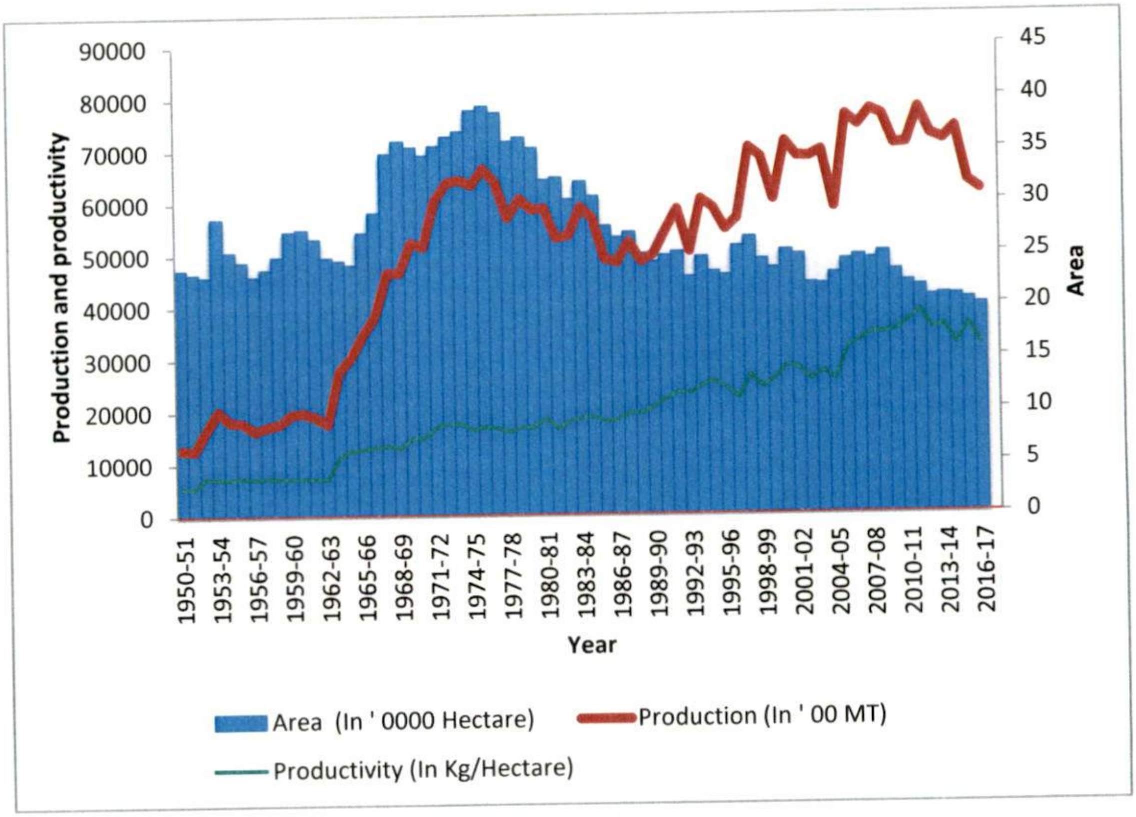

Fig. 4.1Area, production and productivity of tapioca in India

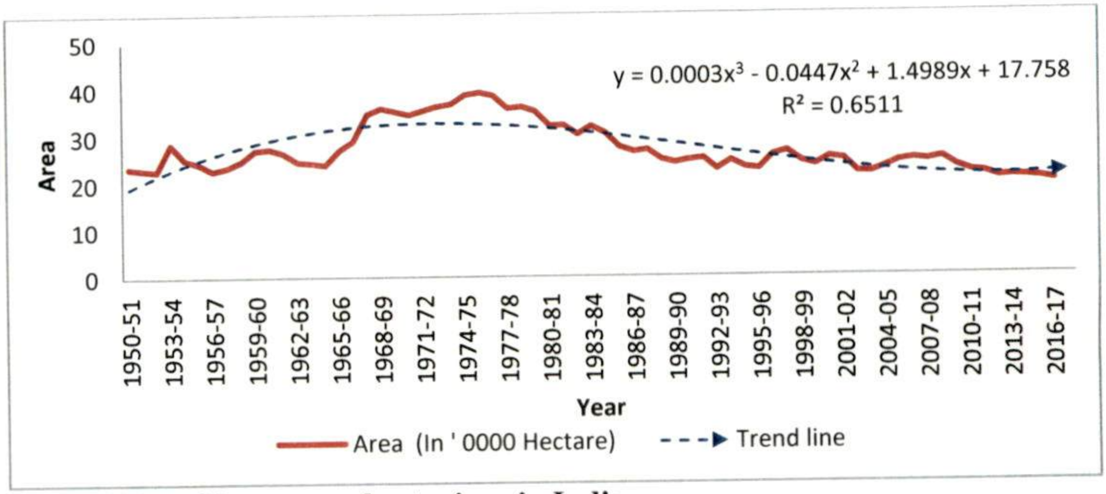

Fig. 4.2 Trend in area under tapioca in India

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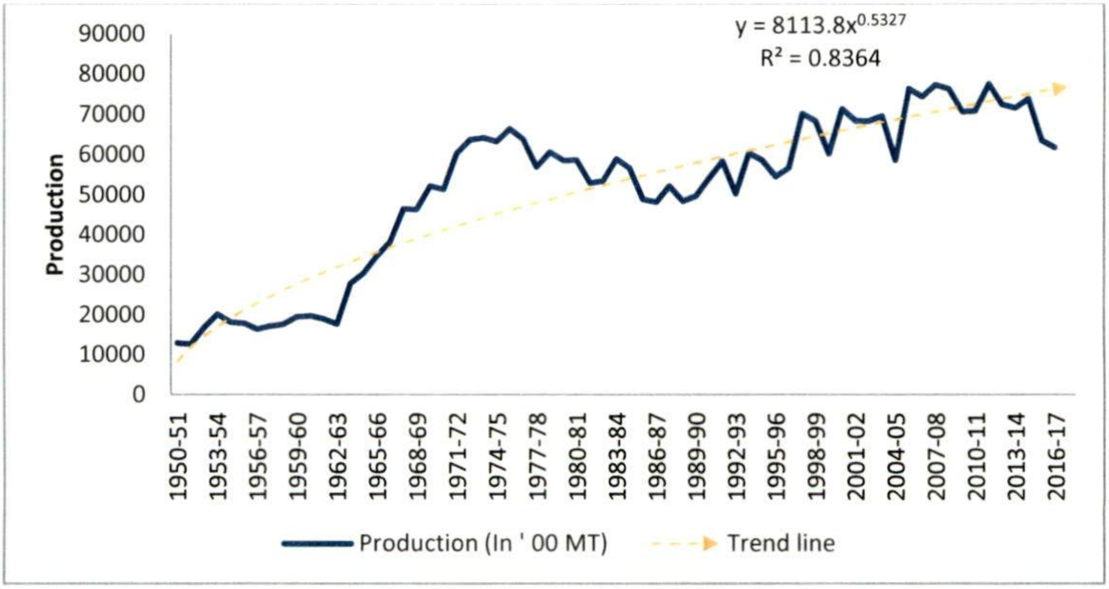

Fig. 4.3 Trend in production of tapioca in India

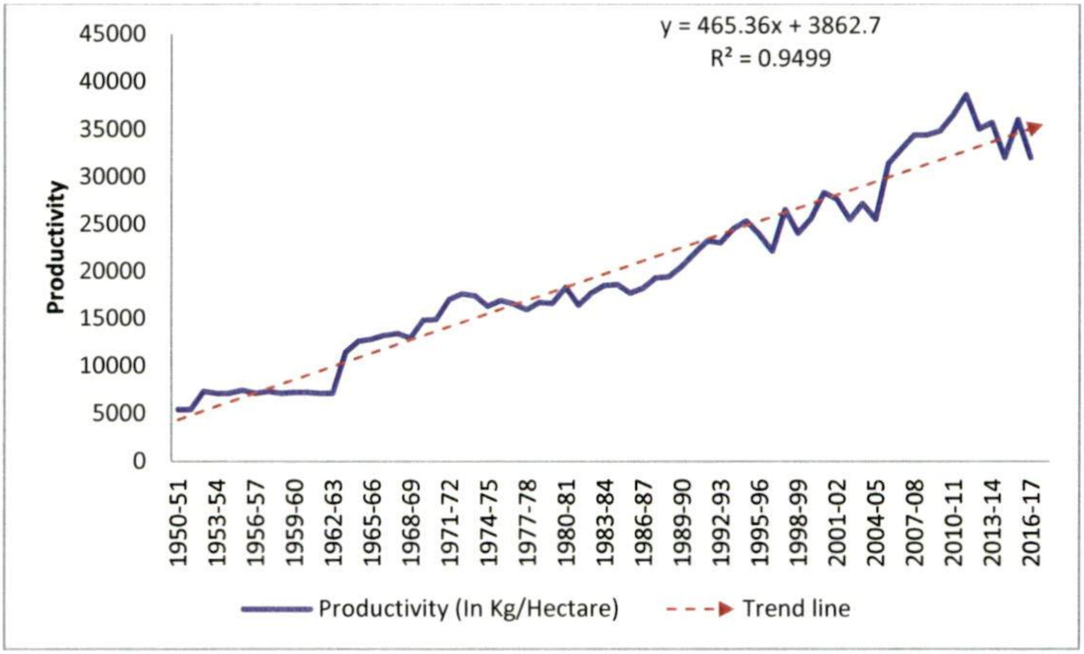

Fig. 4.4 Trend in productivity of tapioca in India

4.1.2 Kerala scenario

The area, production and productivity of tapioca in Kerala for a period from 1950-01 to 2016-17 as presented in Fig. 4.5 revealed that, Kerala had the second position in both area (0.68 lakh hectares) and production (2529.729MT) of tapioca, with a highest productivity of 36.84 tonnes per hectare in the year 2016-17. During 1975-76 the area under tapioca in Kerala reached its peak with about 3.27 lakh hectares. Later on the area showed a sharp decline reaching a bottom level of 0.68 lakh hectares in 2016-17. The maximum productivity was attained during 2014-15. From Fig. 4.6 to 4.8, it is clear that similar to Indian scenario, there was continuous declining trend in case of area during the period from 1950-51 to 2016-17. However, the production and productivity showed an increasing trend during the same period.

The results are in line with the results obtained by Elsamma and Asan (1989) who reported that, that the changes in area and production of tapioca in Kerala between 1975-76 to 1986-87 amounted to a reduction to the extent of about 41 per cent and 39 per cent respectively while productivity increased by 3.51 per cent. It may be noted that the area and production of tapioca in the state had declined, but the productivity increased continuously toward an increased production.

