CHAPTER II

REVIEW OF LITERATURE AND METHODOLOGY

The objective of this chapter is to present a brief review of related literature relating to growth, instability and supply response of agricultural crops, and to state the research methodology followed in this research work. For this purpose this chapter has been divided into two sections. While section I deals with review of literature, section II presents the research methodology adopted in this study. Further section I is organized in three divisions. The first division gives a brief summary of the review of literature relating to growth analysis; the second division focuses on the work done by several others on instability analysis and section three furnishes a concise review of studies on supply response of agricultural crops.

SECTION A: REVIEW OF LITERATURE

1. Studies on Growth Analysis

Sidhu and Carlos\(^1\) have fitted profit and factor demand function from farm level cross-section data for Mexican wheat varieties in the Punjab. The data used in this study were collected by stratified random basis for the crop year 1970-71. In

order to examine the fertilizer demand, the variable inputs of labour, chemical fertilizer and irrigation water and the fixed inputs of land, capital and education were taken into account. They employed Lau-Yotapoulas Profit Function Approach in this study to examine the fertilizer demand. The main findings are as follows.

1. The findings that there are no differences in the technical and price efficiency parameters of small and large farms, that both classes of farm maximize profits, and that there exist constant returns to scale in wheat production, the Punjab suggest that opportunities for growth by improving farmers allocative efficiency are almost non-existent and that policy considerations of farm size may be based only on social and political considerations.

2. The impact of fertilizer use and wheat output of a one per cent decrease on fertilizer price is not symmetric with a one per cent increase in wheat price. Wheat price appears to be much more of a powerful policy instrument than fertilizer price to influence fertilizer use, output supply and returns to fixed farm resources.

3. The results support the conclusion that education of farm people in the Punjab contributes significantly to agricultural production.
K.V. Subrahmanyam\textsuperscript{2} analysed the growth of area, production and productivity of banana in different states of India. The study was based on secondary data covering the period 1965-66 to 1978-79. This period also signifies two important events viz, i) the introduction of high yielding varieties of paddy crop with which bananas rotated and ii) the period in which the 'bunch top' disease acquired epidemic proportion in some of the states where banana is grown on a large scale.

According to this study there was an overall increase in area under banana by about 25 thousand hectares between the two periods, which was nearly 25 per cent more over the triennium ending 1967-68. In states like Assam, Bihar, Gujarat, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu and Andaman & Nicobar Islands there was an increase in area under banana, whereas there was fall in area in other states like Andhra Pradesh, Karnataka, Tripura and Uttar Pradesh.

The largest increase in area was noticed in Madhya Pradesh, which was 27 per cent followed by Andaman & Nicobar Island with 177 per cent. The maximum decrease of around 6 per cent was in Karnataka, followed by Uttar Pradesh (4.76 per cent).

The overall production of banana increased from 3296 thousand tonnes by the triennium ending 1967-68 to 4183 thousand tonnes by the triennium ending 1978-79.

an increase of 27 per cent. In seven states, viz., Assam, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu and Andaman & Nicobar Islands, there was an increase in production between the two periods, whereas in six states names by Andhra Pradesh, Bihar, Gujarat, Karnataka, Tripura and Uttar Pradesh, there was decrease in production.

Growth Rates of Area, Production and Productivity

a) Area:

The area under banana in the country has increased at a compound rate of 1.75 per cent per annum, which is rather low. This was mainly due to the fact that only in six states, viz, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Orissa and Tamil Nadu the growth rate was statistically significant. In other states, it was not significant — they could account only for zero growth rate.

b) Production:

The overall compound growth rate of production of banana was also very low at 2 per cent per annum. The main reason for this seems to be that out of eight states with significant growth rate, three have negative growth rates. Besides the states like Gujarat and Tripura have also registered negative growth rates in production in spite of positive growth rate in area. The significant growth rate of Tamil Nadu was 4 per cent.
C) Productivity:

In majority of the states, the growth of productivity was negative and practically there was no growth in productivity at all India level as evidenced by the statistical non-significance of the growth rate. Out of the four states with positive growth rates, the growth rate was statistically significant only in Tamil Nadu.

This analysis reveals that nearly 94 per cent of production changes were due to area alone and very little due to productivity at all India level. The growth in productivity at all India level was almost zero.

S. Bandyopadhyay examined the extent of banana cultivation during the period 1970-71 to 1983-84 in the selected states of Maharashtra, Karnataka, Tamil Nadu and Kerala in the southern Peninsula of India. The compound growth rates in area, production and yield rate of banana in this state worked out to 1.975 per cent (significant at 5 per cent), 2.18 per cent (significant at 1 per cent) and 0.237 per cent per annum respectively. The corresponding figures for Karnataka are 0.75 per cent, 6.92 per cent (significant at 1 per cent) and 6.376 per cent (significant at 1 per cent) and for Tamil Nadu are 0.664 per cent, 2.343 per cent (significant at 1 per cent) and 1.7 per cent per annum (significant at 5 per cent) respectively. The corresponding figures for Kerala are 0.19 per cent, -1.292 per cent and

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-1.5 per cent per annum respectively. The values of correlation (between cropped area and production of banana) coefficients and regression coefficients indicate that with the allocation of more land area, production will significantly increase in Maharashtra, Tamil Nadu and Kerala. In the case of Karnataka, however land area alone will not influence production in a significant way. Advantages bestowed by nature on these states boost the scope for increased specialization in the production of banana, which substantially contributes to the health, and prosperity of the people of the country.

V.T. Raju, Darsi V.S. Rao and C. Ravisankar\textsuperscript{4} analysed the Growth and Distribution of Fruit crops in Andhra Pradesh. This study was carried out for Banana, Mango, Citrus, Grapes, Guava, Papaya, Cashew and other total fruits. The period of study was from 1970-71 to 1982-83. The distribution of fruit crops in Andhra Pradesh over space and time was studied over three-time periods, namely, 1972-73, 1977-78 and 1982-83 and over three regions (Costal Andhra, Rayalaseema and Telangana). For the analysis purpose, Compound growth rate and simple regression equation were used.

Results and Discussions

Trends in fruit crops Area (1967-68 to 1982-83)

The index numbers of area under total fresh fruits continuously rose to in the III to 1974-75 from 1967-68 (base year) except in 1971-72 when the area under fresh fruits fell by 2.32 per cent from the previous year. The total dry crops area index had shown increase from 100 to 198 during 1967-68 to 1982-83 though there was a decline in the index in four years (1969-70, 1973-74, 1975-76 and 1977-78) varying between – 0.41 per cent and –6.71 per cent. The area index of the total fruit crops fresh and dry fruits together area index increased to 133 in 1982-83 over 1967-68.

Trends in Fruit Crops Out-turn (1970-71 to 1982-83)

The out-turn index of banana with base 1970-71=100 increased to 195 in 1982-83. It reached a high of 208 in 1978-79 with a maximum increase of 102 per cent over the previous year. There was a decline in the production of banana during 1974-76, 1979-81 and 1982-83, the decline being the maximum at 33 per cent in 1972-73.

The out-turn of mango declined steadily from 1735 thousand tonnes in 1973-74 to 1607 thousand tonnes in 1977-78. The out-turn index of citrus fruits stood at 184 in 1982-83. It was very lowest in 1977-78 (113.28 per cent). The out-turn index
of grapes was 88.73 per cent in 1972-73 and it increased to 510.85 per cent in 1982-83. After 1974-75 onwards, the cashew production had decreased in trend.

**Compound Growth Rates of Area and Production:**

The area under Banana had shown a growth rate of 2.05 per cent over the 16 year period under study and its production growth was more than four fold of its area growth (9 per cent) and statistically significant. The compound growth rates of Mango, Citrus fruits, Grapes, Guava, Papaya, Cashew were 5.89 per cent, 2.28 per cent, -2.43 per cent 2.19 per cent, 1.86 per cent 0.94 per cent and 4.23 per cent respectively.

To conclude, the major obstacles in increasing the production of fruits are poor orchard management, non-adoption of package of practices recommended and shortage of disease free planting material. There is need to lay more emphasis on expanding the area under other fruits like sapota, ber, pomegranate, seethaphal etc.

R. Mohan Das\(^5\) examined the factors influencing growth and instability in the production of paddy, coconut, aeronaut, pepper, ginger, tapioca, cashew, rubber, tea, cardamom, sugarcane, banana and coffee, different districts of Kerala. The study was based on secondary data covering the period 1973-74 to 1987-88. He divided all the

districts of Kerala into three categories. He used the tools like compound growth rates and co-efficient of variation.

The following conclusions have emerged from Mohan Das's study:

1) The analysis reveals that only about 22 per cent of the gross cropped area in the state is having productivity above state average and this area accounts for 37 per cent of the total value of agricultural production.

2) The agricultural output per hectare is highest in Idukki district (Rs.16,368) followed by wayanad (Rs. 12,128) while Kozhikode and Alappuzha districts with Rs. 4,439 and Rs. 5115, respectively are having the least productivity.

3) Cashew production registered negative growth rate in all districts and this has adversely affected the traditional cashew industry in the state.

4) Banana and rubber showed a positive growth rate in all districts and the compound growth rates of banana ranges for +5 per cent in Thiruvananthapuram to +18 per cent in Palakkad district.

5) The relative stagnation and deceleration in the output of almost all Crops was mainly due to the unprecedented drought and lack of irrigation facilities. The reason for reduction area and output in respect of crop like coconut, tapioca, paddy etc., is conversion of area under these crops into plantations.

