SUPPLY BEHAVIOUR OF SESAMUM AND GROUNDNUT IN KERALA

By

CHANDRABHANU P.

THESIS

Submitted in partial fulfilment of the
requirement for the degree of

Master of Science in Agriculture

Faculty of Agriculture
Kerala Agricultural University

Department of Agricultural Economics
COLLEGE OF HORTICULTURE
Vellanikkara - Thrissur
1991

DECLARATION

I hereby declare that this thesis entitled "Supply behaviour of sesamum and groundnut in Kerala" is a bonafide record of research work done by me during the course of research and that this thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any University or Society.

Vellanikkara
Feb., 1991

CHANDRABHANU, P.

CERTIFICATE

Certified that this thesis entitled "Supply behaviour of sesamum and groundnut in Kerala" is a record of research work done independently by Sri. Chandrabhanu, P. under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

Dr. E.K. Thomas
Chairman
Advisory Committee
Associate Professor
Department of
Agricultural Economics
Kerala Agricultural
University

Vellanikkara
15 Feb., 1991

Approved by:

Chairman

Dr. E.K. THOMAS
Associate Professor
Department of
Agricultural Economics
Kerala Agricultural
University

Members

1. Dr. V. RADHAKRISHNAN
Professor and Head
Department of
Agricultural Economics
Kerala Agricultural
University

2. Dr. T. PRABHAKARAN
Professor
Department of Animal
Production Economics
Kerala Agricultural
University

3. Sri. V.K.G. UNNITHAN
Associate Professor
Department of
Agricultural Statistics
Kerala Agricultural
University

ACKNOWLEDGEMENTS

I would like to place on record my complete indebtedness to Dr. E.K. Thomas, Associate Professor, Department of Agricultura Economics, Kerala Agricultural University and Chairman of my advisory committee for the valuable guidance given to me throughou the course of my research work and during the preparation of the thesis.

I am deeply thankful to Dr. V. Radhakrishnan, Professor and Head, Department of Agricultural Economics, Kerala Agricultural University who critically examined the work and provided many useful suggestions.

I am much obliged to Dr. T. Prabhakaran, Professor, Department of Animal Production Economics, Kerala Agricultural University for the constructive criticisms offered during the preparation of the manuscript.

I am grateful to Sri. V.K.G. Unnithan, Associate Professor of Agricultural Statistics for providing insights into the statistical analysis of data.

I am also much thankful to my friends Meagle Joseph, Miniraj, Narayanankutty, Viswanathan, Dr. V.K. Raju, Kalyanakrishnan and Ratheesh for their assistance in the preparation of the thesis.

The Junior fellowship offered by the Kerala Agricultural University is thankfully acknowledged.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Introduction

INTRODUCTION

Oils and fats constitute an essential ingredient of human diet. Oilseeds are the main source of vegetable fat. They are also rich in protein. They provide the basic raw material for several processing industries. Oil is an essential cooking medium for most families and it is an ingredient in the manufacture of a number of items such as soaps and paints. It also provides employment to many persons in various activities such as production, marketing and processing. Oilseeds are also an important export item where supply limitations have been the major bottleneck in increasing the export earnings.

India is a major producer of oilseeds accounting for nearly 10 per cent of world vegetable oils and fats production. It also has the largest number of commercial varieties of oilseeds viz., groundnut, rape and mustard, sesamum, linseed castor, safflower, niger, soyabean, sunflower, cotton seed and a number of other minor oilseeds of tree origin.

Prior to the Second World War, India enjoyed a premier position in the world trade in vegetable oils and fats. Even today, it can claim to be the largest producer of groundnut and sesamum and the second largest producer of rape seed - mustard, linseed, and castor seed (F.A.O. 1984). However, the internal demand has been rising over the years on account of increasing population, rising income coupled with high income elasticity of demand and rapid industrialization and infact, the country has been experiencing acute shortage of vegetable oils and fats for the past two decade, as domestic production has been rather sluggish.

With the overall demand for edible oils increasing much faster than production of oil seeds, prices of oil seeds/ vegetable oils have been displaying a secular rising trend since the nineteen fifties, the uptrend gathering momentum particularly since 1967-68 when oil seed output growth started slackening. Liberal imports of edible oils which, in recent years, averaged worth around Rs.1000 crores per annum, and indirect stabilization measures such as banning of forward trading in oil seeds/edible oils selective credit control, regulation of oil mix used in the manufacture of vanaspati etc., besides initiating schemes for stepping up production, were resorted to by the government to manage supply and demand and these measures could at best be in the nature of temporary relief operations.

The importance of increasing oilseeds production has been well recognised by the Government. The Seventh Plan document observed "..........short falls in the availability of edible oils have posed major problems in the sixth plan and hence the seventh plan incorporates a special effort at increasing the production of oil seeds. The area under major oil seeds is expected to go up by 1.5 million ha and yields are expected to increase by 28 per cent. As a result, the total production of major oilseeds is targetted to go up from 13 million tonnes in 1984-85 to 18 million tonnes in 1989-90...."

The targets of production of oilseeds in Seventh Plan were as follows:

Targets of oilseeds production in Seventh Plan

Oilseed crop	1984-85 assumed as base level	Seventh plan target	Compound Growth rate
Groundnut	7.3	9.37	5.11
Rapeseed and mustard	2.6	3.82	8.03
Sesamum	0.6	0.74	4.28
Safflower	0.5	0.72	7.71
Niger	0.2	0.25	4.56
Soyabean	0.6	1.28	16.27
Sunflower	0.3	0.60	14.98
Linseed	0.5	0.66	5.61
Castor	0.4	0.56	6.96
Total oilseeds	13.00	18.00	6.72

Source: Seventh Five Year Plan 1985-90 Vol.2, GOI
Planning Commission, New Delhi.

As a long term solution to the problem of supply-demand equilibrium during the seventh plan the Government of India initiated in 1984-85 the National Oilseeds Development Programme (NODP) by reorienting and integrating the then existing centrally sponsored schemes and two special projects - one on groundnut and the other on soyabean. In order to provide adequate support to the N.O.D.P., a Technology Mission on oil seeds has also been set up. The main objective of the mission is to make the country self-sufficient in edible and non-edible oils and to reduce imports through an integrated approach involving different developmental, scientific, input, banking and marketing agencies. The crops that receive priority are: groundnut, rapeseed, mustard, soyabean, sunflower, safflower, linseed, sesamum and niger in the given order.

The main constraints in the way of increasing the production of oilseeds in India are grouped under four heads viz. Environmental, Technological, socio-economic and organisation-infrastructural (symposium on oilseeds production and utilisation, New Delhi, 1984).

(a) Environmental constraints

About 85.7 percent of the area under oilseed crops is rainfed comprising mostly of marginal and submarginal lands with soils of poor fertility. Pests and diseases also cause substantial production losses.

(b) Technological constraints

Paucity of a large range of high yielding varieties particularly the ones which could give high stable yields under rainfed conditions and resist or evade pests and diseases, centrally sponsored schemes and two special projects - one on groundnut and the other on soyabean. In order to provide adequate support to the N.O.D.P., a Technology Mission on oil seeds has also been set up. The main objective of the mission is to make the country self-sufficient in edible and non-edible oils and to reduce imports through an integrated approach involving different developmental, scientific, input, banking and marketing agencies. The crops that receive priority are: groundnut, rapeseed, mustard, soyabean, sunflower, safflower, linseed, sesamum and niger in the given order.

The main constraints in the way of increasing the production of oilseeds in India are grouped under four heads viz. Environmental, Technological, socio-economic and organisation-infrastructural (symposium on oilseeds production and utilisation, New Delhi, 1984).

(a) Environmental constraints

About 85.7 percent of the area under oilseed crops is rainfed comprising mostly of marginal and submarginal lands with soils of poor fertility. Pests and diseases also cause substantial production losses.

(b) Technological constraints

Paucity of a large range of high yielding varieties particularly the ones which could give high stable yields under rainfed conditions and resist or evade pests and diseases, and lack of appropriate post harvest technology to prevent post harvest losses and deterioration in quality are some of the technological constraints.

(c) Socio-economic constraints

Most of our farmers are small and marginal with little wherewithals to invest on various inputs. Further, oilseeds being grown mostly under rainfed conditions become high risk crops with the result that oilseed crops are grown mostly under poor crop management resulting in low yields. The non-realisation of the benefit of improved crop production technology is, there fore, more due to poor economic condition of the farmer.

(d) Organisational and infrastructural constraints

Inadequate arrangement for production and distribution of quality seeds, timely supply of various inputs, credit, irrigation, transfer of technology from research to farmers, storage, grading and marketing of oil seeds coupled with wide fluctuation in price etc. stand in the way of achieving a rapid increase in oilseed production.

Product price is generally considered as an important instrument for stimulating agricultural production, though as indicated above there are other serious limitations in the case of oil seeds. The N.O.D.P. and the Technology Mission are expected to grapple with the constraints. However, an appropriate price policy has its role to play, at least as a compliment to various other policies and programmes. Thus, according to Kalhon and Gurumurthi (1981) " in the long run, the growth of oilseeds has to be stimulated through primemoving technological and institutional improvements supported by a complementary price policy, which by their positive interaction would help raise the overall profitability of oilseeds vis-a-vis competing crops through yield improvement and lead to reduction in unit cost, thereby benefiting the farmer, the consumer and the country as a whole".

Though Kerala is a minor producer of oil seeds, it appears that there is scope for increasing the production of oilseeds in the state, thus enabling the state to contribute its might in the national effort to become self-sufficient in edible oils.

The two important oilseed crops grown in the state are groundnut and sesamum. Recently, coconut was declared as an oilseed by the Government of India. The cultivation of groundnut is mainly confined to Palakkad district, lying adjascent to Tamil Nadu, a major groundnut producing state in South India. The main cropping season is the kharif, when the crop is rainfed. Recently attempts have been made to propagate the crop in other areas and in Rabi season with a few life saving irrigations. Sesamum is grown mainly in Southern and Central Kerala, in the districts of Kollam, Alappuzha, Ernakulam, Thrissur, Malappuram and Palakkad. The crop is grown in summer as a rainfed crop mainly in rice fallows where a summer rice crop is not possible on account of water scarcity. In a few pockets, however, the crop is grown in uplands during August - December period.

In the state, the two oilseed crops had received only scanty attention in the past. However, in view of the overall efforts to raise the output level of oilseeds at the national level, the state also will have to step up the production of oilseeds. Even as early as in the fifties, the Kerala farmers had shown a tendency to switch over to cash crops from food crops (George, 1965). This trend had persisted over the years. Recently Lakshmi and Pal (1988) in their study on the growth of crop output in Kerala observed, "One of the major changes that has been taking place in Kerala is the gradual shifting of area from food crops like rice and Cassava to plantation crops like rubber, coconut, cashew and coffee. The relative position of pepper, tea, arecanut and ginger have mainly stabilised with slight decrease from the base period........... To a large extent, this is indicative of the desire of the Kerala farmers to switch over to high value crops for optimising income from the limited land resources ...." However oilseeds have been an exception to this trend. The production of both sesamum and groundnut has been falling over the years. This fact is borne out clearly by the following figures.

	Production (in tonnes)			Percentage change between 1983-84 and 1985-86
	1976-77	1983-84	1985-86	
Groundnut	17.453	8.578	6.001	¯30.04
Sesamum	4.45	3.838	3.702	¯3.54

Source: Directorate of Economics and Statistics, Thiruvananthapuram.

The poor performance of the two oilseed crops may be due to several factors. The inhibitory factors identified at the national level may be operating in the state also. However, the present study focuses mainly on the role of prices as a determinant of the supply of oilseeds in the state. In the context of the overall shortage of edible oils in the country, an enquiry into the supply behaviour of oilseeds in non-traditional areas like Kerala assume importance.

The specific objectives of the present study are

i) To estimate trends in area, production and productivity of oilseeds (sesamum and groundnut) in Kerala.

ii) To estimate short run and long run supply elasticities of oilseeds (sesamum and groundnut) in Kerala.

The study is presented in five chapters. In the next chapter a comprehensive review of literature relevant to the present study is given. The third chapter deals with the methodology adopted in the present study. The results and discussion are presented in the fourth chapter. A summary of

Review of Literature

REVIEW OF LITERATURE

Work done by earlier scholars has been reviewed under three sections viz. growth rates, decomposition analysis and supply response.

2.1 Growth rates

Due to the complex nature of agriculture, no single technique of analysis can provide a comprehensive picture of agricultural growth. Some of the techniques used are percentages, averages, trend equations, production functions and decomposition of components.

Dayal and Shian (1963) applied different methods of computing growth rates. They emphasised the need to standardise the 'b' in linear equation. It was found that in case the growth followed geometric rather than arithmetic trend, the 'b' had to be treated as absolute growth rate and the linear equation could be standardised by using the arithmetic average.

Chatterji (1966) opined that the linear trend fitting is the most appropriate tool to measure agricultural growth as it would avoid any effect due to seasonal and cyclical variations, and employed it to measure the growth rates of important cereals, pulses and non-food crops of India over the period from 1950-'51 to 1962-'63. If F_t and F_o are the values in t^{th} and base year respectively, then the comparative growth measured between the base year and t^{th} year denoted by G_{t-o} is defined as

$$G_{t-o} = \frac{F_t - F_o}{F_o}$$

where F_t = trend value of t^{th} year

F_o = trend value of base year

Dayal (1966) examined the progress of agricultural output in 60 countries all over the world for the 1952-'53 to 1962-'63 period by fitting the semi-log least squares trend. In the discrete case the form of the function is $Y_t = Y_o (1 + r)^T$

$$100\ r = ((\text{Antilog } W) - 1) \times 100$$

where $100\ r$ = per cent growth rate and $W = \log (1 + r)$

The continuous function corresponding is

$Y = Ac^{rt}$ where the rate of growth is $100\ r$.

Dayal opined that the continuous function has the advantag of being easily manipulable algebraically. Tests of significance of the continuous function is also easy.

Minhas (1966) commenting on the use of the linear trend equation of the type $Y = a + bx$ in measuring agricultural growth, opined that it is more appropriate to devide the absolute periodic increment b by the harmonic mean of the dependent variable to express it as the compound growth rate.

Reddy (1978) made a detailed exposition about the various types of functional forms commonly employed to measure agricultural growth viz. linear, exponential, quadratic and gompertz, and observed that the statistical analysis consisting of fitting the growth curves, estimating the growth rates, standard errors and choosing an appropriate growth curve was tedious and time consuming and the results based on these exercises were valid only under certain conditions. Use of appropriate simple non-parametric statistics was suggested for broadly indicating the direction of growth rates. Emperical verification was provided using the data of the Indian economy on real net national product, industrial product and agricultural production for the period 1950-'51 to 1973-'74.

While discussing about the appropriateness of various statistical forms to measure agricultural growth Dandekar (1980) opined that the postulate that the change in agricultural output in a year would depend upon the output in the preceeding year is reasonable and so logically the choice should be functional forms such as

$\log y = a + bt$; $\log y = a + bt + ct^2$; $\log y = a + bt^r$ or

$\log y = (a + bt)^{-1}$ rather than the forms like $y = a + bt$;

$y = a + bt + ct^2$; $y + a + bt^r$ etc. Further, he suggested that to check whether the rate of growth is in fact constant over the period, the second degree polynomial form $\log y = a+bt+ct^2$

may be fitted and the significance of c tested to ascertain whether it is significantly different from zero.

Desai and Patel (1983) examined the growth rates of four major food grains - wheat, rice, bajra and jowar - in the western region of India over the 1965-'66 to 1981-'82 period. Based on a priori reasoning and visual impression five statistical functions were tried, viz;

I $\log y = a + bt$

II $\log y = a + bt^2$

III $\log y = a + bt + ct^2$

IV $y = a + bt$

V $y = a + bt^2$

Suitability of the functions were determined by looking to the values of R^2, significance of 'b' values and 'f' values. The growth rates were worked out in the following way

$$G_{yt} = \frac{1}{y_t} \frac{dy_t}{d_t} \times 100 \quad \text{for log linear function}$$

$$G_{yt} = \frac{b}{y_t (HM)} \times 100 \quad \text{for linear function}$$

Sawant (1983) investigated the hypothesis of deceleration in Indian agriculture by examining the growth of major foodgrain and non-foodgrain crops for the post independence period. The compound growth rates were worked out by employing the log-linear function of the form log $y = a + bt$. In order to confirm the emergence of either acceleration of deceleration in growth in different periods, a quadratic in time variable, i.e. log $y = a + bt + ct^2$ was fitted to the production series.

Chattopadhyay and Bhattacharya (1987) worked out the growth rates of Indian agriculture for the period 1950-'51 to 1982-'83 by fitting four different curves viz. straight line, semi-logarithmic, gompertz and logistic. The logistic curve is of the form $\frac{1}{y} = a + bc^t$ where y is the dependent variable and 't' years starting from the base year. As an indicator of first order auto-correlation coefficient of the residuals, a measure known as c was computed which may be defined as $c = \frac{P - Q}{n-1}$ where P is the number of pairs of adjacent residuals of same sign and Q is the number of pairs of adjacent residuals of opposite sign. Authors conclude that in so far as the goodness of fit is concerned, gompertz curve provides the best fit for most of the variables considered and for most of the crops studied. The variation of growth rate measured from the fitted logistic curve is almost the same as the variation in the corresponding gompertz curve and their growth implications do not differ much over time.

Indira Devi, P. _et_ _al_. (1990) analysed the trends in area, production and productivity of banana in Kerala state for the 1970-'71 to 1986-'87 period using three functional forms viz. semilog, exponential and quadratic. The quadratic function was found to be superior over the others in explaining trend, in terms of coefficient of multiple determination. This model could explain satisfactorily the trend in yield during all periods and that of area and production during 1980-87 period.

2.2 Decomposition analysis

Decomposition of aggregate crop output into its component elements was first tried by Minhas and Vaidyanathan (1965) for the country as a whole. A seven factor additive model was employed to analyse the data for a period of eight years from 1951 to 1959. In this additive scheme of decomposition, the first element was the area effect, (with no change in yield per hectare and cropping pattern) the second element the yield effect (for a constant area and cropping pattern) and the third element gives the effect of crop pattern alone. Fourth, fifth, sixth and seventh elements showed interaction between yield and cropping pattern; area and yield, area and cropping pattern and area, yield and cropping pattern respectively.

Examining the relative merits and demerits of the conventionaland Minhas methods, Narula and Vidyasagar (1973) developed another model which they claimed to be more efficacious in that it removes the non-complementarity in contributions in the conventional method and the weight bias in the Minhas method. Empirical verification was provided using data on HYV of wheat crop in IADP districts of Ludhiana, Aligarh etc. for the period 1966-1971. The proposed model was

$$P_n - P_o = (Y_n - Y_o)\ A_w + (A_n - A_o)\ Y_w$$

where $$Y_w = \frac{Y_n + Y_o}{2} \quad \text{and} \quad A_w = \frac{A_n + A_o}{2}$$

For partitioning the contribution of area and productivity towards the changes in production, Sharma (1977) suggested the following method: Mathematically if production, productivity and area are denoted by P_n, Y_n and A_n for the year 'n' and P_o, Y_o and A_o for the base period then,

$$(P_n - P_o) = (Y_n - Y_o)\ A_o + (A_n - A_o)\ Y_o + (Y_n - Y_o)\ (A_n - A_o)$$

Division by $(P_n - P_o)$ and expressing as percentage provide the estimates of percentage contributions of productivity, area and their interaction.

Lakshmi and Pal (1988) carried out the decomposition analysis of aggregate crop output of Kerala into its component elements using a seven factor additive model. The study was done for 1952-'53 to 1984-'85 period and covered crops such as rice, cassava, pepper, arecanut, cashew, ginger, coconut, rubber, tea and coffee which together cover more than 80 per cent of the gross cropped area in Kerala. The analysis revealed that nearly 50 per cent of the change in crop output in Kerala is due to the change in the total area under the 10 crops and 42 per cent through the change in the yield of the concerned crops. The changes in the crop pattern accounted for only 8.4 per cent, much less than the contribution by the interaction of the changes in area and yield which explained 15.3 per cent of the change in total crop output. The total change accounted by the first and second order interactions was negligible being only 0.1 per cent.

2.3 Supply response studies

Ever since the appearance of Nerlove's work on the supply of selected agricultural commodities in United States, similar studies were carried out widely in various parts of the world. In their exhaustive survey of literature on agricultural supply analysis Askari and Cummings (1976) took note of over 600 studies of supply response to price changes. The fact that farmers in developing countries also respond to price changes though to a lesser extent compared to their counterparts in developed countries has been brought out by many studies.

Regarding the type of crops studied most of the literature refer to seasonal and annual crops. Studies on perennial crops particularly those with long gestation periods, are limited for the obvious reason of time lag between planting and supply within which many unforeseen factors, may intervene. The present review is restricted to those studies relating to annual crops and has been presented in two sub sections. Section one stresses on the studies relating to methodological issues while the second section deals with the response behaviour of supply in general.

2.3.1 Methodological issues

Mare Nerlove (1956) in his pioneering work estimated the elasticity of supply for corn, cotton and wheat in the United States over the period 1909-1932. His work dealt primarily with the role of the farmers expectations of future prices play in shaping their decisions as to how much acres they should devote to each crop. Nerlove tried to identify the price variable appropriate in a supply function with an observable variable or several observable variables. He devised a model relating expected 'normal' price to past observed prices. The basic expectations model in linear form was extended to include a trend variable and thus the final estimating equation included lagged prices and lagged area. The results showed that price elasticities were positive and significant. These estimates however, were significantly higher than what have heretofore been obtained.

Rao and Jaikrishna (1965) studied the consequences of using different price expectations on inferences relating to response of acreage under wheat in Uttar Pradesh over the period 1950-1962. The inferences relating to acreage response change drastically as the hypotheses relating to the expectation models used by formers are changed. Out of the 12 different price expectation models tried, average of prices in all preceding years and the predicted price from linear trend in realised price were found to be the most efficient ones based on two criteria viz. their ability to predict realized prices and the explanatory power of

Using the Nerlovian expectations-adjustment model Behrman (1968) studied the supply response of four annual crops viz. rice, cassava, corn and kenaf in Thailand over the period 1937-1963. The standard deviation of the relative price and actual yields over the past three production periods were included as proxies for the farmer's subjective assessment of the uncertainty element in future prices and yields. Behrman concluded that primary producers in Thailand were responsive to changes in their economic environment.

Employing ordinary least squares, Olayide (1972) developed three types of price elasticities of supply for six cash crops, viz. cocoa, oilpalm, groundnut, rubber and cotton of Nigeria. The specification of the supply function was quantity supplied in year 't' as a function of domestic price with appropriate lag, average world market prices, lagged area, index of weather variables, trend variable and the one year lagged supply. Six functional forms - linear, second degree polynomial in price, power, exponential, square root and semi-log functions were fitted. The model parameters were estimated including and excluding the world price. The estimated elasticities for the six crops were positive. The overall results showed that the exponential function can be selected as the lead equation.

Singh <u>et</u> <u>al</u>. (1974) examined some of the methodological issues in supply response studies viz. the relative superiority or otherwise of the Nerlovian lagged adjustment model vis-a-vis traditional model, the appropriate proxy for price expectation and the quantification and incorporation of inter-regional characteristics in the macro models to yield more meaningful results; with the help of data on Indian Virginia tobacco for the 1940-'41 to 1967-'68 period. It was found that both traditional and Nerlovian lagged adjustment models with appropriate price specifications and with the inclusion of the relevant non-price variables proved to be equally efficient in regard to the estimates of short-run elasticities. However the adjustment lag model does explain supply variance better by yielding consistently higher values of R^2. Also the inclusion of lagged acreage in the model led to the reduction of positive serial correlation in the 'errors'. With regard to price specification, in addition to zero-order correlation analysis, it was suggested that separate regression analyses be run with alternate price specifications with regard to the commodity's own prices as well as that of the competing commodities. Also aggregate supply functions must make adequate allowance for the inter-regional characteristics and their impact on the magnitudes of supply and variations therein for this would help establish more reasonable picture of supply response behaviour.

Tyagi (1974) in his study on the farmers of the Meerut district of Western U.P. explored how Indian farmers form price expectations by testing eleven hypotheses relating to price expectations and concluded that farmers expectations are in the form of a range of prices and they form their own price expectations and are not guided by others. Expected prices are more closely rela to recent past prices, the relative importance of past prices in forming expectations declines as one goes back in time. Farm harvest prices are considered important in forming price expectations and there is a reversal in price expectations when the farmers believe that the trough or peak in price has been reached.

Introducing the concept of expected yield Askari and Cummings (1976) tested the empirical difference it made in estimating the standard Nerlovian model. Specifically they postulated yield in period t (Y_t) as a function of past yield (Y_{t-1}) and changes in factors like area, rainfall and inputs other than land (fertilizers, machinery, irrigation) between period t-1 and t. By estimating such a relationship for a variety of cereals and cash crops in the major growing regions of India, (omitting non-land inputs due to data non-availability) an estimated yield series was generated which was used as yield expectation in the Nerlovian model instead of actual yield figures. The authors conclude that though some evidence was obtained indicating that farmers are in fact influenced by such expectation in their planting decisions, the value of such evidence is somewhat mitigated by the absence of any measure of changes in non-land inputs in the yield regressions.

Gardner (1976) used future prices and lagged prices to estimate the United States soyabean acreage response over the period 1950-1974 and cotton acreage response over 1911 through

1933. The study rests on the hypothesis that the futures prices contracted for the supply of next year's crop reflects the market's estimate of the next year's cash price. Since the appropriate price for supply analysis is the price expected by the producers at the time when production decisions are made, futures price should be a good indicator of the expected price. The regression coefficients and the implied supply elasticities were quite close to those obtained from the same supply model estimated using the lagged price.

McKinze (1983) put forth a system approach to analyse the complete system of own and cross price inter-relationships for eight major crops supplied in USA. By viewing supply response as a system as opposed to individual equations, the study showed that a deeper understanding of the supply behaviour is possible. This approach performed well even under conditions of multi-collinearity among the prices of substitute commodities.

Narayana and Shah (1984) made further improvements in the expectations behaviour of the farmers employing ARIMA (Auto regressive integrated moving average) estimation of expected prices and yields in Kenya. The overall result suggested that produce price policy alone would be inadequate to influence small farmer's cropped acreage. In addition, a compatible and integrated policy regarding the provision of input subsidies and credit is necessary to affect the small farmer's yields whereas large farmers reacted more strongly to prices.

2.3.2 Supply response

Stern (1959) using a simple model, involving no expectational or adjustment lags analysed the production of cotton in Egypt over the period 1899-1938. The arc elasticities of supply worked out by him showed that Egyptian cotton producers were responsive to price movements.

Nowshirvani (1962) in his study on the supply elasticities of rice, wheat, barley and sugarcane in Bihar and Eastern Uttar Pradesh considered a modified Nerlovian model with rainfall, crop yield and trend to supplement the price variable. The long run elasticities were positive and significant for sugarcane whereas for rice, wheat and barley the coefficients were negative but insignificant.

Raj Krishna (1963) estimated the price response of major crops in the pre-partition Punjab over the period 1914-1945. In addition to the relative price, he used three shifter variables-relative yield, irrigation and rainfall. The elasticities for cotton and maize were positive and comparable with those of the United States. All crops except jowar showed positive and significant responses. The coefficients range from 0.1 in case of wheat and bajra, 0.2 to 0.4 in case of maize and sugarcane and 0.6 to 0.7 in case of cotton. The corresponding long run elasticities ranged from 0.15 to 0.16.

George (1965) analysed the impact of relative changes in prices on the cropping pattern of Kerala during the decade 1952-'53 to 1960-'61. Paddy, coconut, sugarcane, tapioca, cashew and rubber which aggregately covered 73 per cent of the total cropped area were selected for the above analysis. The results showed that the cropping pattern had undergone a shift from food crops to cash crops during the reference period and that the acreage response to price has been positive in most cases. The study revealed that it is the increase in relative and not the absolute prices which influenced the quantitative response in area under a particular crop.

Using a simple linear model which regressed area under groundnut on the lagged price of groundnut deflated with price of ragi, for a period of 28 years from 1934-1962 in North-Arcot, Kamala Devi and Rajagopalan (1965) concluded that an increase in relative price influences the acreage under groundnut in the following year while its influence on productivity was not at all significant. It was also observed that increase or decrease of acreage was inversely associated with acreage under competing crops.

Manghas et al. (1966) analysed the time series data on rice and maize in the Phillipines for the period 1910 to 1964 using the Nerlovian model. In addition to price they included trend and technology as additional shifter variables. The results showed positive and significant responses to prices. The price elasticity of supply was found to be highest in areas with strong commercial markets and areas with extensive irrigation facilities.

prices on the cropping pattern of Kerala during the decade 1952-'53 to 1960-'61. Paddy, coconut, sugarcane, tapioca, cashew and rubber which aggregately covered 73 per cent of the total cropped area were selected for the above analysis. The results showed that the cropping pattern had undergone a shift from food crops to cash crops during the reference period and that the acreage response to price has been positive in most cases. The study revealed that it is the increase in relative and not the absolute prices which influenced the quantitative response in area under a particular crop.

Using a simple linear model which regressed area under groundnut on the lagged price of groundnut deflated with price of ragi, for a period of 28 years from 1934-1962 in North-Arcot, Kamala Devi and Rajagopalan (1965) concluded that an increase in relative price influences the acreage under groundnut in the following year while its influence on productivity was not at all significant. It was also observed that increase or decrease of acreage was inversely associated with acreage under competing crops.

Manghas et al. (1966) analysed the time series data on rice and maize in the Phillipines for the period 1910 to 1964 using the Nerlovian model. In addition to price they included trend and technology as additional shifter variables. The results showed positive and significant responses to prices. The price elasticity of supply was found to be highest in areas with strong commercial markets and areas with extensive irrigation facilities.

Dantwala (1967) estimated the trend in production and prices of agricultural commodities and inputs for the first three five year plan periods. He found that inspite of the rising trend in prices, absolutely as well as in relation to non-agricultural prices, the increase in production lagged behind the demand. He concluded that prices alone cannot increase production and it is the technology that increases the production.

Rajagopalan (1967) using data for the period 1939-1961 made a supply response study of three subsistence crops - rice, ragi and bajra - and three cash crops - groundnut, cotton and sugarcane - in three types of farming areas in Tamil Nadu. Apart from lagged absolute price, lagged relative price and lagged substitute crop price were used as explanatory variables. Using three variants of the basic Nerlovian model he estimated supply response coefficients for different crops and regions separately. The analysis indicated that the price elasticity of acreage was insignificant for most of the food crops but the coefficients of ragi and groundnut price ratio was significant.

Kahlon and Sud (1969) estimated the supply responsiveness of Punjab farmers to price of wheat and gram for the period of 15 years from 1951-'52 to 1965-'66. For the state as a whole the response of wheat acreage to price was significant with an elasticity of 0.898. The effect of price of gram on wheat acreage was insignificant. In the case of gram the coefficient of yield per acre was significant and positive while that of price of competing crop was negative but insignificant.

Dantwala (1967) estimated the trend in production and prices of agricultural commodities and inputs for the first three five year plan periods. He found that inspite of the rising trend in prices, absolutely as well as in relation to non-agricultural prices, the increase in production lagged behind the demand. He concluded that prices alone cannot increase production and it is the technology that increases the production.

Rajagopalan (1967) using data for the period 1939-1961 made a supply response study of three subsistence crops - rice, ragi and bajra - and three cash crops - groundnut, cotton and sugarcane - in three types of farming areas in Tamil Nadu. Apart from lagged absolute price, lagged relative price and lagged substitute crop price were used as explanatory variables. Using three variants of the basic Nerlovian model he estimated supply response coefficients for different crops and regions separately. The analysis indicated that the price elasticity of acreage was insignificant for most of the food crops but the coefficients of ragi and groundnut price ratio was significant.

Kahlon and Sud (1969) estimated the supply responsiveness of Punjab farmers to price of wheat and gram for the period of 15 years from 1951-'52 to 1965-'66. For the state as a whole the response of wheat acreage to price was significant with an elasticity of 0.898. The effect of price of gram on wheat acreage was insignificant. In the case of gram the coefficient of yield per acre was significant and positive while that of price of competing crop was negative but insignificant.

Reddy (1970) in his study using the Nerlovian adjustment model tested whether groundnut farmers of Kurnool in Andhra Pradesh are responsive to changing circumstances over the period 1931-'43. Relative price and yield lagged by one year, rainfall and trend were the determinants in his function. Positive and significant coefficients were obtained for relative price and yield. The price elasticity of acreage and yield elasticity of acreage were found to be 0.76 and 1.4 respectively for the short run.

