TIME SERIES ANALYSIS OF THE TREND IN AGRICULTURE PRODUCTION

KERALA

EVALUATION DIVISION
KERALA STATE PLANNING BOARD
GOVERNMENT OF KERALA

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PREFACE

       Kerala is recognised as a state of promise and potential, much of which is as yet unrealised. Agriculture is pivotal to the realisation of these aspirations as it contributes twenty four per cent of employment and ten per cent of State Domestic Product. Enhancing agricultural production and productivity is a prerequisite for eradicating poverty and associated food and nutrition insecurity. The smaller the farm, the greater is the need for marketable surplus and thereby money income that is essential for sustainable nutrition security. Agriculture production and productivity trends in recent decades in Kerala have been disappointing. By the end of the eighties, a large proportion of traditional crop area such as rice and tapioca shifted to cash crops like rubber, cashew and cardamom. Also the share of agriculture income to State Domestic Product has been declining consistently. Agriculture is the largest sector of economic activity in Kerala and has a crucial role to play in economic development by providing food and raw materials, employment to a very large proportion of the population, capital for its own development and surpluses for economic development. In this context the focus of the study report on the analysis of the trends in area under cultivation, production and productivity of major agriculture crops in Kerala has great importance.

       I believe that the results of the study will be useful in decisions relating to allocation of resources under various Annual Plans for the development of agriculture in the State. It will also help in completing ongoing programmes effectively. I am confident that this study report will generate renewed interest among the regional and State policy makers. I also note that there has been stakeholder participation while conducting the study. I am also thankful to the policy makers for successfully implementing the suggestions in the report.

       I am happy to thank Dr V. Vijayakumar, Chief, Smt Rekha V. Dev, Assistant Director, Evaluation Division, Kerala State Planning Board and others associated with the study for producing a thought-provoking report.

Thiruvananthapuram   Sd/-

10.10.2011   K M Chandrasekhar

                                                Vice Chairman, Kerala State Planning Board

FOREWORD

Crop production is of increasing importance with a rising population and steadily increasing demand for food per capita. Kerala faces multiple challenges in meeting these needs and in improving its crop production. Moreover, increasing crop production and productivity are not just about the new technologies or crop management. Environmental sustainability is also of vital importance. The complexity of these issues now faced make improving crop production and productivity a more challenging task. Water, fertilisers, crop protection-inputs and professional advice all need to be managed in the most efficient manner.

About seventy per cent of the rural population depends on agriculture for their livelihood. As agriculture develops and as income accruing to the rural people increase, the size of the market for industrial products in rural area will also increase. By the end of eighties the area of food crops were shifted to plantations and cash crops like rubber, tea, coffee, cashew and cardamom. During 50s & 60s, agriculture sector contributed a major share of state domestic income. The percentage contribution of agriculture income to State Domestic Product was steady up to the mid seventies and began to decline considerably during the following decades. The share of agriculture income to State Domestic Product during 2007-08 was 12 per cent against 33.47 per cent during 1990-91. However, the absolute share of agriculture income was ₹ 1761 crore in 1990-91 and increased to ₹ 15181 crore in 2009-10. The land utilisation pattern implied that about 54.45 per cent of the total land in the state was used for agriculture purpose during 2008-09 as against 57.82 per cent during 1990-91. But area, production and productivity of some major crops have been declining consistently over the last several years. The low productivity clearly speaks of the vast potentials of growth in agriculture sector in view of the mechanisation and high yielding variety programme. The falling share of agriculture income in State Domestic Product also indicates the structural as well as occupational changes of the economy. In this context, the objective of the study viz the analysis of the trend in agriculture production, agriculture income, area under cultivation and productivity of major crops is of due importance.

The suggestions and findings of the study will be helpful for the purpose of sectoral planning and policy formulation for the development of agriculture sector of the state. I think that the study will be quite useful for the policy makers.

It is my pleasure to thank Dr V Vijayakumar, Chief and Smt Rekha V. Dev, Assistant Director, Evaluation Division, Kerala State Planning Board for preparing this report.

Thiruvananthapuram   Sd/-

10.10.2011   C P John

Member, Kerala State Planning Board

A C K N O W L E D G E M E N T

First of all I thank GOD Almighty for giving an opportunity to publish this report.

I express my sincere thanks to Shri K M Chandrasekhar, the hon'ble Vice Chairman , State Planning Board, Shri Subrata Biswas, respected Member Secretary, State Planning Board and Dr P Rajasekharan, Chief, Agricultural Division, State Planning Board for the positive attitude that maintains to release this study report.

I would like to record my sincere thanks to the Economists, Statisticians and the Stakeholders in agriculture I have consulted during the research study.

I also thank Librarian, Kerala State Planning Board Library for the help and co-operation extended.

I remember with gratitude the whole-hearted co-operation extended by the respondents interviewed for the study. I place on record my gratitude to all those who have associated with this endeavour.

Sd/-

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List of Abbreviations

CMIE	-	Centre for Monitoring Indian Economy
DES	-	Department of Economics and Statistics
FAO	-	Food and Agriculture Organisation
GDP	-	Gross Domestic Product
GOI	-	Government of India
GOK	-	Government of Kerala
ha	-	Hectare
kg	-	Kilogram
MT	-	Million Tonnes
NDP	-	Net Domestic Product
NNP	-	Net National Product
SDP	-	State Domestic Product
UTs	-	Union Territories

Executive Summary

Kerala is a small state with high density of population and agriculture is the major source of livelihood. But at the end of eighties onwards the area of food crops were shifted to plantations and cash crops. Total reduction in the area of food crops had resulted in substantial decline in the production of the major traditional food crops. During the past decades, agriculture sector contributed a major share of state domestic income. The percentage contribution of agriculture income to SDP was steady up to the mid seventies then began to decline. In this context, the study is confined to time series analysis of the trend in area under cultivation, production and productivity of major agriculture crops.

The following specific objectives were framed for the study:

1. To analyse the trend in area, production and productivity of major crops viz paddy, tapioca, pepper, ginger, turmeric, banana and other plantains in the state.

2. To analyse the trend in area, production and productivity of plantation crops like rubber, tea, coffee, cashew, coconut, cardamom and areca nut in the state.

3. To analyse the trend in agriculture income of the state.

4. To analyse and compare the trend in agriculture income of Kerala with the national trend.

In order to analyse the trend in agriculture production, area brought under cultivation and productivity of major crops, twenty years time series data were used with 1990-91 as the base. The major findings and suggestions of the study are summarised below:

The area under paddy cultivation had continuously decreased over the past twenty years and this shows a clear decreasing trend. The major reasons for declining area under

paddy cultivation are conversion of paddy fields into horticultural crops and non-agricultural purposes. The expected area for cultivation of paddy during 2011-12 is 201311 ha and in 2019-20 it is 134942 ha only. Hence time bound policy measures such as special paddy packages in selected districts are to be needed. Farm insurance and crop insurance should be made compulsory. More importance is to be given to extend irrigation facilities in various parts of the state and also should introduce new improved rice cropping pattern. In 2011-12, the expected production of paddy is 575090 tonnes and in 2019-20, it is 668430 tonnes. Productivity of paddy shows a marginal increase so that it had indicated an increasing trend. The expected productivity of paddy is 2661 kg/ha in 2011-16 and it is 3321 kg/ha in 2019-20.

The area under tapioca cultivation in Kerala shows a downward trend. Major reasons for the declining trend are urbanisation, increased cost of labour, uncertainty regarding product pricing and weak marketing strategies. The policies and programmes extended so far for tapioca cultivation were also weak. Sub division & fragmentation and lack of credit availability to small farmers further aggravated the problem. Projected area for the cultivation of tapioca is 73013 ha in 2011-12 and it is estimated to be 50789 ha in 2019-20. For fetching more land area for tapioca cultivation, the management conditions over the cultivable lands should be standardised and promote regulated markets to ensure better price. Productivity of tapioca in Kerala shows an increasing trend. Expected productivity of tapioca is 35644 kg/ha in 2011-12 and 49579 in 2019-20.

The area under pepper cultivation in Kerala shows random fluctuations. Suggestions to expand pepper cultivation area are government should procure the product from sub markets, pepper cultivation should be extended to all coconut farms and cost of production should be reduced. Comprehensive farm and family insurance of the farmers should also be given due importance. The very poor and declining performance of pepper

production in the state is attributed to higher production cost, increased cost of labour, market uncertainty, lack of proper manuring, poor marketing facilities and lack of processing industries & warehousing facilities in rural areas. Even though there was an increase of around two per cent in the area of cultivation, the production fell down by around nineteen per cent. This negative correlation was the result of decrease in the productivity of pepper over the same period.

The area under ginger cultivation had decreased drastically over the past twenty years. The decrease in the cultivated land for ginger accounts more than fifty per cent and as a consequence production decreased to the extent of thirty seven per cent only because of the increase in productivity during the same periods.

Turmeric cultivation shows random fluctuations. The decrease in the area of cultivation is attributed to small scale cultivation and poor irrigation facilities. In order to bring more land area for the cultivation of turmeric, encourage group farming & modern irrigation facilities, special packages should be announced for cultivation and subsidised inputs should be made available to turmeric cultivators. Productivity of turmeric shows a better performance and data on productivity had showed a systematic trade cycle.

The trend in the area of cultivation of banana and other plantains had showed a slight decreasing trend. Expected area for the cultivation of banana and other plantains in 2011-12 is 110400 ha and 98591 ha in 2019-20. The expected decrease from 2011-12 to 2019-20 is around eleven per cent. Banana production in Kerala is not uniform over the past ten years. This is due to the factors that available irrigation in the state is not adequate, large scale cultivation is low and pest attack is very high in small scale banana cultivation. Adequate irrigation facilities to the cultivable land should be ensured and protect farm from attack of pests to raise the production of banana and other plantains. The major

reason for the low productivity of banana is due to sub division & fragmentation of agricultural farm. Too much rain in short periods and prolonged drought are the another major causes for the low productivity. In Kerala, the farmers are highly concentrated in organic cultivation but natural fertilisers limit the productivity. Another reason for low productivity is people are giving lesser importance in re-planting the plantation.

Area brought under the cultivation of rubber amply revealed an increasing linear trend. The expected area for the cultivation of rubber in 2011-12 is 528156 ha and in 2019-20, it is expected to be 568241 ha. Production data on rubber also clearly revealed an increasing trend. The expected production is 856648 tonnes in 2011-12 and 1054856 tonnes in 2019-20. Rubber productivity in Kerala shows remarkable progress over the past few years. The expected increase in the productivity is 1533 kg/ha in 2011-12 and 1526 kg/ha in 2019-20.

The area under tea cultivation in Kerala shows a slight increase over the past twenty years. Tea production shows wide fluctuations. Reasons for poor production performance are shortage of labour, bad health conditions of cultivators, increased cost of cultivation, poor socio-economic conditions of labourers and pest attack. The suggestions for expanding tea production in the state are to introduce better fertilisers, subsidies will be made available and special importance should be given to export market.

Reasons for the better performance of coffee cultivation are the selling price determination of coffee, which is widely accepted, price fluctuations are less volatile in domestic and international market. Production of coffee fluctuates widely over the past twenty years.

The area under cultivation of cashew continuously decreased over the past two decades so that a severe decreasing trend is observed. Reasons for decreasing area are

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farmers in Kerala are mainly concentrated in small scale farming, the low yield from the crop and low yield from small farms badly affected large scale farming also. Projected area for the cultivation of cashew in 2011-12 is 53210 ha and in 2019-20 it is estimated to be 28658 ha. In spite of the increase in the production of cashew in India, production of cashew had shown a declining trend in Kerala over the past decades. The production of cashew nuts drastically falling with drastic shrinking of land brought under cultivation for cashew nuts. Hence a simple and viable remedy to raise the cultivation of cashew in the state is to bring more land for the cultivation of cashew nut.

The area under coconut cultivation in Kerala over the last few years had shown a declining trend. Majority of coconut farmers are poor and they have only small or marginal land for cultivation, price fluctuation of coconut is very high and lack of storage facility are the major reasons for this declining trend. The trend of coconut production in the state is commendable over the past ten years. Suggestions for further improving coconut production are strengthening of irrigation system, promoting high yielding varieties, more importance to comprehensive insurance for farmers, production of more value added products and establishing more coconut processing industries. Productivity of coconut had commendable progress over the past few years. The expected productivity of coconut in 2011-12 is 7641 nuts/ha and in 2019-20, it is 9043 nuts/ha.

Area under cardamom cultivation in Kerala is more or less the same. Cultivation of cardamom should be extended to lower plains and strengthen the marketing facilities of cardamom. The production of cardamom shows better performance. The productivity of cardamom shows a slight increase over the last few years with some sort of fluctuation. However, expected productivity in 2011-12 is 204 kg/ha and in 2019-20, it is 156 kg/ha only.

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A positive trend is observed in the cultivated area of areca nut. The expected percentage of increase from 2011-12 to 2019-20 is 17.47. The expected area under cultivation is 113784 ha in 2011-12 and 133664 ha in 2019-20. The areca nut production shows an increasing trend. The projected production of areca nut in 2011-12 is 154712 tonnes and in 2019-20 it is 212273 tonnes.

The expected real agricultural income of Kerala in 2011-12 is ₹ 12985 crore and ₹ 10428 crore in 2019-20. There is a declining trend in the real agricultural income of the state. Hence concerted policy measures are to be needed to revive the declining trend. Nominal agriculture income of the state had been showing an increasing trend. This trend is the outcome of an increasing trend of agriculture commodity prices irrespective of fall in agriculture output in some years. The expected nominal agriculture income in 2011-12 is ₹ 22774 crore and in 2019-20, it is expected to be ₹ 29810 crore. Percentage contribution of real agriculture income in SDP had shown a downward trend. The expected percentage contribution of agricultural income to SDP is 8.68 in 2011-12 and 2.27 in 2019-20. This trend in the share of real agricultural income to SDP reveals the expansion of industrial and service sector of the economy and also change in the occupational structure. Hence this fall in the share of real agricultural income in SDP shows that the state economy is on the path of development process. In contrast to the increasing trend in nominal agricultural income, the percentage contribution of nominal agriculture income in SDP had shown a decreasing trend. The expected share is eleven per cent in 2011-12 and eight per cent in 2019-20.

The percentage increase in real agricultural income of India from 1990-91 to 2007-08 was 64.13. Compared to this, the percentage increase in agricultural income of Kerala was only 30.23 from 1990-91 to 2008-09. In terms of percentage share also, the contribution of state agricultural income to national agricultural income was also declining

over the past two decades. Hence it is observed that the trend of national agricultural income is on an increasing path while the state agricultural income is on a decreasing path. The expected national agricultural income is ₹ 533749 crore in 2011-12 and ₹ 621677 crore in 2019-20. The increase in the nominal agricultural income of India over the reference period is 420.77 per cent in contrast to the increase of real agricultural income by 64.13 per cent. That is, this hike in the figures of nominal agricultural income amply reveals the price rise of agricultural products. Here also noted that from 1990-91 to 2008-09 the nominal agricultural income of the state had been increased by 474.43 per cent. That is, the percentage increase in real agricultural income of the state is less than the national figure while the percentage increase in nominal agricultural income of the state is greater than the national figure. Hence it could be inferred that the price rise of agricultural products in Kerala is much higher than the national average. The percentage of real agricultural income in real GDP was 32.19 per cent in 1990-91 and this came down to 18.49 per cent in 2007-08. Compared to this, the percentage of real agricultural income of the state in real SDP was 23.14 in 1990-91, which came down to 10.38 per cent in 2007-08. Hence it could be noted that this decline in percentage contribution of real agriculture income in real domestic product is the same (around 13 per cent) in the case of national as well as in state economy. The percentage of nominal agricultural income in nominal GDP was 30.22 in 1990-91, which declined to 18.96 per cent in 2007-08. Hence the absolute decline was 11.26 per cent. Compared to this, in the case of Kerala economy the decline was 9.11 per cent from 1990-91 to 2008-09. The expected percentage of real and nominal agricultural income in 2019-20 is around nine per cent.

Chapter I

Introduction

This introductory chapter is divided into eight broad sections. The first, second and third sections are confined to a review on the production, productivity and area brought under cultivation of major food and plantation crops at the state, national and global level. The statement of the problem and objectives of the study are given in section four. Section five explains the methodology followed for the study. The scope and limitations of the study are stated in sections six and seven respectively. Section eight explains organisation of the study report.

1.1 Global Agriculture

Agriculture is the key development that contributes directly to food security, supports poverty reduction and helps to promote agro-based industries by providing necessary raw materials. Agriculture faces multiple challenges to produce more food and fibre to feed a growing population.

In 2008, more than one-third of the world population was employed in agriculture. The service sector has over taken agriculture as the economic sector employing the most people worldwide. Despite the size of its workforce, agricultural production accounts for less than five per cent of the world output. In 2009, the agricultural output of China was the largest in the world followed by the European Union, India and the United States.

1.1.1 Major Crops: Global

a) Rice/Paddy: Rice is very important for human beings. Several countries of Asia and Africa are highly dependent on rice as a source of food, foreign exchange earnings and government revenue. According to FAO statistics (2010), the world rice production was 685.87 MT covering an area of 159.25 million ha in 2008. In 2009, though the area under cultivation of paddy had increased to 161.42 million ha, the production had decreased to 678.69 MT. Productivity of paddy had also decreased from 4307 kg/ha to 4204 kg/ha during the same period, registering a negative growth rate of 2.39 per cent.

Rice is the most important crop in Asia and its production is geographically concentrated in Western and Eastern Asia. Asia is the biggest rice producer with more than ninety per cent of the world production as well as consumption of rice during 2009. Two Asian countries China and India together produced 328.53 MT in 2009, which stood at about fifty per cent of the global rice. Indonesia, Bangladesh and Vietnam are the other major producers of rice.

b) Cassava/Tapioca: Cassava commonly known as tapioca grows in many developing countries and is a staple food for over two hundred million people. It is grown in 102 countries worldwide. As per FAO statistics (2010), globally cassava was grown in an area of 18.68 million ha producing 232.46 MT with a productivity of 12446 kg/ha in 2008, which had increased to 19.06 million ha, 240.99 tonnes and 12645 kg/ha respectively in 2009. African continent occupies first position covering more than fifty per cent of total tapioca production in 2009. Indonesia, Thailand, Vietnam and India are the major countries growing tapioca in Asia.

c) Pepper: Pepper, the king of spices, is one of the oldest and most popular spices in the world.   Pepper is being cultivated in developing countries across Asia and South America. Global production of pepper during 2009 was 4.14 lakh tonnes covering an area of 5.47 lakh ha against 4.15 lakh tonnes and 5.06 lakh ha respectively in 2008. Productivity of pepper was also declined from 820 kg/ha in 2008 to 757 kg/ha in 2009 (FAO Statistics 2010). World largest producer of pepper is Vietnam. The country produced more than twenty per cent of the world pepper production in 2008. Besides India, the consumption of pepper is concentrated in industrialised countries.   Price crisis and unfavourable weather conditions were the major reasons for the decline in the output of pepper in recent years.

d) Ginger: Ginger is used in foods, beverages, preservatives, medicines and perfumery industries. Ginger is commonly rotated with other crops such as tapioca, chillies, paddy etc. According to FAO Statistics (2010), world ginger production in 2008 was 1.61 MT, which had increased to 1.62 MT in 2009 and the area under cultivation had also increased from 4.21 lakh ha to 4.27 lakh ha during the same period. Though area as well as production had increased, the productivity of ginger had decreased from 3810 kg/ha in 2008 to 3787 kg/ha in 2009. In 2008, India occupied the first position with 23.60 per cent of global share in the production of ginger followed by China with 20.50 per cent, Indonesia with 11.80 per cent and Nepal with 11.20 per cent.

e) Turmeric: Turmeric, known as Indian saffron, is a seasonal and annual kharif spice crop. Global production of turmeric was estimated around eleven lakh tonnes during 2007-08. India is the largest producer, consumer and exporter of turmeric in the world. In 2007-08, India had produced nearly seventy per cent of the world production. Other major producers are China, Myanmar, Nigeria, Bangladesh, Pakistan, Sri Lanka, Taiwan, Burma and Indonesia.

f) Banana: Banana is the most popular fruit in the world. As per FAO Statistics (2010), total world production of banana was 93.39 MT in 2008, which had increased to 95.60 MT in 2009. Area under cultivation as well as productivity during the same period was also increased from 48.35 lakh ha to 48.44 lakh ha and 19316 kg/ha to 19737 kg/ha respectively. India dominates the world in banana production with an annual production of about 26.22 MT in 2008, which accounts more than twenty five per cent of the world output. Other leading producers are Philippines, Brazil, China, Ecuador, Indonesia, Costarica and Mexico.

1.1.2 Plantation Crops: Global

Plantation crops in general are either export oriented or import substituting. This low volume and high value crops though confined to certain geographical area in the tropics, which provide essential raw materials too for important industries and to other development sectors. Plantation crops support a major portion of the low income population by providing employment throughout the year. The following subsections give a global review of the major plantation crops such as rubber, tea, coffee, cashew, coconut, cardamom and areca nut.

a) Rubber: Rubber is a commercial crop and is produced in developing countries. According to FAO Statistics (2010), world natural rubber production during 2008 was 105.69 lakh tonnes, which was decreased to 102.81 lakh tonnes during 2009. Area under cultivation of rubber in 2008 was 8.96 million ha, which had increased to 8.99 million ha in 2009. Even though the area of natural rubber had increased, productivity had decreased from 1180 kg/ha in 2008 to 1143 kg/ha in 2009. Asia is the largest producing region with 95.22 lakh tonnes in 2009. Thailand is the biggest producer of natural rubber with thirty per cent of the world rubber production in 2008. Indonesia and Malaysia stands in second and third position. India

is the fourth largest producer of natural rubber with 7.70 per cent share of the world production in 2008.

b) Tea: Tea is an important beverage that the world drinks than any other beverage. As per FAO Statistics (2010), world production was 3.89 MT in 2008 and had decreased to 3.88 MT in 2009. The area under cultivation had increased from 2.93 million ha to three million ha during the same period. But productivity of tea had slightly decreased from 1331 kg/ha in 2008 to 1297 kg/ha in 2009. China ranks first in the production of tea in 2008. Other largest producers are India, Kenya, Sri Lanka, and Turkey.

c) Coffee: Coffee is a brewed drink prepared from roasted seeds, commonly called coffee beans of the coffee plant. Coffee is cultivated primarily in Latin America, Southeast Asia, and Africa. Green unroasted coffee is one of the most traded agricultural commodities in the world. World coffee production was 8.25 MT in 2008, which improved to 8.26 MT during 2009. But area under cultivation was declined to 9.75 million ha in 2008 against 9.60 million ha in 2009 indicating a negative growth rate of 1.54 per cent. But the productivity of coffee was slightly rose from 846 kg/ha in 2008 to 861 kg/ha in 2009 (FAO Statistics 2009). In 2009, Brazil was the world leader in production of green coffee, followed by Vietnam, Colombia and Indonesia. Two types of coffee beans viz Arabica coffee beans and Robusta coffee beans are cultivated in the world. Arabica coffee beans are cultivated in Latin America, Eastern Africa, and Asia. Robusta coffee beans are grown in Western and Central Africa, throughout South East Asia and in some parts of Brazil.

c) Cashew: The native of cashew is Eastern Brazil. In the early 1970s, majority of global cashew production took place in African countries, in particular, Mozambique and Tanzania.

According to FAO statistics (2010), world cashew production was almost same in 2008 and 2009 (3.76 MT) by covering an area of 4.11 million ha and 4.15 million ha respectively. Productivity of cashew during the same period was slightly decreased from 914 kg/ha to 908 kg/ha. Asian countries were the biggest producer of cashew during the past three decades. Vietnam dominates the world production by contributing 11.90 lakh tonnes in 2008 followed by India with 6.67 lakh tonnes and Nigeria with 6.60 lakh tonnes.

d) Coconut: Coconut, the tree of life, is grown all over the world except the continents of Europe and Australia. According to FAO Statistics (2010), global production of coconut was 60.71 MT in 2008, which was decreased to 59.86 MT in 2009. Area under cultivation as well as productivity of coconut was also decreased during 2008 and 2009. In 2008, area under cultivation of coconut was 11.23 million ha and had decreased to 11.20 million ha in 2009. Productivity was also decreased from 5406 kg/ha to 5341 kg/ha during the same period. Indonesia occupied the first position with an annual production of 19.50 MT by sharing thirty two per cent of the world production in 2008.

e) **Cardamom:** Cardamom is a reputed fruit and is considered as the "Queen of spices". Cardamom as a crop is generally produced in the tropical regions of the world. The world production of cardamom is around 35000 tonnes per annum. Guatemala was the leading producer of cardamom with a production of around 23000 tonnes in 2004 followed by India and Tanzania.

f) Areca nut: Areca nut is one of the most important commercial crops in South Asia. The world production of areca nut sums up to 0.89 MT in 2008 by covering an area of 0.81 million ha while in 2009 production had slightly increased to 0.90 MT covering an area of 0.81

million ha. Productivity was also slightly increased from 1100 kg/ha in 2008 to1106 kg/ha in 2009. In 2008, India was the leading country with a production of 0.48 MT sharing fifty four per cent of world output. The second place was occupied by China with a production of 0.13 MT, which accounts fifteen per cent of the world output.

1.2 Indian Agriculture

Agriculture provides significant support in the overall development and social transformation of the country. It contributed 18.96 per cent of national income in 2007-08. The spectacular story of Indian agriculture is known throughout the world for its multi-functional success in generating employment, food, nutritional and ecological security. Agriculture sector in India is the largest employment providing sector. Agriculture dominates the economy to such an extent that a very high proportion of working population in India is engaged in agriculture. In 1951, 69.50 per cent of the working population was engaged in agriculture. In 1981, this percentage had fallen marginally to 66.70. As per 2001 Population Census, the percentage of population working in agriculture sector was 22.76 per cent. Development of the other sectors of the economy has not been sufficient to provide employment to the increasing additions to working population who are, therefore, forced to fall back upon agriculture even if their marginal productivity on land is zero or negative. This gives rise to the problem of underemployment and disguised unemployment.

As the country is in the process of development, agriculture becomes the backbone of the economy, supplying not only with larger food surplus and raw materials but also the bulk of the national income. In fact, historical evidences of Japan and Soviet Russia had proved that the developed countries have come up on account of mobilising agricultural surplus for

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industrial development through heavy taxes and compulsory levies. Agricultural taxation also stimulates commercialisation of agriculture which, in turn, would respond to prices and other market forces quickly. Agricultural taxation would encourage farmers to so far improved technology. The government emphasis on agricultural sector by way of increased investment and assigning top priority calls for a parallel effort to tax away a portion of increase in income of the farmers.

Agricultural production has two components viz food grains and non–food grains. Food grain contributes approximately two-third of total agricultural production. Agriculture plays an important role in industrial development also. Agriculture provides raw material to the cotton textiles, jute, sugar and vanuspathi industries.

According to the Annual Report 2009-10 of the Ministry of Agriculture, the total geographical area of India is 328.7 million ha, of which the net sown area is 140.3 million ha while 193.7 million ha is the gross cropped area.

The Green Revolution has paved way for self-sufficiency in food grains. The Green Revolution ushered in a change in not only the attitudes of the farmers, but also technological changes. As a result of this new agricultural strategy, food grains output increased substantively, from 81 MTs in the Third Five Year Plan (1961-66) to 180 MTs in 1992-93. India is the largest producer of coconuts, mangoes, bananas, milk and dairy products, cashew nuts, pulses, ginger, turmeric and black pepper. It is also the second largest producer of rice, wheat, sugar, cotton, fruits and vegetables.

The productivity of agriculture is relatively low in India compared to other countries of the world. Not only productivity per hectare is low, the average productivity of labour

engaged in agriculture is also very low. For example labour productivity in India in 1965 was only 1.8 per cent of the labour productivity of USA. The productivity of paddy in India in 1987 was 2000 kg/ha while in Japan it was 6190 kg/ha. In 2008-09, the productivity of paddy was 2520 kg/ha, whereas in Japan it was 6488 kg/ha.

Indian agricultural plays an important role in the country's export trade. The main agricultural commodities exported are tea, oilcakes, fruits and vegetables, spices, tobacco, cotton, coffee, cocoa, sugar and sugar products, hides and skins, raw wool and other varieties of animal hair and vegetable oils.

It is a well known proverb that the Indian farmer is born in debt, lives in debt, dies in debt and bequeaths debt and indebtedness is a companion of a farmer from cradle to grave. In order to provide financial support to farmers in the event of crop failure due to drought, flood etc and restore the credit eligibility for the next crop season, a Comprehensive Crop Insurance (CCIS) was introduced in April, 1985 which at present covers wheat, paddy, millets, oil seeds and pulses.

1.2.1 Major Crops: India

a) Rice/Paddy: Rice production is an important part of national economy. India has the largest paddy output in the world and also the second largest exporter of rice. Paddy is cultivated at least twice a year (Rabi & Kharif) in the most parts of India. The Rabi cultivation is dependent on irrigation while Kharif depends on monsoon. According to the Statistical Year Book 2011 of DES (GOI), India accounted for 45.54 million ha area with production level of 99.18 MT of rice in 2008-09, against 43.91 million ha area with production level of 96.69 MT in 2007-08. Productivity of rice in 2007-08 was 2202 kg/ha,

which had decreased to 2178 kg/ha in 2008-09. The state-wise statistics showed that during 2008-09, West Bengal was the largest rice producer with 15.04 MT, which accounted nearly sixteen per cent of the rice production in the country. The other major rice producing states in 2008-09 were Andhra Pradesh with 14.24 MT, Uttar Pradesh with 13.10 MT and Punjab with 11 MT.

b) Cassava/Tapioca: Tapioca was introduced in India by the Portuguese. According to CMIE (June 2010), in India, tapioca occupied 2.53 lakh ha of land producing 87.22 lakh tonnes in 2007-08, which was increased to 2.80 lakh ha and 96.23 lakh tonnes respectively in 2008-09. Even though the area under cultivation and production of tapioca increased during 2007-08 and 2008-09, productivity had slightly decreased from 34474 kg/ha to 34368 kg/ha. Tapioca is being cultivated in twelve states and two UTs. The three major producers of tapioca are Tamil Nadu, Kerala and Andhra Pradesh. These three states produced 95.39 lakh tonnes of tapioca that contributed ninety nine per cent of the total production in the country during 2008-09.

c) Pepper: Pepper is a crop, which growing throughout the year. According to the Statistical Year Book 2011 of DES (GOI), India had produced around 0.47 lakh tonnes of black pepper covering an area of 1.97 lakh ha during 2007-08. In 2008-09, even though the area under cultivation was increased to 2.38 lakh ha, the production was remained almost same. Productivity of black pepper in 2006-07 was 280 kg/ha and had decreased to 239 kg/ha in 2007-08. In 2008-09, the productivity of pepper was again decreased to 197 kg/ha, indicating a decline of 17.57 per cent over 2007-08. According to CMIE (June 2010), Kerala was the largest producer of pepper with 0.42 lakh tonnes, accounting nearly ninety per cent of India's total output during 2007-08 followed by Karnataka with 0.04 lakh tonnes.

d) Ginger: Ginger is one of the earliest known oriental spices and is being cultivated in India as a fresh vegetable and as a dried spice. Ginger is also an important foreign exchange earning crop. According to CMIE (June 2010), ginger production in India during 2007-08 was 3.83 lakh tonnes covering an area of 1.04 lakh ha. In 2008-09, production was decreased by 3.40 lakh tonnes showing a decline of about 11.23 per cent over 2007-08. Productivity of ginger in 2006-07 was 3708 kg/ha, which had decreased to 3675 kg/ha in 2007-08. Among the Indian states, Meghalaya was the largest producer of ginger accounting 0.53 lakh tonnes in 2007-08. Kerala, Arunachal Pradesh, Orissa, West Bengal and Nagaland were the other major ginger producing states in India, which together contributed nearly forty per cent of the total production in the country during 2007-08.

e) Turmeric: India is a largest producer, consumer and exporter of turmeric in the world. According to CMIE (June 2010), the total turmeric production in India during 2007-08 was 7.94 lakh tonnes covering an area of 1.75 lakh ha. In 2008-09, production had declined to 7.85 lakh tonnes. Productivity of turmeric in 2007-08 was 4532 kg/ha against 4408 kg/ha in 2006-07. Major state that cultivates turmeric in the country during 2007-08 was Andhra Pradesh with a total production of 4.16 lakh tonnes, which accounted more than fifty per cent of the total production in the country. Tamil Nadu, Karnataka and Orissa were the other major turmeric cultivating states.

f) Banana: Banana is an important fruit crop of many tropical and subtropical regions of India. Banana is the second most important fruit crop in India next to mango. Banana was cultivated in an area of 5.33 lakh ha with a total production of 176.47 lakh tonnes during 2007-08. In 2008-09, the production was increased to 262.17 lakh tonnes covering an area of 7.09 lakh ha, showing an increase in the production of 48.56 per cent and cultivated area of

33.02 per cent respectively between the periods. Tamil Nadu occupies the first position in production as well as in area of cultivation. The state alone produced more than twenty per cent of the total production in the country during 2008-09. Other Indian states like Maharashtra, Gujarat, Andhra Pradesh, Madhya Pradesh and Karnataka together produced more than fifty five per cent of the total production in the country during 2008-09.

1.2.2 Plantation Crops: India

a) Rubber: India is the fourth largest producer of natural rubber in the world. According to CMIE (June 2010), production of natural rubber in the country during 2007-08 was 8.25 lakh tonnes covering an area of 6.10 lakh ha. The production as well as the area was increased to 8.64 lakh tonnes and 6.62 lakh ha respectively in 2008-09. The percentage increase in production and area under cultivation during 2008-09 over 2007-08 was 4.73 per cent and 8.52 respectively. Among the Indian states, Kerala accounted for more than ninety per cent of country's total output with 7.84 lakh tonnes in 2008-09 followed by Tamil Nadu with 0.24 lakh tonnes and Tripura with 0.23 lakh tonnes.

b) Tea: Tea is produced in India for commercial and domestic purposes. According to CMIE (June 2010), total production of tea in India during 2008-09 was 9.81 lakh tonnes compared to 9.86 lakh tonnes in 2007-08. The area of cultivation in 2008-09 was 5.79 lakh ha against 5.78 lakh ha in 2007-08. Assam is the largest producer of tea in India. In 2008-09, the state produced 4.87 lakh tonnes of tea, which accounted for about fifty per cent of the total production in the country. Other major Indian states that produce tea are West Bengal, Tamil Nadu and Kerala.

c) Coffee: Coffee is one of the Indian cash crops that stand next only to tea and admired beverage in the world as well as in India. The birth place of coffee in India is Karnataka. The total production in India during 2007-08 was 2.62 lakh tonnes covering an area of 3.88 lakh ha. In 2008-09, the area under cultivation was slightly increased to 3.94 lakh ha but the production remains almost same. Productivity of coffee had decreased from 675 kg/ha in 2007-08 to 665 kg/ha in 2008-09. Karnataka produced 1.84 lakh tonnes of coffee during 2008-09, which stands about seventy per cent of the total production in the country.

d) Cashew: The Portuguese introduced cashew to the west coast of India and East Africa in the sixteenth century. The first introduction of this commercial crop in India was made in Goa. India is the largest area holder of this crop. Cashew occupied an area of 8.93 lakh ha in the country during 2008-09 with a production of 6.95 lakh tonnes against the production of 6.65 lakh tonnes covering an area of 8.68 lakh ha in 2007-08. Cashew is grown in Kerala, Karnataka, Goa, Maharashtra, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal. Major producer of cashew in India during 2008-09 was Maharashtra followed by Andhra Pradesh, Orissa and Kerala. During 2008-09, Maharashtra produced 2.25 lakh tonnes of cashew, which accounted more than thirty per cent of the total production in the country.

e) Coconut: India occupies the prime position in the world in terms of production of coconut. The production of coconut in 2007-08 was 14743.6 million nuts covering an area of 1.9 million ha. During 2008-09, though the area under cultivation remains the same, production was slightly increased to 14748 million nuts with a productivity level of 7750 nuts per ha. Among the Indian states, Kerala produced about forty per cent of the total production in the country (3882 million nuts) followed by Tamil Nadu (3419 million nuts) and Karnataka (1126 million nuts) in 2008-09. With regard to the productivity level, Tamil Nadu leads with

8918 nuts/ha followed by West Bengal with 8580, Andhra Pradesh with 7604 and Maharashtra with 5738 nuts/ha.

f) Cardamom: India is a dominant player in the context of cardamom production. India is the second largest producer of cardamom. The cardamom cultivation is concentrated on the Western Ghats area in the country and it is termed as cardamom hills. According to CMIE (June 2010), the total production of cardamom in 2006-07 was 0.16 lakh tonnes, which was declined to 0.13 lakh tonnes during 2007-08. The area under cultivation in 2006-07 was 0.98 lakh ha and had decreased to 0.82 lakh ha showing a decline of 16.3 per cent. The states in India that are indulged in the production of cardamom are Kerala, Karnataka and Tamil Nadu. Kerala contributes more than fifty per cent of total production in the country followed by Sikkim with twenty per cent and Karnataka with 7.50 per cent in 2007-08.

g) Areca nut: India is the largest producer and consumer of areca nut in the world. The area under cultivation of areca nut in 2007-08 was 3.87 lakh ha and total production was 4.78 lakh tonnes, while in 2008-09, the area under cultivation remains almost same but the total production had slightly increased to 4.81 lakh tonnes. Areca nut occupies a prominent place among the cultivated crops in the states of Kerala, Karnataka, Assam, Meghalaya, Tamil Nadu and West Bengal. The state having largest production of areca nut is Karnataka. In 2008-09, Karnataka produced 2.24 lakh tonnes, which accounts for more than forty five per cent of the total areca nut production in the country.

1.3 Kerala Agriculture

Agriculture and allied sectors are the most important sectors of Kerala economy as they provide livelihood to about two-third of the population and contribute about ten per cent

of the real SDP in 2008-09. According to 2001 Population Census, twenty four per cent families in Kerala are depending directly on agriculture. Kerala is well known for wide range of products including spices and plantation crops, which contribute export earnings of the state. Besides this, all workers engaged in industries depend for their essential consumption requirement on agriculture. Equally significant is the impact of rural income on industrial consumption goods, that is, clothing, footwear, sugar, edible oils etc.

As agriculture develops and as income accruing to the rural people increase, the size of the market for industrial products in rural areas will also increase. In other words prosperous agriculture means greater purchasing power to buy industrial goods, thus it encourages industries. Agricultural efficiency and production largely depend upon inputs in agriculture and the methods of production. They are land, seeds, fertilisers, manures, pesticides, water, power, machinery, labour and the cattle fodder. By methods, means the technology of production or the way in which these inputs could be effectively combined and agricultural operation managed so as to have maximum returns.

The tools and implements used by the farmers are primitive, crude and antiquated, as compared to the most up-to-date farm machinery used by the farmers of the West. Improved tools and implement viz tractors, threshers, harvester combines, pump sets etc are needed for a number of agricultural operation such as preparation of seed bed, proper placement of seed, control of seeds, application of fertilisers etc.

The mechanisation of agriculture has brought about increased agricultural productivity and reduction of cost. There is a strong belief that progressive agriculture is impossible without mechanisation of agriculture. Mechanisation of agriculture means the use of machines

for carrying out farm operations instead of traditional methods involving human and animal labour. Ploughing is to be done by tractor, sowing and putting fertiliser by the drill, tractor, reaping and threshing by the combined harvester thresher and so on.

The success of agricultural productivity depends to a large extent on climatic factors and the availability of agriculture inputs on easy purchase scheme. Credit of finance to vast majority of needy agriculturist is imperative. At the same time it is difficult to distinguish between productive and unproductive loans of the farmers. A farmer may take loan from a bank and utilise it for unproductive purposes say for marriage ceremony, celebrate festivals or redeem previous loans. Because of these factors, banks did not show much interest in advancing loan to agriculture and allied activities. As a result the farmers were forced to depend on money lenders.

The total geographical area of the state is 38.86 lakh ha, which represents only 1.18 per cent of the total area of the country. Out of it the net sown area was 21.16 lakh ha (54.45 %) and forest occupies 1081 lakh ha (27.83 %) land in 2008-09. The total cropped area in 2008-09 was 27.02 lakh ha. Out of this the food crops occupy only 12.05 per cent. For meeting the food requirements, the state heavily depends on import from other states.

In Kerala, the most common or staple food is rice. About six hundred varieties of rice are growing in the sprawling paddy fields. Other two important food crops are tapioca and banana. Other cash crops like tea, coffee, cashew, pulses, areca nut, ginger etc are also cultivating in Kerala.