6) During 1974-87 period, the area under commercial crops has generally grown faster than that of food grains and resulted in faster expansion of commercial crop production.
Parveen K. Sardana\textsuperscript{6} et al. analysed the factors influencing growth and variations in agricultural performance in Haryana. The period of the study was 1975-76 to 1995-96. Following are the major findings of this study.

1) There has been reduction in disparities among districts of Haryana with regard to agricultural performance (value of agricultural produce per hectare during the last 25 years.

2) The potential for growth in agricultural performance with the existing technology lies in the backward districts only.

3) Though the agricultural performance is dependent on HYVs and fertilizer consumption, the level of dependence has reduced over the period. In the 1990's, the independence of agricultural performance on these inputs got reduced and stagnation in already developed districts started becoming visible. This calls for another varietal breakthrough, especially the development of hybrid rice. Technological efforts should also spread to newer areas. In particular, research on high value crops like fruits, flowers and allied activities should be accorded priority.

Singh and Paramjeet Kaur\textsuperscript{7} have attempted to know the growth and instability in oilseeds production in India. The study was based on secondary data for the


\textsuperscript{7} Singh and Paramjeet Kaur, "Growth and Instability in Oilseeds in India", \textit{Agricultural Situation in India}, Vol. XIVII, April 1993, pp. 9-16.
period 1965-66 to 1975-76 and 1976-77 to 1988-89. In this study, compound growth rates were worked out. Further Caddy Ville Index is used to know the trends in area, production and yield.

This analysis clearly revealed that on the whole, the growth rate of oilseeds production accelerated due to increasing contribution of both area and productivity. The growth rate of production accelerated for rapeseed and mustard and sesamum, and it declined for groundnut, castor and linseed. The analysis also revealed that the variability in yields declined for groundnut rapeseed and mustard and increased for linseed, castor and sesamum.

G.N. Patel and others have analyzed the Growth and Instability of groundnut production in Sourashtra region of Gujarat, during 1960-61 to 1988-89 using Compound growth rate and Coefficient of Variation. According to this study, area, production and productivity of groundnut crop in the state of Gujarat has shown a negative growth during both the study period. Moreover, according to them, the instability in yield levels has caused further instability in groundnut production.

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Shaik Haffis, Rama Rao, Reddy and Katyal conducted a systematic study of the change in the variability of cereal production of India. The study included the change in sorghum and pearl millet. They have used decomposition model and coefficient of variation to know the growth and instability. The study included the periods 1950-51 to 1969-70 and 1970-71 to 1989-90. The study concluded that the yield recorded a faster growth rate in the post-Green Revolution period. In case of pearl millet, the significant positive growth rates of production and productivity in the earlier period become insignificant in the later period. The instability was marginal in case of sorghum and substantial in case of pearl millet.

B. Chinnappa and T.R. Keshava Reddy have made an empirical analysis of growth and instability in Indian sugar industry covering 1930-1993 periods. The study covered the area, yield, production and yield of sugar cane. The empirical findings of the study showed that the area, production and productivity of sugarcane are 1.7257, 3.60358 and 1.84813 respectively. The acreage under the crop reaches lowest level during 1953-54 because the previous year crop was damaged severely by pests and diseases.

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The coefficient of variation for the area is 22.36 per cent. The variability in the area occurs due to shift in acreage from sugarcane to more remunerative crops. The production variability was 42 per cent. This stems from unfavorable weather conditions, diseases, pests and technological break-through. The coefficient of variation for productivity is 22 per cent.

M. Upender\(^{11}\) and etal analyzed the factors influencing growth and instability in acreage production and productivity of groundnut covering the pre and post Green Revolution periods in Andhra Pradesh and all India. He divided the whole period of their study into 2 sub periods, viz., 1949-50 to 1965-66 (pre-Green Revolution period) and 1966-67 TO 1990-91 (Post-Green Revolution period). The study was based on secondary data, which were collected from the basic statistics relating to the Indian Economy published by Economic Intelligence Service, Centre for monitoring Indian Economy. They used the tools of linear growth rates ad coefficient of variation.

The following conclusions have emerged from Upendar Study:

1) The annual average growth rates of area, production and productivity of groundnut were higher during the post-green revolutions period.

2) The growth rates of area and production of groundnut in Andhra Pradesh were higher in the post-green revolution period than that of growth rates in the same period in all India.

3) The high degree of instability in productivity in all India and in production in Andhra Pradesh during the post-green revolution period indicate that the variations were more in productivity in all India and production in Andhra Pradesh.

B.P.Vani and vyasulu\textsuperscript{12} have examined the growth, variability and instability of rice, ragi and jowar in Karnataka state for the period 1955-56 to 1989-90. In order to know the trend value they used quadratic, semi – log linear and log – quadratic equations. To know the instability they used G-test and Chow's test. Six specifications of the growth curve were estimated for all the districts and for the state as a whole. The curve with the best fit was chosen for further analysis. The following conclusions were arrived from the study. They are:

1) Rice productivity was found to be high in the districts chitradurga, Mysore, Mandya and Raichur.

2) Chitradurga and shimoga districts showed higher yield per hectare in the case of ragi crop compared to other districts.

3) The yield per hectare in the case of jowar crop was found to be high in Chitradurga, Dharwad and Bellary districts.

Singh\textsuperscript{13} examined the cropping pattern and growth rate in area, production and productivity of the maize crop in plateau region of Bihar state. The period of the study was 1959-60 to 1990-91. Following are the major findings of this study.

1) There has been shifting in cropping pattern in favour of wheat and potato crop after introduction of green revolution programmes.

2) The average yield per hectare of maize in green revolution period did not show superiority over pre-green revolution in all zones. In most of zones average yield in green revolution period was less than the pre-green revolution period.

3) The growth rates of area, production and yield are found to be negative in green revolution period in all zones. The reverse situation was observed in pre-green revolution period in all cases for all zones.

4) The variability in yield per hectare is recorded to be minimum in green revolution as compared to pre-green revolution period.

A study has been taken by Dhindsa and Anju Sharma\textsuperscript{14} on growth and supply responses of pulses in Punjab. This study is an attempt to identify the acreage response of various factors determining the decisions regarding allocation of land among different pulse crops in Punjab and its various sub-regions and to estimate the short run elasticities of acreage under various pulse crops with respect to various price and not-price factors. The study covers the period 1965-66 to 1991-92. The secondary data on area, production yield, rainfall, gross irrigated area and prices were obtained from Statistical Abstracts of Punjab. The prices of mash, moong and massar have been obtained from unpublished records maintained by Agricultural Marketing Board, Punjab (Chandigarh).

The regression coefficient was estimated with the Ordinary Least Square Method. The Nerlovian lag adjustment model was used to analyze the supply response analysis of pulses in Punjab.

The major findings of the study were:

1) The increase in prices of pulses will hit the poorest section of the society and will create serious imbalances in the dietary mix of the majority of the people.

2) The average yields of gram have declined significantly in various regions of the state. Hence, the scope for increasing the area under gram appears to the very limited in the state.

3) Thirdly, effort should also be made to promote the enterprises like dairy and livestock in agriculture, which provide good substitute to counter the nutritional deficiencies arising from the scarcity of pulses.

A.S. Patel et al. analyzed the growth rate of banana in the districts of Gujarat as well as the various states in India, and India as a whole, from the period from 1970-71 to 1994-95. The secondary data were collected from various sources. This study is divided into four major sections. Section first tries to examine the economy position of this crop at the all India and state level in general and the area growth in Gujarat particular. The second section attempts to deal with the economics of banana cultivation in Gujarat. The farmer’s views on some important issues related to banana cultivation are indicated in the third section. Finally, important policy implications along with a resume of the study are presented in the last section.

Important points of observation and policy implications are noted here:

1) A study of banana economy at farm level, as attempted here clearly indicates that an increasing number of farmers are found opting for banana cultivation

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in the study area. What is observed at the micro level is a general phenomenon observed at the state level in Gujarat. In 1969-72 banana constituted 0.15 per cent share in GCA of Gujarat, which increased to 0.30 per cent of GCA in 1989-92 and was 0.28 per cent in 1992-95. At the district level in all the districts, growing banana except Surat and Valsad relative area under banana increased. In Surat district, the share declined while in Valsad district it remained stagnant at 0.50 per cent level. Among all the districts, six districts of vadodara, Bharuch, Val sad, Kheda, Surat and Junagadh are the major banana producing districts in the state. Over the last 2 decades, the concentration of area in these six districts put together declined while within the six districts, it got shifted from Valsad, Surat and Junagadh to vadodara, Bharuch and kheda. On the whole, the area increased while the spread became more wide than before.

2) To ensure rapid expansion in the area and production of banana, a rapid enhancement of banana market is imminent. This will help maintain or raise the present level of remunerative prices and relatively high level of per hectare income for long time. With relatively high-income elasticity of demand for banana, internal market conditions are likely to remain favourable for long time. However, development of expert market is most crucial as India’s share in world banana production was 14 per cent in 1992 but the share in export was quite insignificant at 0.06 per cent of world expert. Beside, earnest efforts
are required to suitably develop, produce and market processed products from banana. Banana being a perishable commodity, the establishment of processing units to produce processed products like pulp, juice etc. near major production centres will act as a value addition, and product diversification, and would further increase returns for the banana producers.

3) To ensure stability in yield variations in yield per hectare across regions and across farmers in each region need to be reduced. Sustained regular and effective measures will go a long way in educating farmers about the correct and scientific methods of using various strategic inputs including fertilizers.

4) In order to ascertain fair dealing in marketing, it is necessary for banana producers to organize a growers' co-operative society. This will help strengthen their bargaining power and avoid exploitation at the hands of traders or middlemen.

5) Extension of insurance scheme to banana crop is a visible proposal and hence it needs to be introduced at the earliest. This will help reduce risk and uncertainty arising out of natural hazards.