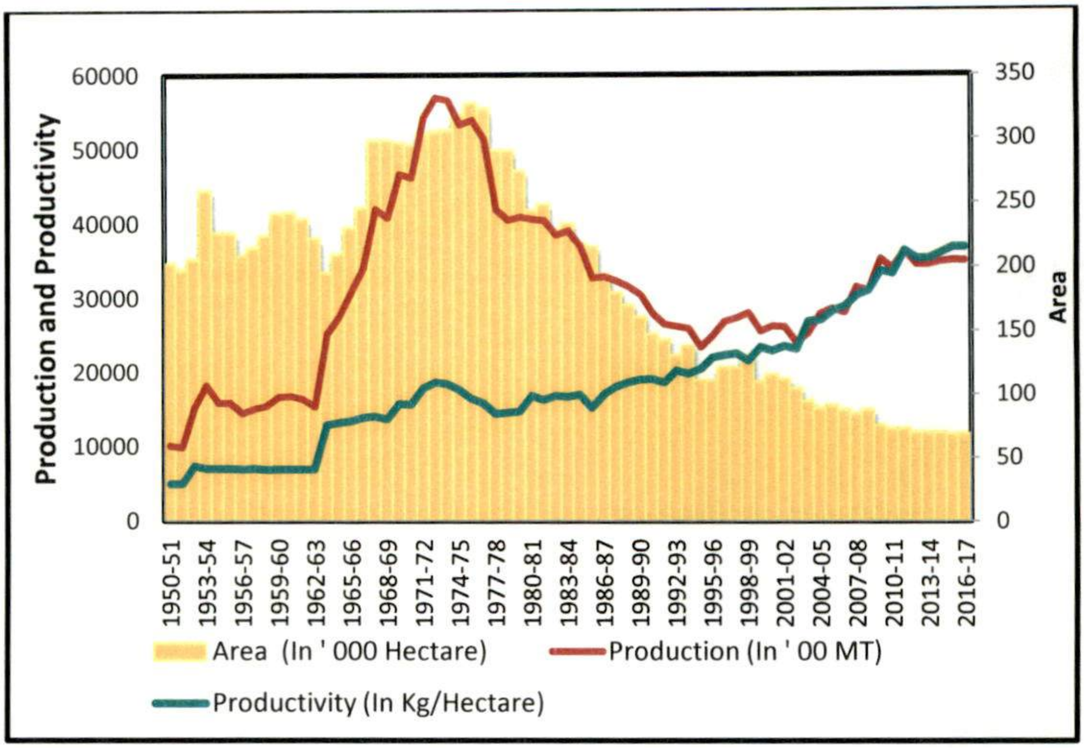

Fig. 4.5 Area, production and productivity of tapioca in Kerala

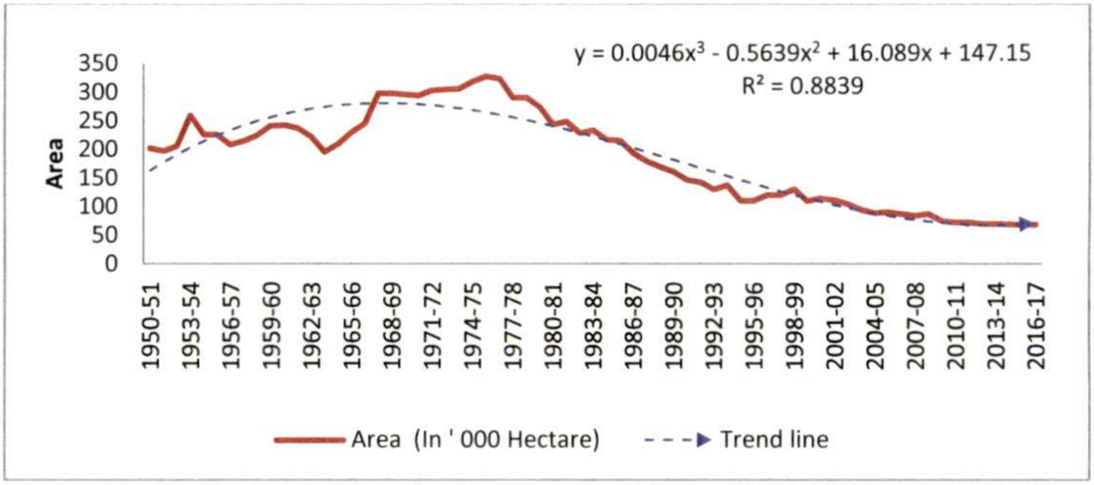

Fig. 4.6 Trend in area under tapioca in Kerala

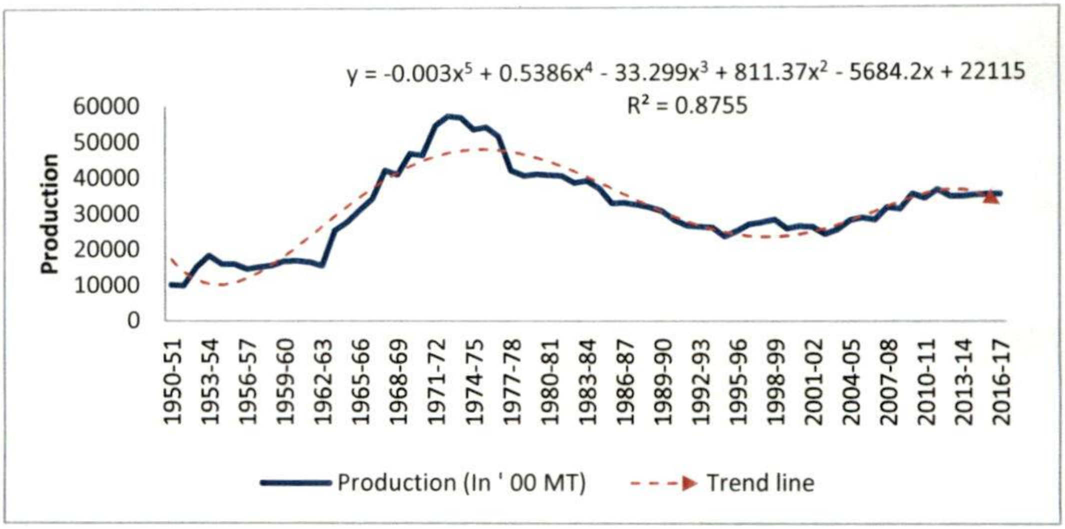

Fig. 4.7 Trend in production of tapioca in Kerala

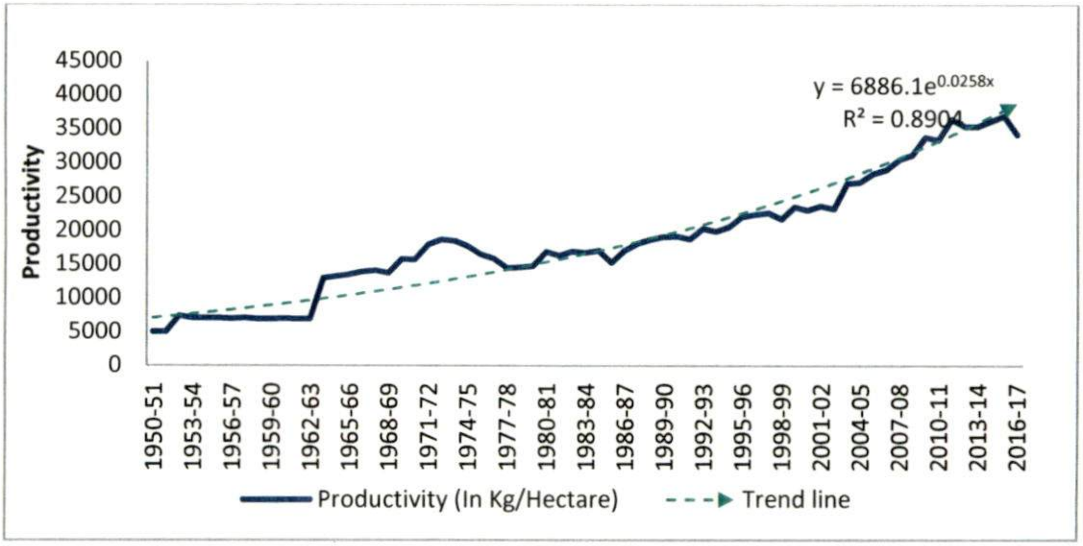

Fig. 4.8 Trend in productivity of tapioca in Kerala

4.2 Growth rates of area, production and productivity of tapioca

Based on the results of trend analysis with respect to the changes in area, production and productivity of tapioca in India and Kerala, so as to include the year to year variation in area, production and productivity, the compound growth rates were computed.Growth rate of a variable may be defined as the absolute or relative growth expressed in units of time, usually a year. Compound growth rates were computed in order to examine the year to year variations in the above variables. Here, exponential growth model was fitted to the time series data on area, production and productivity of tapioca and the results are discussed under two headings, India and Kerala. The entire study period (1950-51 to 2016-17) has been divided into two sub periods, period I: Pre-WTO regime (1950-51 to 1994-95) and period II: Post- WTO regime (1995-96 to 2016-17) and the compound growth rates in area, production and productivity of tapioca have been estimated for the two sub periods as well as for the entire period and the analytical findings are presented and discussed below.

4.2.1 India

The annual growth rates of area, production and productivity of tapioca in India for the whole period and sub- periods estimated using exponential model as presented in Table 4.1 revealed that, throughout the study period there has been considerable changes in the growth of area, production and productivity of tapioca in India. During the overall period growth in area was negative (-1.98 per cent) but production showed a stagnant growth (0.52 per cent) due to the influence of positive growth in productivity (2.53 per cent). During Period I growth in area was reduced by 0.89 per cent while the growth in production (0.40 per cent) was stagnant and productivity (1.30 per cent) was positive; which indicated that the growth in production was influenced by increased growth in productivity Period II also showed a similar pattern of negative growth in area(-1.21 per cent) and positive growth in productivity (1.36 per cent) was positive. It may be noted that growth in production was less in period II (0.13 per cent) as compared to Period I due to the sharp fall in growth in area.

The above analysis on the growth performance of tapioca in India revealed that production and productivity of tapioca had shown an increasing trend, while area t showed negative growth during the entire period as well as in sub periods. Area showed a declining trend throughout the reference period. Production and productivity during Period I exhibited an increasing trend. During Period II, in spite of a higher growth in productivity, the growth rate was lower for production due to reduced growth in area. The above result was in conformity with the findings of Edison *et.al.,(*2005), who had reported that the area showed a negative CGR for the entire study period and it was around -0.78 per cent and the production and productivity remained positive throughout the period.

Table 4.1 Compound growth rate of area, production and productivity of tapioca in India

Period	Growth rate (per cent per annum)		
	Area	Production	Productivity
Period I (1950-51 to 1994-95)	-0.89*	0.40	1.30
Period II (1995-96 to 2016-17)	-1.21*	0.13	1.36
Overall period (1950-51 to 2016-17)	-1.98*	0.52	2.53

Notes: * Indicates significance at five per cent level

4.2.2 Kerala

The growth rates in area, production and productivity of tapioca were also worked out for Kerala and results are presented in Table 4.2. During the entire period of study the growth in area, production and productivity were -2.17 per cent, 0.76 per cent and 2.97 per cent respectively, indicating that area under tapioca in Kerala was declining throughout the reference period. For the overall period higher growth in productivity significantly contributed to production, in spite of the negative growth in area. The increase in productivity had out weighted the decline in the growth of area and as a result growth rate in production remained positive throughout the study period though it was stagnant and steady.

In the period-wise analysis, Period II showed a significant decline in the growth of area by -1.53 per cent while the growth in production was positive (0.92 per cent). This was due to the significant and positive growth rates in productivity (2.73 per cent) during Period II. Similar to period II, in Period I also, growth in area was negative but the rate of decline was lesser (-0.72 per cent) compared to Period II. During period I the highest growth rate in productivity was recorded and it was about 4.32 per cent. Due to increased growth rate in productivity the highest growth rate in production was also reported in period I (3.58 per cent)

The above results on the growth trends in area, production and productivity of tapioca in Kerala were in line with the findings of Srinivas (2005) who reported that in Kerala, area under the crop was declining year after year as the importance of cassava in the food basket of the people of Kerala has been declining. According Thomas *et.al.,*(2015), the main reason for reduction in area under tapioca in Kerala was the liberalization of agricultural sector in the country and Consequently in Kerala, there has been a shift from food crops like paddy and tapioca to commercial crops like rubber, coconut and arecanut. The above report is in line with the findings of the present study.

Table 4.2 Compound growth rate of area, production and productivity of tapioca in Kerala

Period	Growth rate (per cent per annum)		
	Area	Production	Productivity
Period I (1950-51 to 1994-95)	-0.72*	3.58*	4.32*
Period II (1995-96 to 2016-17)	-1.53*	0.92*	2.73*
Overall period (1950-51 to 2016-17)	-2.17*	0.76*	2.97*

Notes: * Denotes significance at five per cent level

4.3 Price behaviour of tapioca

Tapioca is an annual crop and it is cultivated in both wetland and upland as irrigated and rainfed crop in Kerala so the harvesting and arrivals are reported throughout the year. As a result of this there is a high probability of regular price fluctuations, hence it is necessary to ensure steady price to protect the tapioca farmers. In this background, an attempt was made to analyze the price behavior of tapioca in major markets of Kerala from January 2002 to July 2018. Monthly wholesale prices of tapioca were collected from Kozhikode, Ernakulam and Chalai markets and the data was analysed.

In order to analyse the price behavior of tapioca in these markets, the monthly price data of tapioca was decomposed into the four components of time series *viz*., secular trend, seasonal variation, cyclical variation and irregular variation, assuming a multiplicative model of time series and the results obtained are described below under appropriate headings.

4.3.1 Trend analysis of price of tapioca

Trend can be defined as the general tendency of a time series data set to increase or decrease over a long period of time. In order to identify the long run price behavior of tapioca, trend analysis was done separately for each market by applying the method of least squares. Different functional forms were attempted to explain the underlying trend in the price behaviour and the model with highest R^2 value was taken as the best fit.

Exponential function was found to be the best fit in the trend analysis of price of tapioca in the selected markets. The results of trend analysis (Fig 4.8 to 4.10) revealed that, though there were fluctuations in the price of tapioca over the years the monthly average price of tapioca in all the three (Kozhikode. Ernakulam and Chalai) markets were following an exponentially increasing trend in the long run.

As explained already, in spite of high fluctuations, tapioca price in the long run had shown an exponentially increasing trend in all the three markets *Viz.*, Kozhikode, Ernakulam and Chalai markets. These results are in conformity with the findings of Jayasree (2012) who reported that, the growth in cassava price was slow but increasing.

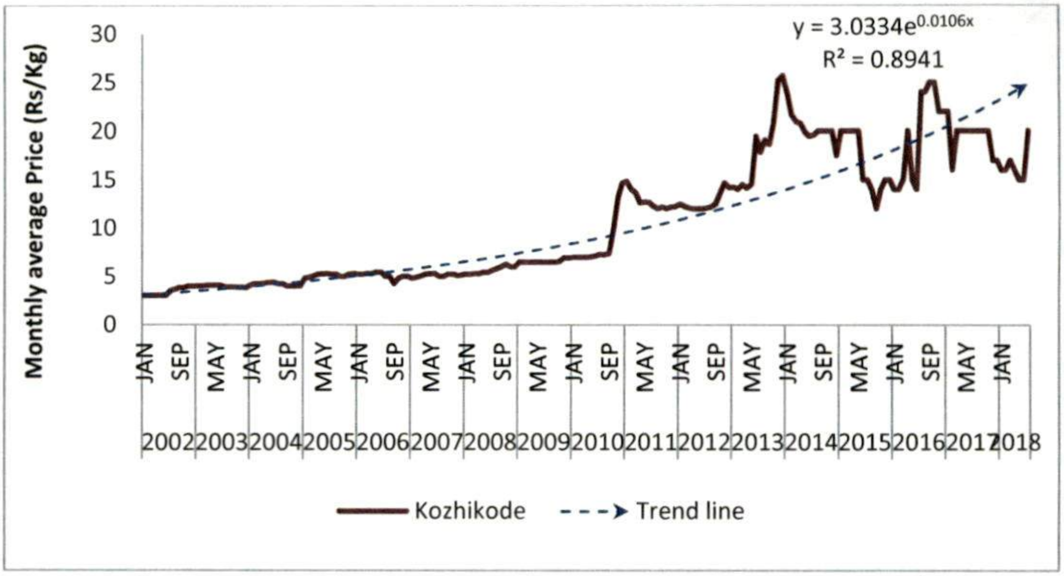

Fig. 4.9 Trend in tapioca prices in Kozhikode market

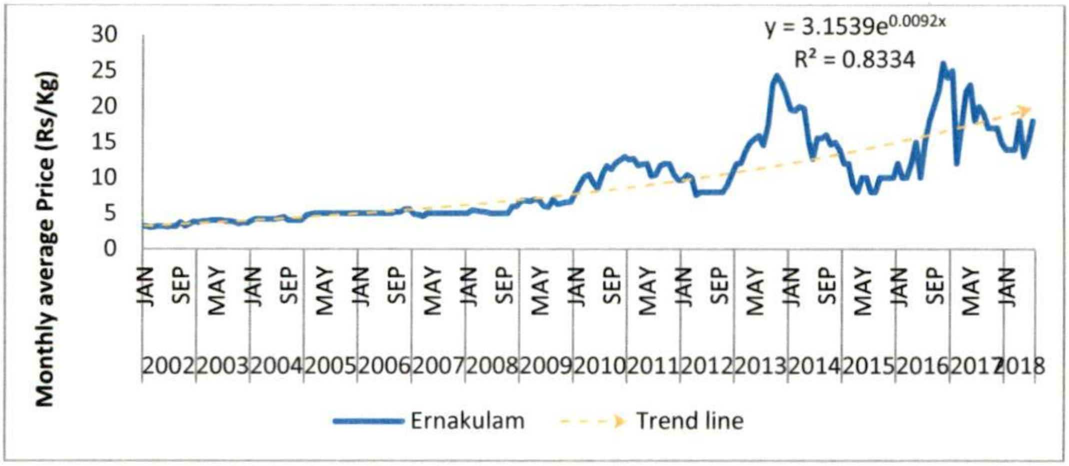

Fig. 4.10 Trend in tapioca prices in Ernakulam market

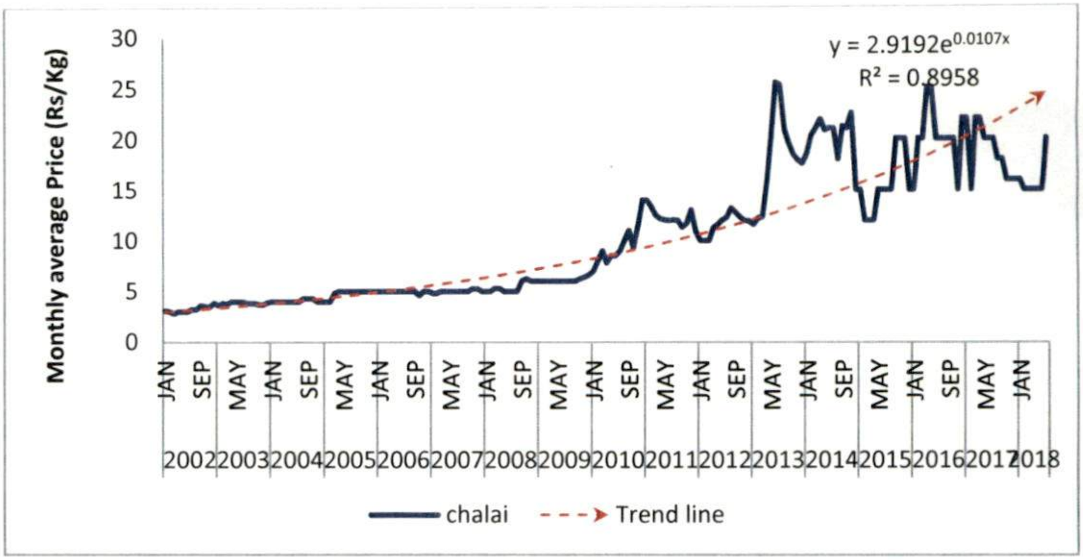

Fig. 4.11 Trend in tapioca prices in Chalai market

4.3.2 Seasonal variations in the prices of tapioca

The variations in time series data which occur at specific regular intervals less than 12 moths, such as weekly, monthly and quarterly intervals are called seasonal variations (Croxton *et. al.,* 1979). Price fluctuations in agricultural commodities are related to seasonality in production. The seasonal variations in the prices of tapioca during 2002 January to 2018 July were analysed using ratio to moving average method and the results are presented below.