Maji _et_ _al_. (1971) studied the supply response of three major Punjab cereals for the period 1948-1965 using a variant of the Nerlovian area adjustment model with an explicit measure of risk in the form of standard deviation of prices over the last three preceding production periods, as one of the explanatory variables. Other determinants were harvest prices, both relative and absolute, relative yield and a trend variable. Positive and significant price parameter estimates were obtained for all the three crops. While the coefficient of risk variable though of a correct negative sign indicating risk aversion behaviour was not statistically significant.

Madhavan (1972) Conducted a detailed multi crop study for Tamil Nadu in which supply of food crops such as rice, ragi and sorghum and cash crops such as cotton, groundnut, sesamum and sugarcane for the period 1947-65 were considered. The adjustment lag model was of the Nerlovian type, expressed in logarithms in which lagged relative price, lagged yield and acreage of the crops and its competitor and a rainfall index were the independent variables considered. The price coefficients estimated turned out statistically significant in the supply of all crops except rice. Further price elasticities were high when both depending and competing crops came from the commercial crop group and low when both were from the cereal crop group. For groundnut, yield was found to be the most important factor influencing acreage while for gingelly relative price was found more important than yield in its influence on acreage.

Cummings (1975) estimated the supply elasticities of Indian farmers in the post-independence period using the Nerlovian supply model. He covered cereals like rice, wheat and barley; oil seed crops like groundnut, sesamum and mustard and cash crops like jute, cotton and tobacco. Among the major groundnut producing states only Andhra Pradesh exhibited a positive and statistically significant supply responsiveness and the district level calculations generally backed up the state wide result. Gujarat, whose cultivators produce about a third of the national output showed a negative market relationship. For sesamum state wide price parameter estimates were positive and significant in the states of Rajasthan, Andhra Pradesh and Maharashtra. In Tamil Nadu, and minor sesamum growing areas like Assam, Bihar, Kerala and Punjab negative price acreage relationship was observed.

Singh and Kumar (1976) studied the responsiveness of Haryana farmers to changing price levels during the period

1960-'73 with respect to important crops of the state viz. wheat, rice and bajra. A Nerlovian lagged adjustment model was used which regressed area at time t on lagged yield, lagged price, average rainfall during the presowing season, one year lagged irrigated area and a trend variable. Price variability and yield variability were represented by the coefficient of variation of prices and yield over the preceding four years. Of the two types of functions considered viz. linear and logarithmic, the logarithmic function was found a better specification than linear one. The farmers in the area considered were found responsive to the changes in relative prices, yield, price variability and yield variability.

Using a basic Nerlovian lagged adjustment model Wagle (1976) studied the impact of tariff protection on sugarcane acreage in India over the period 1921-40. The price variable was insignificant in the pre-tariff period but highly significant after protection. Authors concluded that the results are consistent with the hypothesis that a causal relationship existed between protection and acreage instability operating through the price variable. The cyclical pattern of movements of acreage (after the introduction of protection in 1931) were a function of sugarcane prices.

Combining the features of both annual and perennial crops, Dowling and Jessa-da-char (1979) put forward a supply response model for sugarcane. The above model was fitted to the

Thailand sugarcane data over the period 1959-1976. The short-run elasticities ranged between 0.8 and 0.9 while the long-run elasticities were two to five times that for the short-run.

Using the Nerlovian lagged adjustment model Jhala (1979) analysed inter-regional behaviour in groundnut supply response over the 1951-71 period. Relative price of groundnut, average yield of groundnut and competing crops and rainfall in sowing period were the determinants considered. Coefficient of lagged acreage was significant in most cases indicating very slow adjustment on the part of farmers. The coefficients of own yield variable was positive and significant in most cases while that of competing crops showed mixed pattern and most were not significant. Negative price response was noted for nearly half the acreage under groundnut in India. For such cases the coefficient of sowing period rainfall turned out positive and significant suggesting that in regions of highly uncertain rainfall, sowing period weather seemed to dominate decision making rather than the price factor. Like price coefficient, the coefficient of sowing period rainfall also showed a mixed pattern of positive and negative response. It was also found that in regions where the positive price response was indicated, yield had a much stronger influence and in the regions of negative response, yield had a much weaker influence.

Singh (1979) evaluated the role of both the price and the non-price factors in determining farmers decisions affecting shifts in pulses acreage in Uttar Pradesh, over the period

1950-'74 with a Nerlovian lagged adjustment model in logarithmic form. It was found that the overall supply price relationship was weak and in most cases the results do not support the generally expected positive supply price response relationship. Irrigation and rainfall in the presowing months had a negative impact on gram acreage.

Using profit function analysis Flinn _et_ _al_. (1982) estimated the response of input demand by rice farmers in Philippines using modern technology. The farmers were found responding to price changes with an elasticity of 0.95. Changes in real wages were found to have greater impact on profit and supplies than changes in real prices of mechanised land preparation, fertilizers or pesticides.

Uma Kapila (1982) estimated the acreage response of groundnut for major states and districts over the period 1951-'52 to 1974-'75 by using Nerlovian adjustment lag model. It was observed that although price factor for groundnut has been favourable in all the districts, yet it could not influence groundnut acreage uniformly. In the western states technological factors reflected in varietal developments in respect of competing crops (such as bajra) have been more important than relative prices in influencing groundnut acreage, since it reduced the profitability of groundnut by reducing the relative yield of groundnut despite the rising relative price of groundnut. In southern states irrigation turned out, in general, to be the most important factor influencing groundnut acreage. The elasticity of groundnut acreage to irrigation is fairly high in Tamil Nadu and Andhra Pradesh

Employing a Nerlovian adjustment lag model Ninan (1988) examined the factors affecting growth and instability in production of groundnut and rapeseed mustard in the major growing states over the period 1954-'55 to 1983-'84. He concluded that area has been the main source of growth in output of both the oilseeds, with yields, remaining stagnant. With the onset of green revolution groundnut area declined or remained stagnant in all states except Gujarat and Orissa whereas in the case of rapeseed-mustard it expanded significantly in most states during the post-green revolution period. In the states where there was significant expansion of area under the two oilseeds, technological factors (like yield/irrigation) and/or price as well as rainfall were mainly responsible for this trend. In the states where their area declined the spread of irrigation was found to be inducing farmers to shift from oilseeds to other lucrative crops. Instability in groundnut yields was found to vary inversely with the proportion of the crop area under irrigation. But this was not found in the case of rapeseed-mustard.

Employing a Nerlovian adjustment model Bhagat (1985) examined the determinants of wheat acreage fluctuations in Bihar over the 1956-'57 to 1976-'77 period. In the response functions, area under the crop at time t was regressed upon lagged area, relative price lagged by one year, price risk (represented by coefficient of variation of price for the past three years), relative gross return of wheat lagged by one year, return risk, irrigation in growing season and rainfall. Positive and significant coefficients were obtained for relative gross return variable indicating its importance rather than that of relative price in explaining acreage variations.

The degree of response of rice supply to price changes and to non-price factors in Karnataka over the period 1960-'61 to 1984-'85 were studied by Ramesha et al. (1988) using the Nerlovian lagged adjustment model. The output response function was measured in terms of area and yield. The area response model regressed area sown on price, lagged area, rainfall, risk factor, irrigated area and a time trend. Yield response model included lagged price, rainfall during crop season, lagged yield and price risk as the explanatory variables. Both area and yield were found to respond positively to price. However yield adjustments were found to be comparatively quicker than area adjustments.

Sidhu et al. (1988) examined the area response of commercial crops in Punjab for the period 1965-'66 to 1984-'85 using the Nerlovian lagged adjustment model. Among the oilseeds, for rapeseed and mustard relative yield and price had significant positive influence on area while price risk and irrigation played a significant role in reducing the area under it. In the case of groundnut, in spite of improvements in its yield and price over time as well as the stability in its prices the area declined mainly due to higher profitability of American cotton as a competitive crop. Irrigated area had also inverse relationship with the area under groundnut. Authors concluded that development of new technology in cereals was responsible for replacing area from groundnut. Therefore, only a long run price policy supported by efficient procurement system and market clearance which ensures economic advantage for these crops can boost and stabilise their production.

Thakur et al. (1988) analysed the trends, growth and technological development of oilseeds in Bihar over the 1961-'62 to 1983-'84 period. Compound growth rates were worked out by fitting the exponential function. Technological change was examined by fitting production function models for the pre and post green revolution periods separately and testing whether the parameter estimates for the two periods differed significantly. The study concluded that though the yield of oilseed crops per unit of area has increased during the reference period, it had failed to boost the area under the crops probably because of the shifting of more fertile land to those crops which gave a comparatively higher return and extension of oilseed cultivation to marginal lands.

Employing a Nerlovian partial adjustment model Reddy (1989) analysed the farm supply response of paddy in Andhra Pradesh over the period 1963-'64 to 1983-'84. Both long run and shortrun elasticities of price and non-price variables were estimated for three regions separately. The price elasticities of acreage were lower than the elasticities of yield, rainfall and irrigation among the three regions and Andhra Pradesh as a whole indicating that the attainment of the desired targets with respect to paddy output may not be possible through the relative price change alone. Non-price incentives like provision of assured irrigation and HYV seeds are equally important to increase yields in achieving the targets of paddy output.

Indira Devi *et al*. (1990) estimated the output response behaviour of banana growers in Kerala over the 1970-'71 to 1986-'87 period, both in terms of area and yield by using Nerlovian lagged adjustment models of linear and double log forms. The linear model was found superior to the double log forms. Neither lagged absolute price nor the rainfall during planting months was found to exercise any significant influence on acreage allocation decisions of this crop. Risk variable measured as the standard deviation of prices over the last three preceeding production periods and area lagged by one year had a positive significant influence.

Thomas *et al*. (1990) analysed the acreage and yield response of ginger in Kerala over the period 1968-69 to 1986-'87 by fitting response function of the Nerlovian type. Lagged price of ginger did not show any significant influence on the acreage allocation of the crop. Ginger growers in the state were found to be good risk bearers. Favourable moisture condition during the planting period had a positive and significant influence on acreage.

Materials and Methods

MATERIALS AND METHODS

The methodology adopted in the present study has been presented under three main sections. A general discussion on the analysis of agricultural supply is presented in section one. In section two, the methodology adopted in the analysis of trends in area, production and productivity of groundnut and sesamum have been presented. The last section deals with the analysis of supply of sesamum and groundnut using time series data.

3.1 A general discussion regarding the analysis of agricultural supply

The underlying aim of all supply response studies is to find out how the farmer intends to react to movements in the price of the crop that he produces. When more than one crop is being cultivated the aim is to find out how the farmer intends to reallocate his resources among the various crops in response to changes in the relative price levels.

Theoretical discussion and past empirical work on agricultural supply distinguishes two different approaches in its analysis: normative methods and econometric analysis of time series data. Normative methods are constructive methods which involve derivation of supply functions from data and information relating to production functions and individual behaviour. Econometric analysis of time series data is a positive approach which attempts to study what farmers as a whole will do in response to expected changes in economic variables based on what they had done in the past under dynamic situations.

There are however, serious difficulties in measuring the degree of responsiveness of producers to price changes. They arise mainly from the difficulties in approximating theoretical formulations of functional relationships to observe real world situations. These difficulties are further compounded because of the time lag between changes in production capacity and changes in output. Problems in adequate representation of risk, producer expectations, changing technologies and government policies thus assume importance.

Due to the time lag between changes in agricultural production capacity and changes in output, in any attempt to measure the price responsiveness, the functional relationship should ideally be worked out between planned output and expected prices. However, the possible discrepancy between planned and realised output and non-availability of any kind of data about planned output except acreage under the particular crop have forced the workers in the field of supply response to treat acreage as a proxy for planned output. (In most agricultural activities actual output is not a good proxy for intended output. Most farmers have little control over the elements and therefore, over yield and total output. As land is the major input in agricultural production and since the farmer has considerably greater control over this variable, the acreage planted would give a better indication of the farmer's intentions).

Price elasticity of acreage planted can be used as a reliable proxy for the price elasticity of planned output only if two conditions are satisfied. These are that inputs other than land can be varied in proportion to acreage and that returns to scale are not diminishing. (If inputs other than land cannot be changed in proportion to acreage, then this places a physical constraint on production. At the same time, if there are decreasing returns to scale the acreage planted will not be able to reflect the farmers intentions). These two conditions are, however, largely met in most under developed regions where disguised and seasonal unemployment prevail and where the cost of capital service per unit of land at the existing level of technique is small. Most studies on supply responses in under developed agriculture have therefore used acreage planted as the dependent variable.

The necessity of using expected prices in supply response studies has given rise to many postulates about the ways in which farmers formulate their expectations about future prices. By now, Nerlove's reformation of Cagan's adaptive price expectation model has become a standard tool for estimation of supply functions. As is well known the adaptive expectation hypothesis implies that expected price at time t is the geometrically declining weighted average of all past price changes. However, simpler price formulations like lagged prices and moving average prices have also been used extensively in supply response studies (with Nerlove's area adjustment model).

In addition to acreage expansion, response to economic stimuli can also take the form of adoption of yield increasing measures. However, yield is prone to much more variation than area since yield can be influenced significantly not only by man-made factors but by natural factors as well. Timely application of adequate amounts of manures and fertilizers, availability of water at critical periods of plant growth and adoption of plant protection measures and other cultural practices can substantially increase productivity. However, the prevailing weather condition can also have an important bearing on crop yield. So, theoretically at least, yield response functions should incorporate such important variables as irrigated area, fertilizer price, trend etc. as explanatory variables in addition to the economic incentive in the form of the expected price and uncertainty elements in the form of measures of expected risk and proxies of weather parameters. However continuous time series data on such factors are not always available. Nevertheless, as and when data availability permit, it would be profitable to consider them also in the yield response functions.

Estimates of supply elasticities at the macro level implicitly assumes that the various regions/subregions producing the commodity or commodities possess homogeneous characteristics and that the level of supply and the nature of the producer's response everywhere would be the same. However, since there are inter-regional differences in resource endowments including agroclimatic conditions and managerial skills, the macro supply response relationship may not provide a true picture of resource allocative decision of the farmers. Thus one has to strike a balance between the homogeneity of the region and the level of aggregation to be achieved.

Supply studies, like most other econometric studies with time series data, suffer from problems of multicollinearity and auto correlated disturbances. The problem of multicollinearity prevents the inclusion of all the relevant explanatory variables in the final estimating equation while the deletion of an important explanatory variable causes autocorrelated disturbances.

In the present study the response of sesamum and groundnut producers to changing prices were analysed both at the district and state levels. For groundnut, the study at the district level was confined to Palakkad district which alone accounted for over 98 per cent of the area under the crop in Kerala state in the year 1986-'87. For sesamum, six districts which together accounted for nearly 94 per cent of the total of the state's area under sesamum in 1986-'87 were subjected to study. These districts were Kollam (14 per cent), Alappuzha (28 per cent), Ernakulam (15 per cent), Thrissur (8 per cent), Palakkad (9 per cent) and Malappuram (20 per cent).

The price, acreage and output data included in the study were collected from the publications of the Directorate of Economics and Statistics, Government of Kerala, Thiruvananthapuram and the various issues of the monthly journal Agricultural Situation in India published by the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India. In the absence of a continuous series of prices actually received by farmers it was decided to use the wholesale prices. The absolute prices were considered in the analysis since there were no major competing crops for sesamum and groundnut in the state. The ready availability of price data limited the period of study from 1961-'62 to 1987-'88.

3.2 Trend analysis

3.2.1 Indices

For measuring the year to year movements of area, production and productivity simple indices were computed by dividing the current year's figure with the base period figure and expressing the same as percentage.

Decomposition: For partitioning the contribution of area and productivity towards the changes in production, the method of component analysis given in equation 3.2.1.1 (below) was employed

$$P_n - P_o = (Y_n - Y_o) A_w + (A_n - A_o) Y_w \text{ ....} \quad 3.2.1.1$$

$$A_w = \frac{A_n + A_o}{2} \quad \text{and}$$

$$Y_w = \frac{Y_n + Y_o}{2}$$

where,

P_n = Production in the n^{th} period

Y_n = Yield in the n^{th} period

A_n = Area in the n^{th} period

P_o = Production in the base period

Y_o = Yield in the base period

A_o = Area in the base period

To avoid the influence of extreme values the base period was fixed as the first triennium of the time series.

$$\text{Percentage share of area} = \frac{(A_n - A_o) Y_w}{P_n - P_o} \times 100$$

$$\text{Percentage share of yield} = \frac{(Y_n - Y_o)\ A_w}{P_n - P_o} \times 100$$

3.2.2 Growth rates

For measuring the rate of growth, three functional forms were fitted to the time series data, viz. the linear, the exponential and the quadratic.

(i) The linear function

$$Y = a + bt \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 3.2.2.1$$

where Y = Dependent variable (area/production/ productivity)

a = Y intercept

b = Absolute increment in Y per time period

t = time in years starting from the base year ($t = 1, 2, \ldots\ldots\ldots n$)

For the purpose of comparison compound growth rate was worked out from b using the relation

$$\text{Compound growth rate } (r) = \frac{b}{\text{H.M.Y}} \times 100$$

where H.M.Y = Harmonic mean of Y

$$= n :- \sum_{i=1}^{n} \frac{1}{Y_i}$$

(ii) The exponential function

$$Y = a\ e^{gt} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 3.2.2.2$$

On logarithmic transformation this takes the linear form

$\log Y = \log a + gt$

where Y = area/production/yield

a = constant

g = regression coefficient

t = time in years starting from the base year

Compound growth rate was worked out using the relation given below:

Compound growth rate (r) (expressed in percentage) $= (e^{g} - 1) \quad 100$

(iii) The quadratic function

$$Y = a\ e^{bt + ct^{2}}$$

Taking logarithms

$$\log Y = \log a + bt + ct^{2} \quad \text{..................} \quad 3.2.2.3$$

where Y = area/production/productivity

a = constant

b and c = regression coefficients

Compared to the exponential form, this form allows for varying growth rates. With this form it was examined whether growth is accelerating or decelerating.

The problem of multicollinearity due to the correlation between t and t^{2} was overcome by using the following transformation

$$t' = t - \frac{(n + 1)}{2}$$

where n = number of years in the time series data

In the quadratic model, growth rate $= b + 2ct$

3.2.3 Fluctuations in area, production and yield

Fluctuations were measured by the coefficient of variation. However for time series data, the coefficient of variation computed in the usual way by measuring deviations from the overall mean could be misleading in the presence of time trends. It is therefore, necessary to make corrections for such trend movements. This was done by measuring the deviations for each year from the respective trend value instead of the mean value. The overall mean for the period was then used for computing the coefficient of variation (Rao, 1968). In cases where trend was not significant ordinary coefficient of variation was computed

$$C.V. = \frac{S.D.}{\overline{X}} \times 100 \quad . . . . 3.2.3.1$$

where C.V. = Coefficient of variation in area/production/yield

S.D. = Standard deviation of the variate

$\overline{X}$ = Mean of the variate

3.3 Supply response

Nerlove's supply response model

The basic Nerlovian model is a three equation model.

The equations are

$$A_t^d = a_o + a_1 P_t^e + u_t \quad \ldots\ldots\ldots\ldots\ldots \quad 3.3.1$$

$$P_t^e - P_{t-1}^e = B (P_{t-1} - P_{t-1}^e) \quad \ldots\ldots\ldots\ldots \quad 3.3.2$$

$$A_t - A_{t-1} = r (A_t^d - A_{t-1}) \quad \ldots\ldots\ldots\ldots \quad 3.3.3$$

Where P_t^e is the expected price in the year t, A_t^d is the desired planted area in the year t and A_t and P_t are the actual planted area in the year t and the actual price in the year t respectively.

Equation 3.3.1 relates the desired planted area to the expected future price through a simple linear formulation. It represents a behavioural relationship.

Equation 3.3.2 indicates that expected price in the year t is the expected price in the previous year plus B times the difference between the expected and realised price in the previous year. For each period the farmer revises the price he expects to prevail in the coming period in proportion to the mistake he made in predicting price in this period. This implies that expectations are adaptive, i.e. current expectations are formed by modifying (adapting) previous expectations in the light of the actual achievements. B is the coefficient of expectations and its value lies between 0 and 1.

Equation 3.3.3 is a partial area adjustment equation. It means that in each period actual planted area is adjusted in proportion to the difference between the desired area in this period and the actual planted area in the previous period. The adjustment lag hypothesis implied in this equation reflects technological and/or institutional constraints which permit only a fraction of the intended levels to be realised during a short period. r is the Nerlovian coefficient of adjustment; $0 < r < 1$.

Though this model of supply response is more realistic than one which allows either only the expectational or the adjustment element, simultaneous consideration of both types of lags present serious problems for econometric estimation. Consequently, the commonly used model in supply response analysis (of annual crops) based on time series data is the Nerlovian adjustment lag model.

The lagged adjustment model is said to present a more realistic picture by incorporating distributed lags and thereby introducing a realistic assumption about the farmer's adjustment behaviour. The other advantage of this model compared to the traditional models is that it explains the data better by yielding coefficients more reasonable in sign and magnitude thereby providing better estimates of supply elasticities. Further, it eliminates or reduces the incidence of serial correlation in the residuals (Nerlove, 1958).

The present study also employs the Nerlovian adjustment lag model. In its simplest form, it is based on the relation.

$$A_t^d = A + b\,P_{t-1} + U_t \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; 3.3.4$$

$$A_t - A_{t-1} = B\,(A_t^d - A_{t-1}).,\ 0 < B < 1\ \ldots\ldots\ldots\ 3.3.5$$

For estimation it is necessary to eliminate the unobservable variable A_t^d. This is done by first expressing A_t^d as a function of A_t and A_{t-1} (based on equation 3.3.5) and then substituting this value of A_t^d into the equation 3.3.4 to get the reduced form of estimating equation as given in relation 3.3.6

$$A_t = a_o + b_o\,P_{t-1} + C_o\,A_{t-1} + V_t\ \ldots\ldots\ldots\ldots\ldots\ 3.3.6$$

where $a_o = a\,B$, $b_o = bB$, $C_o = 1-B$ and

$V_t = Bu_t$

Additional variables like lagged yield, rainfall etc. can be very easily incorporated into the structural equation.

Price expectation

The price which farmers take into account for their decision making process is called the expected price. The price expectation implied in the Nerlovian adjustment lag model is previous year's price. The prices prevailing in the recent past influence farmer's expectations as to future prices, so that farmers are likely to be influenced significantly by the prices prevailing during the farm harvest period of the preceding year. In addition to this, two other expectation models were tried in the present study. In the first model expectations were derived by the moving average method.

Thus the expected value

$$P_t^e = \frac{1}{k} \sum_{i=1}^{K} P_{t-i}$$

where P_t^e = expected price in period t

P_{t-i} = observed price in period (t-i)

K = the period of the moving average

The period of the moving average considered here was three years.

In the second model expected values were generated from the linear trend in realised values.

Thus the expected value

$$P_t^e = a + bt$$

where $a = \overline{P} - b\overline{t}$

$$b = \frac{\sum_{t=1}^{n} (t-\overline{t})\ (P_t - \overline{P})}{\sum_{t=1}^{n} (t - \overline{t})^2}$$

P_t^e = expected price in period t

$\overline{P}$ = arithmetic mean of observed price

$\overline{t}$ = arithmetic mean of t values, (t = 1,2 ....n)

P_t = observed price in period t

Area and yield responses

The output response function was measured in terms of area and yield, since farmers respond to economic stimuli initially by altering the productivity by intensifying the cultivation practice and thereafter area under the crop. Since planned output is the product of intended cultivated area and planned yield, the elasticity of output can be easily determined once the area and yield models are developed separately on the basis of Nerlovian lagged adjustment model (Ramesha, 1988).

Choice of variables

Supply decisions in agriculture are expected to be made on knowledge relating to technical coefficients, prices of inputs and prices of products. All these three components needed for decision making are not known with certainty. Variations in such exogenous variables like weather, technology, government policies etc. also influence supply. Therefore, the chosen model should explain important expectations influencing the decision making process regarding the area allocation and adoption of yield increasing techniques. The most relevant variables were selected on the basis of a priori reasoning. The models chosen were as follows

$$A_t = f\ (A_{t-1},\ P^e_t,\ W_{pt},\ Y_{t-1},\ PR_t,\ YR_t,\ T)$$

$$Y_t = f\ (Y_{t-1},\ P^e_t,\ W_t,\ PR_t,\ YR_t,\ T)$$

where A_t = area of the concerned crop in '000 hectares in the current year

Y_t = yield in kg per hectare of concerned crop in the current year

P_t^e = expected price of the concerned crop (represented by three alternate price formulations)

A_{t-1} = area of the concerned crop in '000 hectares lagged by one year

Y_{t-1} = yield of the concerned crop (kg /ha.) lagged by one year

W_{pt} = total rainfall in the presowing months in mm

W_t = total rainfall in mm during the crop period

PR_t^e = expected price risk of the concerned crop in the current year

YR_t^e = expected yield risk of the concerned crop in the current year

T = trend variable

Price expectation

The price variable considered in the study must be one entering the producer's expectations most vitally in influencing their resource allocative decisions. Three alternative price formulations were tried in the response functions. They were (i) annual average prices in the preceding year (ii) average of prices prevailing in the preceding three years (iii) predicted price from the linear trend in realised price.

Preceding year's yield of the crop

Farmers, in their resource allocating decisions regarding a particular crop can be expected to be influenced by the yield of that crop in the previous year. So the crop yield lagged by one year (Y_{t-1}) was included in the area response model as an independent variable.

Rainfall

In the state, both sesamum and groundnut are grown mostly under rainfed conditions. Rainfall is thus a crucial factor determining the area under these crops as well as their yield. However, while the acreage allocation decisions are more influenced by the rainfall in the presowing months, yield mostly depends upon the rainfall during the crop period. Hence in the area response functions total rainfall in the two presowing months was considered. (For sesamum, October and November and for groundnut, March and April). In the yield response functions, the total rainfall during the crop period was taken as a proxy for the influence of weather. (For sesamum the December - April period and for groundnut the May - August period).

Risk factor

In the case of crops grown mainly for the market , one can expect the farmers to be responsive to riskiness. The risk factors in the model were represented by price variability and yield variability. In the lagged price models price risk in period t was represented by the coefficient of variation of price in the past three years from the period t. Likewise, the coefficient of variation of the yield of the crop concerned in the past three years was taken as a measure of yield risk in period t. However, for the response functions employing moving average prices and trend prices, the squared deviations of observed prices from their expected values were treated as observation on risk. The overall mean was then taken for computing the coefficient of variation, which was taken as a proxy for price risk.

Time trend

In addition to the factors mentioned above, production decisions are also influenced by some other factors like technological innovations, changes in supporting infrastructure etc. Hence time trend (T) was included in the models as a catch-all variable.

Introducing all the chosen variables into the Nerlovian lagged adjustment model, the final estimating equations were obtained as follows

(1) Area response function

$$A^{*}_{t} = a_o + a_1 P^{e}_{t} + a_2 W_{pt} + a_3 Y_{t-1} + a_4 PR_t + a_5 YR_t + a_6 T + u_t \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 3.3.7$$

$$A_t - A_{t-1} = B (A^{*}_{t} - A_{t-1}); \quad o < B < 1$$

The final estimating equation was

$$A_t = C_o + C_1 A_{t-1} + C_2 P_t^e + C_3 W_{pt} + C_4 Y_{t-1} +$$

$$C_5 PR_t + C_6 YR_t + C_7 T + V_t \ldots\ldots\ldots 3.3.8$$

were A_t^* = desired crop area in year t

P_t^e = expected price of the concerned crop in year t

The coefficient and error terms of the estimating equation (3.3.8) are related to those of equation 3.3.7 and the coefficient of adjustment in the following way

C_o = $a_o B$

C_1 = $(1-B)$

C_i = a_{i-1} $B; (i = 2, \ldots\ldots\ldots 7)$

V_t = Bu_t

(ii) Yield response function

$$Y_t^* = b_o + b_1 P_t^e + b_2 W_t + b_3 PR_t + b_4 YR_t +$$

$$b_5 T + u_t \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ 3.3.9$$

$$Y_t - Y_{t-1} = r (Y_t^d - Y_{t-1}); \quad 0 < r < 1$$

The final estimating equation was

$$Y_t = d_o + d_1 Y_{t-1} + d_2 P_t^e + d_3 W_t + d_4 PR_t + d_5 YR_t +$$

$$d_6 T + V_t \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ 3.3.10$$

where Y_t^* = planned yield in period t

r = coefficient of yield adjustment

$d_o = b_o r$

$d_1 = (1 - r)$

$d_i = b_{i-1} r$; $(i = 2, ...6)$

$V_t = ru_t$

The functions were estimated both in linear and double log forms by the method of ordinary least squares. The regression coefficients were tested for their significance using 't' test.

Price elasticity

(i) The linear formulation

$$\text{Short run elasticity} = c_i \frac{\bar{P}}{\bar{X}}$$

where C_i = regression coefficient of price

$\bar{P}$ = mean of price

$\bar{X}$ = mean of area/yield

$$\text{Long run elasticity} = \frac{\overset{P}{E(S)}}{B}$$

where $\overset{P}{E(S)}$ = Shortrun price elasticity

B = coefficient of area/yield adjustment

(ii) The non-linear formulation

In the case of Double-log functions, regression coefficient of price itself represents the short run price elasticity. Long run elasticity is obtained as in the case of the linear formulation by dividing the short run elasticity with the coefficient of adjustment (B for area and r for yield)

Speed of adjustment

Speed of adjustment was estimated using the relation $(1-B)^N = 0.05$

where B = coefficient of area/yield adjustment

N = number or years required to realise 95 per cent of the price effect

Statistical problems in estimation

The two major estimation problems arising out of the use of time series data are multicollinearity and auto correlation.

(a) Multicollinearity

When the determinants in a relation are closely correlated it becomes difficult to isolate their separate influences and obtain a reasonably precise estimate of their relative effects (Koutsoyiannis, 1973). The independent variables were tested for multicollinearity by computing the zero order correlation matrix.

Auto correlation

Serial correlation of the random term u violates the assumption of the method of ordinary least squares. Though unbiased estimates of parameters can be obtained, their sampling variances will be unduly large and further, there will be serious underestimation of the variances (Johnston, 1972).

Durbin and Watson d-statistic is commonly employed for testing the incidence of auto correlation

$$d = \frac{\sum_{t=2}^{n} (e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^2}$$

Where e_t and e_{t-1} are residual terms of current and lagged dependent variables respectively.

However, the d statistic is not an appropriate measure of auto correlation if among the explanatory variables there are lagged values of the endogenous variable. For such cases Durbin suggested the h-statistic. Despite the limitations of small sample, the h statistic was employed in the present study (Lal and Singh, 1981; Kapila, 1982).

$$h = (1 - \frac{d}{2}) \frac{n}{1-n \ V(b_1)}$$

where $V(b_1)$ = estimate of the sampling variance of b_1

n = sample size

d = computed Durbin - Watson d - statistic

However, the test involving h statistic breaks down when $n \ V(b_1) \geqslant 1$. For such cases, the d statistic was employed to check the incidence of serial correlation.

Results and Discussion

RESULTS AND DISCUSSION

The results and discussion of the present study have been presented in three main sections. Section one deals with the analysis of trends in area, production and productivity of sesamum and groundnut in Kerala. The growth rates of area, production and productivity of these two crops are dealt with in the second section. In the third section the results of econometic analysis of supply response have been presented.

4.1 Trend analysis

Changes in area, production and productivity of sesamum and groundnut during the period from 1961-62 to 1987-88 were examined both at the district and the state levels by computing simple indices. The relative contributions of area and productivity were partitioned out using the model of Narula and Vidyasagar mentioned in chapter three and the results are presented in the second half of the tables showing the respective indices. In this model the contribution of productivity is the part of production due to additional yield on the average area (of the base and current year) and the contribution of area is the part of production due to additional area with the average productivity. The indices together with the decomposition analysis facilitate a clear understanding of the year to year movements of area, production and productivity and the relative importance of area and productivity in bringing about changes in production.