1.3.1 Major Crops: Kerala

a) **Rice/Paddy:** Rice, the leading commodity in Kerala, is declined continuously in terms of area of production over the last two decades. The average annual decline in the area of paddy cultivation during the Eighth Five Year Plan was around 22000 ha where as it had come down to an average of 13000 ha during the Ninth Plan period. The average annual reduction in area during the Tenth Plan period was 9398 ha. According to DES (GOK), Kerala had produced 5.28 lakh tonnes of rice in 2007-08 by covering an area of 2.29 lakh ha. But during 2008-09, the area as well as the production was increased to 2.34 lakh ha and 5.90 lakh tonnes respectively. The percentage increase was 2.18 and 11.74 respectively between the periods. Productivity of rice in 2007-08 was 2308 kg/ha and had increased to 2520 kg/ha in 2008-09 by registering an increase of 9.19 per cent growth rate.

b) **Cassava/Tapioca:** Tapioca, a crop of food security for people of Kerala in every respect. The area under cultivation of tapioca in 2007-08 was 83990 ha with a production level of 25.56 lakh tonnes. In 2008-09, area as well as the production was increased to 87241 ha and 27.12 lakh tonnes respectively. The percentage increase in area and production was 3.87 per cent and 6.10 per cent respectively. Also productivity had increased from 30438 kg/ha to 31091 kg/ ha during the same period, showing an increase of 2.14 per cent.

c) **Pepper:** The production of pepper in Kerala shows a declining trend during the last three years. The production was decreased from 41952 tonnes in 2007-08 to 33991 tonnes in 2008-09, showing a negative growth rate of nineteen per cent. The area under cultivation was also decreased from 175679 ha in 2007-08 to 153711 ha in 2008-09, registering a decline of 12.50 per cent. In 2009-10, area as well as production had increased to the tune of 171489 ha and

37899 tonnes respectively over 2008-09. The productivity of pepper in Kerala had achieved its peak level of 376 kg/ha during 1998-99. Productivity of pepper in 2007-08 was 239 kg/ha, which had decreased to 221 kg/ha in 2008-09.

d) Ginger: Kerala is considered as the best producer of ginger in the country due to their superior qualities. Apart from export potential, ginger is a labour intensive crop and primarily an important crop for a large number of small and marginal farmers in Kerala. The area as well as the production of ginger had come down from 2005-06 to 2009-10. In 2007-08, area under cultivation of ginger was 8865 ha with a production level of 31726 tonnes. But in 2008-09, the production was decreased to 30809 tonnes with cultivated area of 7421 ha. The percentage decrease in area and production was 16.29 and 2.89 respectively. With regard to the productivity level, it had increased from 3579 kg/ha in 2007-08 to 4152 kg/ha in 2008-09, showing an increase of sixteen per cent.

e) Turmeric: In Kerala, turmeric is cultivated in almost all the districts. The land is only marginally suitable for turmeric cultivation. Hence productivity of turmeric is low in spite of improved varieties and technologies. The area under cultivation of turmeric had shown a declining trend during the last few years. Production of turmeric in 2007-08 was 7434 tonnes by covering an area of 3155 ha and in 2008-09, the production as well as the area under cultivation was decreased to 6364 tonnes and 2782 ha respectively. In 2007-08, productivity of turmeric was 2356 kg/ha, which had decreased to 2288 kg/ha in 2008-09.

f) Banana: Banana is the most important fruit crop of the state next to mango. The area under cultivation of banana and plantain varieties in Kerala had risen from 65600 ha in 1990-91 to 110479 ha in 2002-03. The percentage increase during the period was 68.41. But from

2003-04 onwards, the area under cultivation had showed an up and down variation. In 2007-08, area under cultivation of banana and other plantains was110708 ha and had declined to 104865 ha in 2008-09 by registering a negative growth rate of 5.28 per cent. With regard to the production level, production of banana and other plantains in 1990-91 was 4.92 lakh tonnes, which had increased to 8.49 lakh tonnes in 2006-07, registering an increase of 72.56 per cent. But in 2007-08, the production level was steeply declined to half of the quantity produced in 2006-07. In 2008-09, the production had again decreased to 4.36 lakh tonnes by covering an area of 1.05 lakh ha. Productivity level was also steeply declined to 3973 kg/ha in 2007-08 over 7566 kg/ha in 2006-07. In 2008-09, the productivity had slightly increased from 3973 kg/ha in 2007-08 to 4158 kg/ha in 2008-09. The percentage increase in the productivity level was 4.66 between the periods.

1.3.2 Plantation Crops: Kerala

a) Rubber: Kerala contributes about eighty per cent of the cultivated area of rubber in the country. The coverage under the crop in 2008-09 was 5.17 lakh ha, higher by 5430 ha over the previous year. The production of natural rubber in Kerala during 2008-09 was 7.83 lakh tonnes by indicating 4.03 per cent increase over 2007-08. An increasing trend in productivity was experiencing from 1990-91 onwards. Productivity of rubber was 1471 kg/ha in 2007-08, which rose to 1514 kg/ha during 2008-09.

 b) Tea: Kerala accounts for only 0.37 lakh ha cultivated area of tea against the total area of 5.79 lakh ha in the country during 2008-09. The production of tea in the state had faced a declining trend during the last few years. In 2000-01, the production was 69132 tonnes and had declined to 51726 tonnes in 2008-09 by indicating a decrease of 25.18 per cent. But in

2009-10, the production level had increased to 57809 tonnes by covering an area of 0.37 lakh ha. Productivity of tea had shown an up and down variation.

c) Coffee: The area under cultivation of coffee in Kerala was 0.85 lakh ha against 3.94 lakh ha in the country during 2008-09. Major variety grown in Kerala is Robusta. Production of coffee during 2008-09 was only 0.57 lakh tonnes against 2.62 lakh tonnes as a whole in the country. Productivity of coffee in Kerala (675 kg/ha) is lower than the national average of 748 kg/ha. Area under cultivation of coffee had registered a substantial increase during the last two decades with an annual growth rate of over two per cent.

d) Cashew: The area under cultivation and production of cashew had come down drastically over the last five years. During 2005-06, the area under cultivation of cashew was 78285 ha, which had come down to 53007 ha during 2008-09, showing a decline of 32.29 per cent. Also the production during the same period had showed a decline of thirty eight per cent. The productivity had also come down to eleven per cent in 2008-09 as compared to 2007-08.

e) Coconut: Kerala is the largest coconut growing state that occupies more than forty per cent of the total production in the country during 2008-09. The plant is capable of meeting all the basic needs of food, fibre, fuel, timber etc. During the past three years the area and production of coconut had come down very much due to pest attack. The area under the crop contributes about thirty per cent of the total cropped area in the state during 2008-09. Though the area is declining, the productivity had gone up to 7365 nuts/ha in 2008-09 over 6889 nuts/ha in 2007-08 by indicating an increase of 6.91 per cent.

f) Cardamom: Kerala contributes about sixty per cent of the total cardamom produced in the country during 2008-09. The major cardamom growing zones are Udumbanchola, Perumedu

and Devikuklam taluks in Idukki district. In 2008-09, area as well as the production under cardamom in Kerala had increased to 4.60 per cent and 21.60 per cent respectively over 2007-08. But in 2009-10, though the area had increased to 41593 ha, the production had come down to 7800 tonnes. The productivity of cardamom in 2008-09 was 206 kg/ha, which had come down to 188 kg/ha in 2009-10, indicating a decline of 8.74 per cent.

g) **Areca nut:** In Kerala a declining trend is observed in the production of areca nut. The area under areca nut cultivation had fell down to 97492 ha in 2008-09 from 99787 ha in 2007-08. The decline was 2.30 per cent. But production was increased from 114690 tonnes to 125654 tonnes during the same period, indicating an increase of 9.56 per cent. In 2009-10, the area as well as the production had increased to 1.80 per cent and 1.90 per cent respectively over 2008-09. Productivity of areca nut had showing an increasing trend from 1990-91 onwards. In 2007-08, productivity of areca nut was 1149 kg/ha and had increased to 1289 kg/ha in 2008-09. During 2009-10, even though the area as well as the production had increased, productivity remains constant as compared to 2008-09.

1.4 Statement of the Problem

Kerala is a small state in the country with high density of population and agriculture is the major source of livelihood. Agriculture forms the backbone of the state economy. Agriculture is the largest sector of economic activity and has a crucial role to play in the economic development by providing food and raw materials, employment to a very large proportion of population, capital for its own development and surpluses for economic development.

During the sixties, the state is well known for its produces like paddy, coconut and tapioca and nearly fifty per cent of the population in the state depends on agriculture. By the end of eighties the area of food crops were shifted to plantations and cash crops like rubber, tea, coffee, cashew and cardamom. According to 2001 Population Census, only twenty four per cent of families were depend on agriculture as a major source of livelihood.

Total reduction in the area of food crops had resulted in substantial decline in the production of the major traditional food crops such as paddy and tapioca. The production of paddy was 10.87 lakh MT in 1990-91, which had decreased to more than half of its production (5.28 lakh MT) in 2007-08. Also production of tapioca was 28.03 lakh MT in 1990-91, which had decreased to 25.56 lakh MT in 2007-08. But most of the plantation crops had indicated an increase in production between 1990-91 and 2007-08. Production of rubber was 3.07 lakh MT in 1990-91 and had increased to 7.53 lakh MT in 2007-08. Production of coffee was also increased from 0.21 lakh MT in 1990-91 to 0.48 lakh MT in 1990-91.

During the past decades, agriculture sector contributed a major share of state domestic income. A number of industries like coir, cashew processing, oil mills etc. are depending on agriculture for their raw materials. The percentage contribution of agriculture income to SDP was steady upto the mid seventies and began to decline considerably during the following decades. The share of agriculture income to SDP during 2007-08 was twelve per cent against 33.47 per cent during 1990-91. However, the absolute share of agriculture income was ₹ 1761 crore in 1990-91 and had increased to ₹ 15181 crore in 2009-10.

The land utilisation pattern implied that about 54.45 per cent of the total land in the state was used for agriculture purpose during 2008-09 as against 57.82 per cent during 1990-

91. Land under non-agricultural uses was 7.60 per cent in 1990-91 and had increased to 11.63 per cent in 2008-09.

The above review has shown that area, production and productivity of some major crops have been declining consistently over the last several years. The low productivity clearly speaks of the vast potentials of growth in agriculture sector in view of the mechanisation and high yielding variety programme. The share of real agriculture income in SDP is also declining. This falling share of agriculture income in SDP also indicates the structural as well as occupational changes of the economy. All these signify a better understanding of the trend in agriculture production, agriculture income, area under cultivation and productivity of major crops. In this context, the evaluation study is confined to time series analysis of the trend in area under cultivation, production and productivity of major agriculture crops.

Objectives

Based on the above broad objective, the following specific objectives are framed for the study:

1. To analyse the trend in area, production and productivity of major crops viz paddy, tapioca, pepper, ginger, turmeric, banana and other plantains in the state.
2. To analyse the trend in area, production and productivity of plantation crops such as rubber, tea, coffee, cashew, coconut, cardamom and areca nut in the state.
3. To analyse the trend in agriculture income of the state.
4. To analyse and compare the trend in agriculture income of the state with the national trend.

1.5 Methodology

In order to analyse the trend in agriculture production, area brought under cultivation and productivity of major crops, time series on agriculture production data of twenty years from 1990-91 to 2009-10 are used. The secondary time series data are collected from Directorate of Economics and Statistics, Department of Agriculture, Office of the Agriculture Production Commissioner, and Land Use Board. Necessary quantitative information is also compiled from Economic Review of various years. So the evaluation study is fully based on secondary data. For data analysis, statistical methods such as simple bar diagram, trend lines (linear, polynomial, logarithmic, power and exponential), percentages, growth rates, coefficient of determination etc are used.

The main objective of analysing time series is to understand, interpret and evaluate changes in economic phenomenon in the scope of more correctly anticipating the course of future events. In the analysis of time series, here examined the effect of time on agriculture production, productivity and area brought under cultivation of major agriculture crops. Here the analysis consists of identifying the various forces where interaction produces the variation in agricultural time series data. Analysing and measuring them independently. A study about the effect of these forces would help to understand the past behaviour of the data, general tendency of the data and thus help to forecast the future behaviour of the data.

Time series are usually affected by a multiplicity of causes. The changes in the values of time series agriculture data are the result of a large variety of factors. These factors or forces are inter connected or inter related and can't be distinguish easily. However, the effects of these factors are classified into the following categories viz secular trend, seasonal

variations, cyclical variation and irregular fluctuations. In order to fit mathematical curve, appropriate trend equation is selected on the basis of the following criteria:

The histogram of the given time series enabled a fairly good idea about the type of the trend line selected. With the help of histogram of time series data, first noted that whether the trend is linear or non-linear. If the graph exhibited a non-linear trend then further approximation to the type of the trend curve could be obtained by plotting the data on a semi-logarithmic scale. A careful study of the graph obtained on plotting the data on semi-logarithmic scale often provided an adequate basis for the selection of the type of trend. If the time series values increased or decreased by a constant absolute value, that is, if they formed an arithmetic progression, then straight line trend is used because in this case histogram would give a straight line graph.   If the trend is non-linear, then the data are plotted on a semi-logarithmic scale, if the graph so obtained gives a straight line, if they form a series in geometric progression, then the appropriate trend curve selected is exponential curve. If the data plotted on semi-logarithmic scale is not a straight line graph, but is a concave curve either upward or downward then the appropriate trend curve is logarithmic trend. Coefficient of determination, which is a measure of best fit of a set of data, is also obtained for each of the mathematical curve to understand about the reliability and accuracy for projection with a particular type of trend line. Projections are only done carefully with those estimated trend line, which explains more than eighty five per cent of the total variation of the observed time series data. In short full exercise is done before choosing the type of appropriate trend lines for the study. Based on the above criteria, following trend lines are used for projection and forecasting purposes. Straight line trend equation of the form $Y = a + b\,x$, polynomial trend $Y = a + b\,x + c\,x^2$, logarithmic trend $Y = a \ln(x) + b$, exponential trend $Y = e^{bx}$ and power trend

$Y = a \ x^b$, where Y is the dependent variable viz production or productivity or area brought under cultivation of agricultural products, a, b and c are constants, the term 'a' gives the intercept and 'b' is the slope or coefficient of the equation.

The period 1990-91 is purposively selected as the base year for the study because this year is free from abnormalities like flood, draught or other epidemics and not too distant in the past. These are the important things noted while selecting the base period.

1.6 Scope of the Study

The suggestions and findings of the study will be helpful for the purpose of sectoral planning and policy formulation for the development of agriculture sector of the state. The findings, interpretations and extrapolations will be highly helpful for agricultural programme/project evaluation and implementation. The results of the study will be also useful to a large extent for the optimal allocation of resources under various Annual Plans for the development of agriculture sector in the state. It also helps to finish ongoing programmes effectively. The study results will be very useful to the research scholars in the similar fields.

1.7 Limitations

Due to statistical data analysis constraint only twenty years time series data were used for the study. Out of the four components of time series, viz secular trend, seasonal variation, cyclical variation and irregular fluctuation, the analysis confined to only analysing the characteristics of the time series data in terms of secular trend only. Another limitation of the trend fitting of the principle of Least Squares is the selection of a particular type of mathematical curve. However, full thought and logical exercise were done for the selection of an appropriate trend equation.

1.8 Organisation of the Report

The report is organised into three chapters. Besides this introductory chapter, the trend analysis of area, production and productivity of major crops are analysed in chapter two and major findings and suggestions are given in the last chapter.

Chapter II

Trend Analysis of Area, Production and Productivity

This chapter deals with trend analysis of area under cultivation, production and productivity of important crops such as paddy, tapioca, pepper, ginger, turmeric, banana & other plantains, rubber, tea, coffee, cashew, coconut, cardamom, and areca nut. Analysis are done with twenty year time series data from 1990-91 to 2009-10 and estimates of forecasts are given for 2011-12 to 2019-20. For this purpose the time series data have been extrapolated by fitting linear, polynomial, exponential, logarithmic and power trend lines based on the value of coefficient of determination and other criteria for the selection of trend lines. Projections are done with only those trend lines, which explain at least eighty five per cent of the total variation of the observed time series data on production, productivity and area under cultivation. Trend in agriculture income of the state and percentage contribution of agricultural income in SDP in terms of current as well as at constant prices are also analysed. A comparative study of the trend in agricultural income of the state as well as the share of agricultural income in the value of total output with the national figures are also done in the last section of this chapter.

2.1 Paddy

Paddy is the major food crop for the people in Kerala. The consumption of rice in the state is increasing day by day, but the area of cultivation of paddy is gradually decreasing over the years.

2.1.1 Area under Cultivation: Paddy

The area under paddy cultivation in Kerala had continuously decreased over the past twenty years and this amply shows a clear decreasing trend. In 1990-91, 559500 ha area was brought under the cultivation of paddy, which alarmingly came down to 234013 ha in 2009-10 so

that the percentage decrease was 58.17. That is, around fifty eight per cent of the area which was once brought under the cultivation for paddy production now being used for some other purposes viz for the production of commercial crops, for housing the net addition of population, building infrastructure for industrial or service sector etc.

Table 2.1
Area under Cultivation: Paddy (1990-91 to 2009-10)

(In ha)

Year (X)	Area (Y)	Trend Equation, $Y = 604770\,e^{-0.05x}$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	559500	1	575275.02	-15775.02
1991-92	541300	2	547218.53	-5918.53
1992-93	537600	3	520530.36	17069.64
1993-94	507800	4	495143.80	12656.20
1994-95	503300	5	470995.35	32304.65
1995-96	471100	6	448024.64	23075.36
1996-97	424800	7	426174.22	-1374.22
1997-98	387100	8	405389.45	-18289.45
1998-99	352600	9	385618.38	-33018.38
1999-00	349774	10	366811.55	-17037.55
2000-01	347455	11	348921.94	-1466.94
2001-02	322368	12	331904.81	-9536.81
2002-03	310521	13	315717.62	-5196.62
2003-04	287340	14	300319.89	-12979.89
2004-05	289974	15	285673.12	4300.88
2005-06	275742	16	271740.68	4001.32
2006-07	263529	17	258487.73	5041.27
2007-08	228938	18	245881.13	-16943.13
2008-09	234265	19	233889.37	375.63
2009-10*	234013	20	222482.45	11530.55

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

An exponential trend equation, $Y = 604770\,e^{-0.05x}$, is fitted for the data on area under cultivation of paddy. This line of best fit indicates a coefficient of determination of 0.981 so that the line fitted is 98.10 per cent best fit to the data also.   In the equation, 604770 is the intercept and -0.05 is the slope or the regression coefficient of the equation.   These values show the decreasing trend in the area for the cultivation of paddy.   Details along with the elimination of trend by additive model (actual values – trend values) are given in Table 2.1. The major reasons

for declining area under paddy cultivation are conversion of paddy fields into horticultural crops and non-agricultural purposes, mainly for housing. The other reasons are urbanisation, migration of labour from other states, lack of modern technical know-how and increasing cost of labour for cultivation.

Figure 2.1
Area under Cultivation: Paddy (1990-91 to 2009-10)

(In ha)

$Y = 604770\ e^{-0.05x}$
$R^2 = 0.981$
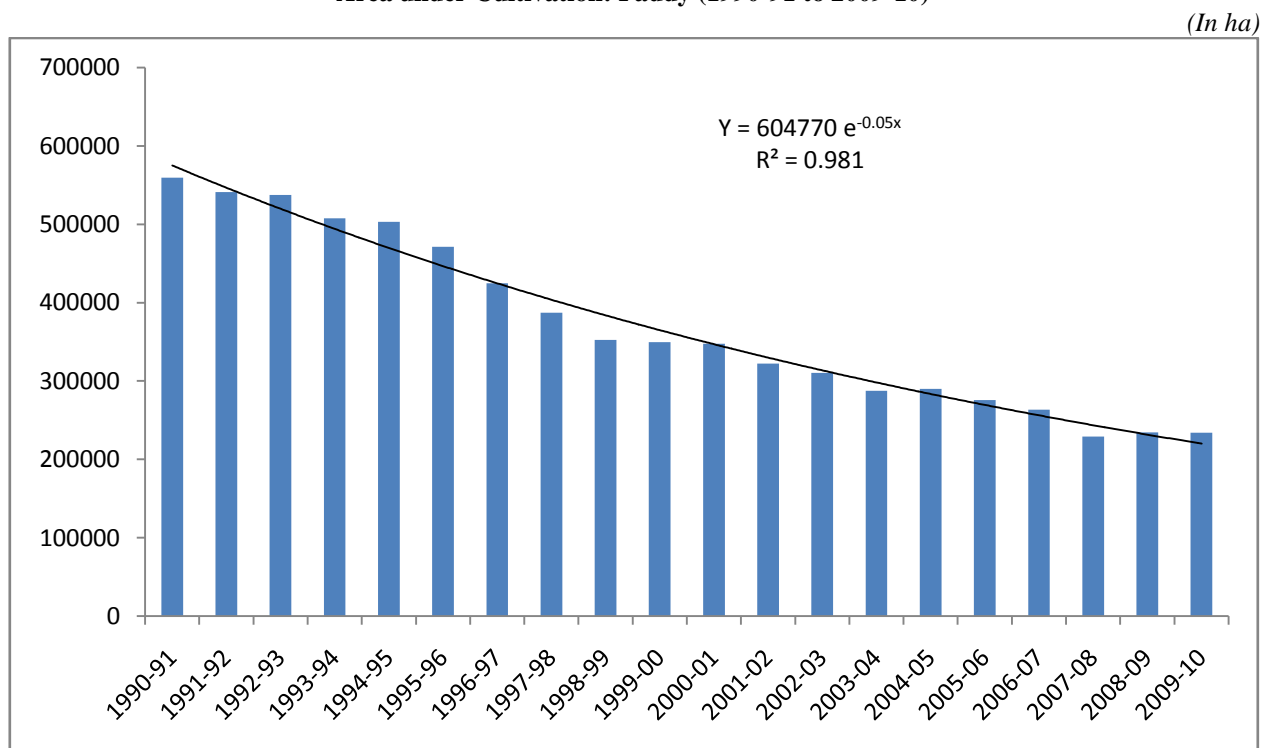
Table 2.2 gives projections. The expected area for cultivation of paddy during 2011-12 is 201311 ha, in 2015-16, it is 164819 ha and in 2019-20 it is estimated to be 134942 ha only. Hence time bound policy measures such as special rice package in selected districts and farm & crop insurance should be made compulsory. More importance is given to extend irrigation facilities in various parts of the state and also should introduce new improved rice cropping pattern.

Table 2.2
Projected Area for Cultivation: Paddy (2011-12 to 2019-20)

(In ha)

Year (X)	Trend Equation, Y = 604770 e$^{-0.05x}$	
	Value of X	*Projected Value of Y (Area for Cultivation)*
2011-12	22	201310.45
2012-13	23	191492.42
2013-14	24	182153.22
2014-15	25	173269.51
2015-16	26	164819.05
2016-17	27	156780.73
2017-18	28	149134.45
2018-19	29	141861.07
2019-20	30	134942.43

Source: Output of MS EXCEL

2.1.2 Production: Paddy

Production of paddy indicates increasing trend with up and down. Production was 1086578 tonnes in 1990-91, which came down to 598339 tonnes in 2009-10. In other words, the percentage decrease over this period was accounted for 44.93. That is, a 58.17 per cent decrease in the area for paddy production caused only a 44.93 per cent decrease in production during the last twenty years. This difference was due to the art of improved agriculture activities, which resulted in substantial improvement in the productivity of paddy. A polynomial trend equation of the form Y = 1.3221 X^2 - 57.082 X + 1191 is estimated with the data for the production of paddy and this equation is 94.82 per cent best fit to the observed data also. The trend values along with elimination of trend are given in Table 2.3.

Table 2.3
Production: Paddy (1990-91 to 2009-10)

(In '000 tonnes)

Year (X)	Production (Y)	Trend Equation, Y = 1.3221 X² - 57.082 X + 1191		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	1086.578	1	1135.24	-48.66
1991-92	1060.35	2	1082.12	-21.77
1992-93	1084.878	3	1031.65	53.23
1993-94	1003.938	4	983.83	20.11
1994-95	975.065	5	938.64	36.42
1995-96	953.026	6	896.10	56.92
1996-97	831.600	7	856.21	-24.61
1997-98	764.610	8	818.96	-54.35
1998-99	726.743	9	784.35	-57.61
1999-00	770.686	10	752.39	18.30
2000-01	751.328	11	723.07	28.26
2001-02	703.504	12	696.40	7.11
2002-03	688.859	13	672.37	16.49
2003-04	570.045	14	650.98	-80.94
2004-05	667.105	15	632.24	34.86
2005-06	629.987	16	616.15	13.84
2006-07	641.575	17	602.69	38.88
2007-08	528.488	18	591.88	-63.40
2008-09	590.241	19	583.72	6.52
2009-10*	598.339	20	578.20	20.14

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.2
Production: Paddy (1990-91 to 2009-10)

(In '000 tonnes)

$Y = 1.3221 X^2 - 57.082 X + 1191$
$R^2 = 0.9482$

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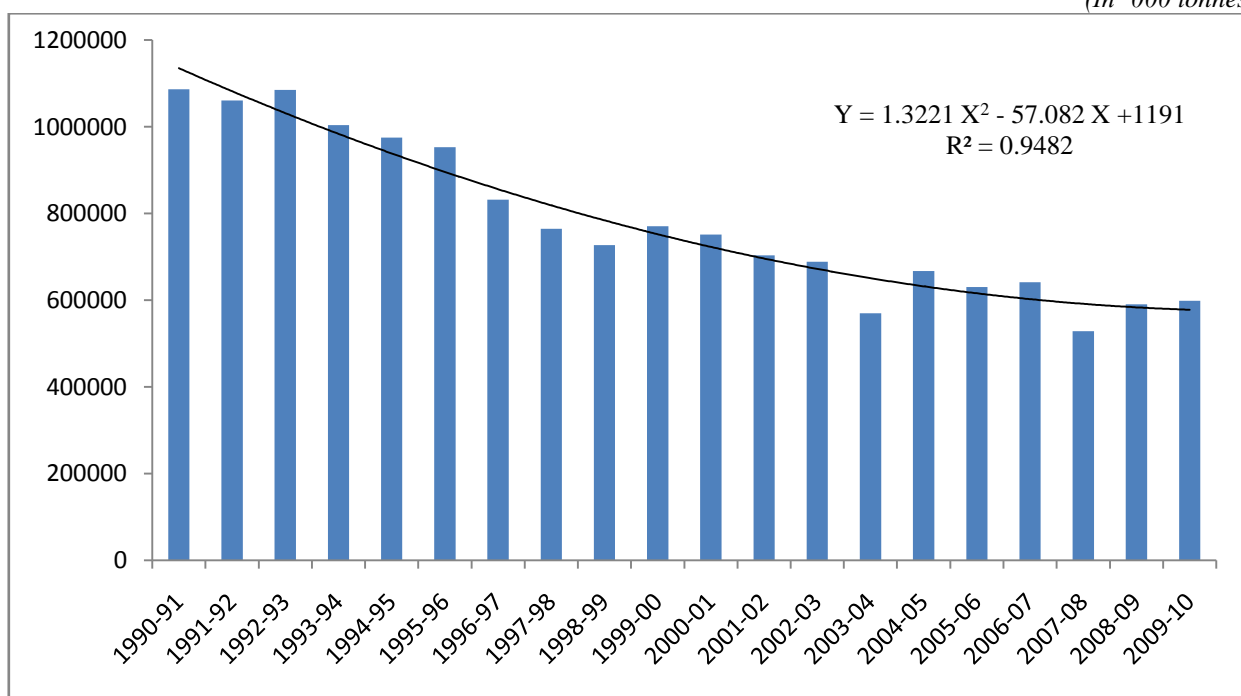
Projections are worked out in Table 2.4. In 2011-12, the expected production of paddy is 575090 tonnes, in 2015-16 it is estimated to be 600610 tonnes and in 2019-20, it is worked out to be 668430 tonnes.

Table 2.4
Projected Production: Paddy (2011-12 to 2019-20)

(In '000 tonnes)

Year (X)	Trend Equation, $Y = 1.3221 X^2 - 57.082 X + 1191$	
	Value of X	**Projected Value of Y (Production)**
2011-12	22	575.09
2012-13	23	577.50
2013-14	24	582.56
2014-15	25	590.26
2015-16	26	600.61
2016-17	27	613.60
2017-18	28	629.23
2018-19	29	647.51
2019-20	30	668.43

Source: Output of MS EXCEL

Some suggestions for improving paddy production in the state are:

- Importance should be given to co-operative farming.

- More importance should be given to post- harvest facilities.

- Special packages should be announced for reducing cost of cultivation.

- Due importance should be given to improved technology.

- High yielding varieties of improved seeds to be made available to all farmers.

- Modern fertilisers should be made available at subsidised rate.

- Irrigation facility should be extended to all farms.

- Introduce new scientific pest control strategies.

2.1.3 Productivity: Paddy

Productivity is defined as total output in kg/ha. It is obtained by dividing total output in kg by land area cultivated in ha. Productivity data of paddy in Kerala shows a marginal increase over the past ten years so that it had indicated an increasing trend. The main reasons for this are the

impact of technological change on rice yield due to the effective implementation of schemes like

National Agricultural Development Programme and National Food Security Mission and also due

to supply of good quality seeds to farmers. In 1990-91, the productivity of paddy was 1942 kg/ha,

which rose to 2557 kg/ha in 2009-10, so that the percentage increase was 31.67 per cent. This

increase in productivity was attributed to improvement in the art of agriculture such as the use of

better fertilisers and manure, better seeds, improved irrigation facilities etc. The polynomial trend

equation fitted of the form $Y = 1.702 X^2 - 5.9872 X + 1968.9$ gives a coefficient of determination

of 0.8529 (See: Table 2.5 and Fig 2.3).

Table 2.5
Productivity: Paddy (1990-91 to 2009-10)

(In kg/ha)

Year (X)	Productivity (Y)	Trend Equation, $Y = 1.702 X^2 - 5.9872 X + 1968.9$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	1942	1	1964.61	-22.61
1991-92	1959	2	1963.73	-4.73
1992-93	2018	3	1966.26	51.74
1993-94	1977	4	1972.18	4.82
1994-95	1937	5	1981.51	-44.51
1995-96	2023	6	1994.25	28.75
1996-97	1958	7	2010.39	-52.39
1997-98	1975	8	2029.93	-54.93
1998-99	2061	9	2052.88	8.12
1999-00	2203	10	2079.23	123.77
2000-01	2162	11	2108.98	53.02
2001-02	2182	12	2142.14	39.86
2002-03	2218	13	2178.70	39.30
2003-04	1984	14	2218.67	-234.67
2004-05	2301	15	2262.04	38.96
2005-06	2285	16	2308.82	-23.82
2006-07	2435	17	2359.00	76.00
2007-08	2308	18	2412.58	-104.58
2008-09	2520	19	2469.57	50.43
2009-10*	2557	20	2529.96	27.04

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.3
Productivity: Paddy (1990-91 to 2009-10)

(In kg/ha)

$$Y = 1.702 X^2 - 5.9872 X + 1968.9$$
$$R^2 = 0.8529$$
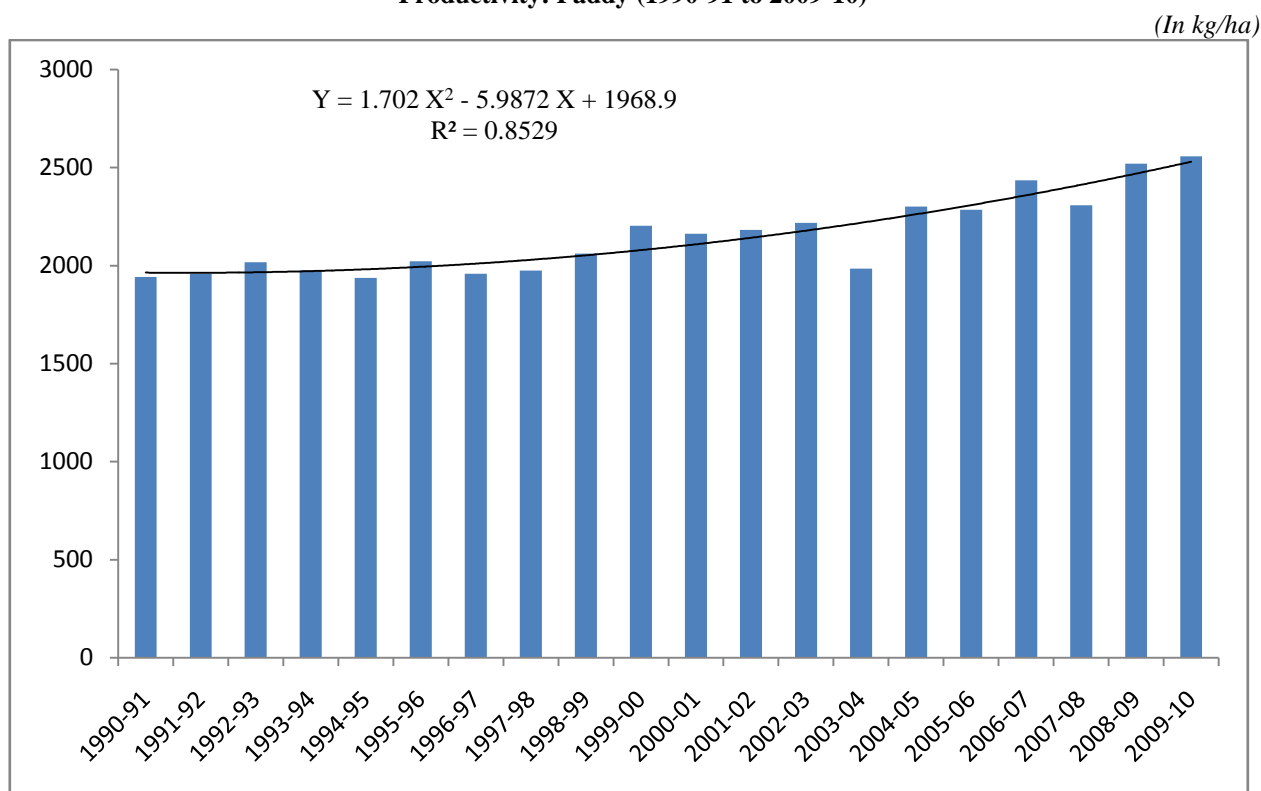
The 85.29 per cent best fitted function is used for projecting the productivity of paddy for the coming years. The expected productivity of paddy is 2661 kg/ha in 2011-16, 2964 kg/ha in 2015-16 and it is 3321 kg/ha in 2019-20. Details of projections are given in Table 2.6

Table 2.6
Projected Productivity: Paddy (2011-12 to 2019-20)

(In kg/ha)

Year (X)	Trend Equation, $Y = 1.702 X^2 - 5.9872 X + 1968.9$	
	Value of X	*Projected Value of Y (Productivity)*
2011-12	22	2660.95
2012-13	23	2731.55
2013-14	24	2805.56
2014-15	25	2882.97
2015-16	26	2963.78
2016-17	27	3048.00
2017-18	28	3135.63
2018-19	29	3226.65
2019-20	30	3321.08

Source: Output of MS EXCEL

2.2 Tapioca

Cassava, commonly known as tapioca grows in many developing countries. It was introduced in India by the Portuguese and is widely consumed in Kerala.

2.2.1 Area under Cultivation: Tapioca

The area under tapioca cultivation in Kerala shows a continuously downward trend over the past twenty years. Major reasons for the declining trend in area under tapioca cultivation are increased urbanisation, increased cost of labour, uncertainty regarding product pricing, weak marketing strategies and poor policies and programmes extended so far for tapioca cultivation. Sub division & fragmentation of land holdings further aggravated the problem. Availability of credit to small farmers is also inadequate.

Table 2.7
Area under Cultivation: Tapioca (1990-91 to 2009-10)

(In ha)

Year (X)	Area (Y)	Trend Equation, $Y = 16.725 X^2 - 3647.7 X + 145167$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	146500	1	141536.03	4963.98
1991-92	141900	2	137938.50	3961.50
1992-93	135000	3	134374.43	625.58
1993-94	131000	4	130843.80	156.20
1994-95	114300	5	127346.63	-13046.63
1995-96	113600	6	123882.90	-10282.90
1996-97	120400	7	120452.63	-52.63
1997-98	121400	8	117055.80	4344.20
1998-99	112800	9	113692.43	-892.43
1999-00	111922	10	110362.50	1559.50
2000-01	114609	11	107066.03	7542.98
2001-02	111189	12	103803.00	7386.00
2002-03	104179	13	100573.43	3605.58
2003-04	94297	14	97377.30	-3080.30
2004-05	88486	15	94214.63	-5728.63
2005-06	90539	16	91085.40	-546.40
2006-07	87128	17	87989.63	-861.63
2007-08	83990	18	84927.30	-937.30
2008-09	87241	19	81898.43	5342.58
2009-10*	74856	20	78903.00	-4047.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

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In 1990-91, the area under tapioca production was 146500 ha, which around by halves in 2009-10.   A polynomial function is best suited to this data and the function is fitted of the form $Y = 16.725 \ X^2 - 3647.7 \ X + 145167$ with a coefficient of determination of 0.929.   The trend values and the elimination of short term fluctuation are given in Table 2.7.

Figure 2.4
Area under Cultivation: Tapioca (1990-91 to 2009-10)

(In ha)
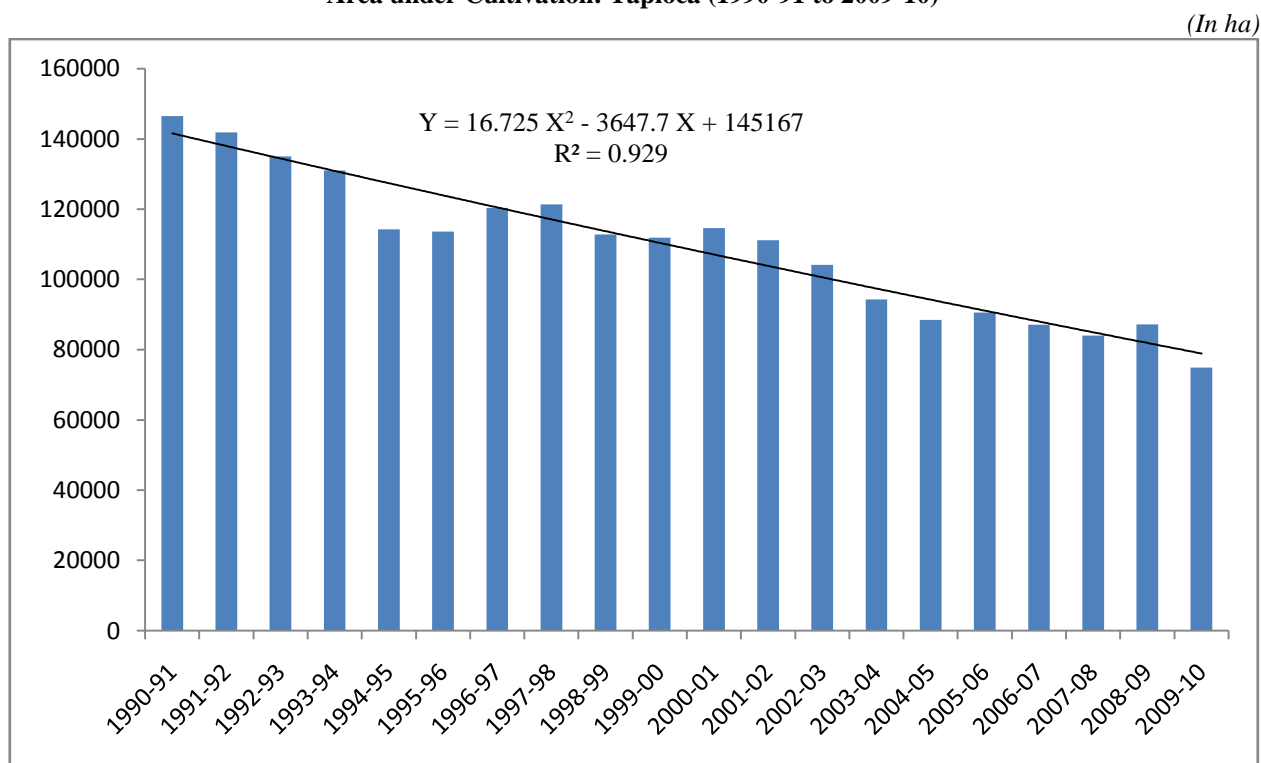
Projections are given in Table 2.8. Projected area to be brought for the cultivation of tapioca is 73013 ha in 2011-12, 61633 ha in 2015-16 and it is estimated to be 50789 ha in 2019-20. For fetching more land area for tapioca cultivation, the management conditions of the cultivable lands should be standardised and promote regulated markets to ensure better price.

Table 2.8
Projected Area for Cultivation: Tapioca (2011-12 to 2019-20)

(In ha)

Year (X)	Trend Equation, $Y = 16.725 X^2 - 3647.7 X + 145167$	
	Value of X	*Projected Value of Y (Area for Cultivation)*
2011-12	22	73012.50
2012-13	23	70117.43
2013-14	24	67255.80
2014-15	25	64427.63
2015-16	26	61632.90
2016-17	27	58871.63
2017-18	28	56143.80
2018-19	29	53449.43
2019-20	30	50788.50

Source: Output of MS EXCEL

2.2.2 Production: Tapioca

The production status of tapioca in Kerala shows wider fluctuations. These fluctuations were not the result of trend, cyclical or seasonal variations, but due to irregular variations. Tapioca production was 2803001 tonnes in 1990-91 and fell down to 2525380 tonnes in 2009-10, so that it had been experienced a 9.90 per cent fall in production. The best selection of trend line is polynomial, but the fitted line explains only 22.25 per cent variation of observed data of production (See: Table 2.9 and Figure 2.5) and hence further application is not worked out for projecting the values of production.

Suggestions for improving tapioca production in the state are:

- Promotion of new high yielding varieties of plants.

- More importance should be given to proper manuring.

- Impart training on scientific management for tapioca cultivation.

- Pest and disease resistant variety of tapioca should be promoted for small scale and large scale cultivation.

- Eliminate market uncertainty and find new foreign markets.

- More concentration should be given to value added products.