The seasonal variations in the price of tapioca from 2002 to 2018 are presented in Table 4.3. It revealed that the highest price for tapioca in the Kozhikode market was observed in November whereas, the lowest price was observed in July. The period from October to March was found to be the buoyant phase and April to September was observed as the depressed phase (Fig. 4.12). In Ernakulam market, the buoyant phase was found to be from August to February with peak price in January. The depression phase was observed from March to July with the trough being in July (Fig. 4.13). In Chalai market, a long period of boom was observed from March to November and the peak price for tapioca in Chalai market was observed in September. While comparing to other markets only a small phase of depression was observed in Chalai market (Fig 4.14) (December to February), with the trough being in February.

Earlier, Srinivas and Anantharaman (2005) had reported price troughs from January to June quarters coinciding with the harvest of cassava in Tamil Nadu and price peaks during the lean arrival period from July to September quarter. Thus, the cassava growers at large were faced with a distorted market on account of intrayear price fluctuations in the main cassava planting season in Kerala (April and May planting) as the peak production season was characterized by trough prices and the lean production period was characterized by buoyant prices.

To summarise the discussion, there was considerable seasonality in the price of tapioca in Kozhikode, Ernakulam and Chalai markets in spite of the fact that tapioca is a short duration crop and its production takes place round the year in Kerala as it is cultivated in all the three seasons as both irrigated as well as rain fed crop. As mentioned earlier, the seasonal behaviour of price of tapioca in Kozhikode, Ernakulam and Chalai markets was distinctly different and not synchronised.

Table 4.3 Seasonal indices for tapioca in Kozhikode, Ernakulam and Chalai markets.

Month	Kozhikode	Ernakulam	Chalai
January	101.9	103.0	96.4
February	99.8	101.5	95.7
March	100.9	100.8	100.0
April	101.7	102.2	102.5
May	99.6	101.5	102.8
June	99.1	91.6	101.0
July	98.6	96.1	100.7
August	98.7	99.3	99.9
September	96.6	101.3	102.9
October	99.9	99.9	100.3
November	102.3	102.1	100.2
December	101.0	100.8	97.6

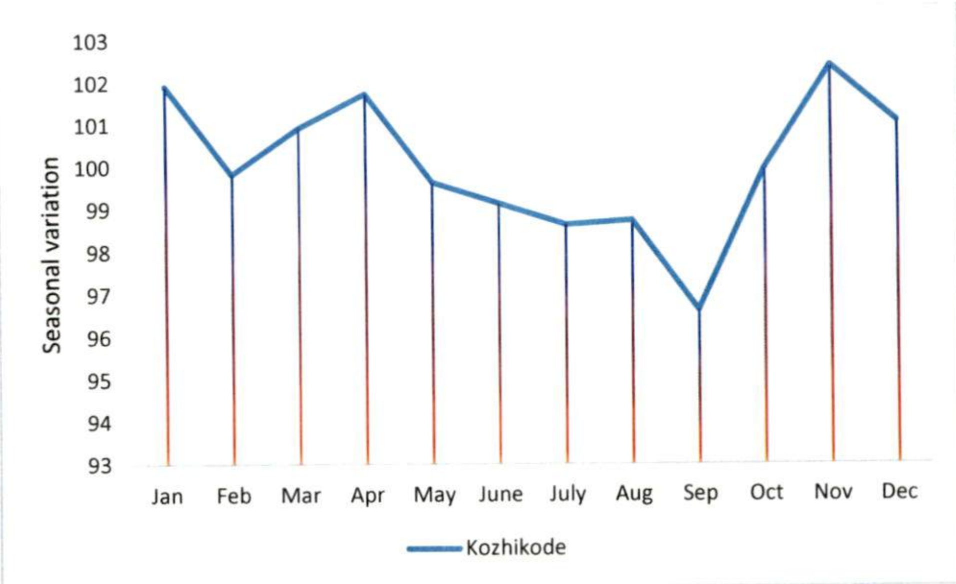

Fig. 4.12 Seasonal variations in Tapioca prices in Kozhikode market

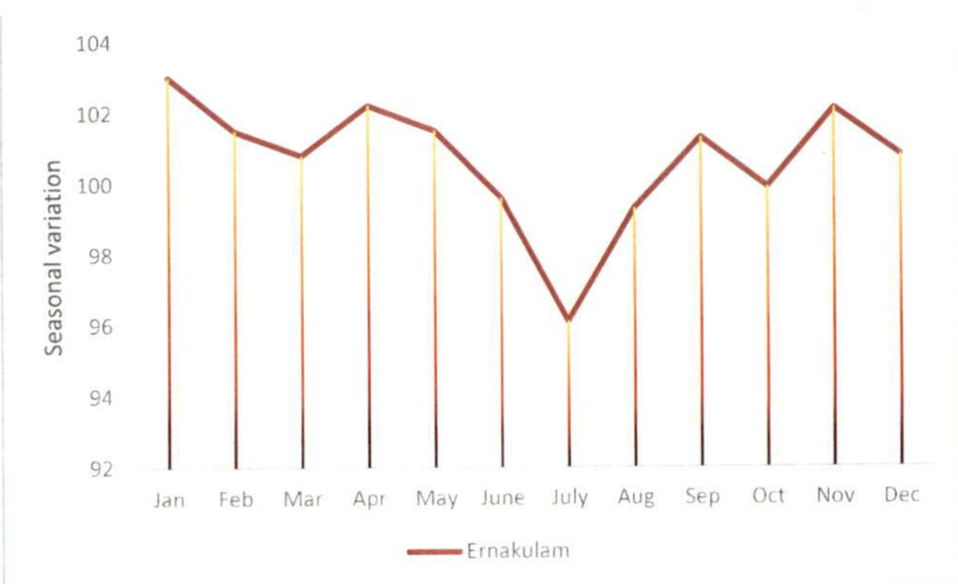

Fig. 4.13 Seasonal variations in Tapioca prices in Ernakulam market

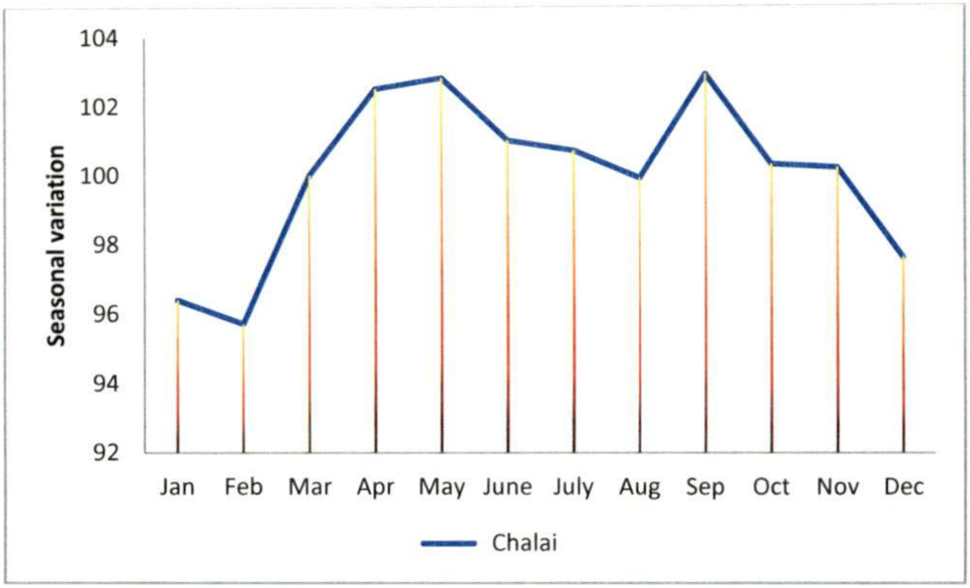

Fig. 4.14 Seasonal variations in Tapioca prices in Chalai Market

4.3.3 Cyclical variations

Cyclical variations are the oscillatory movements in a time series with a period of oscillation more than one year. Cyclic variations in the price of tapioca in major markets of Kerala were worked out by averaging the data after eliminating the trend and seasonal and irregular variations from the original data. The cyclical indices of tapioca for Kozhikode, Ernakulam, and Chalai markets are presented in Fig. 4.15 to 4.17.

Cyclical variation of tapioca prices was dissimilar in Kozhikode, Ernakulam and Chalai markets and the length of the cycles could not be clearly established with the given pattern of cyclical variations as the cycles were small. This result is similar to the findings of Varghese (2011), who reported cycles of short spells for natural rubber during 1995 to 2011. Jayasree *et. al.,*(2012) also reported that short cycles were visible in the price of tapioca during the period from July 1999 to June 2001. It implies that though the booms and depressions in the economy may affect the macro economic variables, price cycles are influenced more by production cycles, consumption and trade patterns and sector wise policies also.

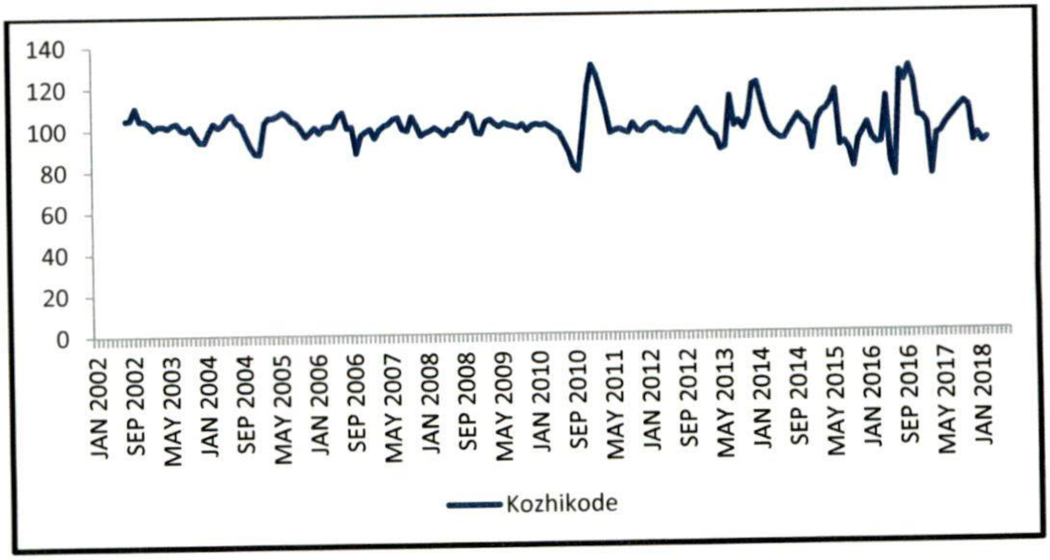

Fig.4.15 Cyclical variation in tapioca prices in Kozhikode market

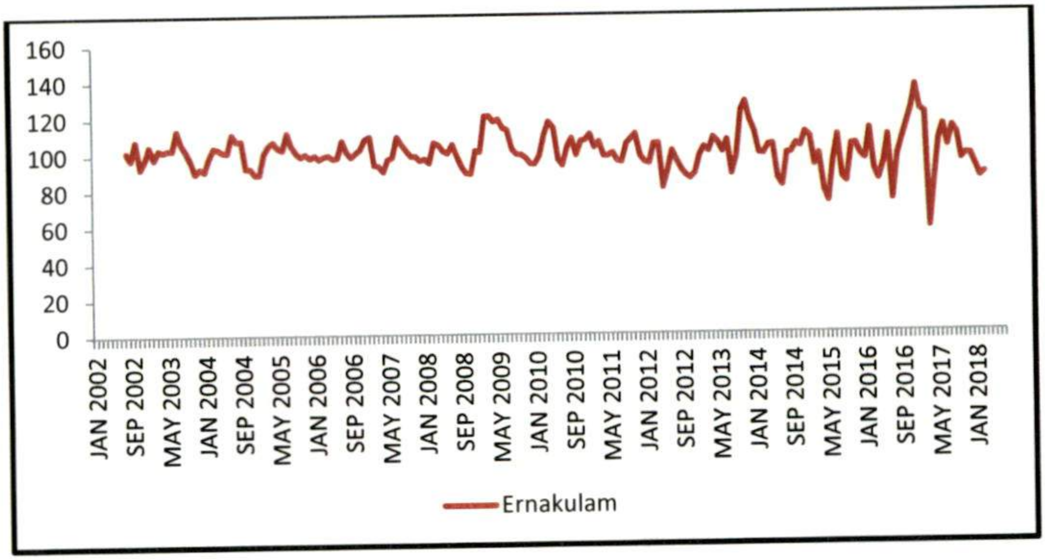

Fig.4.16 Cyclical variation in tapioca prices in Ernakulam market

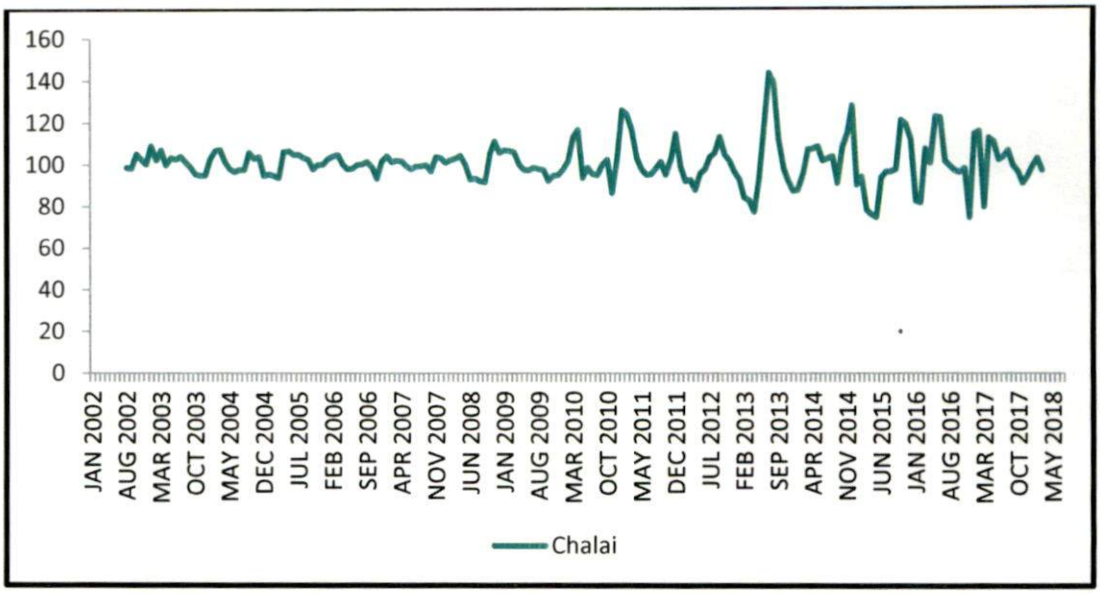

Fig.4.17 Cyclical variation in tapioca prices in Chalai market

4.6.4 Irregular variations

Random, unforeseen, non-recurring and sporadic fluctuations in a time series which are not attributed to seasonal, cyclical or secular factors are referred as irregular variation. These variations short duration effects which are purely random, erratic and unpredictable. Irregular variations in the prices of tapioca occurred owing to numerous non-recurring and irregular circumstances is represented in Fig. 4.18 to 4.20. It was observed that the irregular variations in tapioca price was highly unforeseen and did not follow any uniform pattern over the period.