Examination of the data for the state as well as for most of the districts revealed two distinct phases. The mid-seventies appeared to be the dividing line in most of the cases. Hence for clarity of exposition the entire period of 27 years from 1961-'62 to 1987-'88 was split up into two subperiods as indicated below:

Period I : 1961-'62 to 1974-'75

Period II : 1975-'76 to 1987-'88

In what follows each of the two crops is examined separately

4.1.1 Sesamum

4.1.1.1 State level analysis

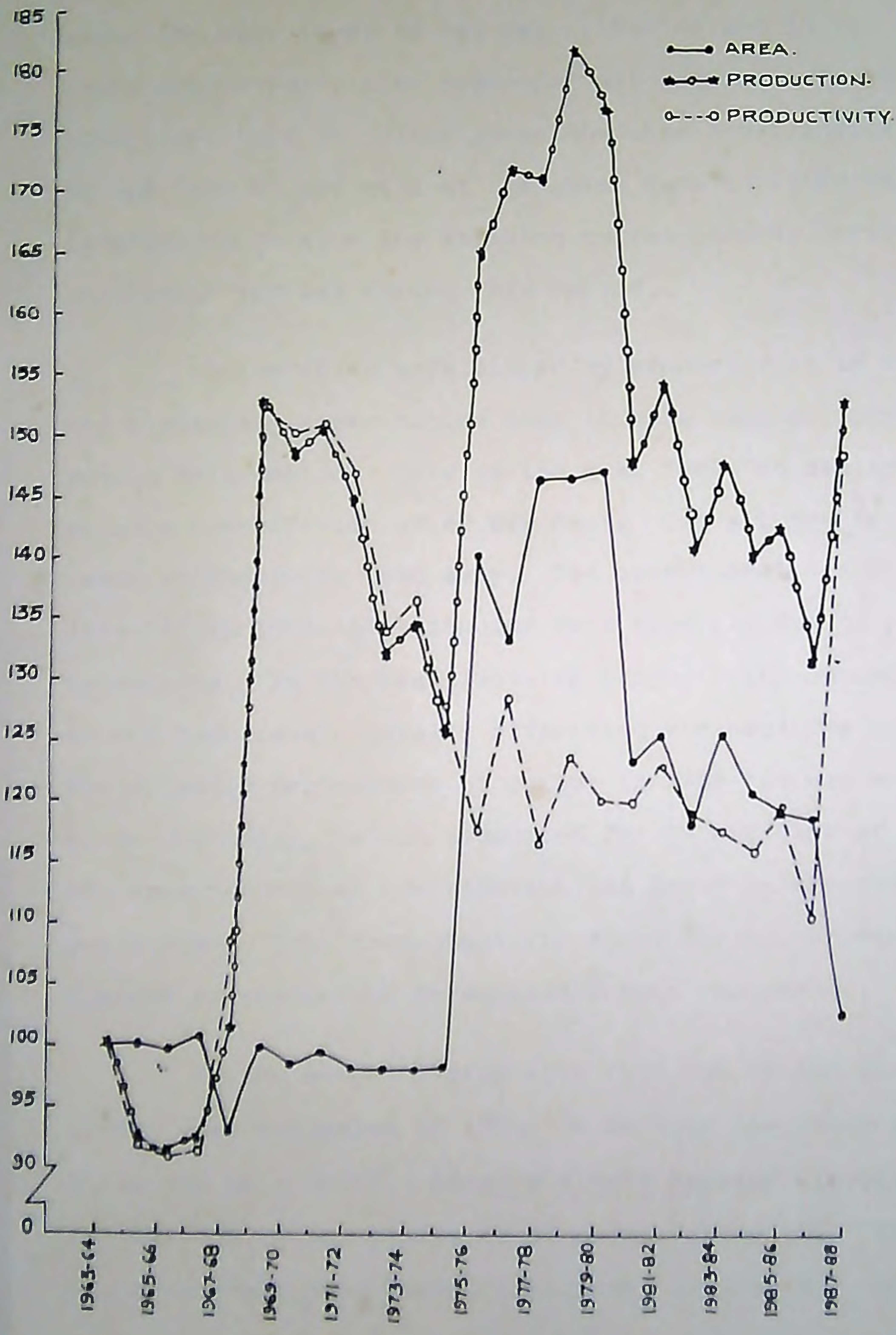
Trends in area, production and productivity of sesamum in the state as represented by their indices are presented in Table 4.1 and the same have been illustrated graphically in Fig.4.1. During the first period area under sesamum in the state was virtually stagnant as indicated by its index which stayed around 100 for the whole of the period. The year 1967-68 was the only exception when there was a seven point decline in area. Productivity, after an initial setback in the 1964-'67 period rose rapidly in the next two years. In the year 1968-'69 the state recorded the maximum yield with the index registering a 52 point increase over the base period. From this peak, productivity declined rapidly and by 1974-'75 it was only 28 points above the base line. In the wake of

Table 4.1 Indices of area, production and productivity and percentage contributions of area and productivity towards the changes in production of sesamum : Kerala state (Base period: 1961-'62 to 1963-'64)

Year	Indices of			Contributions of	
	Area	Production	Productivity	Area	Productivity
(1)	(2)	(3)	(4)	(5)	(6)
1963-'64	100.3	100.5	100.2	62.3	37.7
1964-'65	100.5	92.8	92.3	6.5	-106.5
1965-'66	100.0	91.6	91.6	+0.2	+99.8
1966-'67	101.0	92.8	91.9	-13.2	+113.2
1967-'68	93.4	101.7	108.9	-413.0	513.0
1968-'69	100.4	153.1	152.5	1.0	99.0
1969-'70	98.9	148.5	150.1	-2.8	102.8
1970-'71	99.7	150.8	151.2	-0.7	100.7
1971-'72	98.6	145.0	147.1	-3.9	103.9
1972-'73	98.6	132.2	134.1	-5.2	105.2
1973-'74	98.6	134.9	136.8	-4.8	104.8
1974-'75	98.6	126.2	128.0	-6.2	106.2
1975-'76	140.4	165.1	117.6	67.6	32.4
1976-'77	133.6	172.0	128.7	53.4	46.6
1977-'78	146.8	171.3	116.7	71.2	28.8
1978-'79	146.9	182.2	124.0	63.9	36.1
1979-'80	147.3	177.1	120.2	67.6	32.4
1980-'81	123.4	148.2	120.1	53.5	46.5
1981-'82	125.8	154.6	122.9	52.7	47.3
1982-'83	118.4	141.0	119.1	49.2	50.8
1983-'84	125.9	148.4	117.9	58.3	41.7
1984-'85	120.9	140.4	116.2	55.9	44.1
1985-'86	119.5	143.1	119.7	49.7	50.3
1986-'87	118.8	131.7	110.9	62.5	37.5
1987-'88	103.0	153.2	148.5	7.3	92.7

Source: Indices based on data collected from the Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

FIG. 4(1). INDEX NUMBERS OF AREA, PRODUCTION AND PRODUCTIVITY OF SESAMUM: KERALA STATE.
(TRIENNIUM ENDING 1963-64 = 100)



increase in productivity, output also rose to a peak 53 points above the base level in the year 1968-'69 and in the succeeding years productivity also descended with output. In 1974-'75 output was only 26 points above the base level indicating that it had lost 50 per cent of the gains made in 1968-'69. It is interesting to note the striking correspondence between yield and output indices during this period.

The decisive role played by productivity is clear from the percentage contribution that it made towards output changes during this period. Only in the year 1963-'64 did area make a sizable contribution of 62 per cent. For all the remaining years productivity held sway. The output declines of the 1964-'65 to 1966-'67 triennium were entirely due to yield reductions. In the year 1967-'68 productivity pushed output to the base level, totally offsetting the negative area effects. The splendid performance of output in 1968-'69 was solely due to productivity, which accounted for 99 per cent of the former. The same pattern of contribution was found in the remaining years also. Thus throughout the first period, productivity changes by themselves determined output changes.

In the second period area rose out of the rut. The sudden area expansion of 1975-'76 brought the index 40 points above the base level. After a slight setback, it again rose in 1977-'78 to its climax of 47 points above 100. The state could maintain this record area under sesamum for two more years. In the year 1980-'81 the index slided down and stood only 23 points above the base line. For the next six years area index hovered around 120, indicating a stagnant phase. In the last year of the period, with a sudden drop, the index came down almost to the base level. Productivity, in sharp contrast to the dynamism exhibited in the first period, was rather sluggish in the second period. Its index, throughout the period tarried at 120, with occasional minor deviations. The year 1987-'88 was, however, an exception when productivity shot up and registered a 48 point increase over the base period. The first four years of the second period saw output at its best. In the year 1975-'76 its index registered an impressive 65 point increase over the base period. Rising further it gave its career best performance in 1978-'79 when the index touched the peak, 82 points above the base level. However, output declined rapidly in the next two years and in the year 1980-'81 the index was only 48 points above the base level. Thereafter, rising and falling in alternate years, output took a general downward direction and by 1986-'87 lost another 18 points. The final year of the period, however, witnessed a recovery, with the index climbing up to 153.

The relative importance of area expansion during the second period is evident from the percentage contribution that it made towards output changes during this period. In 10 out of the 14 years its contribution was well over 50 per cent. As against this, yield could make a similar contribution in only three years. Of these three years, its contribution was exactly 50 per cent in two. However, in the last year (1987-'88) 92 per cent of the output increase was brought about by productivity.

Summarizing what is discussed above, it can be stated that in the first period area experienced virtual stagnation. Productivity, after an initial setback in the 1964-'67 period, staged a dramatic recovery in the next two years. Ascending to a peak in the year 1968-'69 it came down rapidly in the next few years and reached a valley by 1974-'75. Throughout this period with area remaining stagnant, productivity single-handedly pushed output along with it.

The beginning of the second period witnessed a rapid expansion in the area under sesamum in the state. This area growth reached a plateau in the year 1977-'78 where it lingered for two more years. In the eighties area declined sharply and came down to the stagnant level experienced in the sixties. Productivity, in this period stayed around the level it had reached by 1974-'75. However, in the last year, it spurted and almost reached the previous peak of 1968-'69. Drawing sustenance mainly from area growth, production soared in the first few years of the second period and reached an all time high in the year 1978-'79. With the decline of area in the eighties, output lost its main prop and came down till 1986-'87. The sudden rise of productivity again pushed up production in the last year of the period.

4.1.1.2 District level analysis

Kollam

The indices of area production and productivity of sesamum in the district and the results of decomposition analysis are presented in Table 4.2. The indices have also been presented graohically in Fig.4.2. Area in the first period grew at a steady but subdued pace till 1970-'71 and then levelled off at 16 points above the base level. Productivity also rose in this period but exhibited comparatively greater fluctuations. In the year 1969-'70 it gained 36 points above the base period. In the next year productivity again slightly improved its position. This level at 39 points above the base line was the maximum attained by productivity in the first period. Thereafter yield rapidly declined and in the year 1974-'75 dropped 19 points below 100. But for a mild setback in the year 1967-'68, output rose continuously for the first eight years of the period. In the year 1970-'71 the index scored 66 points above 100, the maximum in the two periods. It is interesting to note that both area and productivity were at their respective first period peaks in this year.

Area, throughout the first period gave unflinching support to output. Its percentage contribution, except for three years was consistently above 50. In the 1963-'65 period and in 1974-'75 output growth wholely depended on area expansions. Yield contributions were more unsteady. On the positive

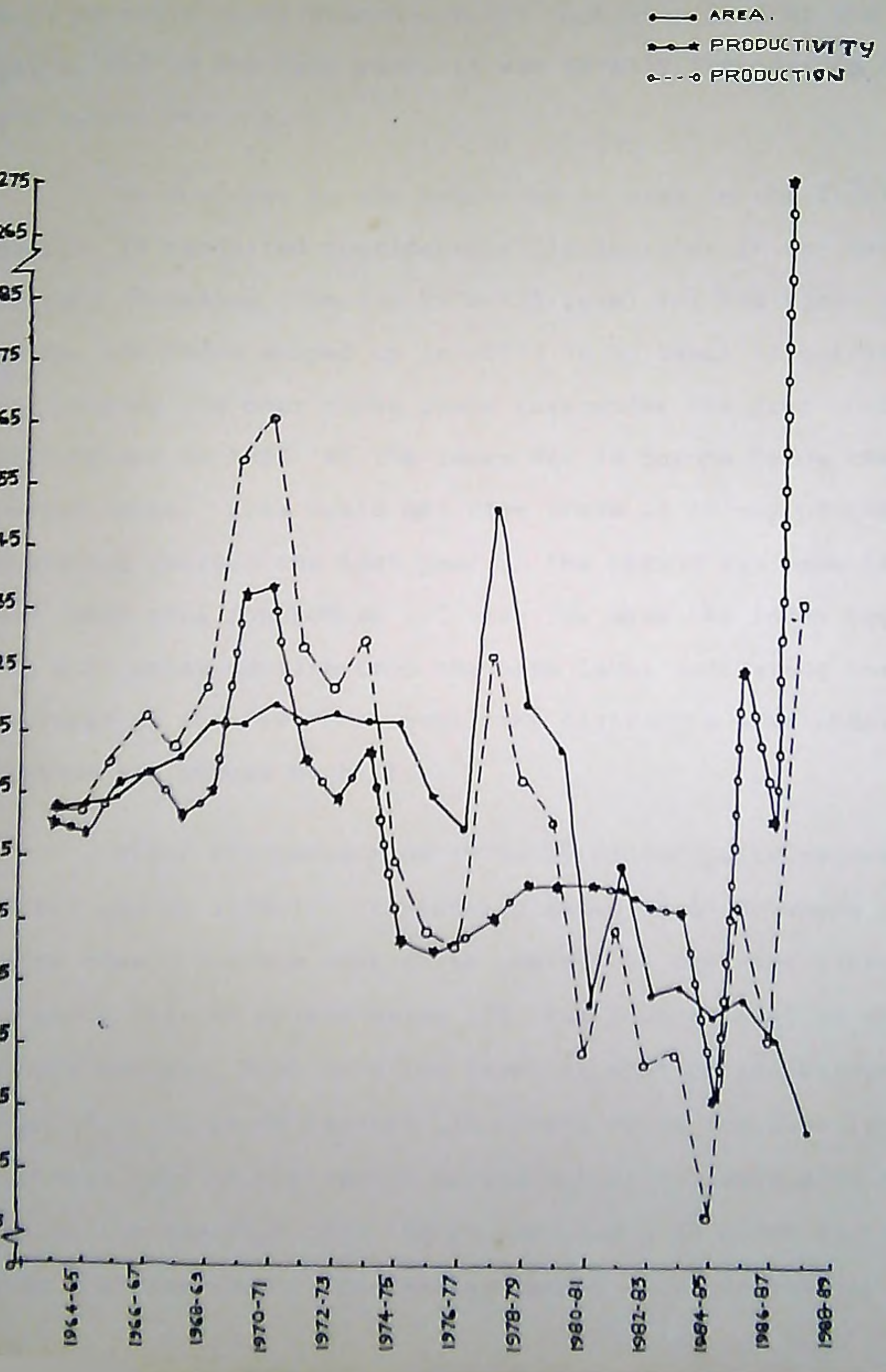
Table 4.2 Indices of area, production and productivity and percentage contributions of area and productivity towards the changes in production of sesamum : Kollam district (Base period 1961-'62 to 1963-'64)

Year	Indices of			Contributions of	
	Area	Production	Productivity	Area	Productivity
(1)	(2)	(3)	(4)	(5)	(6)
1963-'64	102.6	102.3	99.7	111.4	-11.7
1964-'65	103.6	102.3	98.7	155.8	-55.8
1965-'66	104.7	111.2	106.2	43.1	56.8
1966-'67	108.9	118.2	108.5	51.0	49.0
1967-'68	111.1	112.4	101.1	90.2	9.8
1968-'69	116.6	122.7	105.2	75.3	24.7
1969-'70	116.6	159.2	136.5	33.3	66.7
1970-'71	119.9	166.3	138.7	35.9	64.1
1971-'72	116.6	129.0	110.6	60.3	39.7
1972-'73	117.7	122.2	103.8	81.3	18.7
1973-'74	116.6	130.6	112.0	57.6	42.4
1974-'75	116.6	94.9	81.4	297.6	-397.6
1975-'76	104.5	83.1	79.6	23.7	-123.7
1976-'77	99.3	81.1	81.7	-3.3	-96.7
1977-'78	151.2	128.4	84.9	166.6	-66.6
1978-'79	119.7	107.7	90.0	243.1	-143.1
1979-'80	112.4	101.1	90.0	1039.9	-940.0
1980-'81	71.1	64.0	90.0	-76.5	-23.5
1981-'82	93.7	84.4	90.0	-38.2	-61.8
1982-'83	72.4	62.5	86.4	-68.7	-31.3
1983-'84	74.8	64.0	85.5	-64.9	-35.1
1984-'85	69.2	38.6	55.9	-39.2	-60.8
1985-'86	70.1	87.6	124.8	-269.9	169.9
1986-'87	65.8	65.4	99.4	-98.7	-1.3
1987-'88	50.2	136.7	272.2	-252.3	352.7

Source: Indices based on data collected from the Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

FIG. 4(2). INDEX NUMBERS OF AREA, PRODUCTION AND PRODUCTIVITY OF SESAMUM: KOLLAM DIST.

(TRIENNIUM ENDING 1963-64 = 100)



side, it ranged between 9 and 66 per cent and was over 50 per cent only in three years. In two years (1963-'65 period) with negative contributions, yield took away some of the area gains, and in the last year, it was totally responsible for the output decline.

In contrast to the behaviour of area in the first period, it exhibited considerable fluctuations in the second period. Receding from the 1974-'75 level for the first two years, the index surged up in 1977-'78 to reach 51 points above it. During the next three years area under the crop contracted sharply and by 1980-'81 the index was 29 points below the base period level. Area could not rise above it in any of the remaining years. The last year of the period was especially bad, when area touched an all time low with the index registering a 50 point decline from the base level indicating that compared to the 1961-'63 level, the district's area under sesamum had shrunk by half.

After the setback of 1974-'75 productivity recovered slowly and by 1978-'79 its index climbed up to 90 where it ruled steady for the next three years. In the year 1984-'85 it again fell 45 points below 100, its lowest level in the entire period. From this low level it shot up and within a span of three years reached 172 points above the base line. For most part of the second period output followed area movements. In the year 1977-'78 it recorded a 28 point increase over the base level. Thereafter output declined rapidly and in

1984-'85 suffered its worst, with the index slipping below the base line by 62 points. However, output recovered in the year 1987-'88 in which year the index stood at 136.

Area contributions for most part of the second period were negative. Only in the 1977-'80 triennium did area, rising above the base line, make positive contributions. During this three-year period output increases over the base level were entirely due to area expansions. For whole of the first decade yield contributions remained negative. Thereafter in 1985-'86 and 1987-'88 it made positive contributions. However, only in the latter year could yield offset the negative area effect and raise output above the base period level.

Alappuzha

Among the sesamum growing districts of Kerala, Alappuzha occupies an important place. The district accounts for 24 per cent of the sesamum area in the state, the highest for any district. This is equal to the combined area of Kollam and Ernakulam, two other prominent sesamum growing districts. The area and productivity movements of the crop in the district is of special significance since it is bound to have a decisive influence on the prospects of the crop at the state level. The details of trend analysis done for the district are presented in Table 4.3 and its graphic presentation is given in Fig.4.3.

In the district, area under sesamum experienced a slight decline in the first period. The lowest level was recorded in

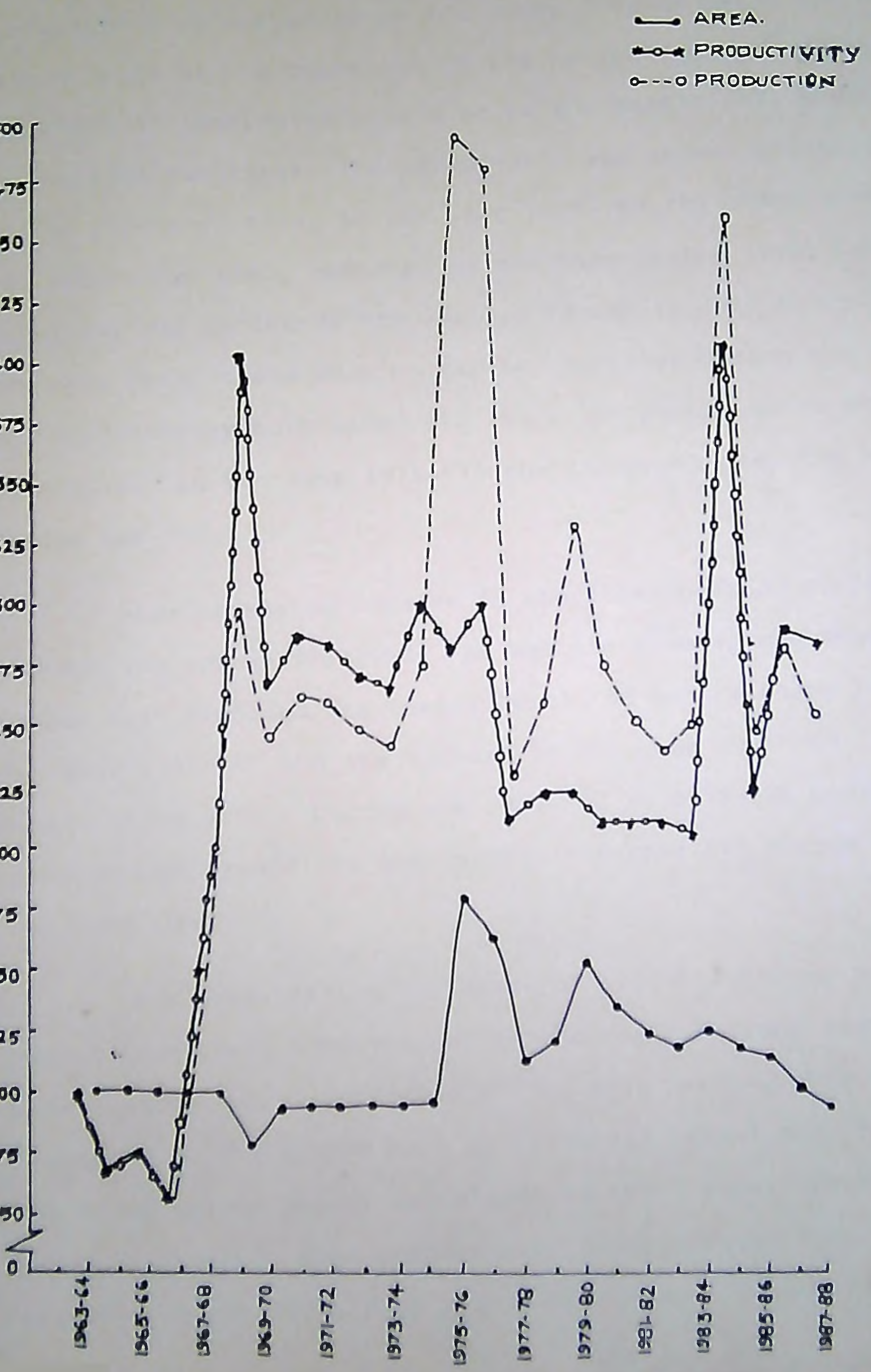
Table 4.3 Indices of area, production and productivity and percentage contributions of area and productivity towards the changes in production of sesamum : Alappuzha district (Base period 1961-'62 to 1963-'64)

Year	Indices of			Contributions of	
	Area	Production	Productivity	Area	Productivity
(1)	(2)	(3)	(4)	(5)	(6)
1963-'64	99.4	98.6	99.3	-44.9	-55.1
1964-'65	99.4	67.0	67.4	-1.5	-98.5
1965-'66	97.4	74.0	76.0	-8.8	-91.2
1966-'67	97.4	52.2	53.6	-4.2	-95.8
1967-'68	97.4	148.0	152.0	-6.9	106.9
1968-'69	74.0	299.7	405.0	-32.9	132.9
1969-'70	91.0	243.7	267.7	-11.5	111.5
1970-'71	91.0	261.7	287.5	-10.7	110.7
1971-'72	91.0	258.5	284.0	-10.9	110.9
1972-'73	91.0	247.5	271.9	-11.3	111.3
1973-'74	91.0	241.4	265.2	-11.6	111.6
1974-'75	91.0	274.8	301.8	-10.3	110.3
1975-'76	176.2	494.1	280.5	36.8	63.2
1976-'77	159.4	480.8	301.7	31.3	68.7
1977-'78	108.4	228.9	211.3	10.1	89.9
1978-'79	116.6	260.0	222.9	16.8	83.2
1979-'80	149.6	333.7	223.1	34.3	65.7
1980-'81	131.0	276.8	211.3	27.3	72.7
1981-'82	119.4	252.1	211.3	19.8	80.2
1982-'83	113.8	240.2	211.2	15.3	84.7
1983-'84	121.4	251.3	207.1	21.7	78.3
1984-'85	112.9	461.0	408.4	9.1	90.9
1985-'86	110.4	248.7	225.3	11.3	88.7
1986-'87	97.3	284.3	292.3	-2.9	102.9
1987-'88	88.6	254.5	287.3	-14.3	114.3

Source: Indices based on data collected from the Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

FIG. 4(3). INDEX NUMBERS OF AREA, PRODUCTION AND PRODUCTIVITY OF SESAMUM: ALAPPUZHA DIST.

(TRIENNIUM ENDING 1963-64 = 100)



1968-'69 when the index fell 26 points below the base line. Productivity as reflected by its index dropped below the base period level at the beginning of the period and by the year 1966-'67, it reached 48 points below the base line. However, in the next two years, its performance was indeed breath-taking and by virtue of this, in the year 1968-'69 the index rose to 405 indicating that, compared to the base period level productivity had increased four-fold. Though it fell sharply in the next year, there were no further declines during the period and productivity maintained its level 165 points above the base line. In the year 1974-'75 the increment over the base period was 201.

Area remaining passive in the first period, yield led the way and output followed. As was the case with productivity, output also recorded its lowest level (48 points below 100) in the year 1966-'67 and its highest in the year 1968-'69 (200 points above 100). During the 1969-'70 to 1973-'74 period the index stayed around 240 and in 1974-'75 rose 174 points above the base line.

The overwhelming influence of productivity on total output is evident from the percentage contributions that it made towards output increases during this period. The figures presented in the second half of Table 4.3 reveal that during the first period output was almost entirely under the control of productivity. When productivity contributions became negative in the first four years, output went below the base line. With positive yield contributions, it rose above the base level. Area effects were negative throughout this period but insignificant. Till 1966-'67 they worked with the negative productivity contributions. Thereafter, when yield contributions became high and positive, they could not do much to depress output.

Breaking the stagnation of the first period, area under the crop expanded in the second period. In the year 1975-'76 the index scored 76 points above the base level. Alappuzha district recorded the highest sesamum area in this year. However, in the next two years area declined sharply and in 1977-'78 it was only 8 points above the base line. In the year 1979-'80 area again rose 49 points above the base level and thereafter declined steadily and in the year 1987-'88 the index fell below the base line by 11 points. Productivity index in the year 1976-'77 rose to 301. The next year it fell sharply losing 90 points at the margin. For the next six years (i.e. from 1978-'79 to 1983-'84) yield growth stalled and the index hovered above 210. Then came the record yield of 1984-'85 when the yield index rose to 408, 3 points higher than the peak of 1968-'69. But in the very next year the index came down just as it went up and yield was again almost at the stagnant level of 1978-'84. The last two years saw productivity again going up. It has to be noted that in spite of all its vagaries, productivity had maintained itself fairly high above the base line and the index never dropped below 205.

Output experienced considerable fluctuations in the second period also. In the year 1975-'76, output broke all previous records with its index rising 394 points over the base level. Compared to the base period, output had increased nearly fivefold. This prosperity was however short lived. In 1977-'78 production nose-dived bringing the index to a more reasonable 228. This was followed by two other upswings, one in 1979-'80 and a more stronger one in 1984-'85 when the index rose almost to the 1975-'76 peak. Coming down from this level, the output index stayed around 250 for the last three years.

Examination of the percentage contribution of area and productivity towards production reveal that as in the first period productivity was mainly responsible for keeping output above the base level in the second period also. The contribution of productivity was consistently above 60 per cent in all the 13 years and out of these, in eight years it was over 80. Till 1985-'86, the positive area contributions complemented the yield effects. However, in none of these years was it above 40 per cent. In the last two years area contributions were negative but insignificant.

Ernakulam

The indices of output and its components for sesamum in the district are presented in Table 4.4 and portrayed graphically in Fig.4.4. Area under sesamum in the district exhibited considerable inertia in the first period. The index

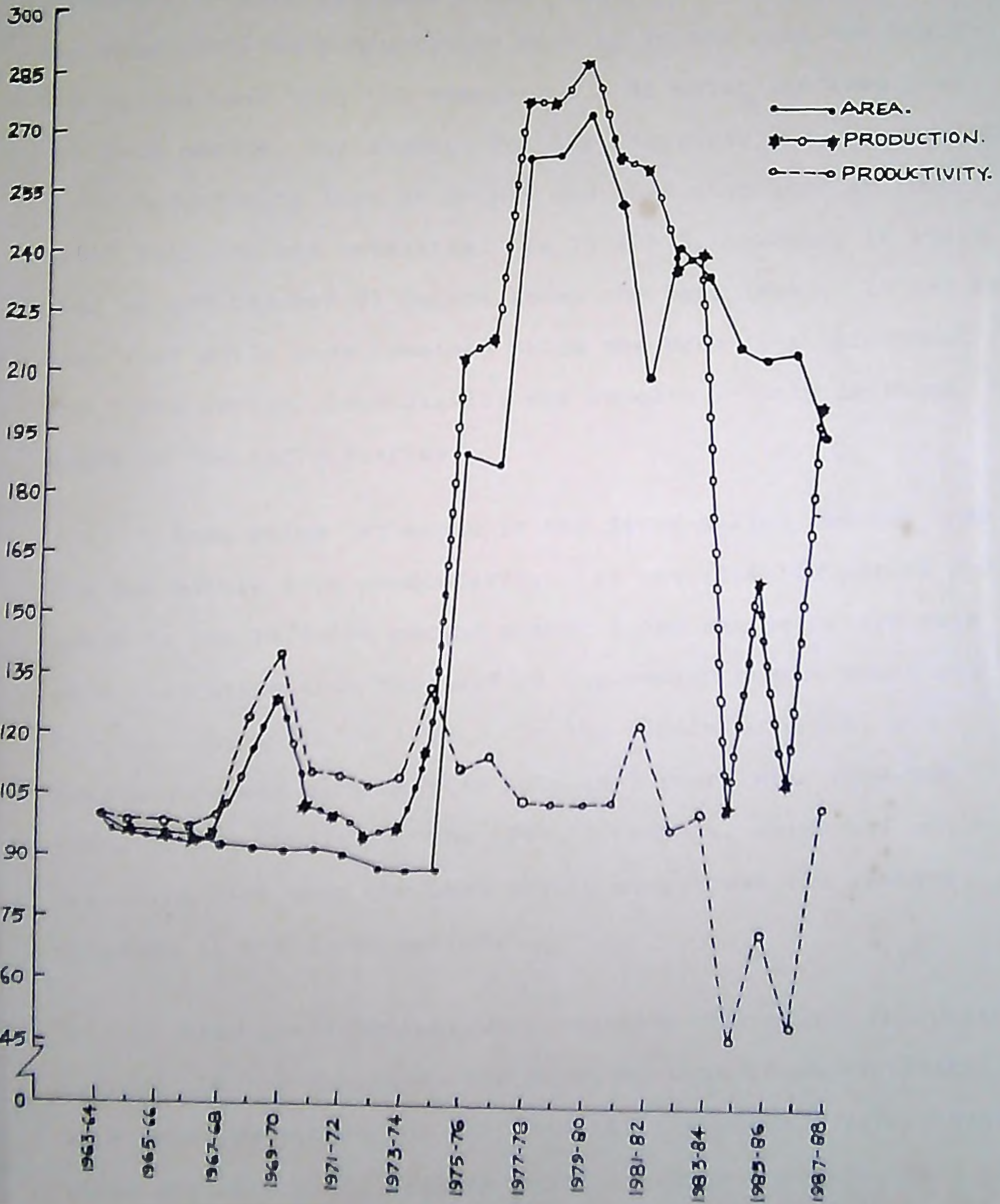
Table 4.4 Indices of area, production and productivity and percentage contributions of area and productivity towards the changes in production of sesamum : Ernakulam district (Base period 1961-'62 to 1963-'64)

Year	Indices of			Contributions of	
	Area	Production	Productivity	Area	Productivity
(1)	(2)	(3)	(4)	(5)	(6)
1963-'64	99.5	100.5	101.0	-118.9	218.9
1964-'65	97.9	97.0	99.1	-69.0	-31.0
1965-'66	97.8	97.0	99.2	-72.5	-27.5
1966-'67	96.8	95.3	98.4	-67.3	-32.7
1967-'68	93.9	95.3	101.4	-129.3	29.3
1968-'69	92.1	115.4	125.3	-58.1	158.1
1969-'70	92.1	130.6	141.8	-31.3	131.3
1970-'71	92.1	103.2	112.1	-259.8	359.8
1971-'72	91.2	101.5	111.3	-622.5	722.5
1972-'73	87.8	95.3	108.5	-269.2	169.2
1973-'74	87.8	97.7	111.3	-559.1	459.0
1974-'75	87.8	117.4	133.8	-81.9	181.9
1975-'76	191.2	215.1	112.5	84.2	15.8
1976-'77	188.5	219.3	116.3	80.2	19.8
1977-'78	265.4	279.9	105.5	94.4	5.6
1978-'79	266.4	279.2	104.8	95.1	4.9
1979-'80	276.9	290.3	104.9	95.2	4.8
1980-'81	254.2	266.4	104.8	94.9	5.1
1981-'82	210.7	263.6	125.1	76.1	23.9
1982-'83	243.0	238.3	98.1	102.3	-2.3
1983-'84	235.9	242.8	102.9	96.5	3.5
1984-'85	218.3	103.2	47.3	2694.0	-2594.1
1985-'86	215.2	160.7	74.7	165.7	-65.7
1986-'87	217.2	109.5	50.4	931.1	-831.1
1987-'88	196.7	204.0	103.8	94.6	5.4

Source: Indices based on data collected from the Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

FIG. 4(4). INDEX NUMBERS OF AREA, PRODUCTION AND PRODUCTIVITY OF SESAMUM : ERNAKULAM DIST.