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Table 2.9
Production: Tapioca (1990-91 to 2009-10)

(In'000 tonnes)

Year (X)	Production (Y)	Trend Equation, $Y = 1.3923 X^2 - 35.342 X + 2741.8$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	2803.00	1	2707.85	95.15
1991-92	2657.87	2	2676.69	-18.83
1992-93	2629.13	3	2648.30	-19.17
1993-94	2602.21	4	2622.71	-20.5
1994-95	2344.24	5	2599.90	-255.66
1995-96	2500.11	6	2579.87	-79.76
1996-97	2691.12	7	2562.63	128.49
1997-98	2741.70	8	2548.17	193.53
1998-99	2630.16	9	2536.5	93.66
1999-00	2531.75	10	2527.61	4.14
2000-01	2586.90	11	2521.51	65.39
2001-02	2455.88	12	2518.19	-62.31
2002-03	2413.22	13	2517.65	-104.43
2003-04	2540.79	14	2519.90	20.89
2004-05	2400.04	15	2524.94	-124.9
2005-06	2568.28	16	2532.76	35.52
2006-07	2519.00	17	2543.36	-24.36
2007-08	2556.46	18	2556.75	-0.30
2008-09	2712.43	19	2572.92	139.51
2009-10*	2525.38	20	2591.88	-66.50

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.5
Production: Tapioca (1990-91 to 2009-10)

(In '000 tonnes)

$$Y = 1.3923 \ X^2 - 35.342 \ X + 2741.8$$
$$R^2 = 0.2225$$
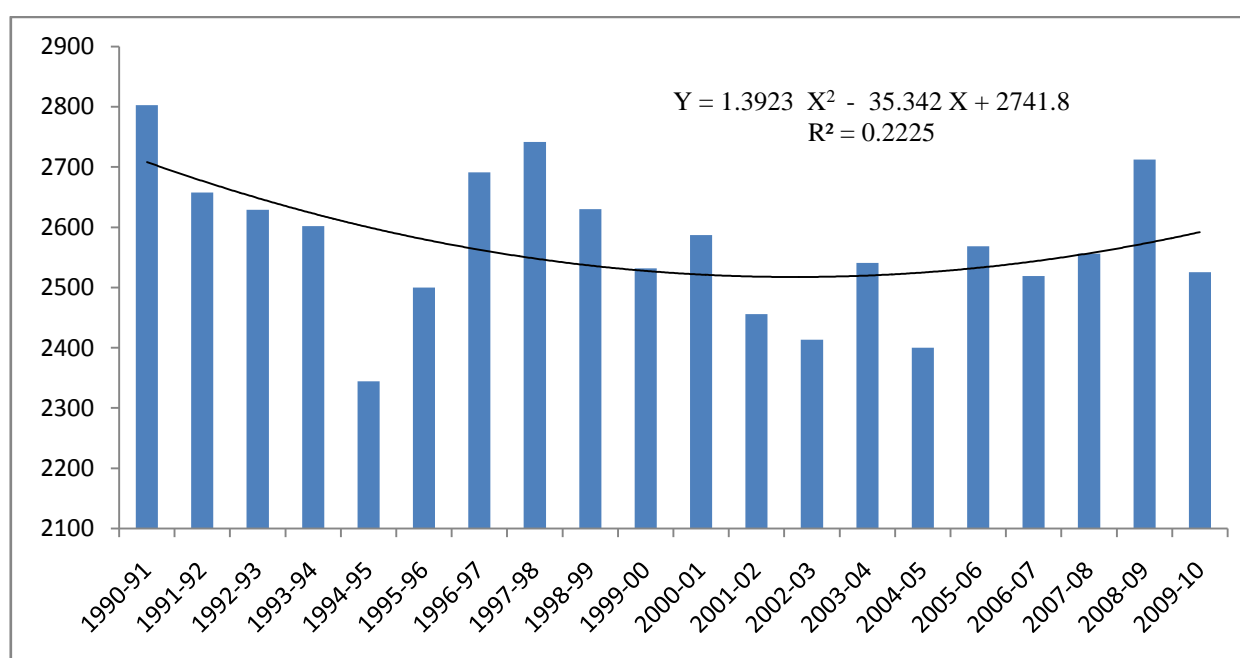
2.2.3 Productivity: Tapioca

Productivity of tapioca in Kerala shows an increasing trend over the past twenty years. Reasons for increasing trend in productivity of tapioca in the state are better climatic conditions, availability of good quality fertilisers and good crop management. The productivity was 19133 kg/ha in 1990-91, which increased to 33737 kg/ha in 2009-10. That is, a 76.33 per cent increase in productivity. By selection, a best fitted line of the form $Y = 33.549 X^2 - 2.6958 X + 19466$ is estimated with a coefficient of determination of 0.9501 (See: Table 2.10 and Figure 2.6).

Table 2.10
Productivity: Tapioca (1990-91 to 2009-10)

(In kg/ha)

Year (X)	Productivity (Y)	Trend Equation, $Y = 33.549 X^2 - 2.6958 X + 19466$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	19133	1	19496.85	-363.85
1991-92	18731	2	19594.80	-863.80
1992-93	19475	3	19759.85	-284.85
1993-94	19864	4	19992.00	-128.00
1994-95	20510	5	20291.25	218.75
1995-96	22008	6	20657.59	1350.41
1996-97	22351	7	21091.03	1259.97
1997-98	22584	8	21591.57	992.43
1998-99	23317	9	22159.21	1157.79
1999-00	22621	10	22793.94	-172.94
2000-01	22572	11	23495.78	-923.78
2001-02	22087	12	24264.71	-2177.71
2002-03	23164	13	25100.74	-1936.74
2003-04	26945	14	26003.86	941.14
2004-05	27123	15	26974.09	148.91
2005-06	28367	16	28011.41	355.59
2006-07	28911	17	29115.83	-204.83
2007-08	30438	18	30287.35	150.65
2008-09	31091	19	31525.97	-434.97
2009-10*	33737	20	32831.68	905.32

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.6
Productivity: Tapioca (1990-91 to 2009-10)

(In kg/ha)

$$Y = 33.549 X^2 - 2.6958 X + 19466$$
$$R^2 = 0.9501$$
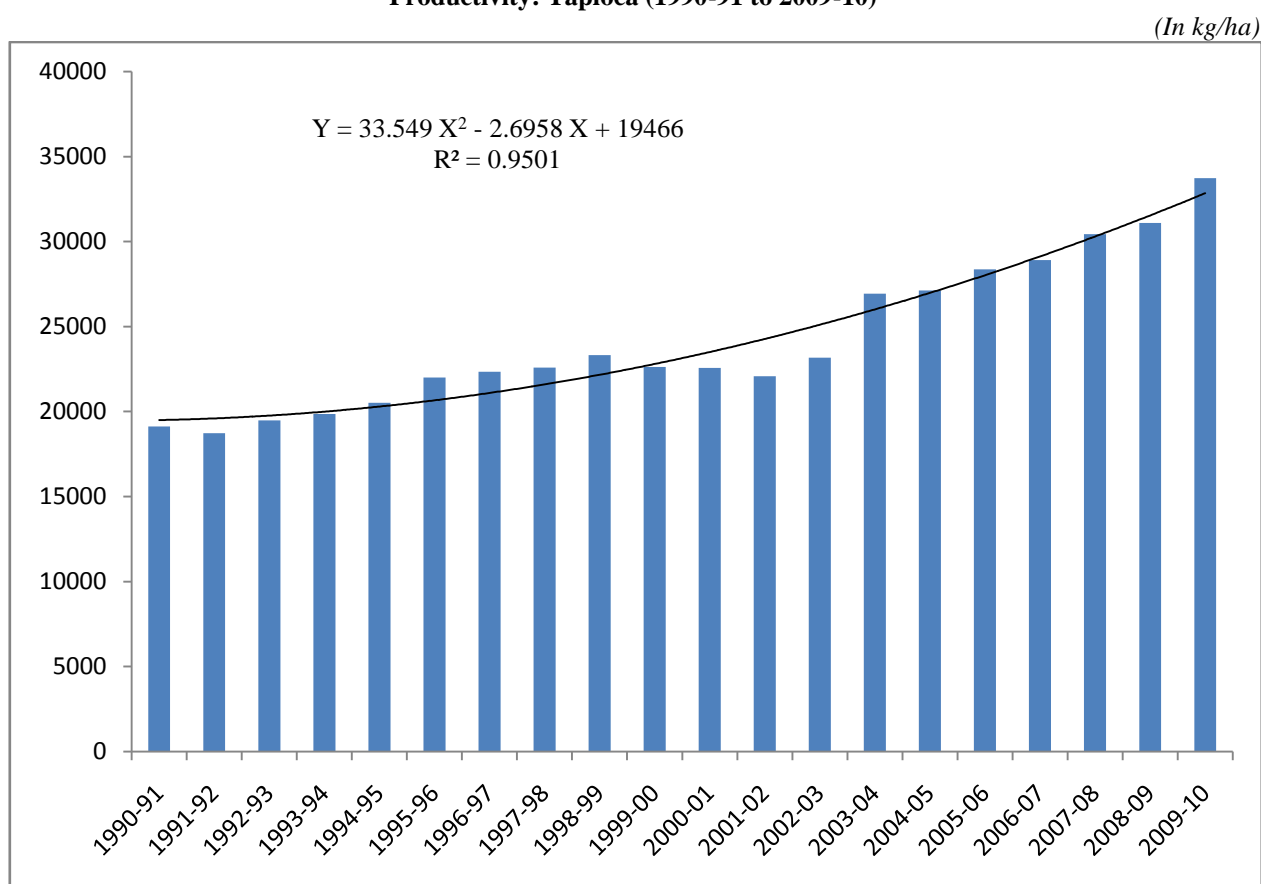
Projections are given in Table 2.11. Expected productivity of tapioca is 35644 kg/ha in 2011-12 and 49579 in 2019-20.

Table 2.11
Projected Productivity: Tapioca (2011-12 to 2019-20)

(In kg/ha)

Year (X)	Trend Equation, Y = 33.549 X² - 2.6958 X + 19466	
	Value of X	*Projected Value of Y (Productivity)*
2011-12	22	35644.41
2012-13	23	37151.42
2013-14	24	38725.52
2014-15	25	40366.73
2015-16	26	42075.03
2016-17	27	43850.43
2017-18	28	45692.93
2018-19	29	47602.53
2019-20	30	49579.23

Source: Output of MS EXCEL

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2.3 Pepper

Pepper, known as the 'king of spices' is one of the oldest and most popular spices in the world. It is growing throughout the year. Kerala and Karnataka are the major producers of pepper in India.

2.3.1 Area under Cultivation: Pepper

The area under pepper cultivation in Kerala shows some random fluctuations over the past few years and not attributed to any type of particular trend. The area was 168500 ha in 1990-91, which went up to 171489 ha in 2009-10, so that the percentage increase in the area was only 1.77 per cent during this period. A polynomial trend equation is fitted to the actual values of area brought under cultivation of pepper for the last twenty years for the elimination of short term fluctuation (See: Table 2.12). But the trend line is only 35.39 per cent best fit to the data (See: Fig 2.7) and hence no attempt was made to project the values of area to be brought under cultivation of pepper.

Suggestions for increasing more area for cultivating more pepper are government should procure the product from sub markets, pepper cultivation should be extended to all coconut farms and cost of production should be reduced. Comprehensive farm and family insurance of the farmers should also be given due importance.

Table 2.12
Area under Cultivation: Pepper (1990-91 to 2009-10)

(In ha)

Year (X)	Area (Y)	Trend Equation, Y = -384.35 X² + 9099.9 X + 152670		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	168500	1	161385.55	7114.45
1991-92	178100	2	169332.40	8767.60
1992-93	183500	3	176510.55	6989.45
1993-94	184400	4	182920.00	1480.00
1994-95	186700	5	188560.75	-1860.75
1995-96	191600	6	193432.80	-1832.80
1996-97	182900	7	197536.15	-14636.15
1997-98	180400	8	200870.80	-20470.80
1998-99	182400	9	203436.75	-21036.75
1999-00	198406	10	205234.00	-6828.00
2000-01	202133	11	206262.55	-4129.55
2001-02	203956	12	206522.40	-2566.40
2002-03	208607	13	206013.55	2593.45
2003-04	216440	14	204736.00	11704.00
2004-05	237669	15	202689.75	34979.25
2005-06	237998	16	199874.80	38123.20
2006-07	216709	17	196291.15	20417.85
2007-08	175679	18	191938.80	-16259.80
2008-09	153711	19	186817.75	-33106.75
2009-10*	171489	20	180928.00	-9439.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.7
Area under Cultivation: Pepper (1990-91 to 2009-10)

(In ha)

$Y = -384.35 X^2 + 9099.9 X + 152670$
$R^2 = 0.3539$
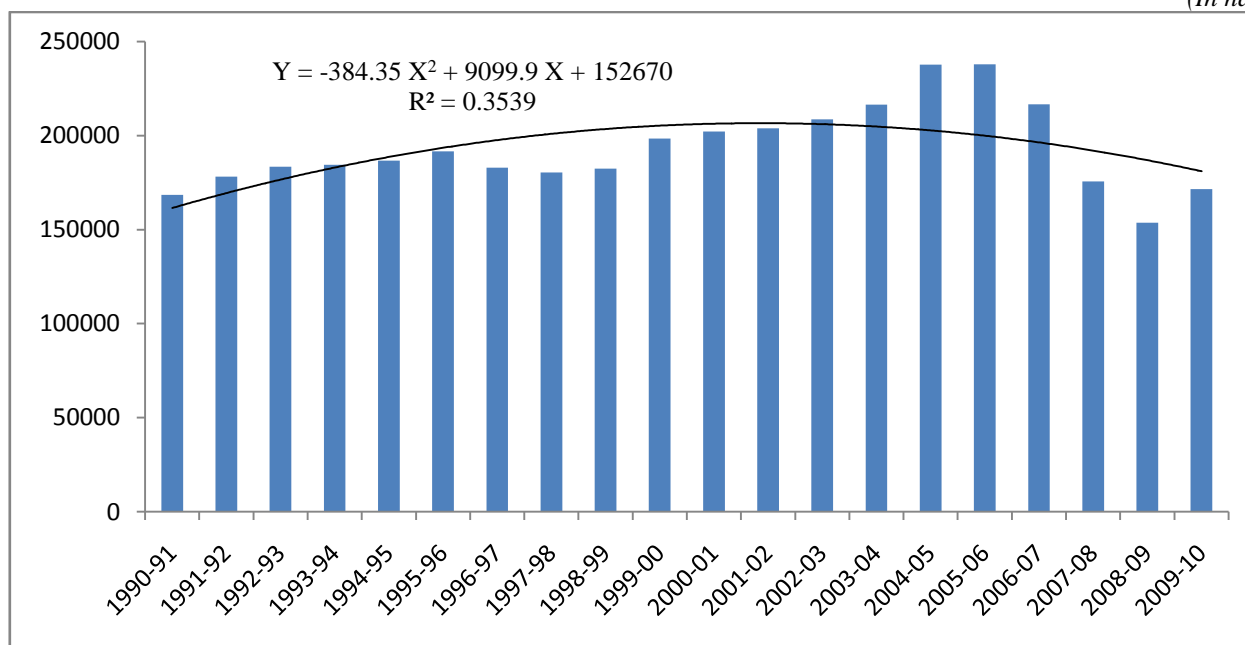
2.3.2 Production: Pepper

The data about pepper production in Kerala shows greater fluctuation over the past few years. That is, no severe trend was implicit in the production of pepper. The production was 46802 tonnes in 1990-91, which fell down to 37899 tonnes in 2009-10. That is, 19.02 per cent decrease in the production over the reference period. The very poor and decreasing performance of pepper production in the state is attributed to higher production cost, market uncertainty, lack of proper manuring, poor marketing facilities and inadequate number of processing industries and warehousing facilities in rural areas. It is noteworthy to mention here that even though there was an increase of around two per cent in the area of cultivation, the production fell down by around nineteen per cent during the same period. This controversy was the outcome of decrease in the productivity of pepper over the same period. A polynomial trend equation is fitted by selecting an appropriate trend equation by minimising short term fluctuation. But the line is only 30.46 per cent best fit to the data (See: Table 2.13 and Figure 2.8) so that the unexplained variation is 69.52 per cent and hence the fitted function is not taken for projecting the production of pepper.

The following are some suggestions for improving pepper production in the state:

- Update the technique of cultivation.

- Introduce and made available new hybrid varieties of pepper plant.

- Encourage mixed farming.

- Risk coverage and safety net aspects should be provided to all farmers.

- More credit facilitates should be given to farmers.

- More importance should be given to post-harvesting facilities.

- More subsidies should be given.

- Appropriate measures should be taken for increasing the area under cultivation.

Table 2.13
Production: Pepper (1990-91 to 2009-10)

(In tonnes)

Year (X)	Production (Y)	Trend Equation, Y = -242.89 X² + 5229.4 X+ 36912		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	46802	1	41898.51	4903.49
1991-92	50309	2	46399.24	3909.76
1992-93	49666	3	50414.19	-748.19
1993-94	49845	4	53943.36	-4098.36
1994-95	59256	5	56986.75	2269.25
1995-96	68568	6	59544.36	9023.64
1996-97	56546	7	61616.19	-5070.19
1997-98	46040	8	63202.24	-17162.24
1998-99	68510	9	64302.51	4207.49
1999-00	47543	10	64917.00	-17374.00
2000-01	60929	11	65045.71	-4116.71
2001-02	58240	12	64688.64	-6448.64
2002-03	67358	13	63845.79	3512.21
2003-04	69015	14	62517.16	6497.84
2004-05	74980	15	60702.75	14277.25
2005-06	87605	16	58402.56	29202.44
2006-07	64264	17	55616.59	8647.41
2007-08	41952	18	52344.84	-10392.84
2008-09	33991	19	48587.31	-14596.31
2009-10*	37899	20	44344.00	-6445.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.8
Production: Pepper (1990-91 to 2009-10)

(In tonnes)

$$Y = -242.89 X^2 + 5229.4 X + 36912$$
$$R^2 = 0.3046$$
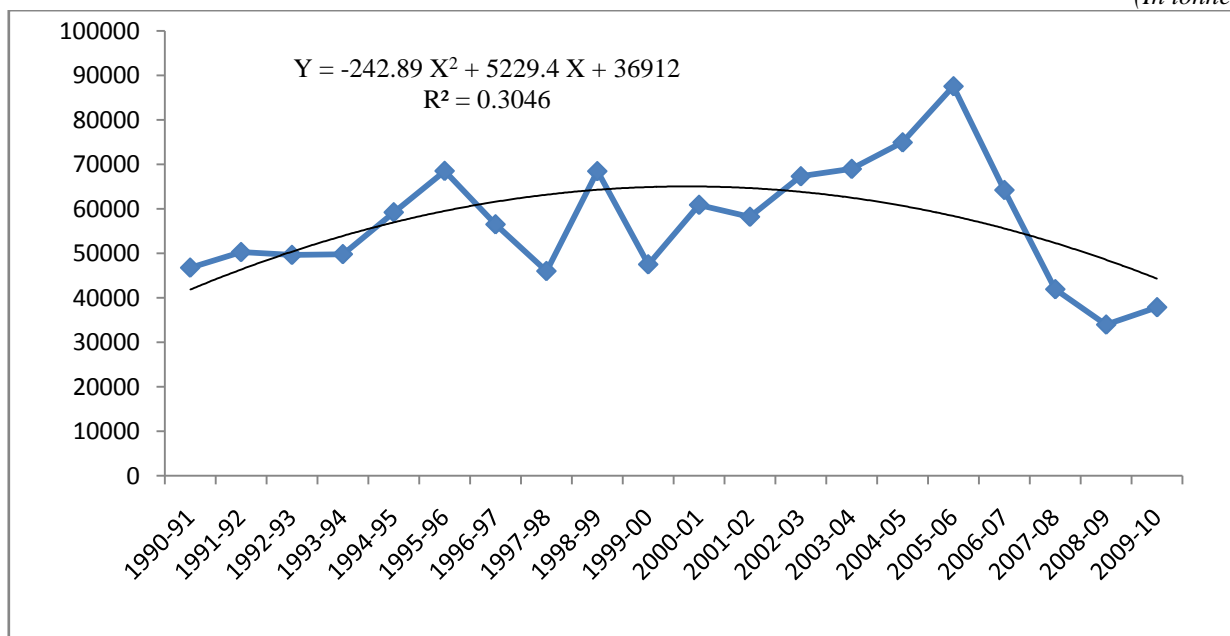
2.3.3 Productivity: Pepper

Random fluctuation is observed on the productivity of pepper and not confined to any type of trend. The productivity was 278 kg/ha in 1990-91 and this came down to 221 kg/ha in 2009-10, so that a 20.50 per cent decrease in productivity was actually felt during the reference period. This is attributed to shortage of labour, pest attack, par post harvest practices and weak crop management. The best trend equation for productivity data is a polynomial function of the form $Y = -0.745 X^2 + 14.237 X + 249.73$. But the function is only 28.65 per cent best fit to the data and hence it is not desirable to forecast the productivity values with this function (See: Table 2.14 and Figure 2.9)

Table 2.14
Productivity: Pepper (1990-91 to 2009-10)

(In kg/ha)

Year (X)	Productivity (Y)	Trend Equation, $Y = -0.745 X^2 + 14.237 X + 249.73$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	278	1	263.22	14.78
1991-92	282	2	275.22	6.78
1992-93	271	3	285.74	-14.74
1993-94	270	4	294.76	-24.76
1994-95	317	5	302.29	14.71
1995-96	358	6	308.33	49.67
1996-97	309	7	312.88	-3.88
1997-98	255	8	315.95	-60.95
1998-99	376	9	317.52	58.48
1999-00	240	10	317.60	-77.60
2000-01	301	11	316.19	-15.19
2001-02	286	12	313.29	-27.29
2002-03	323	13	308.91	14.09
2003-04	319	14	303.03	15.97
2004-05	315	15	295.66	19.34
2005-06	368	16	286.80	81.20
2006-07	297	17	276.45	20.55
2007-08	239	18	264.62	-25.62
2008-09	221	19	251.29	-30.29
2009-10*	221	20	236.47	-15.47

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.9
Productivity: Pepper (1990-91 to 2009-10)

(In kg/ha)
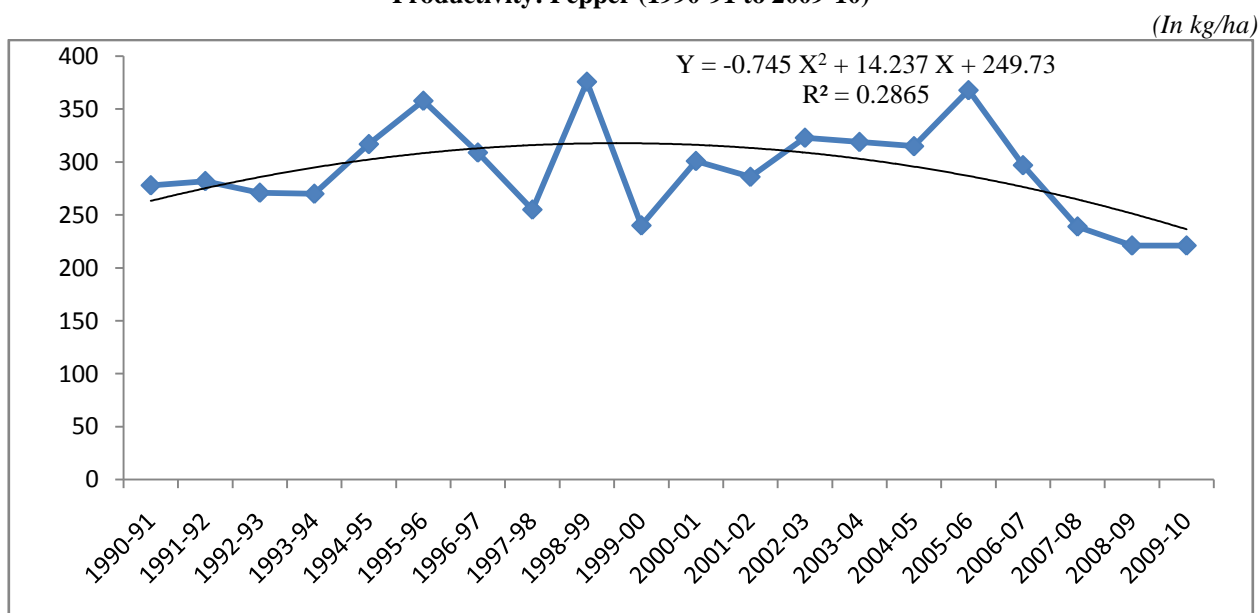
The following are some suggestions for raising pepper productivity in the state:

- Encourage pepper cultivation by providing subsidised inputs.

- Government should procure pepper at reasonable price through regulated shops.

- Irrigation should be extended to both small and large scale pepper farms.

- Importance should be given to soil checking before applying fertilisers.

- Ensure better harvest and storage facility.

- Special policies should be framed for pepper marketing.

- Produce more value added products using pepper and encourage both internal and external trade.

2.4 Ginger

Ginger is an herb. It is used as a dried spice and also as a medicine. It is commonly rotated with other crops such as tapioca, chillies, paddy etc. It is being cultivated in Kerala as a fresh vegetable. It is also an important foreign exchange earning crop.

2.4.1 Area under Cultivation: Ginger

In Kerala, the area under ginger cultivation had decreased drastically over the past twenty years. Area under cultivation of ginger was 14100 ha in 1990-91 and fell down to 5408 ha in 2009-10. This means that the area under cultivation of ginger in 2009-10 was decreased by more than half of the area brought under cultivation in 1990-91. Table 2.15 revealed that the area under cultivation of ginger is exhibiting a severe decreasing trend. A linear trend line of the form $Y = -354.72 X + 14929$ is fitted to the observed values with coefficient of determination, $R^2 = 0.7136$, which implies that the trend line explains only 71.36 per cent of the total fluctuation. Hence no attempt was made to project the values of area to be brought under cultivation in future.

Table 2.15
Area under Cultivation: Ginger (1990-91 to 2009-10)

(In ha)

Year (X)	Area (Y)	Trend Equation, Y = -354.72 X + 14929		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	14100	1	14574.28	-474.28
1991-92	15400	2	14219.56	1180.44
1992-93	13900	3	13864.84	35.16
1993-94	11100	4	13510.12	-2410.12
1994-95	13900	5	13155.40	744.60
1995-96	12900	6	12800.68	99.32
1996-97	13200	7	12445.96	754.04
1997-98	12400	8	12091.24	308.76
1998-99	11100	9	11736.52	-636.52
1999-00	11264	10	11381.80	-117.80
2000-01	11612	11	11027.08	584.92
2001-02	10706	12	10672.36	33.64
2002-03	8998	13	10317.64	-1319.64
2003-04	8516	14	9962.92	-1446.92
2004-05	9991	15	9608.20	382.80
2005-06	12226	16	9253.48	2972.52
2006-07	11082	17	8898.76	2183.24
2007-08	8865	18	8544.04	320.96
2008-09	7421	19	8189.32	-768.32
2009-10*	5408	20	7834.60	-2426.60

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.10
Area under Cultivation: Ginger (1990-91 to 2009-10)

(In ha)
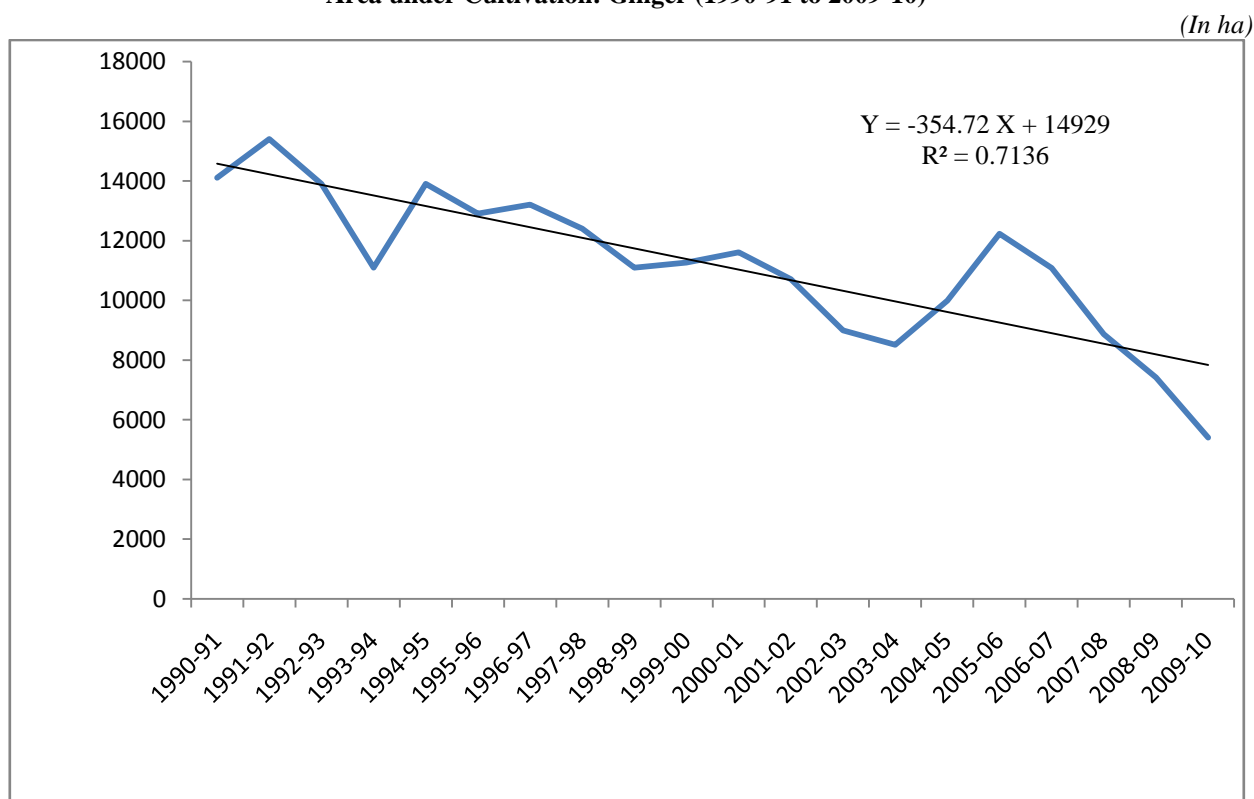
2.4.2 Production: Ginger

In 1990-91, the production of ginger was 45685 tonnes and was drastically fell down to 28605 tonnes in 2009-10. That is, 37.39 per cent fall in production of ginger was observed over these periods. This is because of the drastic shrinking of cultivable land brought under cultivation for the production of ginger. The decrease in the cultivated land for ginger accounts more than fifty per cent from 1990-91 to 2009-10 and as a consequence production decreased to the extent of thirty seven per cent only because of the increase in productivity during the same periods. A diminishing trend in production is observed and a linear trend equation of the form $Y = -663.41 X + 48437$ is fitted to the observed values with $R^2 = 0.2874$. Since the estimated line explains only 28.74 per cent of the total variation, the trend line fitted is not suitable for forecasting the production of ginger. Details are given in Table 2.16 and in Figure 2.11.

Table 2.16
Production: Ginger (1990-91 to 2009-10)

(In tonnes)

Year (X)	Production (Y)	Trend Equation, Y = -663.41 X + 48437		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	45685	1	47773.59	-2088.59
1991-92	50274	2	47110.18	3163.82
1992-93	45403	3	46446.77	-1043.77
1993-94	37676	4	45783.36	-8107.36
1994-95	49748	5	45119.95	4628.05
1995-96	46455	6	44456.54	1998.46
1996-97	46371	7	43793.13	2577.87
1997-98	43617	8	43129.72	487.28
1998-99	39362	9	42466.31	-3104.31
1999-00	41344	10	41802.9	-458.9
2000-01	42699	11	41139.49	1559.51
2001-02	40181	12	40476.08	-295.08
2002-03	32412	13	39812.67	-7400.67
2003-04	32972	14	39149.26	-6177.26
2004-05	45305	15	38485.85	6819.15
2005-06	56288	16	37822.44	18465.56
2006-07	42496	17	37159.03	5336.97
2007-08	31726	18	36495.62	-4769.62
2008-09	30809	19	35832.21	-5023.21
2009-10*	28605	20	35168.8	-6563.8

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.11
Production: Ginger (1990-91 to 2009-10)

(In tonnes)

$Y = -663.41 X + 48437$
$R^2 = 0.2874$
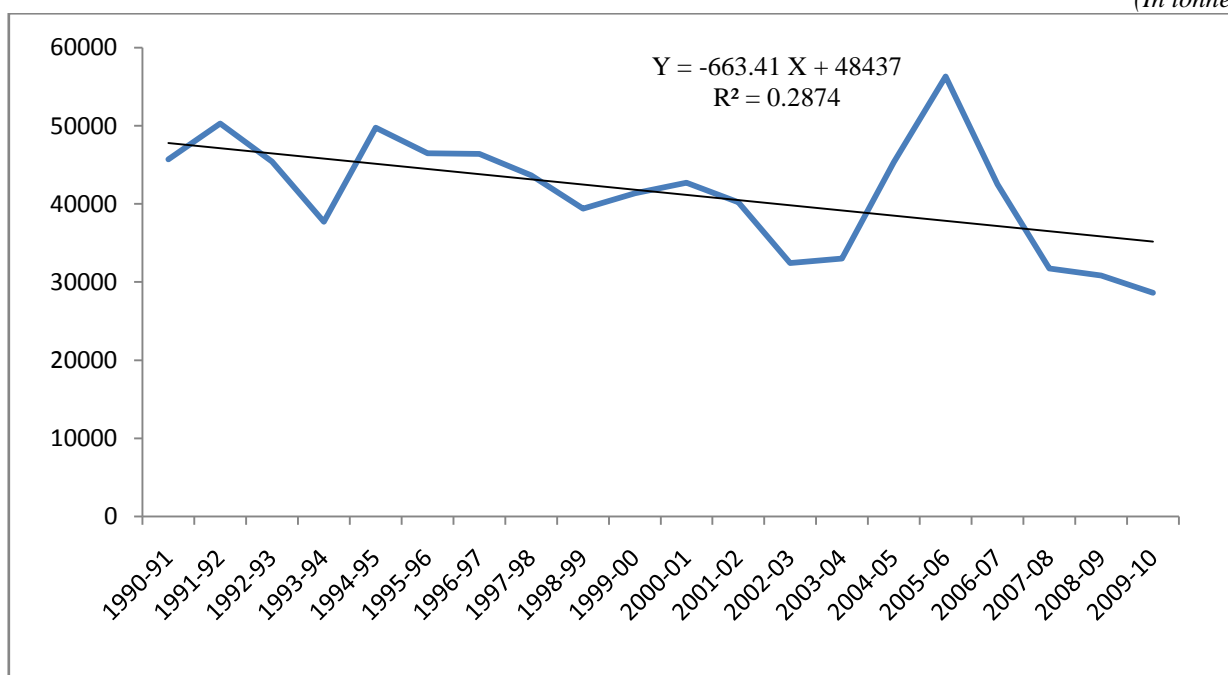
The following are some suggestions to increase ginger production in the state:

➢ Encourage large scale farming.

➢ Government should encourage subsidised farming.

➢ Coverage should be given to farm insurance.

➢ Avoid frequent price fluctuations.

➢ Introduce better marketing system.

➢ Encourage co-operative farming.

➢ Good quality fertilisers to be made available at cheap rate.

➢ Introduce better storage facility.

➢ Introduce new and improved means of training programmes.

➢ Strengthen the post-harvest management facilities.

2.4.3 Productivity: Ginger

Productivity of ginger in the state shows an increasing trend. But during some years, slight irregular fluctuations were observed. Table 2.17 had revealed that from the year 1990-91 onwards, the productivity of ginger was steadily increased and followed a sustained path. The productivity of ginger was 3240 kg/ha in 1990-91, which increased to 5289 kg/ha in 2009-10. That is, 63.24 per cent increase in the productivity of ginger. No severe fluctuation is observed in the past twenty years except during a couple of years from 2006-07 to 2007-08.

A linear trend equation of the form $Y = 65.925 \ X + 3082.3$ is fitted to the values of productivity with $R^2 = 0.5771$. As the trend line explains only 57.71 per cent of the total variation, it is not recommended for forecasting the values of productivity. However, only the short term fluctuations are eliminated by assuming an additive model (See: Table 2.17).

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Table 2.17
Productivity: Ginger (1990-91 to 2009-10)

(In kg/ha)

Year (X)	Productivity (Y)	Trend Equation, Y = 65.925 X + 3082.3		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	3240	1	3148.23	91.77
1991-92	3265	2	3214.15	50.85
1992-93	3266	3	3280.08	-14.08
1993-94	3394	4	3346.00	48.00
1994-95	3579	5	3411.93	167.08
1995-96	3601	6	3477.85	123.15
1996-97	3513	7	3543.78	-30.78
1997-98	3518	8	3609.70	-91.70
1998-99	3546	9	3675.63	-129.63
1999-00	3670	10	3741.55	-71.55
2000-01	3677	11	3807.48	-130.48
2001-02	3753	12	3873.40	-120.40
2002-03	3602	13	3939.33	-337.33
2003-04	3872	14	4005.25	-133.25
2004-05	4535	15	4071.18	463.83
2005-06	4604	16	4137.10	466.90
2006-07	3835	17	4203.03	-368.03
2007-08	3579	18	4268.95	-689.95
2008-09	4152	19	4334.88	-182.88
2009-10*	5289	20	4400.80	888.20

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.12
Productivity: Ginger (1990-91 to 2009-10)

(In kg/ha)

$Y = 65.925 X + 3082.3$
$R^2 = 0.5771$
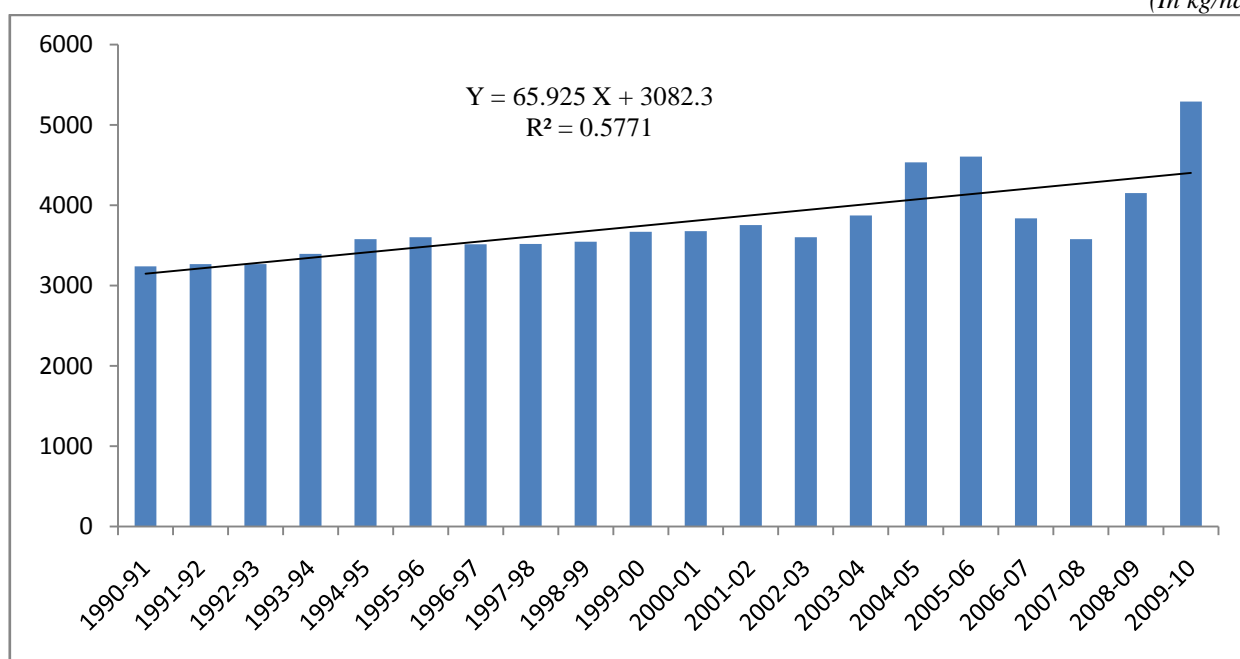
2.5 Turmeric

Turmeric is a seasonal and annual kharif crop. It is widely used as an ingredient for cooking food. It is also used as a powerful anti-inflammatory in ayurvedic medicines.

2.5.1 Area under Cultivation: Turmeric

Turmeric cultivation in Kerala shows some random fluctuations over the past few years. Area under the cultivation of turmeric had also registered a negative growth rate of 8.65 per cent by accounting area under cultivation of 2669 ha in 1990-91 and 2438 ha in 2009-10. This decrease in the area of cultivation is attributed to small scale cultivation and poor irrigation facilities. By criteria, polynomial trend is fitted to the actual data. The fitted line is only 50.81 per cent best fit to the actual data and hence no projection is done (See: Table 2.18 and Figure 2.13).