The above results can be compared with the results of other similar studies. Highly irregular variations were expected in tapioca prices as it is a primary produce characterised by bulkiness and short shelf life. Moreover, tapioca being a small holder's crop, producer sells it immediately after harvest at prevailing market price. To sum up the discussion on price behaviour, secular trend, seasonal variation, cyclical variation and irregular variation were observed in tapioca price

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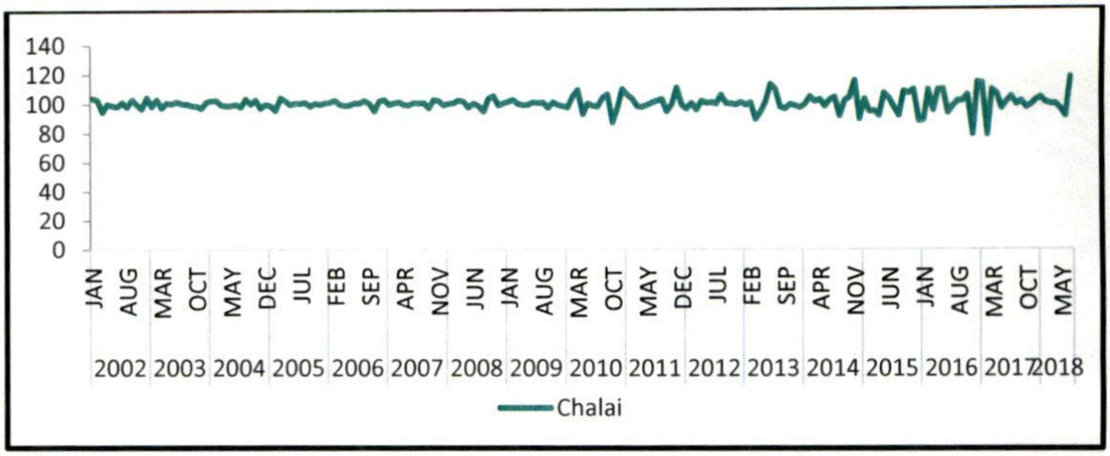


Fig.18 Irregular variations in Tapioca prices in Chalai market

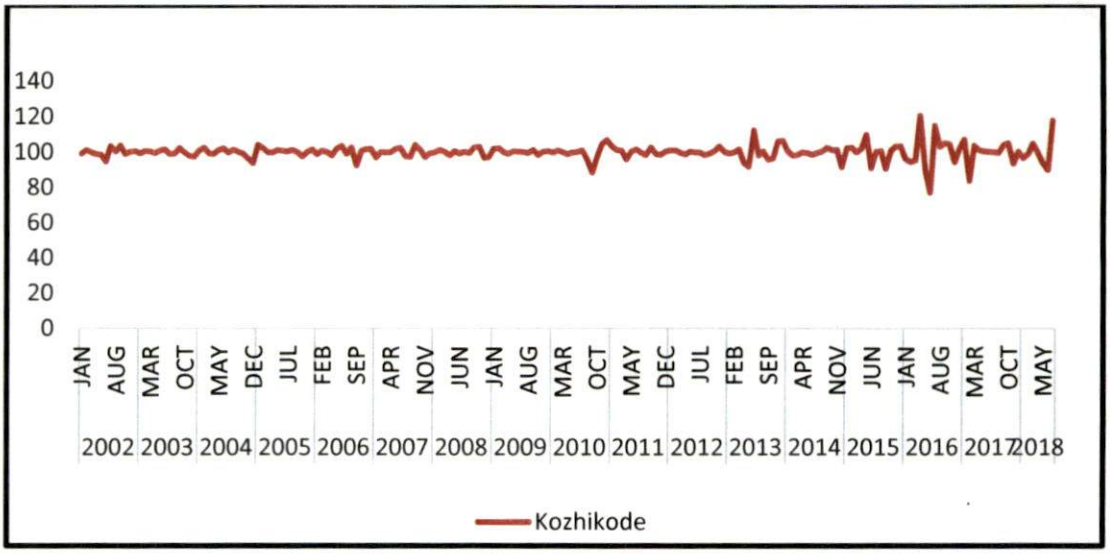


Fig.19 Irregular variations in Tapioca prices in Kozhikode Market

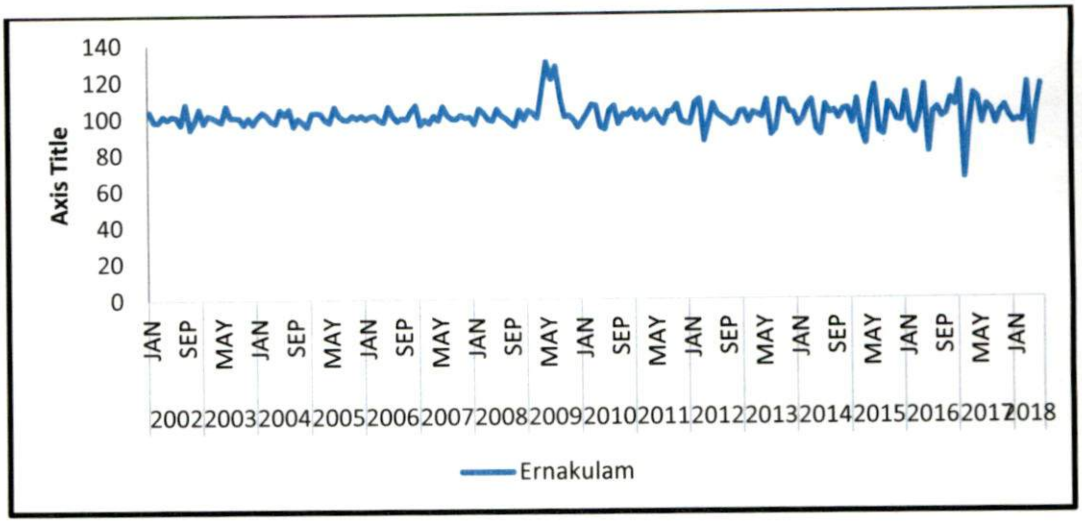


Fig.20 Irregular variations in Tapioca prices in Ernakulam market

4.3.5 Market integration and price transmission

4.3.5.1 Cointegration analysis using monthly prices

The concept of cointegration of market prices explains the relationship between the prices in two or more spatially separated markets. In this study, the integration among three markets, Kozhikode, Ernakulam and Chalai for tapioca prices was examined using cointegration analysis. Cointegration is regarded as the empirical counterpart of the theoretical notion of a long run relationship between two or more variables. Augmented Dickey Fuller (ADF) unit root test was employed prior to attempting Johansen's cointegration tests, to confirm non-stationarity of the data levels and also that the prices were integrated of the same order. A time series is said to be stationary if the underlying generating process is based on a constant mean or a constant variance.

All the price series were transformed into natural logarithms before testing for stationarity as well as cointegration. The estimated test statistics from ADF tests for tapioca prices in both the markets at levels and first difference in different time periods are presented in Table 4.4. The results showed that the price series of tapioca in Kozhikode, Ernakulam and Chalai markets were stationary at their first differenced series; hence the null hypothesis of non-stationarity for tapioca prices in both the markets could be rejected after first differencing.

The procedure for cointegration propounded by Johansen (1988), Johansen and Juselius (1990, 1992) and Juselius (2006) were used in this study. The Johansen's maximal eigen value and trace tests detects the number of cointegrating vectors that exist between two or more time series that are econometrically integrated. Cointegration analysis was carried out for the price series which were of the same order of integration. The results of cointegration tests among the prices of tapioca Kozhikode, Ernakulam, and Chalai markets as presented in Table 4.5 revealed that the null hypothesis of no cointegration ($r = 0$) was rejected for the study period on the basis of confirmation of the null hypothesis of presence of cointegration ($r = 1$). It could be observed from Table 4.5 that one cointegration relationship exists between Kozhikode, Ernakulam and Chalai markets at 5 per cent level of significance with critical value for $r = 0$ and $r = 1$ as 15.49 and 3.76 respectively. Similarly, all the pair-wise cointegration using tapioca price series *viz.,* Kozhikode, Ernakulam and Chalai proved that one cointegration relationship existed between all the markets, which proved the co-movement of tapioca prices in different markets within the state.

Three market price series for tapioca, *viz.,* Kozhikode, Ernakulam and Chalai were integrated of the same order and hence, the test for co-integration among multiple markets was attempted using the Maximum Likelihood Estimation procedure. In this case, the null hypothesis of no cointegration and at least one cointegration ($r=0$, $r=1$) could be rejected at one per cent level of significance for all the periods. But the null hypothesis of $r = 2$ was accepted confirming that there are two or less than two cointegrating vectors among the different price series. The results revealed that in case of tapioca prices, Kozhikode, Ernakulam and Chalai markets were integrated with each other indicating that the variation in tapioca prices in each market influences the tapioca prices of other market.

Table 4.4 Results of Augmented Dickey Fuller tests for monthly prices of tapioca

Market		2002-2018 July
Levels	Kozhikode	-2.83
	Ernakulam	-3.65
	Chalai	-3.36
First difference	Kozhikode	-10.93*
	Ernakulam	-12.19*
	Chalai	-14.93*

Table 4.5 Results of pair-wise cointegration tests between monthly tapioca price in Kerala

Market/price series	Eigen value	Null	Trace statistics
Kozhikode and Ernakulam	0.114	r = 0	25.45
	0.007	r <=1	1.401
Kozhikode and Chalai	0.194	r = 0	43.96
	0.006	r <=1	1.267
Ernakulam and Chalai	0.104	r = 0	23.062
	0.007	r <=1	1.378

Note: Critical value for r= 0 is 15.41 and r<=1 is 3.76 at five per cent level of significance

Table 4.6 Results of multiple cointegration tests between prices of tapioca in Kozhikode, Ernakulam and Chalai markets of Kerala

Market / price series	Eigen value	Null	Trace statistics
Kozhikode, Ernakulam and Chalai	0.210	r = 0	67.74
	0.962	r <=1	21.15
	0.006	r <=2	1.210

Note: Critical value for r= 0 is 29.68, r =1 is 15.41 and r =2 is 3.76 at five per cent level of significance

4.3.5.2 Direction of price transmission - Granger Causality Tests

The cointegration analysis proved that the tapioca prices moved together and there is transmission of price signals between Kozhikode, Ernakulam and Chalai markets and that there is causality at least in one direction. But it does not provide information regarding the direction of flow of information on prices, *i.e.* whether it is from Kozhikode to Ernakulam market or from Ernakulam to Kozhikode market or in both directions. The Granger causality tests provide additional evidence as to whether and in which direction, price transmission is occurring. The tests carried out on monthly prices (Table 4.7) proved that Ernakulam market caused the Kozhikode market prices of tapioca in both the directions while the Kozhikode market influenced Chalai marked in one direction. Similarly Ernakulam market also influenced Chalai market and this influence was unidirectional, that is from Ernakulam to Chalai.

Table 4.7 Results of the Granger causality tests for monthly prices of tapioca

Null hypothesis	F Stat	Probability
Kozhikode does not granger cause Ernakulam	6.22*	0.002
Ernakulam does not granger cause Kozhikode	5.17*	0.006
Kozhikode does not granger cause Chalai	11.11*	0.003
Chalai does not granger cause Kozhikode	1.91	0.15
Ernakulam does not granger cause Chalai	3.24*	0.41
Chalai does not granger cause Ernakulam	0.33	0.72

Note: * Denotes significant at one per cent level

To summarise this discussion, till now we had seen the scenario of trend in area, production and productivity of tapioca in India and Kerala and price behaviour and price transmission of tapioca. Since the subsequent sections involve micro level analysis with primary data collected from sample respondents it may be in the fitness of things to provide some relevant information about the sample households. A brief description of the general socio- economic features of the respondent farmers with respect to land holding, family size, age, education, occupation etc. has been included in the coming section in order to serve as a background to the study.

4.4 Socio economic profile of sample respondents

The socio economic background of sample respondents gives an idea of distribution of sample respondents based on different profile characteristics like age, family size, gender, education, occupation, land holding, annual income and experience in farming and provides a better understanding of the farms as well as the rural farming scenario.

4.4.1 Age

The sample farmers were classified into three categories that is age between 20 to 40, 40 to 60 and greater than 60. The results of this are presented in Table 4.8. From the table it is found that majority of the tapioca growers falls under the age group of 40 to 60 years that is, 51.67 per cent, however 37.50 per cent of them are above 60 years. Only 10.83 per cent of farmers fall under the category of 20 to 40 years, which suggests the declining interest of youngsters in agriculture and allied sectors.

Table 4.8 Age-wise distribution of sample respondents

Age	Kollam		Malappuram		Total
	Chadayamangalam	Sasthamcotta	Perinthalmanna	Wandoor	
20-40	2 (6.67)	4 (13.33)	5 (16.67)	2 (6.67)	13 (10.83)
40-60	19 (63.33)	14 (46.67)	16 (53.33)	13 (43.33)	62 (51.67)
>60	9 (30.00)	12 (40.00)	9 (30.00)	15 (50.00)	45 (37.50)
Total	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)

Note: Figures in parentheses indicate per cent to column total

4.4.2 Gender

The gender-wise status of sample farmers is presented in Table 4.9. from the table it is clear that out of 120 the farmers, majority were males that is around 89.17 per cent and only thirteen respondents (10.83 per cent) were females. This shows that participation of women in agriculture is declining

Table 4.9 Gender-wise distribution of sample respondents

Gender	Kollam		Malappuram		Total
	Chadaya Mangalam	Sastham cotta	Perinthalm anna	Wandoor	
Female	4 (13.33)	3 (10.00)	4 (13.33)	2 (6.66)	13 (10.83)
Male	26 (86.67)	27 (90.00)	26 (86.67)	28 (93.33)	107 (89.17)
Total	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)

Note: Figures in parentheses indicate per cent to column total

4.4.3 Family size

The family size of the sample farmers according to the total number of family members are depicted in Table 4.10. The sample respondents were classified into two groups based on family size viz., family o with 1 to 3 members and 4 to 6 members. It could be understood from the table that majority of the (around 88.33 per cent) farmers came under the group of 4 to 6 members per family and only remaining 11.6 per cent was under the category of 1 to 3 members. The availability of labour for farm operations is supposed to increase in accordance with the number of family members. Farmers who fall under the family size of 4 to 6 members were using family labour in substitution with hired labour.

