CHAPTER 7
CONCLUSION

This study has focused on the economic and environmental aspects of the changes of cropping pattern in Kerala. It analysed the various issues of the changing cropping pattern in the state such as; inter-temporal changes of cropping pattern among the principal crops, extent of crop diversification, growth trends of area, production and productivity of principal crops, relative contribution of different elements (real and monetary) to the overall growth of output of principal crops, determinants of changes of cropping pattern, the main economic and environmental impact of cropping pattern change, changes of cropping pattern and the sustainability of the agrarian economy, etc. Before embarking upon this study, it was implicitly hypothesized that the state has experienced significant change in the cropping pattern from food crops to non-food crops and from non-food crops to another non-food crops and this has severe economic and environmental impact and adversely affect the sustainability of the agrarian economy of Kerala. The overall conclusion that emerges from the study is that the state witnessed significant change in the cropping pattern from 1960-61 to 2009-10 which adversely affected the environment and the sustainability of the agrarian economy of Kerala.

Over the 50 years from 1960-61 to 2009-10, agriculture in Kerala has shown a degree of change in the cropping pattern. The analysis of cropping pattern shows that the years 1976-77 and 1980-81 marked two important turning points in the cropping pattern. The area under tapioca was at its maximum in 1976-77 and then...
declined continuously and the area under rice was at its peak in 1980-81 and then continuous decline set in. The area under total food crops rapidly declined since 1976-77. Rice and tapioca lost the maximum area during the period while rubber and coconut gained the maximum area. The substitution of rubber and coconut at the cost of rice and tapioca has far reaching implications for food and price policies. The continuous rise in price of food grains and food shortage affect the poor population adversely than before.

The change in cropping pattern has given a new dimension in the last period. The period wise analysis clearly shows that, recently rubber seems to be replacing both food crops and non-food crops among the twelve principal crops selected for the study. District wise analysis of the changes of cropping pattern revealed the same picture presented in the state level analysis. The expansion of rubber and the conversion of food and other non-food crops brought significant change within the farm sector of Kerala.

The inter-temporal analysis of cropping pattern change in Kerala over the years from 1960-61 to 2009-10 under different periods gives the following results.

1. Percentage of area under rice, tea and ginger has decreased and other crops increased during Period I

2. During Period II area under crops (coconut, arecanut, pepper and tea) has shown stability, rice shows fluctuations and all other crops have shown increase.

3. During Period III, IV and V area under rice, tapioca and cashewnut has declined and the area under coconut fluctuated.

4. The year 1976-77 marked a turning point in the cropping pattern after which decline was set in the food crops area.
(5) In the overall period rice, tapioca and cashewnut lost the maximum area, while rubber and coconut gained the maximum area.

(6) Inter-district analysis indicated that the area proportion of food crops decreased and that of non-food crops increased.

(7) Largest fall in area under rice among districts was noted in Thiruvananthapuram and Kozhikkode and the smallest in Alappuzha and Palakkad.

(8) The proportion of rice area ranked first or second in almost all districts during 1960-61 lowered to sixth or seventh place in 2009-10 in majority of the districts; whereas the proportion of area under rubber ranked sixth or seventh place in 1960-61 improved to first or second place and the proportion of area under coconut ranked second place in almost all districts during 1960-61 moved to first place in many districts.

By the calculation of index of crop diversification, the diversities in the cropping pattern can be noticed. The measure of diversification tells about less diversification in the initial years, viz, 1960-61 and 1970-71 and high diversification exists in Kerala and in districts in the later years, viz, 1980-81, 1990-91, 2000-01 and 2009-10. The diversification in cropping pattern mainly towards rubber was noticed during the recent years.

Time series analysis of acreage, production and productivity data of twelve principal crops in Kerala during the five periods and overall period (1960-61 to 2009-10) revealed the performance of major crops in terms of growth of area, production and productivity. The area under rice decreased from 33.16 percent in 1960-61 to 8.77 percent in 2009-10, cashewnut area decreased from 2.31 percent to 1.84 percent, tapioca cropped area decreased from 10.31 percent to 2.80 percent, proportion of tea area decreased from 1.60 percent to 1.38 percent and ginger from
0.51 percent to 0.20 percent of the total cropped area. The area under rubber cultivation on the other hand increased to 19.69 percent in 2009-10 from 5.23 percent in 1960-61, coconut to 29.18 percent from 21.32 percent, arecanut to 3.72 percent from 2.31 percent, pepper to 6.43 percent from 4.25 percent, coffee to 3.18 percent from 0.72 percent, cardamom to 1.56 percent from 1.22 percent and banana to 3.71 percent from 1.89 percent respectively.