Table 2.18
Area under Cultivation: Turmeric (1990-91 to 2009-10)

(In ha)

Year (X)	Area (Y)	Trend Equation, $Y = -12.381 X^2 + 245.68 X + 2545.8$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	2669	1	2779.10	-110.10
1991-92	2738	2	2987.64	-249.64
1992-93	2938	3	3171.41	-233.41
1993-94	3250	4	3330.42	-80.42
1994-95	3938	5	3464.68	473.33
1995-96	3968	6	3574.16	393.84
1996-97	4053	7	3658.89	394.11
1997-98	3586	8	3718.86	-132.86
1998-99	3706	9	3754.06	-48.06
1999-00	3971	10	3764.50	206.50
2000-01	4127	11	3750.18	376.82
2001-02	3558	12	3711.10	-153.10
2002-03	3140	13	3647.25	-507.25
2003-04	2774	14	3558.64	-784.64
2004-05	2881	15	3445.28	-564.28
2005-06	3384	16	3307.14	76.86
2006-07	3917	17	3144.25	772.75
2007-08	3155	18	2956.60	198.40
2008-09	2782	19	2744.18	37.82
2009-10*	2438	20	2507.00	-69.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.13
Area under Cultivation: Turmeric (1990-91 to 2009-10)

(In ha)

$Y = -12.381 X^2 + 245.68 X + 2545.8$
$R^2 = 0.5081$
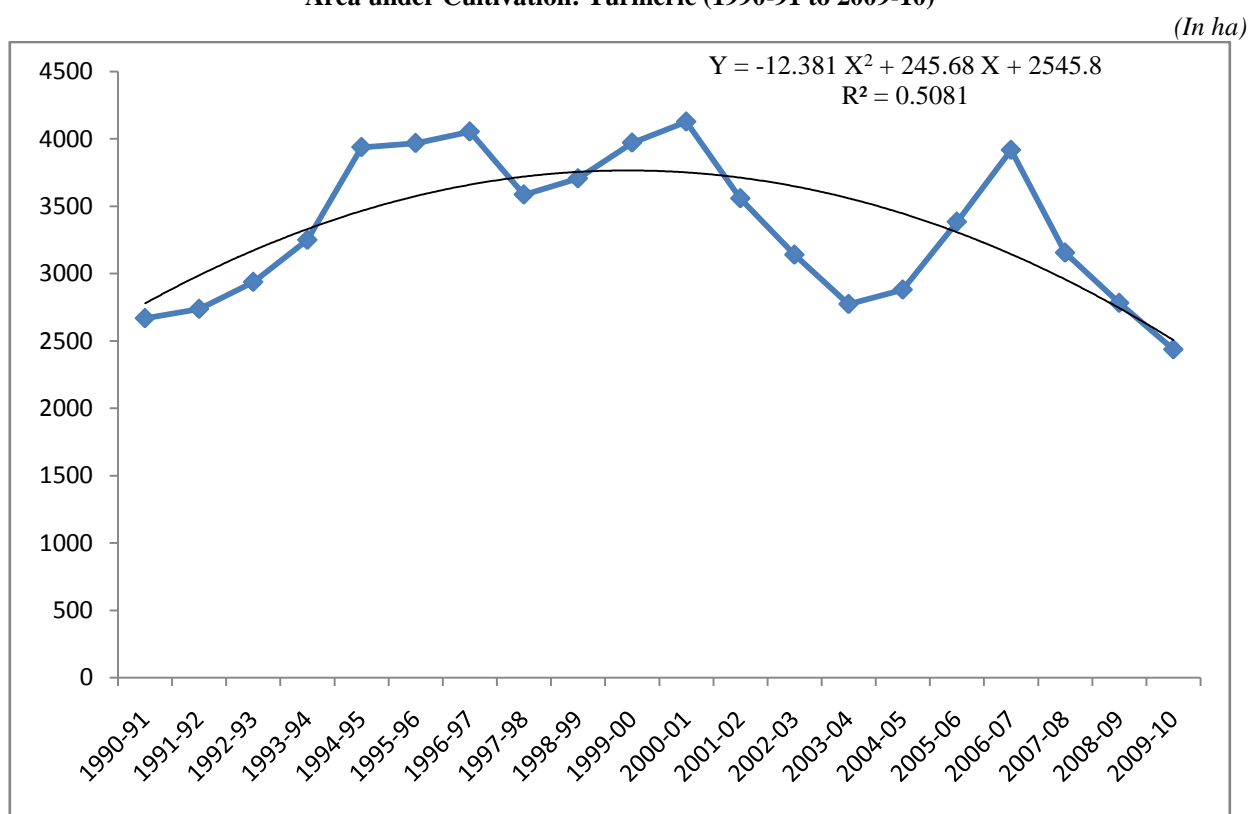
In order to bring more land area for the cultivation of turmeric, encourage group farming and modern irrigation facilities, special packages should be announced for cultivation and subsidised inputs should be made available to turmeric cultivators.

2.5.2 Production: Turmeric

Production data on turmeric had also revealed that the fluctuations are not confined to any type of trend or seasonal or cyclical fluctuation. The production was 5123 tonnes in 1990-91, which increased to 6065 tonnes in 2009-10 by registering a growth rate of 18.39 per cent. Polynomial trend is selected for extrapolating the data, but the line fitted had explained only 34.12 per cent of the total variation and hence no forecasting is to be made. (See: Table 2.19 and Figure 2.14). In order to ensure more production in the state, introduce effective export promotional measures and better fertilisers should be made available to farmers.

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Table 2.19
Production: Turmeric (1990-91 to 2009-10)

(In tonnes)

Year (X)	Production (Y)	Trend Equation, Y = -30.351 X² + 662.2 X + 4893.3		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	5123	1	5525.15	-402.15
1991-92	5230	2	6096.30	-866.30
1992-93	5662	3	6606.74	-944.74
1993-94	6296	4	7056.48	-760.48
1994-95	9283	5	7445.53	1837.48
1995-96	9559	6	7773.86	1785.14
1996-97	9840	7	8041.50	1798.50
1997-98	8585	8	8248.44	336.56
1998-99	8034	9	8394.67	-360.67
1999-00	8362	10	8480.20	-118.20
2000-01	9037	11	8505.03	531.97
2001-02	7895	12	8469.16	-574.16
2002-03	6938	13	8372.58	-1434.58
2003-04	5652	14	8215.30	-2563.30
2004-05	6244	15	7997.33	-1753.33
2005-06	8237	16	7718.64	518.36
2006-07	9980	17	7379.26	2600.74
2007-08	7434	18	6979.18	454.82
2008-09	6364	19	6518.39	-154.39
2009-10*	6065	20	5996.90	68.10

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.14
Production: Turmeric (1990-91 to 2009-10)

(In tonnes)

$$Y = -30.351 X^2 + 662.2 X + 4893.3$$
$$R^2 = 0.3412$$
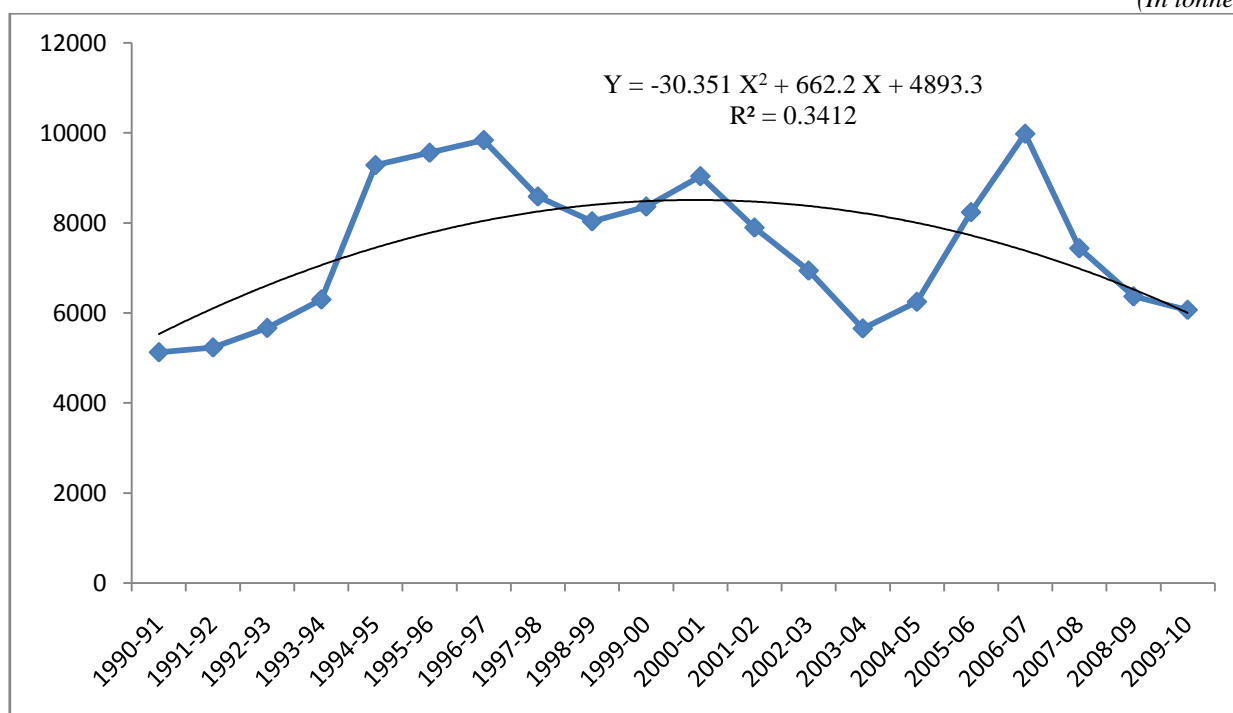
2.5.3 Productivity: Turmeric

Productivity of turmeric in Kerala shows a better performance over the past few years and data on productivity had showed a systematic trade cycle. The better productivity level is due to better crop management, low cost of cultivation and the intervention and supervision of more domestic labour. The productivity was 1919 kg/ha in 1990-91, which increased to 2488 kg/ha in 2009-10 by registering a growth rate of 29.65 per cent. For eliminating the short term fluctuations a straight line trend equation is fitted. But the equation is not used for forecasting productivity of turmeric since unexplained variation is 65.29 per cent. Details are given in Table 2.20 and in Figure 2.15.

Table 2.20
Productivity: Turmeric (1990-91 to 2009-10)

(In kg/ha)

Year (X)	Productivity (Y)	Trend Equation, Y = 20.198 X + 2012.5		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	1919	1	2032.70	-113.70
1991-92	1910	2	2052.90	-142.90
1992-93	1927	3	2073.09	-146.09
1993-94	1937	4	2093.29	-156.29
1994-95	2357	5	2113.49	243.51
1995-96	2409	6	2133.69	275.31
1996-97	2428	7	2153.89	274.11
1997-98	2394	8	2174.08	219.92
1998-99	2168	9	2194.28	-26.28
1999-00	2106	10	2214.48	-108.48
2000-01	2190	11	2234.68	-44.68
2001-02	2219	12	2254.88	-35.88
2002-03	2210	13	2275.07	-65.07
2003-04	2037	14	2295.27	-258.27
2004-05	2167	15	2315.47	-148.47
2005-06	2434	16	2335.67	98.33
2006-07	2548	17	2355.87	192.13
2007-08	2356	18	2376.06	-20.06
2008-09	2288	19	2396.26	-108.26
2009-10*	2488	20	2416.46	71.54

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.15
Productivity: Turmeric (1990-91 to 2009-10)

(In kg/ha)
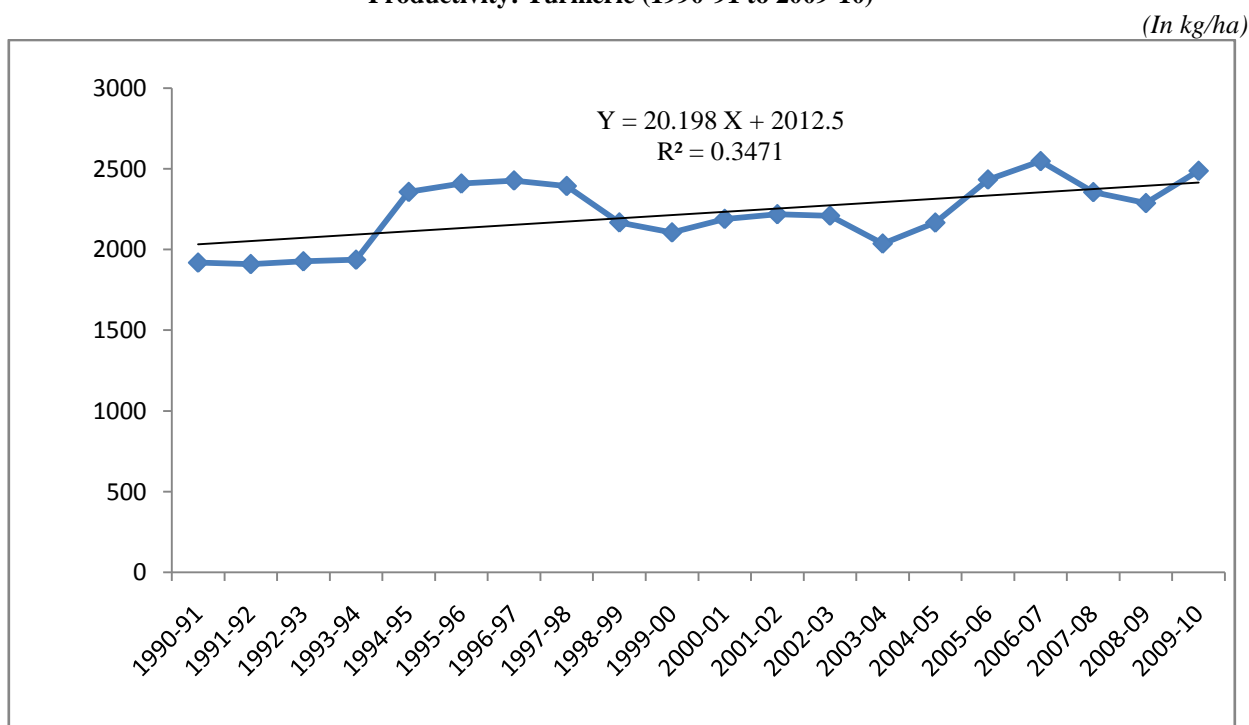
2.6 Banana and other Plantains

Banana is the most popular fruit demanded by the people all over the world. India ranks the first position in the world with regard to the production of banana and is not highly entered in external trade. Tamil Nadu occupies the first position in India in terms of production as well as in the area of cultivation of banana and other plantains. Farmers engaged in banana and other plantains cultivation in some parts of Kerala also engaged in multiple cropping. In Kerala, people demand higher volume of domestically produced banana. Recently it was observed that many states are competing to stimulate export of banana to Kerala. The farmers in Kerala are yet to exploit the production potentials of banana and other plantains.

2.6.1 Area under Cultivation: Banana and other Plantains

The area under cultivation of banana and other plantains was 65600 ha in 1990-91 and 99075 ha in 2009-10. That is, the percentage increase in the area of cultivation from 1990-91 to

2009-10 was 51.03. This is due to the reasons that small farmers are largely concentrated on banana cultivation, small plots can also be taken for banana cultivation, price of banana is comparatively low volatile and thus the farmers get better price and day to day domestic demand for value added products of banana. The trend in the area of cultivation had showed a slight increasing trend. Table 2.21 also shows that from 2001-02 to 2008-09, area brought under cultivation for banana and other plantains was very high compared to that in other years. Equation of the form $Y = -139.1 X^2 + 5757 X + 51071$ is fitted to the observed values of area under cultivation of banana with a coefficient of determination of 0.875. This means that the line fitted is 87.50 per cent best fit to the observed values so that forecasts are to be made till 2019-20. Short term fluctuations are also eliminated by assuming additive model.

Table 2.21
Area under Cultivation: Banana and other Plantains (1990-91 to 2009-10)

(In ha)

Year (X)	Area (Y)	Trend Equation, $Y = -139.1 X^2 + 5757 X + 51071$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	65600	1	56688.90	8911.10
1991-92	65100	2	62028.60	3071.40
1992-93	68000	3	67090.10	909.90
1993-94	72200	4	71873.40	326.60
1994-95	72600	5	76378.50	-3778.50
1995-96	72900	6	80605.40	-7705.40
1996-97	78100	7	84554.10	-6454.10
1997-98	80600	8	88224.60	-7624.60
1998-99	81500	9	91616.90	-10116.90
1999-00	92298	10	94731.00	-2433.00
2000-01	99412	11	97566.90	1845.10
2001-02	106054	12	100124.60	5929.40
2002-03	110479	13	102404.10	8074.90
2003-04	109402	14	104405.40	4996.60
2004-05	113478	15	106128.50	7349.50
2005-06	116622	16	107573.40	9048.60
2006-07	112239	17	108740.10	3498.90
2007-08	110708	18	109628.60	1079.40
2008-09	104865	19	110238.90	-5373.90
2009-10*	99075	20	110571.00	-11496.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.16
Area under Cultivation: Banana and other Plantains (1990-91 to 2009-10)

(In ha)
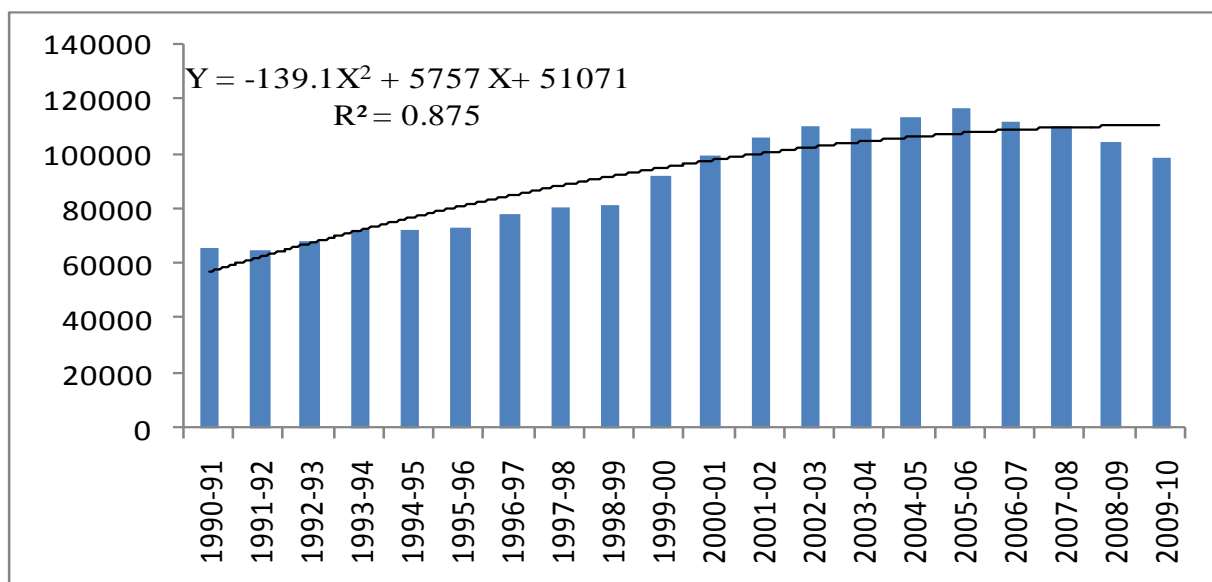
Projected values are given in Table 2.22. Expected area for the cultivation of banana and other plantains in 2011-12 is 110400 ha and 98591 ha in 2019-20. That is, declining trend will be estimated on the area of cultivation of banana and other plantains. The expected decrease from 2011-12 to 2019-20 is around eleven per cent. Hence measures are needed to counteract the declining trend in the area of cultivation.

Table 2.22
Projected Area for Cultivation: Banana and other Plantains (2011-12 to 2019-20)

(In ha)

Year (X)	Trend Equation, $Y = -139.1 X^2 + 5757 X + 51071$	
	Value of X	*Projected Value of Y (Area for Cultivation)*
2011-12	22	110400.60
2012-13	23	109898.10
2013-14	24	109117.40
2014-15	25	108058.50
2015-16	26	106721.40
2016-17	27	105106.10
2017-18	28	103212.60
2018-19	29	101040.90
2019-20	30	98591.00

Source: Output of MS EXCEL

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2.6.2 Production: Banana and other Plantains

Banana production in Kerala is not uniform over the past ten years. This is due to the factors that irrigation available in the state is not adequate, large scale cultivation is low, small scale banana cultivation is also profitable but pest attack is very high. Table 2.23 revealed that from 1990-91 to 1997-98, the production of banana and other plantains had been increased gradually and then exhibited severe wave like fluctuations. So no particular type of trend was inherent in the production of banana. A polynomial trend equation of the form $Y = -3163.4 X^2 + 77362 X + 335878$ is fitted to the observed values with $R^2 = 0.5152$. This means that the unexplained variation is 48.48 per cent so that no forecast is to be made. Adequate irrigation facilities to the cultivable land should be ensured and protect farm from attack of pests to raise the production of banana and other plantains.

Table 2.23
Production: Banana and other Plantains (1990-91 to 2009-10)

(In tonnes)

Year (X)	Production (Y)	Trend Equation, $Y = -3163.4 X^2 + 77362 X + 335878$		Elimination of Trend
		Value of X	Trend Values	
(1)	(2)	(3)	(4)	(5=2-4)
1990-91	491935	1	410076.60	81858.40
1991-92	496405	2	477948.40	18456.60
1992-93	520057	3	539493.40	-19436.40
1993-94	573668	4	594711.60	-21043.60
1994-95	574264	5	643603.00	-69339.00
1995-96	582410	6	686167.60	-103757.60
1996-97	742544	7	722405.40	20138.60
1997-98	793339	8	752316.40	41022.60
1998-99	784574	9	775900.60	8673.40
1999-00	808711	10	793158.00	15553.00
2000-01	731650	11	804088.60	-72438.60
2001-02	769085	12	808692.40	-39607.40
2002-03	831091	13	806969.40	24121.60
2003-04	841937	14	798919.60	43017.40
2004-05	891486	15	784543.00	106943.00
2005-06	937156	16	763839.60	173316.40
2006-07	849202	17	736809.40	112392.60
2007-08	439803	18	703452.40	-263649.40
2008-09	435979	19	663768.60	-227789.60
2009-10*	789514	20	617758.00	171756.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.17
Production: Banana and other Plantains (1990-91 to 2009-10)

(In tonnes)
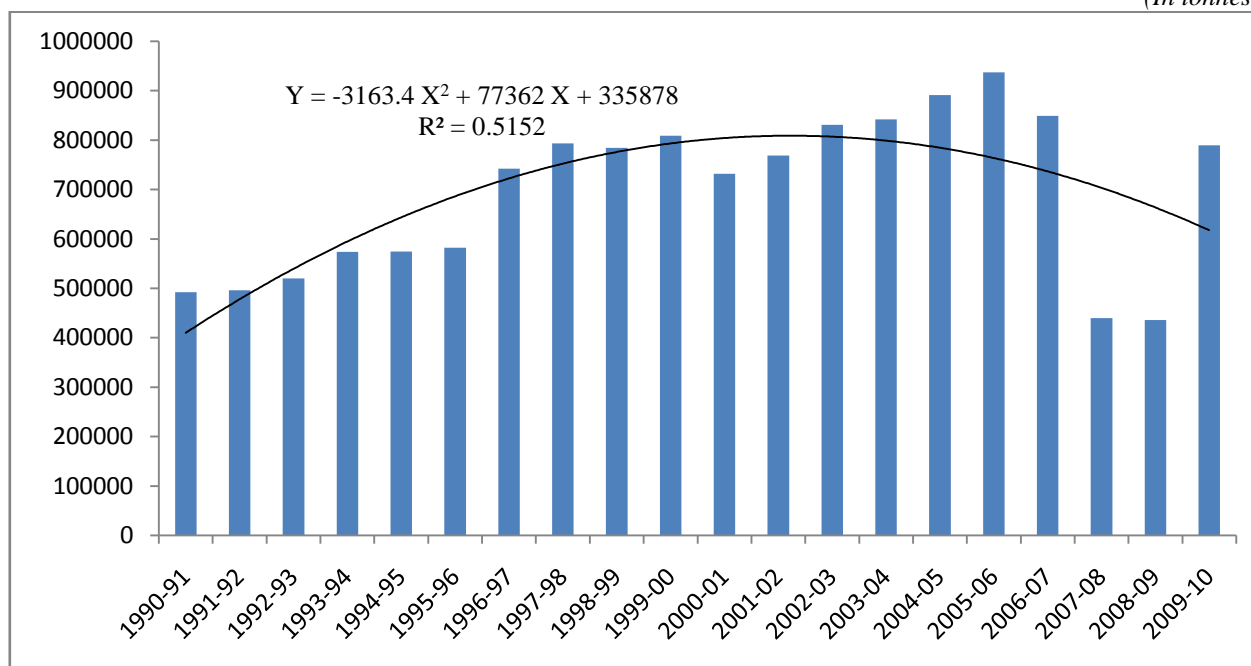
2.6.3 Productivity: Banana and other Plantains

The productivity of banana and other plantains per ha had increased from 7499 kg/ha in 1990-91 to 7969 kg/ha in 2009-10. This means that the percentage increase in the productivity over these periods was only 6.27. No cyclical or seasonal fluctuations or secular trend was observed on the data of productivity of banana and other plantains, but fluctuations were due to random elements. That is why the fitted polynomial equation $Y= -22.281\ X^2 + 360.6\ X + 7098.2$ explains only 40.98 per cent of the variation of the original data. Hence no forecast is to be made with this R^2 value. (See: Table 2.24 and Figure 2.18). The percentage increase on the productivity from 1990-91 to 2009-10 had shown an increase in the total production of banana and other plantains in the state even if there was happened a decline in the area brought under cultivation of banana and other plantains during the same period. The figure also revealed that banana productivity in Kerala fluctuates widely over the last few years and now showing a

decreasing trend. The major reason for this is due to the sub division & fragmentation of agricultural farm. Small plots used for cultivation had reduced the productivity of banana in the state. Too much rain in short periods and prolonged drought are the another major cause for low productivity. In Kerala, the farmers are highly concentrated in organic cultivation but natural fertilisers limit the productivity. Another reason for low productivity is people are giving lesser importance in re-planting the plantation. This further reduced the productivity. For improving banana productivity in the state, new high yielding variety plants should be introduced, good quality scientific fertilisers should be made available to farmers at cheap rate, introduce modern irrigation facilities and to provide new means to filter down the scientific knowledge of cultivation to farmers.

Table 2.24
Productivity: Banana and other Plantains (1990-91 to 2009-10)

(In kg/ha)

Year (X)	Productivity (Y)	Trend Equation, $Y = -22.281 X^2 + 360.6 X + 7098.2$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	7499	1	7436.52	62.48
1991-92	7625	2	7730.28	-105.28
1992-93	7648	3	7979.47	-331.47
1993-94	7946	4	8184.10	-238.10
1994-95	7910	5	8344.18	-434.17
1995-96	7989	6	8459.68	-470.68
1996-97	9508	7	8530.63	977.37
1997-98	9843	8	8557.02	1285.98
1998-99	9627	9	8538.84	1088.16
1999-00	8762	10	8476.10	285.90
2000-01	7360	11	8368.80	-1008.80
2001-02	7252	12	8216.94	-964.94
2002-03	7523	13	8020.51	-497.51
2003-04	7696	14	7779.52	-83.52
2004-05	7856	15	7493.98	362.03
2005-06	8036	16	7163.86	872.14
2006-07	7566	17	6789.19	776.81
2007-08	3973	18	6369.96	-2396.96
2008-09	4158	19	5906.16	-1748.16
2009-10*	7969	20	5397.80	2571.20

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.18
Productivity: Banana and other Plantains (1990-91 to 2009-10)

(In kg/ha)

$$Y = -22.281 X^2 + 360.6 X + 7098.2$$
$$R^2 = 0.4098$$
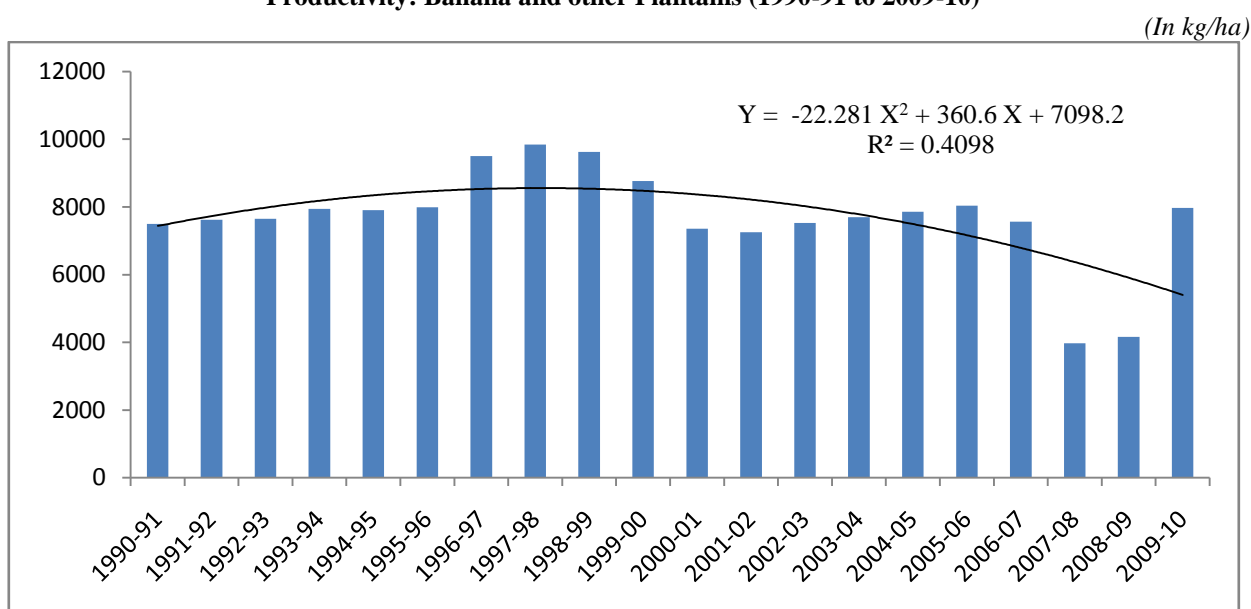
2.7 Rubber

Rubber is a commercial crop and Asia is the largest producing region. India is the fourth largest producer of natural rubber. Kerala is the major rubber producing state with more than ninety per cent of the total production in the country.

2.7.1 Area under Cultivation: Rubber

Area under rubber cultivation in Kerala shows slight increase over the past ten years. That is area brought under the cultivation of rubber amply revealed an increasing linear trend. This is due to the increase in the price of rubber because rubber is a major input to many industries. Area brought under cultivation of rubber in 1990-91 was 411600 ha, which gradually and steadily increased to 525408 ha in 2009-10 so that the percentage increase was 27.65 per cent. A linear trend equation of the form $Y = 5010.6 \, X + 417923$ is estimated with a coefficient of determination of 0.9543. Here the intercept is 417923, slope, 5010.6 and the line fitted is 95.43 per cent best fit also. The calculated trend values along with its elimination are given in Table 2.37.

Table 2.25
Area under Cultivation: Rubber (1990-91 to 2009-10)

(In ha)

Year (X)	Area (Y)	Trend Equation, Y = 5010.6 X + 417923		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	411600	1	422933.60	-11333.60
1991-92	425800	2	427944.20	-2144.20
1992-93	444100	3	432954.80	11145.20
1993-94	437100	4	437965.40	-865.40
1994-95	443300	5	442976.00	324.00
1995-96	449000	6	447986.60	1013.40
1996-97	455600	7	452997.20	2602.80
1997-98	465300	8	458007.80	7292.20
1998-99	469900	9	463018.40	6881.60
1999-00	472900	10	468029.00	4871.00
2000-01	474364	11	473039.60	1324.40
2001-02	475039	12	478050.20	-3011.20
2002-03	476047	13	483060.80	-7013.80
2003-04	478402	14	488071.40	-9669.40
2004-05	480661	15	493082.00	-12421.00
2005-06	494400	16	498092.60	-3692.60
2006-07	502240	17	503103.20	-863.20
2007-08	512045	18	508113.80	3931.20
2008-09	517475	19	513124.40	4350.60
.2009-10*	525408	20	518135.00	7273.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.19
Area under Cultivation: Rubber (1990-91 to 2009-10)

(In ha)

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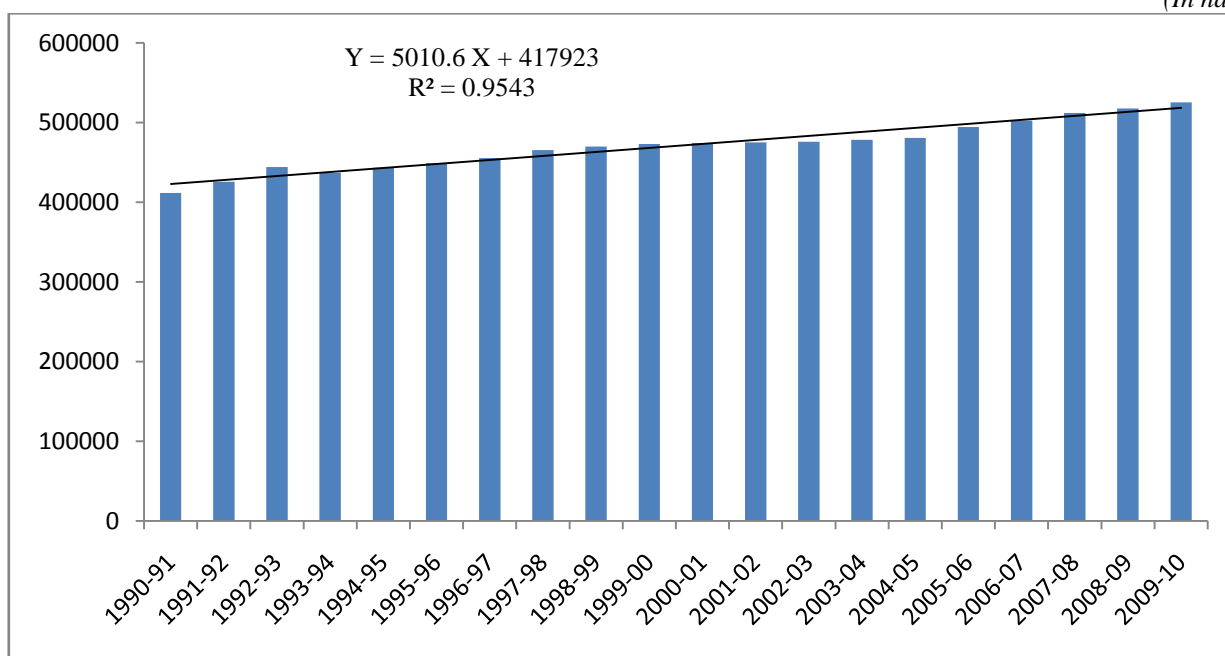
Projections are given in Table 2.26. The expected area for the cultivation of rubber in 2011-12 is 528156 ha, in 2015-16, it is 548199 ha and in 2019-20, it is expected to be 568241 ha.

Table 2.26
Projected Area for Cultivation: Rubber (2011-12 to 2019-20)
(In ha)

Year *(X)*	Trend Equation, Y = 5010.6 X + 417923	
	Value of X	*Projected Value of Y* *(Area for Cultivation)*
2011-12	22	528156.20
2012-13	23	533166.80
2013-14	24	538177.40
2014-15	25	543188.00
2015-16	26	548198.60
2016-17	27	553209.20
2017-18	28	558219.80
2018-19	29	563230.40
2019-20	30	568241.00

Source: Output of MS EXCEL

2.7.2 Production: Rubber

Production data on rubber also clearly revealed an increasing trend. The production was 307521 tonnes in 1990-91, which was more than doubled to 745510 tonnes in 2009-10. Increased rubber production in the state is due to better price of the product. Rubber cultivation requires less hired labour and high yielding variety increased productivity. A straight line trend equation of the form Y = 24776 X + 311576 is fitted with simple coefficient of determination of 0.9674 so that the line explains 96.74 per cent of the total variation of rubber production. The trend values and short term fluctuation are given in Table 2.27.

Table 2.27
Production: Rubber (1990-91 to 2009-10)

(In tonnes)

| Year (X) | Production (Y) | Trend Equation, Y = 24776 X + 311576 | | Elimination of Trend |
		Value of X	Trend Values	
(1)	(2)	(3)	(4)	(5=2-4)
1990-91	307521	1	336352.00	-28831.00
1991-92	343109	2	361128.00	-18019.00
1992-93	368646	3	385904.00	-17258.00
1993-94	408311	4	410680.00	-2369.00
1994-95	442830	5	435456.00	7374.00
1995-96	474555	6	460232.00	14323.00
1996-97	512756	7	485008.00	27748.00
1997-98	541935	8	509784.00	32151.00
1998-99	559099	9	534560.00	24539.00
1999-00	572820	10	559336.00	13484.00
2000-01	579866	11	584112.00	-4246.00
2001-02	580350	12	608888.00	-28538.00
2002-03	594917	13	633664.00	-38747.00
2003-04	655134	14	658440.00	-3306.00
2004-05	690778	15	683216.00	7562.00
2005-06	739225	16	707992.00	31233.00
2006-07	780405	17	732768.00	47637.00
2007-08	753135	18	757544.00	-4409.00
2008-09	783485	19	782320.00	1165.00
2009-10*	745510	20	807096.00	-61586.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.20
Production: Rubber (1990-91 to 2009-10)

(In tonnes)

$Y = 24776 X + 311576$
$R^2 = 0.9674$
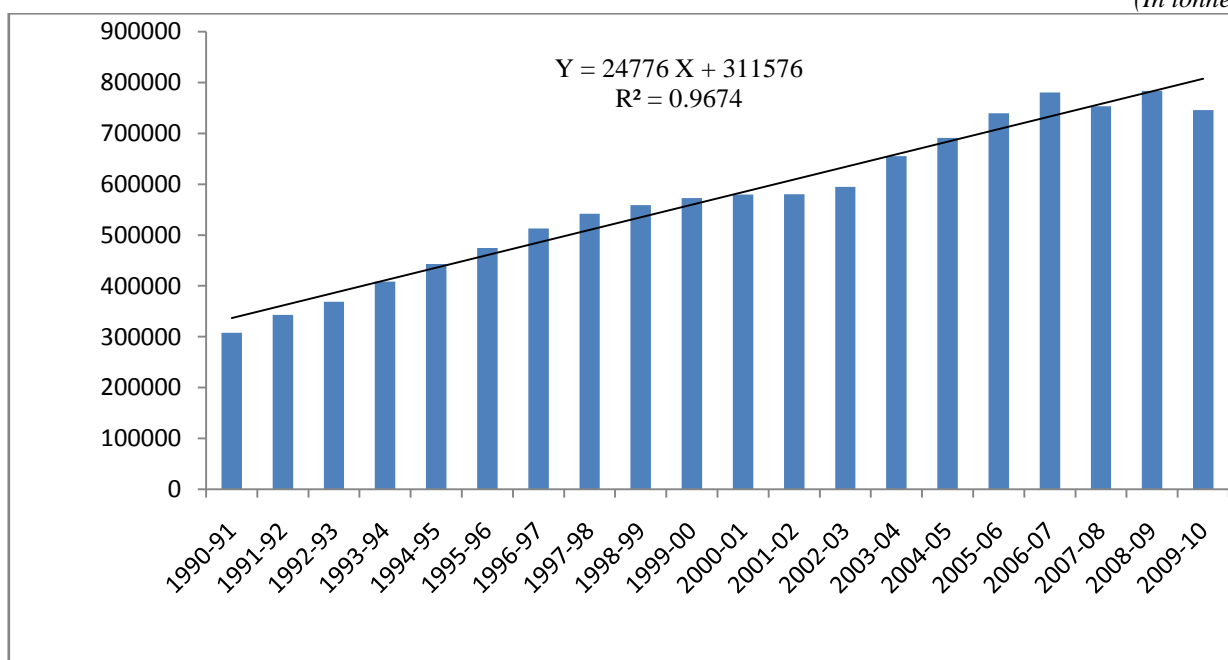
The best fitted linear trend equation is being used for the projection of the quantity of rubber production. The expected production is 856648 tonnes in 2011-12, 955752 tonnes in 2015-16 and 1054856 tonnes in 2019-20 (See: Table 2.28)

Table 2.28
Projected Production: Rubber (2011-12 to 2019-20)

(In tonnes)

Year (X)	Trend Equation, Y = 24776 X + 311576	
	Value of X	**Projected Value of Y (Production)**
2011-12	22	856648.00
2012-13	23	881424.00
2013-14	24	906200.00
2014-15	25	930976.00
2015-16	26	955752.00
2016-17	27	980528.00
2017-18	28	1005304.00
2018-19	29	1030080.00
2019-20	30	1054856.00

Source: Output of MS EXCEL

2.7.3 Productivity: Rubber

Rubber productivity in Kerala shows a remarkable progress over the past few years. Rubber productivity shows constant trend with cyclical fluctuations. The productivity was 747 kg/ha in 1990-91 and it was around doubled in 2009-10. By proper selection, a polynomial trend line of the form $Y = -1.3264 X^2 + 68.152 X + 675.6$ is estimated with a coefficient of determination of 0.9604, as a measure of best fit of the observed data. Details are given in Table 2.29.

With the best fitted line, forecasted values are given in Table 2.30. The expected increase in the productivity is 1533 kg/ha in 2011-12, 1551 kg/ha in 2015-16 and 1526 kg/ha in 2019-20. In order to stabilise the increase in productivity, the following suggestions are recommended.

- Introduce new high yielding variety programme.
- Encourage more domestic production and trade.
- Special policies to be needed for the expansion of export sector.
- Dumping of rubber should be legally controlled.

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- Multiple cropping reduce soil nutrient. So it should not be promoted.

- More research and innovation can further increase productivity.

- Extend financial support to the needy cultivators.

- Increase the access of credit to rural areas.

- Expands market opportunities.

- More investment should be made in market structure to enhance market efficiency.