(TRIENNIUM ENDING 1963-64 = 100)



remained fairly close to 100 for the first four years and then very slowly slid down to reach 13 points below the base line by the end of the first period. For the first three years productivity also followed area. However, steadying itself in the year 1967-'68 productivity went up in the next two years and in the year 1969-'70 registered a 41 point increase over the base period, the highest for the district. In the very next year productivity lost 29 points and then stagnated at that level till the mid seventies. In 1974-'75, however, it again went up and reached 33 points above the base level. It can be seen that while area remained below the base line throughout the first period, productivity was beneath it only in three years in the early sixties.

Area being lethargic in the first period, output took the cue mainly from productivity. In the 1964-'68 period and again in the 1972-'74 period output index was below the base line indicating that for half of the period output could not maintain the 1961-'63 level. In the remaining years, its performance was worth noting only in 3 years viz. 1968-'69, 1969-'70 and 1974-'75. The 1969-'70 output, which was about one-third more than the base period output was the maximum obtained in the first period.

Area contributions were negative throughout the first period. On the contrary, the contributions of productivity were positive except for the 1964-'67 triennium. Nevertheless, these positive yield effects could outweigh the negative area effects in only six years. Of these, in three years, the yield effect just offset the area effect leaving output unchanged at the base level and in the remaining years (viz. 1968-'69, 1969-'70 and 1974-'75) it brought about appreciable increases in output.

The beginning of the second period witnessed sharp increases in area under sesamum in the district. The rapid area expansion of 1975- 76 brought the index 91 points above the base line. Climbing up further, the index reached the 276 point mark in 1979-'80, an all time high. In the next two years area came down and in the year 1981-'82 the index stood at 210. After a recovery in 1982-'83 when the index gained 33 points, it again declined in the remaining years of the period. Still in the year 1987-'88 the index was 96.4 points above the base period level.

The yield index stayed above the base line for the first two years of the second period; in 1977-'78, it came down to 105 and then ruled steady till 1981-'82. The 25 point increase over the base period recorded in 1981-'82 was the best in the second period. Two years later, in 1984-'85 the yield index fell to its lowest level, 53 points below base line, indicating that yield was not even half of that obtained during the base period. After a similar poor performance in 1986-'87, the index rose and touched the base line in 1987-'88.

Following area, output also rose in the second period and reached a peak in 1979-'80 when there was a record sesamum output in Ernakulam, nearly thrice that of the base periods. From the level, declining year after year, output fell steeply in 1984-'85 losing 139 points at the margin. Thereafter, output fluctuated, rising and falling in alternate years and in the final year rose 104 points above the base line.

The impact of area variations on output is clearly brought out in the second half of the Table 4.4 which provides information on the relative contributions of area and productivity towards changes in production. Till 1983-'84 area changes almost by themselves determined the changes in production. Contributions of productivity, though positive, were insignificant. In the 1984-'87 triennium productivity, with significant negative contributions, in fact, took away some of the area induced output gains. The sharp output fall of 1984-'85 was mainly due to yield decline. Thus, while yield was the sole contributor towards output growth in the first period, the situation changed completely in the second period with area making significant contributions.

Thrissur

Indices representing the trends in area, production and productivity of sesamum in the district are presented in Table 4.5 and illustrated graphically in Fig.4.5. In the first period Thrissur district was under an 'area freeze' as far as sesamum crop was concerned. The growth curve of area was nothing but a straight line parallel to the X-axis and 100 points

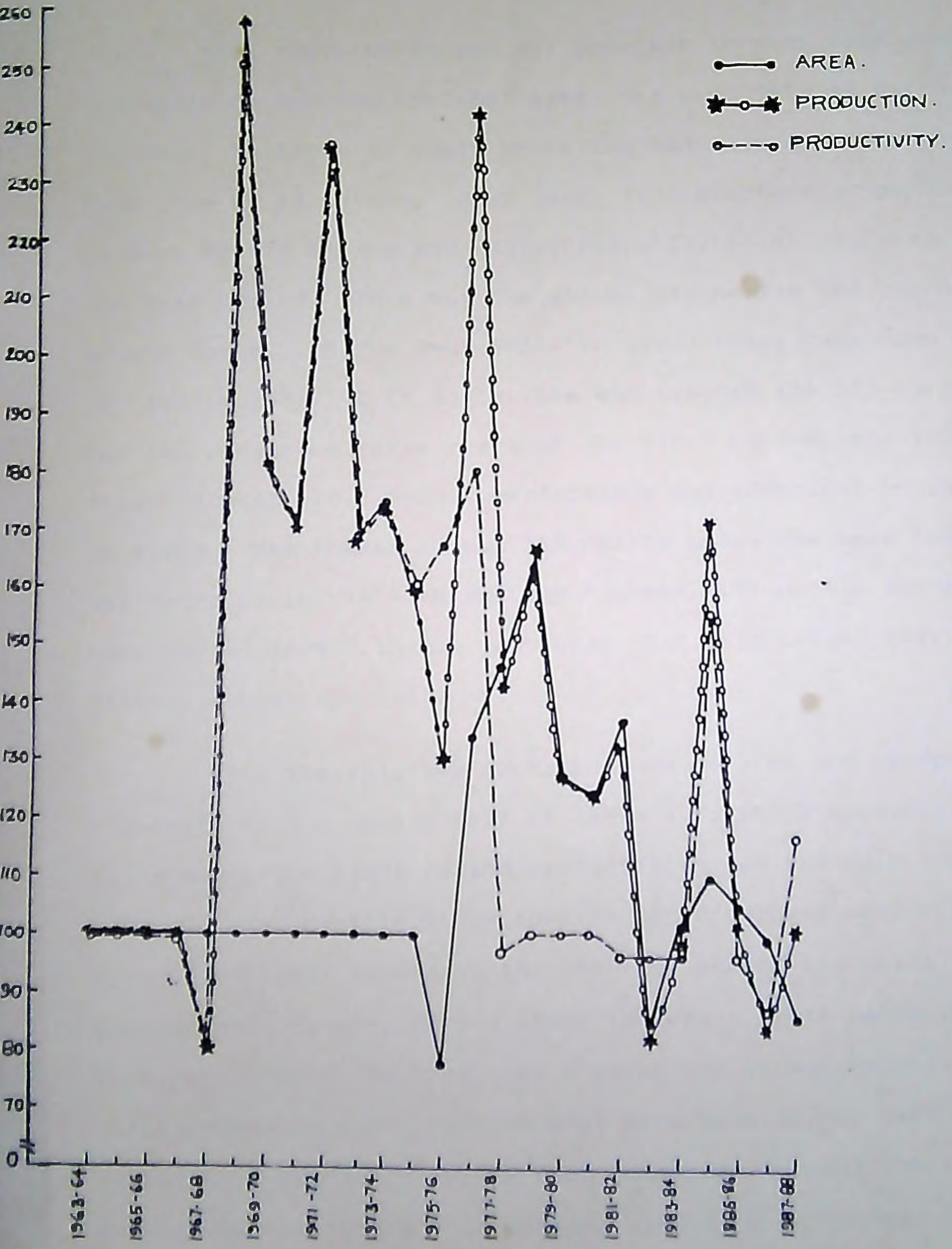
Table 4.5 Indices of area, production and productivity and percentage contributions of area and productivity towards the changes in production of sesamum : Thrissur district (Base period 1961-'62 to 1963-'64)

Year	Indices of			Contributions of	
	Area	Production	Productivity	Area	Productivity
(1)	(2)	(3)	(4)	(5)	(6)
1963-'64	100.0	99.8	99.8	0.0	-100.0
1964-'65	100.0	99.8	99.8	0.0	-100.0
1965-'66	99.9	99.8	99.9	-50.0	-50.0
1966-'67	99.9	99.8	99.9	-50.0	-50.0
1967-'68	99.9	81.4	81.4	-0.5	-99.5
1968-'69	99.9	250.9	251.1	-0.1	100.1
1969-'70	99.9	180.2	180.4	-0.2	100.2
1970-'71	99.9	170.7	170.9	-0.2	100.2
1971-'72	99.9	235.5	235.7	-0.1	100.1
1972-'73	99.9	167.7	167.8	-0.2	100.2
1973-'74	99.9	174.4	174.6	-0.2	100.2
1974-'75	99.9	160.9	161.0	-0.2	100.2
1975-'76	77.8	129.9	167.0	-99.3	199.3
1976-'77	133.9	242.0	180.7	33.5	66.5
1977-'78	146.9	142.5	97.0	108.8	-8.8
1978-'79	166.2	165.8	99.8	100.4	-0.4
1979-'80	128.1	127.7	99.8	101.1	-1.1
1980-'81	124.5	124.4	99.9	100.7	-0.7
1981-'82	137.1	132.3	96.5	112.8	-12.8
1982-'83	84.6	81.4	96.2	-81.2	-18.8
1983-'84	101.4	97.6	96.3	57.5	-157.5
1984-'85	110.1	171.0	155.4	18.1	81.9
1985-'86	104.9	101.3	96.6	362.7	-262.7
1986-'87	99.1	83.2	84.0	-5.2	-94.8
1987-'88	85.6	100.4	117.3	-3816.8	3916.8

Source: Indices based on data collected from the Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

FIG.4(5). INDEX NUMBERS OF AREA, PRODUCTION AND PRODUCTIVITY OF SESAMUM: TRISSUR DIST.

(TRIENNIUM ENDING 1963-64=100)



above it. Consequently output and productivity growth curves became one and the same.

Till 1967-'68 it was not possible to even talk about growth since nothing, neither area, nor productivity nor output, changed. In 1967-'68 yield broke ice and slipped below the base line by 19 points. Next year, in a spectacular performance it rose by 170 points and registered a 151 point increase over the base period. This was the global maxima for the yield growth curve. In the year 1969-'70 yield index came down to 180 and in 1971-'72 it again rose and touched the 235 mark. For the remaining three years of the first period, the index stayed around 170. Output performance was identical to that of yield. The lowest output (19 points below the base level) was recorded in 1967-'68 and the highest (151 points above the base period level) in the very next year, indicating very violent output fluctuations.

From the relative contributions of area and productivity, presented in the second half of Table 4.5, it is apparent that all through the first period productivity was the main contributor . Area contributions towards output growth were virtually nil. The higher values of the 1965-'67 period are quite misleading. Output, during these two years, fell below the base period level by less than a point and it was to this infinitesimally small decline that area made 50 per cent contribution. Productivity, in fact accounted for all the major output changes during this period, with it's percentage share steady at 100 except for the two years mentioned above.

Area broke its first period's monotony with a fall in the very first year of the second period, in which it reached its lowest level (23 points below the base level). Rapid area expansion took place during the next three years and in 1978-'79 sesamum area in the district reached its maximum level, 66 per cent more than the base period level. Though area declined by 38 points in 1979-'80, it remained above the base period level for two more years. In 1982-'83, however, the index slid below the base line. In the 1983-'86 triennium area regained the base period level but again went beneatn it during the last two years of the period.

Productivity, after commendable performance in the first two years, when on an average it made a 75 per cent increase over the base period, plunged down and crossed the base line in 1977-'78. For the rest of the period it remained just beneath the base line and emerged only twice, once in 1984-'85 to register a 55 point increase and again in 1987-'88 to score a 17 point increment over the base period level.

The nexus betwuen productivity and output broke in the second period. Area decline of 1975-'76 pulled output curve out of the 'mongrel curve' that existed till then. The sharp expansion of area in the year 1976-'77 which was also accompained by productivity increase pushed output up to a peak 141 points above the base period level. The decline in productivity in the year 1977-'78 brought output down from this peak and the index sobered down to 142. For the next six years output closely followed area movements. Coming down with area it went below the base line in the year 1982-'83, registering an 18 per cent decline from the base period level. In the remaining years output did well only in 1984-'85 when there was a 70 per cent increase over the base period level.

The primal role of area is obvious from the significant contributions that it made towards output changes during the second period. Except for four years, area contributions were positive throughout. In the 1977-'82 quinquennium area solely accounted for the output increases over the base period. Yield made sizeable positive contributions only in four years viz. the 1975-'77 period and in 1984-'85 and 1987-'88. In all the remaining years yield effects were negative.

Palakkad

The indices of area, production and productivity of sesamum are presented in Table 4.6 and their graphic presentation is done in Fig.4.6. Till the end of the seventies, area stuck to the base period level. In 1970-'71, the index suddenly fell to 41 indicating a 60 per cent reduction in area from the base period level. Area index ruled steady at this low level for the rest of the first period.

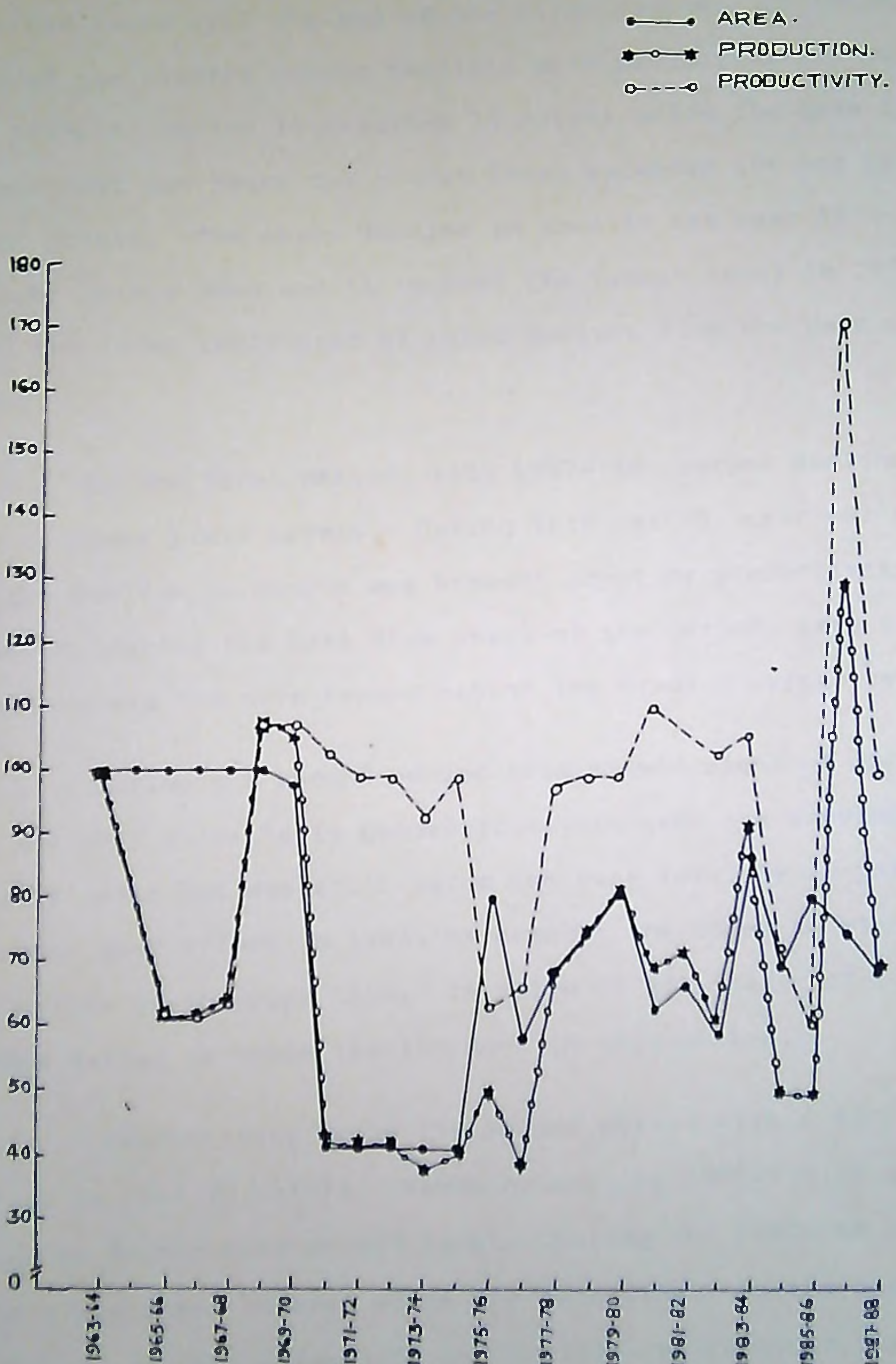
Productivity declined during the early sixties. In 1965-'66 the index recorded 38 point decline from the base level. Steadying itself in the next two years, the index climbed up to 107 in 1968-'69. This level was maintained for two more

Table 4.6 Indices of area, production and productivity and percentage contributions of area and productivity towards the changes in production of sesamum : Palakkad district (Base period 1961-'62 to 1963-'64)

Year	Indices of			Contributions of	
	Area	Production	Productivity	Area	Productivity
(1)	(2)	(3)	(4)	(5)	(6)
1963-'64	100.0	99.7	99.7	13.5	-113.5
1964-'65	100.0	81.5	81.4	0.2	-100.2
1965-'66	100.1	62.3	62.2	0.2	-100.2
1966-'67	100.1	62.3	62.2	0.2	-100.2
1967-'68	100.1	64.6	64.5	0.2	-100.2
1968-'69	100.1	107.8	107.7	1.4	98.6
1969-'70	98.1	106.2	108.2	-32.1	132.1
1970-'71	41.4	42.9	103.6	-104.5	4.5
1971-'72	41.4	41.3	99.7	-99.7	-0.3
1972-'73	41.4	41.3	99.7	-99.7	-0.3
1973-'74	41.4	38.5	93.0	-92.0	-8.0
1974-'75	41.4	41.3	99.7	-99.7	-0.3
1975-'76	80.8	51.2	63.4	-32.2	-67.8
1976-'77	58.1	38.5	66.4	-56.8	-43.2
1977-'78	70.4	69.0	98.0	-94.6	-5.4
1978-'79	74.8	74.5	99.6	-98.7	-1.3
1979-'80	81.6	81.2	99.6	-97.9	-2.1
1980-'81	62.8	69.5	110.7	-128.5	28.5
1981-'82	67.3	72.0	107.1	-121.1	21.1
1982-'83	59.1	61.2	103.4	-107.0	7.0
1983-'84	86.8	92.3	106.3	-176.5	76.5
1984-'85	70.1	50.5	72.1	-51.9	-48.1
1985-'86	80.8	49.4	61.1	-30.6	-69.4
1986-'87	75.5	130.4	172.7	-109.9	209.9
1987-'88	68.8	69.7	101.4	-103.8	3.8

Source: Indices based on data collected from the Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

FIG. 4(6). INDEX NUMBERS OF AREA, PRODUCTION AND PRODUCTIVITY OF SESAMUM: PALAKKAD DIST.
(TRIENNIUM ENDING 1963-64 : 100)



years. In 1971-'72 the index again touched the base line and remained there till the end of the first period. In the first half of the sixties output declined with productivity. During the 1965-'68 period it remained 38 points below the base line. In the next two years the output index exceeded 100 but by only eight points. The sharp decline in area in the year 1970-'71 brought output down and it touched the lowest level in 1973-'74 when the index registered 62 point decline from the base period level.

In the first period, till 1967-'68, output decline was due to lower yield levels. During this period, cent per cent of the decline in output was brought about by productivity. However, during the last five years of the period, area contraction was the main reason behind the drastic output reduction.

During the second period area showed signs of recovery. In the year 1975-'76 it gained 40 points over the previous year's level but was still below the base level by 20 points. Another good effort in 1983-'84 brought the index to within 15 points of the base line. In spite of all these efforts area index failed to touch the 100 mark in this period.

Productivity began the second period with a fall in which it lost 37 points. Nevertheless, by 1977-'78 it again came up to the base period level. During the 1980-'84 period, the yield index hovered above the base line. In the year 1984-'85 it went below 100, and in 1985-'86 recorded its lowest figure of 61. In the very next year, productivity soared to a new peak 72 points above the base line but again came down to the base level in 1987-'88.

Throughout the second period output remained beneath the base period level, except for the year 1986-'87. In 1976-'77 there was a severe decline similar to the one experienced in 1973-'74. Again in the 1984-'86 period significant output decline occured, with the index dropping down to 50. Only in the year 1986-'87 did output perform commendably when there was a 30 per cent increase over the base period level.

During the first two years of the second period area and productivity were jointly responsible for the output decline. In the 1977-'84 period, reduction in area was the main reason for output slump. Yield contributions were positive during the 1980-'84 period but were of no avail against the overwhelming negative area effects. However, in the year 1986-'87 yield effectively countered the negative area effect and raised output above the base level. In 1987-'88, the negative area effects again prevailed. It may be noted that throughout the second period area contributions were negative and significant indicating that area reduction was the main factor inhibiting output growth.

Though the analysis showed Palakkad in a very poor light, the findings have to be tempered with certain other considerations. It was noticed earlier that in the year 1970-'71 there was a sudden decline in the area under sesamum in the district. Interestingly, around this period a new district (Malappuram) was created by incorporating some parts of Palakkad and Calicut districts. The official records examined did not reveal how much of the sesamum growing tracts were transferred to the new district from Palakkad. Nevertheless, Calicut being a minor producer of the crop, it can be safely concluded that a major chunk of Malappuram's sesamum area came from Palakkad.

Viewed in this new light, the performance of area under the crop in Palakkad does not appear that bad. It can be seen that recovering from the shock of dismemberment the area index went up in 1975-'76 and for the remaining years maintained an upward, though unsteady trend. All the same, the initial impact of the 1970-'71 area loss was too much and the district could not completely recover from it during the second period.

Malappuram

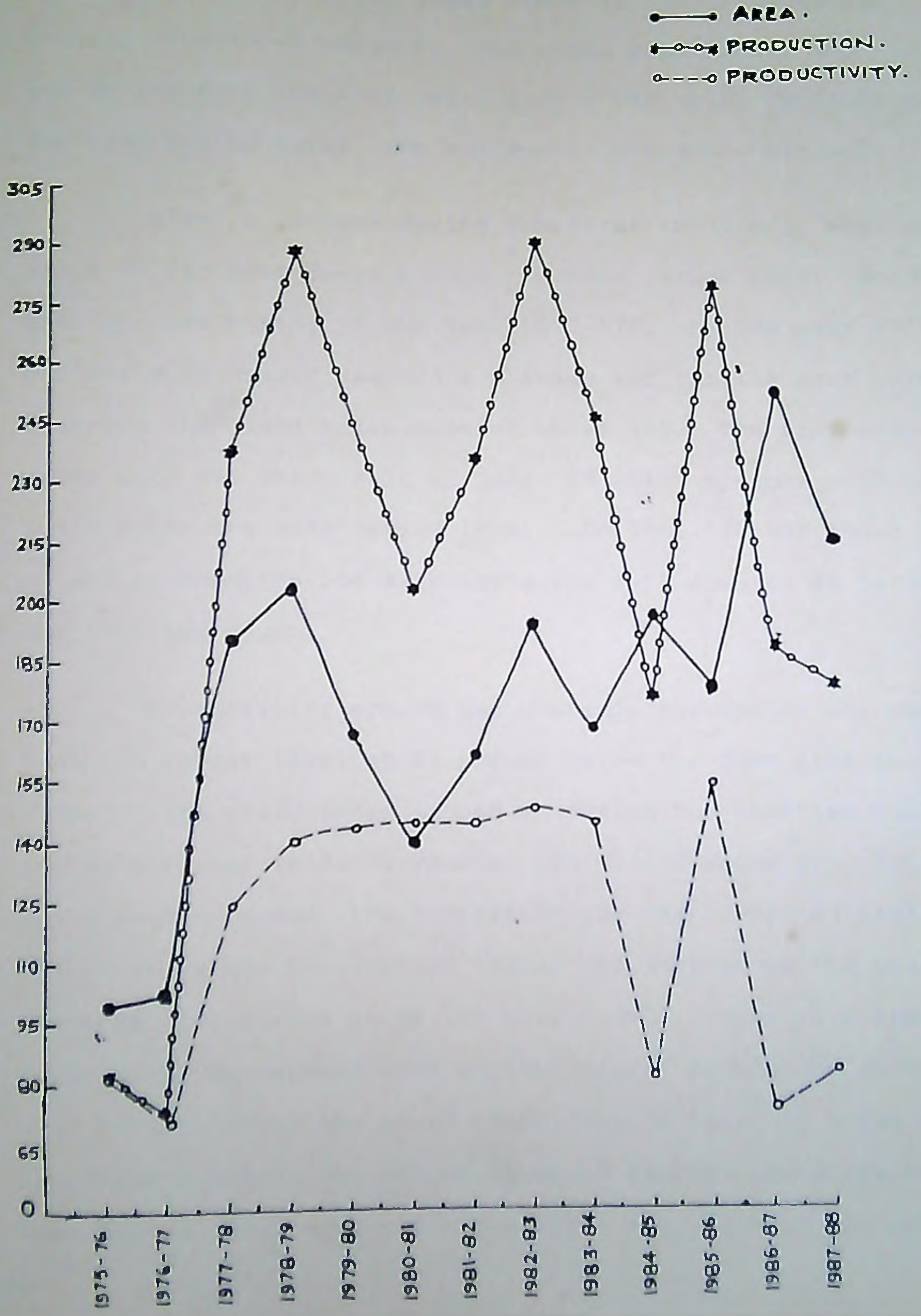
In the case of Malappuram district data availability restricted the analysis to the second period. Details of the trend analysis are presented in Table 4.7 and their graphic presentation is given in Fig.4.7. It is evident that, sesamum area in the district expanded considerably during the reference period. Area growth began with the sharp rise of 1977-'78 when the index gained 91 points over the base level. In the next year, it again rose by 14 points to reach 105 points above the base. Thus within the first four years, area under the crop

Table 4.7 Indices of area, production and productivity and percentage contributions of area and productivity towards the changes in production of sesamum : Malappuram district (Base period 1961-'62 to 1963-'64)

Year	Indices of			Contributions of	
	Area	Production	Productivity	Area	Productivity
(1)	(2)	(3)	(4)	(5)	(6)
1975-'76	99.1	82.5	83.3	-4.6	-95.4
1976-'77	102.3	73.0	71.4	7.3	-107.3
1977-'78	190.9	238.3	124.9	73.9	26.1
1978-'79	205.4	289.8	141.2	67.0	33.0
1979-'80	168.0	244.0	145.4	57.9	42.1
1980-'81	140.4	204.3	145.6	47.6	52.4
1981-'82	163.0	236.8	145.4	56.5	43.5
1982-'83	196.0	293.2	149.7	62.0	38.0
1983-'84	169.2	248.2	146.7	57.6	42.4
1984-'85	198.0	162.7	82.2	142.4	-42.4
1985-'86	180.4	281.5	156.1	56.7	43.3
1986-'87	254.4	190.3	74.8	149.4	-49.4
1987-'88	216.6	180.8	83.5	132.4	-32.4

Source: Indices based on data collected from the Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

FIG-4(7). INDEX NUMBERS OF AREA PRODUCTION AND PRODUCTIVITY OF SESAMUM: MALAPPURAM DIST. (TRIENNIUM ENDING 1975-1976=100).



doubled. However, during the next two years area declined and in the year 1980-'81 the index stood at 140. Thereafter braving occasional setbacks, the index rose higher and higher and in the year 1986-'87 registered a 154 point increase over the base period level, the maximum in the whole period.

After a setback during the first two years, when there was a 29 per cent decline from the base period level, productivity started rising in the year 1977-'78. By the year 1979-'80, productivity growth reached a plateau and for the next quinquennium the yield index hovered above 145. The stagnation ended with the sharp fall of 1984-'85 which brought productivity again below the base period level. In 1985-'86 the index leapt up and touched the 156 mark but again fell down to 80 during the last two years.

Productivity growth was unsteady throughout the period. From its lowest level at 27 points below the base line in 1976-'77 the yield index zooned up during the next two years and in the year 1978-'79 reached 189 points above it. Two other peaks were recorded, the highest in the year 1982-'83 (193 points above the base period level) and another in the year 1985-'86 (191 points above the base line). There were also depressions in between with a particularly strong one in the year 1984-'85 when the yield index fell to 162. In spite of all these fluctuations output remained fairly high above the base period level except for the first two years of the period.

The dominant role played by area is revealed by the fact that its percentage contribution was consistently above 50 in all but three years. Increases in output during the 1977-'84 period, were brought about primarily through area expansions, accompanied by appreciable yield growth. In the year 1984-'85 and again in the 1986-'88 period, positive area contributions outweighed the negative yield effects and kept output from falling below the base period level. For the first two years of the period productivity with negative contributions was instrumental in keeping output below the base period level. From 1980-'81 onwards, it started making positive contributions towards output growth. However, yield effects again became negative towards the end of the period.

4.2 Groundnut

More than 97 per cent of the groundnut area in Kerala is concentrated in the district of Palakkad. Hence in the present study analysis was confined to the district. The indices of area, production and productivity of groundnut in the district are presented in Table 4.9 and further illustrated graphically in Fig.4.8.