The growth trends of area, production and productivity of these crops during the five periods and overall period give the results as follows:

(1) The major food crop rice, shows negative growth rate in area in all the decades except 1960’s; where the highest decline is noted in the fourth period. The decline in area is due to the large scale conversion of area to other crops like coconut and rubber. During the overall period the compound growth rates of area, production and productivity of rice were negative.

(2) Tapioca, another main food crops also followed the same pattern of decline in the growth rate in area under cultivation. In the case of tapioca, the rate of decline was highest in the third period. The tendency of conversion of area under food crops to non-food crops are seen from 1976-77 onwards; the same picture is exhibited here also.

(3) Compound growth rates of area of other crops except rubber shows fluctuating trend in area and production during the different time periods.

(4) Out of the twelve crops analysed eight crops (rice, coconut, pepper, cashewnut, tapioca, tea, cardamom and ginger) shows negative compound growth rates in area and two crops (coffee and banana) recorded less than one percent growth rates per annum during the fifth period (2000-01 to 2009-10). Rubber and arecanut are the
two crops registered significant compound growth rates. This shows that recently (since 2000-01), rubber is replacing food and other non-food crops.

(5) During the overall period rice, tapioca and cashewnut are the three crops which shows negative growth rates in area and production; rice and cashewnut shows negative growth rates both in area, production and productivity.

(6) Except rubber and arecanut, during the fifth period, majority of the crops like that of area shows negative growth rates in production.

(7) Over the fifty years from 1960-61 to 2009-10, out of the twelve crops studied, rubber is the only crop revealed comparatively higher performance in area, production and productivity.

To assess the growth performance of the crops, the growth rate in productivity is to be considered along with area. All the crops considered depicted fluctuating trend in productivity growth rate during the different time periods. Among the sub-periods, in the fifth period, the productivity performance of rice and tapioca increased. This was mainly due to the various programmes implemented in the paddy sector of Kerala. In spite of this the growth trends in production in the state shows declining trend. This dismal production performance of these two food crops in the state are exclusively due to the sharp decline in their area. However, banana and other plantains have showed a positive growth rate in production. The growth performance of this crop is due to the positive rate of growth in area and yield.

The major cash crops, coconut exhibited positive growth rate in yield in the last three periods. Areanaut showed positive growth rate in yield in all the periods. In all periods both in terms of production and yield, the crop rubber presented outstanding performance. Considering the overall period almost all non-food crops displayed better performance than food crops in production and yield.
From the analysis of area, production and productivity of food crops and non-food crops during the overall period, the general conclusions derived are:

(1) The production of major food crops, rice and tapioca reached at a negative growth rates due to the declining trend of their area; but the production rate of banana and other plantains increased due to the increase in area.

(2) Both area and productivity growth rates influenced the production rates of non-food crops. Pepper production growth and growth rate of coconut production was determined more by increase in area. Increase in yield growth rate was responsible for increase in production growth rate of arecanut. Productivity growth rate was responsible for good production growth rate for ginger. Decline in area and yield growth rate was responsible for the negative growth rate in production for cashewnut. For cardamom and tea only yield growth rate is helpful for production growth. In the case of coffee both area and yield growth rates helped the increase in production growth rate. The outstanding performance of rubber in the production growth rate is as a result of the combined growth of area and productivity.

During the study period the highest growth rate in production and area rate is recorded by rubber while arecanut attained the highest productivity growth rate.

The growth of agricultural output in the state like that of other parts of India is influenced by the gross cropped area, productivity and level of prices. The increase in agricultural output is decomposed into real and monetary components. The real component includes area effect, yield effect, cropping pattern effect and interaction effect. The monetary elements consist of the pure price effect, price yield effect, price cropping pattern effect and total interaction effect.
From the analysis of the decomposition of output growth into real and monetary components of Kerala agriculture in the reference period, the general conclusions derived are:

(1) There are fluctuations in the overall growth of crop output in Kerala over different periods.

(2) There is a perceptible increase in the monetary growth and decline in the real growth of crop output in Kerala from period I to period V.

(3) Price factor is the major element in determining the relative contribution of different elements to the growth of crop output.