Table 2.29
Productivity: Rubber (1990-91 to 2009-10)

(In kg/ha)

Year (X)	Productivity (Y)	Trend Equation, Y = -1.3264 X^2 + 68.152 X + 675.6		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	747	1	742.43	4.57
1991-92	806	2	806.60	-0.60
1992-93	830	3	868.12	-38.12
1993-94	934	4	926.99	7.01
1994-95	999	5	983.20	15.80
1995-96	1057	6	1036.76	20.24
1996-97	1125	7	1087.67	37.33
1997-98	1165	8	1135.93	29.07
1998-99	1190	9	1181.53	8.47
1999-00	1211	10	1224.48	-13.48
2000-01	1222	11	1264.78	-42.78
2001-02	1222	12	1302.42	-80.42
2002-03	1250	13	1337.41	-87.41
2003-04	1369	14	1369.75	-0.75
2004-05	1437	15	1399.44	37.56
2005-06	1495	16	1426.47	68.53
2006-07	1554	17	1450.85	103.15
2007-08	1471	18	1472.58	-1.58
2008-09	1514	19	1491.66	22.34
2009-10*	1419	20	1508.08	-89.08

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.21
Productivity: Rubber (1990-91 to 2009-10)

(In kg/ha)

$$Y = -1.3264 X^2 + 68.152 X + 675.6$$
$$R^2 = 0.9604$$
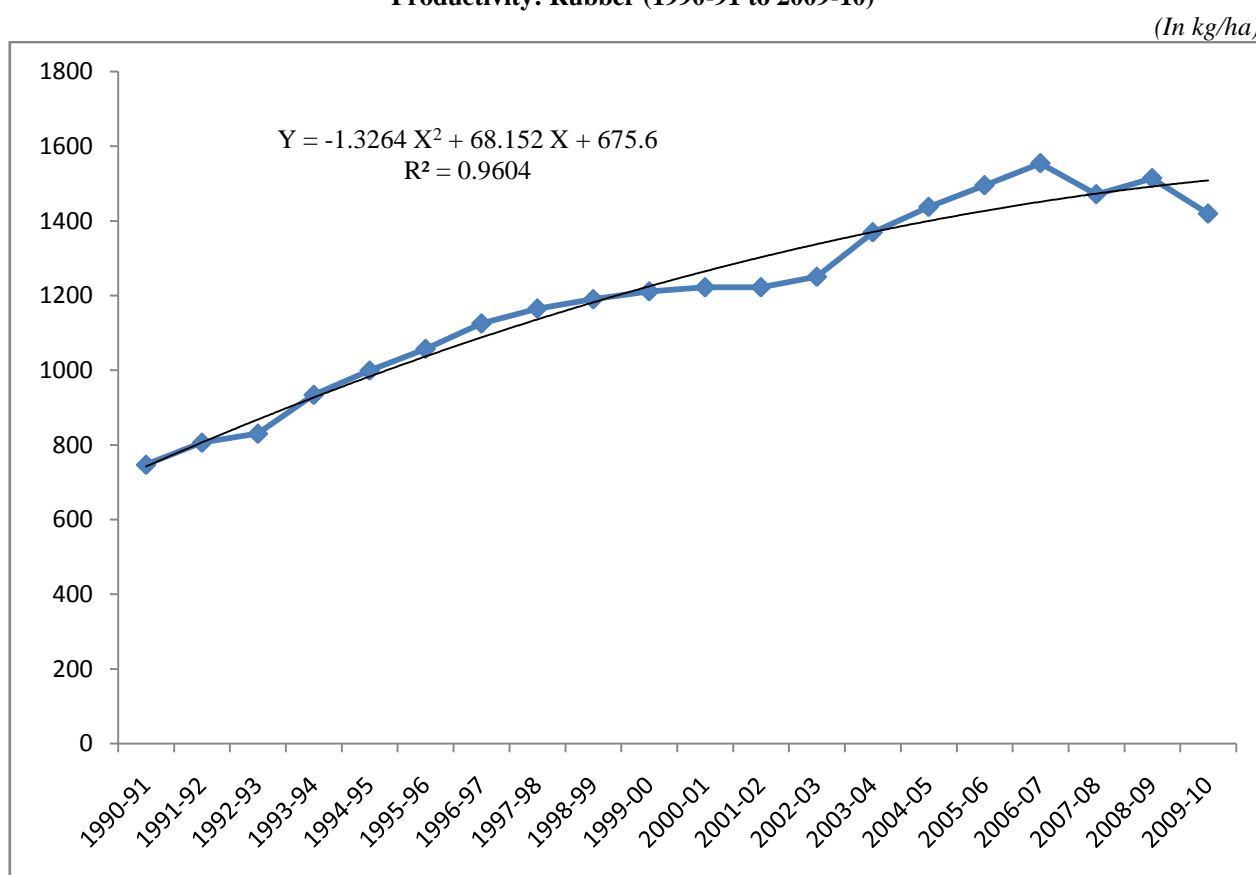
Table 2.30
Projected Productivity: Rubber (2010-11 to 2019-20)

(In kg/ha)

Year (X)	Trend Equation, $Y = -1.3264 X^2 + 68.152 X + 675.6$	
	Value of X	*Projected Value of Y (Productivity)*
2011-12	22	1532.97
2012-13	23	1541.43
2013-14	24	1547.24
2014-15	25	1550.40
2015-16	26	1550.91
2016-17	27	1548.76
2017-18	28	1543.96
2018-19	29	1536.51
2019-20	30	1526.40

Source: Output of MS EXCEL

2.8 Tea

After water, tea is the most widely consumed beverage in the world. In Kerala, tea is produced for commercial and domestic purpose.

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2.8.1 Area under Cultivation: Tea

The area under tea cultivation in Kerala shows a slight increase over the past twenty years.   During certain years, higher performance was observed. The fluctuations in the area for the cultivation of tea were not attributed to secular trend, seasonal variation or cyclical fluctuation but due to random variations. The area in 1990-91 was 34600 ha, which increased to 36840 ha in 2009-10, so that it had registered a 6.47 per cent growth rate in the area for cultivation.   The best selection is polynomial trend, but it explains only 40.23 per cent of the total variation (See: Table 2.31 and Figure 2.22) so that projected values will not be reliable and accurate and hence no projection is done.

Table 2.31
Area under Cultivation: Tea (1990-91 to 2009-10)

(In ha)

Year (X)	Area (Y)	Trend Equation, Y = -3.6591 X^2 + 198.61 X + 33975		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	34600	1	34169.95	430.05
1991-92	34600	2	34357.58	242.42
1992-93	34500	3	34537.90	-37.90
1993-94	34800	4	34710.89	89.11
1994-95	34700	5	34876.57	-176.57
1995-96	34600	6	35034.93	-434.93
1996-97	34600	7	35185.97	-585.97
1997-98	34700	8	35329.70	-629.70
1998-99	34700	9	35466.10	-766.10
1999-00	34793	10	35595.19	-802.19
2000-01	36847	11	35716.96	1130.04
2001-02	36899	12	35831.41	1067.59
2002-03	37068	13	35938.54	1129.46
2003-04	38327	14	36038.36	2288.64
2004-05	35040	15	36130.85	-1090.85
2005-06	35043	16	36216.03	-1173.03
2006-07	35365	17	36293.89	-928.89
2007-08	36131	18	36364.43	-233.43
2008-09	36557	19	36427.65	129.35
2009-10*	36840	20	36483.56	356.44

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.22
Area under Cultivation: Tea (1990-91 to 2009-10)

(In ha)

$$Y = -3.6591 X^2 + 198.61 X + 33975$$
$$R^2 = 0.4023$$
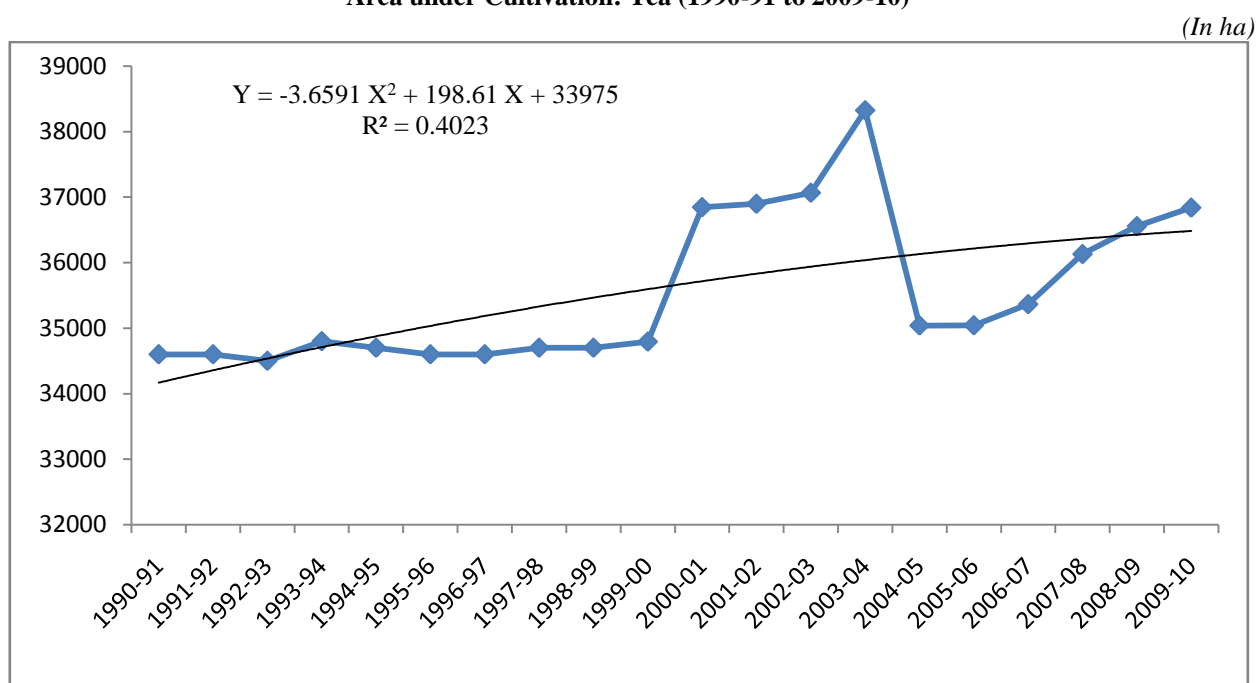
2.8.2 Production: Tea

The data on tea production in Kerala shows wide fluctuations over the past twenty years. Just like area, time series data on production of tea also disclosed that fluctuations are due to irregularities. Production was 60638 tonnes in 1990-91, which fell down to 57809 tonnes in 2009-10. That is, it had registered a negative growth rate of 4.67 per cent. Reasons for poor production performance are attributed to shortage of labour, bad health conditions of cultivators, increased cost of cultivation, poor socio-economic conditions of labourers and pest attack. Polynomial trend is the best selection for extrapolation, but the polynomial trend fitted explains only 41.52 per cent of total fluctuations of observed data and hence no attempt was made to project the values of production of tea (See: Table 2.32 and Figure 2.23). The suggestions for expanding tea production in the state are to introduce better fertilisers, subsidies will be made available and special importance should be given to export market.

Table 2.32
Production: Tea (1990-91 to 2009-10)

(In tonnes)

Year (X)	Production (Y)	Trend Equation, Y = -84.702 X^2 + 1055.5 X + 59908		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	60638	1	60878.80	-240.80
1991-92	66080	2	61680.19	4399.81
1992-93	54435	3	62312.18	-7877.18
1993-94	61488	4	62774.77	-1286.77
1994-95	60715	5	63067.95	-2352.95
1995-96	64802	6	63191.73	1610.27
1996-97	69319	7	63146.10	6172.90
1997-98	65225	8	62931.07	2293.93
1998-99	58726	9	62546.64	-3820.64
1999-00	61955	10	61992.80	-37.80
2000-01	69132	11	61269.56	7862.44
2001-02	66090	12	60376.91	5713.09
2002-03	55348	13	59314.86	-3966.86
2003-04	57553	14	58083.41	-530.41
2004-05	49508	15	56682.55	-7174.55
2005-06	56384	16	55112.29	1271.71
2006-07	53659	17	53372.62	286.38
2007-08	36131	18	51463.55	-15332.55
2008-09	51726	19	49385.08	2340.92
2009-10*	57809	20	47137.20	10671.80

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.23
**Production: Tea (1990-91 to 2009-10)**

(In tonnes)

$$Y = -84.702 X^2 + 1055.5 X + 59908$$
$$R^2 = 0.4152$$
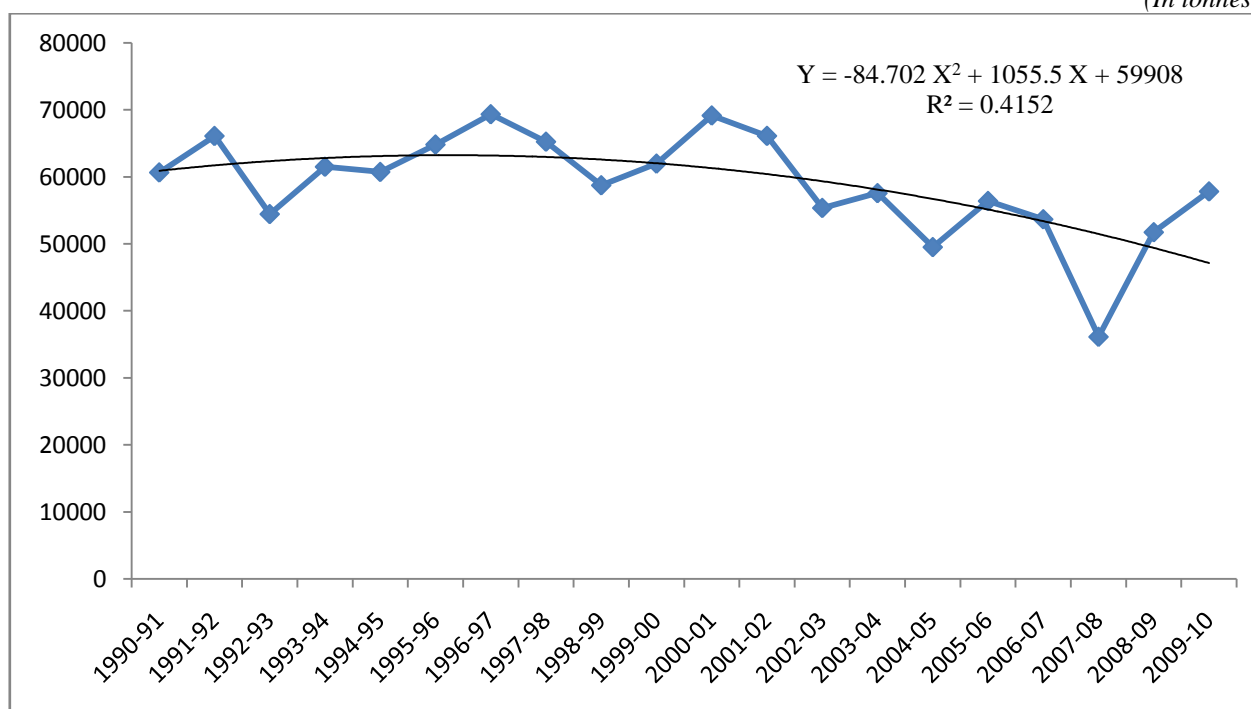
2.8.3 Productivity: Tea

The productivity data of tea in Kerala shows slight increase and decrease over the past few years. It had also revealed that the fluctuations are due to random elements. In 1990-91, productivity was 1753 kg/ha, which came down to 1569 ha in 2009-10 by registering a negative growth rate of 10.50 per cent. Polynomial equation is the best selection, but this function explains only 51.76 per cent of the total fluctuation of the data on productivity and hence no attempt is exercised to work out the projection of values on productivity of tea. Details are given in Table 2.33 and Figure 2.24.

Table 2.33
Productivity: Tea (1990-91 to 2009-10)

(In kg/ha)

Year (X)	Productivity (Y)	Trend Equation, $Y = -2.1785 X^2 + 19.755 X + 1763.8$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	1753	1	1781.38	-28.38
1991-92	1910	2	1794.60	115.40
1992-93	1578	3	1803.46	-225.46
1993-94	1767	4	1807.96	-40.96
1994-95	1750	5	1808.11	-58.11
1995-96	1873	6	1803.90	69.10
1996-97	2003	7	1795.34	207.66
1997-98	1880	8	1782.42	97.58
1998-99	1692	9	1765.14	-73.14
1999-00	1781	10	1743.50	37.50
2000-01	1876	11	1717.51	158.49
2001-02	1791	12	1687.16	103.84
2002-03	1493	13	1652.45	-159.45
2003-04	1502	14	1613.38	-111.38
2004-05	1413	15	1569.96	-156.96
2005-06	1609	16	1522.18	86.82
2006-07	1517	17	1470.05	46.95
2007-08	1000	18	1413.56	-413.56
2008-09	1415	19	1352.71	62.29
2009-10*	1569	20	1287.50	281.50

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.24
Productivity: Tea (1990-91 to 2009-10)

(In kg/ha)

$$Y = -2.1785 X^2 + 19.755 X + 1763.8$$
$$R^2 = 0.5176$$
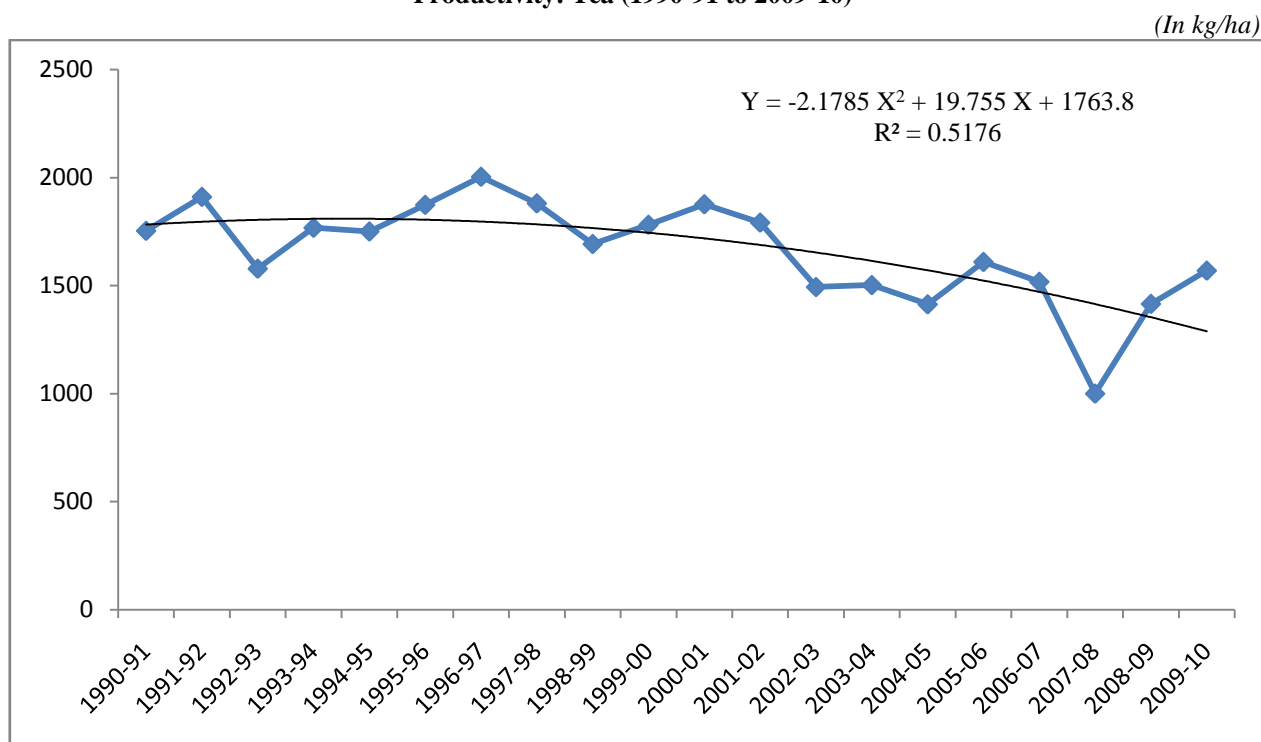
The following are the suggestions for raising the productivity of tea in the state:

- Better quality fertilisers will be made available.

- Supply subsidised inputs to cultivators.

- Ensure price stability.

- Reduce cost of production.

- Better post harvest management.

- Introduce better marketing facilities.

2.9 Coffee

Coffee is one of the most consumed beverages in the world next to tea and is one of the most traded agricultural commodities in the world. Coffee grows in tropical high lands at heights varying between 900 to 1800 metres above sea level.

2.9.1 Area under Cultivation: Coffee

The area under coffee cultivation in Kerala remains more or less same or fluctuates less over the past twenty years. Reasons for the better performance of coffee cultivation are the selling price determination of coffee is very much impressive, price fluctuations are less volatile in domestic and international market and functioning of Coffee Board in the state is appreciable. Area under cultivation of coffee in 1991-92 was 84000 ha and has slightly increased to 84796 ha in 2009-10. The percentage increase over this period was only 0.95, which means that the area under cultivation of coffee over the past two decades had shown only a marginal increase. Details are given in Table 2.34.

Table 2.34

Area under Cultivation: Coffee (1990-91 to 2009-10)

(In ha)

Year (X)	Area (Y)	Trend Equation, Y = 1971.5 ln(x) + 79258		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	75100	1	79258.00	-4158.00
1991-92	84000	2	80624.54	3375.46
1992-93	84000	3	81423.91	2576.09
1993-94	82300	4	81991.08	308.92
1994-95	82300	5	82431.01	-131.01
1995-96	82300	6	82790.45	-490.45
1996-97	83000	7	83094.36	-94.36
1997-98	83000	8	83357.62	-357.62
1998-99	83700	9	83589.83	110.17
1999-00	84139	10	83797.55	341.45
2000-01	84735	11	83985.45	749.55
2001-02	84795	12	84156.99	638.01
2002-03	83113	13	84314.80	-1201.80
2003-04	84684	14	84460.90	223.10
2004-05	84644	15	84596.92	47.08
2005-06	84644	16	84724.16	-80.16
2006-07	84571	17	84843.68	-272.68
2007-08	84115	18	84956.37	-841.37
2008-09	84696	19	85062.96	-366.96
2009-10*	84796	20	85164.09	-368.09

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

A logarithmic trend line of the form Y = 1971.5 ln(x) + 79258 is fitted for the observed values with R^2 = 0.5528. This means that the trend line explains only 55.28 per cent of the total variation and hence it is not desirable for projecting expected area for the cultivation of coffee with this trend equation.

Figure 2.25
Area under Cultivation: Coffee (1990-91 to 2009-10)

(In ha)
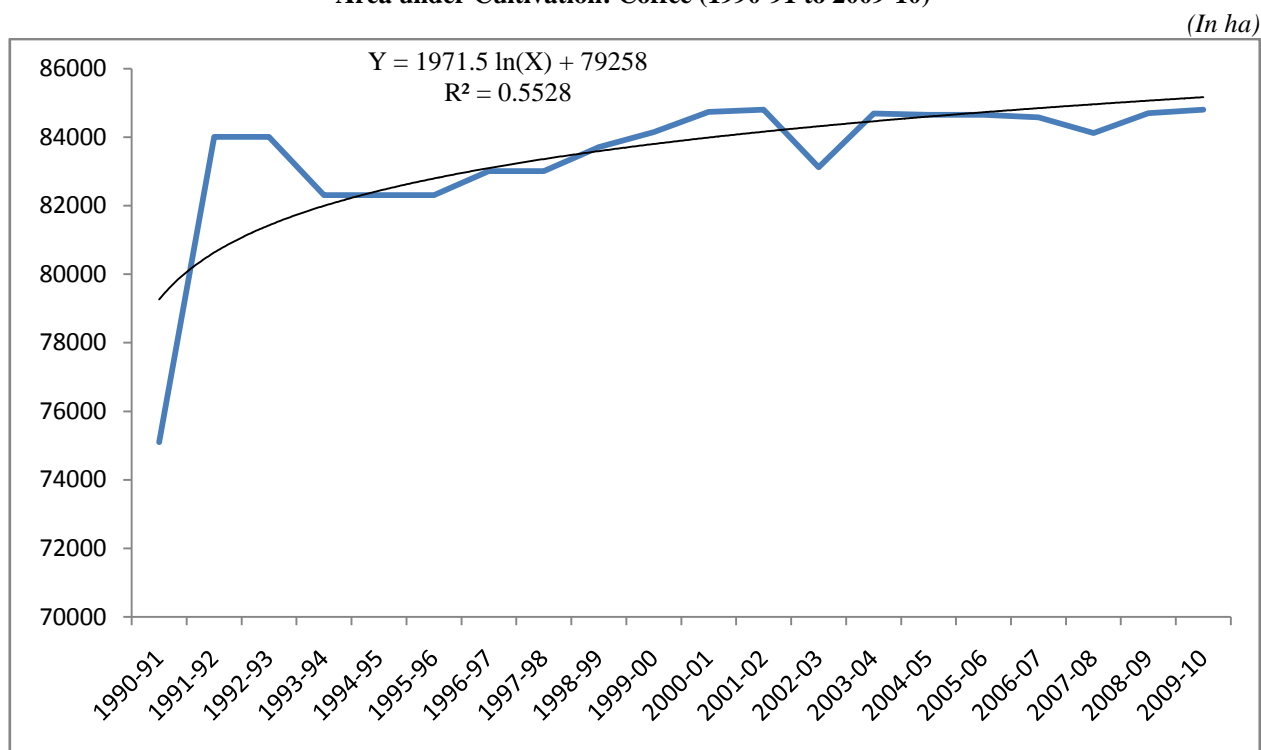
2.9.2 Production: Coffee

Production of coffee in Kerala fluctuates widely over the past twenty years. Data shows that production had up and down movements over the years. Table 2.35 shows the production of coffee from 1990-91 to 2009-10 along with trend values and short term fluctuations. It revealed that cyclical fluctuation was occurred in the production of coffee from 1992-93 to 2006-07. In 2007-08, a peak production level of 84115 tonne coffee was produced and this fell down to 59250 tonnes in 2009-10. No severe trend is observed in the production of coffee, instead the

fluctuations in production are confined to business fluctuations. However, a polynomial trend line of the form Y= -208.49 X^2 + 6429.3 X + 15503 is fitted to the observed values with R^2= 0.7917. This means that the trend line explains only 79.17 per cent of the total variation and hence no attempt was made to forecast the production for coming years. Details are given in Table 2.23 and Figure 2.26.

Table 2.35
Production: Coffee (1990-91 to 2009-10)

(In tonnes)

Year (X)	Production (Y)	Trend Equation, Y = -208.49 X^2 + 6429.3 X + 15503		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	20910	1	21723.81	-813.81
1991-92	20040	2	27527.64	-7487.64
1992-93	36170	3	32914.49	3255.51
1993-94	46240	4	37884.36	8355.64
1994-95	46240	5	42437.25	3802.75
1995-96	45000	6	46573.16	-1573.16
1996-97	47320	7	50292.09	-2972.09
1997-98	50659	8	53594.04	-2935.04
1998-99	49886	9	56479.01	-6593.01
1999-00	60470	10	58947.00	1523.00
2000-01	70550	11	60998.01	9551.99
2001-02	66690	12	62632.04	4057.96
2002-03	63322	13	63849.09	-527.09
2003-04	63850	14	64649.16	-799.16
2004-05	54300	15	65032.25	-10732.25
2005-06	60175	16	64998.36	-4823.36
2006-07	59475	17	64547.49	-5072.49
2007-08	84115	18	63679.64	20435.36
2008-09	57200	19	62394.81	-5194.81
2009-10*	59250	20	60693.00	-1443.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

The following are the suggestions for raising coffee production:

- Ensure price stability in domestic and international market.

- Strengthen research and development to increase production.
- Farmer co-operatives should be established.
- Modern marketing system should be organised.
- Encourage large scale investment in coffee industry.

- Ensure availability of credit through co-operative farmer societies and agricultural banks.

- Ensure disciplinary trading system.

Figure 2.26
Production: Coffee (1990-91 to 2009-10)

(In tonnes)

Y = -208.49 X^2 + 6429.3 X + 15503
R^2 = 0.7917
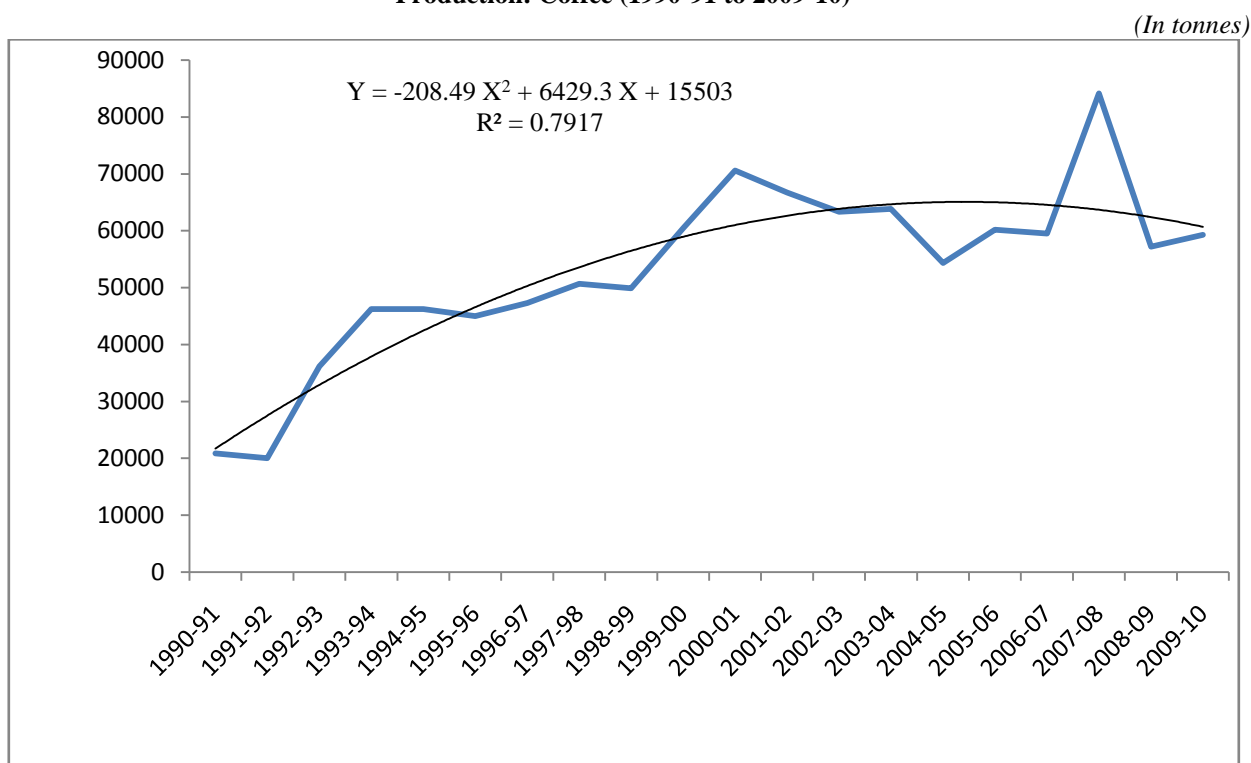
2.9.3 Productivity: Coffee

The productivity of coffee in Kerala shows wide fluctuations. Table 2.36 had revealed that cyclical fluctuation was inherent in the productivity level of coffee during the past two decades. In 2007-08, the productivity of coffee touches four digit figures and came down to 699 kg/ha in 2009-10. However, a polynomial equation of the form Y= -2.4236 X^2 + 74.208 X + 202.56 is fitted to the observed values with R^2 =0.775. Since the trend line explains only 77.50 per cent of the total variation on productivity, it is not recommended for projection since projection will not be reliable and accurate by employing this trend equation.

Table 2.36
Productivity: Coffee (1990-91 to 2009-10)

(In kg/ha)

Year (X)	Productivity (Y)	Trend Equation, $Y = -2.4236 X^2 + 74.208 X + 202.56$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	278	1	274.34	3.66
1991-92	239	2	341.28	-102.28
1992-93	431	3	403.37	27.63
1993-94	562	4	460.61	101.39
1994-95	562	5	513.01	48.99
1995-96	547	6	560.56	-13.56
1996-97	570	7	603.26	-33.26
1997-98	610	8	641.11	-31.11
1998-99	596	9	674.12	-78.12
1999-00	719	10	702.28	16.72
2000-01	833	11	725.59	107.41
2001-02	786	12	744.06	41.94
2002-03	762	13	757.68	4.32
2003-04	754	14	766.45	-12.45
2004-05	642	15	770.37	-128.37
2005-06	711	16	769.45	-58.45
2006-07	703	17	763.68	-60.68
2007-08	1000	18	753.06	246.94
2008-09	675	19	737.59	-62.59
2009-10*	699	20	717.28	-18.28

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.27
Productivity: Coffee (1990-91 to 2009-10)

(In kg/ha)

$Y = -2.4236 X^2 + 74.208 X + 202.56$
$R^2 = 0.775$
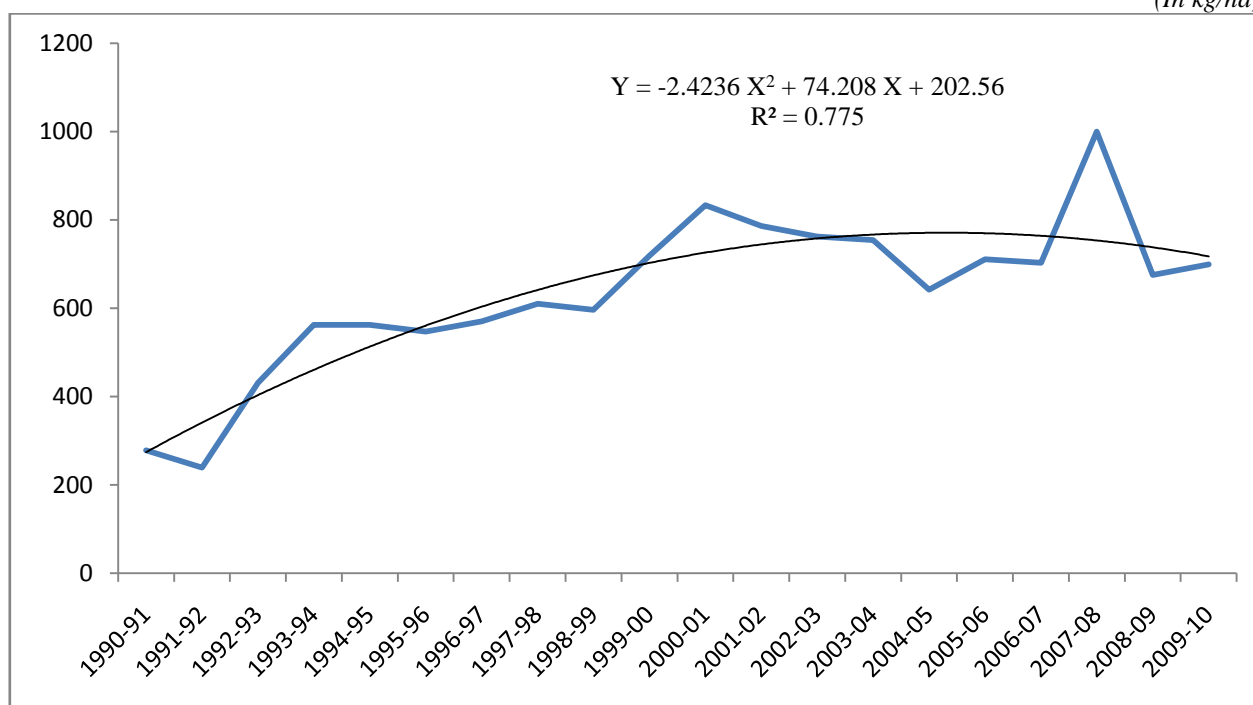
The following suggestions are placed for raising the productivity of coffee:

- Encourage large scale farming.

- Ensure fair price for better quality products.

- Credit facility should be made available.

- Encourage fair trading system for coffee.

- Proper shading of plantation should be encouraged.

- Coffee has long gestation period, which needed sustained investments and efforts.

- Adequate post harvesting and marketing facilities should be made available.

2.10 Cashew nut

Cashew is a native to North-Eastern Brazil. The Portuguese introduced cashew to the west coast of India in the sixteenth century. India is the largest area holder of this crop. In Kerala, area and production of cashew nuts had come down drastically during the last five years.

2.10.1 Area under Cultivation: Cashew nut

In Kerala the area under cultivation continuously decreased over the past two decades so that a severe decreasing trend is observed on the area brought under cultivation of cashew. Decreased area under cultivation was the result that the farmers in Kerala were mainly concentrated in small scale farming. Another reason was low yield from the crop. In 1990-91, 115600 ha land brought under cultivation, which drastically came down to 48972 ha in 2009-10. Hence a straight line trend is best suited to this observed data for extrapolation of values of the area. The fitted line Y= -3069.1 X +120731 explains 91.65 percentage of total variation. The term 120731 is the intercept and -3069.1 is the slope or regression coefficient. Short term variations are also eliminated. Details are given in Table 2.37.

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Table 2.37
Area under Cultivation: Cashew (1990-91 to 2009-10)

(In ha)

Year (X)	Area (Y)	Trend Equation Y = -3069.1 X + 120731		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	115600	1	117661.90	-2061.90
1991-92	112100	2	114592.80	-2492.80
1992-93	109000	3	111523.70	-2523.70
1993-94	106700	4	108454.60	-1754.60
1994-95	103500	5	105385.50	-1885.50
1995-96	103300	6	102316.40	983.60
1996-97	97100	7	99247.30	-2147.30
1997-98	94700	8	96178.20	-1478.20
1998-99	91300	9	93109.10	-1809.10
1999-00	89403	10	90040.00	-637.00
2000-01	92122	11	86970.90	5151.10
2001-02	89718	12	83901.80	5816.20
2002-03	88548	13	80832.70	7715.30
2003-04	86376	14	77763.60	8612.40
2004-05	81547	15	74694.50	6852.50
2005-06	78285	16	71625.40	6659.60
2006-07	70463	17	68556.30	1906.70
2007-08	58381	18	65487.20	-7106.20
2008-09	53007	19	62418.10	-9411.10
2009-10*	48972	20	59349.00	-10377.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.28
Area under Cultivation: Cashew (1990-91 to 2009-10)
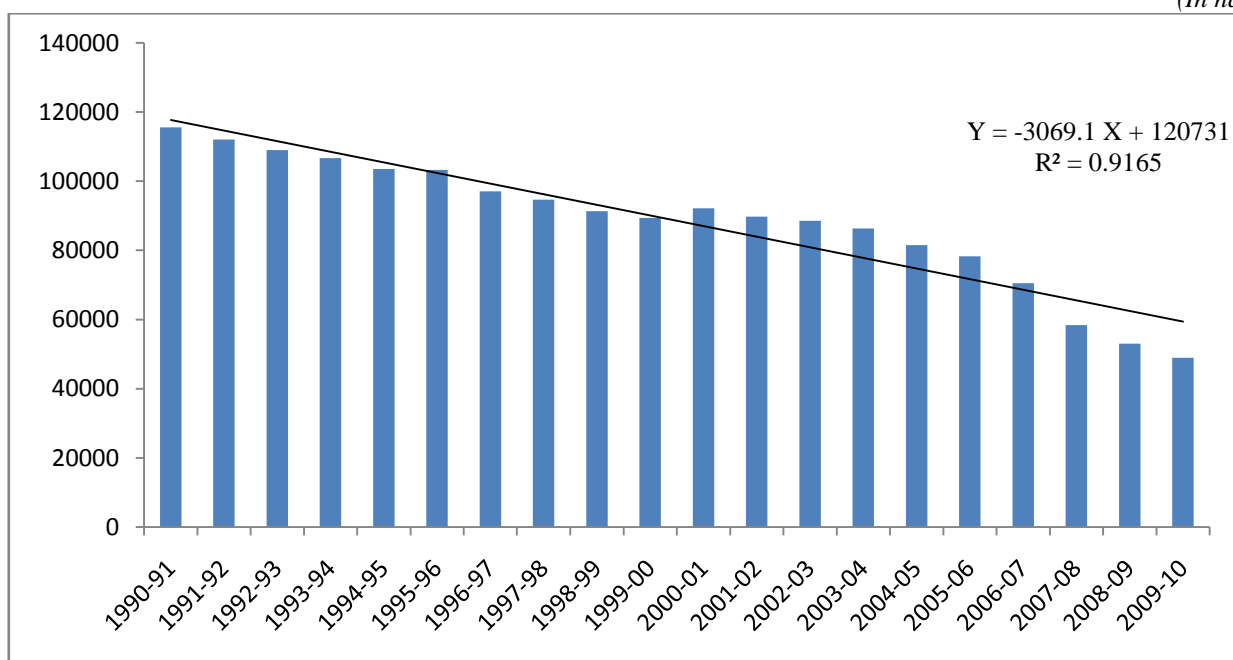
(In ha)

Y = -3069.1 X + 120731
R² = 0.9165

Projected area for the cultivation of cashew in 2011-12 is 53210 ha, in 2015-16 it is 40934 ha and in 2019-20 it is estimated to be 28658 ha (See: Table 2.38). Policy makers should consider seriously this declining trend while planning policies for the development of agriculture sector in the state. Suggestions to bring more land for cashew cultivation are importance should be given to large scale cultivation, special farm packages for cultivation should be introduced and constant awareness creation on economic potentials and the health benefits of cashew consumption should be propagated.

Table 2.38
Projected Area for Cultivation: Cashew (2011-12 to 2019-20)

(In ha)

Year (X)	Trend Equation Y = -3069.1X + 120731	
	Value of X	*Projected Value of Y (Area for Cultivation)*
2011-12	22	53210.80
2012-13	23	50141.70
2013-14	24	47072.60
2014-15	25	44003.50
2015-16	26	40934.40
2016-17	27	37865.30
2017-18	28	34796.20
2018-19	29	31727.10
2019-20	30	28658.00

Source: Output of MS EXCEL

2.10.2 Production: Cashew nut

In spite of the increase in the production of cashew in India, production of cashew had shown a declining trend in Kerala over the past decades. Cashew production in the world shows a small increase while the consumption status shows a very high increase. The production of cashew nut was 102771 tonnes in 1990-91. This drastically came down to 36450 tonnes in 2009-10. So the percentage decrease during the period was 64.53. The production of cashew nuts also exhibited slight economics fluctuations. A straight line trend equation Y= -2734.4 X + 98184 is fitted to the observed values with R^2= 0.7307. This means that the trend line explains only 73.07 per cent of the total variation. Hence no attempt was made to forecast the production of cashew.

Details are given in Table 2.39. Hence it is found a direct correlation between the area brought under cultivation and production of cashew nuts. That is, production of cashew nuts drastically falling with drastic shrinking of land brought under cultivation for cashew nuts.   Hence a simple and viable remedy to raise the cultivation of cashew in the state is to bring more land for the cultivation of cashew nut or expand plantation of cashew.

Table 2.39
Production: Cashew (1990-91 to 2009-10)

(In tonnes)

| Year (X) | Production (Y) | Trend Equation, Y = -2734 X + 98184 | | Elimination of Trend |
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	102771	1	95449.60	7321.40
1991-92	104601	2	92715.20	11885.80
1992-93	95623	3	89980.80	5642.20
1993-94	79925	4	87246.40	-7321.40
1994-95	95548	5	84512.00	11036.00
1995-96	82760	6	81777.60	982.40
1996-97	68963	7	79043.20	-10080.20
1997-98	56885	8	76308.80	-19423.80
1998-99	51336	9	73574.40	-22238.40
1999-00	65547	10	70840.00	-5293.00
2000-01	66178	11	68105.60	-1927.60
2001-02	65867	12	65371.20	495.80
2002-03	66087	13	62636.80	3450.20
2003-04	65655	14	59902.40	5752.60
2004-05	60584	15	57168.00	3416.00
2005-06	68262	16	54433.60	13828.40
2006-07	61680	17	51699.20	9980.80
2007-08	52402	18	48964.80	3437.20
2008-09	42334	19	46230.40	-3896.40
2009-10*	36450	20	43496.00	-7046.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

The following are the suggestions for raising cashew production in the state:

- More value added and industrial products should be produced from cashew.
- Proper irrigation and manuring should be done.
- Cashew processing units are concentrated in Kollam district and are working at the optimal level. So steps should be taken to establish cashew factories in other districts also.