6) Finally, there is a strong case for banana to be included in the list of crops for which the Government declares support prices. Of course, this can be done only if a market for banana is made stable but expanding one.
Colby H et.al make a growth supply response model in China. This analysis is used in between the four major crops like rice, wheat, maize and soyabean. For this analysis the time series data for the period 1978-99 were taken from various govt. publications. The total factor productivity (TFP) contribution to growth in grain production is found in the period immediately following China’s rural economic reform (1978-85). In recent years the growth rate of TFP fell sharply, contributing to less than 20 per cent of growth in grain production, as increased use of inputs became the major engine of growth. The supply response of the four grain is estimated using a multiproduct framework. Finally, it shows a joint production system in China’s grain sector and gross complimentarity in the effect of a price change on the supply of outputs and demand for inputs.

Balappa Shivaraya et.al examined the pattern of growth in red gram production in Gulbarga district and for the Karnataka state as a whole from 1980 to 1994. Among the districts Gulbarga ranks first both in area and production by contributing 40 per cent of the area and 47.23 per cent of production of the state. In 1992-93, the productivity was lowest (201 kg/ha) in Gulbarga district.


For the Karnataka state as a whole, production of red gram declined by 4 per cent. However, it was not significant. It was worth noting that the productivity of red gram has increased significantly as is indicated by the 11 per cent increase in Karnataka state. Even though the area had declined significantly, the production did not decline due to the significant increase in its productivity for the state as a whole.

Nilotpal Borthakur examined the growth and instability in jute production in Assam. This study applied variance decomposition procedure to analyze the sources of change in growth and instability of jute production in Assam, India. For this analysis, data for the period 1951/52-1994/95 are used in the analysis. It is observed that in the absence of significant yield improvement, the declining growth in area of jute led to a fall in production in the Green revolution period. Area instability and area yield convariability increased the instability in production of jute. Relative profitability, unremunerative price and inadequate marketing facility, together, resulted in a declining trend in jute area. So an appropriate policy measures should be undertaken to minimize the instability in area under production.

The influence of growth and trends in area, production and yield of potato on change in price of potato in West Bengal is investigated. Data for the period 1947-96 are used in the analysis. The study reveals that inspite of an increasing trend in area,

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18 Nilotpal Borthakur; “Growth and Instability in Jute production in Assam”, *Journal of Interacademia* 3(3/4) 339-344[En, 3ref] Department of Agricultural Economics, Assam Agricultural University, Jorhat, Assam, India, 1999.
production, and yield, changes in the price of potato have been random. Path coefficient analysis indicates that the present area under potato is directly associated with the previous year’s production and market price.

Kerala is the largest producer of tea in India. It being one of the major tea growing states of the country, an analysis of growth and instability in tea production of Kerala was conducted. Data related with area, production and yield of tea were collected for the period 1951-1994. Various growth models like exponential trends; semi-log quadratic trends and decomposition models were used. This study revealed that tea production in Kerala has shown significant improvement over time. The growth rate in terms of area was negative due to substitution with other crops. Analysis of change in variance of production indicated that yield-related variables are a major source of production instability.

Arun S. Patel analyzed the growth pattern of agriculture in Gujarat for the period of 1970-1996. This analysis takes into account of non-food grain crops like

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rapeseed and mustard castor, sesamum, sugarcane, tobacco, banana and potato. The area of cotton and groundnut declined in trend. The rest of the crops except banana increased. In the case of banana, the share of area declined while that of production increased.

Sharad Bhatnagar and K.K. Saxena\textsuperscript{22} examined the area, production and average yield of wheat in Haryana for the period of 33 years from 1966-67 to 1998-99. The following linear equation is used to find out the growth rate.

\[ Y_1 = a + bt \]

Further the linear growth rates for the 33 years from 1966-67 to 1998-99 have been calculated for each year by taking the successive year’s area/production of wheat into consideration. The 33 years growth rates are classified into a frequency distribution table by using stuges formula to determine the class intervals of linear growth rates as

\[ I = (L - S) / (1+3.222 \log n) \]

**Results and Discussion:**

In Haryana, the average area under wheat increases from 827.33 to 2094.33 thousand hectares during the study periods of 33 years. It increased the production

from 1342.00 thousand tons to 8000.33 thousand tons in the current period. The yield has also increased by 136.77 per cent over base period.

For comprehensive study, the period of 33 years have been split up into three decades. The average area of wheat has increased to 23.76 per cent over the first decade. It has increased to 14.39 per cent in the third decade. Similarly, the production of wheat has shown an increase of 48.07 and 41.07 per cent in second and third decades respectively. The third year yield of wheat is 20.30 per cent, which is slightly higher than the second decade (3.76 per cent).

The growth rate of wheat is continuously decreasing for the 3 decades. But the growth rate of production and yield of wheat is going on increasing.

The area of wheat is expected to increase minimum 4.1422 to 4.1619 per cent and maximum 5.8729 to 5.9160 per cent by the year 2002. Regarding the production it is also expected to increase.

The growth performance of production of wheat is better than its growth in area and yield. Area and production have decreased in the third decade but it has not affected the average yield of wheat. An estimate of area, production and yield of wheat in Haryana has been obtained for next three years with 95 per cent confidence limits.
Mohammad pervez wasim\textsuperscript{23} have examined the factors responsible for growth and instability of major crops production in Pakistan during 1970-71 to 1997-98 using compound growth rates, semi-log exponential form. The study reveals that in period I the growth in production in most of the crops of Punjab was mostly due to the growth in area rather than productivity. In period II in most of the crops production, productivity contributed more than the area, which clearly indicated that new farm technologies were adopted.

Further area and productivity both contributed towards fluctuations in almost all crops except wheat, jowar gram and rapeseed and mustard in period I in Sindh. In period II the synchronized movements in area and productivity were responsible for increased instability in bajra and chilies production.

Studies on Instability

Singh and Gang war\textsuperscript{24} conducted a systematic study of the components of change in the variability of cereal production of Haryana. The study included the changes in rice, jowar, bajra, maize, wheat and barley as well as the change in total cereals production. They have followed the decomposition model developed by


\textsuperscript{24}J.P. Sing and A.C. Gangwar, “Instability in cereal production in Haryana. A decomposition Analysis”, \textit{Agricultural Statistics Research,}, pp.130-139.
Hazell. The study included the periods 1960-61 to 1966-67 and 1967-68 to 1985-86. This study arrived at the conclusion that aggregate production instability is an inevitable outcome of rapid agricultural growth and there is little that can effectively be done about it. However policies to stabilize the supplies of fertilizers and effective irrigation facilities might be effective to reduce the instability of cereals production in Haryana.

Suresh Pal and A.S. Sirohi 25 have studied the instability in India crop production (cereals, pulses and oilseeds) for the period 1950-51 to 1964-65 and 1967-68 to 1983-84. The coefficient of variation was used to measure the magnitude of instability. He did crop-wise study and come to the following conclusions.

1) After the adoption of HYVs, there was no major change in the probability of shortfall in production. The instability in production increased in comparatively less irrigated crops.

2) Yield variance contributed largely to variance of production in pulses and oilseeds and their contribution increased over time. But the share of yield variances declined slightly in cereals.

3) The adoption of HYVs the absolute variability (variance) increased on account of increased sensitivity of HYVs to inputs and weather, especially rainfall.

4) The intensive use of irrigation led to comparatively stable production, especially in wheat.

5) The possibility of severe drought as observed in 1987-88 further stresses the need for production stabilization policies.

6) Since larger time log is involved in these policies and year-to-year changes in the production are large, buffer stock policy may continue to be the immediate safeguard against production instability.

Pal and Sirohi\textsuperscript{26} analyzed the extent and source of instability in the production of rice, wheat total cereals, gram and total pulses in India over the periods 1950-51 to 1964-66 and 1967-68 to 1983-84. They indicated that the yield instability was the main source of production instability and a decline in yield instability had in stabilized the production of wheat in the post technology period. They concluded that increased co-variability between area and yield could hardly be attributed to the improved technology and that improved technology was of stable nature.

Subashree\textsuperscript{27}, in her analysis of pulses in Tamil Nadu, covering the period 1965-66 to 1988-89 has studied the shift in acreage under pulses, trends in area, production and productivity of pulses and has analysed the instability in pulse production.

\textsuperscript{26} Ibid., pp.241-256.

production. The environmental, technological, socio-economic, organizational, management and institutional constraints, lack of research, in different extension services to pulses, lack of plant protection and quality control measures and faulty marketing are highlighted as constraints.

R. Cauvery attempted to examine the extent of instability of groundnut production in Tamil Nadu with particular reference to the four major groundnuts growing regional viz, North Arcot, South Arcot, Coimbatore and Salem. The instability was studied for two periods 1965-66 to 1975-76 and 1977-78 to 1988-89. The methodology is built up on the lines of the work by Peter B.R.Hazell. The area and yield data were detrended. Then using the data of detrended production a decomposition model has been developed by the author with 10 components. The study arrived at the following conclusions:

1) The instability in groundnut production in Tamil Nadu is brought about by the vehement production instability in the districts of Coimbatore and Salem.

2) The changes in mean area has immensely contributed to production instability in Coimbatore dist. but it is by no means the only variable the changes in relative production instability.

3) Quite contrary to Coimbatore dist. the production of groundnut in Salem dist. appears to have been affected by yield instability rather than area instability.

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4) Of all the components, change in area-yield covariance has been the major contributing factor to instability in groundnut production in both the districts.

5) The inter-period variation in production in salem dist. has registered an increase in production variation during the second period unlike Coimbatore dist. which has exhibited a decline in production variation, the out-come instability in area.