4.2.1 Palakkad

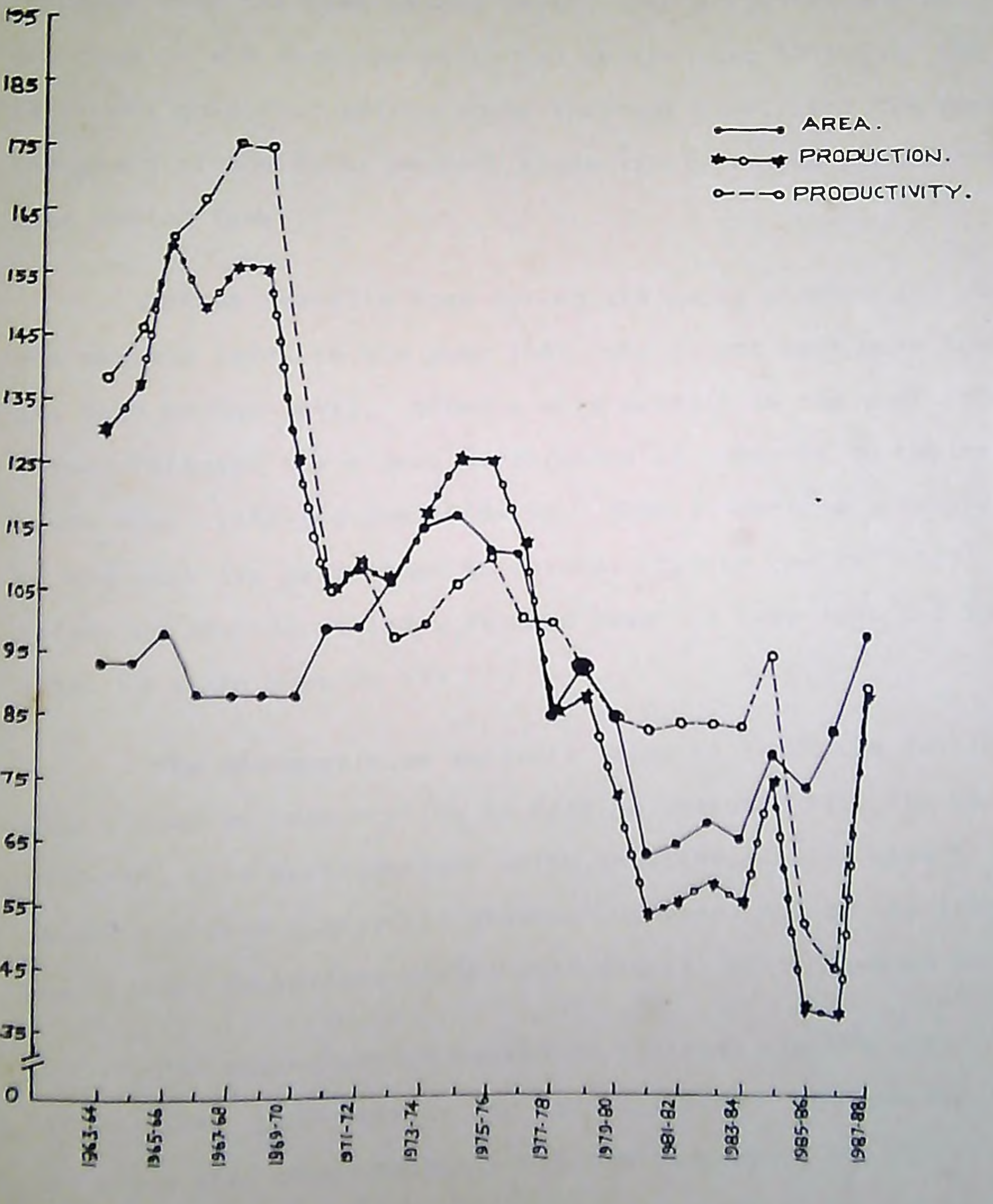
During the sixties and the early seventies, groundnut area in the district declined slightly, its index ranging between 88 and 99. However, towards the end of the period area index crossed 100 and in 1974-'75 rose to its maximum

Table 4.8 Indices of area, production and productivity and percentage contributions of area and productivity towards the changes in production of groundnut : Palakkad district (Base period 1961-'62 to 1963-'64)

Year	Indices of			Contributions of	
	Area	Production	Productivity	Area	Productivity
(1)	(2)	(3)	(4)	(5)	(6)
1963-'64	93.2	130.8	138.5	-26.3	126.3
1964-'65	93.3	137.9	145.9	-21.8	121.8
1965-'66	97.9	159.2	160.5	-4.6	104.6
1966-'67	88.1	149.0	166.9	-32.3	132.3
1967-'68	88.1	156.5	175.2	-28.9	128.9
1968-'69	88.1	156.5	175.2	-28.9	128.9
1969-'70	88.1	126.0	141.1	-55.0	155.0
1970-'71	98.7	104.8	104.7	-27.7	127.7
1971-'72	98.7	109.2	109.2	-14.7	114.7
1972-'73	107.8	107.2	98.2	107.0	-7.0
1973-'74	115.3	117.5	100.5	87.8	12.2
1974-'75	117.6	126.8	106.4	67.9	32.1
1975-'76	112.0	126.8	111.7	47.6	52.4
1976-'77	111.6	113.7	100.5	85.0	15.0
1977-'78	85.0	86.5	100.5	-111.6	11.6
1978-'79	93.6	88.9	93.8	-55.8	-44.2
1979-'80	84.5	72.4	84.6	-51.8	-48.2
1980-'81	62.5	53.0	83.7	-73.3	-26.7
1981-'82	64.6	55.3	84.5	-73.0	-27.0
1982-'83	68.4	58.6	84.5	-70.3	-29.7
1983-'84	65.2	55.2	83.6	-71.4	-28.6
1984-'85	78.9	71.2	95.3	-86.5	-13.5
1985-'86	73.4	38.8	52.1	-33.0	-67.0
1986-'87	83.1	37.7	44.8	-19.7	-80.3
1987-'88	99.0	90.5	90.2	-9.8	-90.2

Source: Indices based on data collected from the Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

FIG. 4(B). INDEX NUMBERS OF AREA, PRODUCTION AND PRODUCTIVITY OF GROUNDNUT: PALAKKAD DIST.
(TRIENNIUM ENDING 1963-64=100)



level, 17 points above the base line. Productivity began on an optimistic note, registering a 38 point increase over the base period level. Rising year after year it reached the maximum level in the 1967-'69 period when there was a 75 per cent increase over the base period level. Productivity rapidly declined in the next two years and by the year 1970-'71, the index was only four points above the base line. For the remaining years of the first period, productivity stayed around the base period level.

Output steadily rose during the early sixties and reached the maximum level in the year 1965-'66, 60 per cent more than the base period level. After a mild setback in the year 1966-'67 output repeated the signal performance of 1965-'66 in two more years viz. 1967-'68 and 1968-'69. Then it declined sharply and in the next two years lost 52 points. During the 1970-'73 triennium the output index skimmed over the base line and in 1974-'75 again rose to 127.

The decomposition analysis bring to light the critical role played by productivity in raising output. Till the year 1972-'73, area contributions being negative, output growth banked entirely upon yield growth. However, during the last 3 years, area expansions contributed significantly towards output.

The second period presented a dismal picture with falling area, productivity and output levels. For the first two years area could maintain its position above the base period level. In 1977-'78 area index fell to 85. Sliding down further, it reached the lowest level in 1980-'81 when there was a 35 per cent decline in area compared to the base period level. Struggling up through the rest of the period area index at last managed to touch the base line in 1987-'88. Productivity also showed a similar trend. Declining gradually, the index slipped down to 94 and then clung to this level for the next five years. After a slight recovery in the year 1984-'85, the index again fell sharply and reached the lowest level in the year 1986-'87, 55 points below the base period level.

Output experienced drastic reductions in the second period. In 1976-'77 its index lost 13 points but was still above 100. In 1977-'78, loosing another 27 points, the index went below the base line. The succeeding years saw output go lower and lower, though there were sporadic efforts at recovery. In the 1985-'87 period, it reached the lowest level, 62 per cent below the base line, indicating that output had declined to nearly one-third of the base period level. However, in the last year the index rose to 90.

Till 1977-'78 both area and productivity made positive contributions towards output. Thereafter, area and productivity declined simultaneously causing significant reductions in output. During the first half of the eighties area was the main wrecker, its contributions averaging over -70 per cent. However, in the last three years output reduction was mainly due to the decline in productivity.

4.2 Growth Rates

Three statistical functions viz. linear, log-linear and second degree curve in logarithm were fitted to the time series data on area, production and productivity. The apriori reason for the log-linear function was the same as given by Dandekar (1980) viz., "the postulate that the change in agricultural output in a year would depend upon the output in the previous year is reasonable ....." However, the log-linear function assumes a constant compound rate of growth and there is no reason to believe beforehand that it would be so always. The quadratic function has theadvantage that it allows for varying growth rate. It leaves the matter of whether growth rate is increasing or decreasing over time to be decided by the data and thus places no prior restrictions on the results. This function can also account for a constant compound rate of growth, like the log-linear form in which case the coefficient of the square term will not be significantly different from zero. Suitability of the functions tried were determined after considering the sign and statistical significance of the parameter estimates, the coefficient of multiple determination and 'F' values.

The whole period was devided into two sub periods (as was done earlier for the analysis using indices, mentioned in section 4.1); period one extending up to the mid seventies and the post 1975 period as the second period.

Regressions were run for the two sub periods separately as well as for the whole period. Trends in area, production and productivity were studied at the district and state levels.

4.2.1 Sesamum

4.2.1.1 State level analysis

Growth rates of area, production and productivity obtained from the three models are presented in Table 4.9.

Growth rate of area:

In the first period none of the functions tried could adequately explain area movements, as indicated by the very low R^2 values. All the functions yielded negative and non-significant b values. Compound growth rate obtained was a very low figure of -0.13 per cent. Overall, there was no evidence of any growth during this period. Coefficient of variation of area was only 1.81 per cent indicating that relative variations were practically nil. The analysis revealed that though there was no instability during the first period, there was no growth either.

The second period was characterised by a distinct downward trend in area. All the functions gave significant 'b' values with negative sign. Quadratic function had the highest R^2 of 0.74 coupled with an 'F' significant at one per cent level. The coefficient of 't^2' had a negative sign, indicating an accelerated ddcline. However, it was significant only at 20 per cent level. Average annual compound growth rate obtained

Table 4.9 Estimated trend equations for area, production and productivity of sesamum : Kerala state

Y =	a	+ bt	R^2	C.G.R	ln Y = a	+ bt	R^2	C.G.R	ln Y = a	+ bt	+ ct^2	R^2
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
						Area						
P.I	11.8694	-0.0160**** (0.0150)	0.089	-0.1337	2.4823	-0.0013 (0.0012)	0.0844	-0.1328	2.4689	+0.0013 (0.0013)	+0.0002 (0.0004)	0.0991
P.II	17.8131	-0.3501* (0.0680)	0.7049	-2.3027	2.8884	-0.0231* (0.0041)	0.7123	-2.2834	2.7466	-0.0231* (0.0044)	-0.0014 (0.0013)	0.7428*
W.P	11.3856	+0.1541* (0.0431)	0.3366	1.1619	2.4357	+0.0114* (0.0031)	0.3679	1.1454	2.6318	+0.0114 (0.0029)	-0.0006 (0.0004)	0.4217*
						Productivity						
P.I	189.9027	+9.4025* (2.4874)	0.5436	3.7552	5.2645	+0.0371* (0.0091)	0.5654	3.7802	5.5714	+0.0371* (0.0096)	-0.0018 (0.0026)	0.5819*
P.II	256.8554	+0.9427 (1.5401)	0.0346	0.3593	5.5523	+0.0028 (0.0053)	0.0245	0.2826	5.5435	+0.0028 (0.0050)	+0.0021**** (0.0015)	0.1593
W.P	239.7720	+1.5790*** (0.9590)	0.0979	0.6169	5.4576	+0.0071** (0.0041)	0.1325	0.7098	5.6348	+0.0070** (0.0032)	-0.0013* (0.0004)	0.3480*
						Production						
P.I	2.2764	+0.1084* (0.0301)	0.5126	3.6300	0.8395	+0.0358* (0.0102)	0.5380	3.6424	1.1328	+0.0358* (0.0098)	-0.0016 (0.0027)	0.5521**
P.II	4.6092	-0.0824* (0.0201)	0.5959	-2.0481	1.5326	-0.0203* (0.0051)	0.6014	-2.0070	1.3824	-0.0203* (0.0052)	+0.0006 (0.0015)	0.6068*
W.P	2.7211	+0.0593* (0.0141)	0.4247	1.7334	0.9854	+0.0185* (0.0041)	0.4625	1.8634	1.3589	+0.0185* (0.0030)	-0.0014* (0.0004)	0.7055*

Figures in parentheses are standard errors.

*	Significant at 0.01 level of significance
**	Significant at 0.05 level of significance
***	Significant at 0.10 level of significance
****	Significant at 0.15 level of significance

C.G.R : Compound growth rate
P.I : Period one 1961-'62 to 1974-'75
P.II : Period two 1975-'76 to 1987-'88
W.P. : Whole period 1961-'62 to 1987-'88

was $^{-}$2.31 per cent. The results point to a distinct decline in the state's area under sesamum in the second period, with some indication of an increase in the rate of decline with the passage of time. Coefficient of variation of area during the period was 10.23 per cent, indicating that compared to the first period there were more fluctuations in the second period. So the decline of area in the second period was also accompanied by disturbances.

Analysis of growth of area over the whole period revealed a positive trend. The 'b' values of all the functions were positive and significant at one per cent level. The quadratic trend in time performed comparatively better with an R^2 of 0.43 and a significant 'F' value. Coefficient of 't^2' was negative and significant suggesting deceleration. The average annual compound growth rate obtained was 1.14 per cent.

Coefficient of variation of area for the whole period was 15.32 per cent. As the analysis of the sub-periods revealed, almost the whole of this variability arose during the second period.

It can be seen that when the growth of area over the entire period was considered, the emerging results on the surface appeared to contradict those obtained from the analysis of the two sub-periods separately. Both the sub-periods showed negative growth in area, whereas, the whole period analysis revealed positive growth. This apparent contradiction, however, was caused by the sharp area increase during a few years at the beginning of the second period, in particular in the 1975-'80 period. (The compound growth rate worked out by considering only the first and last year values and using the compound interest formula was 8.36 per cent). This rapid area expansion soon petered out and a decline set in the eighties which continued right up to the end of the decade. The negative growth rate exhibited by area in the second period when this period was analysed as a separate segment, reflected this downslide from the peak it had reached in the latter half of the seventies. However, the average level of the second period was, relatively higher than the stagnant level of the sixties. Consequently, a regression run over the entire period would undoubtedly show a positive growth rate. The underlying roughly parabolic trend is evident from the relatively better performance of the quadratic function which produced a positive 'b' value and a negative 'c' value.

The foregoing analysis revealed that area under sesamum in the state experienced three distinct phases of growth. In the sixties and upto the mid seventies, there was near stagnation in area, with an almost imperceptible decline. The latter half of the seventies witnessed a rapid area expansion which continued up to the end of the decade. The eighties were characterised by a declining trend.

Growth rate of productivity:

In the first period all the functions gave positive and significant 'b' values, indicating a rise in productivity during this period. The functions, in general, could explain more than 50 per cent of the variations in productivity. The quadratic model was comparatively better with an R^2 of 0.58 and an 'F' value significant at one per cent level. Coefficient of square term was negative but non-significant. The average growth rate obtained was 3.71 per cent. Thus, though area was remaining practically stagnant during this period, productivity was on the rise.

Coefficient of variation of productivity during this period was 13.33 per cent, indicating that the growth in productivity was not a steady one. There were appreciable fluctuations.

None of the functions had significant 'b' values in the second period. Their explanatory powers were also very low, especially that of linear and log-linear forms. The compound growth rate obtained was a negligible 0.28 per cent. This very low value, together with the non-significance of the coefficients of time trend and very poor explanatory powers of the regressions pointed towards possible stagnation in productivity, rather than growth.

Coefficient of variation of productivity during the period was 6.59 per cent. The insignificant growth rate and low C.V. indicate that productivity was lingering around its average value. During this period, as already seen area under sesamum was declining at a rate of 2.31 per cent. The second period thus presented very disturbing features - declining area and a stagnant yield level.

When regressions were run for the whole period, the coefficient of 't' was found to be positive and significant in all the three equations. Maximum significance (0.025 level) was noticed for the 'b' value of the quadratic functions. This function also had the highest explanatory power. Coefficient of 't^2' was negative and significant at one per cent level. The average growth rate was 0.71 per cent. The sign and significance of 'c' indicated that there was distinct deceleration in growth over time. It also implied that at the beginning of the first period growth rates were fairly high and productivity increases appreciable, inspite of the fact that the average growth rate for the whole period was very low. These results tally with those obtained from the analysis of the two sub-periods separately, where it was found that whereas there was positive growth at an average rate of 3.71 per cent in the first period, with the negative though insignificant 'c' value of the quadratic indicating possible deceleration, the second period was characterised by near stagnation with a very low growth rate of 0.28 per cent. However, the accelerated decline in the second period, which the negative 'c' value of the quadratic fitted to the whole period implied, cannot be accepted in toto because, as the separate analysis of the second period showed, there was near stagnation during this period and even faint signs of growth.

Coefficient of variation of productivity over the whole period was 12.36 per cent. As indicated earlier major part of the fluctuation was experienced during the first period.

The analysis revealed that productivity began its growth in the first period with appreciably high, though declining growth rates. In the second period, it tended to stagnate at the level where it had reached by the end of the first period. In contrast, area was virtually stagnant inthe first period. It shot up to a peak in the initial phase of the second period from where it steadily slid down all through the eighties.

Growth rate of output

Output being a function of area and productivity follows a course which these two factors compel it to take. With area remaining stagnant, it rises and falls with productivity. With productivity remaining static, it follows area movements. When both area and productivity change, it takes a direction determined by the relative strengths of these two movements.

Estimated trend equations for output presented in Table 4.9 show that positive and significant 'b' values were obtained for all the functions during the first period. Compared to the other two, quadratic function was better with a relatively higher R^2 and a significant 'F' value. Coefficient of 't^2'

though negative was insignificant. Average growth rate was 3.58 per cent. With area remaining stagnant, it was the upward trend in productivity which pushed production up in this period. Since productivity was growing at a compound rate of 3.71 per cent, production also kept pace with a growth rate of 3.58 per cent. The slight discrepancy between the two growth rates was due to the negligible decline in area during this period.

Earlier analysis showed that the second period was characterised by stagnation in productivity and decline in area. Such a combination was bound to cause an adverse effect on production. Analysis of production behaviour during the second period confirmed these observations. The 'b' values were found negative and significant in all cases. However, the R^2 values being almost identical nothing could be said as to the form of the underlying trend. For the quadratic function the coefficient of 't^2' was positive but insignificant. The function yielded a growth rate of $^{-}2.03$ per cent. With productivity remaining practically stagnant and area declining at the rate of 2.31 per cent output could not but decline at a similar rate. The slightly lower rate of decline of output was indicative of an almost imperceptible growth in productivity during this period.

Compared to the first period (which had a C.V. of 13.70 per cent), output experienced lesser fluctuations in the second period, coefficient of variation being 6.21 per cent. Both area and productivity were contributing to output variability during this period with area exerting more weight.

When considered over the whole period production showed an upward trend. All the functions had positive and significant 'b' values and reasonably good R^2 values. The production trend was best approximated by the quadratic function which could explain 70 per cent of the output variations. Coefficient of 't^2' was negative and significant at one per cent level. Average growth rate obtained was 1.85 per cent. The sign and magnitude of 'b' and 'c' values of the quadratic function indicate that at the beginning of the first period growth rate was positive and fairly high, but was decreasing over time. This positive but declining rate persisted throughout the first period and also extended to the first few years of the second period. Then it changed sign and became negative and thereafter assumed larger and larger negative values. These observations lead to the conclusion that the peak in production was reached in the first phase of the second period, to be more specific in the late seventies.

Separate analysis of the two sub periods also revealed a similar pattern with positive rates of growth in the first period and negative growth rate in the second period.

For the period as a whole area exhibited a growth rate of 1.14 per cent. Productivity was creeping along with a growth rate of 0.71 per cent. Due to their combined influence output rose at a rate of 1.85 per cent.

4.2.1.2 District level analysis

Kollam

The estimated trend equations for the district are presented in Table 4.10. During the first period growth rate of area under sesamum in the district was a low 1.54 per cent. The quadratic function could explain as much as 95 per cent of the total variations in area. Coefficient of square term was negative and significant indicating deceleration in area growth. The growth rate of productivity was lower at 0.38 per cent. However none of the functions tried could adequately explain the yield movements. In the case of output, the quadratic function had a comparatively better R^2 and a significant F value. The average rate of growth was 1.93 per cent. Here also, the negative 'c' value of the quadratic function implied a decline in the rate of growth over time.

Area declined sharply in the second period at a compound rate of 6.36 per cent. Nevertheless yield growth was higher, the growth rate being 4.58 per cent. Like area, output also declined during the second period but at a lower rate of 1.99 per cent. However the 'R^2' values of all the output functions were low and their regression coefficients non-significant; indicating the presence of powerful random disturbances.

When considered over the whole period, area was found declining at a rate of 1.97 per cent. The quadratic function could explain 81 per cent of the area movements and both the

Table 4.10 Estimated trend equations for area, production and productivity of sesamum : Kollam district

	Y = a (1)	+	bt (2)	R^2 (3)	C.G.R (4)	ln Y = a (5)	+	bt (6)	R^2 (7)	C.G.R (8)	ln Y = a (9)	+	bt (10)	+	ct^2 (11)	R^2 (12)
								Area								
P.I	3016.0142	+	51.6864* (6.2681)	0.8501	1.5255	8.0154	+	0.0154* (0.0021)	0.8503	1.5565	8.1543	+	0.0154* (0.0011)	-	0.0015* (0.0003)	0.9475*
P.II	3964.5768	-	176.1925* (39.7264)	0.6414	-7.0173	8.3346	-	0.0657* (0.0120)	0.7159	-6.3626	7.9151	-	0.0657* (0.0126)	-	0.0033 (0.0038)	0.7352*
W.P	3776.4531	-	49.7556* (14.4221)	0.3225	-1.7155	8.2861	-	0.0196* (0.0045)	0.3901	-1.9458	8.1823	-	0.0197* (0.0028)	-	0.0029* (0.0004)	0.8094*
								Productivity								
P.I	286.4500	+	1.558 (2.7934)	0.0253	0.5313	5.6614	+	0.0038 (0.0094)	0.0145	0.3826	5.7679	+	0.0038 (0.0079)	-	0.0049** (0.0022)	0.3181
P.II	146.5431	+	19.6751** (9.7720)	0.2693	7.8428	5.2546	+	0.0458** (0.0239)	0.2437	4.6840	5.3948	+	0.0458** (0.0217)	+	0.0128** (0.0065)	0.4531**
W.P	268.6147	+	1.6324 (2.6174)	0.0153	0.6018	5.6453	-	0.0008 (0.0068)	0.0005	-0.0769	5.5473	-	0.0007 (0.0066)	+	0.0014*** (0.0009)	0.0867
								Production								
P.I	867.2314	+	20.1690*** (11.4460)	0.2056	2.035	6.7678	+	0.0193** (0.0099)	0.2192	1.9450	7.0153	+	0.0193** (0.0086)	-	0.0064** (0.0024)	0.5238**
P.II	792.7314	-	9.5334 (18.1668)	0.0244	-1.4619	6.6763	-	0.0199 (0.0261)	0.0519	-1.9767	6.4025	-	0.0199 (0.0251)	+	0.0095**** (0.0075)	0.1823
W.P	1080.7786	-	14.5082* (5.7621)	0.2023	-1.8304	7.0167	-	0.0204* (0.0068)	0.2498	-2.0212	6.8226	-	0.0204* (0.0069)	-	0.0015*** (0.0009)	0.3148**

Figures in parentheses are standard errors.

*	Significant at 0.01 level of significance
**	Significant at 0.05 level of significance
***	Significant at 0.10 level of significance
****	Significant at 0.15 level of significance

C.G.R : Compound growth rate
P.I : Period one 1961-'62 to 1974-'75
P.II : Period two 1975-'76 to 1987-'88
W.P : Whole period 1961-'62 to 1987-'88

parameter estimates were significant at one per cent level. The negative sign of 'c' value indicated an increase in the pace of decline towards the end of the period. For yield while the linear trend yielded a positive growth rate, the logarithmic functions showed negative growth. The explanatory power of the regressions were generally poor. Altogether there is no evidence of any definite long term trend in yield.

Output exhibited a distinct declining trend at a rate of 2.04 per cent. The quadratic function had a comparatively higher R^2 and a significant 'F' value. 'C' value being negative there was indication of an accelerated decline through time. However, it was significant at 10 per cent level only.

During the first period area growth followed a steady course and yield variability (C.V = 11.00 per cent) was the main reason for fluctuations in output (C.V = 12.30 per cent). Area exhibited comparatively higher variability in the second period (C.V = 12.40 per cent) but it was still lower than that of yield (C.V = 36.82 per cent). Output variability was much higher in the second period (C.V = 31 per cent) and as was the case in the first period, in the second period also yield variability was the main source of output variability.

Alappuzha

The estimated growth rates of area, production and productivity of sesamum in the district are presented in

Table 4.11 Estimated trend equations for area, production and productivity of sesamum : Alappuzha district

	Y = a (1)	+ bt (2)	R^2 (3)	C.G.R (4)	ln Y = a (5)	+ bt (6)	R^2 (7)	C.G.R (8)	ln Y = a (9)	+ bt (10)	+ ct^2 (11)	R^2 (12)
					Area							
P.I	4078.9451	- 38.4314** (15.8641)	0.3284	-1.0197	8.3129	- 0.0100** (0.0049)	0.2824	-0.9981	8.2123	- 0.0100** (0.0045)	+ 0.0016**** (0.0013)	0.3705
P.II	6414.3465	-202.9296* (47.8753)	0.6203	-4.2046	8.7738	- 0.0394* (0.0091)	0.6378	-3.8667	8.4987	- 0.0394* (0.0094)	- 0.00002 (0.0028)	0.6376*
W.P	3824.6247	+ 38.9554*** (22.3081)	0.1087	0.9246	8.2409	+ 0.0087** (0.0051)	0.1265	0.8757	8.4068	+ 0.0087 (0.0046)	- 0.0007**** (0.0006)	0.1704
					Productivity							
P.I	33.5164	+ 17.6973* (4.2921)	0.5862	15.9053	3.9901	+ 0.1243* (0.0298)	0.5960	13.2393	4.9089	+ 0.1243* (0.0308)	+ 0.0007 (0.0081)	0.5962*
P.II	197.0021	+ 2.6891 (3.8052)	0.0435	1.2967	5.2787	+ 0.0105 (0.0164)	0.0387	1.0550	5.2364	+ 0.0105 (0.0141)	+ 0.0083** (0.0042)	0.3079
W.P	112.9601	+ 5.5113* (1.7024)	0.2956	3.8479	4.5368	+ 0.0423* (0.0109)	0.3830	4.3250	5.3649	+ 0.0423* (0.0091)	- 0.0039* (0.0013)	0.5398*
					Production							
P.I	144.5936	+ 61.7493* (12.4791)	0.6705	14.2435	5.3948	+ 0.1143* (0.0267)	0.6041	12.1090	6.2149	+ 0.1143* (0.0277)	+ 0.0023 (0.0077)	0.6071*
P.II	1335.1544	- 36.7250*** (23.7440)	0.1786	-3.6620	7.1464	- 0.0289*** (0.0214)	0.1616	-2.8530	6.8268	- 0.0289*** (0.0189)	+ 0.0083*** (0.0057)	0.3089
W.P	405.4073	+ 30.6274* (8.0036)	0.3694	5.1335	5.8678	+ 0.0511* (0.0110)	0.4701	5.2388	6.8656	+ 0.0510* (0.0089)	- 0.0046* (0.0012)	0.6573*

Figures in parentheses are standard errors.

*	Significant at 0.01 level of significance
**	Significant at 0.05 level of significance
***	Significant at 0.10 level of significance
****	Significant at 0.15 level of significance

C.G.R	: Compound growth rate
P.I	: Period one 1961-'62 to 1974-'75
P.II	: Period two 1975-'76 to 1987-'88
W.P	: Whole period 1961-'62 to 1987-'88

Table 4.11. Till the mid-seventies area under the crop showed signs of a slight decline (at a rate of 1.00 per cent). The explanatory power of all the regressions were low though the 'b' value was significant at five per cent level in all the equations. Yield growth was quite remarkable, the growth rate being 13.24 per cent. All the functions had significant 'b' values and the 'R^2' values were also satisfactory. However with identical 'R^2' values none of the functions could be preferred over the other. Output grew at a compound rate of 12.11 per cent. Linear trend had a comparatively higher 'R^2' value of 0.67. The compound growth rate derived from the linear equation was higher at 14.24 per cent.

During the second period decline in area was more perceptible, the growth rate being $^-$3.87 per cent. Yield, as against it's first period behaviour grew at a greatly reduced rate of 1.05 per cent, and none of the functions could satisfactorily explain the yield movements. In sharp contrast to its first period growth, output declined in the second period at a rate of 2.89 per cent. The coefficient of 't' in all the three functions were significant at 10 per cent level, but the 'R^2' values were low indicating that output growth did not conform to any of the trend functions tried. Yet the quadratic function had a slightly better 'R^2' and a positive and significant 'C' value indicating a slowing down of the pace of decline.

For the period as a whole area grew at a rate of 0.87 per cent, but there was no evidence of any specific trend.

Growth rate of yield was higher at 4.23 per cent and growth generally followed the quadratic trend.

Coefficient of 't^2' was negative and significant (at one per cent level) indicating that the growth rate declined with time. Output growth also showed a similar trend. The average growth rate was 5.10 per cent and deceleration was evident from the negative sign and significance of 'c' value.

During the first period area variability was low, coefficient of variation being 5.80 per cent, but yield fluctuated violently (C.V = 36 per cent). Output variability was also high in the first period (C.V = 28.70 per cent) mainly due to the yield fluctuations. In the second period area variation was higher (C.V = 11.81 per cent) but that of yield was lower at 18.49 per cent. Output variability was lower in the second period (C.V = 24.71 per cent) primarily because of the lower yield variability.

Ernakulam

Results of regression analysis done to measure rate of growth in area, production and productivity of sesamum are presented in Table 4.12. Area under sesamum declined steadily in the first period at a rate of 1.16 per cent. The log-linear functions could explain as much as 97 per cent of the area movements. Growth rate of yield was 1.88 per cent. For output none of the functions was a good fit and the growth rate was a low 0.70 per cent.

Table 4.12 Estimated trend equations for area, production and productivity of sesamum : Ernakulam district

	Y = a (1)	+ bt (2)	R^2 (3)	C.G.R (4)	ln Y = a (5)	+ bt (6)	R^2 (7)	C.G.R (8)	ln Y = a (9)	+ bt (10)	+ ct^2 (11)	R^2 (12)
					Area							
P.I	998.6813	- 10.6815* (0.5734)	0.9666	-1.1655	6.9089	- 0.0116* (0.0013)	0.9700	-1.1578	6.8229	- 0.0116* (0.0006)	- 0.00006 (0.0002)	0.9656*
P.II	2335.9624	- 14.0496 (22.2631)	0.0349	-0.6378	7.7410	- 0.0051 (0.0123)	0.0229	-0.5061	7.7990	- 0.0051 (0.0069)	- 0.0067* (0.0023)	0.4698**
W.P	570.3676	+ 70.2363* (10.7160)	0.6321	5.5090	6.5896	+ 0.0469* (0.0068)	0.6554	4.8025	7.2243	+ 0.0469* (0.0069)	+ 0.0004 (0.0009)	0.6580*
					Productivity							
P.I	279.4084	+ 6.1741* (2.2483)	0.3859	1.9212	5.6389	+ 0.0186* (0.0059)	0.4201	1.8834	5.7829	+ 0.0186* (0.0066)	- 0.0003 (0.0018)	0.4213**
P.II	362.8301	- 11.1843** (4.3191)	0.3787	-4.2917	5.9368	- 0.0469** (0.0188)	0.3518	-4.5837	5.6378	- 0.0469** (0.0213)	- 0.0018 (0.0063)	0.3578
W.P	343.3045	- 2.6720** (1.4201)	0.1244	-0.9250	5.8654	- 0.0118** (0.0058)	0.1519	-1.1770	5.8406	- 0.0118* (0.0046)	- 0.0023* (0.0006)	0.4371*
					Production							
P.I	281.4078	+ 2.2221**** (1.9901)	0.0941	0.7517	5.6434	+ 0.0073**** (0.0061)	0.0952	0.7038	5.6984	+ 0.0070 (0.0065)	- 0.0003 (0.0018)	0.0981
P.II	831.3854	- 27.6480** (11.1530)	0.3584	-4.8340	6.7739	- 0.0519** (0.0212)	0.3472	-5.0660	6.5341	- 0.0519** (0.0206)	- 0.0086*** (0.0062)	0.4519**
W.P	236.0856	+ 16.1134* (4.2881)	0.3609	4.1831	5.5486	+ 0.0351* (0.0089)	0.4023	3.5684	6.1532	- 0.0350* (0.0080)	- 0.0019*** (0.0011)	0.4593*

Figures in parentheses are standard errors.

*	Significant at 0.01 level of significance
**	Significant at 0.05 level of significance
***	Significant at 0.10 level of significance
****	Significant at 0.15 level of significance

C.G.R	: Compound growth rate
P.I	: Period one 1961-'62 to 1974-'75
P.II	: Period two 1975-'76 to 1987-'88
W.P	: Whole period 1961-'62 to 1987-'88

In the second period the quadratic function was found better to measure area growth. Coefficient of 't^2' was negative and significant but that of 't' was not significant in any of the equations. This implied that area growth rate was positive at the beginning of the second period (i.e. the latter half of the seventies) but became negative in the eighties. The average growth rate was a low ¯0.51 per cent. Productivity showed symptoms of decline with all the functions, yielding negative and significant 'b' values. The linear function had comparatively higher R^2 value and the growth rate derived from it was ¯4.29 per cent. Output was also found to decline at a slightly higher rate of 5.19 per cent. The quadratic function had higher explanatory power and its 'c' value was negative and significant suggesting that the decline in output gained momentum over time.

When considered over the whole period area growth turned out to be positive in contrast to the results obtained from the analysis of the two sub-periods separately. This was so because as was the case with the state, there was a rapid expansion of area under sesamum in the district during the latter half of the seventies, which, however, ended by the close of the decade. After that area under the crop declined all through the eighties. Yet, the average level of the eighties was fairly high compared with that of the early sixties. Consequently when the functions were fitted to the whole period they yielded a positive growth rate of 4.80 per cent.

Productivity was found declining at a rate of 1.18 per cent. The quadratic trend in time could explain more variation than the linear forms and its 'c' value was negative and significant too, indicating a tendency towards faster decline. Growth rate of output over the whole period was 3.50 per cent. Here also the quadratic trend fit the data better and its negative and significant 'c' value suggested deceleration in growth.

Output variability was comparatively lower (C.V = 9.31 per cent) in the first period and almost the whole of this arose from yield fluctuation (C.V = 9.60 per cent). In the second period both area (C.V = 12.41 per cent) and yield (C.V = 18.82 per cent) showed higher variability and consequently output fluctuations were also higher (C.V = 21.72 per cent).