- Standard branding and marketing are required for the product to compete directly in the world market.

- New production technology should be developed through research and development to exploit the production of by-products.

Figure 2.29
Production: Cashew (1990-91 to 2009-10)

(In tonnes)

$$y = -2734 X + 98184$$
$$R^2 = 0.7307$$
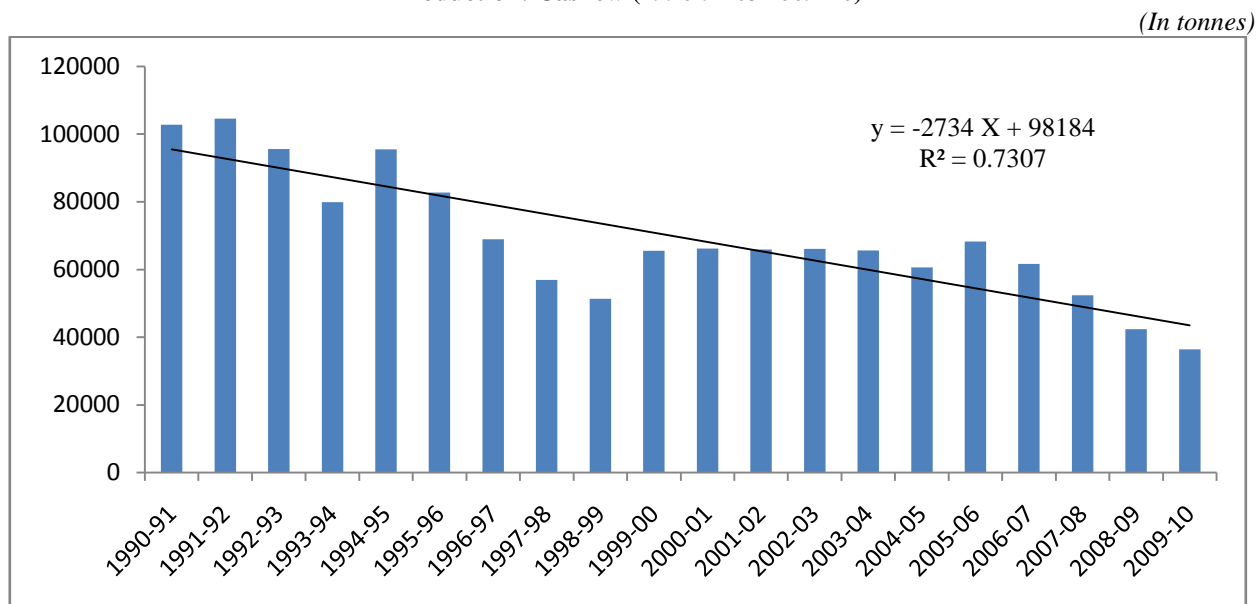
2.10.3 Productivity: Cashew nut

In Kerala, the productivity statistics shows a cyclical trend. The data on the productivity of cashew nut had followed the path of a severe business cycle till 1999-00. After that the fluctuations were the result of accidental events. The productivity was 889 kg/ha in 1990-91, which came down to 744 kg/ha in 2009-10. That is, a 16.31 per cent decrease in productivity had been experienced during the period. This is due to the reasons that lack of awareness on the economic potential of cashew, planting of cashew in marginal and poor fertile land, non-adoption of recommended package of practices, pest infestation leading to yield reduction upto thirty to forty per cent and ageing trees. The most suited trend line by minimising the short term variations is a polynomial equation of the form $Y = 2.0116 X^2 - 44.188 X + 958.66$ with a coefficient of

91

determination of 0.3773. Hence unexplained variation in this case is 62.27 per cent. With this R^2

value projection will not be accurate and reliable so that no projection is to be made.

Table 2.40
Productivity: Cashew (1990-91 to 2009-10)

(In kg/ha)

Year (X)	Productivity (Y)	Trend Equation, $Y = 2.0116 X^2 - 44.188 X + 958.66$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	889	1	916.48	-27.48
1991-92	933	2	878.33	54.67
1992-93	877	3	844.20	32.80
1993-94	749	4	814.09	-65.09
1994-95	923	5	788.01	134.99
1995-96	801	6	765.95	35.05
1996-97	710	7	747.91	-37.91
1997-98	601	8	733.90	-132.90
1998-99	562	9	723.91	-161.91
1999-00	733	10	717.94	15.06
2000-01	718	11	716.00	2.00
2001-02	734	12	718.07	15.93
2002-03	746	13	724.18	21.82
2003-04	760	14	734.30	25.70
2004-05	743	15	748.45	-5.45
2005-06	872	16	766.62	105.38
2006-07	875	17	788.82	86.18
2007-08	898	18	815.03	82.97
2008-09	799	19	845.28	-46.28
2009-10*	744	20	879.54	-135.54

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

The following suggestions will be helpful for raising the productivity of cashew:

- Large scale farming should be promoted and encouraged by announcing special packages.

- Phased replanting programmes should be encouraged.

- Organic cashew farming should be encouraged.

- Better marketing and trade system should be promoted.

- More value added products should be produced and exported.

Figure 2.30
Productivity: Cashew (1990-91 to 2009-10)

(In kg/ha)

$$Y = 2.0116 X^2 - 44.188 X + 958.66$$
$$R^2 = 0.3773$$
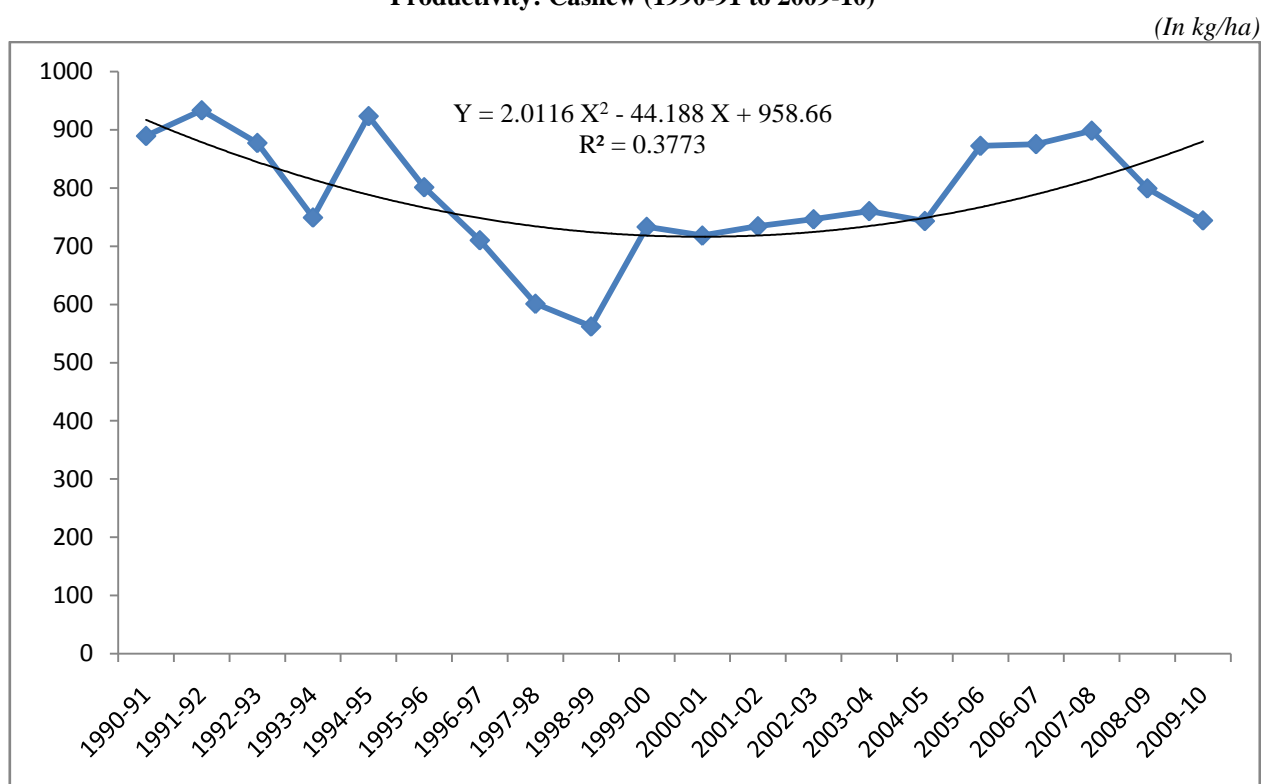
2.11 Coconut

Coconut is grown all over the world except the continents of Europe and Australia. India ranks first in the production of coconut. Among the Indian states, Kerala contributes more than forty per cent of the total production in the country. Consumption of coconut oil in the state is also very high and it is better priced also.

2.11.1 Area under Cultivation: Coconut

The area under coconut cultivation in Kerala over the last few years had shown a declining trend. The major reason for this declining trend are majority of coconut farmers are poor and they have only small or marginal land for cultivation. Other reasons are very high price fluctuation of coconut and inadequate storage facility in the state. Area brought under cultivation of coconut was 870000 ha in 1990-91 and this came down to 778619 ha in 2009-10. That is, the

percentage decrease during this period was 10.50. Coconut cultivated area during the past did not show any secular trend such as increasing, decreasing or constant, but it exhibited some sort of economic instability. That is, cyclical fluctuations are inherent in the area of cultivation of coconut.

A polynomial trend equation of the form $Y = -1043.5 X^2 + 18777 X + 832376$ is fitted for the observed values with $R^2 = 0.8065$. This means that the trend line explains only 80.65 per cent of the total variation. With this result the projection of area will not be accurate. Details are presented in Table 2.41 and Figure 2.31.

Table 2.41
Area under Cultivation: Coconut (1990-91 to 2009-10)

(In ha)

| Year (X)	Area (Y)	Trend Equation, $Y = -1043.5 X^2 + 18777 X + 832376$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	870000	1	850109.50	19890.50
1991-92	863100	2	865756.00	-2656.00
1992-93	877000	3	879315.50	-2315.50
1993-94	882300	4	890788.00	-8488.00
1994-95	911000	5	900173.50	10826.50
1995-96	914300	6	907472.00	6828.00
1996-97	902100	7	912683.50	-10583.50
1997-98	884300	8	915808.00	-31508.00
1998-99	882300	9	916845.50	-34545.50
1999-00	925035	10	915796.00	9239.00
2000-01	925783	11	912659.50	13123.50
2001-02	905718	12	907436.00	-1718.00
2002-03	899198	13	900125.50	-927.50
2003-04	898498	14	890728.00	7770.00
2004-05	899267	15	879243.50	20023.50
2005-06	897833	16	865672.00	32161.00
2006-07	872943	17	850013.50	22929.50
2007-08	818812	18	832268.00	-13456.00
2008-09	787769	19	812435.50	-24666.50
2009-10*	778619	20	790516.00	-11897.00

 Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.31
Area under Cultivation: Coconut (1990-91 to 2009-10)

(In ha)

$$Y = -1043.5 X^2 + 18777 X + 832376$$
$$R^2 = 0.8065$$
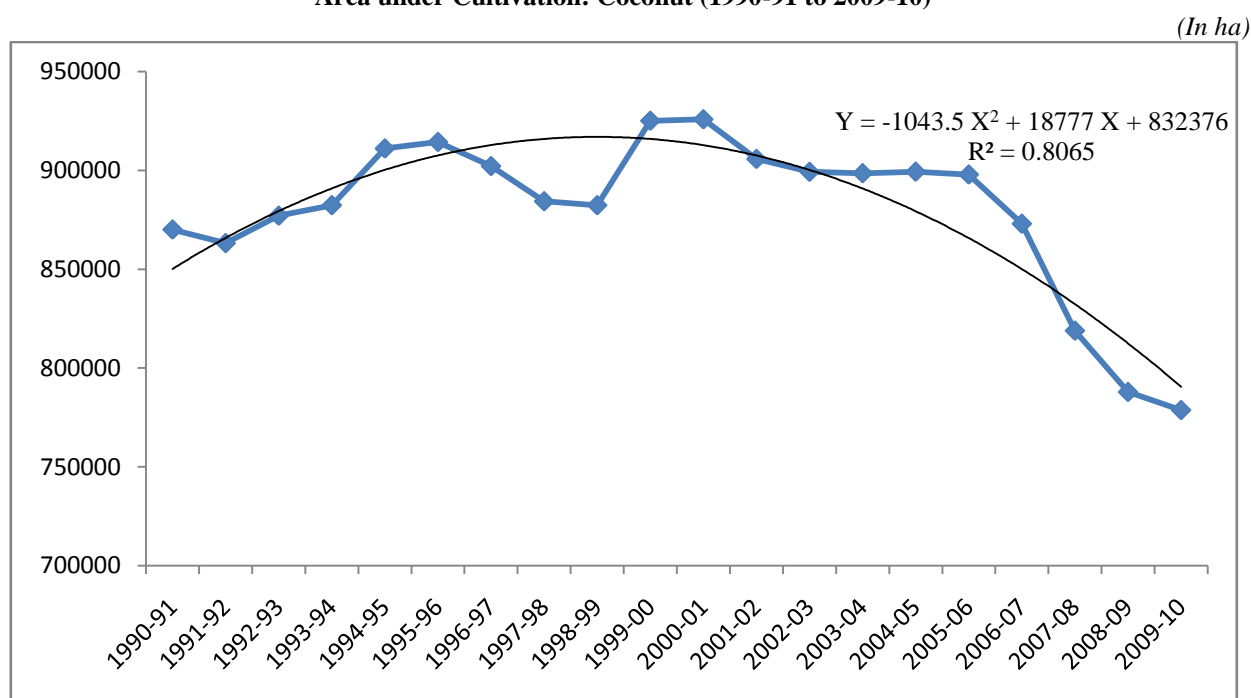
2.11.2 Production: Coconut

The trend of coconut production in the state is commendable over the past ten years and during some years there were some irregular downswings. The production of coconut was 4232 and 5667 million nuts respectively in 1990-91 and in 2009-10. The percentage increase over this period was 33.91. The production of coconut had showed a marginal increasing trend. Here a power trend line of the form $Y = 4354.4 \, X^{0.1044}$ is fitted to the observed values with coefficient of determination of 0.8297, which means that the line fitted is 82.97 per cent best fit to the original data. Hence no exercise is done to project the production of coconut. Suggestions for further improving coconut production in the state are strengthening of irrigation system, promotion of high yielding varieties, more importance to comprehensive insurance for farmers, production of more value added products, establishing more coconut processing industries and more importance should be given to irrigation facilities.

Table 2.42
Production: Coconut (1990-91 to 2009-10)

(In million nuts)

Year (X)	Production (Y)	Trend Equation, Y = 4354.4 X$^{0.1044}$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	4232	1	4354.40	-122.40
1991-92	4641	2	4681.19	-40.19
1992-93	5124	3	4883.60	240.40
1993-94	5192	4	5032.50	159.50
1994-95	5336	5	5151.11	184.89
1995-96	5155	6	5250.10	-95.10
1996-97	5276	7	5335.27	-59.27
1997-98	5210	8	5410.17	-200.17
1998-99	5132	9	5477.11	-345.11
1999-00	5680	10	5537.69	142.31
2000-01	5536	11	5593.06	-57.06
2001-02	5479	12	5644.10	-165.10
2002-03	5709	13	5691.46	17.54
2003-04	5876	14	5735.67	140.33
2004-05	6001	15	5777.13	223.87
2005-06	6326	16	5816.19	509.81
2006-07	6054	17	5853.12	200.88
2007-08	5641	18	5888.15	-247.15
2008-09	5802	19	5921.48	-119.48
2009-10*	5667	20	5953.27	-286.27

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.32
Production: Coconut (1990-91 to 2009-10)

(In million nuts)

$Y = 4354.4 X^{0.1044}$
$R^2 = 0.8297$
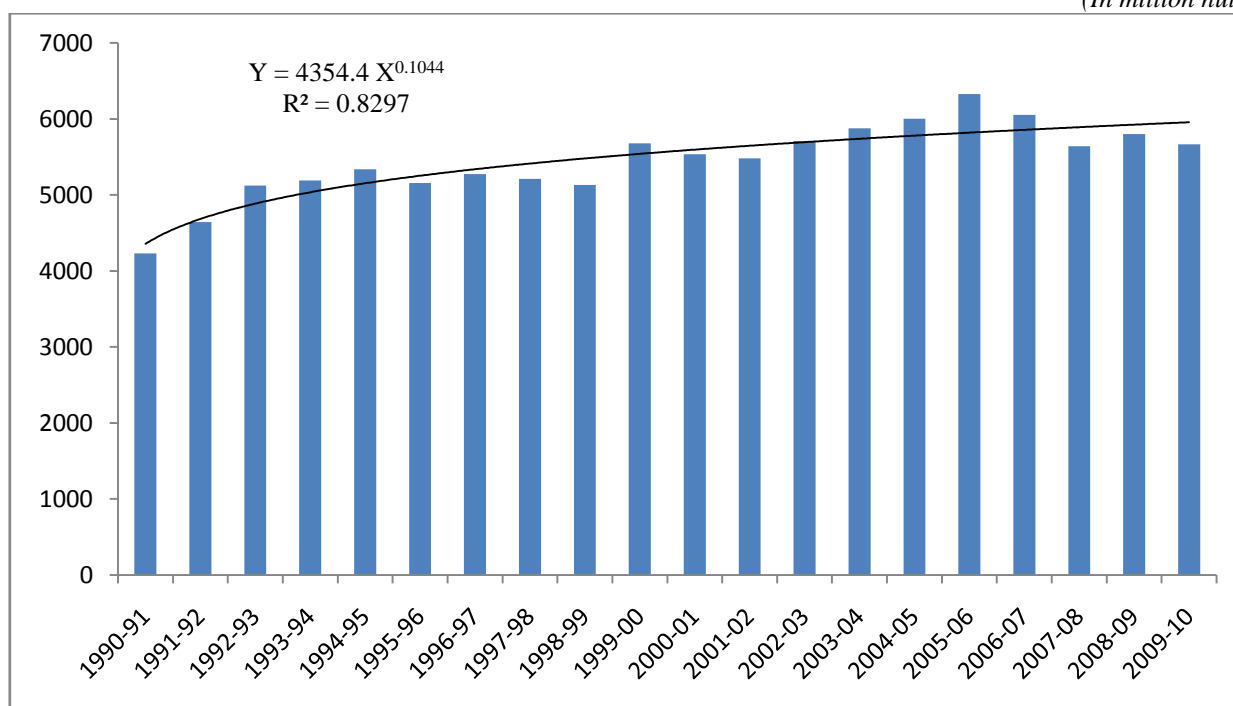
2.11.3 Productivity: Coconut

Productivity of coconut in Kerala shows commendable progress over the past few years. The productivity of coconut had been gradually increased during the reference period of the study. The percentage increase in productivity of coconut from 1990-91 to 2009-10 was 49.63. The productivity of coconut was 7278 nuts/ha in 2009-10. Fig 2.33 revealed that the productivity of coconut had a sustained increase over the past two decades. This sustained growth in the productivity of coconut is to be maintained in the future also by planning and executing necessary policy measures. A polynomial trend line of the form $Y = 2.2792 X^2 + 56.688 X + 5291$ is fitted for the values of productivity of coconut with $R^2 = 0.9009$, which means that the line fitted is 90.09 per cent best fit to the observed values.

Figure 2.33
Productivity: Coconut (1990-91 to 2009-10)

(In nuts/ha)

$Y = 2.2792 X^2 + 56.688 X + 5291$
$R^2 = 0.9003$
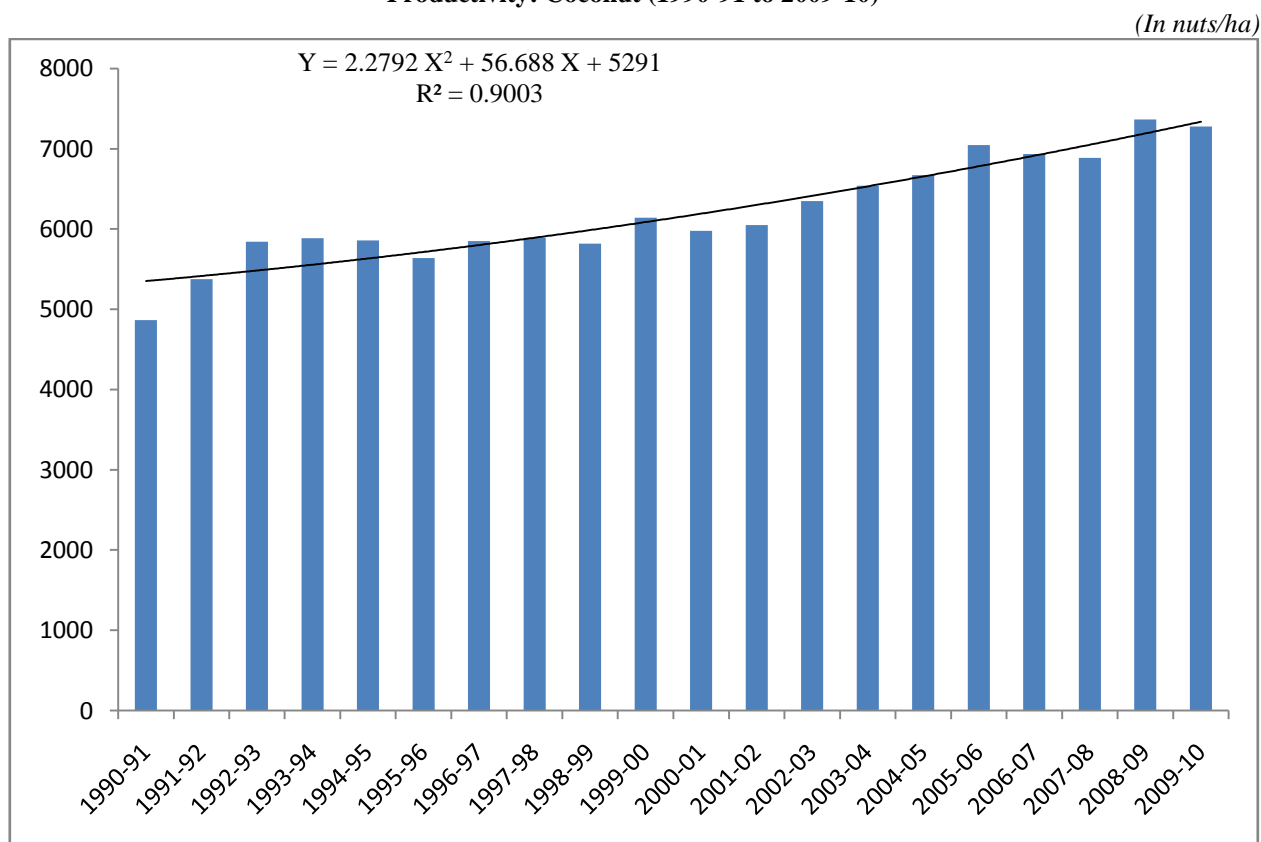
Table 2.43
Productivity: Coconut (1990-91 to 2009-10)

(In nuts/ha)

Year (X)	Productivity (Y)	Trend Equation, $Y = 2.2792 X^2 + 56.688 X + 5291$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	4864	1	5349.97	-485.97
1991-92	5377	2	5413.49	-36.49
1992-93	5843	3	5481.58	361.42
1993-94	5885	4	5554.22	330.78
1994-95	5857	5	5631.42	225.58
1995-96	5638	6	5713.18	-75.18
1996-97	5849	7	5799.50	49.50
1997-98	5892	8	5890.37	1.63
1998-99	5817	9	5985.81	-168.81
1999-00	6140	10	6085.80	54.20
2000-01	5980	11	6190.35	-210.35
2001-02	6049	12	6299.46	-250.46
2002-03	6349	13	6413.13	-64.13
2003-04	6540	14	6531.36	8.64
2004-05	6673	15	6654.14	18.86
2005-06	7046	16	6781.48	264.52
2006-07	6935	17	6913.38	21.62
2007-08	6889	18	7049.84	-160.84
2008-09	7365	19	7190.86	174.14
2009-10*	7278	20	7336.44	-58.44

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

The projected productivity of coconut is worked out in Table 2.44. From the Table it could be inferred that the productivity of coconut will be further increased in future also. The expected productivity of coconut in 2011-12 is 7641 nuts/ha and in 2019-20, it is 9043 nut/ha. The expected percentage increase from 2011-12 to 2019-20 is 18.35. Suggestions for further improvement in the productivity of coconut are introduction of high yielding variety programme, introduction of appropriate irrigation facilities and more effective pest control strategies.

Table 2.44
Projected Productivity: Coconut (2011-12 to 2019-20)

(In nuts/ha)

Year (X)	Trend Equation, $Y = 2.2792 X^2 + 56.688 X + 5291$	
	Value of X	*Projected Value of Y (Productivity)*
2011-12	22	7641.27
2012-13	23	7800.52
2013-14	24	7964.33
2014-15	25	8132.70
2015-16	26	8305.63
2016-17	27	8483.11
2017-18	28	8665.16
2018-19	29	8851.76
2019-20	30	9042.92

Source: Output of MS EXCEL

2.12 Cardamom

Cardamom is generally produced in the tropical regions of the world. India is the second largest producer of cardamom in the world. Indian cardamom is world widely demanded because it is aromatic. Kerala produces about sixty five per cent of the total cardamom produced in the country. This cash crop is highly labour intensive.

2.12.1 Area under Cultivation: Cardamom

Over the past decades the area under cardamom cultivation in Kerala is more or less constant. People prefer hilly place for cardamom cultivation. The forest area is continuously decreasing and this creates future threats to cardamom cultivation. The area brought under cultivation of cardamom had decreased from 43824 ha to 41593 ha from 1990-91 to 2009-10 and the percentage decrease during the period was 5.09. The time series data exhibited random fluctuations. For this reason, the polynomial equation $Y = 13.986 X^2 - 454.67 X + 44783$ had explained only 66.98 percentage of fluctuations of the observed values so that no severe trend has been visualised. Hence no forecast is to be made with the estimated trend line. However, trend has been eliminated using additive model. Details are given in Table 2.45.

Table 2.45
Area under Cultivation: Cardamom (1990-91 to 2009-10)

(In ha)

Year (X)	Area (Y)	Trend Equation, Y = 13.986 X²- 454.67 X + 44783		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	43824	1	44342.32	-518.32
1991-92	43670	2	43929.60	-259.60
1992-93	43386	3	43544.86	-158.86
1993-94	43456	4	43188.10	267.90
1994-95	44237	5	42859.30	1377.70
1995-96	44245	6	42558.48	1686.52
1996-97	41268	7	42285.62	-1017.62
1997-98	40867	8	42040.74	-1173.74
1998-99	41449	9	41823.84	-374.84
1999-00	41491	10	41634.90	-143.90
2000-01	41288	11	41473.94	-185.94
2001-02	41336	12	41340.94	-4.94
2002-03	41412	13	41235.92	176.08
2003-04	41332	14	41158.88	173.12
2004-05	41378	15	41109.80	268.20
2005-06	41367	16	41088.70	278.30
2006-07	41362	17	41095.56	266.44
2007-08	39763	18	41130.40	-1367.40
2008-09	41588	19	41193.22	394.78
2009-10*	41593	20	41284.00	309.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.34
Area under cultivation: Cardamom (1990-91 to 2009-10)
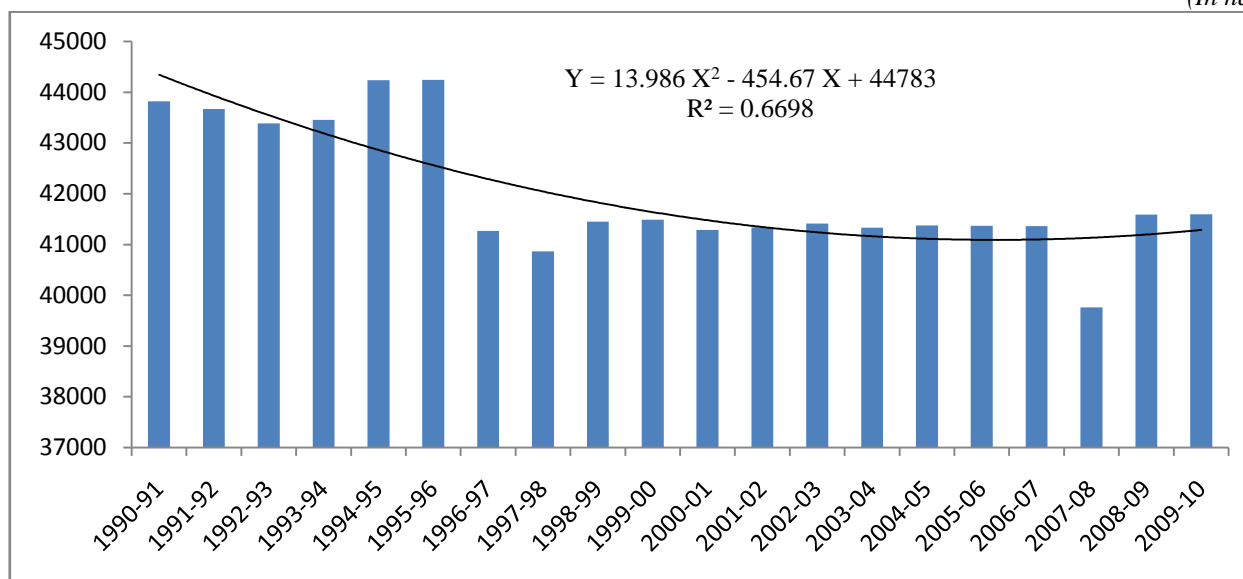
(In ha)

$$Y = 13.986 X^2 - 454.67 X + 44783$$
$$R^2 = 0.6698$$

Cultivation of cardamom should be extended to lower plains and strengthen the marketing facilities of cardamom.

2.12.2 Production: Cardamom

The production of cardamom in Kerala shows better performance. The production had followed a trade cycle movement. The trough point in the cycle is in 1992-93 (2570 tonnes) and peak in 2005-06 (9765 tonnes). The percentage increase in the production of cardamom was 126.09 per cent during the period from 1990-91 to 2009-10. In order to minimise short term fluctuations, a polynomial equation of the form $Y= -18.204 X^2 + 707.67 X + 1643.6$ is fitted with $R^2= 0.8389$. So the fitted line explains only 83.89 per cent of the total variation of the observed data on production. Hence no attempt was made to project the values of production.

Table 2.46
Production: Cardamom (1990-91 to 2009-10)

(In tonnes)

Year (X)	Production (Y)	Trend Equation, $Y = -18.204 X^2 + 707.67 X + 1643.6$		Elimination of Trend
		Value of X	**Trend Values**	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	3450	1	2333.07	1116.93
1991-92	3450	2	2986.12	463.88
1992-93	2570	3	3602.77	-1032.77
1993-94	4430	4	4183.02	246.98
1994-95	4720	5	4726.85	-6.85
1995-96	5380	6	5234.28	145.72
1996-97	4550	7	5705.29	-1155.29
1997-98	5290	8	6139.90	-849.90
1998-99	4990	9	6538.11	-1548.11
1999-00	6585	10	6899.90	-314.90
2000-01	7580	11	7225.29	354.71
2001-02	8380	12	7514.26	865.74
2002-03	8680	13	7766.83	913.17
2003-04	8875	14	7983.00	892.00
2004-05	8616	15	8162.75	453.25
2005-06	9765	16	8306.10	1458.90
2006-07	8545	17	8413.03	131.97
2007-08	7031	18	8483.56	-1452.56
2008-09	8550	19	8517.69	32.31
2009-10*	7800	20	8515.40	-715.40

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.35
Production: Cardamom (1990-91 to 2009-10)
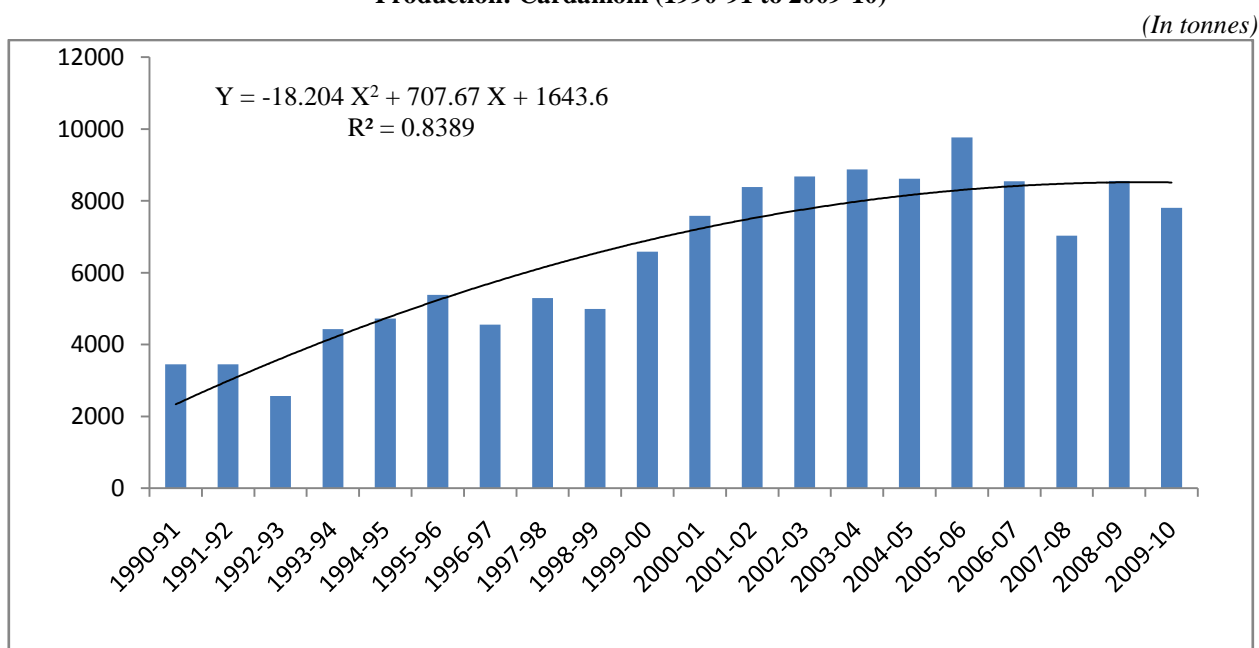
(In tonnes)

$$Y = -18.204 X^2 + 707.67 X + 1643.6$$
$$R^2 = 0.8389$$

The following are the suggestions for raising cardamom production in the state:

- Drip Irrigation should be strengthened.
- Harvesting should be done in forty five days interval.
- Area under cardamom cultivation should be increased.
- Export market should be strengthened through proper planning.
- Ensure better international price stability for the product.

2.12.3 Productivity: Cardamom

The productivity of cardamom shows a slight increase over the last few years with some sort of fluctuation. The productivity of cardamom was 79 kg/ha in 19990-91 and 188 kg/ha in 2009-10, so the percentage increase was 137.97 per cent. Cyclical fluctuation is observed on the productivity of cardamom and hence a polynomial trend line of the form $Y = -0.4606 X^2 + 17.922 X + 32.914$ is filled with $R^2 = 0.8604$. This means that the line fitted is 86.04 per cent best fit to the observed values. Short term fluctuations are also eliminated in Table 2.47 and forecasts are made in Table 2.48.

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Table 2.47
Productivity: Cardamom (1990-91 to 2009-10)

(In kg/ha)

Year (X)	Productivity (Y)	Trend Equation, Y = -0.4606 X² + 17.922 X + 32.914		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	79	1	50.38	28.62
1991-92	79	2	66.92	12.08
1992-93	59	3	82.53	-23.53
1993-94	102	4	97.23	4.77
1994-95	107	5	111.01	-4.01
1995-96	122	6	123.86	-1.86
1996-97	110	7	135.80	-25.80
1997-98	129	8	146.81	-17.81
1998-99	120	9	156.90	-36.90
1999-00	159	10	166.07	-7.07
2000-01	184	11	174.32	9.68
2001-02	203	12	181.65	21.35
2002-03	210	13	188.06	21.94
2003-04	215	14	193.54	21.46
2004-05	208	15	198.11	9.89
2005-06	236	16	201.75	34.25
2006-07	207	17	204.47	2.53
2007-08	177	18	206.28	-29.28
2008-09	206	19	207.16	-1.16
2009-10*	188	20	207.11	-19.11

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.36
Productivity: Cardamom (1990-91 to 2009-10)
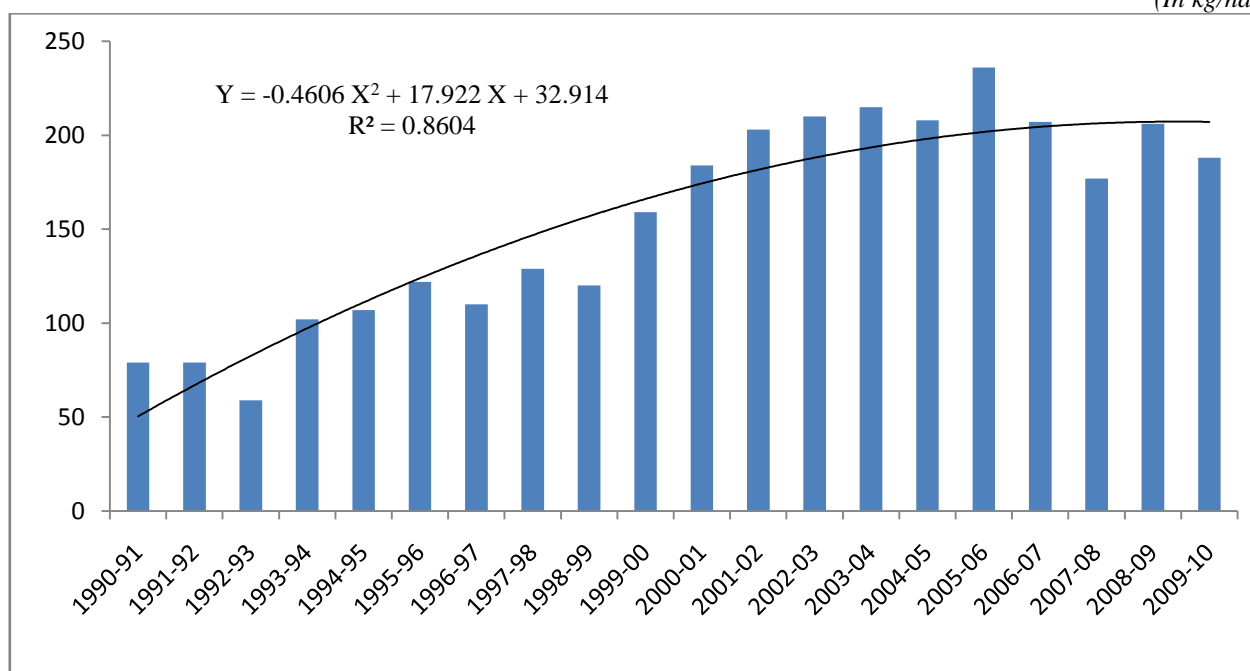
(In kg/ha)

$$Y = -0.4606 X^2 + 17.922 X + 32.914$$
$$R^2 = 0.8604$$

Expected productivity in 2011-12 is 204 kg/ha and in 2019-20, it is worked out to be 156 kg/ha. Hence, decrease in productivity of cardamom over the coming years to be happened so that severe measures are to be planned and executed to counteract this trend by raising the productivity. The following suggestions will be helpful for raising the productivity of cashew:

- Introduce modern methods of cultivation.

- Plant protection strategies should be encouraged.

- Good quality fertilisers should be made available to cultivators at cheap rate.

- Harvesting should be done in proper intervals.

- Cost of cultivation should be reduced.

- Pest attacks should be controlled.

Table 2.48

Projected Productivity: Cardamom (2011-12 to 2019-20)

(In kg/ha)

Year (X)	**Trend Equation, Y = -0.4606 X^2+17.922 X + 32.914**	
	Value of X	*Projected Value of Y (Productivity)*
2011-12	22	204.27
2012-13	23	201.46
2013-14	24	197.74
2014-15	25	193.09
2015-16	26	187.52
2016-17	27	181.03
2017-18	28	173.62
2018-19	29	165.29
2019-20	30	156.03

Source: Output of MS EXCEL

2.13 Areca nut

Areca nut is a tropical plantation crop and is one of the most important commercial crops in South Asia. India is the largest producer and consumer of areca nut in the world. Karnataka, Kerala, Assam and West Bengal are the important states growing areca nut.

2.13.1 Area under Cultivation: Areca nut

Area under cultivation of areca nut was 64800 ha in 1990-91 and after fluctuations it was increased to 99219 ha in 2009-10. That is, the percentage increase in the area under cultivation of areca nut was 53.12. A straight line trend equation of the form $Y = 2485 X + 59114$ is fitted with coefficient of determination of 0.861.   This implies that the curve fitted is 86.10 per cent best fit to the original data. Short term fluctuations are also eliminated by assuming additive model. Details are given in Table 2.49.

Table 2.49
Area under Cultivation: Areca nut (1990-91 to 2009-10)

(In ha)

Year (X)	Area (Y)	Trend Equation, Y = 2485 X + 59114		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	64800	1	61599.00	3201.00
1991-92	63400	2	64084.00	-684.00
1992-93	63900	3	66569.00	-2669.00
1993-94	69200	4	69054.00	146.00
1994-95	71700	5	71539.00	161.00
1995-96	70900	6	74024.00	-3124.00
1996-97	76100	7	76509.00	-409.00
1997-98	73300	8	78994.00	-5694.00
1998-99	73600	9	81479.00	-7879.00
1999-00	81941	10	83964.00	-2023.00
2000-01	87360	11	86449.00	911.00
2001-02	93193	12	88934.00	4259.00
2002-03	97485	13	91419.00	6066.00
2003-04	102504	14	93904.00	8600.00
2004-05	107572	15	96389.00	11183.00
2005-06	108590	16	98874.00	9716.00
2006-07	102078	17	101359.00	719.00
2007-08	99787	18	103844.00	-4057.00
2008-09	97492	19	106329.00	-8837.00
2009-10*	99219	20	108814.00	-9595.00

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Table 2.50 gives projected values for area under cultivation of areca nut from 2011-12 to 2019-20. The table shows that area under cultivation has been gradually increasing from 2011-12 to 2019-20. The expected percentage of increase from 2011-12 to 2019-20 is 17.47. The expected area under cultivation is 113784 ha in 2011-12, 123724 ha in 2015-16 and 133664 ha in 2019-20.