(4) Overall growth in the Kerala agriculture is monetary growth in nature rather than real growth.

(5) During Period V price yield effect and price cropping pattern effect are positive and high. Corresponding to this among twelve crops, for rubber these two elements are positive and high. This implies that the cropping pattern has shifted in favour of those crops for which money value and yield are high.

(6) Among twelve crops studied during different periods, rubber is the only crop exhibited positive values in all the components in the decomposition analysis.

(7) For all crops during the overall period, the share of monetary components is more than 90 percent for the overall growth of output of these crops compared to real components.

From the analysis of the growth trends of area of principal crops in Kerala over the different periods, it is clearly established that the cropping pattern in the state made a significant change from food crops to non-food crops and recently (since 2000-01) the shift is towards rubber. This change in cropping pattern is mainly due to farmers’ decisions. There must be certain determinants that motivated the farmers
to make such a shift in the cropping pattern. Area response and yield response
models were used to analyse the determinants. The determinants estimated are
lagged area, expected price of the crop, lagged yield, expected yield risk and price
risk, average annual rainfall, irrigated area, etc. Three crops - paddy, coconut and
rubber which covered 57 percent of the total cropped area are considered for this
analysis.

The analysis which covered fifty years time period divided into two sub-
periods and estimated area responses and yield responses of paddy, coconut and
rubber revealed the following results:

(1) In area adjustments, past year’s area, irrigated area and yield risk were found to be
the most significant factors influencing the acreage decision behaviour of paddy
farmers. Past years yield and expected price were the significant factors influencing
the yield response of paddy during the first period. In the second period the risk
factors also turned out to be positively significant, indicating farmers’ decision to
adopt modern technologies to improve the yield of paddy.

(2) For coconut the past years area and irrigated area, rainfall and price risk factors are
the significant variables affecting the area allocation of the crop in Kerala during the
period 1960-61 to 2009-10. For the crop’s yield response, lagged yield, irrigated
area, rainfall and expected price risk are the strong variables.

(3) In the case of rubber, the price variable (expected price and expected price of
competing crop) is the major determining factor in addition to tapped area for area
decision. In the yield response decision, past years yield and rainfall were the
significant variables for rubber. The area response and yield response of rubber
shows that area under rubber was price responsive. Future expectations about price
are the dominating factor governing the acreage decision of rubber in Kerala.
Knowledge about the decision behaviour is crucial and the analysis revealed that non-price factors such as yield risk variables, rainfall, past years area, irrigated area etc, are the significant determinants of farmers behaviour and price played only a nominal role in the case of paddy indicating frequent shift to other crops like coconut and rubber; in the case of rubber price is the dominant governing determinant. Farmers’ decision behaviour is more sensitive in the case of rubber.

At the end of this summary and conclusion emerging from this study, it would be useful to analyse the economic and environmental impact of cropping pattern change and how it affect the sustainability of the agrarian economy of the state.

The economic and environmental impact of cropping pattern change studied in four aspects revealed the following conclusions:

1. The conversion of rice lands decreased the supply of rice in Kerala and widened the supply demand gap of rice. During 1960-61 the shortage of rice was only 40.12 percent of the total demand increased to 83.45 percent in 2009-10. In 2026 the total demand for rice will again increased to 10606.55 thousand tonnes in Kerala.

2. Land degradation another important impact of change in cropping pattern is studied by analysing the soil fertility status (PH status and macro nutrients, NPK) of 36 panchayaths in the Kasaragod district during the period 2000 to 2009. In 2000, 58 percentages of the panchayaths showed 5.6 to 6 percent average PH status, 36 percentages of the panchayaths showed 6.1 to 6.5 percent average PH statuses and the remaining panchayaths showed 6.6 to 7 percent average PH status. During 2009, 97 percent of the panchayaths in the district had low or very low soil PH status (that is, PH below 5 percent). Out of the 36 panchayaths studied 32 had high N, 24 had high P and 4 had high K macro nutrients during 2000; in 2009 the number of panchayaths observed high macro nutrients were 9 for N, one for P and zero for K.
During 2009 for available P and K more than 50 percent of the panchayaths rated low or very low status. Some negative features of the soil fertility status over the years are worth noting. They include (i) nearly 97 percent of the panchayaths studied had low or very low soil PH status, (ii) the available P levels were low or very low in more than 50 percent of the panchayaths, (iii) K nutrients were low or very low in 50 percent of the panchayaths, (iv) P nutrient status was very low in 40 percent of the panchayaths and (v) there is nutrient depletion, decline and acidification in the soil of the panchayaths studied.