Table 4.10 Distribution of sample respondents based on family size

Family size	Kollam		Malappuram		Total
	Chadaya Mangalam	Sasthamcotta	Perinthalmanna	Wandoor	
1-3	2 (6.67)	7 (23.33)	2 (6.67)	3 (10)	14 (11.67)
4-6	28 (93.33)	23 (76.67)	28 (93.33)	27 (90.00)	102 (88.33)
Total	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)

Note: Figures in parentheses indicate per cent to column total

4.4.4 Education

In table 4.11 the sample respondents were classified based on their educational status. Educational status is an indicator to determine the efficiency of any field activity. It was revealed that 42.50 per cent of them had education up to pre-degree, 30 per cent of them were having primary education. 15 per cent up to the primary level and 7.50 per cent were graduates.

Table 4.11 Distribution of sample respondents according to their educational status

Education	Kollam		Malappuram		Total
	Chadaya-mangalam	Sastham-cotta	Perinthal-manna	Wandoor	
Primary	9 (30)	7 (23.33)	14 (46.67)	6 (20)	36 (30)
Secondary	13 (43.33)	13 (43.33)	9 (30)	16 (53.33)	51 (42.50)
Pre-degree	3 (10.00)	4 (13.33)	4 (13.33)	7 (23.33)	18 (15.00)
Graduate	3 (10.00)	2 (6.67)	3 (10.00)	1 (3.33)	9 (7.50)
Diploma	2 (6.67)	2 (6.67)	0 (0.00)	0 (0.00)	4 (3.33)
PG	0 (0.00)	2 (6.67)	0 (0.00)	0 (0.00)	2 (1.67)
Total	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)

Note: Figures in parentheses indicate per cent to column total

4.4.5 Land holding pattern

The classification of sample farmers based on the size of their operational holdings is presented in Table 4.12. It could be observed from the table that majority of the farmers were having holdings of less than five acres (93.33 per cent), only 6.67 per cent had more than five acres of land. Out of small farmers 31.67 per cent had very small holding of less than one acres and 30 per cent fell under the category of less than 2 acres.

Table 4.12 Distribution of sample respondents according to size of land holding

Area in Acres	Kollam		Malappuram		Total
	Chadayamangalam	Sasthamcotta	Perinthalmanna	Wandooor	
<1	14 (46.67)	10 (33.33)	6 (20.00)	8 (26.67)	38 (31.67)
1-2	8 (26.67)	12 (40.00)	7 (23.33)	9 (30.00)	36 (30.00)
2-5	6 (20.00)	7 (23.33)	14 (46.67)	11 (36.67)	38 (31.67)
>5	2 (6.67)	1 (3.33)	3 (10)	2 (6.67)	8 (6.67)
Total	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)

Note: Figures in parentheses indicate per cent to column total

4.4.6 Occupation of respondents

The distribution of sample respondents based on their occupation is given in Table 4.13. It is clear from the table that 85 per cent of the farmers were dependent on agriculture and allied sectors as their main source of income. Only 6.67 per cent of the farmers were working in public sector and 8.33 per cent were working in public sector were self-employed.

Table 4.13 Distribution of sample respondents based on their occupation

Occupation	Kollam		Malappuram		Total
	Chadayamangalam	Sasthamcotta	Perinthalmanna	Wandoor	
Agriculture	24 (80)	28 (93.33)	26 (86.66)	24(80)	102 (85)
Public sector	3(10)	1(3.33)	3 (10)	1(3.33)	8 (6.67)
Self employed	3(10)	1(3.33)	1 (3.33)	5(16.66)	10 (8.33)
Total	30 (100.00)	30 (100.00)	30(100.00)	30(100)	120 (100)

Note: Figures in parentheses indicate per cent to column total

4.4.7 Annual income

The distribution of sample respondents based on their annual income is shown in Table 4.14. A comparison of the two districts revealed that 40 per cent of respondents in Kollam district and 58.33 per cent in Malappuram district had income below ₹ 25000. It was also found that sample tapioca farmers with a high income of above two lakh were more in Kollam district (60 per cent). Out of total sample respondents 49.13 per cent had income below ₹ 25000 and 47.50 percent belonged to an income group between ₹ 25000 and ₹ one lakh. Only 3.33 per cent of the total sample respondents fell under the category of above two lakh.

Table 4.14 Distribution of sample respondents based on their annual income

Annual income (Rupees)	Kollam		Malappuram		Total
	Chadaya-mangalam	Sastham-Cotta	Perinthal-manna	Wandoor	
<25000	15 (50)	9 (30)	14 (46.67)	21 (70)	59 (49.13)
25000-1 lakh	14 (46.67)	18 (60)	16 (53.33)	9 (30)	57 (47.50)
>2 lakh	1 (3.33)	3 (10)	0 (0)	0 (0)	4 (3.33)
Total	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)

Note: Figures in parentheses indicate per cent to column total

4.4.8 Experience in farming

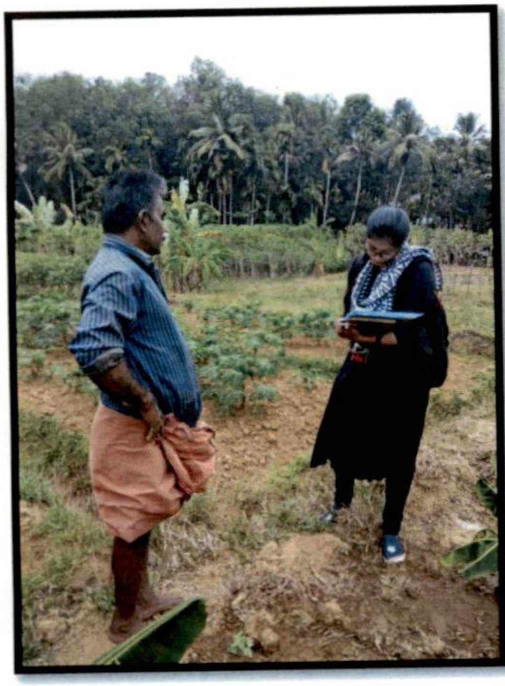
The number of years of experience of sample tapioca farmers is represented in Table 4.15. The farmers were categorized into two according to their experience in farming as having one to 20 years of experience and more than 20 years of experience. It could be observed from the table that around 58.33 per cent of the farmers were having more than 30 years of experience in tapioca farming and 41.67 per cent have an experience between 5 and 20 years.

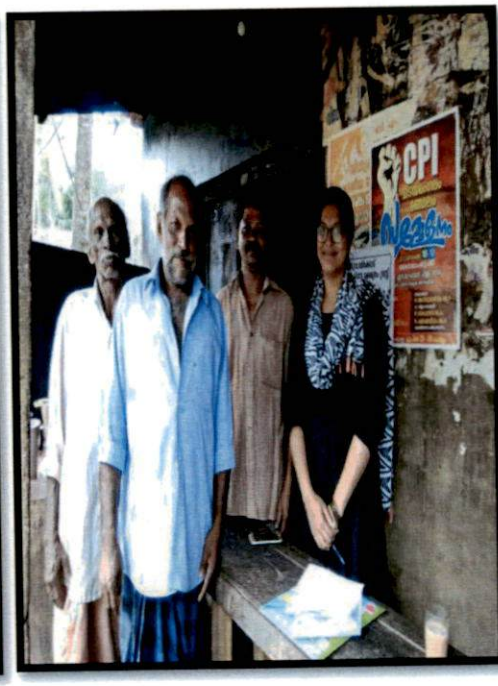
Table 4.15 Distribution of sample respondents based on their experience

Experience (Years)	Kollam		Malappuram		Total
	Chadayam angalam	Sastham Cotta	Perinthal Manna	Wandoor	
0 – 20	10(33.33)	15(50.00)	12(40.00)	13(43.33)	50(41.67)
>20	20(66.67)	15(50.00)	18(60.00)	17(56.67)	70(58.33)
Total	30 (100.00)	30(100.00)	30 (100.00)	30 (100.00)	120(100.00)

Note: Figures in parentheses indicate per cent to column total

Socio economic features were studied to understand the back ground of the sample farmers and based on the data collected from sample respondents, cost and returns, marketing cost, margin, price spread and marketing efficiency of tapioca were worked out.

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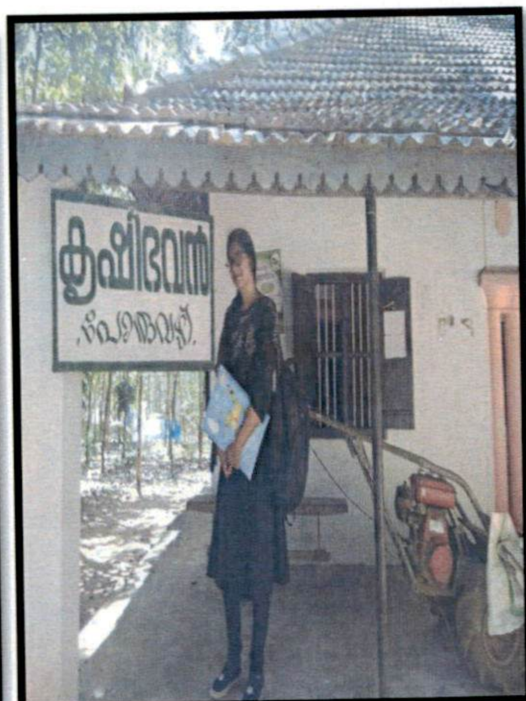
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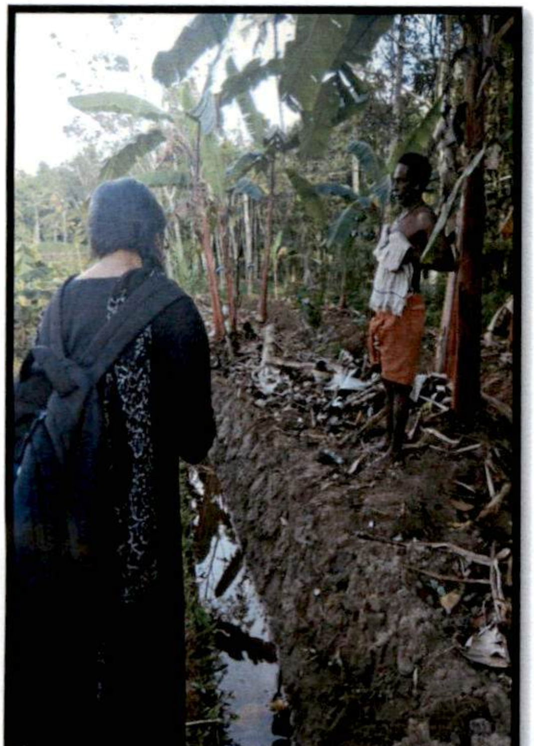

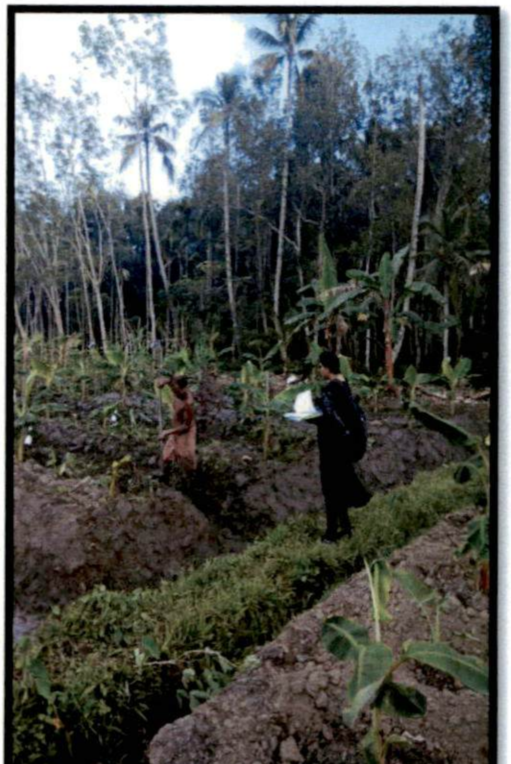

Plate 1: Survey in the study area

4.5 Economics of tapioca cultivation

Tapioca is an annual tuber crop and it is grown in all the three seasons in Kerala. Under upland conditions, farmers plant tapioca with the onset of monsoon i.e., during March-April, June July and September-October. Setts of 15 to 20 cm are planted at a spacing of 75 x 90 cm. Generally farmers incorporate FarmYard Manure (FYM) at the time of land preparation. Intercultural operations include weeding and turning the soil upside down around the base of the plant. Generally the first weeding is done 30 to 45 days after planting, second weeding at 5 to 6 months age of the crop and during the latter, soil is tilted so as to cover the base of the plant. Intercultural operations are done manually with the help of a spade. irrigation is given only during initial stages of planting; irrigation is given four to five times during the first fortnight after planting. In some locations in upland conditions, farmers take up pot watering to the cassava plants during initial days when planted during March-April. Two methods are followed in harvesting tapioca in Kerala. Harvesting by farmer himself that is farmers harvest an area of 2 to 3 cents every day. Tubers are collected and taken to the nearby market for selling. This process continues for 10 to 15 days depending on the area cultivated by farmer. Another method is harvest by contract merchant, here contract merchants purchase cassava grown by farmer and the tubers are valued based on random observation of tubers from plants in the field. If the farmer is satisfied by the value offered, crop is sold to the merchant. Expenditure on harvesting, collecting, loading and transportation is borne by the contract merchant.

The cost of cultivation refers to the total expenses incurred by the farmers, expressed per unit area. The cost of cultivation of tapioca in the study area was worked out and the obtained results are presented in this segment. All the costs from planting up to the harvesting of the crop including cost of hired human labour, machine labour, cost of manures and fertilizers, irrigation cost, cost of plant protection chemicals, harvesting cost and interest on working capital were added in Cost A_1 rent on leased land, rent on owned land, imputed wage of family labour and management cost were included in accounting of Cost B and C. From this cost A, B and C were worked out for accounting of economics of tapioca. The costs according to cost concepts were worked out at aggregate level as well as for the different districts (Kollam and Malappuram) are presented in Table 4.16. For calculating gross and net returns, an average price of ₹ 9.8 per kilogram which prevailed during the survey period from January to April was considered.

Cost A_1, A_2, B_1, B_2, C_1, C_2, per hectare were worked out separately for both Kollam and Malappuram and in an aggregate level. From the results of cost of cultivation analysis it was revealed that hired labour costs accounted for larger share in cost A1 in both the districts. The share of different components in cost A_1 in Kollam, Malappuram and for aggregate levels presented in Fig 21 to 23 and the results revealed that majority of the production cost is contributed by labour cost followed by cost of manures and interest on working capital in all the three cases. In Kollam and Malappuram districts as well as in aggregate level cost of hired human labour contributed around 63 per cent to 64 per cent. Cost of manures was the second highest cost in all the three categories. Cost of farm yard manures and fertilizers was worked out as 27104 rupees per hectare in aggregate level and in Malappuram and Kollam it was ₹26007 per hectare and ₹26168 per hectare respectively. After adding all the components cost A1 in Malappuram district was found to be ₹ 119600 per hectare and for Kollam district it was around ₹125600 per hectare. It may be noted that Cost A1 in Kollam was larger compared to cost A1 in Malappuram. The aggregate cost A1 for all the sample respondents was found to be ₹ 121219 per hectare. In Kollam, Malappuram and for aggregate levels cost C3 was worked out as ₹ 159191 per hectare, ₹153139 per hectare and ₹154619 per hectare respectively.