S.V. Bharathi\(^{29}\) and others have analyzed the factors responsible for the instability of pulses production in Andhra Pradesh during 1970-71 to 1986-87 using Cop pock’s Instability Index, Coefficient of variation and Standard Deviation. According to this study, the area has greatly contributed to the pulses’ production than yield in the major pulses growing districts and Andhra Pradesh. Moreover, according to them the instability in yield levels has caused further instability in pulses’ production.

Jena\(^{30}\) et. al analyzed the instability in groundnut production in Orissa. For this analysis, 38 years (1954-55 to 1971-72) data were collected from various sources. The data were further divided into pre-techno period (18 years) and post-techno period 20 years. The analysis revealed that neither the time factor nor the


introduction of new technology has played any role in increasing the production of groundnut, which is solely due to greater coverage under the crop. It is found that the instability in both area and production was convergent in nature except in the kharif season in Dhenkanal and Ganjam districts, and in the Rabi season in Puri and Sambalpur district. The yield status has remained stagnant over the years except in the sambalpur district where it decreased in the kharif season, which is rather disappointing. It is also observed that the rent paid to the owners for the leased-in land in share cropping system is decreasing year by year which also adds to the instability. It has been found that the very objective of the new technology for increasing the production through yield augmentation programme has not been achieved so far. The study also reveals that the theory of instability could be fruitfully utilized for projection of different parameters.

Mani\textsuperscript{31} analyzed the trends in area, production and yield of coconut in major states over a 25 year period from 1969-70 and also traced the degree of variability in these three variables. Time series data on area, production and yield were compiled and the growth patterns were examined using exponential functions. Computation of coefficient of variation helped to examine and assess variability. The total area under coconut was only 10.33 lakh ha in 1969-70, which increased to 16.31 lakh ha by the

end of 1994-95. The major coconut cultivating states are Orissa, Assam, Tamil Nadu, West Bengal, Andhra Pradesh, Karnataka, Kerala and Tripura. The total production of nut increased to 12355 million nuts by the end of 1993-94, 12 per cent greater than that of 1969-70. The present yield of coconut is approximately 7600 nuts per hectare compared to 5600 nuts per hectare in 1969-70. Significant growth in yield was recorded in Orissa, West Bengal, Assam, Andhra pradesh and Maharastra, Kerala which contributes notably to area and production, recorded a negative growth in yield. Consistency in area, production and yield is achieved in Orissa, Assam and West Bengal.

Savitha Vadnere and V.K. Pandey studies examined the extent of instability of twelve crops in various regions of India for the periods 1970-71 to 1990-91. The methodology in this study is built on the lines of the work by Hazel.(MOTAD MODEL). The time series and yield data were detrended.

The study arrived at the following conclusions:

1) Strengthening the agricultural planning machinery at the state and district levels for regulating the desired crop acreage through a set of incentives and disincentives.

2) The relative support price structure would have to be made region specific, i.e., decentralization of the price support policy up to the state level.

3) The use of differential crop insurance premium rates (i.e., a low or nil insurance premium for desired crops in a state and high insurance premium for less desired crops) would also help in regulating the crop acreages.

4) Provision of input subsidies only for some crop specific inputs like quality seeds, plant protection chemicals, etc. required for the desired crops would act as an incentive for expansion of area under such crops.

5) Further efforts in developing agricultural production and processing technologies would have to concentrate on these crops and regions which need to be encouraged as per the optimal crop plan.

6) Imparting crop specific extension education to the farmers in any region.

Mohammad Parvez Wassim\textsuperscript{33} analyzed the nature of instability in major crop output in SAARC countries. He estimated period-wise instability in crop output of major crops separately for each SAARC country and within SAARC countries. He has made a period wise comparison of instability of crop output of major crops in total SAARC countries (Except Maldives). The study is based on secondary data for the last 20 years i.e., from 1976-77 to 1995-96. It is further divided into period I (1976-77 to 1985-86) and period II (1986-87 to 1995-96).

The specific objectives are:

1) To estimate period-wise instability in crop output of major crops separately for each SAARC country and within SAARC countries.

2) To make a period wise comparison of instability in crop output of major crops in total SAARC countries.

The study showed that in period I bajra, rapeseed and mustard, sesameum and groundnut have the highest degree of instability in production. Whereas wheat, tea, potatoes and jowar has the lowest degree of instability in production in total SAARC countries. The magnitude of instability in the production of jute, chillies, jowar, bajra, tobacco and groundnut increased during period II relative to period I in total SAARC countries and the fluctuations in both area and productivity turned out to be behind this instability.

Another attempt was made by R.K. Rahane et al. to study the performance of fruits and vegetables in Maharashtra both at the state and regional level. For this purpose secondary data were collected from the Directorate of Agriculture and Directorate of Horticulture, Govt. of Maharashtra. The data were divided into two parts (i) time-series data on area, production and productivity of surveyed crops such as arecanut, coconut, cashew nut, grape, orange, sweet orange, banana, onion grown.

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in Maharastra and its regions for the period 1983-84 to 1997-98 and (ii) data on non-surveyed crops such as fruits (pomegranate, papaya, chikku, ber, custard apple etc.) and vegetables (chilly, garlic, potato, cauliflower, brinjal, tomato, pea, beans, ladiesfinger and cabbage) for the period 1994-95 to 1997-98. For analysis purpose econometric tools like compound growth rates and exponential function were used.

The study revealed that among the surveyed crops Banana is grown in all the four regions of Maharastra and major area is covered in Western Maharastra. Amongst vegetables onion is the only crop cultivated in all the four regions of Maharastra.

The area and production of all non-surveyed fruit crops like pomegranate, guava, papaya, chikku, ber, custard apple and mango showed an increase. But the productivity of pomegranate, papaya, chikku and mango decreased. Amongst non-surveyed vegetables, the area under chillies, potato, cauliflower, tomato and ladiesfinger showed a decline while the area under garlic, brinjal, pea and cabbage showed an increase and productivity was observed to be constant in almost all vegetables except chillies and potato.
Studies on Supply Response

Robert N. Herdt\textsuperscript{35} attempted to estimate the responses of supply and aggregate agricultural output to change in prices of agricultural products. He used a disaggregated approach and estimated individual crop supply functions for area under different crops. Besides he introduced own prices and the prices of other crops which enabled him to get both own price elasticity and cross price elasticity. The index of non-agricultural prices is also introduced as a separate variable in his equation. Own price elasticities and cross price elasticities were then aggregated in this study to get an estimate of elasticity of aggregate farm production, using average value of production of different crops as weight. The results for the period showed positive response of aggregate output to changes in real prices of agricultural products. During this period the contribution of weather also has been found to be significant.

Madhavan\textsuperscript{36} studied the supply of groundnut and gingelly, in Madras by using Nerlovian model expressed in log form with crop acreage, as a function of lagged crop price, lagged yield and the acreage of the crops and its competitor, and rainfall index computed for the sowing period. The study has revealed that commercial crops


\textsuperscript{36} M.C. Madhavan, "Acreage Response of Indian Farmers – A Case Study of Tamil Nadu," \textit{The Indian Journal of Agricultural Economics}, Vol.27, January–March 1972, pp.67-84,
were more responsive to the relative prices than the food crops. Yield was an equally important factor affecting Tamil Nadu acreage decision of the farmers.

In Coimbatore district of Tamil Nadu Kandaswamy\textsuperscript{37} has estimated normative supply functions with reference to price of groundnut by adopting linear programming approach. The estimated elasticities have been compared with the estimates of positive analysis of time series data. The comparison revealed that the price elasticity of normative supply was greater, than that of time-series analysis. The difference was one of the gap between ex ante and ex post decisions. The risk in production against which the farmers have to discount was offered as the reason for the lesser export elasticity of time-series analysis.

Flinn, Kalirajan and Casillo\textsuperscript{38} have used profit function analysis to estimate rice supply and input demand elasticities for a sample of rice farmers in Languna, Philippines. The required data were collected from four farmers. Among the four, two were owners and the other two were lease holders and share tenants. The study was confined to the year 1977-78. The supply response and input demand by farmers using modern rice technology in Languna, Philippines were estimated using profit


function. The results indicated that the farmers did maximize short-term profits which responded to price changes efficiently. That is output supply was most sensitive to wage rates and cost of mechanical land preparation and to a lesser extent of fertilizer. The supply elasticity of rice with respect to its own price was approximately unity. Changes were estimated to have a greater impact on rice profit and supplies than changes in the real prices of mechanized land preparations, fertilizers or pesticides.

Chhotan Singh and Pramod Kumar\(^{39}\) have analyzed the time-series data (1970-81) of Wholesale prices of orange, banana, apple, almond and cashew in important markets of the country for these fruits. The wholesale price indices of fruits with 1970 as the base year were worked out for each market. The gross marketing margins and producer’s as well as middle men’s share in the consumer’s rupee of fruits were determined at two points of time, viz., 1970-71 and 1980-81 for the markets under study.

The results of the study indicate that during the last decade the wholesale price indices of almost all the fruits except apple showed a rising trend. The largest rise in the price was observed for cashew followed by banana and orange. The price of apple exhibited an erratic trend in all the markets. Hence special attention needs to

be paid for increasing the production of fruits in order to check the rising prices of fruits.

They have compared the changes in producer’s share in the consumers’ rupee at two points of time and reported that there is decline in the share in the case of fresh fruits and it remained more or less the same in the case of dry fruits but fail to give any reason for this. Similarly, comparison of gross marketing margins between markets for particular fruit fails to highlight the reasons for the kind of trend observed.