(3) Groundwater level changes another important impact was worked out by calculating the average groundwater level (Bore well and Dug well) in the block wise and district wise in the Kasaragod district from 1985 to 2009. The analysis showed decline in the groundwater level over the years in all the blocks. The district level average also shows decline.

(4) Change in cropping pattern and the overuse of chemical fertiliser leads to chemical pollution. Data analysis on the difference between suggested dose and actual used doses of chemical fertilisers of five crops - paddy, coconut, arecanut, banana and rubber revealed that rubber and banana farmers were using overdose of chemical fertilisers and under use of organic manures and lime as suggested compared to other three crops. Paddy, coconut and arecanut farmers were using approximately the same amount of NPK chemical fertilisers as suggested.

There are no quick tests to indicate the sustainability or unsustainability of the crop sector and the agrarian economy. Sustainability has three important components - continued profitability, soil stability overtime and absence of adverse impact on the environment. In this context, the sustainability of the crop sector and the agrarian economy of Kerala analysed in three grounds (that is, decline in soil
fertility status, decrease in the groundwater level and decline in total factor productivity growth) revealed the following results.

(1) Decline in soil fertility status was measured by calculating the average soil fertility status of four crop growing areas (paddy, coconut, arecanut and rubber) for the period 2000 to 2009. The soil fertility status was evaluated by analysing the PH status and NPK status. The analysis revealed that (i) PH status was decreasing over the years in all crop growing areas; but the decline was severe in rubber cropped systems. (ii) The continuous decline of soil health and soil fertility in general and the decline of P and K soil status in particular were observed in the rubber cropped areas compared to other cropped areas.

(2) Decrease in the average ground water level in different crop growing areas has been used to study the extent of groundwater depletion. Average groundwater level in four crop growing areas during 1998 to 2009 revealed that the water level in rubber crop growing areas were very low (below 4 meter) compared to rice, coconut and arecanut.

(3) The performance of the crop sector in Kerala, at the state level and district level measured in terms of total factor productivity growth indicated that except Wayanad, Idukki, Palakkad and Kollam, all other districts and the state as a whole registered negative growth rates during the period 1980-81 to 2008-09. The period wise analysis also derived deceleration in the total factor productivity growth. The percentage share of total factor productivity in output growth of the crop sector is also negative in almost all districts and state.

These negative indicators have primarily arisen as a result of the changing cropping pattern in Kerala experienced in the past years seemed to be more serious and question the sustainability of the agrarian economy of Kerala.
The overall analysis of changing cropping pattern an economic and environmental study on Kerala revealed the following general findings:

(1) Kerala experienced change in cropping pattern during the period 1960-61 to 2009-10.

(2) In the initial years the change was from food crops to non-food crops.

(3) The change to non-food crops was severe since 1976-77.

(4) Districts in Kerala also exhibited the same picture that the state experienced.

(5) High crop diversification exists in the state in the latter years compared to the earlier periods.

(6) Since 2000-01, the change in cropping pattern was from food crops and non-food crops to rubber.

(7) Among the twelve crops, rubber is the only crop registered higher performance in area, production and productivity growth rates over the last 50 years.

(8) The overall growth of Kerala agriculture in the last 50 years was monetary growth in nature rather than real growth.

(9) For paddy non-price factors are the significant determinants than price factors in the area allocation decision of farmers.

(10) Price is the dominant significant determinant governing the acreage decision of rubber farmers in Kerala.

(11) The shortage of rice in Kerala increased tremendously to 83.45 percent of the total demand.

(12) In the coming years it will again increase and the projected demand for rice is 10606.55 thousand tonnes in 2026 AD.

(13) The PH status and NPK status of the soil decreased in Kerala over the years.
(14) There is a decrease in the soil fertility status in the different crop growing areas in Kerala and it was very high in the rubber cropped areas.

(15) The average groundwater level in the state also decreased in different periods.

(16) The average groundwater level was very low in rubber cropped areas compared to other cropped areas.

(17) There exists a difference in the suggested dose and actual used dose of chemical fertilisers in the state.

(18) Chemical fertiliser application is not according to the soil test results in the rubber planted areas.

(19) Rubber and banana cultivators were using overdose of chemical fertilisers and under use of organic manures and lime compared to other farmers.