Figure 2.37
Area under Cultivation: Areca nut (1990-91 to 2009-10)

(In ha)

Y = 2485 X + 59114
R² = 0.861
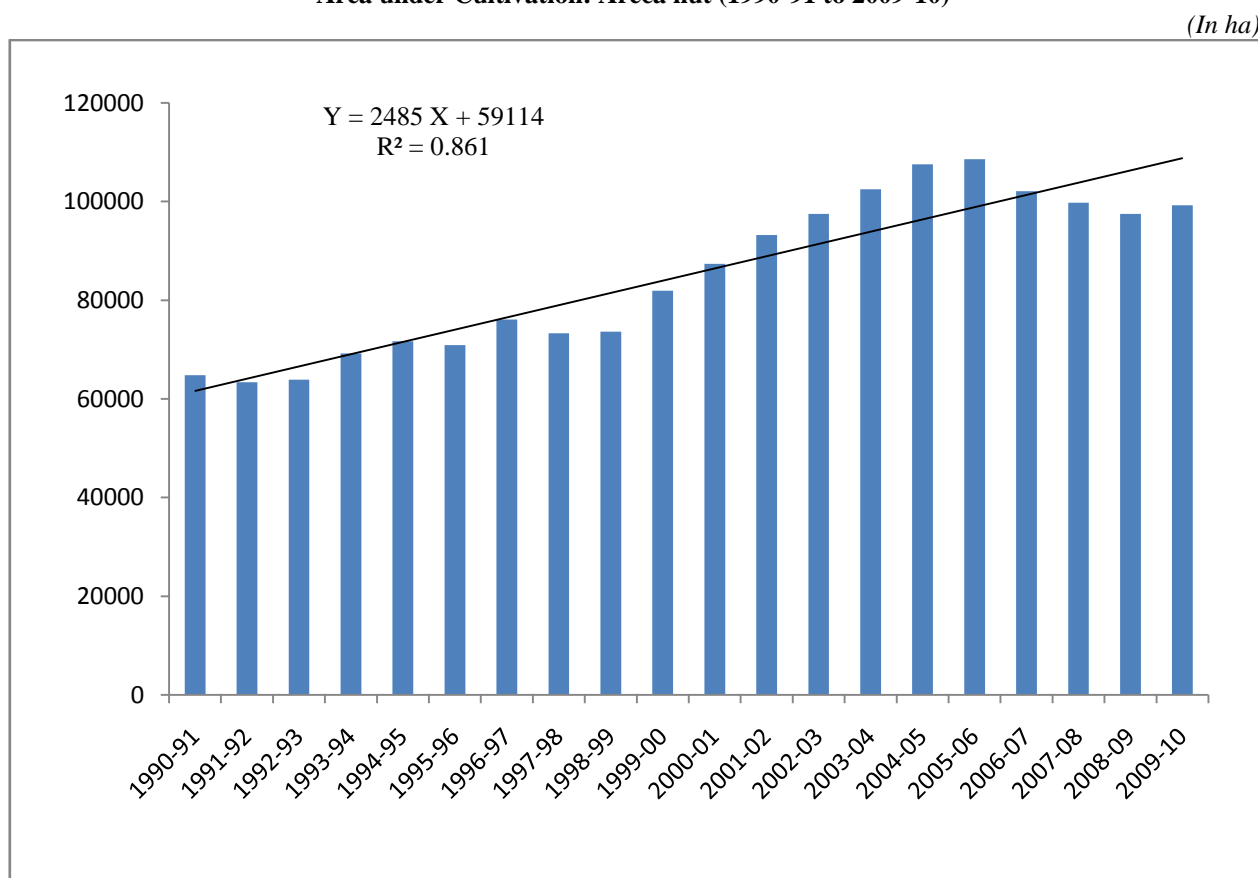
Table 2.50
Projected Area for Cultivation: Areca nut (2011-12 to 2019-20)

(In ha)

Year (X)	Trend Equation, Y = 2485 X + 59114	
	Value of X	*Projected Value of Y (Area for Cultivation)*
2011-12	22	113784.00
2012-13	23	116269.00
2013-14	24	118754.00
2014-15	25	121239.00
2015-16	26	123724.00
2016-17	27	126209.00
2017-18	28	128694.00
2018-19	29	131179.00
2019-20	30	133664.00

Source: Output of MS EXCEL

2.13.2 Production: Areca nut

The areca nut production shows an increasing trend over the past ten years. This tremendous increase is due to the improvement in cultivation and the favourable climatic

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conditions prevailing in the state. Farmers are able to continue cultivation because the cost of maintaining the crop is comparatively low. The production of areca nut was 13074 tonnes in 1990-91 and went up to 127893 tonnes in 2009-10. No cyclical fluctuation is observed in the production of areca nut from 1990-91 to 1996-97. Then from 1997-98 onwards there has been an increasing trend. The percentage of increase from 1997-98 to 2009-10 was 46.94 per cent.

A linear trend equation of the form Y = 7195.1 X - 3580.1 is fitted to the given data of production with R^2= 0.8911. This means that the line fitted is 89.11 per cent best fit to the data. Short term fluctuations are also eliminated by assuming additive model. Details are given in Table 2.51.

Table 2.51
Production: Areca nut (1990-91 to 2009-10)

(In tonnes)

Year (X)	Production (Y)	Trend Equation, Y = 7195.1 X – 3580.1		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	13074	1	3615.00	9459.00
1991-92	13116	2	10810.10	2305.90
1992-93	13643	3	18005.20	-4362.20
1993-94	15357	4	25200.30	-9843.30
1994-95	17466	5	32395.40	-14929.40
1995-96	17429	6	39590.50	-22161.50
1996-97	17175	7	46785.60	-29610.60
1997-98	87038	8	53980.70	33057.30
1998-99	68479	9	61175.80	7303.20
1999-00	83337	10	68370.90	14966.10
2000-01	87947	11	75566.00	12381.00
2001-02	84681	12	82761.10	1919.90
2002-03	107279	13	89956.20	17322.80
2003-04	105490	14	97151.30	8338.70
2004-05	110340	15	104346.40	5993.60
2005-06	119309	16	111541.50	7767.50
2006-07	109968	17	118736.60	-8768.60
2007-08	114690	18	125931.70	-11241.70
2008-09	125654	19	133126.80	-7472.80
2009-10*	127893	20	140321.90	-12428.90

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.38
Production: Areca nut (1990-91 to 2009-10)

(In tonnes)

$Y = 7195.1 \, X - 3580.1$
$R^2 = 0.8911$
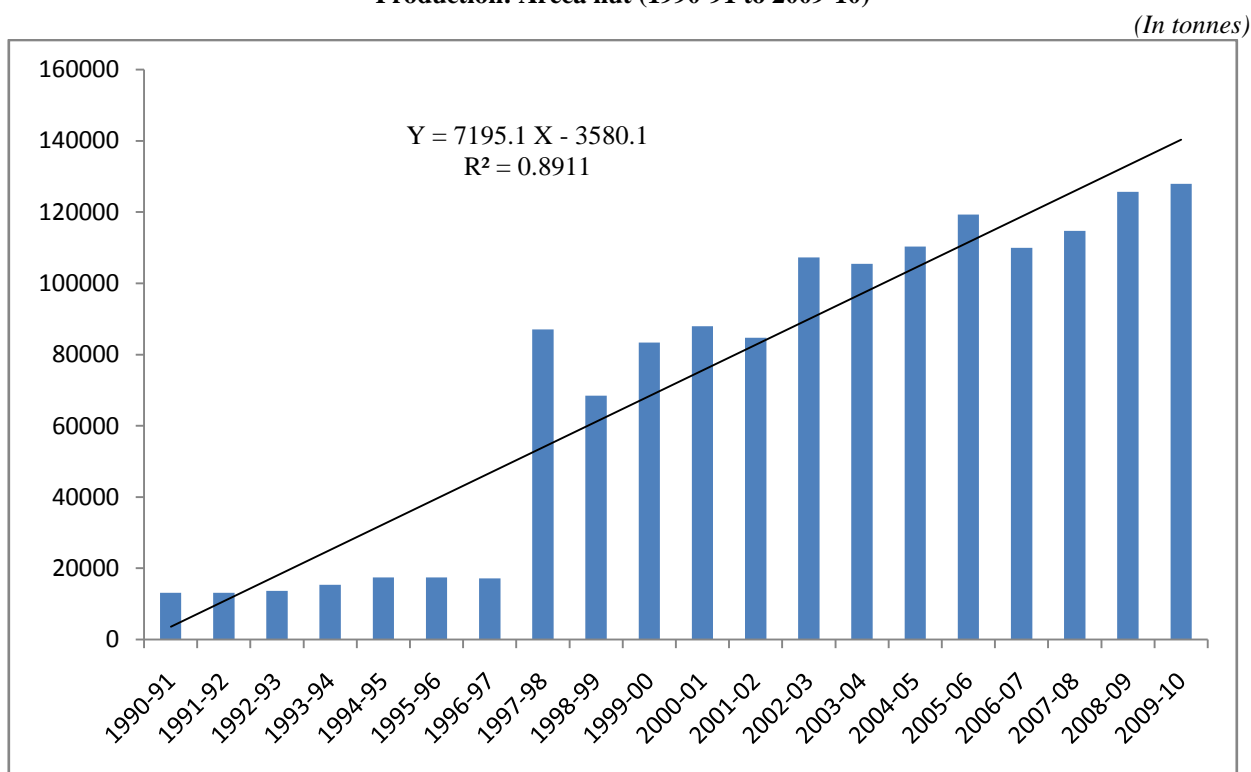
Table 2.52 shows that the projected production of areca nut in 2011-12 is 154712 tonnes and in 2019-20 it is 212273 tonnes. The expected percentage of increase from 2011-12 to 2019-20 is 37.21. This means that the production of areca nut will be steadily increased in future.

Table 2.52
Projected Production: Areca nut (2011-12 to 2019-20)

(In tonnes)

Year (X)	Trend Equation, $Y = 7195.1 \, X - 3580.1$	
	Value of X	**Projected Value of Y (Production)**
2011-12	22	154712.10
2012-13	23	161907.20
2013-14	24	169102.30
2014-15	25	176297.40
2015-16	26	183492.50
2016-17	27	190687.60
2017-18	28	197882.70
2018-19	29	205077.80
2019-20	30	212272.90

Source: Output of MS EXCEL

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2.13.3 Productivity: Areca nut

The productivity of areca nut was 202 kg/ha in 1990-91 and 1289 kg/ha in 2009-10. This means that the percentage increase in the productivity from 1990-91 to 2009-10 was 538. A polynomial trend equation of the form $Y = -2.625 X^2 + 119.6 X - 95.51$ is fitted with $R^2 = 0.811$, which implies that the trend line explains only 81.10 per cent of the total variation. Hence no forecast is to be made (See: Table 2.53 and Figure 2.39). In order to raise the productivity of areca nut, manuring and irrigation should be extended to all parts of Kerala.

Table 2.53
Productivity: Areca nut (1990-91 to 2009-10)

(In kg/ha)

Year (X)	Productivity (Y)	Trend Equation, $Y = -2.625 X^2 + 119.6 X - 95.51$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	202	1	21.47	180.53
1991-92	207	2	133.19	73.81
1992-93	214	3	239.67	-25.67
1993-94	222	4	340.89	-118.89
1994-95	244	5	436.87	-192.87
1995-96	246	6	527.59	-281.59
1996-97	226	7	613.07	-387.07
1997-98	1187	8	693.29	493.71
1998-99	930	9	768.27	161.73
1999-00	1017	10	837.99	179.01
2000-01	1007	11	902.47	104.53
2001-02	909	12	961.69	-52.69
2002-03	1100	13	1015.67	84.33
2003-04	1029	14	1064.39	-35.39
2004-05	1026	15	1107.87	-81.87
2005-06	1099	16	1146.09	-47.09
2006-07	1077	17	1179.07	-102.07
2007-08	1149	18	1206.79	-57.79
2008-09	1289	19	1229.27	59.73
2009-10*	1289	20	1246.49	42.51

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure

Figure 2.39
**Productivity: Areca nut (1990-91 to 2009-10)**

(In kg/ha)

$$Y = -2.625\,X^2 + 119.6\,X - 95.51$$
$$R^2 = 0.811$$
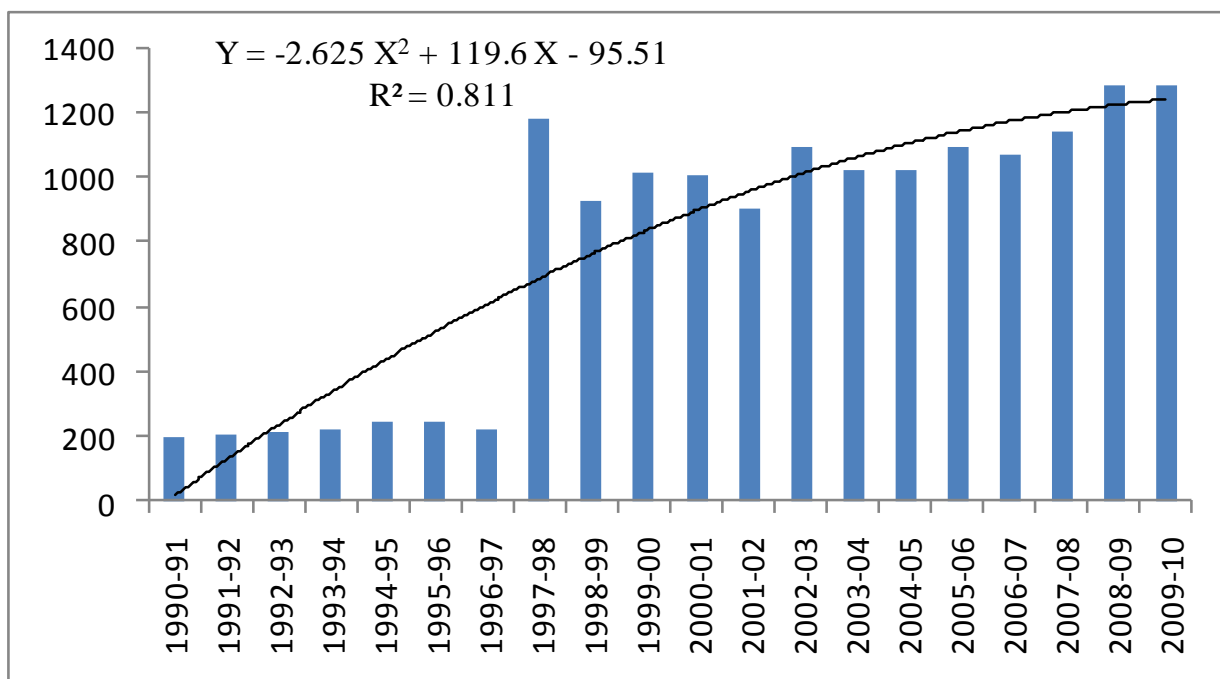
2.14 Real Agricultural lncome: Kerala

Real agricultural income or agricultural income at constant prices in 1990-91 was ₹ 10071.30 crore, which gradually as well as with fluctuation increased to ₹ 13116.22 crore in 2008-09. That is, real agricultural income with base year 1999-00 was increased by 30.23 per cent over the reference period of nineteen years from 1990-91 to 2008-09. The fluctuation in real agricultural income is an indicator of fluctuation in agricultural output. That is, our economy had been witnessed fall in agriculture output in some years compared to the preceding period (See: Table 2.54). This tendency of the economy should be dealt with appropriate policy measures. By best selection, a polynomial trend equation of the form $Y = -15.387\,X^2 + 480.4\,X + 9863.8$ is estimated with a coefficient of determination of 0.86. So the fitted line explains eighty six per cent of the total variation of the original data. Short term variation in real agricultural income is also eliminated by assuming additive model.

Table 2.54

Agriculture Income at Constant Prices with 1999-00 as the Base (1990-91 to 2008-09) - Kerala

(In crore)

| Year (X)	Agricultural Income (Y)	Trend Equation, $Y = -15.387 X^2 + 480.4 X + 9863.8$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	10071.30	1	10328.81	-257.51
1991-92	10918.58	2	10763.05	155.53
1992-93	10946.15	3	11166.52	-220.37
1993-94	11372.74	4	11539.21	-166.47
1994-95	12517.01	5	11881.13	635.89
1995-96	12676.01	6	12192.27	483.74
1996-97	12900.79	7	12472.64	428.15
1997-98	12331.05	8	12722.23	-391.18
1998-99	12567.25	9	12941.05	-373.80
1999-00	12784.86	10	13129.10	-344.24
2000-01	13070.22	11	13286.37	-216.15
2001-02	13177.52	12	13412.87	-235.35
2002-03	13399.72	13	13508.60	-108.88
2003-04	13121.19	14	13573.55	-452.36
2004-05	14091.71	15	13607.73	483.99
2005-06	14582.14	16	13611.13	971.01
2006-07	13914.87	17	13583.76	331.11
2007-08*	13122.00	18	13525.61	-403.61
2008-09**	13116.22	19	13436.69	-320.47

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure ** Quick Estimate

Figure 2.40
Agriculture Income at Constant Prices with 1999-00 as the Base (1990-91 to 2008-09) - Kerala

(In crore)

$Y = -15.387 X^2 + 480.4 X + 9863.8$
$R^2 = 0.860$

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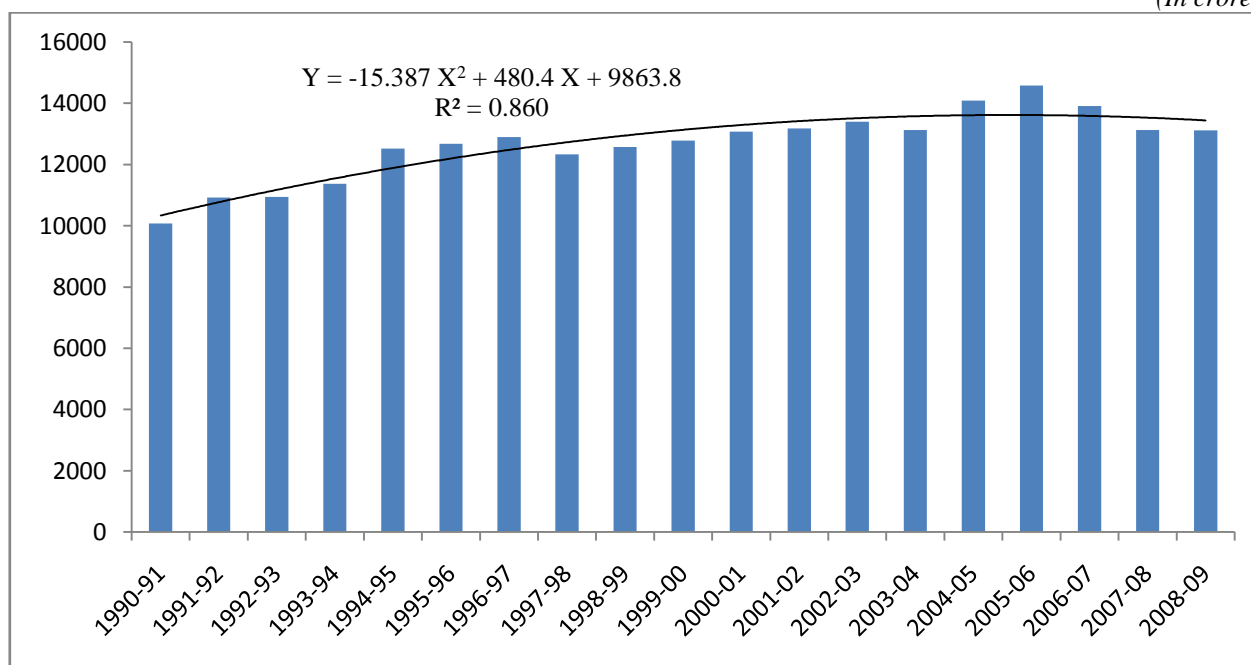
The projected values of real agricultural income are given in Table 2.55. The expected income in 2011-12 is ₹ 12985 crore, ₹ 11953 crore in 2015-16 and ₹ 10428 crore in 2019-20. The Table clearly shows that there is a declining trend in the real agricultural income of the state. Hence concerted policy measures are to be needed to revive the declining trend.

Table 2.55
Projected Value of Agriculture Income at Constant Prices with 1999-00 as the Base (2011-12 to 2019-20) - Kerala

(In crore)

Year (X)	Trend Equation, Y = -15.387 X² + 480.4 X + 9863.8	
	Value of X	*Projected Value of Y (Agricultural Income)*
2011-12	22	12985.29
2012-13	23	12773.28
2013-14	24	12530.49
2014-15	25	12256.93
2015-16	26	11952.59
2016-17	27	11617.48
2017-18	28	11251.59
2018-19	29	10854.93
2019-20	30	10427.50

Source: Output of MS EXCEL

2.15 Nominal Agricultural Income: Kerala

Nominal agriculture income or agricultural income at current prices had been showing an increasing trend. This trend is the outcome of an increasing trend of agriculture commodity prices irrespective of fall in agriculture output in some preceding years. An analysis of nominal income had revealed that the income was ₹ 3872.54 crore in 1990-91, which increased to ₹ 22244.98 crore in 2008-09. Hence, due to price rises the nominal agricultural income increased by 474.43 per cent over the study period in contrast with 30.23 per cent increase in real agricultural income. Hence the difference between these two percentage values is the outcome of price rise of agriculture commodities. A linear trend equation of the form Y = 879.46 X + 3425.7 is estimated with a coefficient of determination of 0.94 so that the fitted

line is 94 per cent best fit to the original data. Short term fluctuations are also eliminated in Table

2.56.

Table 2.56
**Agriculture Income at Current Prices (1990-91 to 2008-09) - Kerala**

(In crore)

| Year (X) | Agricultural Income (Y) | Trend Equation, Y = 879.46 X + 3425.7 | | Elimination of Trend |
		Value of X	Trend Values	
(1)	(2)	(3)	(4)	(5=2-4)
1990-91	3872.54	1	4305.16	-432.62
1991-92	5761.01	2	5184.62	576.39
1992-93	5933.15	3	6064.08	-130.93
1993-94	6565.08	4	6943.54	-378.46
1994-95	8074.02	5	7823.00	251.02
1995-96	9959.80	6	8702.46	1257.34
1996-97	11119.15	7	9581.92	1537.23
1997-98	11182.32	8	10461.38	720.94
1998-99	11692.69	9	11340.84	351.85
1999-00	12784.86	10	12220.30	564.56
2000-01	11424.49	11	13099.76	-1675.27
2001-02	11967.39	12	13979.22	-2011.83
2002-03	13236.95	13	14858.68	-1621.73
2003-04	14144.62	14	15738.14	-1593.52
2004-05	15104.90	15	16617.60	-1512.70
2005-06	16990.22	16	17497.06	-506.84
2006-07	19560.74	17	18376.52	1184.22
2007-08*	20566.86	18	19255.98	1310.88
2008-09**	22244.98	19	20135.44	2109.54

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
* Provisional Figure ** Quick Estimate

Figure 2.41
Agriculture Income at Current Prices (1990-91 to 2008-09) - Kerala
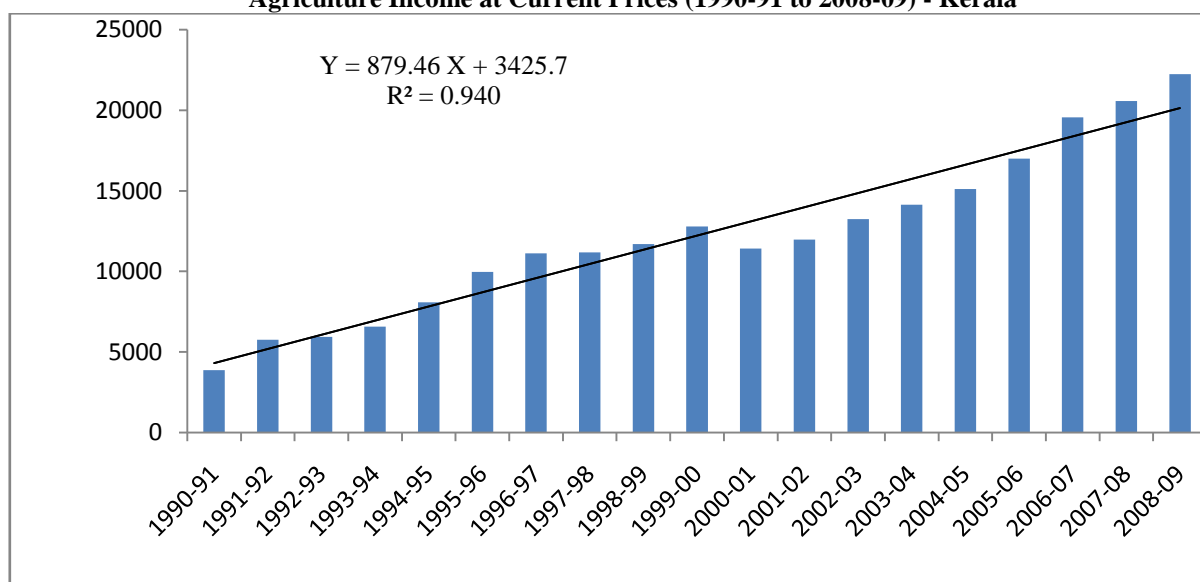
The extrapolated values of nominal agriculture income are given in Table 2.57. The expected nominal agriculture income in 2011-12 is ₹ 22774 crore , ₹ 26292 crore in 2015-16, and in 2019-20, it is expected to be ₹ 29810 crore.

Table 2.57
Projected Value of Agriculture Income at Current Prices (2011-12 to 2019-20) - Kerala

(In crore)

Year (X)	Trend Equation, Y = 879.46 X + 3425.7	
	Value of X	*Projected Value of Y (Agricultural Income)*
2011-12	22	22773.82
2012-13	23	23653.28
2013-14	24	24532.74
2014-15	25	25412.20
2015-16	26	26291.66
2016-17	27	27171.12
2017-18	28	28050.58
2018-19	29	28930.04
2019-20	30	29809.50

Source: Output of MS EXCEL

2.16 Percentage of Real Agricultural Income in SDP: Kerala

As in the case of real agricultural income, percentage contribution of real agriculture income in SDP had also shown a downward trend. The percentage is decreased from 23.14 in 1990-91 to 9.70 in 2008-09. By strictly following appropriate selection of trend line, a straight line trend equation is estimated to the actual data with intercept term 26.314 and slope of -0.8014. The trend equation fitted (Y = -0.8014 X + 26.314) is 95.83 per cent best fit also, so that an accurate and reliable forecast is made. Details are given in Table 2.58.

The expected percentage contribution of agricultural income in SDP is 8.68 in 2011-12, 5.48 in 2015-16 and 2.27 in 2019-20 (See: Table 2.59). This trend in the share of real agricultural income to SDP reveals the expansion of industrial and service sector of the economy and also change in the occupational structure of the economy. These structural and occupational changes

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are prime requisites for the development of an economy. Hence this fall in the share of real

agricultural income in SDP shows that the state economy is on the path of development process.

Table 2.58
Percentage of Agriculture Income in SDP at Constant Prices (1990-91 to 2008-09) - Kerala

Year (X)	% of Income (Y)	Trend Equation, Y = -0.8014 X + 26.314		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	23.14	1	25.51	-2.37
1991-92	24.76	2	24.71	0.05
1992-93	23.51	3	23.91	-0.40
1993-94	22.39	4	23.11	-0.72
1994-95	22.9	5	22.31	0.59
1995-96	22.29	6	21.51	0.78
1996-97	21.93	7	20.70	1.23
1997-98	20.25	8	19.90	0.35
1998-99	19.34	9	19.10	0.24
1999-00	18.48	10	18.30	0.18
2000-01	18.25	11	17.50	0.75
2001-02	17.5	12	16.70	0.80
2002-03	16.58	13	15.90	0.68
2003-04	15.28	14	15.09	0.19
2004-05	14.92	15	14.29	0.63
2005-06	14.01	16	13.49	0.52
2006-07	12.09	17	12.69	-0.60
2007-08*	10.38	18	11.89	-1.51
2008-09**	9.7	19	11.09	-1.39

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram 2. Output of MS EXCEL
* Provisional Figure ** Quick Estimate

Figure 2.42
Percentage of Agriculture Income in SDP at Constant Prices (1990-91 to 2008-09) - Kerala
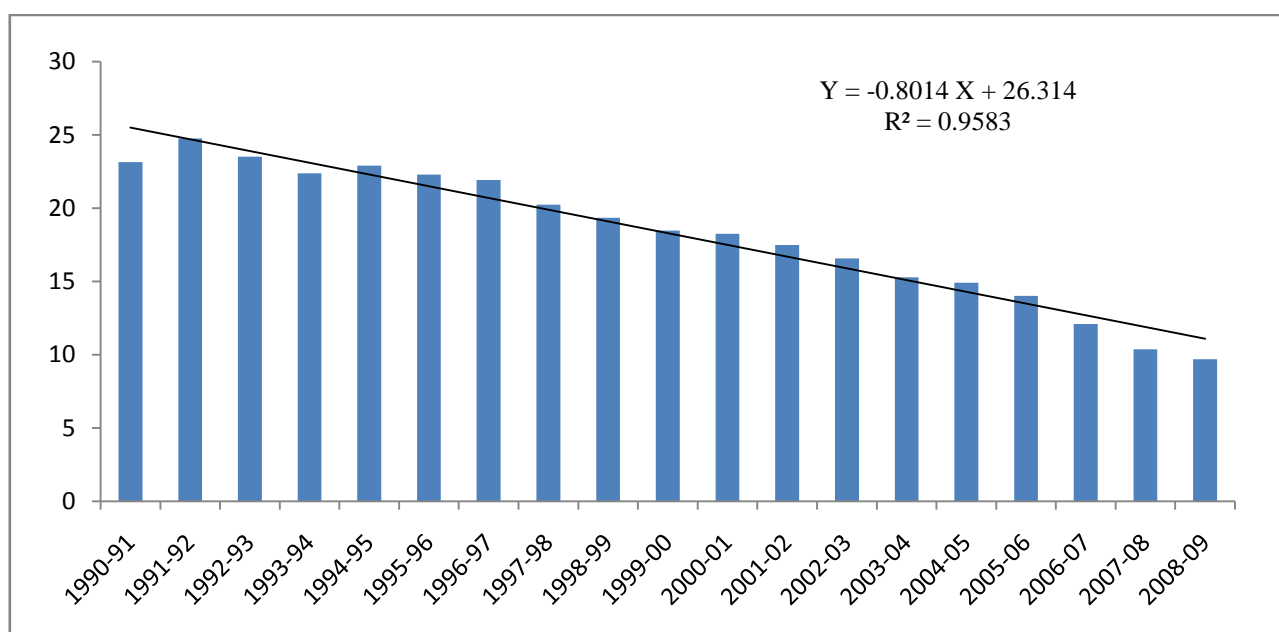

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Table 2.59
Projected Percentage of Agriculture Income in SDP at Constant Prices (2011-12 to 2019-20) - Kerala

(In crore)

Year (X)	Trend Equation, Y = -0.8014 X + 26.314	
	Value of X	*Projected Value of Y (% of Agricultural Income)*
2011-12	22	8.68
2012-13	23	7.88
2013-14	24	7.08
2014-15	25	6.28
2015-16	26	5.48
2016-17	27	4.68
2017-18	28	3.87
2018-19	29	3.07
2019-20	30	2.27

Source: Output of MS EXCEL

2.17 Percentage of Nominal Agricultural Income in SDP: Kerala

In contrast to the increasing trend in nominal agricultural income, the percentage contribution of nominal agriculture income in SDP had shown a decreasing trend. The percentage contribution was 20.83 in 1990-91, which came down to 11.72 per cent in 2008-09. By following the criteria for the selection of trend line, an exponential trend equation $Y = 26.935 e^{-0.042X}$ is estimated with a coefficient of determination of 0.9112 (See: Table 2.60 and Figure 2.42).

The 91.12 per cent best fitted line is used for extrapolating the percentage share of nominal agricultural income in SDP. The expected share is eleven per cent in 2011-12, nine per cent in 2015-16 and eight per cent in 2019-20. Projected values are given in Table 2.61.

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Table 2.60
Percentage of Agriculture Income in SDP at Current Prices (1990-91 to 2008-09) - Kerala

Year (X)	% of Income (Y)	Trend Equation, $Y = 26.935e^{-0.042X}$		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	20.83	1	25.83	-5.00
1991-92	25.6	2	24.76	0.84
1992-93	22.93	3	23.75	-0.82
1993-94	22.59	4	22.77	-0.18
1994-95	23.03	5	21.83	1.20
1995-96	23.43	6	20.94	2.49
1996-97	22.77	7	20.07	2.70
1997-98	20.46	8	19.25	1.21
1998-99	18.77	9	18.46	0.31
1999-00	18.48	10	17.70	0.78
2000-01	15.72	11	16.97	-1.25
2001-02	15.36	12	16.27	-0.91
2002-03	15.23	13	15.60	-0.37
2003-04	14.63	14	14.96	-0.33
2004-05	13.7	15	14.35	-0.65
2005-06	13.53	16	13.76	-0.23
2006-07	13.49	17	13.19	0.30
2007-08*	12.41	18	12.65	-0.24
2008-09**	11.72	19	12.13	-0.41

Source: 1.Directorate of Economics and Statistics, Thiruvananthapuram   2. Output of MS EXCEL
** Provisional Figure ** Quick Estimate*

Figure 2.43
Percentage Agriculture Income in SDP at Current Prices (1990-91 to 2008-09) - Kerala
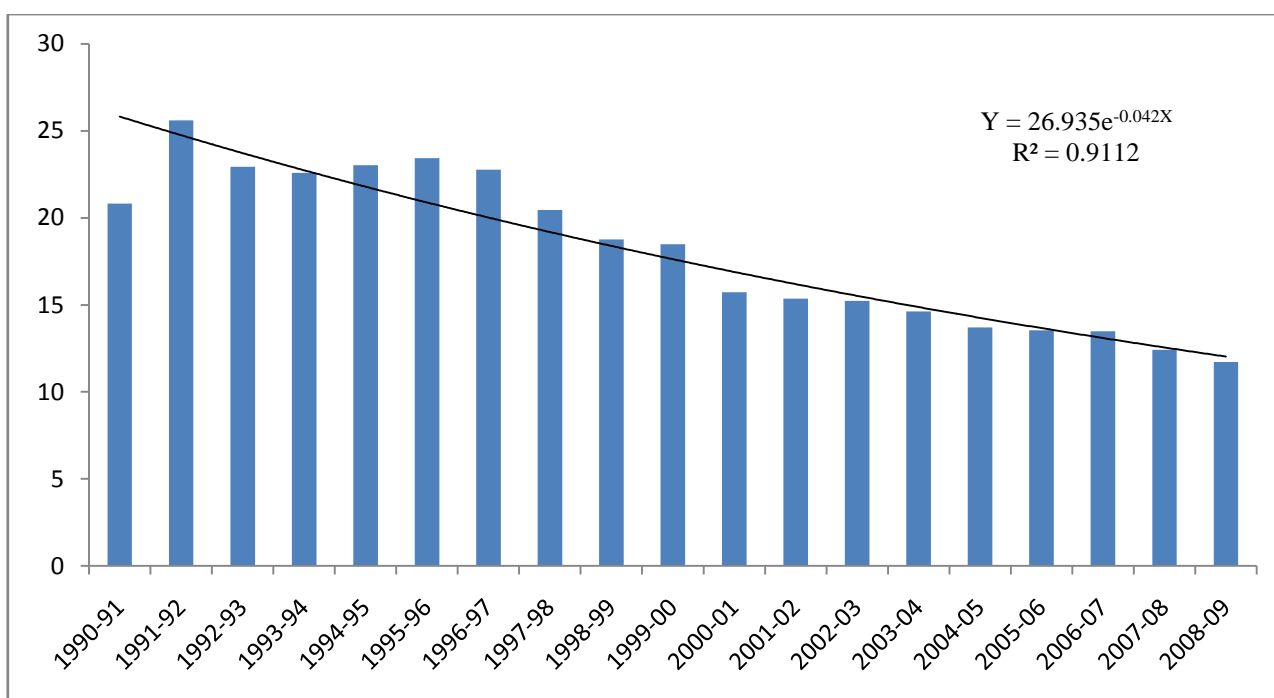

$Y = 26.935e^{-0.042X}$
$R^2 = 0.9112$

Table 2.61
Projected Percentage of Agriculture Income in SDP at Current Prices (2011-12 to 2019-20) - Kerala

(In crore)

Year (X)	Trend Equation, $Y = 26.935e^{-0.042X}$	
	Value of X	*Projected Value of Y (% of Agricultural Income)*
2011-12	22	10.69
2012-13	23	10.25
2013-14	24	9.83
2014-15	25	9.43
2015-16	26	9.04
2016-17	27	8.67
2017-18	28	8.31
2018-19	29	7.97
2019-20	30	7.64

Source: Output of MS EXCEL

2.18 Real Agricultural Income: India

The real agricultural income of the Indian Economy was ₹ 311500 crore in 1990-91, which increased to ₹ 511274 crore in 2007-08 so that the percentage increase over these periods was 64.13. Compared to this percentage increase, the percentage increase in agricultural income of Kerala were only 30.23 from 1990-91 to 2008-09. The percentage contribution of agricultural income of the state to national agricultural income was 3.23 in 1990-91 and 2.57 in 2007-08. Hence in terms of percentage share also the contribution of state agricultural income to national agricultural income was   also declining over the past two decades.

A straight line trend equation is fitted to the data on national agricultural income. The estimated equation is Y = 10991 X + 291947. This equation explains 95.18 per cent of the total variation of the observed data with a positive slope of 10991 (See: Table 2.62). Hence it is observed that the trend of national agricultural income is on an increasing path while the state agricultural income is on a decreasing path. Hence utmost attention is to be ensured from the policy decision-makers for correcting the declining trend in the real agricultural income of the state economy.

Table 2.62
Agriculture Income at Constant Prices with 1999-00 as the Base (1990-91 to 2007-08) - India

(In crore)

Year (X)	Agricultural Income (Y)	Trend Equation, Y = 10991X + 291947		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	311500	1	302938.00	8562.00
1991-92	304301	2	313929.00	-9628.00
1992-93	325777	3	324920.00	857.00
1993-94	336136	4	335911.00	225.00
1994-95	352069	5	346902.00	5167.00
1995-96	348626	6	357893.00	-9267.00
1996-97	384886	7	368884.00	16002.00
1997-98	373446	8	379875.00	-6429.00
1998-99	400030	9	390866.00	9164.00
1999-00	409660	10	401857.00	7803.00
2000-01	407176	11	412848.00	-5672.00
2001-02	433475	12	423839.00	9636.00
2002-03	398206	13	434830.00	-36624.00
2003-04	441360	14	445821.00	-4461.00
2004-05	441647	15	456812.00	-15165.00
2005-06	467984	16	467803.00	181.00
2006-07	487010	17	478794.00	8216.00
2007-08*	511274	18	489785.00	21489.00

Source: 1. CMIE-2009&2010, Economic Survey (2009-10) 2. Output of MS EXCEL
* Provisional Figure

Figure 2.44
Agriculture Income at Constant Prices with 1999-00 as the Base (1990-91 to 2007-08) - India

(In crore)

Y = 10991 X + 291947
R² = 0.9518

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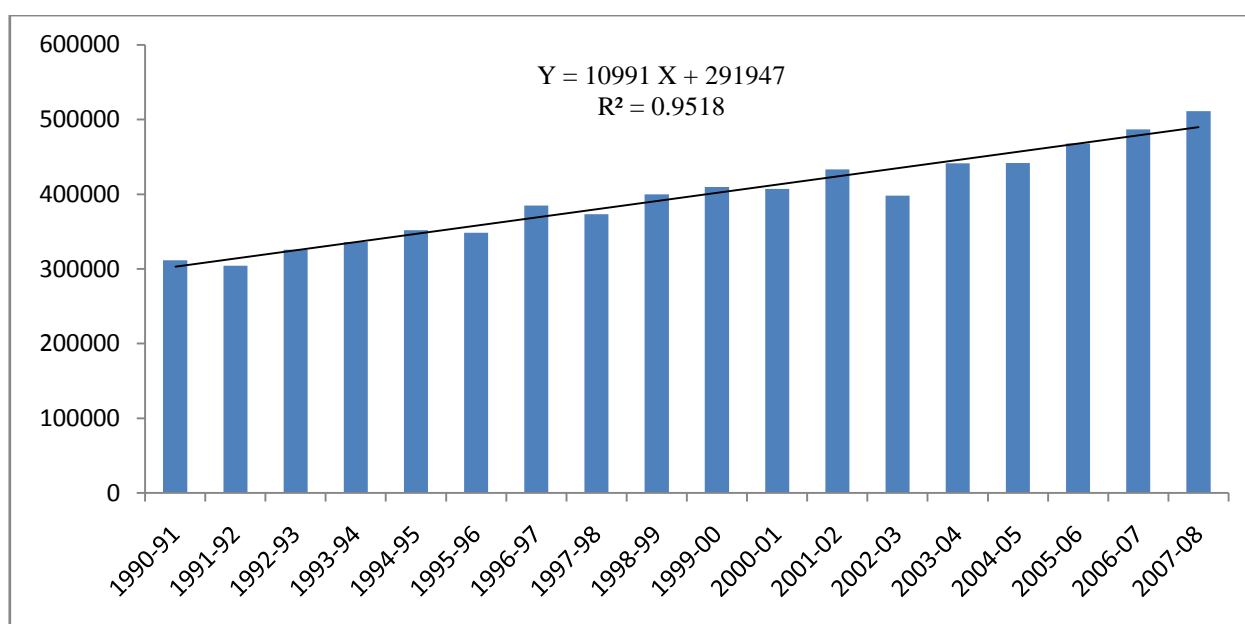
The extrapolated figures on the value of national agricultural output are given in Table 2.63. The expected national agricultural income is ₹ 533749 crore in 2011-12, ₹ 577713 crore in 2015-16 and ₹ 621677 crore in 2019-20. A gradual and sustained increase in national agricultural income is visualised in the future periods in terms of extrapolated values.