The above results on cost of cultivation of tapioca was on par with the results obtained by Sheena (1997) while conducting a study on economics of production and marketing of tuber crops in Palakkad district. She reported that cost on other items accounted for the highest share in coat A_1 followed by labour cost and material cost. She also opined that the high cost of cultivation was due to higher expenditure on labour.

Table 4.16 Cost of Cultivation of Tapioca (Rs/hectare)

Sl. No.	Components	Kollam	Malappuram	Aggregate
1	Hired human labour	78630	75600	77175
2	Hired machine labour	2455	2342	2438
3	Manures	19258	18547	18902
4	Fertilizers	6910	7460	7185
5	Plant protection chemicals	73	33	53
6	Irrigation	2471	410	1440
7	Repair and maintenance charge of implements	450	425	437
8	Miscellaneous	1895	1965	1930
9	Interest on working capital	13457	12818	13137
	Cost 'A1'	125600	119600	121219
10	Rent on leased in land	1104	1083	1094
	Cost 'A2'	126704	120683	122313
11	Interest on value of owned fixed assets	242	230	236
	Cost 'B1'	126946	120913	122549
13	Rent on owned land	5245	5362	5303
	Cost 'B2'	132191	126275	127852
14	Imputed value of household labour	12528	12894	12711
	Cost 'C1' (Cost 'B1'+ FL)	139474	133807	135260
	Cost 'C2' (Cost 'B2'+FL)	144719	139169	140563
15	10% of cost C2	14472	13970	14056
	Cost 'C3'	159191	153139	154619

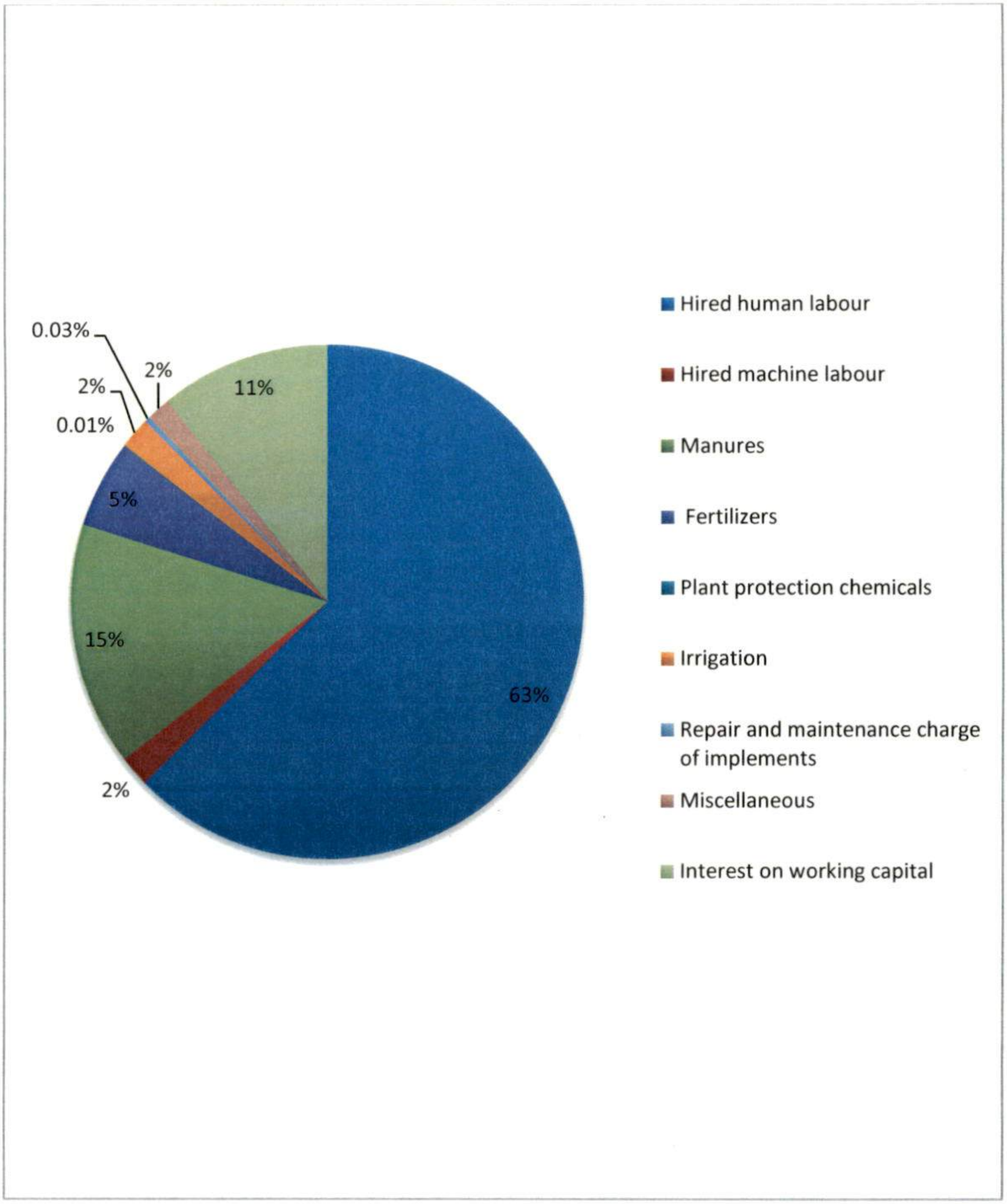

Fig 21. Share of different components in cost A_1 in Kollam

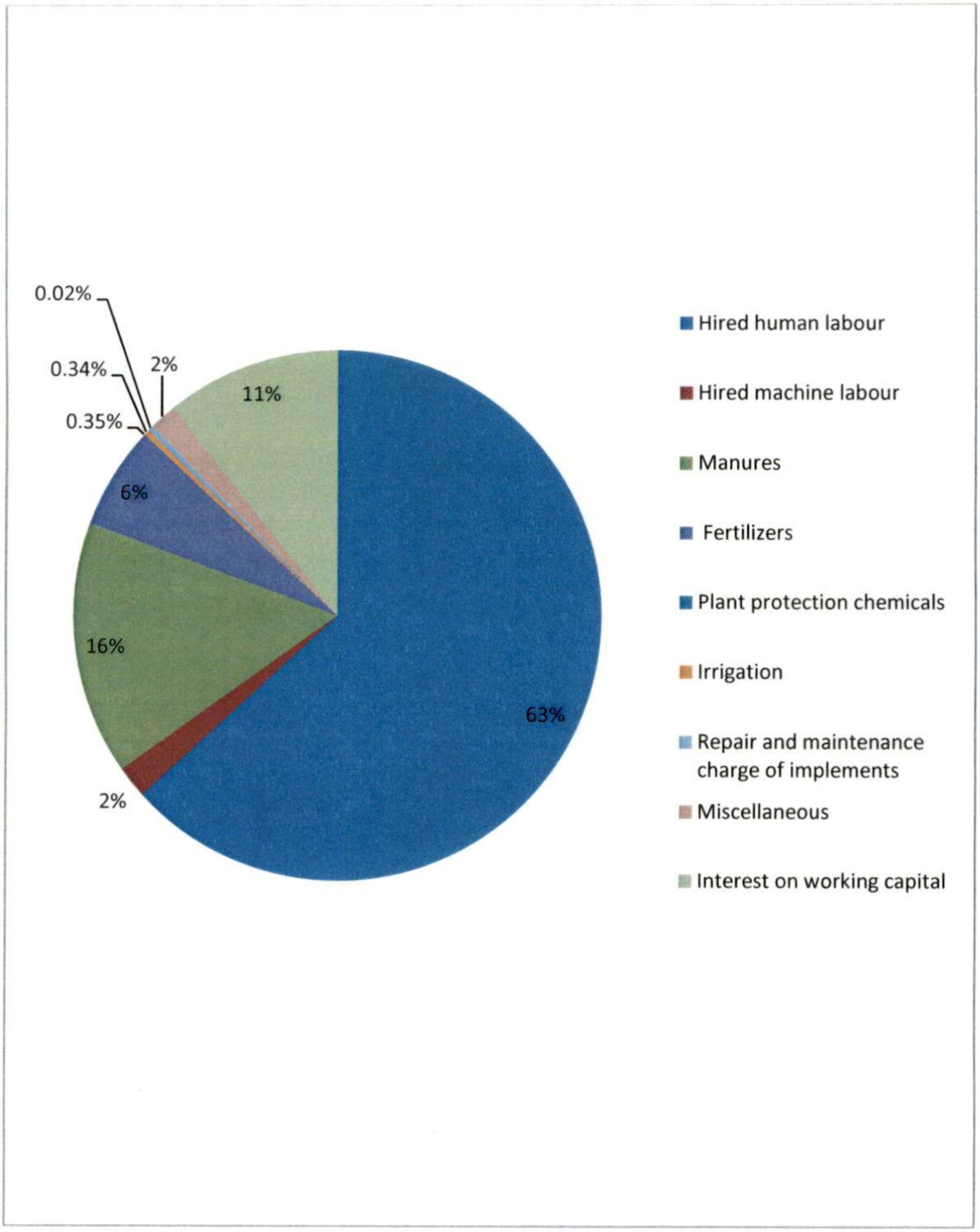

Fig 22. Share of different components in cost A_1 in Malappuram

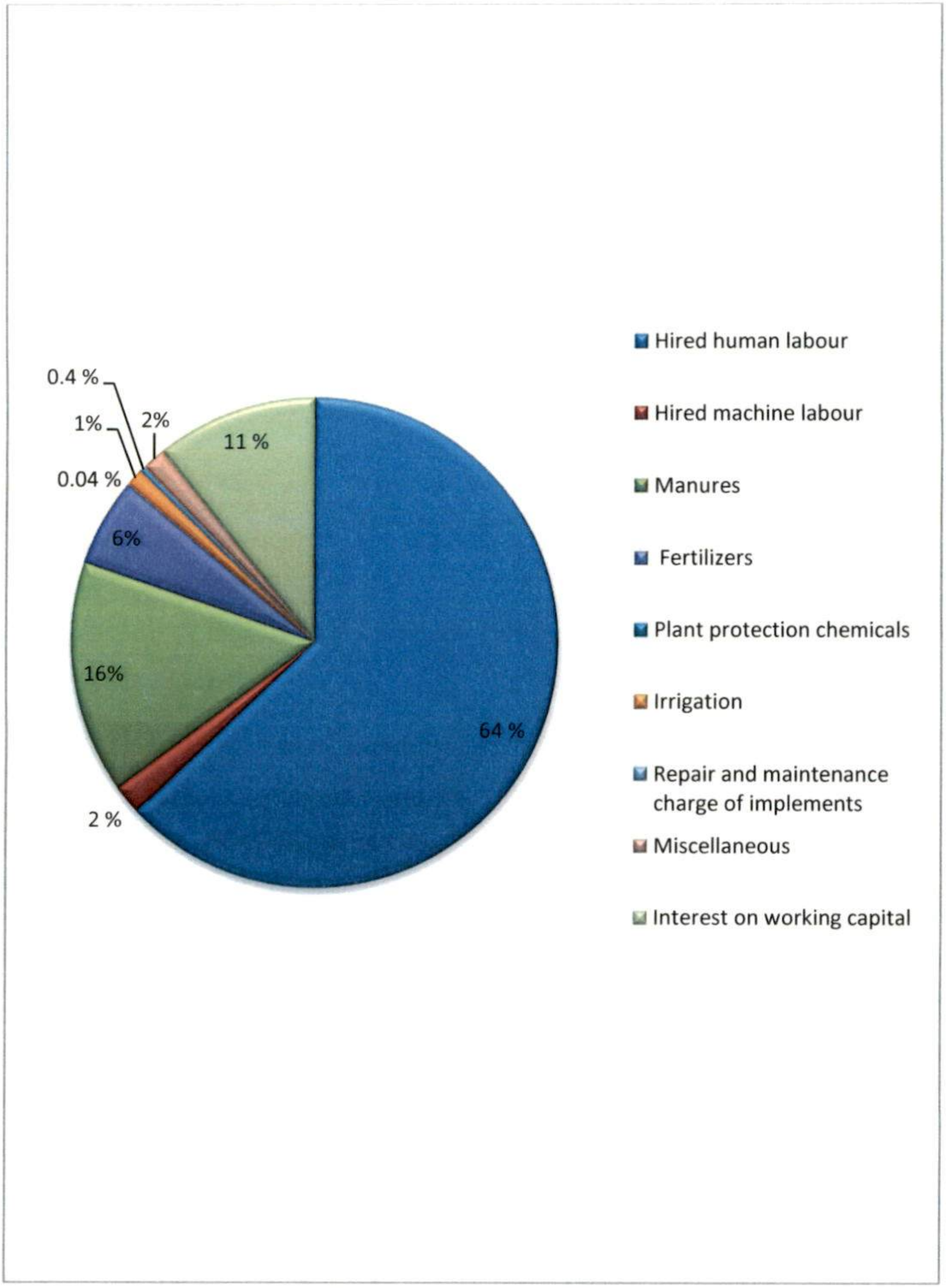

Fig 23. Share of different components in cost A_1 in aggregate level

4.5.3 Yield and returns

Tapioca is an annual crop of 6 to 10 months duration and it is harvested twice in a year. The study area was characterised by extreme values of yield in the farms, varying from 2 to 10 kilogram per plant. With an average of 6 kilograms per plant per year and the average price during the period of survey was ₹ 9.45 per kilogram in Kollam, ₹10.3 per kilogram in Malappuram and ₹9.8 per kilogram in aggregate level. The average yield was worked out based on an average yield of 21.48 tonnes per hectare in Kollam, 19.04 tonnes per hectare in Malappuram and 20.26 tonnes per hectare for the whole sample. From Table 4.17 the gross income was worked out to be ₹202598 per hectare for Kollam, ₹196112 per hectare for Malappuram and ₹197974 per hectare for the aggregate. Net returns was worked out by subtracting total cost C_3 from gross returns and net returns for Kollam, Malappuram and for aggregate was ₹40645 per hectare ₹42973 per hectare and ₹43190 per hectare respectively.

Table 4.17 Yield and returns from tapioca

Particulars	Kollam (Quantity/Value)	Malappuram (Quantity/Value)	Aggregate (Quantity/Value)
Average yield (t/ha)	21.48	19.04	20.26
Average price (Rs/kg)	9.45	10.3	9.8
Gross returns(Rs/ha)	202598	196112	197974
Total cost C3(Rs/ha)	159191	153139	154784
Net returns (Rs/ha)	43407	42973	43190

4.6 Resource use efficiency of tapioca production

Efficiency of allocation of farm resources can be examined by an analysing the cost. Based on the cost and return analysis of tapioca, it was revealed that labour costs accounted for a key role in influencing the cost of cultivation. In the above background, an examination of resource use efficiency at the micro level was found to be significant. Resource use efficiency in production could be attained when resources are organized in such a manner as to get maximum profit. Cobb Douglas production function was used to estimate the resource use efficiency of the variable inputs used in tapioca production in the study area. It is one of the most widely used functions in the economic analysis of the problems relating to empirical estimation in agriculture. The production function was estimated using Ordinary Least Square (OLS) method and the estimated coefficients were tested for statistical significance using t-test. The overall significance of the fitted model or equation was tested with the help of F-test and also expressed in terms of coefficient of determination (R^2).