(20) There is deceleration in the total factor productivity growth in the crop sector in Kerala.

(21) The share of total factor productivity in the output growth of the crop sector is negative in ten districts and in Kerala during the last three decades.

(22) The negative indicators observed in the agricultural sector question the sustainability of the agrarian economy of Kerala.

The above analysis clearly revealed that over the years there has been stagnation in agriculture in Kerala. The growth rates of food crops in area, production and productivity are found to be low and negative. The supply demand gap of rice increased tremendously. The TFP growth rates of the crop sector also registered negative value. The soil fertility status and groundwater level of the state is also decreasing. In the light of these negative indicators, the following are the most important suggestions:
(1) Yield of crops should be increased. The yield of major crops in the state are much lower and rice is negative in Kerala than rest of the state. Considering that the frontiers of expansion of cultivated area are almost closed in the state, the future increase in rice production to meet the continuing high demand must come from increase in yield. There is a need to strengthen research and yield improving technologies should be strengthened. The existing wide gap in technology transfer should be bridged by forming an appropriate network of extension service both at top-down and bottom-up flows of information among farmers, extension workers and research scientists.

(2) Appropriately devised nutritional management programmes should be followed in the state. This comprises of soil testing, distribution of soil health cards to all the farmers, creating awareness on farm nutrition management, effective monitoring, etc. Adequate soil testing facilities within the easy reach of the farmers would need to be provided to enable them to get their soil tested for efficient fertiliser usage. This would need to be supplemented by appropriate extension facilities to make the farmers understood the necessity of following these recommendations of soil testing and fertiliser usage is on the basis of these recommendations. The effective co-ordination of various research institutions, government departments, local administrative bodies, etc, should be strengthened and encouraged in this regard.

(3) Attention should be given to the balanced use of fertilisers for crops in the state. To improve efficiency of fertiliser use, what is really needed is location-specific research on efficient fertiliser practices such as correct soil testing practices, correct use of balanced nutrients (in the form of organic manures, chemical fertilisers, lime, etc), correct timings and placement of fertilisers, monitoring of the overuse or under
use of fertilisers, availability of improved fertilisers, development and efficient use of physical and institutional infrastructure, etc.

(4) Agriculture is the biggest user of water, and it is revealed that groundwater level is decreasing in the crop growing areas and it is very acute in rubber cropped areas. To increase the recharge of groundwater in the rubber cropped areas various water recharging methods should be practiced. For that the existing programmes in the state should be extended to all areas.

(5) Total factor productivity index in the state showed negative growth rate due to relatively high growth of input use compared to that of output index. This calls for better resource management strategy in the state. All the efforts in the state in the future have to be concentrated on accelerating the pace of total factor productivity growth and at the same time sufficient caution has to be exercised to conserve natural resources and promoting institutional infrastructure. It provides both physical inputs as well as induces technical change. More public investment in irrigation, infrastructure development (road, electricity, etc), research and extension, efficient use of water, micro, macro and plant nutrients, etc, are essential in the state for accelerating TFP growth.

(6) The situation of rice production in the state can be augmented only if policy prescriptions are launched by the government to make the farmers risk bearers. Yield can be improved by adopting better technology involving adequate, efficient, effective right type of inputs. Keeping in view the better productivity trend of rice and tapioca since 2000-01, strengthen the different present day programmes implemented in the paddy sector through various agencies in the state.

(7) In the paddy sector strict enforcement of various laws relating to land use should be followed by the revenue authorities. Keeping in view the sustainability and
ecological problems created by crops like rubber, there is a need to introduce legislative measures, if possible, to divert area from these crops to rice.

(8) There is a need to enhance the positive contributions that agriculture makes to the environment. At the same time environmental protection and sustainability are to be followed in the overall planning for agricultural growth and development. Development and usage of agro-chemicals and organic manures, strengthening of integrated plant nutrient system, monitoring of the usage of chemical fertilisers and pesticides, monitoring of climate change, etc, should be practiced in the crop sector of Kerala.

(9) Identify the low-yielding areas in the state through micro data planning and appropriate crop cultivation strategies should be followed in that area.

(10) There are many agencies in the state for the development of the agriculture sector in general and separate crops in particular in the form of research institutions, departments, local bodies, etc. Agricultural growth is accelerated only if these agencies functioned in an effective co-ordinated manner. Therefore, an effective co-ordination from bottom to top and vice versa should be ensured in this regard.