Thrissur

The estimated trend equations for area, production and productivity of sesamum in the district are presented in Table 4.13. Stagnation of sesamum area during the first period was evident from the infinitesimally small growth rate of -0.008 per cent. Consequently productivity and output grew at identical rates of 6.48 per cent.

The second period was characterised by decline in area, productivity and output, their growth rates being -2.40, -2.60 and -4.88 per cent respectively. In the case of area and productivity, the quadratic function had a comparatively higher R^2, and both of its regression coefficients were significant.

Table 4.13 Estimated trend equations for area, production and productivity of sesamum : Thrissur district

	Y = a (1)	+ bt (2)	R^2 (3)	C.G.R (4)	ln Y = a (5)	+ bt (6)	R^2 (7)	C.G.R (8)	ln Y = a (9)	+ bt (10)	+ ct^2 (11)	R^2 (12)
					Area							
P.I	1160.9457	- 0.0884* (0.0204)	0.5128	-0.0076	7.0568	- 0.00007 (0.0002)	0.0147	-0.0069	7.0561	- 0.00008* (0.00001)	+ 0.00001* (0.0000)	0.8076*
P.II	1588.5391	-35.5381*** (21.3651)	0.2010	-2.7868	7.3436	- 0.0240*** (0.0160)	0.1628	-2.3725	7.2854	- 0.0240*** (0.0151)	- 0.0078*** (0.0045)	0.3537
W.P	1162.558	+ 6.0104**** (5.6384)	0.0435	0.4955	7.0589	+ 0.0039 (0.0038)	0.0344	0.3951	7.1659	+ 0.0039 (0.0042)	- 0.0009*** (0.0005)	0.1264
					Productivity							
P.I	223.0104	+24.2960* (8.0020)	0.4345	6.7950	5.4689	+ 0.0628* (0.0179)	0.5047	6.4818	5.9687	+ 0.0628* (0.0186)	- 0.0021 (0.0054)	0.5120**
P.II	388.3225	- 9.6604*** (6.2214)	0.1798	-3.1857	5.9228	- 0.0261*** (0.0171)	0.1694	-2.5724	5.6124	- 0.0260*** (0.0154)	+ 0.0092** (0.0046)	0.4031
W.P	398.0576	- 2.3954 (3.2876)	0.0208	-0.7276	5.9169	- 0.0053 (0.0081)	0.0164	-0.5251	6.0346	- 0.0053 (0.0071)	- 0.0030* (0.0010)	0.2903**
					Production							
P.I	258.9565	+28.1585* (9.2825)	0.4340	6.7875	5.6182	+ 0.0627* (0.0178)	0.5040	6.4737	6.1223	+ 0.0627* (0.0180)	- 0.0021 (0.0052)	0.5113**
P.II	578.9236	-21.8791** (8.8481)	0.3573	-5.6090	6.3589	- 0.0501* (0.0180)	0.4004	-4.8838	5.9879	- 0.0501** (0.0193)	+ 0.0014 (0.0058)	0.4037
W.P	462.5738	- 0.9854 (4.0481)	0.0024	-0.2448	6.0681	- 0.0013 (0.0081)	0.0010	-0.1320	6.2904	- 0.0014 (0.0065)	- 0.0040* (0.0009)	0.4348*

Figures in parentheses are standard errors.

*	Significant at 0.01 level of significance
**	Significant at 0.05 level of significance
***	Significant at 0.10 level of significance
****	Significant at 0.15 level of significance

C.G.R	: Compound growth rate
P.I	: Period one 1961-'62 to 1974-'75
P.II	: Period two 1975-'76 to 1987-'88
W.P	: Whole period 1961-'62 to 1987-'88

However, the negative 'c' value of the area function indicated an accentuated decline in area, whereas slowing down of the pace of decline in yield was evident from the positive 'c' value of the yield function. The output growth functions, though poor fits, yielded significant 'b' values.

For the whole period, area growth rate was low at 0.39 per cent. (In Thrissur district also it was the rapid area expansion of the post 1975 period, that made the overall growth rate positive, though low.) The 'b' value was significant only for the linear function and that too at 15 per cent level, and the explanatory power of the regressions were very low. Both yield and output growth generally followed the quadratic trend with yield exhibiting comparatively greater deviations from the long term trend than output. Coefficient of 't' was non-significant while that of t^2 was significant at one per cent level for both the functions suggesting appreciable growth in the first period and decline during the second period. The average growth rate of yield and output were -0.53 and -0.14 per cent respectively, which however, were non-significant.

Output variability was higher in the first period (C.V = 27.54 per cent) and the whole of this was inherited from yield fluctuations (C.V = 27.54 per cent). During the second period area experienced comparatively more disturbances (C.V = 17.33 per cent) but yield variability at 20.49 per cent was lower than that of the first period. Output fluctuation was comparatively less in the second period (C.V = 25.81 per cent) but was still fairly high in absolute terms with both yield and area variations contributing to it.

Palakkad

Details of trend analysis done for the district are presented in Table 4.14. The severe decline in area under sesamum in the district during the first period is evident from the high negative growth rate of -8.73 per cent. The quadratic trend could explain 79 per cent of the area variations and was a better fit than the other forms. In the case of yield, none of the functions tried gave a good fit. Nevertheless the quadratic function had a comparatively higher R^2 and its 'c' value was significant (at 10 per cent level) indicating negative growth rates in the first half of the period and positive growth rates in the second half. The average growth rate obtained was 1.16 per cent, but it was not statistically significant. Output declined at a compound rate of 7.29 per cent with the log-linear function explaining 60 per cent of the variation.

In the second period growth of area, productivity as well as output followed an irregular course as was evident from the low R^2 values of the functions fitted. In the case of area the regressions could not explain even five per cent of the variation. The growth rate obtained was 0.42 per cent but none of the 'b' values was significant. Yield grew at a compound rate of 2.67 per cent and output at a slightly higher rate of

Table 4.14 Estimated trend equations for area, production and productivity of sesamum : Palakkad district

	Y = a (1)	+ bt (2)	R^2 (3)	C.G.R (4)	ln Y = a (5)	+ bt (6)	R^2 (7)	C.G.R (8)	ln Y = a (9)	+ bt (10)	+ ct^2 (11)	R^2 (12)
Area												
P.I	1958.5824	- 92.8430* (17.5691)	0.6994	-8.7488	7.7164	- 0.0873* (0.0167)	0.6970	-8.3620	7.2069	- 0.0873* (0.0143)	- 0.0090** (0.0040)	0.7921*
P.II	1121.3086	+ 4.3520 (11.0543)	0.0139	0.3834	7.0123	+ 0.0042 (0.0104)	0.0169	0.4238	7.0278	+ 0.0042 (0.0101)	+ 0.0009 (0.0031)	0.0271
W.P	1468.7835	- 18.5512** (7.9222)	0.1799	-1.6935	7.2304	- 0.0127*** (0.0079)	0.0988	-1.2640	6.8654	- 0.0127** (0.0065)	+ 0.0030* (0.0009)	0.3792*
Productivity												
P.I	228.9685	+ 2.5782 (3.0451)	0.0564	1.0795	5.4104	+ 0.0116 (0.0141)	0.0562	1.1660	5.4089	+ 0.0116 (0.0132)	+ 0.0053*** (0.0031)	0.2085
P.II	207.3447	+ 7.9694*** (5.6114)	0.1550	3.2663	5.3498	+ 0.0263**** (0.0210)	0.1286	2.6700	5.6104	+ 0.0263**** (0.0209)	- 0.0054 (0.0063)	0.1886
W.P	226.5034	+ 2.0673*** (1.5303)	0.068	0.8567	5.4218	+ 0.0066**** (0.0059)	0.0468	0.6648	5.4854	+ 0.0066**** (0.0060)	+ 0.0005 (0.0008)	0.0589
Production												
P.I	461.5384	- 20.6814* (5.6963)	0.5235	-7.8551	6.2179	- 0.0757* (0.0179)	0.6016	-7.2930	5.7089	- 0.0757* (0.0181)	- 0.0036 (0.0051)	0.6197*
P.II	230.9235	+ 10.3192*** (7.1752)	0.1583	3.7223	5.4544	+ 0.0306*** (0.021)	0.1465	3.1051	5.7303	+ 0.0306**** (0.0229)	- 0.0044 (0.0069)	0.1804
W.P	331.5612	- 1.9081 (2.7173)	0.0193	-0.7070	5.7438	- 0.0061 (0.0091)	0.0183	-0.6077	5.4386	- 0.0061 (0.0075)	+ 0.0035* (0.0010)	0.3207*

Figures in parentheses are standard errors.

*	Significant at 0.01 level of significance
**	Significant at 0.05 level of significance
***	Significant at 0.10 level of significance
****	Significant at 0.15 level of significance

C.G.R	: Compound growth rate
P.I	: Period one 1961-'62 to 1974-'75
P.II	: Period two 1975-'76 to 1987-'88
W.P	: Whole period 1961-'62 to 1987-'88

3.10 per cent. However, in the case of yield and output the 'b' values were significant at 15 per cent level only.

Analysis for the entire period yielded an area growth rate of -1.27 per cent. The quadratic function could explain the secular movement satisfactorily. Coefficient of t^2 was significant and had a positive sign indicating that though area declined in the first period there were signs of recovery in the second period. For productivity the irregular variation was evident from the low R^2 values of all the functions fitted. The growth rate was 0.66 per cent but its level of significance was low at 15 per cent. Output growth was satisfactorily approximated by the quadratic function. Coefficient of 't' was not significant but that of 't^2' was significant (at one per cent level) and positive, suggesting negative growth rates till the mid seventies and positive growth rates thereafter. Average growth rate was negative (-0.61 per cent) but not significant.

Output variability was higher in the second period (C.V = 29.41 per cent) than in the first period (C.V = 25.92). % The higher second period variability was mainly due to yield fluctuations (C.V = 26.54 per cent) with area variations (C.V = 11.90 per cent) playing a supplementary role. In the first period, though area variability was high (C.V = 16.04 per cent) that of yield was lower at 15.73 per cent.

Malappuram

The district was formed in the early seventies and so the analysis could be done only for the second period. Results of trend analysis for the same period are presented in Table 4.15. Area growth was fairly high at a compound rate of 5.22 per cent. In the case of productivity, the quadratic function was a good fit and it yielded an average growth rate of -0.24 per cent. However, coefficient of 't' was not significant while that of t^2 was negative and significant at one per cent level indicating appreciable growth in the initial stage (i.e. the late seventies) and decline later. Output growth at a rate of 4.85 per cent was also accompanied by deceleration as indicated by the negative and significant 'c' value of the quadratic function.

In the district, both area and yield varied appreciably (the respective coefficients of variations being 16.84 and 17.68) and so there was significant variability in output also (C.V = 20.95 per cent).

4.2.2 Groundnut - Palakkad

The estimated trend equations for area, production and productivity of groundnut in the district are presented in Table 4.16.

Area growth

During the first period area growth followed a distinct

Table 4.15 Estimated trend equations for area, production and productivity of sesamum : Malappuram district

	Y = a (1)	+ bt (2)	R^2 (3)	C.G.R (4)	ln Y = a (5)	+ bt (6)	R^2 (7)	C.G.R (8)	ln Y = a (9)	+ bt (10)	+ ct^2 (11)	R^2 (12)
					Area							
P.II	1350.8853	+ 90.6434* (26.4591)	0.5162	4.8950	7.2048	+ 0.0509* (0.0149)	0.5204	5.2198	7.6148	+ 0.0508* (0.0149)	- 0.0038 (0.0045)	0.5528**
					Productivity							
P.II	281.1374	- 0.3421 (6.1426)	0.0003	-0.1341	5.6049	- 0.0024 (0.0239)	0.0009	-0.2371	5.8478	- 0.0024 (0.0161)	- 0.0186* (0.0048)	0.5939**
					Production							
P.II	445.8853	+ 15.4674**** (13.8344)	0.1020	3.3582	5.9018	+ 0.0485*** (0.0312)	0.1791	4.9704	6.5548	+ 0.0485** (0.0229)	- 0.0224* (0.0069)	0.5999**

Figures in parentheses are standard errors.

*	Significant at 0.01 level of significance
**	Significant at 0.05 level of significance
***	Significant at 0.10 level of significance
****	Significant at 0.15 level of significance

C.G.R : Compound growth rate
P.II : Period two 1975-'76 to 1987-'88

Table 4.16 Estimated trend equations for area, production and productivity of groundnut : Palakkad district

Y =	a (1)	+ bt (2)	R^2 (3)	C.G.P (4)	ln Y = a (5)	+ bt (6)	R^2 (7)	C.G.R (8)	ln Y = a (9)	+ bt (10)	+ ct^2 (11)	R^2 (12)
					Area							
P.I	13.4916	+ 0.1604*** (0.0904)	0.2076	1.1000	2.6068	+ 0.0102*** (0.0061)	0.1884	1.0214	2.5936	+ 0.0101* (0.0024)	+ 0.0054* (0.0007)	0.8780*
P.II	14.3594	- 0.2810*** (0.1750)	0.1895	-2.3554	2.6419	- 0.0206*** (0.0141)	0.1616	-2.0368	2.3225	- 0.0206* (0.0068)	+ 0.0125* (0.0021)	0.8232*
W.P	15.5013	- 0.1374* (0.0521)	0.2196	-1.0396	2.7503	- 0.0111* (0.0039)	0.2439	-1.1064	2.6288	- 0.0110* (0.0039)	- 0.0006 (0.0005)	0.2769**
					Productivity							
P.I	1405.3284	- 9.7926 (24.4265)	0.0132	-0.7883	7.1894	- 0.0039 (0.0189)	0.0035	-0.3905	7.3968	- 0.0039 (0.0113)	- 0.0146* (0.0031)	0.6346*
P.II	1132.3696	- 34.3016* (10.8136)	0.4770	-4.0896	7.0708	- 0.0435* (0.0151)	0.4297	-4.2536	6.7594	- 0.0435** (0.0158)	+ 0.0005 (0.0047)	0.4302
W.P	1534.5435	- 29.5945* (6.9315)	0.4217	-2.9343	7.3524	- 0.0272* (0.0059)	0.4294	-2.6860	7.0868	- 0.0272* (0.0057)	- 0.0019** (0.0008)	0.5335*
					Production							
P.I	18.8086	+ 0.0523 (0.2666)	0.0032	0.2838	2.8878	+ 0.0062 (0.0140)	0.0153	0.6270	3.0845	+ 0.0063 (0.0113)	- 0.0092* (0.0031)	0.4379**
P.II	16.3184	- 0.7224* (0.2414)	0.4492	-7.2997	2.8049	- 0.0640* (0.0220)	0.4359	-6.2037	2.1744	- 0.0640* (0.0185)	+ 0.0130** (0.0055)	0.6351*
W.P	22.5736	- 0.5143* (0.0998)	0.5211	-3.9475	3.1938	- 0.0383* (0.0069)	0.5304	-3.7626	2.8087	- 0.0380* (0.0060)	- 0.0025* (0.0009)	0.6407*

Figures in parentheses are standard errors.

*	Significant at 0.01 level of significance	C.G.R	:	Compound growth rate
**	Significant at 0.05 level of significance	P.I	:	Period one 1961-'62 to 1974-'75
***	Significant at 0.10 level of significance	P.II	:	Period two 1975-'76 to 1987-'88
****	Significant at 0.15 level of significance	W.P	:	Whole period 1961-'62 to 1987-'88

quadratic trend, with an average rate of 1.01 per cent. Coefficient of 't^2' was positive in sign and significant at one per cent level. From the signs and relative magnitudes of 'b' and 'c' values it can be inferred that there was decline in area in the intial phases and growth later in the period.

For the second period also the quadratic function turned out to be a good fit. Though the average growth rate was -2.06 per cent the positive and significant 'c' value indicated that the decline slowed down over time and there was recovery towards the end of the period. The only difference with the first period trend was that the initial decline was severe in the second period while it was rather mild in the first period.

Analysis for the entire period revealed that area was declining at a rate of 1.10 per cent. Here also, the quadratic function performed better than the linear forms but the explanatory power of the regressions were generally low.

Coefficient of variation of area was low in the first as well as the second periods indicating that there were only minor deviations from the secular trend. Yet, it was comparatively higher in the second period (C.V = 8.1 per cent) that in the first period (C.V = 3.4 per cent).

Yield growth rates

During the first period the quadratic function could explain the yield movements bettern than the linear forms.

However coefficient of 't' was not significant while that of 't^2' was significant at one per cent level. The negative sign of the coefficient of 't^2' implied growth in productivity at the beginning of the period and decline at later stages. The overall growth rate, though not significant was -0.39 per cent.

Decline in productivity was more evident during the second period. The linear trend had comparatively higher explanatory power and it yielded a growth rate of -4.09 per cent.

When considered over the whole period, productivity was found to decline at a rate of 2.72 per cent. The quadratic function was a good fit and both of its regression coefficients were significant. The negative 'c' value indicated an increase in the rate of decline over time.

Coefficient of variation of productivity was 15.59 per cent and 15.10 per cent respectively in the first and second periods, indicating that random disturbances in productivity were appreciable and more or less of the same magnitude in both the periods.

Output growth

During the first period output exhibited a trend similar to that of productivity. The quadratic function had more explanatory power and its 'c' value alone was significant with its negative sign implying output growth during the first half of the period and decline during the second half. The average growth rate was positive (0.63 per cent) but not significant.

There were signs of severe decline in output during the second period, growth rate being -6.40 per cent. However, the quadratic trend was evident in this period also, suggesting a reduction in the rate of decline towards the end of the period.

As was the case in the first and second periods, the quadratic function proved to be a good fit for the whole period also. The average growth rate was -3.80 per cent with the negative 'c' value indicating that the rate of decline increased over time. However, as the separate analysis of the second period revealed, there was an indication of a slowing down of the pace of decline towards the end of the second period. The analysis thus revealed striking similarity between productivity and output movements.

Output experienced more disturbances in the second period (C.V = 21.35 per cent) than in the first period (C.V =14.75 per cent). Area movement was fairly steady in the first period (C.V = 3.4 per cent) and yield fluctuation (C.V = 15.59 per cent) was the main cause for output variability. During the second period variability of yield did not lessen (C.V = 15.1 per cent) while that of area increased slightly (C.V = 8.1 per cent). Consequently output variability was also higher in the second period. However, it may be noted that in both the periods yield fluctuated more than area and was the main reason for the instability in output.

The foregoing analysis revealed that during the first period area under sesamum declined in the districts of Alappuzha, Ernakulam and Palakkad while in Thrissur area was stagnant. Kollam was the only district which experienced positive area growth. At the state level there was near stagnation in area with an insignificant rate of decline of 0.13 per cent.

In Alappuzha, the major sesamum growing district of Kerala, decline in area was at a low rate of 1.00 per cent and further there was indication of a decrease in the rate of decline over time. The drastic decline at a rate of 8.73 per cent in Palakkad was due to the transfer of area to Malappuram and so left the total sesamum area of the state unaffected. In the case of Ernakulam and Kollam, their similar but opposing growth rates of -1.16 per cent and 1.54 per cent respectively would more or less cancel out each other. Thus, on the aggregate, no perceptible change was noticed in area under the crop during the first period.

In the case of productivity all the districts showed signs of growth in the first period. The performance of Alappuzha and Thrissur were quite spectacular with growth rate of 13.24 per cent and 6.48 per cent respectively. Growth rates were lower in Ernakulam (1.88 per cent) and Palakkad (1.16 per cent) and in Kollam it was an insignificant 0.38 per cent. However, deceleration in growth was evident in Kollam and acceleration in Palakkad. At the state level productivity grew at a rate of 3.71 per cent and as was evident from the analysis, yield growth in the districts of Alappuzha and Thrissur was the reason behind the state's commendable performance.

Growth in output was experienced by all the districts during the first period, except Palakkad. In Alappuzha (14.24 per cent) and Thrissur (6.48 per cent) output growth was exceptionally good and this helped aggregate output grow at a rate of 3.58 per cent. In Kollam the lower growth rate of 1.93 per cent was also accompanied by deceleration and in Ernakulam it was a negligible 0.7 per cent. The sharp decline at a rate of 7.29 per cent in Palakkad was due to the decline in geographical area of the district.

During the second period decline in area under sesamum was noticed in Kollam (6.36 per cent) Alappuzha (3.87 per cent) Thrissur (2.40 per cent) and Ernakulam (0.51 per cent). However in these districts there was a brief spell of area growth in the latter half of the seventies. The negative growth rates observed in fact indicate decline from the higher levels reached by the end of the seventies. Overall growth was observed only in Palakkad (0.42 per cent) and Malappuram (5.22 per cent). Aggregate area declined at a rate of 2.31 per cent. As was the case with most of the districts, the state also witnessed rapid expansion in area under sesamum in the initial phase of the second period, which however was masked by the decline of the

Rise in productivity was evident during the second period in the districts of Kollam (4.58 per cent), Palakkad 2.67 per cent) and Alappuzha (1.05 per cent) while decline was noticed in Ernakulam (4.29 per cent) and Thrissur (2.60 per cent). However in Kollam and Alappuzha yield growth showed signs of acceleration while in Thrissur the decline in the productivity tended to slow down over time. At the state level, growth rate of productivity was an insignificant 0.28 per cent.

Output declined during the second period in the districts of Ernakulam (5.19 per cent), Thrissur (4.88 per cent), Alappuzha (2.89 per cent) and Kollam (1.99 per cent) while Palakkad (3.1 per cent) and Malappuram (4.85 per cent) districts experienced growth in output. Nevertheless there was appreciable output growth in the latter half of the seventies in the districts of Ernakulam, Thrissur, Alappuzha and Kollam brought about mainly through expansion of area under the crop. There were also signs of recovery towards the end of the eighties in Alappuzha and Kollam. But in Ernakulam there was a tendency towards faster decline and in Malappuram though there was growth it exhibited signs of deceleration. The growth rate of aggregate output was -2.03 per cent which however concealed beneath it the growth of the late seventies.

During the first period output variability was considerable in the districts of Alappuzha, Thrissur and Palakkad while in Kollam and Ernakulam it was lower. In Alappuzha and

Thrissur yield fluctuation was the main reason for output variability while in Palakkad it was due to disturbances in area. Fluctuation of aggregate output also originated from the wayward yield movements, aggregate area variations being small.

Significant output variability was felt during the second period in all the districts examined. In Kollam and Palakkad this variability was especially high and it originated mainly from random yield movements. In the remaining districts output was subjected to both area and yield variations. Surprisingly, output fluctuation at the state level was comparatively lower during the second period, possibly because the random variation in area and yield in the various districts offset each other leaving the secular trend of aggregate output unaffected to a large extent.

In the case of groundnut, the analysis revealed a general decline in output and its components, area and yield. Though the overall growth rate of area under the crop in the first period was 1.01 per cent, there was a slight decline in the initial phases of the period. On the contrary, productivity rose in the initial stages of the period but declined later, resulting in an overall growth rate of -0.39 per cent. Output exhibited a similar trend, rising during the first half of the period and falling in the second half.

Area under groundnut declined in the second period at a rate of 2.06 per cent but there were signs of recovery towards the end of the period. Yield decline was at a higher rate of 4.09 per cent. Decline in output was more severe at 6.40 per cent, but as was the case with area, here also signs of recovery were evident.

Area disturbances were low in the first period and output variability was caused mainly by yield fluctuations. During the second period yield fluctuations did not lessen, but area variability rose slightly. Consequently, output variability was comparatively higher in the second period.

4.3 Supply response

Changes in crop output, in response to economic stimuli, can be brought about in two ways, initially by varying the use of yield increasing inputs and secondly by altering the area under the crop. Hence an estimate of the total output response can be obtained by measuring its two components viz. area response and yield response. In the case of seasonal crops like sesamum and groundnut both area and yield changes can be effected concurrently in the same year, though only to the extent allowed by technological, institutional and other constraints including subjective ones.

4.3.1 Area response

The area response model specified in chapter three was as follows:

$$A_t = f(A_{t-1}, P^e_t, PRF, Y_{t-1}, PR_t, YR_t, T)$$

where

A_t = Area under the crop in period t

A_{t-1} = Area under the crop in period t-1

P^e_t = Expected price during the period t

PRF = Total rainfall in two presowing months

Y_{t-1} = Yield of the crop lagged by one year

PR_t = Price risk in period t, measured by the coefficient of variation of price for the preceding three years

YR_t = Yield risk in period t represented by coefficient of variation of yield of the crop concerned in three preceding years

T = Time trend

Result of regression analysis with these explanatory variables revealed strong correlation between the price variable and time trend causing serious multicollinearity problem, both in sesamum and groundnut acreage response functions. To overcome this defect the trend variable was not considered in the subsequent analyses. Ramesha (1988) and TrairalVorkul (1994) experienced a similar problem (where irrigated area and trend were linearly dependent on price) and were found to adopt an identical procedure to overcome the problem. The remaining independent variables were introduced into the acreage response functions in two stages. In model I area under sesamum was regressed upon area lagged by one year, expected price of the crop, presowing rainfall and one year lagged yield. In model II in addition to the variables in model I price risk and yield risk variables were also incorporated. For both the models, the three alternate price formulations viz. price lagged by one year, price derived by the moving average method and price generated from the linear trend in observed price, were tried, thus resulting in six model specifications, viz. model I a (with lagged area, lagged price, presowing rainfall and lagged yield as the explanatory variables) and model II a (with price risk and yield risk in addition to the explanators of model I a); model I b (with lagged area, moving average price, presowing rainfall and lagged yield as the explanatory variables) and model II b (with price risk and yield risk as additional explanators); model I c (with lagged area, trend price, presowing rainfall and lagged yield as the explanatory variables) and model II c (with representations of price risk and yield risk also as additional explanatory variables). All these models were estimated in the linear and log-linear forms.

Sesamum

Acreage response functions for sesamum estimated in the log-linear form was found to be consistently superior to the linear forms both in terms of the proper sign and significance of the coefficients and overall explanatory power. Hence only these functions were taken up for discussion.

The estimated acreage response functions for sesamum at the state level are presented in Table 4.17. In model I a the independent variables considered could explain as much as 71 per cent of the variation in area under sesamum.

The computed Durbin h-statistic indicated absence of first order autoregressive schemes among the residual terms. All the parameter estimates, except that of lagged price turned out to be significant, though at varying levels. Coefficient of lagged area was significant at one per cent level and the adjustment coefficient worked out to 0.3401, indicating that only 34 per cent of the desired change in area could be effected in a year. This adjustment was rather slow and it would take seven years for 95 per cent of the effect of the price change to be realised.

Coefficient of lagged price, though not significant showed positive relationship with area. The estimated short-run and long-run elasticities were 0.0232 and 0.0682 respectively indicating the influence of price on area though positive was very weak. Coefficient of rainfall during presowing months was significant at five per cent level. Sesamum being a predominantly rainfed crop in the state, rainfall during the presowing period can be expected to have a significant bearing on the acreage decision of the farmer. The results also indicate that availability of adequate soil moisture at the time of sowing is a much more important consideration to the farmer than the price

Table 4.17 Area response functions for sesamum (1961-'62 to 1987-'88) : Kerala state

Models	Constant term	Explanatory variables									Elasticity	
		A_{t-1}	P^e_t	W_{pt}	Y_{t-1}	PR_t	YR_t	R^2	d	h	S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I a	-0.3894	0.6599* (0.1729)	0.0232 (0.0410)	0.0681** (0.0360)	0.1422**** (0.1290)			0.7162*	1.8000	1.0030	0.0232	0.0682
IIa	0.0929	0.6788* (0.1819)	0.0229 (0.0421)	0.0559*** (0.0410)	0.0683 (0.1764)	-0.0287 (0.0389)	0.0091 (0.0211)	0.7246*	1.905	0.5689	0.0229	0.0713
I b	-0.2764	0.6008* (0.1750)	0.0432 (0.0424)	0.0725** (0.0350)	0.1252 (0.1281)			0.7259*	1.7040	1.5400	0.0432	0.1082
IIb	0.1054	0.6286* (0.1894)	0.0386 (0.0451)	0.0613*** (0.0410)	0.0667 (0.1734)	-0.0227 (0.0391)	0.0081 (0.0210)	0.7311*	1.807	1.516	0.0386	0.1039
I c	-0.0389	0.6199* (0.1750)	0.0292 (0.0331)	0.0677** (0.0341)	0.0925 (0.1443)			0.7224*	1.7540	1.2607	0.0292	0.0768
IIc	0.2768	0.6480* (0.1889)	0.0257 (0.0356)	0.0575*** (0.0410)	0.0441 (0.1810)	-0.0237 (0.0389)	0.0061 (0.0221)	0.7280*	1.854	1.1383	0.0257	0.0730

Figures in parentheses are standard errors.

* Significant at 0.01 level of significance

** Significant at 0.05 level of significance

*** Significant at 0.10 level of significance

**** Significant at 0.15 level of significance

expectation. Lagged yield showed positive influence on area under the crop in the current year. This is to be expected since a good harvest in one year will raise optimistic expectations, so that farmers will tend to devote more acreage to the crop in the next year. However, the yield coefficient was significant only at 15 per cent level.

Overall, the results indicated positive, though not significant, relationship between area under sesamum and product price. However, non-price factors like presowing rainfall and lagged yield seemed to exert much more stronger influence on acreage. Acreage adjustment was also very slow and various techno-institutional factors seem to influence a great deal the decision making of sesamum growers in the state.

Contrary to these results, Cummings (1975) in his study on the price responsiveness of major cereals and cash crops obtained negative price response for sesamum acreage in Kerala for the period 1958-'68. However, the coefficient of adjustment obtained for Kerala was 0.44 confirming the slow adjustment observed in the current study. In the same study elasticity estimates for Mysore (0.03 for shortrun and 0.4 for long run) and Gujarat (0.08 and 0.1) for the period 1955-'68 came very close to the current estimates. Similarly positive price elasticity of acreage was observed by Madhavan (1972) in his response study using the relative price of sesamum (with ragi as the competing crop) in Tamil Nadu for the period 1947-'65.

However, his elasticity estimates were higher at 0.42-0.48 for the shortrun. Also as against the results of the present study, relative price was found more important than yield in its influence on acreage. Slow adjustment and positive response to price were observed in the states of Rajasthan, Madhyapradesh and Bihar by Ninan (1988) for rapeseed-mustard for the period 1965-'82.

In the estimated equation for model II a the price coefficient continued to be positive but non-significant. Lagged area and presowing rainfall had significant positive influence as was the case with model I a, but the lagged yield coefficient became non-significant. Coefficient of price risk had a positive sign while yield risk was negatively related with acreage. However, both these coefficients were not significant, indicating that the risk factors had no significant influence on acreage allocation decisions. Ninan (1988) in his study employing the standard deviation of past three years prices and yields relative to that of competing crops as proxies for expectations on price and yield risk obtained similar results for Rajasthan and Madhyapradesh with negative price risk coefficients and positive yield risk coefficients, both of which were statistically non-significant. Such results were observed by Singh (1979) also for pulses in the eastern and central regions of Uttar Pradesh.

Both the models I and II were re-estimated after replacing the lagged price with the three year moving average price and modifying the risk variables accordingly.

For the first model, (Ib), overall explanatory power improved slightly and there was no evidence of serial correlation. Though the price coefficient continued to be non-significant, the short-run and long-run elasticities were slightly higher at 0.0432 and 0.1082 respectively, compared to the lagged yield model. The adjustment coefficient also rose slightly to 0.3992. However, coefficient of lagged yield became non-significant with the inclusion of the modified price variable. In the second model also, the new price variable brought identical changes with slightly higher R^2 value, elasticities and adjustment coefficient. There was not much change in any of the other coefficients.

For the third estimation, price series projected from the linear trend in observed price was employed as a proxy for the expected price. Price risk was also modified suitably. In both models Ic and IIc the price coefficient continued to be non-significant and the elasticity estimates obtained were on par with those obtained from the lagged price models. Coefficient of lagged yield was not significant while lagged area exerted significant positive influence, as was the case with model Ib.

Altogether the analysis revealed that in the aggregate area response functions studied, the two alternative price specifications viz. prices derived from the moving average model and the linear trend model, did not possess any significant advantage over lagged prices in explaining the area movements. Contrary to these results Rao and Jaikrishna (1965) in their study on wheat acreage response in Uttar Pradesh found that out of 12 different price expectation models tried, average of prices in all preceding years and the predicted price from linear trend in realised price were the most efficient ones based on two criteria viz. their ability to predict realised prices and the explanatory power of the acreage response equations with different price expectations. Employing the second criterion in the present study, though it as observed that there was some slight improvement in the R^2 value of the response functions when the moving average and trend prices were used it was offset by the loss of significance of the lagged yield coefficient.

For a better understanding of the regional variation in the pattern of response of the farmers and to throw more light onthe relative importance of the determining factors in the different regions, analysis was carried at the district level also. All the major sesamum growing districts viz. Kollam, Alappuzha, Ernakulam, Thrissur, Palakkad and Malappuram were subjected to study. The response models and the price specifications employed for the disaggregate analysis were the same as those used for the state level study.