B.N. Patil and et al., examined the trends and growth rates in area, production and productivity and the factors responsible for change in acreage under banana crop in Jalgaon district of Maharashtra. The data were collected for the years 1950-51 to 1979-80 from published as well as unpublished secondary sources. The trends in area, production and productivity were estimated by fitting simple linear regression equation. A modified version of adjustment lag model developed by Overlove was used in linear form. In all, ten models were developed and regression analysis was carried out for the entire period. In addition to this, the regression analysis for different time periods (1950-51 to 1964-65 and 1965-66 to 1979-80) was also carried out.

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The important findings of the study are as follows:

The area under banana increased tremendously from 66 hundred hectares (1950-51) to 344 hundred hectares (1970-80) in the district. The production of banana has also increased sharply by almost 689 per cent during the same period. Farmers are responsive to banana prices. Current area under banana is observed to the highly responsive to lagged price. The effect of previous year’s prices of sugarcane, cotton, paddy, wheat, groundnut etc., is not significant in influencing the acreage of banana. There is no impact of rainfall in determining the acreage under banana. Net irrigated area and one year lagged price of banana jointly explained nearly 97 per cent of the variations in the acreage under banana. Lagged price of banana has influenced the acreage under banana in the same direction and magnitude during different periods. Net irrigated area has not exercised any influence on the acreage under banana in the early years. Farmers’ adjustment to changing circumstances is found to be quick during recent years of the study.

Khan\textsuperscript{41} et al., conducted a study on the inter regional analysis of farmers supply response of gram and lentil acreage for 1964-1985. They have analyzed the farm area, crop yield, cost-benefit analysis of a few grams and lentils in Punjab and Pakistan. Findings have revealed that the area under gram, lentils and over rabi pulse

declined by 14.8 per cent whereas Khariff pulses acreage has increased by 33.1 per cent. Growth rate trends showed a lower rate of decline for the lentil areas, but a higher rate of increase in yield. Gram acreage as well as yield declined. The role of both price and non-price factors in determining farmers' decision affecting shifts in gram and lentil acreage is examined with reference various regions of Punjab. The positive and significant impact of relative prices on both gram and lentil acreage was shown by multiple regression analysis in major gram and lentil growing regions. The relative yield variable had a positive and significant impact on gram acreage in Thal region, but a negative and non-significant effect in Sargodha region.

Bhagat\(^{42}\) examined the supply response of farmers growing wheat in Bihar using Nerlove's partial adjustment model for a period of 21 years (1956-57 to 1976-77) and measure acreage elasticities of wheat with respect to price, yield and other factors. Data for this study were collected from secondary sources of Season and crops reports and office of the department of agriculture, Government of Bihar. The ordinary least square method was employed for estimating the co-efficients of regression functions.

The findings of the study were

1) The study indicates inter-district variations in the supply response of wheat in Bihar. The partial variation in supply response is mainly responsible to the district characteristics.

2) The agricultural facilities in the districts appear to be the most important factor explaining inter-district variations in production.

3) The study supports the hypothesis of greater supply response in districts where the crop is less dominated.

4) The study also indicates the importance of tribal population and big landowners in explaining inter-district variations in supply response of wheat crop in Bihar.

5) The study emphasizes the need for suitable policy for the raising the level of agricultural infrastructure in the districts.

P. Indira Devi, E.K. Thomas and Jesy K. Thomas\textsuperscript{43} have analyzed the growth and supply response of banana in Kerala. The specific objectives of the study were:

a) To analyze the trend in area, production and productivity of banana in Kerala state.

b) To estimate the output response behaviour of banana growers in the state.

The data required for this study were compiled from various volumes of publications such as 'Statistics for Planning' by the Department of Statistics and the Economic Review of the State Planning Board. The semi log, exponential and quadratic models were tried to study the trend in area, production and productivity. A decomposition model was used to identify the relative contribution area and productivity of total production.

This study observed that the yield showed a declining trend in 1970-1980, while there was increasing trend during 1980-87. At the aggregate level its trend was found to be slightly decreasing mainly because of the effect in the first effect. The area under this crop during seventies showed a rising trend, whereas sharp decline was noticed during eighties.

From the analyses, it is evident that neither lagged absolute price nor the rainfall during planting months (September-October) as proxy for weather, responded significantly which indicated that they did not exercise any significant influence on the acreage allocation of this crop. The price variable, measured as the standard deviation of prices over the last three-preceeding production periods was found to be
positive and significant reflected the farmers risk bearing capacity trend on the
cultivation of banana. The price of banana had been showing an increasing trend
over the past 17 years. This may be one reason why the farmers always consider this
crop to be a worthwhile investment.

A.L. Nadda\textsuperscript{44} has specified two types of multiple regression models, i.e., linear
and double-log with different combinations of independent variables for estimating
acreage supply response in apple in Himachal Pradesh. The results in respect of
regression co-efficient and their significance are consistently superior in double-log
model. He has considered three alternative specifications in linear model and four in
double-log model to explain the variations in the area under apple, a perennial crop
of considerable economic interest. Among the set of various explanatory variables,
raw prices emerged as the crucial factor influencing the expectation behaviour of
apple growers in all the specified models. This finding supports the hypothesis that
hill farmers respond to prices while taking long-term investment decisions. The sign
and the magnitude of parity ratios indicate that though apple prices have not
increased at the same pace as the consumer price index. It indicates that the demand
for apples has not shown a commensurate increase with its supply. The other
variables like expected profitability, road length and trend are found to be associated
positively with acreage in all the models but do not emerge as strong as the raw price.

\textsuperscript{44} A.L.Nadda, “Supply Response of Perennial Crops a Study of Himachal Apples”,
The study provides sufficient clue to the planners and policy makers that price policy in apple can be an effective instrument in increasing the acreage under such crops.

Subramanian\textsuperscript{45} analyzed the area response of farmers growing groundnut in TamilNadu using Nerlove's Partial Adjustment Model for a period of 29 years (1957-58 to 1985-86). Further he measured the acreage elasticities of groundnut with respect to price, yield and rainfall. The secondary data for this study were collected from ‘Season and Crops Reports’ and ‘Handbook of Statistics’ published by the Govt. of Tamil Nadu. The ordinary least square method was employed for estimating the co-efficient of the regression functions.

The following were the findings of this study:

1) The decision of the groundnut growers of TamilNadu regarding area allocation for groundnut had positive correspondence with the prices of the competing crop and negative correspondence with its own farm harvest prices. These coefficients were of course statistically significant only for the state as a whole and few selected districts.

2) The area under groundnut was inelastic due to the farm harvest price of the government.

3) The factors such as socio-economic background, natural conservation, infrastructure and informal shortages and very little possibility of expanding the supply of land may be attributed to the poor acreage response of groundnut in TamilNadu.

Nagaraj and M.V.Srinivasa Gowda\textsuperscript{46} examined the supply response and instability of groundnut production in Karnataka state for the period of 26 years from 1964-65 to 1989-90. The time series data on the area, production and yield of groundnut crop and related agricultural statistics, Bangalore. To analyze the area and the response behaviour of groundnut the Nerlovian adjustment model was used. Hazell’s trend equation was used to know the instability of groundnut productions in Karnataka state.

The results indicated that lagged price of the crop influences significantly the area allocation decisions of farmers in Tumkur (151.010) Chitradurga (10.570) Raichur (64.825) and Kolar (2.313) districts. Farmer’s decisions are often based on the previous year’s prices, since they hope that the same price would continue in the current year also.

Further it reveals that lagged areas was a significant factor influencing the farmer’s decision regarding area allocation of groundnut in the state.

The instability of production of groundnut was relatively more stable in Chitradurga, Bijapura and Kolar districts. However, in Gulbarga district the production was destabilized to the extent of 12.86 per cent mainly due to yield variability (6.26 per cent). In Bijapur district, the production of groundnut was stabilized mainly by change in area variance (-348.44 per cent). This meant that stability of production was due to increase in area variability. The instability of groundnut production in the state was mainly due to change in the area variance in non-major groundnut producing district.

Nilabja Ghosh\(^47\) has attempted to test several hypotheses regarding supply response of food grains in agricultural policy. The hypotheses tested by them were 1) the growth of per capita production of rice, wheat and food grains as a whole and 2) to find out the possible connection between different policy actions of the government, on the one hand, and production and market prices on the other. They analysed the behaviour and responses of the supply of food grains in India. The Nerlovian model is used to study supply responses in agriculture particularly in India. The supply response of 1964-65 to 1989-90 was studied for rice, wheat and food grains as a whole.

This study reveals that the technology as well as the price policy favoured wheat; the same is not true for rice.

Hattink\textsuperscript{48} w et.al studied the cocoa supply response in Ghana. It is derived from the aggregate time series data. The present study presents results of a cross-section profit function analysis, based on farm level data. The data are obtained from the Agricultural Economics Survey conducted by the Ghana cocoa board 1987-88 (N-122). The results are compared with those of previous time series studies, and the methodologies of both type of study are compared and evaluated.

Omezzine and Jabri\textsuperscript{49} studied the supply response of vegetable growers in the Sultanate of Oman and the empirical investigation of vegetable grower’s responses to prices in Oman. It develops a single supply response function incorporating adaptive expectation model for prices. Results indicate that growers adjust relatively fast to changes in expected prices. However, these adjustments are rather low for some crops in the short and long run. Grower’s production decisions have also shown a significant response to prices of other products competing for farm space and other

\textsuperscript{48} Hattink, W, Heerink, N; Thussen, G; Supply response of cocoa in Ghana; a farm level profit function analysis. Tijdschrift voor Social Western Schappelijk Onderzoek van de Land-bour (1998/ 13 (2) 92-102 [En, 21 ref.]) Wageningen Agricultural University, Netherlands.

production resources. These results will support efforts aimed at market development and crop enhancement programmes.