Specification of the model:

$\ln Y = \ln a_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4$

Where,

Y : Yield per ha

X_1 : Human labour (mandays/ha)

X_2 : Amount spent on manures (Rs/ha)

X_3 : Experience in farming (years)

X_4 : Amount spent on fertilizers (Rs/ha)

b_i (i = 1, 2 . . .4) are the elasticity coefficients of respective input variables.

The results of the estimated Cobb-Douglas production function for tapioca is furnished in Table 4.18.

The coefficient of multiple determinations (R^2) was 0.81 indicating that the selected variables could explain 81 per cent variation in the yield of tapioca. It was found that human labour was significant at one per cent level with a regression coefficient of 0.70 indicating one percent increase in the use of human labour from the mean level would increase the yield by 0.7 per cent from the mean level. The regression coefficient of manure was negative indicating that the expenses on manure were above those of the recommended level, but the coefficients were significant at 5 per cent level. The cost structure analysis in the previous section also substantiated the above point, as is evident from the expenses on manure. Plant protection was also found to be non significant, while experience in farming exhibited significant coefficient.

Labour and experience in farming are the two factors which are significantly contributing to the yield. The above results are in conformity with the findings of Sheena (1997) who had estimated the the resource use efficiency by fitting cobb- Douglas production function and labour and farmyard manure were found to be significantly contributing towards the yield.

Returns to scale

Returns to scale explains the behavior of the rate of change in production relative to the associated simultaneous increase or decrease in the factors of production in the same proportion in long run. In the Cobb-Douglas production function, regression coefficients are the production elasticities of each variable input. Thus, the summation of regression coefficients (bi) of all the input variables provides a ready estimate of the returns to scale. If the sum of bi is not significantly different from one, it shows constant returns to scale. If sum of bi is less than one, decreasing returns to scale is indicated and if it is greater than one, increasing returns to scale is indicated. Here, the returns to scale is found to be 1.09, which indicated that a proportionate increase in all the inputs by one per cent, would increase the tapioca yield by 1.09 per cent, indicating the operation of increasing return to scale in tapioca production.

To summarise the discussion, the efficiency analysis of tapioca production in the study area revealed that there is plenty of scope to increase the profit of farmers by proper adoption of technology and by optimal allocation of resources.

Table 4.18Estimates of the fitted Cobb-Douglas production function for tapioca

Sl.no	Explanatory variable	Parametric values	Standard error	t-ratio
1	Constant	0.72	0.46	-0.71
2	Human labour	0.70**	0.09	7.54
3	Manures	-0.026	0.04	-0.57
6	Experience in farming	0.43*	0.06	7.06
7	Fertilizers	-0.020	0.02	-0.87
9	R^2	0.818		
10	Adjusted R^2	0.812		

Note: ** Denotes significance at one per cent level, * denotes significance at five per cent level

4.7 Marketing of tapioca

Marketing plays a prime role in agricultural development and is as significant as production to any producer. Thus, an efficient marketing system can increase the level of income of producers and raise the satisfaction of consumers. Marketing of tapioca needs further attention in Kerala, due to its higher productivity in the state. In this segment, an attempt has been made to identify major market functionaries in the study area, to identify different marketing channels preferred by the sample farmers for their produce, to estimate marketing cost, marketing margin and price spread and to find out the efficiency in marketing using Shepherd's index.

4.7.1 Market functionaries

Major market functionaries identified in the study area are described below.

1) Village trader

Village traders are the merchants having their small establishments in villages. They purchase entire crop from farmers at harvesting stage at the prevailing market price and sell on the same day or once in two days. Invariably, they bear the harvesting cost and transportation cost. Therefore it is profitable for the producers who are otherwise dependent on the other intermediaries for marketing.

2) Wholesalers

Wholesalers purchase raw tapioca from farmers as well as from village traders. Most of the wholesalers sold their produce to nearby retailers.

3) Retailers

Retailers are the most common and important market intermediary in the study area who purchase raw tapioca from the wholesalers and sell to consumers. They are located at local markets so that producers can also ensure market availability for their produce instead of depending only on traders.

4.7.2 Marketing channels and market structure

The routes through which the products move from the producers to the consumers is called marketing channels. Majority of the sample farmers in the study area used to sell raw tapioca. Lack of storage facilities and fluctuating prices drive the producers to sell raw immediately after the crop reaching harvesting stage. Majority of wholesalers in the study area sell raw tapioca in local markets and to various retailers for a reasonable price. In this section, various marketing channels predominant in the study area through which tapioca flow from producer to consumer have been described.

Channel 1 : Producer → Village trader → Wholesalers → Retailers →Consumers

Channel 2 : Producer → Wholesalers → Retailers → Consumers

Channel 3 : Producer → Retailers → Consumers

Channel 4 : Producer → Consumers

Table 4.19 Farmers' sale to different market functionaries

Market functionaries	Kollam	Malappuram	Number of farmers	Percentage
Village traders	38	46	84	70.0
Wholesalers	6	3	9	7.5
Retailers	12	9	21	17.5
Consumers	4	2	6	5 .0
Total	60	60	120	100

Table 4.21 shows the different market intermediaries to whom farmers of the study area sell their produce. Out of 120 sample farmers, 70 per cent sell tapioca to village traders while, 22.5 per cent sold directly to the retailers. Only 7.5 per cent farmers sold their produce to wholesalers. Village traders buy tapioca from farmers and sell it to wholesalers or to processing industries. Majority of the farmers were selling their produce to village traders to avoid harvesting cost and other marketing expenses.

4.7.3 Marketing costs and margins

Marketing costs include all the items of expenditure incurred in transferring commodities from the producer to the consumer. It generally consists of expenditure incurred in performing market functions such as transporting, storing, processing *etc*. It is one of the chief components of price spread, the difference between the price paid by the consumer and the price received by the farmer for an equivalent quantity of the farm produce. Table 4.22 represents marketing costs of tapioca per kg for identified channels in the study area.

Table 4.20 Marketing cost of tapioca (Rs/kg)

Market functionaries	Items	Channel 1	Channel 2	Channel 3	Channel 4
Farmer	Transportation	-	0.64	0.65	1.5
	Harvesting		0.80		0.92
	Loading and unloading	-	0.20	0.35	
	Storage cost	-	-		
Village trader	Transportation	0.95	-	-	-
	Harvesting	0.64			
	Loading and unloading	0.04	-	-	-
	Storage cost	-	-	-	-
	Transportation	0.20	-	-	
Wholesalers	Transportation	-	1.25	-	
	Loading and unloading	0.08	0.50	-	
	Storage cost	-	-	-	
Retailers	Transportation	0.36	0.42	0.35	-
	Loading and unloading	0.1	-	0.20	-
	Storage cost	-	-	-	
Total		**2.37**	**3.81**	**1.55**	**2.42**

While computing the marketing costs of tapioca, the costs incurred for harvesting, transporting, loading and unloading and storage were considered as the main components of the marketing cost. Marketing costs, worked out for 1 kg of tapioca was the highest for channel 2 (₹ 3.81) as compared to other channels.

Marketing costs for channel 1, channel 3 and channel 4 were ₹ 2.37, 1.55 and 2.42 respectively. It was clear from the above table that, channel 3 had the lowest marketing cost followed by channel 2 and channel1. But the most common channel identified in the study area was channel 1.

Around 70 per cent of the sample respondents have opted for channel 1 due to high harvesting cost. Village traders were purchasing the standing crop at the harvesting stage. The retailers in the local markets also assured a fixed market for their produce at reasonable market prices.

The most common marketing channel found in the study area was channel 1 because the village traders purchased tapioca at harvesting stage from farmers at prevailing market price and bear all the costs such as those incurred for harvesting, transportation, loading and unloading.

4.7.4 Price spread

In the marketing of agricultural commodities the difference between the price paid by the consumer and the price received by the producer for an equivalent quantity of Farm produce is often known as farm retail spread to price spread (Acharya and Agarwal, 1983). Table 4.23 presents the separately worked out marketing margins and costs of tapioca per kilogram for each functionary in the identified channels. It could be observed from the table that the highest price spread of ₹ 5 was estimated for channel 1 in which the producer's share in consumer's rupee was only 66.66 per cent. Channel 4 was observed to be having the least price spread of ₹ 0 with 100 per cent of producer's share in consumer's rupee because here the producers are directly selling their produce to the customers so that no marketing margin is involved. The most common channel (channel 1) identified in the study area was observed to be having a price spread of ₹ 5.00 and the producer's share in consumer's rupee was 66.66 per cent which was less than that of channel 2(80.00) and channel 3 (86.66).

Marketing cost was highest for channel 2 which was found to be twice higher than that of channel 3. Marketing margin was least in channel 2 and highest marketing margin was observed in channel 1. Contrary to the highest price spread and marketing margin which were found in channel 1, majority (70 per cent) of the sample respondent used channel 1 to sell tapioca. This is mainly due to the fact that most of the village traders are buying the standing crop at harvesting stage, because of this farmer doesn't have to incur the harvesting cost.

Table 4.21 Price spread of tapioca for different marketing channels (Rs/kg)

Sl.no	Price spread	Channel 1	Channel 2	Channel 3	Channel 4
1	Farmer's selling price	10.00	12.00	13.00	16.00
	Production cost	2.5	4.24	4.24	5.6
	Marketing cost	0	1.64	1	2.48
	Net price received by farmer	7.5	6.12	7.76	7.92
2	Village trader selling price	12.00	-	-	-
	Marketing cost	1.83	-	-	-
	Marketing margin	0.17	-	-	-
4	Wholesaler's sales price	14.00	14		-
	Marketing cost	0.12	1.75	-	-
	Marketing margin	1.88	0.25	-	-
5	Retailer's sales price	15.00	15	15	
	Marketing cost	0.7	0.42	0.55	-
	Marketing margin	0.3	0.58	1.45	-
6	Consumer's purchase price	15.00	15.00	15	-
	Total marketing cost	2.65	3.81	1.55	2.48
	Total marketing margin	2.35	0.83	1.45	0
Price spread		5.00	3.00	2.00	0
Producer's share in consumer's rupee		66.66	80.00	86.66	100

Note: Producer's share in consumer's rupee is farmers selling price as a per cent of consumer's purchase price

4.7.5 Marketing efficiency

In the present study, marketing efficiency of different channels was computed using Shepherd's method which is the ratio of total value of goods marketed to the sum of the total marketing costs and margins. Marketing efficiency indices of four marketing channels is given in Table 4.24.

Marketing efficiency indices for channel 1, 2, 3 and 4 were estimated to 2, 3.12, and 4.33 and 6.45 respectively. Channel 4 was observed to be the most efficient channel among the four channels with an efficiency index of 6.45. It could be understood from this result that direct marketing to consumers was much more profitable for producers in the study area. Though channel 1 is efficient only a few farmers opted for this channel because finding customers for huge quantum of produce is found to be difficult.

Table 4.22 Marketing efficiency of different channels of tapioca

Sl.No.	Channel	Marketing cost	Marketin g margin	Price sprea d	Producer's share in consumer' s rupee	Marketing efficiency
1	Channel 1	2.65	2.35	5	66.66	2
2	Channel 2	3.81	0.83	3	80	3.12
3	Channel 3	1.55	1.45	2	86.66	4.33
4	Channel 4	2.48	0	0	100	6.45

4.8 Constraints in tapioca cultivation

An attempt was made in the study to identify the constraints of tapioca faced by the sample farmers by incorporating specific questions in the interview schedule. The responses have been analysed using Garrett's ranking technique and the results are presented in Table 4.23

Table 4.23 Constraints in production faced by tapioca farmers

Sl. No	Problems	Score value	Rank
1	Inadequacy of genuine and disease free planting materials	33.75	5
2	Labour shortage	62.37	2
3	Shortage of irrigation facilities	42.87	4
4	High labour charges	67	1
5	Occurrence of pests (rats and rodents)	44	3

The results revealed that major production constraints faced by tapioca farmers were high labour charges (67 per cent) and shortage of labour (62.37 per cent). This accounted the major share of cost of cultivation. Utilization of family labour was nominal in most of the cases leading to high labour cost. Family labour was found being used mainly for irrigation and manuring. However, hired labour was widely used for land preparation, intercultural operations and harvesting.

Destruction of the tubers by pests like rats and rodents was another constraint faced by the sample farmers. 42.87 per cent of the respondents faced shortage of irrigation facilities, most of them were depending on rain for irrigation. Though the farmers were not using newly developed high yielding varieties they didn't find it as a constraint. Rani and Murugan (2010) reported that production constraints like mosaic and tuber rot diseases, labour scarcity, un availability of quality planting materials, and lack of short duration varieties were the major constraints expressed by many of the cassava growers and this results was in conformity with the above results.

Table 4.24 Constraints in marketing faced by tapioca farmers

Sl.No	Problem	Score value	Rank
1	Low price	82.33	1
2	More distance to marketing society	50.91	4
3	High Transport charges	44.22	6
4	Transport losses	21.53	8
5	Non availability of storage facilities	55.87	3
6	Lack of processing unit for value addition	46.43	5
7	Distress sale to traders	68.27	2
8	Labour problem (loading and unloading)	38.41	7

From Table 4.24 it was found that the major marketing constraint for tapioca cultivation faced by all the sample farmers was low price of tapioca throughout the year. It was very hard for most of the farmers to stay in this field due to uncertain fluctuations in the prices of tapioca. 68.27 per cent respondents faced the problem of distress sale, because of low price farmers were forced to sell their produce for a lower price than the market price. Non availability of storage facilities was also an important constraint faced by 55.87 percent of the respondents. Construction of zero energy chambers was not economically feasible for most of the farmers. The above results are in line with the findings of Rani and Murugan (2010). They had reported that, exploitation by middle man, malpractices in Point scale fixation, lack of regulated market and low price for tubers due to fluctuations in price were the major marketing constraints of tapioca cultivation.

Summary and Conclusion

5. SUMMARY AND CONCLUSION

The present study entitled "Economic analysis of production, marketing and price behaviour of tapioca" was undertaken during the year 2016-18. The study was focused on the production and marketing aspects along with the price behaviour analysis. The major objectives of the study were to analyse the trend in area, production and productivity of tapioca in Kerala, to study the price behavior, estimate the costs and returns in tapioca cultivation, evaluate resource use efficiency, study the marketing cost, margins and price spread and to analyze the constraints in production and marketing.

The study was based on both primary and secondary data. The data on area, production and productivity of tapioca in India and Kerala from 1950-51 to 2016-17 and monthly prices of tapioca in major markets of Kerala and monthly average price data of tapioca, published by various institutions were collected to analyse the trend and price behaviour of tapioca from January 2002 to July 2018. Kollam and Malappuram districts were purposively selected for the study since these districts contributed to maximum area under tapioca in Kerala. Two blocks from each district were purposively selected based on area and from each block two krishibavans were randomly selected. Based on the list of farmers collected from the krishibhavans, 15 respondents were randomly selected from each Panchayat. 30 farmers were randomly selected from each block making a total sample size of 120. The primary data was collected from the selected farmers using a pretested structured interview schedule by personal interview method. The information on marketing was also collected from 30 market intermediaries including wholesalers and retailers.