The acreage response functions for the district of Kollam, estimated with different price specifications are presented in Table 4.18. In model Ia, the independent variables (lagged price, presowing rainfall, lagged area and lagged yield) could explain 67 per cent of the variation in sesamum area in the district. But the computed Durbin-h-statistic indicated the presence of significant auto correlation between the disturbance terms. Coefficient of lagged area was significant at one per cent level and the adjustment coefficient at 0.3157 indicated slow adjustment; as was the case with aggregate area response. Coefficient of lagged price was negative and significant at 5 per cent level indicating negative area response. Presowing rainfall and lagged yield had negative coefficients, but these were not statistically significant. The shortrun and long run elasticities estimated were -0.151 and -0.478 respectively. These are in line with the short run and long run estimates of -0.3 and -0.68 respectively obtained by Cummings (1975) for sesamum in the state. In the same study Cummings noted negative area response to price for sesamum in three other states viz. Maharashtra, Karnataka and Tamil Nadu.

The incorporation of risk variables in the second model neither improved the overall explanatory power of the regression nor reduced serial correlation in the residuals. Coefficients of price, rainfall and lagged yield continued to be negative, with the price coefficient significant at the five per cent level. Risk variables had non-significant coefficients but as

Table 4.18 Area response functions for sesamum (1961-'62 to 1987-'88) : Kollam district

Models	Constant term	Explanatory variables									Elasticity	
		A_{t-1}	P_t^e	W_{pt}	Y_{t-1}	PR_t	YR_t	R^2	d	h	S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I a	3.8549	0.6841* (0.1940)	- 0.1510** (0.0690)	- 0.0185 (0.0361)	- 0.0657 (0.1918)			0.6718*	2.509	-5.4123	-0.1510	-0.4780
IIa	3.6209	0.6950* (0.2040)	- 0.1444** (0.0740)	- 0.0181 (0.0378)	- 0.0462 (0.2049)	0.0052 (0.0579)	- 0.0122 (0.0211)	0.6782*	2.4489		-0.1444	-0.4734
I b	3.8374	0.7034* (0.1931)	- 0.1504** (0.0710)	- 0.0173 (0.0362)	- 0.0941 (0.1973)			0.6671*	2.5210	-4.8633	-0.1504	-0.5071
IIb	3.5958	0.7142* (0.2029)	- 0.1424** (0.0760)	- 0.0166 (0.0384)	- 0.0681 (0.2119)	- 0.0123 (0.0584)	- 0.0114 (0.0219)	0.6727*	2.5029		-0.1424	-0.4982
I c	1.8906	0.8401* (0.1820)	- 0.0657*** (0.0470)	- 0.0168 (0.0380)	- 0.0297 (0.2034)			0.6299*	2.6050	-3.6302	-0.0657	-0.4108
IIc	1.6829	0.8462* (0.1904)	- 0.0599**** (0.0490)	- 0.0159 (0.0410)	- 0.0002 (0.2159)	- 0.0124 (0.0609)	- 0.0147 (0.0229)	0.6389*	2.5831	-4.6143	-0.0599	-0.3895

Figures in parentheses are standard errors.

* Significant at 0.01 level of significance

** Significant at 0.05 level of significance

*** Significant at 0.10 level of significance

**** Significant at 0.15 level of significance

against the state level results, yield risk was negatively related to area while price risk was positively related.

In the estimated response functions using moving average price, no significant change was noticed on the coefficient, R^2 values or the value of d-statistic. However, in the second model (model IIb) coefficients of both the risk variables, though not significant, had the expected negative sign which seem more logical as against the positive coefficient of price risk in the lagged price models. When price derived from the linear trend equation was employed, the price coefficient was still negative, but it lost some of its significance. The short and long run price elasticities were also lower at -0.0657 and -0.4108 respectively. However, there was some lose of explanatory power of the regressions and the problem of serial correlation persisted.

The analysis revealed significant negative relationship between area and price in Kollam district. One possible reason may be the shrinking area under paddy in the district. (Whereas in 1966-'67 the area under paddy in the district was 50057 ha. it came down to 49657 ha. in 1976-'77 and further to 47880 ha. in 1983-'84). Since sesamum is grown mainly in the paddy fallows it is possible that diversion of rice land to other crops may have affected the acreage under sesamum. Another important factor that may negatively influence sesamum acreage is irrigation. Extension of irrigation to hitherto unirrigated fallow lands may expel sesamum from these areas. Further investigations regarding the acreage shifts between paddy and its competitors and the development and coverage of irrigation facilities in the district may throw more light on the subject. However, it may be noted that negative acreage response is not so uncommon in the literature on supply response studies especially among oilseeds and pulses. Jhala (1979) in his study on inter-regional groundnut supply response covering the 1951-'71 period noted negative price response for nearly half the acreage under groundnut in India. Similarly significant negative price co-efficients were obtained for rapeseed and mustard in Orissa by Ninan (1988) in his acreage response studies using lagged relative price (the competing crop being gram). The elasticity estimates obtained in current study though negative were very low. When price lagged by one year and the moving average price were used as proxies for price expectation, the results pointed towards a distinct negative relationship. However, when price expectation derived by the linear trend in observed price was employed the evidence in support of negative response was rather weak. The presence of auto correlation among the disturbance terms may have also impaired the regression results.

The estimated acreage response functions for Alappuzha district presented in Table 4.19 show that the independent variables considered in model Ia could explain only less than 40 per cent of the variation in sesamum acreage. However, the R^2 value was significant at five per cent level. The d-statistic indicated absence of auto correlation among the residual terms.

Table 4.19 Area response functions for sesamum (1961-'62 to 1987-'88) : Alappuzha district

Models	Constant term	Explanatory variables									Elasticity	
		A_{t-1}	P^e_t	W_{pt}	Y_{t-1}	PR_t	YR_t	R^2	d	h	S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I a	4.1358	0.4841** (0.2120)	0.0132 (0.0781)	0.0689**** (0.0610)	0.0571 (0.0801)			0.3754**	1.7840		0.0130	0.0252
IIa	3.5781	0.4216** (0.2249)	0.0113 (0.0829)	0.0804**** (0.0639)	0.0592 (0.0891)	- 0.0259 (0.0651)	- 0.0213 (0.0241)	0.4151	1.8429		0.0113	0.0195
I b	3.7594	0.4546** (0.2140)	0.0363 (0.0827)	0.0704**** (0.0610)	0.0425 (0.0831)			0.3805*	1.7360		0.0363	0.0665
IIb	4.2714	0.3995** (0.2280)	0.0299 (0.0850)	0.0813**** (0.0640)	0.0473 (0.0901)	- 0.0256 (0.0631)	- 0.0208 (0.0234)	0.4185	1.8031		0.0299	0.0498
I c	3.8336	0.4545** (0.2110)	0.0307 (0.0654)	0.0707**** (0.0610)	0.0342 (0.0934)			0.3814**	1.7430		0.0307	0.0563
IIc	4.4314	0.3864*** (0.2270)	0.0325 (0.0670)	0.0828**** (0.0630)	0.0333 (0.0979)	- 0.0265 (0.0631)	- 0.0215 (0.0234)	0.4221	1.8014		0.0325	0.0529

Figures in parentheses are standard errors.

* Significant at 0.01 level of significance

** Significant at 0.05 level of significance

*** Significant at 0.10 level of significance

**** Significant at 0.15 level of significance

In the estimated function co-efficient of lagged area was significant at five per cent level and the adjustment coefficient worked out to 0.5159 indicating that in the district factors inhibiting adjustment were not so rigid. Yet it would take, on an average, a little over four years for 95 per cent of the effect of price to materialize. Coefficient of lagged price was positive but not significant. The estimated shortrun and long run elasticities were 0.013 and 0.0252 respectively, lower than the aggregate response coefficients. The results indicate that area response to price, though positive was very weak. Among the non-economic determinants, presowing rainfall was observed to have some influence on acreage decision of the farmers, with its coefficient significant at 15 per cent level. Coefficient of lagged yield, though positive was not significant.

With the introduction of price risk and yield risk, R-square value improved slightly. Coefficient of adjustment was also higher at 0.5784. The risk variables had negative, though non-significant coefficients, which is in conformity with the logical risk aversion behaviour among farmers. There was no significant change in any of the remaining parameter estimates.

In models Ib and IIb estimated with the price coefficient derived by the moving average method, there was no improvement in the significance of the coefficients over the lagged price models. However, the price elasticities of acreage were slightly higher at 0.0363 and 0.0665 for the short run and long run respectively. Similar results were obtained when prices derived from the linear trend was employed (model Ic and IIc). There was no noticeable change in the sign or significance of any of the coefficients or in the explanatory power of the regressions except for a slight increase in the size of the price coefficient compared to the lagged yield models.

From the above analysis, it can be concluded that the acreage price relationship in the district was more or less similar to the aggregate relationship, weak yet positive. However the process of adjustment was comparatively quicker, in the district, than at the aggregate level.

Estimated area response functions for Ernakulam district are presented in Table 4.20. The R^2 values of the functions in general were quite high. In model Ia the independent variables considered could explain as much as 89 per cent of the variation in area under sesamum. The h-statistic indicated absence of first order autoregressive schemes among the regression residuals. All the parameter estimates turned out to be significant, though at varying levels. Coefficient of lagged area was significant at one per cent level and the computed adjustment coefficient was 0.2295, indicating that it would take nearly 11.5 year for 95 per cent of the price effect to be realized. This implied the existence of severe constraints restricting expansion of crop area in the district. However, it is evident from the positive and significant price

Table 4.20 Area response functions for sesamum (1961-'62 to 1987-'88) : Ernakulam district

Models	Constant term	Explanatory variables									Elasticity	
		A_{t-1}	P_t^e	W_{pt}	Y_{t-1}	PR_t	YR_t	R^2	d	h	S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I a	-1.8256	0.7705* (0.1183)	0.1955** (0.0930)	0.0879*** (0.0521)	0.3356** (0.1550)			0.8942*	2.1800	-0.5582	0.1955	0.8518
IIa	-1.9934	0.8015* (0.1210)	0.1611*** (0.0990)	0.0899*** (0.0520)	0.3597** (0.1570)	- 0.0191 (0.0712)	0.0292**** (0.0270)	0.9073*	2.1524	-0.4786	0.1611	0.8116
I b	-1.9104	0.7004* (0.1180)	0.2627* (0.0950)	0.1035** (0.0501)	0.3601** (0.1450)			0.9065*	2.1850	-0.5728	0.2627	0.8768
IIb	-2.0589	0.7485* (0.1280)	0.2119** (0.1070)	0.0986** (0.0510)	0.3753** (0.1530)	- 0.0002 (0.0650)	0.0249 (0.0265)	0.9127*	2.1660	-0.5387	0.2119	0.8425
I c	-1.0556	0.8310* (0.1110)	0.0992*** (0.0601)	0.0684*** (0.0520)	0.2412*** (0.1520)			0.8865*	2.1680	-0.5025	0.0992	0.5874
IIc	-1.5394	0.8721* (0.1130)	0.0651 (0.0630)	0.0692*** (0.0520)	0.2975** (0.1601)	0.0052 (0.0748)	0.0361**** (0.0280)	0.8997*	2.1550	-0.4684	0.0651	0.5090

Figures in parentheses are standard errors.

* Significant at 0.01 level of significance	*** Significant at 0.10 level of significance
** Significant at 0.05 level of significance	**** Significant at 0.15 level of significance

coefficient, that, in spite of these constraints, farmers in the district did respond positively towards price. Regression coefficient of lagged yield was positive and significant at five per cent level suggesting that farmers responded positively to higher yield levels in one year by devoting more acreage to the crop in the next year. Presowing rainfall also exerted positive influence on acreage decisions as was indicated by the positive sign and significance of the rainfall coefficient. However, comparing the levels of significance of the coefficients it seems that farmers in the district are more influenced by price and yield considerations rather than by the immediate weather conditions in their acreage allocating decisions. The infrastructural facilities are comparatively better developed in the district due to the existence of a number of industries as well as the proximity to the Kochi port. This may be one of the reasons for the positive response observed. The estimated price elasticities of acreage for the shortrun and long run were 0.1995 and 0.8518 respectively, which appear fairly high compared to the aggregate elasticities of 0.0232 for the short-run and 0.0682 in the long run.

In the estimated equation of the second model with the risk variables (model IIa) all the regression coefficients except that of price risk was significant. The R^2 values continued to be high and there was no indication of serial correlation. However coefficient of price was now significant at the 10 per cent level only as against its significance at five per cent level in the first model. The short run and long run elasticities were slightly lower at 0.1611 and 0.8116 respectively. The short run and long run price elasticity estimates obtained by Cummings (1975) for groundnut in Saurashtra at 0.16 and 0.87 respectively for the period 1951-'67 come very close to the current estimates. Coefficient of price risk, though not significant had the expected negative sign while coefficient of yield risk was positive and significant at 15 per cent level indicating that farmers were not averse to bearing yield risk. It is possible that farmers who are more responsive to market forces than to the immediate weather conditions in their production decisions, would be willing to take some degree of yield risk. Under such a situation they would be more vigilant against price slumps and consequently price variability would have a deterrent effect on area.

For model Ib, employing price expectation derived by the moving average method, the explanatory power was slightly higher, R^2 value being 0.9065. The d-statistic showed no evidence of serial correlation among the error terms and there was improvement in the significance of the parameter estimates. Coefficient of price variable was now significant at one per cent level as against its significance at five per cent level in the lagged price model. Similarly coefficient of presowing rainfall was significant at five per cent level while it was significant at only 10 per cent level in the lagged yield model. Lagged yield and lagged area continued to have significant positive influence on current acreage. The price elasticity estimates, both short run and long run were slightly higher at 0.2627 and 0.8768 respectively. Adjustment coefficient was also higher at 0.2996. Altogether there was notable improvement in the explanatory power of the determinants with the inclusion of the moving average price as proxy for price expectation. Also, the relative importance of expected price over presowing rainfall and lagged yield in influencing acreage decisions was much more in evidence. With the inclusion of risk variables (model IIb) R^2 value further improved slightly. But the price coefficient now became significant at only five per cent level. The coefficients of presowing rainfall and lagged yield continued to be significant at previous levels. Both the risk coefficients were not significant but their signs were similar to that of the lagged price model.

Price derived from the linear trend did not make any significant improvement over the other two price expectations. The overall explanatory power was in fact slightly lower for both the models. In the first model (model Ic) coefficient of lagged area was significant at one per cent level while those of price, presowing rainfall and lagged yield were significant at 10 per cent level only. The shortrun and long run elasticity estimates were 0.0992 and 0.587 respectively, lower than those obtained from the lagged price models. In the second model (model IIc) the price coefficient, though positive became non-significant.

On the whole, the analysis revealed significant and positive influence of price on acreage under sesamum in the district, which however, was kept in check by institutional and/or technological constraints. Along with economic factors, weather and yield expectations were found to play a significant role in determining acreage under the crop. Yet product price was observed to be the strongest of the determinants. Both shortrun and long run elasticities were comparatively higher than the state level values. It was also found that expected price derived by the moving average model performed better than the lagged price models and the trend price models.

Least square estimates of area response functions for Thrissur district, presented in Table 4.21 show that the overall explanatory power of the regressions were, in general, very low. For model Ia the R^2 value was only 0.2472. However the d-statistic indicated absence of serial correlation among the residuals. This may probably be due to the limitations of the d-statistic in detecting auto-correlation in the models involving lagged endogenous variables as an explanatory variable (Durbin, 1970). Coefficient of lagged area was significant at one per cent level and the adjustment coefficient obtained was fairly high at 0.5497 indicating that nearly 55 per cent of the desired area changes can be effected in one year. Thus it would take 3.75 years for 95 per cent of the changes to be made. The price coefficient had a negative sign whereas presowing rainfall and lagged yield were positively related with

Table 4.21 Area response functions for sesamum (1961-'62 to 1987-'88) : Thrissur district

Models	Constant term	Explanatory variables									Elasticity	
		A_{t-1}	P^e_t	W_{pt}	Y_{t-1}	PR_t	YR_t	R^2	d	h	S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I a	3.4712	0.4503** (0.2190)	- 0.0020 (0.0556)	0.0365 (0.0467)	0.0454 (0.1045)			0.2472	2.1700		-0.0020	-0.0036
IIa	3.0874	0.4357** (0.2370)	0.0063 (0.0621)	0.0421 (0.0510)	0.0966 (0.1311)	0.0529 (0.0611)	- 0.0067 (0.0190)	0.2875	2.1110		0.0063	0.0112
I b	3.4646	0.4470** (0.2190)	0.0027 (0.0578)	0.0362 (0.0474)	0.0462 (0.1046)			0.2473	2.1640		0.0027	0.0048
IIb	2.9723	0.4304** (0.2370)	0.0227 (0.0651)	0.0406 (0.0501)	0.1077 (0.1324)	0.0549 (0.0612)	- 0.0087 (0.0192)	0.2919	2.1067		0.0227	0.0398
I c	3.5618	0.4278** (0.2240)	0.0143 (0.0420)	0.0359 (0.0470)	0.0418 (0.1040)			0.2515	2.132		0.0143	0.0250
IIc	3.0714	0.4102*** (0.2370)	0.0324 (0.0478)	0.0403 (0.0489)	0.1064 (0.1264)	0.0552 (0.0612)	- 0.0117 (0.0191)	0.3046	2.0800		0.0324	0.0549

Figures in parentheses are standard errors.

** Significant at 0.05 level of significance *** Significant at 0.10 level of significance area. However none of those coefficients was significant. The short run and long run price elasticities were very low at -0.002 and -0.0036 respectively indicating practically no response to price. Though not significant, coefficients of presowing rainfall and lagged yield were larger in magnitude compared to that of lagged price, suggesting that influence of non-economic factors were relatively more important.

The inclusion of price risk and yield risk as additional explanatory variables raised the R^2 value slightly. But, as was the case with model Ia, here also significant regression coefficient was obtained only for lagged area. However, it is interesting to note that with the inclusion of risk variables the price coefficient became positive. Lagged yield and presowing rainfall continued to be positively related with area and among the risk variables, yield risk had the expected negative sign. The estimated short run and long run price elasticities were 0.0063 and 0.0112 respectively as against the negative elasticity estimates obtained from model Ia. The results thus appear contradictory. However, whether positive or negative, the very low elasticity estimates and the non-significant price coefficients suggest that price had no significant influence on area.

In model Ib the moving average price did not improve the explanatory power of the regression and among the independent variables only lagged area had a significant coefficient. However, price coefficient, though not significant, had a positive sign as against its negative sign in model Ia. Coefficients of lagged yield and presowing rainfall continued to be positive. The short run and long run elasticity estimates were 0.0027 and 0.0048 respectively. With the inclusion of price risk and yield risk, there was a marginal increase in the size of the price coefficient. The estimated short run and long run elasticities were 0.0227 and 0.0398 respectively.

Analysis with price derived from the linear trend gave results very similar to that obtained by using the moving average price. Only lagged area was found to exert significant influence on current area. However the short run and long run elasticity estimates were slightly higher.

Summing up, it can be concluded that there was no concrete evidence in support of a significant relationship between area and price in Thrissur district. The remaining independent variables considered, such as presowing rainfall, lagged yield and the risk factors also could not adequately explain area movements. This calls for further investigation with additional explanatory variables.

For Palakkad district area response was measured only for the post 1973-'74 period to avoid the influence of the decline in geographical area of the district caused by the formation of Malappuram district. The estimated area response functions for the above period are presented in Table 4.22. More than 65 per cent of the area variations were explained

Table 4.22 Area response functions for sesamum (1975-'76 to 1987-'88) : Palakkad district

Models	Constant term	Explanatory variables									Elasticity	
		A_{t-1}	P^e_t	W_{pt}	Y_{t-1}	PR_t	YR_t	R^2	d	h	S.R	L.R
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I a	4.4626	0.0642 (0.1964)	0.4037* (0.1301)	0.1183*** (0.0791)	- 0.1937 (0.2178)			0.5496**	2.0400	-0.1520	0.4037	0.4313
IIa	4.1353	0.0861 (0.2284)	0.4129* (0.1400)	0.1161**** (0.0969)	- 0.1484 (0.2441)	- 0.0547 (0.0878)	- 0.0010 (0.0581)	0.5650	2.0430	-0.3668	0.4129	0.4518
I b	4.0041	0.0152 (0.1714)	0.4822* (0.1167)	0.1121*** (0.0689)	- 0.1244 (0.1864)			0.6600*	2.0440	-0.1367	0.4822	0.4896
IIb	3.8144	0.0376 (0.2031)	0.4845* (0.1278)	0.1223*** (0.0860)	- 0.1228 (0.2140)	- 0.0063 (0.0778)	- 0.0130 (0.0511)	0.6624**	2.1130	-0.4671	0.4845	0.5034
I c	4.1913	0.0250 (0.1614)	0.4329* (0.0967)	0.0767**** (0.0660)	- 0.0907 (0.1784)			0.6886*	2.2670	-0.7787	0.4329	0.4440
IIc	4.1604	0.0201 (0.1932)	0.4334* (0.1049)	0.0656 (0.0810)	- 0.0623 (0.2029)	- 0.0285 (0.0743)	0.0114 (0.0483)	0.6940**	2.2450	-0.9095	0.4334	0.4423

Figures in parentheses are standard errors.

* Significant at 0.01 level of significance

** Significant at 0.05 level of significance

*** Significant at 0.10 level of significance

**** Significant at 0.15 level of significance

by the independent variables considered in model Ia. The Durbin-h statistic indicated absence of auto correlation problems. The adjustment coefficient was high at 0.9358 indicating almost full adjustment within a year itself. Response to price was evident from the positive and significant price coefficient. The estimated elasticities were 0.4037 and 0.4313 respectively for the short run and long run, fairly high compared to the state level response. Area was also significantly influenced by presowing rainfall as indicated by the rainfall coefficient (significant at 10 per cent level). Coefficient of lagged yield was negative but not significant. There was no substantial improvement in the significance of coefficients or in R^2 value with the inclusion of price risk and yield risk. Risk coefficients, though not significant had the expected negative sign.

Use of moving average prices significantly improved the explanatory power of the regressions. Both price and rainfall coefficients continued to be positive and significant. The estimated elasticities (for model Ib) were slightly higher at 0.4822 for the short run and 0.4896 for the long run.

With trend prices the R^2 values again improved slightly; but there was not much change in the elasticity values. In model IIc price became the sole significant determining factor, with the rainfall coefficient, though positive, turning non-significant.

From the foregoing analysis it was evident that area under sesamum responded positively to price. Presowing rainfall also exerted significant positive influence on area, which is only to be expected. Similarly the negative sign of the variables representing risk can also be considered as on expected lines since it is possible that cultivators may become cautious in expanding the area under sesamum in presence of significant price and yield risk.

For Malappuram district, acreage response functions were fitted for the post 1975 period only. Also, due to non-availability of data the presowing rainfall variable could not be considered in the models. Consequently model I had only three independent variables (viz. lagged area, expected price and lagged yield) and model II, five (viz. price risk and yield risk in addition to the variables of model I). Regressions were run with the three different price specifications and the results are presented in Table 4.23.

The determinants in model Ia could explain over 60 per cent of the area variations. Nevertheless, computed 'h' statistic indicated the presence of serial correlation among the disturbance terms. Lagged area had significant positive influence on current area and the adjustment coefficient was 0.4899 indicating that it would take a little over four years for 95 per cent of the desired acreage adjustments to be made. Price coefficient was positive and significant at 15 per cent level. The estimated short run and long run elasticities were

Table 4.23 Area response functions for sesamum (1975-'76 to 1987-'88) : Malappuram district

Models	Constant term	Explanatory variables									Elasticity	
		A_{t-1}	P^e_t	W_{pt}	Y_{t-1}	PR_t	YR_t	R^2	d	h	S.R	L.R
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I a	1.7734	0.5101** (0.2560)	0.2922**** (0.2220)		0.0170 (0.2143)			0.6350*	1.8140	2.9500	0.2922	0.5964
IIa	1.8104	0.4037**** (0.3370)	0.3588**** (0.2670)		0.1004 (0.2960)	- 0.0743 (0.1050)	0.0250 (0.0490)	0.6598**	1.8301		0.3588	0.6017
I b	1.7766	0.3942*** (0.2750)	0.4216*** (0.2540)		0.0324 (0.2060)			0.6624*	1.8180		0.4216	0.6959
IIb	1.6289	0.3210 (0.3662)	0.4647*** (0.3210)		0.1043 (0.2910)	- 0.0034 (0.1101)	0.0185 (0.0460)	0.6685**	1.8274		0.4647	0.6844
I c	2.5780	0.1762 (0.2954)	0.5733** (0.2480)		0.0028 (0.1870)			0.7154*	1.8689		0.5733	0.6959
IIc	2.4753	0.1165 (0.3701)	0.6091** (0.3010)		0.0516 (0.2543)	0.0133 (0.1012)	0.0123 (0.0413)	0.719**	1.8858		0.6091	0.6890

Figures in parentheses are standard errors.

* Significant at 0.01 level of significance

** Significant at 0.05 level of significance

*** Significant at 0.10 level of significance

**** Significant at 0.15 level of significance

0.2922 and 0.5964 respectively indicating that response of sesamum area in the district was higher than that of aggregate area. Lagged yield was positively related with area but the coefficient was not significant.

With the inclusion of price risk and yield risk (model IIa) there was a slight improvement in the R^2 value. The 'h' statistic was not available and the computed 'd' value indicated absence of serial correlation. Lagged area and lagged price continued to exhibit significant positive influence on current area. Adjustment coefficient rose to 0.5963 indicating moderate adjustment. Both the short run and long run elasticity estimates were also higher at 0.3588 and 0.6017 respectively. Price risk as along the expected line, was negatively related with area but coefficient yield risk was positive. However, both were not significant.

When the three year moving average price was used as a measure of price expectation, the explanatory power of the regressions, as well as the significance of the price variable improved. In model Ia price coefficient was now significant at 10 per cent level. The short run and long run elasticities were higher at 0.4216 and 0.6959 respectively. In model IIb, coefficient of lagged area became non-significant. The risk variables had the same sign as in the lagged price models and continued to be non-significant. However there was a slight improvement in the short run elasticity value and adjustment coefficient.

Price derived from the linear trend further improved the explanatory power of the regression. R^2 values were 0.7154 and 0.719 respectively (for model Ic and IIc). Durbin 'd' statistic moved closer to two, strengthening the evidence against the presence of serial correlation. In model Ic coefficient of lagged area became non-significant; and the adjustment coefficient was 0.8238 indicating very quick adjustment, with a lag of less than two years. Price coefficient was now significant at five per cent level. The estimated short run and long run elasticities were 0.5733 and 0.6959 respectively. Coefficient of lagged yield continued to be positive but not significant. In model IIc, the adjustment coefficient as well as the elasticity estimates were slightly higher. Both the risk variables were non-significant. There was no change in any of the remaining coefficients.

The analysis revealed that in the district area response was significantly positive. Other than previous years area, expected price seemed to be the main determinant. It was observed that with the use of different price specifications, the long run elasticity ranged between 0.6 to 0.7 while the short run elasticity estimates showed much more variability and ranged between 0.3 and 0.6. Short run elasticity estimates of similar magnitudes were obtained for sesamum by Madhavan (0.42 to 0.48) for Tamil Nadu and by Cummings (0.29) for Andhra Pradesh. The significant influence of price was quite evident when price expectation derived from the linear trend was employed. In fact, in these models price turned out to be the sole determinant. With the three year average price, significance of price coefficient was at 10 per cent and in lagged price models, it was still lower at 15 per cent. Overall explanatory power of the regressions were highest when the trend price was employed. Thus, in the case of Malappuram district, the results obtained with the different price expectations tally with those obtained by Rao and Jaikrishna (1965) in their studies on the suitability of alternate price specifications.

Groundnut

The explanatory variables considered in the acreage response functions for groundnut were the same as those tried for sesamum. In the first model, area under groundnut in the current year was hypothesised to depend upon the lagged area, the expected future price of groundnut, expected yield (i.e. yield lagged by one year) and rainfall in the presowing months. In the second model, in addition to the variables considered in model I, the coefficient of variation of price and yield for the preceeding three years was included as a measure of price and yield risk. The three alternative price specifications (viz. price lagged by one year, moving average of past three year's prices and price projected from the linear trend in realised price) were also tried.

The estimated acreage response functions for groundnut in Palakkad district are presented in Tables 4.24. In the first model employing lagged price (model Ia) the independent

Table 4.24 Area response functions for groundnut (1961-'62 to 1987-'88) : Palakkad district

Models	Constant term	Explanatory variables						R^2	d	h	Elasticity	
		A_{t-1}	P^e_t	W_{pt}	Y_{t-1}	PR_t	YR_t				S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Ia	1.0434	0.7737* (0.1630)	- 0.0219 (0.0601)	0.0076 (0.0660)	0.0538 (0.1091)			0.6318*	1.8321	0.7234	-0.0219	-0.0968
IIa	0.5029	0.7568* (0.1720)	0.0129 (0.0820)	- 0.0052 (0.0742)	0.0071 (0.1473)	- 0.0027 (0.0331)	0.0203 (0.0301)	0.6407*	1.9340	-0.3211	0.0129	0.053
I b	0.9587	0.7821* (0.1601)	- 0.0168 (0.0610)	0.0047 (0.0650)	- 0.0469 (0.1080)			0.6303*	1.8530	0.6133	-0.0168	-0.0771
IIb	0.3546	0.7584* (0.1691)	0.0219 (0.0843)	- 0.0062 (0.0721)	0.0202 (0.1501)	- 0.0008 (0.0343)	0.0225 (0.0310)	0.6411*	1.9250	0.3519	0.0219	0.0906
I c	0.7604	0.7947* (0.1530)	- 0.0046 (0.0361)	0.0042 (0.0663)	- 0.0326 (0.0921)			0.6297*	1.873	0.4912	-0.0046	-0.0224
IIc	0.4728	0.7540* (0.1661)	0.0148 (0.0443)	- 0.0073 (0.0724)	0.0120 (0.1123)	- 0.0022 (0.0334)	0.0234 (0.0283)	0.6424*	1.9284	0.3244	0.0148	0.0602

Figures in parentheses are standard errors.

* Significant at 0.01 level of significance

variables could together explain 64 per cent of the variation in area. The Durbin-W statistic indicated absence of first order auto regressive schemes among the error terms. Among the parameter estimates only the coefficient of lagged area was significant. The adjustment coefficient worked out to 0.2263 indicating that only 22 per cent of the desired acreage changes could be effected in one year implying the existence of significant institutional and technological constraints. At such a slow rate of adjustment it would take nearly 12 years for 95 per cent of the effect of price to be realized. Coefficient of lagged price was negative while that of presowing rainfall and lagged yield were positive. The results indicate that, though not significant yield expectations and weather conditions had a positive influence on acreage allocation. The estimated short and long run elasticities were -0.0219 and -0.0968 respectively indicating very low negative response. Similar results were obtained by Jhala (1979) in his study on groundnut acreage response where the coefficient of relative price turned out to be non-significant with a negative sign while the coefficient of yield was positive and significant for Marathwada, Madhya Maharashtra and Vidarbha regions. For Karnataka, none of the variables considered (yield, relative price and rainfall) turned out to be significant in explaining acreage allocation decisions.

Addition of price risk and yield risk (model IIa) did not significantly improve the explanatory power of the regressions. However, it is interesting to note that though the price coefficient continued to be non-significant, its sign changed over to positive. But the coefficient of presowing rainfall became negative while that of lagged yield continued to be positive. Among the risk variables, price risk was negatively related to area, along the expected lines, but coefficient of yield risk was positive. The estimated elasticities were 0.0129 and 0.053 respectively for the short run and long run; indicating low positive response.

When the moving average price was used, model I continued to exhibit the negative price acreage relationship. Here also the coefficient of lagged area was significant. However, coefficient of lagged yield was negative as against its positive sign in the lagged price model. As regards the overall explanatory power, this model was on par with the lagged price models. With the inclusion of risk variables results similar to the lagged price models were obtained. The price coefficient turned positive while that of rainfall became negative. Lagged yield was also positively related with acreage. Price risk had the expected negative coefficient while yield risk was positively related with acreage. The short run and long run elasticities were estimated at 0.0219 and 0.0906 respectively slightly higher than those obtained by using price lagged by one year.

Price trend, when used in the model gave similar results. In both the models only lagged area showed significant influence. The elasticity estimates for model IIc were 0.0148 and 0.0602 for the short run and long run respectively.