Lin, Sanford and Skinner\textsuperscript{50} analyzed the acreage response of cotton. The own price supply elasticity is estimated at 0.466 for U.S. Upland cotton (0.466 per cent increase in cotton planting is associated with a 1 per cent increase in the expected cotton farm price.) up 7.9 per cent from 1986-90 when little planting flexibility existed. The cross-price elasticities, in all cases show larger increases under the 1996 Act. The cross price elasticity with respect to maize prices, for example is estimated at −0.147, compared with −0.019 during 1986-90. The increase in 1999 cotton planting intentions over 1998 partly reflects the facts that the expected decline in competing crop prices more than offsets the expected effective cotton price, along with 4 to 8 per cent declines in most competing crop price expectations, point to a slight increase in 2000 cotton planting intentions.

Parameshwar\textsuperscript{51} et. al, analyzed the production behaviour of ground nut farmers' in Karnataka employing Nerlovian Expectation-cum-adjustment model. The district-wise time series data for 18 years from 1975-76 to 1992-93 pertaining to


the hectarage, yield, production and post-harvest prices of ground nut and its competing crops (jowar, cotton, chilli and ragi) and month rainfall data were abstracted from the Bureau of Economics and Statistics, Government of Karnataka Bangalore. The prices of chemical fertilizers were collected from the Karnataka state Department of Agriculture, Bangalore.

The analysis reveals that the groundnut production lagged one year and showed a positive relationship with groundnut production in the current year. Its regression coefficient were statistically significant only in two districts.

The positive impact of rainfall factor on groundnut production revealed its pivotal role in the hectarage allocation decisions.

The negative elasticity of the production of groundnut with reference to fertilizer prices in all but two of the districts shows that the farmers are sensitive to changes in the price of fertilizers and reduce its application following a rise in its price.
C. Ramasamy et al. examined the supply response of sugarcane in Tamil Nadu with special reference to Erode District. The data related to this analysis are collected from various sources for the period of 1969-70 to 1994-95. In this study, elasticity coefficients were measured at the arithmetic mean of prices, areas and yields. Supply elasticity was obtained by summing the hectarage and yield elasticities, which were estimated separately. In Tamil Nadu, short run acreage elasticity is 0.4562; yield elasticity is 0.2872 and the supply elasticity is 0.7424. In case of Erode district, it is 0.0325, 0.0123 and 0.0448. Long run elasticity for Tamil Nadu in case of acreage elasticity is 1.0898. On the other hand, the Erode district long run elasticity is 0.0404, 0.0182 and 0.0568 respectively. In Erode district, acreage and yield elasticities are of lower magnitude resulting in inelastic nature of area response.

A farm level supply response model was framed in Sri Lanka by Mayadunne and others. This study reveals the relationship between price uncertainties and uncertain profits. An area supply model for paddy and chilli crop system was developed within a multi crop framework, assuming that farmers maximize the

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53 Mayadunne, A.G. Bogahawatta, C; Abeyratne, F; Area supply response to other field crops with uncertain prices and yields the case of chilli. Tropical Agricultural research (1999) 11, 239-254 (En,29 ref) Postgraduate Institute of Agriculture, University of Paredeniya, Paredeniya, Sri Lanka.
expected utility of a multi-attribute utility function having wealth at the end of the season and household rice requirement as the arguments. The model is estimated using Two stage Least Squares employing data collected from a cross section of farm households from Hambantota, Matale, Kurunegala and Anuradhapura districts, covering the 1995/96 Maha and 1996 Yala seasons. The estimates indicate that farmers are unlikely to be risk averse in Maha but in the Yala own profit risk is likely to be of significance in area supply. The simulation demonstrates the profit risk reducing and mean increasing effects of floor prices and the importance of cross commodity effects in the formulation of price support programmes. This analysis reveals that intensive cultivation increases agricultural productivity and there by meets the needs of the households demand.

Shakuntla Gupta examined the extent of acreage responses of major oil seeds crops in Punjab for the periods 1966-67 to 1995-96. In order to know the acreage response in this state multiple linear regression, multi-collinearity and auto-correlation have been used. Further in order to know farmers’ acreage allocation behaviour acreage elasticities were calculated.

The study arrived at the following conclusions:

1) The acreage allocation under groundnut crop in Punjab state is generally, governed by economic technological and structural reasons.

2) It has been found that relative yield, relative price and irrigation are the major factors affecting acreage, and allocation decisions.

3) The farmers in Punjab state are relatively more price conscious and commercially minded in area allocation decisions to realize the gain of price changes whereas the farmers in Bhatinda region are more responsive to yield.

Suriagandhi\textsuperscript{55} has studied the supply response banana in Tamil Nadu with special reference to Madurai District for the period 1976-77 to 1995-96 using Nerlovian Partial Adjustment model in both linear and log-linear form. The above study came to the following conclusions.

The acreage response analysis laid down using log-linear form has led to the conclusion that the one year and two year lagged price, standard deviations and trend variable were found to be statistically significant in all cases which indicated that these variables have positive impacts on important decision making variables of area under banana. All other variables did not play any principal role in the acreage allocation under banana crop in Tamil Nadu.

The estimated yield response of banana for Tamil Nadu using linear form indicated that the two-year lagged price, annual and monsoon rainfall, profit factors and trend variable influenced positively and significantly in all cases. Moreover the co-efficient of competing crop acreage (paddy) showed negative influence in a few cases and all other variables did not appear to be significant. The short-run and long run elasticities and co-efficient of adjustments were worked out from the area response functions of linear form.

The cross price elasticities of the inputs were negative and low in all cases implying that these variables were complements rather than substitutes of every other factor input. The output supply elasticities for small and large farmers with respect to own prices were 0.0481 and 0.0943 respectively. A 10 per cent increase in banana price would increase their output supply by 0.48 per cent and 0.94 per cent respectively. This implied that the Vaddipatti farmers were highly response to changes in banana price. Banana price is considered as an effective tool to increase output supply in Vaddipatti Block.

Venkatram56 et. al examined the supply response of major food crops in the three districts of Tamil Nadu viz, Kanyakumari, Tirunelveli and Thoothukudi. The study is based on the secondary data covering the period from 1970-71 to 1996-97.

The data on area, production and productivity of different crops, rainfall, and prices were collected from various sources like Season and Crop reports and from Department of Statistics. The study was carried out for rice, banana, blackgram and chillies. The Nerlevian dynamic model was used.

The study concluded that in Tirunelveli district the area under banana, sugar crops and vegetables showed a gradual increase and the other major food crops like chillies and coriander showed only a mixed trend. In Kanyakumari district, a gradual decline in area under food crops both in actual area and also in percentage of area under food crops to gross cropped area is noticed. Except the area under banana, the area under other crops like sugar crops, mango, cashew, tapioca and vegetables showed only a decline in area. Among the non-food crops in Kanyakumari district, a gradual decline in area under groundnut is noticed.

The cropping pattern index worked out for the Tirunelveli (composite) district showed that the area under millets pulses and food grains in aggregate has been declining since 1970’s. The other crops like banana and spices are found to be showing an increasing trend.

The cropping pattern index in Kanyakumari district also revealed a gradual decline in area under rice. Except banana other crops like Palmyra, mangoes and cashew have been reduced.
The equation estimated in Tirunelveli (composite) district the $R^2$ value was 0.44 for rice. In Kanyakumari district, it was at the rate 0.72. For banana the $R^2$ value in Tirunelvelli District was 0.78 and for Kanyakumari district it was 0.84.

A brief review of literature carried out above it is clear that the studies on instability and supply response of banana at the district level are very limited. The present study attempts to fulfill this research gap for Kanyakumari District of Tamil Nadu.
SECTION II: METHODOLOGY

The present study aims to analyse the growth performance of banana in Kanyakumari district in terms of its production, area and yield, to estimate the extend of instability and to examine the influence of price and non price factors on acreage under banana in Kanyakumari district during the period 1970-71 to 1999-2000. This section has been divided into three sub-sections, the first sub-section devoted to the study of growth rates, the second sub-section delineates the estimation of instability and its contributing factor to the production of banana and the third sub-section explains the acreage response models adopted in this study. The three objectives of this study are closely interrelated and bear significance in agricultural planning and development of Kanyakumari district.

A. Growth Analysis

Compound growth rates were used to know the growth pattern in production, area and yield of banana in Kanaykumari district, using the exponential trend of the following form:

\[ Y_t = ab^t \]

i.e., \( \log Y_t = \log a + t \log b \)

Growth rate \( r = [(\text{anti log } b) - 1] \times 100 \)

t is the year represented by 1,2,3,----------
Y_t = Production / area / yield in the year t.

a and b are parameters to be estimated.

r = compound growth rate.

Semilog quadratic trend equation of the following form was also tried to the data of production, area and yield of banana to find out the acceleration and deceleration trend.

Log Y_t = a + bt + ct^2

In this model the growth rate is

\[ G = \frac{\sum (b+2ct)}{n} , t=1,2, \ldots \ldots n \]

For the significant c and b, if b>0 and c>0 the growth rate is increasing at an increasing rate ie; accelerating. If b<0 and c>0 the growth rate is increasing from a negative value increasing rate provided \( t > \frac{-b}{2c} \)

if b>0 and c<0, the growth curve Y is decreasing as long as

\[ t > \frac{-b}{2c} \] since \[ \frac{dGt}{dt} \] is negative\(^{58}\)

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B. Analysis of Instability

Before measuring instability, the variability in production of the selected crops are tested using Mann-Whitney's non-parametric test of variability.