Trend analysis was done to understand the growth pattern of tapioca in terms of area, production and productivity both at national and state level from 1950-51 to

2016-17. In India production and productivity of tapioca showed an increasing trend throughout the study period but the area showed a declining trend after eighties. In the case of Kerala, similar trend was observed in the case of area, for the entire period of study area was declining but the production was increasing due to high growth of productivity. Compound growth rate of area under tapioca in India and Kerala was negative for entire period of study while the growth rate in productivity was positive and higher which outweighed the effect of declining area and as a result production was positive throughout the period.

The price behavior of tapioca in major markets of Kerala *viz*., Kozhikode, Ernakulam and Chalai were analyzed by decomposing the monthly price data into four components viz., secular trend, seasonal variation, cyclical variation and irregular variation assuming a multiplicative model of time series. The price of tapioca in these markets showed an increasing trend in the long run. While analysing the seasonal variation it was noticed that during the entire study period (2002 to 2018), price of tapioca showed wide fluctuations in all the three markets. Due to high fluctuations in price no definite cycles were seen in the market prices. Co-integration analysis of tapioca prices in the above three markets were carried out and it was revealed that all the three markets were integrated. In order to provide additional evidence on the direction of price transmission, Granger causality test was carried out and the results proved the existence of causality between Kozhikode and Ernakulam markets in the long run in both the directions. Unidirectional causality was found between Kozhikode and Chalai markets and Ernakulam and Chalai markets.

Socio- economic features of the respondent farmers with respect to land holding, family size, age, education, occupation education, landholding, experience in farming and annual income were analysed. Majority of the tapioca growers were in the age group of 40 to 60 years and around 89 per cent of the sample farmers were male. Among the sample farmers 42.5 per cent had secondary level of education. Out of total sample respondents 85 per cent farmers had a family size of four to six this enhances the availability and utilization of family labour as substitute to hired human labour in the study area. Most of the farmers had a small holding which is less than one hectare and primary occupation of 85 per cent of them was agriculture. Around seventy farmers had an experience of more than 20 years in farming.

The economics of tapioca cultivation was worked out considering the costs, yield and returns. ABC cost concepts were used to estimate the cost and returns from tapioca cultivation. The total cost incurred in tapioca cultivation was estimated to be Rs. 154619 and in Malappuram and Kollam it was ₹ 159191 and ₹ 153139 respectively. It was noted that human labour accounted for 49 per cent of the total cost of cultivation. To evaluate resource use efficiency of tapioca cultivation, Cobb-Douglas production function was fitted with four explanatory variables such as human labour, amount spent on manures, experience in farming and amount spent on fertilizers. Human labour and experience in farming were found to be significantly contributing towards the yield. And also an increasing returns to scale in tapioca cultivation was observed in the study area which implies that there are plenty of scope to increase the profit of farmers by proper adoption of technology and by optimal allocation of resources.

While studying the marketing aspects four marketing channels were identified in the study area. Village traders, wholesalers and retailers were the major market intermediaries identified in the study area. Most of the sample farmers (70 per cent) in the study area sold tapioca at the harvesting stage to the village traders for a price less than the market price. Lack of storage facilities, bulkiness of the produce and fluctuating prices made the producers to sell raw tubers at the stage of harvesting instead of waiting for a higher price. Majority of the wholesalers in the study area sell raw tubers in various markets of Tamil Nadu where many value addition units and starch industries are concentrated. The most efficient marketing channel identified in the study area was channel 4 (Producer- consumers) with a high efficiency index of 6.45.

The most important problem faced by sample farmers in tapioca production was high wage rate and labour shortage. Major constraints identified in the marketing of tapioca were low price and distress sales to the traders. It was very difficult for most of the farmers to remain tapioca cultivation because of uncertain fluctuations in the prices of tapioca.

Policy suggestions:

Based on the present study the following policy interventions are suggested;

- At present, the importance of tapioca in food basket of Kerala is declining, so government has to give more emphasis on value addition of tapioca by encouraging young entrepreneurs to bring their attention in the industrial uses of tapioca.
- In the present scenario most of the farmers are using local varieties. To make tapioca cultivation more remunerative, supply and use of high yielding varieties should be promoted.
- Majority of the cost incurred in the production of tapioca was from hired human labour. As a solution to this problem mechanisation can be done in the field to carry out various cultural operations like land preparation, intercultural operations and harvesting.
- Better post harvest technology for storage of the tubers has to be encouraged to increase the shelf life of tapioca tubers.
- In the current situation due to interventions of middle men farmers are not getting remunerative price for the tubers hence suitable price polices for raw tubers has to be formulated so as to ensure a guarantee price throughout the year.

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Appendices

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APPENDIX I

Survey questionnaire for farmers

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE

KAU (P.O)

Vellanikara, Thrissur

Department of Agricultural economics

Economic analysis of production, marketing and price behaviour of Tapioca

District: Block: Panchayath:

1. Socio economic profile of farmers:

1. Name of the farmer:

2. Age:

3. Gender:

4. Address:

5. Phone no:

6. Educational qualification:

Class	Up to 9^{th}	SSLC	Pre-degree	Graduate	Diploma	Post graduate	Others
Code	1	2	3	4	5	6	7

7. Experience in farming (years):

8. Annual income:

Income	<25000	25000-50000	50000-75000	75000-100000	100000-200000	>200000
Code	1	2	3	4	5	6

2. Family details

Sl No.	Name	Gender (M/F)	Relationship with respondent	Age	Education	Occupation		Annual income	
						Primary	Secondary	Primary	Secondary

*A- Agriculture, E- Employed, SE- Self-employed, NE- Non employed, S- Student

3. Land details:

Particulars	Owned (ha)	Leased in (ha)	Leased out (ha)	Total (ha)
Garden				
Permanent fallow				
others				
Total (ha)				

4. Crop details:

Sl. No	Crop	Variety	Cropped area (acres)	Main product		By-product	
				Qty(Kg)	Value(Rs)	Qty(Kg)	Value(Rs)

5. Details of non-crop activities:

Sl. No	Activities	Area/No	Annual maintenance expenses	Gross returns
1	Livestock activities			
2	Poultry			
3	Self -employment			
4	Others			

6. Cost of cultivation:

Area:

No. of plants:

No. of harvesting per year:

Main product yield (kg/ha): Price/kg:

By product yield (if any): Price/unit:

Wage rate (Rs/man days):

Fixed inputs	Year of purchase	Initial cost (Rs)	Useful life (years)
Land value			
Farm building			

	Skilled labour		Unskilled labour	
	M	F	M	F
Wage rate (Rs/man days)				

Rental value of land: Land revenue:

Interest on fixed capital: Interest on working capital:

Machinery and equipments	Quantities	Year of purchase	Initial cost	Subsidy (if any)	Useful life (years)
1.Pump sets(No) 2.Spade(No) 3.Gunny sack(No) 4.Plastic sack(No) 5.Basket(No) 6.machete(No)					

Variable inputs	
Stem cuttings (No)	
FYM (kg/palm)	
Urea (g/palm)	
SSP (g/palm)	
MOP (g/palm)	
Other fertilizers(g/palm)	
Plant protection chemicals (Rs)	
Soil ameliorants (Rs)	
Irrigation cost (Rs)	
Labour cost	
Land preparation	
Digging, filling and planting	
Manure and fertilizer application	
Pesticide application	
Intercultural operations	
Irrigation	
Harvesting	
Collection & handling	
Post-harvest operations(processing if any)	

7. Details of marketing of tapioca:

Total quantity produced:

Quantity retained for family consumption:

Quantity retained for on-farm uses:

Total marketed quantity:

Name of the nearest primary market:

Distance:

Name of the nearest wholesale or secondary market:

Distance:

Method of sale:

Sl.No	Method of sale	Quantity	Price/unit
1	Village trader		
2	Commission agent/brokers		
3	Primary/retail market		
4	Secondary/wholesale market		
5	Direct sale to consumers		
6	Other modes (specify)		

Do you know through which channel your produce will reach to ultimate consumers?

a. Channel 1 – Producer – village trader – wholesaler – retailer – consumer
b. Channel 2 – Producer – wholesaler – retailer – consumer
c. Channel 3 – Producer – village trader – retailer – consumer
d. Specify any channels, if any?

Reasons for sales to the local leader/wholesaler/consumer/commission agents/agencies

Price received per unit:

Mode of payment:

Do you know the price at which final intermediary sells the produce to ultimate consumers?

Marketing cost incurred

a. Transportation cost:
b. Commission/brokerage:
c. Storage cost:
d. Loading and unloading:
e. Other costs of marketing:
f. Total marketing cost:

Do you engage in the processing of tapioca before selling: (Yes/No)

If yes, in which form do you sell the produce:

Quantity processed:

Cost of processing:

Price received for the produce after processing:

Do you engage in storage of the produce?

Time period of storage:

Do you have any pre contract tie up with any agencies for marketing the produce? (Yes/No)

If yes, since which year? Mention the amount of produce sold to agencies and the price per unit?

Sources of information on price data?

Have you availed any credit? Yes/No (specify year also)

Sl. No	Sources of finance	Type of loan			Loan amount	
		ST	MT	LT	Taken	Outstanding

Do you have any contact with development agencies?

Sl. No	Agencies	Type of assistance			
		Planting material	Technology	Subsidy	Marketing
1	CTCRI				
2	Department of Agriculture				
3	KAU				
4	Co-operatives				
5	NGO				
6	Others				

8. Constraints in production and marketing:

Ranking of production constraints:

S1. No	Problem	Occurrence of problem (yes/ no)	Extent of problem	Rank
1	Inadequacy of genuine and disease free planting materials			
2	Labour shortage			
3	Shortage of irrigation facilities			
4	High labour charges			
5	Occurrence of diseases			
6	Others if any			

Ranking of marketing constraints:

S1.NO	Problem	Occurrence of problem (yes/no)	Extent of problem	Rank
1	Low price			
2	More distance to marketing society			
3	High Transport charges			
4	Transport losses			
5	Non availability of storage facilities			
6	Lack of processing unit for value addition			
7	Distress sale to traders			
8	Labour problem (loading and unloading)			
9	Others if any			

APPENDIX II

Survey questionnaire for market intermediaries

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKARA, THRISSUR

Department of Agricultural economics

Economic analysis of production, marketing and price behaviour of Tapioca

District: Block: Panchayath:

1. Name :
2. Address:
3. Age:
4. Gender:
5. Type of market intermediary

   (Village merchant/ commission agents/wholesalers/retailer/exporter)
6. No of years of experience in tapioca trading:
7. Main product(s) dealt with:
8. Quantity(volume) of transaction/year:
9. Transactions made:
10.

Sl. No	Place		Distance	Total quantity transacted	Purchase price	Remarks
	From	To				

11. Expenditure:

Sl. No	Particulars	Amount (Rs)	Remarks
1	Transport cost		
2	Loading and unloading charges		
3	Drying charges if any		
4	Other processing expenses, if any		
5	Storage cost		
6	Brokerage		
7	Other expenses		

12. Do you have any shop or stall for marketing the produce?
13. If yes, mention the location, size and number of stalls:
14. From whom you mostly purchase?
15. To whom the product sold?
16. Constraints faced in buying it from producers/traders:
17. Problems faced in marketing of tapioca
18. Give suggestions to overcome the problems

ECONOMIC ANALYSIS OF PRODUCTION, MARKETING AND PRICE BEHAVIOR OF TAPIOCA

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ABSTRACT OF THE THESIS

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ABSTRACT

Tapioca (*Manihot esculenta* Crantz) is a staple food crop cultivated in several developing countries around the globe. Among the tropical root and tuber crops, tapioca stands first in terms of area and production. India is the tenth largest producer of tapioca with production of 8.10 million tonnes from an area of 2.17 lakh hectares. India acquires its significance in global tapioca economy due to highest productivity in the world (36.4 t/ha).

Among Indian states Kerala stands second in production of tapioca. The area under tapioca was showing a declining trend from the eighties which has resulted in stagnant production. In the above background, the present study was carried out with the objective of analysing the trend in area, production and productivity and price behaviour of tapioca, estimating the economics and resource use efficiency of tapioca production, identifying the marketing channels, estimating marketing costs, margins and marketing efficiency and finding out the major constraints in production and marketing of tapioca in Kerala.

The study is based on both primary and secondary data. The time series data on area, production and productivity of tapioca in Kerala and India for a period of 1950-51 to 2016-17 were collected to study the trend and growth rate. Monthly average prices of tapioca in various markets of Kerala were collected to evaluate the trend and price behaviour of tapioca over the period 2002 to 2018. Primary data was collected from 120 selected farmers of Kollam district and Malappuram district using pretested interview schedule by personal interview method.

Trend analysis was done to understand the growth pattern of tapioca in terms of area, production and productivity both at national and state level from 1950-51 to 2016-17. In India production and productivity of tapioca showed an increasing trend but the area was showing a declining trend. In the case of Kerala, similar trend was

observed with negative growth in area for the entire period of study, but the growth rate in production was positive due to high and positive growth rate in productivity.

The price behavior of tapioca in major markets of Kerala *viz*., Kozhikode, Ernakulam and Chalai were analyzed by decomposing the monthly price data into four components viz., secular trend, seasonal variation, cyclical variation and irregular variation assuming a multiplicative model of time series. The price of tapioca in these markets showed an increasing trend in the long run. While analysing the seasonal variation it was noticed that during the entire study period (2002 to 2018), price of tapioca showed wide fluctuations in all the three markets. Due to high fluctuations in price no definite cycles were seen in the market prices. Co-integration analysis of tapioca prices in the above three markets were carried out and it was revealed all the three markets were integrated. In order to provide additional evidence on the direction of price transmission, Granger causality test was carried out and the results proved the existence of causality between Kozhikode and Ernakulam markets in the long run in both the directions. Unidirectional causality was found between Kozhikode and Chalai markets and Ernakulam and Chalai markets.

The cost and returns were estimated using ABC cost concepts. The cost of cultivation per hectare was Rs.1,54,619 with a net return of Rs.43,190. It was noted that human labour accounted for 48.50 per cent of the total cost. To evaluate resource use efficiency in tapioca cultivation, Cobb-Douglas production function was fitted. Human labour and experience in farming were found to be significantly contributing towards the yield. Moreover, an increasing returns to scale in tapioca production was observed in the study area which implies that there is ample scope to increase the profit of farmers by proper adoption of technology and by optimal allocation of resources.

Marketing plays a predominant role in agricultural development and is as important as production to any producer. Thus, an efficient marketing system can increase the level of income of producers and raise the satisfaction of consumers. The most common marketing channel identified in the study area was channel I (Producer- village trader- wholesaler- retailer- consumer) with a marketing efficiency of 2.0, while channel IV (Producer- consumer) was found to be the most efficient channel (6.45) as there were no intermediaries.

Major production constraints identified were high labour cost and labour shortage and the marketing constraints were low price and distress sale to traders. The future of tapioca lies in the promotion of diversified uses of tapioca, especially in the industrial sector so policy intervention to encourage potential entrepreneurs to start industries to produce diverse value added products from tapioca is needed to tackle these problems.