Table 2.63
Projected Agriculture Income at Constant Prices with 1999-00 as the Base (2011-12 to 2019-20) - India

(In crore)

Year *(X)*	Trend Equation, Y = 10991 X + 291947	
	Value of X	*Projected Value of Y* *(Agricultural Income)*
2011-12	22	533749.00
2012-13	23	544740.00
2013-14	24	555731.00
2014-15	25	566722.00
2015-16	26	577713.00
2016-17	27	588704.00
2017-18	28	599695.00
2018-19	29	610686.00
2019-20	30	621677.00

Source: Output of MS EXCEL

2.19 Nominal Agricultural Income: India

The national agricultural income at current prices was ₹ 137925 crore in 1990-91 and ₹ 718278 crore in 2007-08. Hence the increase over the reference period is 420.77 per cent in contrast to the increase of real agricultural income by 64.13 per cent. That is, this hike in the figures of nominal agricultural income amply reveals the price rise of agricultural products during the study period. Here also noted that from 1990-91 to 2008-09 the nominal agricultural income of the state had been increased by 474.43 per cent. That is, the percentage increase in real agricultural income of the state is less than the national figure while the percentage increase in nominal agricultural income of the state is greater than the national figure. Hence it could be inferred that the price rise of agricultural products in Kerala is much higher than that of India as a whole.

A straight line trend equation of the form of Y = 3023 X + 91209 is fitted with a coefficient determination of 0.9659. The trend values along with the elimination of short term fluctuations are given in Table. 2.64

Table 2.64
Agriculture Income at Current Prices (1990-91 to 2007-08) - India

(In crore)

Year (X)	Agricultural Income (Y)	Trend Equation, Y = 30232 X + 91209		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	137925	1	121441.00	16484.00
1991-92	162403	2	151673.00	10730.00
1992-93	181799	3	181905.00	-106.00
1993-94	201518	4	212137.00	-10619.00
1994-95	241990	5	242369.00	-379.00
1995-96	263446	6	272601.00	-9155.00
1996-97	318410	7	302833.00	15577.00
1997-98	334713	8	333065.00	1648.00
1998-99	386922	9	363297.00	23625.00
1999-00	409660	10	393529.00	16131.00
2000-01	408932	11	423761.00	-14829.00
2001-02	442464	12	453993.00	-11529.00
2002-03	425521	13	484225.00	-58704.00
2003-04	483030	14	514457.00	-31427.00
2004-05	501415	15	544689.00	-43274.00
2005-06	567897	16	574921.00	-7024.00
2006-07	625161	17	605153.00	20008.00
2007-08*	718278	18	635385.00	82893.00

Source: 1. CMIE-2009&2010, Economic Survey (2009-10) 2. Output of MS EXCEL
* Provisional Figure

The projected values of the nominal agricultural income of the national economy are given in Table 2.63. The expected income is ₹ 756313 crore in 2011-12, ₹ 877241 crore in 2015-16 and ₹ 998169 crore in 2019-20.

Figure 2.45
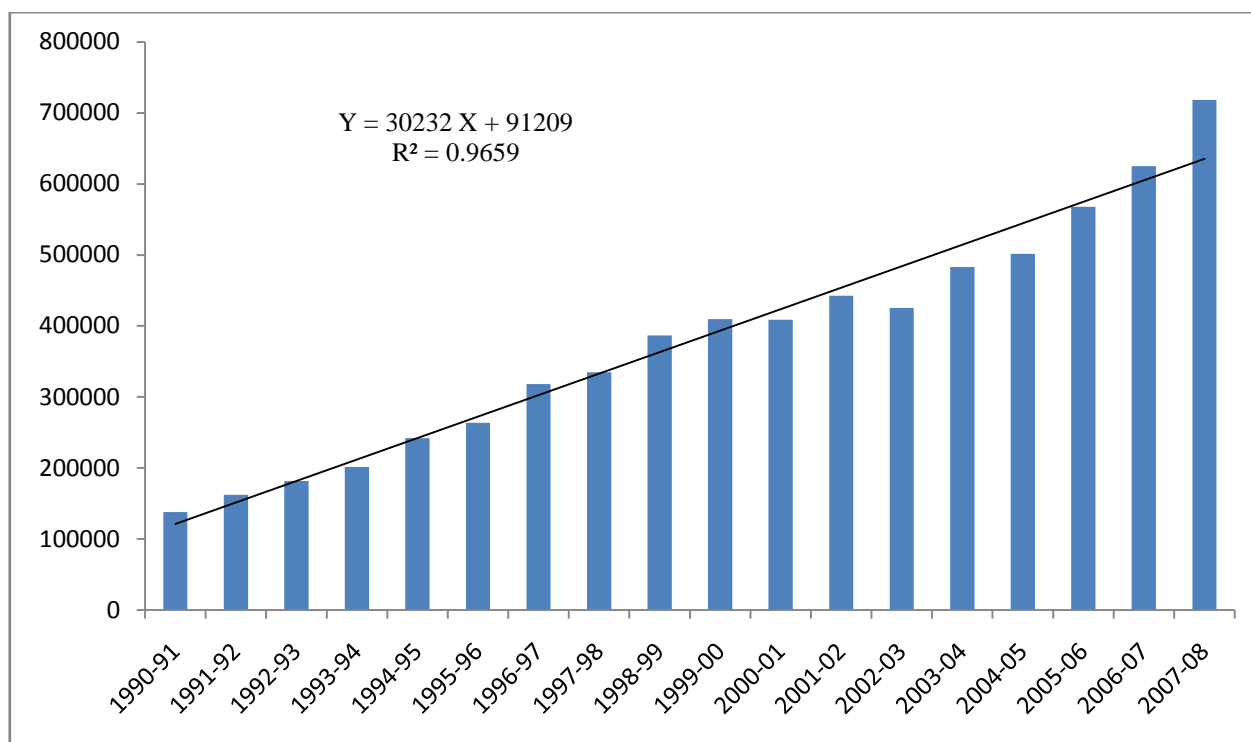**Agriculture Income at Current Prices (1990-91 to 2007-08) - India**

$Y = 30232\ X + 91209$
$R^2 = 0.9659$

Table 2.65
Projected Value of Agriculture Income at Current Prices (2011-12 to 2019-20) - India

(In crore)

Year (X)	Trend Equation, Y = 30232 X + 91209	
	Value of X	*Projected Value of Y (Agricultural Income)*
2011-12	22	756313.00
2012-13	23	786545.00
2013-14	24	816777.00
2014-15	25	847009.00
2015-16	26	877241.00
2016-17	27	907473.00
2017-18	28	937705.00
2018-19	29	967937.00
2019-20	30	998169.00

Source: Output of MS EXCEL

2.20 Percentage of Real agricultural Income in GDP

The share of agriculture in national income is often taken as an indicator of economic development. Normally developed countries are less dependent on agriculture as compared to

developing countries. For example, in the U.K. agriculture contributes only 0.9 per cent of the national income in 2010, in the U.S.A it is 1.2 per cent in 2007, in Canada it is 1.58 per cent in 2007, in Australia it is four per cent and so on. But agriculture sector contributes a large share to the national income of India. The distribution of national income as industrialisation started from 1950-51 to 1979-80 shows that the share of various agricultural commodities, animal husbandry and other activities has always been more than forty per cent. As a matter of fact, during the fifties it contributed around half of the national income. In the sixties and seventies its contribution, though it has shown a fall, has been more than forty four per cent. During the eighties and later, a further fall in this proportion is indicated. During 1990-91 it stood at about thirty three per cent.

The percentage of real agricultural income in real GDP was 32.19 per cent in 1990-91 and this came down to 18.49 per cent in 2007-08. Compared to this, the percentage of real agricultural income of the state in real SDP was 23.14 in 1990-91, which came down to 10.38 per cent in 2007-08. Hence it could be noted that this decline in percentage contribution of real agriculture income in real domestic product is the same (around 13 %) in the case of national as well as state figure. A straight line trend equation $Y = -0.8329\,X + 33.749$ is fitted to the data on percentage of agricultural income in GDP at constant prices and this estimated line explains 98.13 per cent of the total variation of the observed data. Details in this regard are given in Table 2.66 and Figure 2.46.

Here it is noteworthy to point out that the slope of the trend line of the national as well as the state figure is -0.83 so that the decline in the percentage contribution of agriculture income to domestic income in real terms is same with regard to the national as well as the state economy.
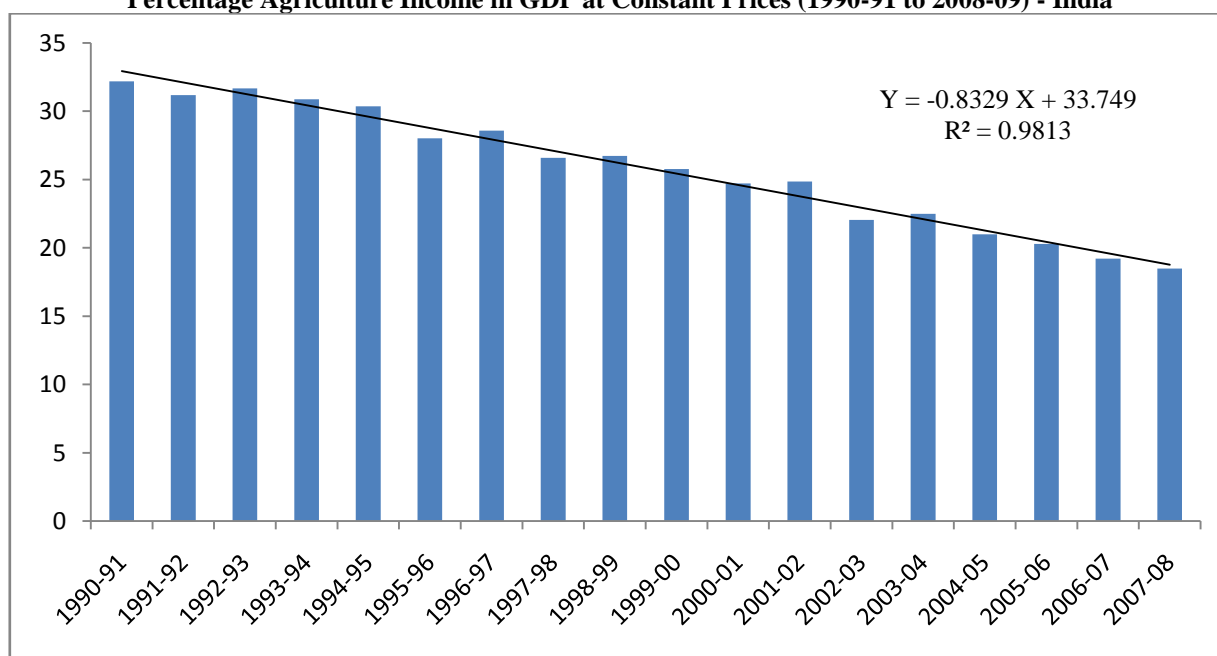
Table 2.66
Percentage Agriculture Income in GDP at Constant Prices (1990-91 to 2008-09) - India

Year (X)	% of Income (Y)	Trend Equation, Y = -0.8329 X + 33.749		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	32.19	1	32.92	-0.73
1991-92	31.17	2	32.08	-0.91
1992-93	31.67	3	31.25	0.42
1993-94	30.87	4	30.42	0.45
1994-95	30.37	5	29.58	0.79
1995-96	28.03	6	28.75	-0.72
1996-97	28.59	7	27.92	0.67
1997-98	26.6	8	27.09	-0.49
1998-99	26.72	9	26.25	0.47
1999-00	25.77	10	25.42	0.35
2000-01	24.71	11	24.59	0.12
2001-02	24.86	12	23.75	1.11
2002-03	22.04	13	22.92	-0.88
2003-04	22.5	14	22.09	0.41
2004-05	20.98	15	21.26	-0.28
2005-06	20.28	16	20.42	-0.14
2006-07	19.22	17	19.59	-0.37
2007-08*	18.49	18	18.76	-0.27

Source: 1. CMIE-2009&2010, Economic Survey (2009-10) 2. Output of MS EXCEL
* Provisional Figure

Figure 2.46
Percentage Agriculture Income in GDP at Constant Prices (1990-91 to 2008-09) - India

$$Y = -0.8329 X + 33.749$$
$$R^2 = 0.9813$$

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The projected figure on the percentage of agricultural income in GDP at constant prices is given in Table 2.67. The expected percentage is 15.43 in 2011-12, 12.09 in 2015-16 and 9.59 in 2019-20. This trend of the declining share of agriculture can be attributed to the following reasons:

i.   Government's economic policy has opened up scope for industrialisation and more so with the new liberalised economic policies.

ii.   Excess population in the rural areas have begun to realise the futility of seeking job in the rural sector, which is already overcrowded. As a result, they began to migrate urban areas, thereby, reducing the dependence upon agriculture.

iii.   Uncertain rain and lack of irrigation facilities have urged the farmers to seek job in manufacturing sector.

iv.   Agro-industries have made inroads into rural sector, thereby enabling villagers to find alternative source of living other than cultivation of land.

v.   Government's endeavour to promote literacy has made the people to realise the stark realities of too much dependence upon agricultural sector.

Table 2.67
Projected Percentage of Agriculture Income in GDP at Constant Prices (2011-12 to 2019-20) - India
(In crore)

Year *(X)*	Trend Equation, Y = -0.8329 X + 33.749	
	Value of X	*Projected Value of Y* *(% of Agricultural Income)*
2011-12	22	15.43
2012-13	23	14.59
2013-14	24	13.76
2014-15	25	12.93
2015-16	26	12.09
2016-17	27	11.26
2017-18	28	10.43
2018-19	29	9.59
2019-20	30	8.76

Source: Output of MS EXCEL

This gradual percentage decline of real agricultural income in real GDP explains the development of the economy in terms of structural and occupational changes. In the light of the above reasons, the share of the secondary sector and tertiary sector is slowly increasing.

2.21 Percentage of Nominal Agricultural Income in GDP: India

The percentage of nominal agricultural income in nominal GDP was 30.22 in 1990-91, which declined to 18.96 per cent in 2007-08. Hence the absolute decline was 11.26 per cent. Compared to this, in the case of Kerala economy the decline was 9.11 per cent from 1990-91 to 2008-09. The estimated trend equation for the national figure is Y = -0.7834 X + 32.662 with coefficient of determination of 0.9613. Details are given in Table 2.68 and Figure 2.47.
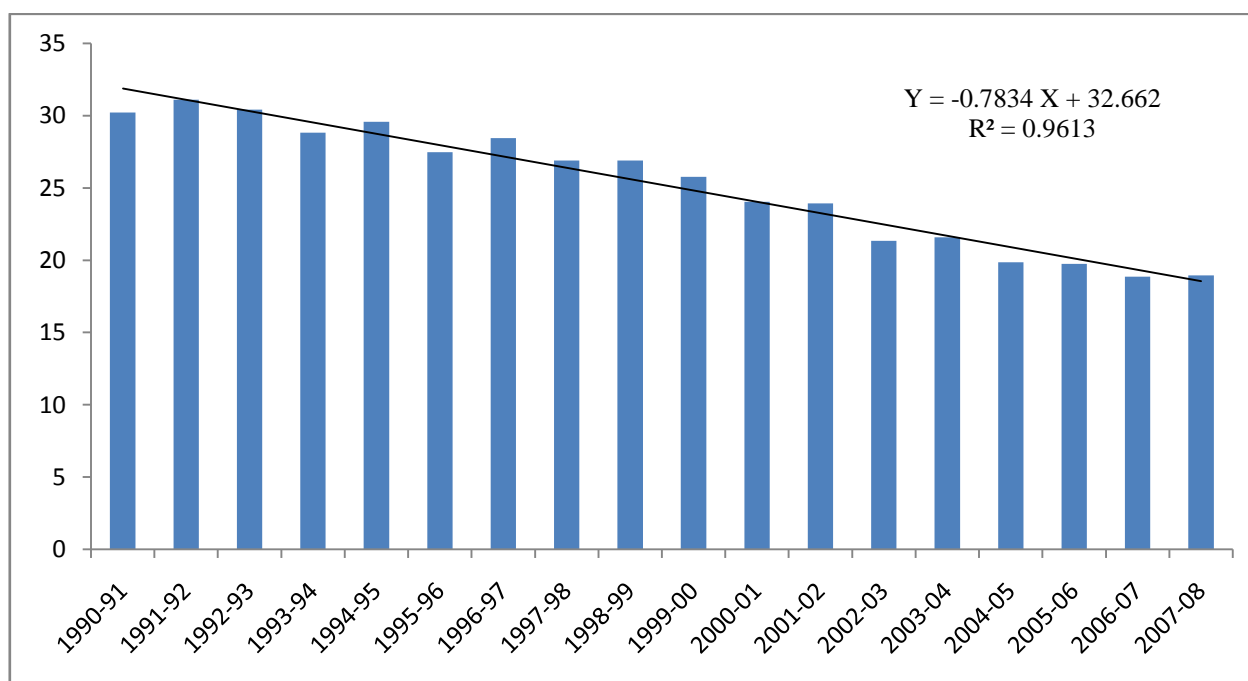
Table 2.68
Percentage of Agriculture Income in GDP at Current Prices (1990-91 to 2008-09) - India

Year (X)	% of Income (Y)	Trend Equation, Y = -0.7834 X + 32.662		Elimination of Trend
		Value of X	Trend Values	
(1)	*(2)*	*(3)*	*(4)*	*(5=2-4)*
1990-91	30.22	1	31.88	-1.66
1991-92	31.1	2	31.10	0.00
1992-93	30.41	3	30.31	0.10
1993-94	28.82	4	29.53	-0.71
1994-95	29.57	5	28.75	0.83
1995-96	27.48	6	27.96	-0.48
1996-97	28.45	7	27.18	1.27
1997-98	26.89	8	26.39	0.50
1998-99	26.89	9	25.61	1.28
1999-00	25.77	10	24.83	0.94
2000-01	24.05	11	24.04	0.01
2001-02	23.93	12	23.26	0.67
2002-03	21.34	13	22.48	-1.14
2003-04	21.59	14	21.69	-0.10
2004-05	19.85	15	20.91	-1.06
2005-06	19.75	16	20.13	-0.38
2006-07	18.87	17	19.34	-0.47
2007-08*	18.96	18	18.56	0.40

Source: 1. CMIE-2009&2010, Economic Survey (2009-10) 2. Output of MS EXCEL
* Provisional Figure

Figure 2.47
Percentage of Agriculture Income in GDP at Current Prices (1990-91 to 2008-09) - India

The expected percentage of agricultural income in GDP at current prices is given in Table 2.69. The expected percentage is 15.43 in 2011-12, 12.29 in 2015-16 and 9.16 in 2019-20. Hence it is inferred that the percentage of agricultural income in terms of real and nominal terms is around nine per cent in 2019-20.

Table 2.69
Projected Percentage of Agriculture Income in GDP at Current Prices (2011-12 to 2019-20) - India
(In crore)

Year (X)	Trend Equation, Y = -0.7834 X + 32.662	
	Value of X	*Projected Value of Y (% of Agricultural Income)*
2011-12	22	15.43
2012-13	23	14.64
2013-14	24	13.86
2014-15	25	13.08
2015-16	26	12.29
2016-17	27	11.51
2017-18	28	10.73
2018-19	29	9.94
2019-20	30	9.16

Source: Output of MS EXCEL

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Chapter III

Findings and Suggestions

Kerala is a small state with high density of population and agriculture is the major source of livelihood. During the sixties, the state is well known for its produces like paddy, coconut and tapioca but at the end of eighties the area of food crops were shifted to plantations and cash crops. Total reduction in the area of food crops had resulted in substantial decline in the production of the major traditional food crops such as paddy and tapioca. A number of industries like coir, cashew processing, oil mills etc are depending on agriculture for their raw materials. During the past decades, agriculture sector contributed a major share of state domestic income. The percentage contribution of agriculture income to SDP was steady up to the mid seventies and began to decline considerably. In this context, the study is confined to time series analysis of the trend in area under cultivation, production and productivity of major agriculture crops.

The following specific objectives were framed for the study:

1. To analyse the trend in area, production and productivity of major crops viz paddy, tapioca, pepper, ginger, turmeric, banana and other plantains in the state.
2. To analyse the trend in area, production and productivity of plantation crops like rubber, tea, coffee, cashew, coconut, cardamom and areca nut in the state.
3. To analyse the trend in agriculture income of the state.
4. To analyse and compare the trend in agriculture income of Kerala with the national trend.

In order to analyse the trend in agriculture production, area brought under cultivation and productivity of major crops, time series on agriculture production data of

twenty years were used with 1990-91 as the base. Statistical methods such as simple bar diagram, trend lines (linear, polynomial, logarithmic, power and exponential), percentages, growth rates, coefficient of determination etc were used for the analysis. The findings and suggestions evolved out of the study are summarised below:

3.1 Paddy

The area under paddy cultivation in Kerala had continuously decreased over the past twenty years and this amply shows a clear decreasing trend. Fifty eight per cent of the area, which was once brought for the cultivation of paddy production, is now being used for some other purposes. The major reasons for declining area under paddy cultivation are conversion of paddy fields into horticultural crops and non-agricultural purposes. Urbanisation, lack of modern technical know-how, migration of labour from other states and increasing cost of labour for cultivation are the other reasons. The expected area for cultivation of paddy during 2011-12 is 201311 ha and in 2019-20 it is estimated to be 134942 ha only. Hence time bound policy measures such as special paddy packages in selected districts are to be needed. Farm insurance and crop insurance should be made compulsory. More importance is to be given to extend irrigation facilities in various parts of the state and also should introduce new improved rice-cropping pattern.

Production of paddy indicates increasing trend with up and down. A fifty eight per cent decrease in the area for paddy production caused only a fifty five per cent decrease in yield. This difference was due to the art of improved agriculture activities, which resulted in substantial improvement in the productivity of paddy. In 2011-12, the expected production of paddy is 575090 tonnes, in 2015-16 it is estimated to be 600610 tonnes and in 2019-20, it is worked out to be 668430 tonnes. Suggestions for improving paddy production in the state are:

- Importance should be given to co-operative farming.

- More importance should be given to post harvest facilities.

- Special packages should be announced for reducing cost of paddy cultivation.

- Due importance should be given to improved technology.

- Made available high yielding varieties of improved seeds to all farmers.

- Modern fertilisers should be made available at subsidised rate.

- Irrigation facility should be extended to all farms.

- Introduce new scientific pest control strategies.

Productivity data of paddy in Kerala shows a marginal increase over the past ten years so that it had indicated an increasing trend. The main reasons for this are the impact of technological change on rice yield due to the effective implementation of schemes like National Agricultural Development Programme and National Food Security Mission, and also due to supply of good quality seeds to farmers. The expected productivity of paddy is 2661 kg/ha in 2011-16, 2964 kg/ha in 2015-16 and it is 3321 kg/ha in 2019-20.

3.2 Tapioca

The area under tapioca cultivation in Kerala shows a downward trend. Major reasons for the declining trend are urbanisation, increased cost of labour, uncertainty regarding product pricing and weak marketing strategies. The policies and programmes extended so far for tapioca cultivation were also weak. Sub division & fragmentation and lack of credit availability to small farmers further aggravated the problem. Projected area for the cultivation of tapioca is 73013 ha in 2011-12, 61633 ha in 2015-16 and it is estimated to be 50789 ha in 2019-20. For fetching more land area for tapioca cultivation, the management conditions over the cultivable lands should be standardised and promote regulated markets to ensure better price.

The production status of tapioca in Kerala had shown wider fluctuations. Suggestions for improving tapioca production in the state are:

- New high yielding varieties of plants should be promoted.

- More importance should be given to proper manuring.

- Government should impart training on scientific management for tapioca cultivation.

- Pest and disease resistant variety of tapioca should be promoted for small scale and large scale cultivation.

- Eliminate market uncertainty.

- More concentration should be given to value added products.

- Find new foreign markets.

Productivity of tapioca in Kerala shows an increasing trend over the past twenty years. Reasons for increasing trend in productivity of tapioca in the state are attributed to better climatic conditions, availability of good quality fertilisers and good crop management. Expected productivity of tapioca is 35644 kg/ha in 2011-12 and 49579 in 2019-20.

3.3 Pepper

The area under pepper cultivation in Kerala shows random fluctuations. Suggestions to expand pepper cultivation area in the state are government should procure the product from sub markets, pepper cultivation should be extended to all coconut farms and cost of production should be reduced. Comprehensive farm and family insurance of the farmers should also be given due importance.

The data about pepper production in Kerala shows wide fluctuation. The very poor and declining performance of pepper production in the state is attributed to high price fluctuations, increased cost of labour, market uncertainty, lack of proper manuring, poor marketing facilities and lack of processing industries & warehousing facilities in rural areas. Even though there was an increase of around two per cent in the area of cultivation, the production fell down by around nineteen per cent. This negative correlation was the result of decrease in the productivity of pepper over the same period. The following are the suggestions for improving pepper production in the state:

- Update the technique of cultivation.

- Introduce and made available new hybrid varieties of pepper plant.

- Encourage mixed farming.

- Risk coverage and safety net aspects should be provided to farmers.

- More credit facilitates should be given to farmers.

- More importance should be given to post harvesting facilities.

- More subsidies should be given for reducing cost of cultivation.

- Appropriate measures should be taken for increasing the area under cultivation.

Random fluctuation is observed on the productivity of pepper. The following are the suggestions for raising pepper productivity:

- Encourage pepper cultivation by providing subsidised inputs.

- Government should procure the pepper through regulated shops and ensure fair price.

- Irrigation should be extended to both small and large scale pepper farms.

- Importance should be given to soil checking before applying fertilisers.

- Ensure better harvest and storage facility.

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- Special policies should be framed for pepper marketing.

- Produce more value added products using pepper and encourage both internal and external trade.

3.4 Ginger

The area under ginger cultivation had decreased drastically over the past twenty years. The decrease in the cultivated land for ginger accounts more than fifty per cent and as a consequence production decreased to the extent of thirty seven per cent only because of the increase in productivity during the same periods. Productivity of ginger in the state shows an increasing trend. The following are the suggestions to increase ginger production:

- Encourage large scale farming.

- Government should encourage subsidised farming.

- Coverage should be given to farm insurance.

- Avoid frequent price fluctuations of ginger.

- Introduce better marketing system.

- Encourage co-operative farming.

- Good quality fertilisers are made available at cheap rate.

- Introduce better storage facility.

- Introduce new and improved training programmes.

- Strengthen the post harvest management facilities.

3.5 Turmeric

Turmeric cultivation in Kerala shows some random fluctuations. The decrease in the area of cultivation is attributed to small scale cultivation and poor irrigation facilities.

In order to bring more land area for the cultivation of turmeric, encourage group farming & modern irrigation facilities, special packages should be announced for cultivation and subsidised inputs should be made available to turmeric cultivators.

In order to ensure more production in the state, the state should introduce effective export promotional measures. Better fertilisers should also be made available to the farmers.

Productivity of turmeric shows a better performance and data on productivity had showed a systematic trade cycle. The better productivity level is due to better crop management, low cost of cultivation, the intervention and supervision of more domestic labour.

3.6 Banana and other Plantains

The percentage increase in the area of cultivation from 1990-91 to 2009-10 was 51.03. This is due to the simple reasons that small farmers are largely concentrated on banana cultivation, small plots can also be taken for banana cultivation and price of banana is comparatively low volatile so that the farmers get better price. Increasing day to day domestic demand for value added products of banana is another major reason. However, the trend in the area of cultivation had showed a slight decreasing trend. Expected area for the cultivation of banana and other plantains in 2011-12 is 110400 ha and 98591 ha in 2019-20. That is, declining trend will be occurred on the area of cultivation of banana and other plantains. The expected decrease from 2011-12 to 2019-20 is around eleven per cent. Hence measures are needed to counteract the declining trend in the area of cultivation.

Banana production in Kerala is not uniform over the past ten years. This is due to the factors that available irrigation in the state is not adequate, large scale cultivation is low and pest attack is very high in small scale banana cultivation. Adequate irrigation facilities to the cultivable land should be ensured and protect farm from attack of pests to raise the production of banana and other plantains.

No cyclical or seasonal fluctuations or secular trend was observed on the data of productivity of banana and other plantains, but fluctuations were due to random elements. The major reason for this is due to sub division fragmentation of agricultural farm. Small plots used for cultivation had reduced the productivity of banana. Too much rain in short periods and prolonged drought are the another major causes for the low productivity. In Kerala, the farmers are highly concentrated in organic cultivation but natural fertilisers limit the productivity. Another reason for low productivity is people are giving lesser importance in re-planting the plantation. For improving banana productivity in the state, new high yielding variety plants should be introduced, good quality scientific fertilisers should be made available to farmers at cheap rate, introduce modern irrigation facilities and to provide new means to filter down the scientific knowledge of cultivation to farmers.

3.7 Rubber

Area brought under the cultivation of rubber amply revealed an increasing linear trend. This is due to the high and increasing price of rubber. The expected area for the cultivation of rubber in 2011-12 is 528156 ha, in 2015-16, it is 548199 ha and in 2019-20, it is expected to be 568241 ha.

Production data on rubber also clearly revealed an increasing trend. Increased rubber production in the state is due to better price of the product, rubber cultivation

requires less hired labour and high yielding variety plantation. The expected production is 856648 tonnes in 2011-12, 955752 tonnes in 2015-16 and 1054856 tonnes in 2019-20.

Rubber productivity in Kerala shows remarkable progress over the past few years. Rubber productivity shows a constant trend. The expected increase in the productivity is 1533 kg/ha in 2011-12, 1551 kg/ha in 2015-16 and 1526 kg/ha in 2019-20. In order to stabilise the increase in productivity, the following suggestions are recommended.

- Introduce new high yielding variety programme.

- Encourage more domestic production and trade.

- Special policies to be needed for the expansion of export sector.

- Dumping of rubber should be legally controlled.

- Multiple cropping reduce soil nutrient. So it should not be promoted.

- More research and innovation can further increase productivity.

- Extend financial support to the needy cultivators.

- Increase the access of credit to rural areas.

- Expands market opportunities.

- More investment should be made in market structure to enhance market efficiency.

3.8 Tea

The area under tea cultivation in Kerala shows a slight increase over the past twenty years. The fluctuations in the area were due to random variations.

The data on tea production shows wider fluctuations. Reasons for poor production performance are attributed to shortage of labour, bad health conditions of cultivators, increased cost of cultivation, poor socio-economic conditions of labourers and pest attack.

The suggestions for expanding tea production in the state are to introduce better fertilisers, subsidies will be made available and special importance should be given to export market.

The productivity data of tea in Kerala shows slight increase and decrease over the past few years. It had also revealed that the fluctuations are due to random elements. The following are the suggestions for raising the productivity of tea:

- Made available better quality fertilisers.

- Supply subsidised inputs to cultivators.

- Ensure price stability.

- Reduce cost of production.

- Promote better post harvest management.

- Introduce better marketing facilities.

3.9 Coffee

The area under coffee cultivation in Kerala remains the same or fluctuates less over the past twenty years. Reasons for the better performance of coffee cultivation are the selling price determination of coffee, which is widely accepted, price fluctuations are less volatile in domestic and international market, and functioning of Coffee Board in the State is appreciable.

Production of coffee in Kerala fluctuates widely over the past twenty years. The following are the suggestions for raising coffee production:

- Ensure price stability in domestic and international market.

- Strengthen research and development to increase production.

- Farmers' Co-operatives should be established.

- Modern marketing system should be organised.

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- Encourage large scale investment in coffee industry.

- Ensure availability of credit through Co-operative farmers' societies and agricultural banks.

- Ensure disciplinary trading system.

The productivity of coffee in Kerala shows wide fluctuations. The following suggestions are recommended for raising the productivity of coffee:

- Encourage large scale farming.

- Ensure fair price for better quality products.

- Credit facility should be made available.

- Encourage fair trade for coffee.

- Proper shading of plantation should be encouraged.

- Coffee has long gestation period which needed sustained investments and efforts.

- Adequate post harvesting and marketing facilities should be made available.

3.10 Cashew nut

The area under cultivation continuously decreased over the past two decades so that a severe decreasing trend is observed. Reasons for decreasing area are farmers in Kerala are mainly concentrated in small scale farming, the low yield from the crop and low yield from small farms badly affected large scale farming also. Projected area for the cultivation of cashew in 2011-12 is 53210 ha, in 2015-16 it is 40934 ha and in 2019-20 it is estimated to be 28658 ha only. Policy makers should consider seriously this declining trend while planning policies for the development of agriculture sector in the state. Suggestions to bring more land for cashew cultivation are importance should be given to large scale cultivation, special farm packages should be introduced, constant awareness

creation on economic potentials and should propagate the health benefits of cashew consumption.

In spite of the increase in the production of cashew in India, production of cashew had shown a declining trend in Kerala over the past decades. The production of cashew nuts drastically falling with drastic shrinking of land brought under cultivation for cashew nuts. Hence a simple and viable remedy to raise the cultivation of cashew in the state is to bring more land for the cultivation of cashew nut or expand plantation of cashew. The following are the suggestions for raising cashew production in the state:

- More value added industrial products should be produced from cashew.

- Proper irrigation and manuring should be done.

- Cashew processing units in Kerala are working at the optimal level and concentrated in Kollam district. So steps should be taken to establish cashew factories in other districts also.

- Standard branding and marketing are required for the product to compete directly in the world market.

- New production technology should be developed through research and development to exploit the production of by-products.

In Kerala, the productivity statistics shows a cyclical trend. This is due to the reasons of lack of awareness on the economic potential of cashew, planting of cashew in marginal and poor fertile land, non- adoption of recommended package of practices, pest infestation leading to yield reduction up to thirty to forty per cent and ageing trees. The following suggestions would be helpful for raising the productivity of cashew:

- Large scale farming should be promoted and encouraged by announcing special packages.

- Phased replanting programmes should be encouraged.

- Organic cashew farming should be encouraged.

- Better marketing and trading system should be promoted.

- More value added products should be produced and exported.

3.11 Coconut

The area under coconut cultivation in Kerala over the last few years had shown a declining trend. The major reasons for this declining trend are majority of coconut farmers are poor and they have only small or marginal land for cultivation, price fluctuation of coconut is very high in the state and lack of storage facility.

The trend of coconut production in the state is commendable over the past ten years and during some years there were some irregular downswings. Suggestions for further improving coconut production in the state are strengthening of irrigation system, promoting high yielding varieties, more importance to comprehensive insurance for farmers, production of more value added products and establishing more coconut processing industries.

Productivity of coconut had commendable progress over the past few years. The productivity of coconut had been gradually increased. The expected productivity of coconut in 2011-12 is 7641 nuts/ha and in 2019-20, it is 9043 nut/ha. Suggestions for further improvement in the productivity of coconut are introduction of high yielding variety programme, introduction of appropriate irrigation facilities and more effective pest control strategies.

3.12 Cardamom

Over the past decades the area under cardamom cultivation in Kerala is more or less the same. People prefer hilly place for cardamom cultivation. Cultivation of cardamom should be extended to lower plains and strengthen the marketing facilities of cardamom.

The production of cardamom in Kerala shows better performance. The production had followed a trade cycle movement. The following are the suggestions for raising cardamom production in the state:

- Drip Irrigation should be strengthened.

- Harvesting should be done in forty five days interval.

- Area under cardamom cultivation should be increased.

- Export market should be strengthened through proper planning.

- Ensure better international price stability for the product.

The productivity of cardamom shows a slight increase over the last few years with some sort of fluctuation. Expected productivity in 2011-12 is 204 kg/ha and in 2019-20, it is worked out to be 156 kg/ha. Hence, decrease in productivity of cardamom over the coming years to be happened so that severe measures are to be planned and executed to fight against this trend. The following suggestions would be helpful for raising the productivity of cashew:

- Introduce modern methods of cultivation.

- Plant protection strategies should be encouraged.

- Good quality fertilisers should be made available to cultivators at cheap rate.

- Harvesting should be done in proper intervals.

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- Cost of cultivation should be reduced.

- Pest attacks should be controlled.

3.13 Areca nut

A positive trend is observed in the cultivated area. The expected percentage of increase from 2011-12 to 2019-20 is 17.47. The expected area under cultivation is 113784 ha in 2011-12, 123724 ha in 2015-16 and 133664 ha in 2019-20.

The areca nut production shows an increasing trend. This tremendous increase is the result of improvement in cultivation, which is due to the favourable climatic conditions. Farmers are able to continue cultivation because the cost of maintaining the crop is comparatively low. The projected production of areca nut in 2011-12 is 154712 tonnes and in 2019-20 it is 212273 tonnes. The expected percentage of increase from 2011-12 to 2019-20 is 37.21. This means that the production of areca nut will be steadily increased in future.

In order to maintain and raise the productivity of areca nut, manuring and irrigation should be extended to all parts of Kerala.

3.14 Real Agricultural lncome: Kerala

The fluctuation in real agricultural income is an indicator of fluctuation in agricultural output. That is, our economy had been witnessed fall in agriculture output in some years compared to the preceding period. This tendency of the economy should be dealt with appropriate policy measures. The expected income in 2011-12 is ₹ 12985 crore, ₹ 11953 crore in 2015-16 and ₹ 10428 crore in 2019-20. There is a declining trend in the real agricultural income of the state. Hence concerted policy measures are to be needed to revive the declining trend.

3.15 Nominal Agricultural Income: Kerala

Nominal agriculture income had been showing an increasing trend. This trend is the outcome of an increasing trend of agriculture commodity prices irrespective of fall in agriculture output in some years. Hence the difference between these two percentage values is the outcome of price rise of agriculture commodities. The expected nominal agriculture income in 2011-12 is ₹ 22774 crore , ₹ 26292 crore in 2015-16, and in 2019-20, it is expected to be ₹ 29810 crore.

3.16 Percentage of Real Agricultural Income in SDP: Kerala

Percentage contribution of real agriculture income in SDP had shown a downward trend. The expected percentage contribution of agricultural income to SDP is 8.68 in 2011-12, 5.48 in 2015-16 and 2.27 in 2019-20. This trend in the share of real agricultural income to SDP reveals the expansion of industrial and service sector of the economy and also change in the occupational structure of the economy. These structural and occupational changes are prime requisites for the development of an economy. Hence this fall in the share of real agricultural income in SDP shows that the state economy is on the path of development process.

3.17 Percentage of Nominal Agricultural Income in SDP: Kerala

In contrast to the increasing trend in nominal agricultural income, the percentage contribution of nominal agriculture income in SDP had shown a decreasing trend. The expected share is eleven per cent in 2011-12, nine per cent in 2015-16 and eight per cent in 2019-20.

3.18 Real Agricultural Income: India

The percentage increase of real agricultural income from 1990-91 to 2007-08 was 64.13. Compared to this, the percentage increase in agricultural income of Kerala were only 30.23 from 1990-91 to 2008-09. In terms of percentage share also, the contribution of state agricultural income to national agricultural income was also declining over the past two decades. Hence it is observed that the trend of national agricultural income is on an increasing path while the state agricultural income is on a decreasing path. Hence utmost attention is to be required from the policy decision-makers for correcting this declining trend of the state economy. The expected national agricultural income is ₹ 533749 crore in 2011-12, ₹ 577713 crore in 2015-16 and ₹ 621677 crore in 2019-20. A gradual and sustained increase in national agricultural income is visualised.

3.19 Nominal Agricultural Income: India

The increase in the nominal agricultural income over the reference period is 420.77 per cent in contrast to the increase of real agricultural income by 64.13 per cent. That is, this hike in the figures of nominal agricultural income amply reveals the price rise of agricultural products. Here also noted that from 1990-91 to 2008-09 the nominal agricultural income of the state had been increased by 474.43 per cent. That is, the percentage increase in real agricultural income of the state is less than the national figure while the percentage increase in nominal agricultural income of the state is greater than the national figure. Hence it could be inferred that the price rise of agricultural products in Kerala is much higher than the national average. The expected income is ₹ 756313 crore in 2011-12, ₹ 877241 crore in 2015-16 and ₹ 998169 crore in 2019-20.

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3.20 Percentage of Real agricultural Income in GDP: India

The percentage of real agricultural income in real GDP was 32.19 per cent in 1990-91 and this came down to 18.49 per cent in 2007-08. Compared to this, the percentage of real agricultural income of the state in real SDP was 23.14 in 1990-91, which came down to 10.38 per cent in 2007-08. Hence it could be noted that this decline in percentage contribution of real agriculture income in real domestic product is the same (around 13 per cent) in the case of national as well as state figure. The slope of the trend line on the national as well as on the state figure is -0.83 so that the decline in the percentage contribution of agriculture income to domestic income in real terms is same in the national as well as in the state economy. The expected percentage is 15.43 in 2011-12, 12.09 in 2015-16 and 9.59 in 2019-20. This gradual percentage decline of real agricultural income in real GDP explains the development of the economy in terms of structural and occupational changes.

3.21 Percentage of Nominal Agricultural Income in GDP: India

The percentage of nominal agricultural income in nominal GDP was 30.22 in 1990-91, which declined to 18.96 per cent in 2007-08. Hence the absolute decline was 11.26 per cent. Compared to this, in the case of Kerala economy the decline was 9.11 per cent from 1990-91 to 2008-09. The expected percentage is 15.43 in 2011-12, 12.29 in 2015-16 and 9.16 in 2019-20. Hence it is inferred that the percentage of agricultural income in terms of real and nominal terms will be around nine per cent in 2019-20.

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