To know whether there is variability in the statistical sense in the production of the banana, the time series data of production of banana crop is subjected to Mann-Whitney's Non parametric Test\textsuperscript{59}

We may test the Null Hypothesis

\[ H_0: \text{Var}(X) = \text{Var}(Y) \]

Against, \[ H_1 = \text{Var}(X) > \text{Var}(Y) \text{ or } \text{Var}(X) < \text{Var}(Y) \] where 'X' s and 'Y' s are the values of variables in the first and second periods respectively.

In order to study the instability in area and yield which are the sources of production instability, the coefficient of variation and the Coppock's instability index were estimated.

\[
\text{Coefficient of variation}^{60} = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100
\]


\textsuperscript{60}S.V. Bharathi, S.M.Shareefi and V.T.Ragu, "Instability of pulses production in Andhra Pradesh - An Economic Analysis", \textit{Agricultural Situation in India}, Vol XLVII, No.8, November, 1952, P.631
Coppock's Instability index\textsuperscript{61} is calculated using the formula of

\[
\log v = \frac{(\sum (\log X)_t + 1) - M}{N}
\]

The Instability Index

\[=(\text{Antilog} \sqrt{\log v - 1}) \times 100\]

Where \( x \) = Area or productivity of a crop in year \( t \)

\( N \) = the number of years minus one

\( M \) = the arithmetic mean of the differences between the logs of \( X_t \) and \( X_{t+1} \)

\( V \log V \) = The logarithmic variance of the series

The following steps are involved in the construction of Coppock’s Instability Index:

1. Logarithms are obtained for each annual value of a variable

2. The logarithm of the value for year two is subtracted from the logarithm of the value for year one etc in order to get the first differences of logarithm of the value for the year.

3. The arithmetic mean of the logarithmic first differences is then obtained.

4. The logarithmic mean is then subtracted from each year to year logarithmic first difference in order to obtain the logarithmic differences between the actual and the average year to year logarithmic differences.

5. The logarithmic differences from trend some positive and some negative are then squared, summed up and divided by the number of years minus one. The resulting number is referred to as the log variance.

6. The next step is to take the square root of the log variance and obtain the antilog of the square root value. Unity is then subtracted from the antilog and decimal moved two places to the right. The resulting instability index is a close approximation of the average year to year percentage variation adjusted for trend.

Sources of Instability

The methodology to analyse instability used in this study is built upon the lines of the work by Peter B.R. Hazell\textsuperscript{62}. Here an attempt is made to break down the growth of production during the period 1970-71 to 1999-2000 for banana crop of Kanyakumari district. The area and yield data for banana is detrended using linear relations of the form:

\[ Z = a + bt + e \quad \ldots \ldots \ldots \ldots \ldots \; 1 \]

Where \( z \) denotes dependent variable (area/yield), \( t \) is time and \( e \) is a random residual with mean 0 and variance \( \sigma^2 \). Separate regressions are run for each of the two time periods 1970-71 to 1984-85 and 1985-86 to 1999-2000. After detrending the residuals centered on the mean areas or yield for each period, \( \overline{Z} \) resulting in detrended time series data is of the form:

\[ Z = e + \overline{z} \quad \ldots \ldots \ldots \ldots \ldots \; 2 \]

The residuals centered on the mean areas or yields for each period became the primary data for analysis time series data on detrended production for each crops are calculated by the detrended areas and yields.

Let \( Q \) denotes production, \( a \), the area sown and \( Y \) the yield. Then for banana crop \( Q = aY \). As shown by Goodman (1960) and Bohrnstedt and gold Berger (1969) the variance of production \( V(Q) \) can be expressed as

\[ V(Z) = \overline{A}^2 V(Y) + \overline{Y}^2 V(A) + 2 \overline{A} \overline{Y} \text{Cov} (A,Y) - \text{Cov}^2 (A,Y) + R \quad \ldots \ldots \ldots \ldots \ldots \; 3 \]

Where \( \overline{A} \) and \( \overline{Y} \) denote the mean areas and yields and \( R \) is a residual term clearly a change in any one of these components will lead to a change in \( V(Q) \) between two periods in time. Similarly, average production \( E(Z) \) can be expressed as

\[ E(Z) = \overline{A}Y + \text{Cov} (A,Y) \quad \ldots \ldots \ldots \ldots \ldots \; 4 \]
It is affected by changes in the covariance between area and yield and by changes in mean area and mean yield. The objective of the decomposition analysis is to partition of the changes in \( V(Q) \) and \( E(Q) \) between the first and second periods into constituent parts, which can be attributed separately to changes in the means, variance and covariances of areas and yields. We present the method of decomposition of average production because it is a least cumbersome to present and adequately illustrates the principles involved.

Using equation (4), average production in the first period is

\[
E(Q_1) = \bar{A}_1 \bar{Y}_1 + \text{Cov}(A_1, Y_1) \quad --- 5
\]

and in the second period it is

\[
E(Q_2) = \bar{A}_2 \bar{Y}_2 + \text{cov}(A_2, Y_2) \quad --- 6
\]

Each variable in the second period can be expressed as its counterpart in the first plus the change in the variable between the two periods for example,

\[
\bar{A}_2 = \bar{A}_1 + \Delta A \text{ as.}
\]

\[
E(Q_2) = (A_1 + \Delta A_1) (\bar{Y}_1 + \Delta \bar{Y} + \text{cov}(A_1, Y_1) + \Delta \text{Cov}(A, Y)) \quad --- 7
\]

The change in average production \( \Delta E(Q) \) is then obtained by subtracting equation 5 from equation 7. Thus

\[
\Delta E(Q) = E(Q_2) - E(Q_1) = \bar{A}_1 \Delta \bar{Y} + \bar{Y} \Delta \bar{A} + \Delta \bar{A} \Delta \bar{Y} + \Delta \text{Cov}(A, Y) \quad --- 8
\]

which can be arranged as in Table 6.1.
### TABLE 2.1

COMPONENTS OF CHANGE IN AVERAGE PRODUCTION

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Sources of Change</th>
<th>Components of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Change in mean yield</td>
<td>$\Delta \bar{Y}$</td>
</tr>
<tr>
<td>2</td>
<td>Change in mean area</td>
<td>$\Delta \bar{A}$</td>
</tr>
<tr>
<td>3</td>
<td>Interaction between changes in mean area and mean yield.</td>
<td>$\Delta \bar{Y} \Delta \bar{A}$</td>
</tr>
<tr>
<td>4</td>
<td>Change in area yield covariance</td>
<td>$\Delta \text{Cov} (A,Y)$</td>
</tr>
</tbody>
</table>

The change in the variance of production $\Delta V(Q)$ can be decomposed in the same way and can be arranged as in Table 6.2.
## TABLE 2.2

### COMPONENTS OF CHANGE IN THE VARIANCE OF PRODUCTION

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Sources of Change</th>
<th>Description</th>
<th>Symbols</th>
<th>Components of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Change in mean yield</td>
<td>Δ ( \bar{Y} )</td>
<td>[2Δ\bar{A}_1Δ\bar{Y}\text{Cov} [Y_1, A_1] + 2Y_1Δ\bar{Y} + (Δ\bar{Y})^2 \text{V}(A_1)]</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Change in mean yield</td>
<td>Δ ( \bar{A} )</td>
<td>[2Y_1Δ\bar{A}\text{Cov} (Y_1, A_1) + (2\bar{A}_1, Δ\bar{A} + [Δ\bar{A}] \text{V}(Y)_1]</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Change in yield variance</td>
<td>Δ ( V(Y) )</td>
<td>[ [Δ\bar{A}_1]^2 Δ V(Y) ]</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Change in area variance</td>
<td>Δ ( V(A) )</td>
<td>[ (\bar{Y}_1)^2 Δ V[A] ]</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Interaction between changes in mean yield and mean area</td>
<td>Δ ( \bar{Y} Δ \bar{A} )</td>
<td>[2Δ\bar{Y} Δ \bar{A}\text{Cov}(Y_1, A_1)]</td>
<td></td>
</tr>
</tbody>
</table>
| 6      | Changes in area yield covariance | Δ \( \text{Cov}(Y,A) \) | \[(2\bar{A}_1\bar{Y}_1 - 2\text{Cov}[Y_1, A_1] Δ \text{Cov}[Y, A] - (Δ \text{Cov}(Y_1 A_1^2)) \]
| 7      | Interaction between changes in mean area and yield variance | Δ \( \bar{A} Δ V(Y) \) | \[2\bar{A}_1Δ \bar{A} + [Δ \bar{A}]^2 Δ V(Y) \] |
| 8      | Interaction between changes in mean yield and area variance | Δ \( \bar{Y} Δ V(A) \) | \[2\bar{Y}_1Δ \bar{Y} + (Δ \bar{Y})^2 Δ V(A) \] |
| 9      | Interaction between change in mean area and yield | Δ \( Y Δ A Δ \) \( \text{Cov}(Y, A) \) | \[2\bar{Y}_1Δ \bar{A} + 2\bar{A}_1Δ \bar{Y} + 2Δ \bar{A} Δ \bar{Y}) Δ \text{Cov}(Y, A) \] |
| 10     | Change in area yield covariance change in residual | ΔΩ | Δ\( V(AY) \) - Sum of the other components |
C. Analysis of Supply Response

There are three distinct approaches for analysing the acreage response in the case of farm commodities, viz; the traditional model, expectation model and Nerlovian adjustment lag model\(^{63}\). In the present study the adjustment lag model will be utilized for analysis. Nerlove introduced the element of dynamism by incorporating the concept of distributed lags in the analysis of the acreage response of agricultural commodities. He defined a long-run acreage (supply) response function in the following manner.

\[ A_t^* = \alpha + \beta + P_{t-1} + V_t \]

\[ A_t^* = \text{desired long-run acreage} \]

\[ P_{t-1} = \text{price lagged by one year} \]

\[ V_t = \text{error term} \]

\[ \alpha \text{ and } \beta \text{ are the constant and partial regression coefficients respectively.} \]

Again it is related with the actual average by assuming that in each period the actual area under crop is adjusted in proportion to the difference between the long run desired level of area and actual area under the crop in question.

\[ A_t - A_{t-1} = \beta (A_t^* - A_{t-1}) \]

Where $\beta$ = coefficient of adjustment and substituting the value of equation 1 into equation 2 and solving for $A_t$ we get.

$$A_t = C_0 + C_1 P_{t-1} + C_2 A_{t-1} + V_t \quad \text{-------3}$$

Where $C_0 = a_0 \beta$

$C_1 = a_1 \beta$

$C_2 = (1-\beta)$ and

$V_t = \beta_{ut}$

Equation (3) is the reduced form and its parameters can be estimated by the use of ordinary least squares. However, more independent variables can be included in the model. In this study the independent non-price variables such as annual rainfall, yield of banana, risk in prices and profit per hectare have been added.

The short run elasticity (SRE) and to long run elasticity (LRE) can be obtained by using the following relations.

$$SRE = \frac{\bar{P}_{t-1}}{\bar{A}_t}$$

$$LRE = \frac{C_1}{1-C_2} \frac{\bar{P}_{t-1}}{\bar{A}_t}$$

Where $\bar{A}_t$ and $\bar{P}_{t-1}$ are the averages of the variables.
Regression models of the following 10 types have been used in this study.  

I. \[ A_t = \alpha + \beta_1 P_{t-1} + \beta_2 A_{t-1} + u_t \]  

II. \[ A_t = \alpha + \beta_1 P_{t-1} + \beta_2 A_{t-1} + \beta_3 W_t + u_t \]  

III. \[ A_t = \alpha + \beta_1 \begin{bmatrix} P_{t-1} \\ P_{t-2} \end{bmatrix} + \beta_2 A_{t-1} + u_t \]  

IV. \[ A_t = \alpha + \beta_1 \begin{bmatrix} P_{t-1} \\ P_{t-2} \end{bmatrix} + \beta_2 A_{t-1} + \beta_3 W_t + u_t \]  

V. \[ A_t = \alpha + \beta_1 P_{t-1} + \beta_2 A_{t-1} + \beta_3 Y_{t-1} + u_t \]  

VI. \[ A_t = \alpha + \beta_1 \begin{bmatrix} P_{t-1} \\ P_{t-2} \end{bmatrix} + \beta_2 A_{t-1} + \beta_3 Y_{t-1} + u_t \]  

VII. \[ A_t = \alpha + \beta_1 \begin{bmatrix} P_{t-1} \\ P_{t-2} \end{bmatrix} + \beta_2 A_{t-1} + \beta_3 Y_{t-1} + \beta_4 W_t + u_t \]  

VIII. \[ A_t = \alpha + \beta_1 \begin{bmatrix} P_{t-1} \\ P_{t-2} \end{bmatrix} + \beta_2 A_{t-1} + \beta_3 Y_{t-1} + \beta_4 W_t + \beta_5 R_t + u_t \]
IX. \[ A_t = \alpha + \beta_1 \left[ \frac{P_b}{Pr} \right] + \beta_2 A_{t-1} + \beta_3 Y_{t-1} + \beta_4 W_t + \beta_5 R_t + \beta_6 \pi_{t-1} + u_t \]

X. \[ A_t = \alpha + \beta_1 \left[ \frac{P_b}{Pr} \right] + \beta_2 A_{t-1} + \beta_3 Y_{t-1} + \beta_4 W_t + \beta_5 R_t + \beta_6 \pi_{t-1} + T_t + u_t \]

Where,

\( A_t \) = Area under banana during the current year

\( P_{t-1} \) = Price of banana during the previous year, expressed in rupees for 100 units

\( A_{t-1} \) = Area under banana during the previous year in hectares.

\( W_t \) = Annual rainfall in mms during the current year

\( P_b \) = Price of banana in rupees per kilograms

\( Pr \) = Price of rice in rupees per kilogram

\( Y \) = Yield of banana in Kg/ha during the previous year

\( R \) = risk during the current year, measured by standard deviation of prices of banana during the previous 3 years.

\( \pi \) = Profit per hectares in rupees (Yield per hectare x Price – Cost of Production)

\( T \) = time trend variable measured as 1,2,3………

\( u \) = Stochastic disturbance term

\( \alpha \) = Constant term
$\beta_i \ldots \beta_6$ are the partial regression coefficients.

$t$ = time subscript.

In all the above the regression models area under banana. $A_t$ is the dependent variable. In the equation I lagged price (and lagged are $A_{t-1}$) are the explanatory variables. In equation II apart from $P_{t-1}$ and $A_{t-1}$ the weather variable rainfall ($W_t$) has been added. In equation III the lagged relative price $P_r$ and lagged area are the explanatory variables.

In equation IV apart from lagged relative price and lagged area, weather variable has also been included. In equation V lagged price, lagged area, lagged yield are the independent variables, while in equation VI instead of lagged price lagged relative price has been included. Equations VII to IX are extension of equation VI. In equation VII $W_t$ has been added. In equation VIII. In the last equation X $W_t$, $R_t$, $\pi_{t-1}$ and $T_t$ have been added apart from lagged price variable, lagged area, and lagged yield. In equation IX lagged price, lagged area, lagged yield, current rainfall risk variable and lagged profit are the explanatory variables.

All the above ten equations have been estimated in both linear and log linear forms. For the estimation of these equations the method of ordinary least square has been employed.
Choice of banana

With the progress in the standard of living, fruits have been gaining popularity in human life. Fruits are a rich source of nutrition and their importance cannot be overlooked. Fruits are a rich source of energy and have medicinal values. As a horticultural crop they yield a significant percentage of income to the farmers of Tamil Nadu. Of the various types of fruits cultivated in India banana is one of the important fruit crops. In production of banana India ranks first at the international level. Banana is one of the three fruits popularly known as Mukkanikal (Mango, Jack and banana).

Tamil Nadu, Banana trees are known as 'Kalbatarus', the reason being that all parts of the this tree are used by the people for various purposes. Besides banana fruits are available for consumption throughout the year. This is a rare feature found in banana among the various fruits in Tamil Nadu. Banana is supposed to be a major commercial crop in Kanyakumari district and the development in the banana economy is expected to go a long way in the economic development of cultivators and farmers in Kanyakumari district.

Choice of Kanyakumari district

This district was purposively selected for this study. It is one of the progressive agricultural districts of Tamil Nadu. More than 50% of the population of
this district depends upon agriculture. Banana is one of the important food crops cultivated in this district. Of the total area of this district, banana occupies more than 5 per cent of the total cropped area. This district has mango, and banana based small scale industries for which banana fibres are the basic raw materials. These industries produce a wide range of decorative articles and utility articles like carry bags, toys, tablemats, tea coaster, pot hangers and ladies hand bags. Different varieties of banana are cultivated in this district because of favourable climatic and soil conditions. At the state level this district, occupies about 5 per cent in total banana area and about 5 per cent in total banana production. The yield per hectare in this district almost coincides with the state level average yield of banana. This district is most famous for the best variety of nendran banana.

Choice of the Period

The present study covers the period 1970-71 to 1999-2000. This period was arbitrarily chosen. This period of 30 years has been divided into two sub-periods namely sub period i) 1970-71 to 1984-85 sup period ii) 1985-86 to 1999-2000 and iii) the whole period 1970-71 to 1999-2000. The year 1984-85 is considered as a year of demarcation for the reason specified below. From 1984-85 onwards Kanyakumari district suffered from a severe drought for a continuous period of three years which brought a turning point in the cultivation practices of farmers in Kanyakumari.

\[64\] Rainfall statistics, season and Crop Report for the years 1985-86 to 1987-88; Directorade of statistics Government of Tamilnadu Madras.
district. During the drought years paddy producing farmers shifted the cultivation from paddy to banana due to the reason that banana can be cultivated with less water compared with paddy. Though the situation changed after 3 years the paddy-growing farmers continued banana cultivation as it was more profitable than paddy. Therefore 1984-85 was taken as a cut off year for the classification of the while period into two sub-periods.

Limitations of the Study

Following are the limitations of this study

a) The study deals with the district level aggregate variables of production, area and yield of banana, not the micro level production, area and yield.

b) The study is based on only the published secondary data and not on field level primary data.

c) Though in Kanyakumari district many varieties of banana are grown the variety-wise data on area and yield are not available. So the study has utilized the aggregate data representing all the varieties cultivated in this district. The conclusions derived in this study should not be applied to any particular variety of banana cultivated in this district.

d) The study could arrive at conclusions regarding only the district level analysis of banana economy in terms production area and yield. So the conclusion regarding

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65Department of Statistics, Kanyakumari District, Nagercoil.
growth, instability and supply response should not be extended to the banana economy of the state.

e) The time-series data used in this study are subject to many limitations. One of the limitations of time series data is that annual series of data is a sample. It is usually assumed that these annual observations are independent of each other. However this assumption is rarely fulfilled. This leads to the problem of auto correlation. Besides in multiple regression models the tendency of many economic variables to move together in the same trend and cyclical pattern over time creates the problem of multi collinearity. Temperature and evaporation have crucial relation to the growth process of crops. But these factors could not the included in this study.

f) All the limitations of the techniques used in the study are applicable to this study also. The conclusions arrived in this study should be interpreted keeping in view the above limitations of this study.