Overall, the results do not give a clear indication of either positive or negative response. Such unclear and contradictory results had been observed by Cummings (1975) also. Among the major groundnut producing states, except for Andhra Pradesh, in most of the other states not much significance was indicated. Gujarat, a major groundnut producing state showed a negative market relationship. Similar negative relationship was also noted for Maharashtra and Rajasthan. For Tamil Nadu for the period 1950-'67 his short run elasticity estimate of -0.01 coincides with that obtained in the present study (in the range -0.01 to -0.02) employing lagged price and moving average price in model I. Positive area response to price was reported for groundnut in Tamil Nadu by Madhavan (1972) during the 1947-'65 period. His short run elasticity estimates ranged between 0.03 and 0.35. The estimates obtained in the present study employing the second model ranged from 0.012 which more or less approach the lower limit obtained by Madhavan. Positive and low area response was also noted by Sahay (1971) for groundnut in Madhya Maharashtra for the period 1954-'68. Jhala (1979) in his study on inter-regional groundnut supply response in India for the period 1951-'71 observed that while in the traditional groundnut growing regions of Maharashtra, Karnataka etc. farmers were price unresponsive, in other important producing regions like Rayalaseema the supply response was positive but rather weak. However, Venkataramanan's study (1979) of cropping pattern changes in Andhra Pradesh for the period 1950-'75 showed that relative price, variance in relative price and rainfall had significant influence on groundnut acreage variations. Thus, there is considerable variation in the responsiveness of farmers among different regions. The elasticity estimates obtained in the present study are lower than those obtained by most other workers and give no indication of any significant area response to price.

Palakkad is a traditional groundnut growing pocket of Kerala. Lying adjacent to Tamil Nadu, the agroclimatic conditions of the district are most suited to the crop. The cropping pattern can change only with the availability of irrigation, which, however, is not well developed in the district. As such it faces no competition from any other crop especially in the major growing season (Rabi). Under such a situation, market responsivness would tend to be low, as is further confirmed by the present study.

4.3.2 Yield response

The response model for yield specified in chapter three was as follows:

$$Y_t = f(Y_{t-1}, P_t^e, RF, PR_t^e, YR_t^e, T)$$

Where Y_t and Y_{t-1} are the yield in time period t and t-1, RF the rainfall during crop stand, PR_t^e and YR_t^e measures of expectations regarding price risk and yield risk and T the time trend. As was the case with area response functions, in the yield response functions also time trend had to be dropped from the list of explanatory variables in order to overcome the problem of multicollinearity caused by its strong correlation with price variables. (Yield response models developed by Ramesha (1988) and Trairalvorkul (1984) suffered from a similar problem. In Ramesha's study, important variables such as irrigated area, fertilizer price and trend had to be deleted from the originally concieved model due to their strong correlation with price.) Further the independent variables were introduced into the yield response models in two stages. In model I expected price, rainfall, lagged yield and yield risk were the explanatory variables considered. In model II, in addition to the variables in model I price risk was also added. Six estimating equations were specified with the three alternate price formulations - model Ia and IIa (lagged price models), model Ib and IIb (moving average price models) model Ic and IIc (trend price models).

Sesamum

Comparison of the yield response functions estimated in the linear and log-linear forms gave no evidence of consistent superiority of one form over the other. Judging by the criteria such as overall explanatory power of the regression, significance of coefficients and freedom from auto correlation problems, it was observed that while at the state level and in some districts the linear form performed better, in the remaining districts the log linear form was superior. Only the suitable form was taken up for discussion.

The estimated yield response functions (in linear form) for the state are presented in Table 4.25. More than 60 per cent of the yield variation in the state was explained by the determinants in model Ia. The Durbin h-statistic close to zero indicated absence of serial correlation among the error terms. Coefficient of lagged yield was significant at one per cent level suggesting that past yield level significantly influenced present yield. The yield adjustment coefficient was 0.4607 indicating that only less than half of the desired yield changes could be achieved in one year. Price coefficient was positive and significant at 10 per cent level. The price elasticities of yield were 0.057 and 0.1237 respectively for the short run and long run, indicating that response of yield to price though positive was weak. Rainfall had a negative coefficient which however, was not significant. For rainfed crops like sesamum the distribution of rainfall (temporal as well as spatial) is equally, if not more important than the total quantum of rainfall. In fact untimely showers and those concentrated over a short period could even result in crop failure. Due to the non-availability of such data, the present study had approximated the influence of weather by using the total rainfall during the crop period. The non-significance of the rainfall coefficient may be due to this.

Yield risk was significant and positively related with yield. It appears that sesamum growers in the state are good risk bearers. It is possible that being responsive to market

Table 4.25 Yield response functions (linear) for sesamum (1961-'62 to 1987-'88) : Kerala state

Models	Constant term (1)	Explanatory variables								Elasticity	
		Y_{t-1} (2)	P^e_t (3)	W_t (4)	PR_t (5)	YR_t (6)	R^2 (7)	d (8)	h (9)	S.R. (10)	L.R. (11)
Ia	100.4768	0.5393* (0.1638)	0.0372*** (0.0230)	- 0.0549 (0.1224)		2.9812** (1.3214)	0.6280*	1.9890	0.0481	0.0570	0.1237
IIa	98.3457	0.5449* (0.1767)	0.0366*** (0.0240)	- 0.0546 (0.1264)	0.0949 (0.9673)	2.9462** (1.4010)	0.6282*	1.9840	0.0866	0.0560	0.1247
I b	101.2271	0.5404* (0.1670)	0.0375*** (0.0270)	- 0.0496 (0.1244)		2.9472** (1.3580)	0.6151*	1.9500	0.2298	0.0525	0.1143
IIb	92.6773	0.5602* (0.1780)	0.0367**** (0.0280)	- 0.0491 (0.1270)	0.3716 (0.9510)	2.8390** (1.4150)	0.6182*	1.9330	0.3711	0.0514	0.1168
I c	107.8210	0.5187* (0.1750)	0.0316**** (0.0260)	- 0.0437 (0.1260)		2.9204** (1.3840)	0.6073*	1.9040	0.4928	0.0484	0.1007
IIc	99.6610	0.5384* (0.1870)	0.0305**** (0.0270)	- 0.0433 (0.1280)	0.3475 (0.9641)	2.8123** (1.4459)	0.6100*	1.8870	0.7697	0.0467	0.1012

Figures in parentheses are standard errors.

*	Significant at 0.01 level of significance
**	Significant at 0.05 level of significance
***	Significant at 0.10 level of significance
****	Significant at 0.15 level of significance

forces they are willing to take some degree of yield risk. In model IIa coefficient of price risk turned out to be positive but non-significant. There was no notable change in any of the remaining coefficients.

In the moving average price models the log linear forms suffered from auto correlation problem while the linear forms did not. The estimated linear functions are presented in Table 4.25. In model Ib lagged yield was significant at one per cent level and the adjustment coefficient worked out 0.46. Price continued to show significant positive influence on yield. The estimated elasticities were 0.0525 and 0.1143 respectively for the short run and long run, quite close to the estimates obtained from lagged price models. Similarly, coefficient of yield risk was positive and significant, while rainfall coefficient though negative was not significant. In model IIb, the results did not differ much from those obtained from the lagged price models.

With trend prices, both the models had slightly lower R^2 values. The price coefficients of both model Ic and IIc were now significant at 15 per cent level. The estimated short run and long run elasticities were 0.0484 and 0.1 for model Ic and 0.0467 and 0.1012 for model IIc. There was no significant difference in any of the remaining coefficients.

Altogether the analysis revealed positive but weak yield response to price in the state. Lagged yield seemed to exert significant influence on current yield. This is to be expected since past yield levels would play a significant role in shaping the farmer's expectations regarding future yields and this would influence the allocation of yield increasing inputs, including labour. Interestingly coefficient of yield risk turned out to be positive and significant. The only logical conclusion that can be drawn from this is that the farmers are good risk bearers. There was no significant improvement in the results when moving average price and trend price were used in the place of lagged prices as a proxy for price expectation.

The estimated yield response functions (linear) for Kollam are presented in Table 4.26. The explanatory power of model Ia was rather low, R^2 being 0.4242 (which, however, was significant at five per cent level). Durbin d-statistic was close to two indicating absence of serial correlation among the error terms. Lagged yield turned out to be non significant and the adjustment coefficient was high at 0.7. Previous years yield did not seem to exert much influence on current yield and it was possible to effect 70 per cent of the desired yield changes in one year itself. Price coefficient was positive but not significant. The estimated elasticities were 0.0758 and 0.1084 for the short run and long run respectively indicating only very weak positive response. Coefficient of rainfall was positive and significant at 10 per cent level. This is to be expected as rainfall during the crop period would exert significant positive influence on crop yield; especially for rainfed crops. Yield

Table 4.26 Yield response functions (linear) for sesamum (1961-'62 to 1987-'88) : Kollam district

Models	Constant term (1)	Explanatory variables Y_{t-1} (2)	 P^e_t (3)	 W_t (4)	 PR_t (5)	 YR_t (6)	R^2 (7)	d (8)	h (9)	Elasticity S.R. (10)	 L.R. (11)
I a	96.9768	0.2999 (0.4263)	0.0545 (0.0984)	0.4054*** (0.2670)		6.5203* (2.6624)	0.4242**	1.9110		0.0758	0.1084
IIa	95.1528	0.1448 (0.4043)	0.0076 (0.0943)	0.3162**** (0.2520)	6.0104** (2.9730)	7.3118* (2.5081)	0.5262*	1.962		0.0106	0.0124
I b	158.7918	0.1380 (0.4530)	- 0.0228 (0.1191)	0.4428*** (0.2650)		7.7217* (2.7260)	0.4163**	1.873		-0.029	-0.0336
IIb	127.5283	0.0578 (0.4190)	- 0.0333 (0.1101)	0.3283**** (0.2510)	6.1093**** (2.8776)	7.9011* (2.5150)	0.5283*	1.9300		-0.0423	-0.0450
I c	196.1174	0.0485 (0.4421)	- 0.0607 (0.1040)	0.4387*** (0.2610)		8.2082* (2.5430)	0.4251**	1.8390		-0.0845	-0.0888
IIc	166.1534	0.0358 (0.4073)	- 0.0720 (0.0950)	0.3201**** (0.2460)	6.1865* (2.8430)	8.3899** (2.3360)	0.5398*	1.8870		-0.1002	-0.0968

Figures in parentheses are standard errors.

* Significant at 0.01 level of significance

** Significant at 0.05 level of significance

*** Significant at 0.10 level of significance

**** Significant at 0.15 level of significance

Table 4.25 Yield response functions (linear) for sesamum (1961-'62 to 1987-'88) : Kerala state

Models	Constant term	Explanatory variables								Elasticity	
		Y_{t-1}	P^e_t	W_t	PR_t	YR_t	R^2	d	h	S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Ia	100.4768	0.5393*	0.0372***	- 0.0549		2.9812**	0.6280*	1.9890	0.0481	0.0570	0.1237
		(0.1638)	(0.0230)	(0.1224)		(1.3214)					
IIa	98.3457	0.5449*	0.0366***	- 0.0546	0.0949	2.9462**	0.6282*	1.9840	0.0866	0.0560	0.1247
		(0.1767)	(0.0240)	(0.1264)	(0.9673)	(1.4010)					
I b	101.2271	0.5404*	0.0375***	- 0.0496		2.9472**	0.6151*	1.9500	0.2298	0.0525	0.1143
		(0.1670)	(0.0270)	(0.1244)		(1.3580)					
IIb	92.6773	0.5602*	0.0367****	- 0.0491	0.3716	2.8390**	0.6182*	1.9330	0.3711	0.0514	0.1168
		(0.1780)	(0.0280)	(0.1270)	(0.9510)	(1.4150)					
I c	107.8210	0.5187*	0.0316****	- 0.0437		2.9204**	0.6073*	1.9040	0.4928	0.0484	0.1007
		(0.1750)	(0.0260)	(0.1260)		(1.3840)					
IIc	99.6610	0.5384*	0.0305****	- 0.0433	0.3475	2.8123**	0.6100*	1.8870	0.7697	0.0467	0.1012
		(0.1870)	(0.0270)	(0.1280)	(0.9641)	(1.4459)					

Figures in parentheses are standard errors.

*	Significant at 0.01 level of significance	***	Significant at 0.10 level of significance
**	Significant at 0.05 level of significance	****	Significant at 0.15 level of significance

Table 4.26 Yield response functions (linear) for sesamum (1961-'62 to 1987-'88) : Kollam district

Models	Constant term	Explanatory variables					R^2	d	h	Elasticity	
		Y_{t-1}	P^e_t	W_t	PR_t	YR_t				S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
I a	96.9768	0.2999 (0.4263)	0.0545 (0.0984)	0.4054*** (0.2670)		6.5203* (2.6624)	0.4242**	1.9110		0.0758	0.1084
IIa	95.1528	0.1448 (0.4043)	0.0076 (0.0943)	0.3162**** (0.2520)	6.0104** (2.9730)	7.3118* (2.5081)	0.5262*	1.962		0.0106	0.0124
I b	158.7918	0.1380 (0.4530)	- 0.0228 (0.1191)	0.4428*** (0.2650)		7.7217* (2.7260)	0.4163**	1.873		-0.029	-0.0336
IIb	127.5283	0.0578 (0.4190)	- 0.0333 (0.1101)	0.3283**** (0.2510)	6.1093**** (2.8776)	7.9011* (2.5150)	0.5283*	1.9300		-0.0423	-0.0450
I c	196.1174	0.0485 (0.4421)	- 0.0607 (0.1040)	0.4387*** (0.2610)		8.2082* (2.5430)	0.4251**	1.8390		-0.0845	-0.0888
IIc	166.1534	0.0358 (0.4073)	- 0.0720 (0.0950)	0.3201**** (0.2460)	6.1865* (2.8430)	8.3899** (2.3360)	0.5398*	1.8870		-0.1002	-0.0968

Figures in parentheses are standard errors.

* Significant at 0.01 level of significance

** Significant at 0.05 level of significance

*** Significant at 0.10 level of significance

**** Significant at 0.15 level of significance

risk coefficient was also positive and significant, suggesting that higher yield levels were associated with higher instability. Incorporation of price risk (model IIa) improved R^2 value to 0.5262. Lagged yield continued to be non-significant and the yield adjustment coefficient was higher at 0.8552, indicating very little time lag for adjustment. The price coefficient did not improve in significance and the estimated elasticities were lower at 0.0106 and 0.0124 for the short run and long run respectively. Contrary to prior expectation, coefficient of price risk turned out to be positive and significant indicating that farmers were not averse to bearing price risk.

When the moving average price was employed, though the price coefficient continued to be non-significant, both the models yielded negative price elasticities. For model Ib they were -0.029 and -0.0336 and for model IIb -0.0423 and -0.045 for the short run and long run respectively. Yield adjustment coefficient was in the range of 0.85 to 0.95 indicating that nearly all of the desired yield changes could be accomplished within one production period itself. As is to be expected rainfall was positively related with yield; but the risk coefficients continued to be positive. Use of price trend in the response model also yielded negative price elasticities, which however, were slightly higher than those obtained from moving average models. There was no noticeable change in any of the remaining coefficients.

Altogether the analysis revealed that price had not much significant influence on yield in the district. When lagged prices were used yield response was found to be positive but with moving average and trend prices, the relationship appeared negative. The positive relationship of rainfall is along the expected lines since it is very evident that showers in adequate amounts would substantially raise crop yields for rainfed crops like sesamum.

For Alappuzha district, the logarithmic forms of the yield response functions had higher explanatory power and more significant coefficients than the linear forms. They were also free from the problem of serial correlation among the stochastic terms. These estimated (log linear) functions are presented in Table 4.27. Sixty three per cent of the yield variations were explained by the determinants of model Ia. Coefficient of lagged yield was significant at one per cent level and the adjustment coefficient computed was 0.3938, indicating strong dependence of current yield on past yield levels. Price coefficient was significantly positive and the estimated short run and long run elasticities were 0.23 and 0.584 respectively suggesting appreciable yield response to price. Similarly rainfall was also found to exert significant positive influence on yield, which is only to be expected.

With the inclusion of price risk (model IIa) the R^2 value rose to 0.68; and there was improvement in the significance of lagged price and rainfall coefficients. Price risk coefficient was negative and significant at five per cent level

Table 4.27 Yield response functions (log-linear) for sesamum (1961-'62 to 1987-'88) : Alappuzha district

Models	Constant term	Explanatory variables								Elasticity	
		Y_{t-1}	P^{e}_{t}	W_t	PR_t	YR_t	R^2	d	h	S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
I a	0.2889	0.6062* (0.1620)	0.2300*** (0.1480)	0.0862*** (0.0570)		0.0574**** (0.0470)	0.6278*	2.0750	-0.3223	0.2300	0.5840
IIa	0.5988	0.4919* (0.1670)	0.3319** (0.1520)	0.1217** (0.0579)	-0.2295** (0.1300)	0.0893** (0.0481)	0.6803*	2.01	-0.0461	0.3319	0.6532
I b	0.0753	0.5531* (0.1620)	0.3069** (0.1530)	0.0991** (0.0560)		0.0649*** (0.0450)	0.6530*	2.0260	-0.1114	0.3069	0.6867
IIb	0.4313	0.4742* (0.1640)	0.3636** (0.1520)	0.1270** (0.0570)	-0.1911*** (0.1210)	0.0883** (0.0460)	0.6932*	1.9970	0.0125	0.3636	0.6915
I c	0.6649	0.4527* (0.1701)	0.2907* (0.1150)	0.1050** (0.0540)		0.0615*** (0.0420)	0.6843*	2.1030	-0.4900	0.2907	0.5311
IIc	1.172	0.3584** (0.1700)	0.3384* (0.1120)	0.1345** (0.0530)	-0.2038** (0.1140)	0.0848** (0.0420)	0.7299*	2.1440	-0.6796	0.3384	0.5274

Figures in parentheses are standard errors.

*	Significant at 0.01 level of significance
**	Significant at 0.05 level of significance
***	Significant at 0.10 level of significance
****	Significant at 0.15 level of significance

indicating that price variability had a deterrent effect on yield increasing efforts. However, yield variability continued to be positively related to yield. The estimated price elasticities were slightly higher at 0.3319 and 0.6532 respectively for the short run and long run.

Use of moving average prices slightly improved the overall explanatory power of the functions. However, there was not much change in the estimated price elasticity values. Lagged yield, price and rainfall exerted significant positive influence on current yield while price risk had the expected negative coefficient. However, yield risk continued to be positively related to yield.

Trend prices further improved the R^2 values of both the models. Determinants of model Ic and IIc could explain 68 per cent and 73 per cent respectively of the yield variations. The price coefficients of both models were now significant at one per cent level, but the estimated elasticities were not much different from those obtained with lagged and moving average prices. The remaining independent variables continued to exhibit the same pattern of response.

Overall, the analysis revealed significant positive influence of price on sesamum yield in the district. This influence was found especially strong when trend prices were employed. Another important factor influencing yield appeared to be rainfall. The deterrent effect of price risk was also very much in evidence. However, yield risk did not exert such a negative influence and higher yield levels were closely associated with yield instability.

The estimated yield response functions (linear) for Ernakulam district presented in Table 4.28 show that overall explanatory power of the regressions in general were poor. In model Ia lagged yield appeared to exert positive influence on current yield while the influence of price and rainfall were negative. However none of the coefficients was significant. The estimated elasticities were -0.0492 and -0.0634 for the short run and long run respectively. Interestingly, yield risk coefficient was negative and significant at 10 per cent level indicating the dampening influence of yield variability on farmers efforts, as against the positive risk coefficient observed so far. In model IIa coefficient of lagged yield became significant but that of yield risk lost its significance. Price risk, contrary to expectations was positively related with yield.

With moving average prices, there was a marginal increase in the explanatory power of the regression. In model IIb lagged yield and price showed significant relationship with current yield. However, price coefficient had an unexpected negative sign, indicating a decline in yield in the face of rising prices. The estimated elasticities were -0.0701 and -0.998 respectively for the short run and long run. In the analysis done in the earlier part on area response it was observed that sesamum area in the district responded significantly to price incentive.

Table 4.28 Yield response functions (linear) for sesamum (1961-'62 to 1987-'88) : Ernakulam district

Models	Constant term (1)	Explanatory variables Y_{t-1} (2)	P^e_t (3)	W_t (4)	PR_t (5)	YR_t (6)	R^2 (7)	d (8)	h (9)	Elasticity S.R. (10)	L.R. (11)
I a	281.7029	0.2239 (0.2271)	- 0.0371 (0.0614)	- 0.1402 (0.2520)		- 2.3385*** (1.6950)	0.3447	2.1820		-0.0492	-0.0634
IIa	221.6773	0.3132**** (0.2390)	- 0.0644 (0.0651)	- 0.0961 (0.2541)	2.6473**** (2.3611)	- 0.8891 (2.1235)	0.3853	2.2770		-0.0485	-0.0707
I b	295.8683	0.2051 (0.2201)	- 0.0710 (0.0740)	- 0.1526 (0.2491)		- 1.8757 (1.7810)	0.3620	2.2010		-0.0861	-0.1083
IIb	236.0319	0.2980**** (0.2390)	- 0.0850**** (0.0750)	- 0.1088 (0.2530)	2.2302 (2.2090)	- 0.7482 (2.1020)	0.3945	2.3090		-0.0701	-0.0998
I c	278.7130	0.2448**** (0.2140)	- 0.0458 (0.0634)	- 0.1599 (0.2554)		- 2.1572**** (1.7520)	0.3495	2.2440		-0.0608	-0.0805
IIc	220.1620	0.3385*** (0.2370)	- 0.0562 (0.0641)	- 0.1217 (0.2590)	2.1023 (2.2331)	- 1.1214 (2.0733)	0.3785	2.3600		-0.0746	-0.1128

Figures in parentheses are standard errors.

* Significant at 0.01 level of significance

** Significant at 0.05 level of significance

*** Significant at 0.10 level of significance

**** Significant at 0.15 level of significance

probably, such area expansions were achieved by bringing marginal lands under sesamum, resulting in lower productivity. This may be one possible reason for the negative yield response observed.

In models employing trend prices (model Ic and IIc) lagged yield turned out to be the major variable influencing current yield. Price coefficient was negative but not significant.

The analysis revealed that the independent variables considered could not adequately explain the yield movements. Price appeared to exert a weak negative influence on yield which may have been caused quite inadvertently by the extension of sesamum cultivation to marginal lands. Current yield was also influenced to some extent, by past yield levels. Yield risk had a dissuading effect on farmers.

Results of regression analysis for Thrissur district are presented in Table 4.29. Determinants of model Ia could explain only lessthan 40 per cent of the yield variations. However, there was no problem of serial correlation as indicated by the Durbin-d statistic. Lagged yield had significant positive influence on current yield, but, the price coefficient was negative indicating a decline in yield in spite of rising prices. The estimated short run and long run elasticities were -0.1309 and -0.1978 respectively. Rainfall coefficient, though negative was not significant. Yield risk had a positive coefficient

Table 4.29 Yield response functions (log-linear) for sesamum (1961-'62 to 1987-'88) : Thrissur district

Models	Constant term	Explanatory variables					R^2	d	h	Elasticity	
		Y_{t-1}	P^e_t	W_t	PR_t	YR_t				S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
I a	4.6884	0.3382*** (0.2130)	- 0.1309**** (0.1040)	- 0.0356 (0.0412)		0.0395**** (0.0310)	0.3935**	2.0880		-0.1309	-0.1978
IIa	4.7039	0.3366*** (0.2250)	- 0.1309**** (0.1070)	- 0.0352 (0.0431)	- 0.0034 (0.1067)	0.0395**** (0.0320)	0.3936	2.092		-0.1309	-0.1973
I b	4.7074	0.3349*** (0.2160)	- 0.1321**** (0.1090)	- 0.0372 (0.0390)		0.0409**** (0.0320)	0.3905**	2.0830		-0.1321	-0.1986
IIb	4.8361	0.3224*** (0.2300)	- 0.1349**** (0.1120)	- 0.0344 (0.0430)	- 0.0213 (0.1080)	0.0413**** (0.0330)	0.3918	2.1100		-0.1349	-0.1991
I c	4.0519	0.3918** (0.2090)	- 0.0730 (0.0810)	- 0.0426**** (0.0400)		0.0371**** (0.0330)	0.3709**	2.0910		-0.0730	-0.1200
IIc	4.0964	0.3874** (0.2210)	- 0.0733 (0.0830)	- 0.0415 (0.0430)	- 0.0087 (0.1091)	0.0371**** (0.0340)	0.3711	2.1010		-0.0733	-0.1196

Figures in parentheses are standard errors.

*	Significant at 0.01 level of significance	***	Significant at 0.10 level of significance
**	Significant at 0.05 level of significance	****	Significant at 0.15 level of significance

indicating the presence of instability at higher yield levels. In model IIa, price coefficient continued to exhibit the negative relationship and there was no noticeable change in the elasticity values. Price risk had the expected negative sign, which however, turned out to be non significant.

Use of moving average prices (models Ib and IIb) gave results identical to those obtained from lagged price models. When trend prices were employed (models Ic and IIc) there was a slight reduction in the explanatory power of the regression. Lagged yield gained in significance while price coefficient though negative became non-significant. The estimated elasticities were slightly lower at -0.0730 and -0.1200 respectively for short run and long run.

From the above analysis it can be concluded that in spite of rising prices, yield was declining in the district. Current yield level was influenced significantly by past levels, indicating a traditional set up. Higher yield levels were prone to instability.

The estimated yield response functions (log linear forms) for Palakkad are presented in Table 4.30. The very low R^2 values indicate that none of the models was a good fit. In model Ia price, though not significant, was positively related with yield and the estimated short run and long run elasticities were 0.0657 and 0.0721 respectively. Rainfall coefficient was negative and significant at 15 per cent level. As mentioned earlier, a much more correct picture of the relationship between able 4.30 Yield response functions (log-linear) for sesamum (1961-'62 to 1987-'88) : Palakkad district

odels	Constant term	Explanatory variables					R^2	d	h	Elasticity	
		Y_{t-1}	P^e_t	W_t	PR_t	YR_t				S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
I a	4.7391	0.0891 (0.2674)	0.0657 (0.1443)	- 0.0472**** (0.0360)		0.0167 (0.0531)	0.1396	2.2670		0.0657	0.0721
IIa	5.0089	0.0353 (0.2851)	0.0491 (0.1504)	- 0.0512*** (0.0371)	0.0675 (0.1043)	0.0131 (0.0541)	0.1689	2.3360		0.0491	0.0509
I b	4.9204	0.1084 (0.2650)	0.0178 (0.1523)	- 0.0467**** (0.0360)		0.0197 (0.0540)	0.1268	2.2940		0.0178	0.0199
IIb	5.1458	0.0443 (0.2851)	0.0163 (0.1550)	- 0.0512*** (0.0370)	0.0732 (0.1030)	0.0147 (0.0550)	0.1622	2.3540		0.0163	0.0170
I c	4.8053	0.1104 (0.2641)	0.0351 (0.1321)	- 0.0471**** (0.0360)		0.0184 (0.0531)	0.1307	2.3010	1.25	0.0351	0.0394
IIc	5.0531	0.0472 (0.2841)	0.0294 (0.1352)	- 0.0515*** (0.0370)	0.0720 (0.1031)	0.0138 (0.0551)	0.1647	2.3580		0.0294	0.0308

Figures in parentheses are standard errors.

*** Significant at 0.10 level of significance

**** Significant at 0.15 level of significance

rainfall and yield could have been obtained by measuring the rainfall during critical periods of plant growth, which however, was not available. Yield risk was positively related with area but the coefficient was not significant. Inclusion of price risk (model IIb) did not make any significant change in the results. Sign of the price risk coefficient turned out to be positive, but like that of yield risk was not significant.

Moving average prices and trend prices did not improve the results either in terms of the overall explanatory power of the regressions or in terms of the significance of the coefficients. The estimated price elasticities of yield were found to be slightly lower.

Altogether, the analysis revealed no evidence of significant yield response to price in the district. Moreover, the very low explanatory power of the regressions calls for further investigation with additional/modified variables in the analysis.

For Malappuram district due to non-availability of a continuous series of rainfall data, analysis was carried out with the remaining variables. The log-linear forms were found comparatively better and the results are presented in Table 4.31. The explanatory power of the regressions, in general were very poor and none of the variables considered appeared to exert a significant influence on yield. When moving average prices and trend prices were employed in the response models the price elasticities of yield ranged between -0.0343 to -0.0742 (for the

Table 4.31 Yield response functions (log-linear) for sesamum (1975-'76 to 1987-'88) : Malappuram district

Models	Constant term	Explanatory variables					R^2	d	h	Elasticity	
		Y_{t-1}	P^e_t	W_t	PR_t	YR_t				S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
I a	5.0529	0.1841 (0.3420)	- 0.0733 (0.2321)			- 0.0278 (0.0541)	0.0931	2.0571		-0.0733	-0.0898
IIa	4.8805	0.1891 (0.3554)	- 0.0742 (0.2410)		0.0680 (0.1480)	- 0.0313 (0.0561)	0.1119	2.0860		-0.0742	-0.0915
I b	4.9624	0.1883 (0.3442)	- 0.0637 (0.2478)			- 0.0264 (0.0541)	0.0903	2.0540		-0.0637	-0.0785
IIb	4.6443	0.1881 (0.3586)	- 0.0343 (0.2680)		0.0623 (0.1543)	- 0.0301 (0.0570)	0.1050	2.0700		-0.0343	-0.0422
I c	4.3821	0.1544 (0.3536)	0.0613 (0.2310)			- 0.0306 (0.0551)	0.0907	2.0100		0.0613	0.0725
IIc	4.0274	0.1474 (0.3662)	0.0959 (0.2473)		0.0829 (0.1521)	- 0.0366 (0.0582)	0.1168	2.0400		0.0959	0.1124

Figures in parentheses are standard errors.

* Significant at 0.01 level of significance

** Significant at 0.05 level of significance

*** Significant at 0.10 level of significance

**** Significant at 0.15 level of significance

short run) and -0.0422 to -0.0915 (for the long run). With the trend prices, however, positive elasticities in the range of 0.0613 to 0.0959 (short run) and 0.0725 to 0,1124 (long run) were obtained. Altogether the analysis did not reveal any insight into the yield behaviour of sesamum in the district. This may be partly due to the failure to include rainfall variable in the analysis. However, from the present analysis yield doesn't seem to respond much to price.

Groundnut

The estimated groundnut yield response functions, in log-linear form are presented in Table 4.32. The linear forms, though having slightly higher R^2 values, suffered from serious serial correlation problems and hence were not taken up for discussion. Model Ia was a good fit and was free from auto-correlation problems. Lagged yield appeared to exert significant positive influence on current yield. Rainfall had a similar positive influence, but the coefficient was not significant. Price coefficient was significantly negative, indicating a decline in yield in the face of rising prices. The estimated elasticities were -0.3154 and 0.4487 respectively for the short run and long run. Yield risk, though not significant was negatively related with yield. In model IIa, the price risk coefficient turned out to be significantly positive. However, coefficient of yield risk was negative and significant at 15 per cent level, indicating a risk aversion behaviour among farmers.

Table 4.32 Yield response functions for groundnut (1961-'62 to 1987-'88) : Palakkad district

Models	Constant term	Explanatory variables								Elasticity	
		Y_{t-a}	P^e_t	W_t	PR_t	YR_t	R^2	d	h	S.R.	L.R.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
I a	6.6970	0.2971*** (0.2250)	-0.3154** (0.1270)	0.0102 (0.1591)		-0.0355 (0.0472)	0.6812	1.711		-0.3154	-0.4487
IIa	6.4190	0.2648**** (0.2090)	-0.3482* (0.1190)	0.0757 (0.1501)	0.1059** (0.0510)	-0.0475**** (0.0440)	0.7404	1.691		-0.3482	-0.4736
I b	8.6680	0.1203 (0.2011)	-0.4425* (0.1150)	0.0114 (0.1372)		-0.0683*** (0.0420)	0.7599	1.6390	14.9811	-0.4425	-0.5030
IIb	7.9160	0.1556 (0.1960)	-0.4249* (0.1130)	0.0463 (0.1350)	0.0674*** (0.0460)	-0.0662*** (0.0410)	0.7840	1.6150	4.7102	-0.4249	-0.5032
I c	5.5790	0.4201* (0.1489)	-0.2268* (0.0639)	-0.0263 (0.1408)		-0.0337 (0.0380)	0.7433	1.6970	1.1369	-0.2268	-0.3911
IIc	4.9840	0.4261* (0.1379)	-0.2320* (0.0601)	0.0264 (0.1329)	0.0936** (0.0450)	-0.0388**** (0.0360)	0.7903	1.7990	0.6947	-0.2320	-0.4042

Figures in parentheses are standard errors

* Significant at 0.01 level of significance

** Significant at 0.05 level of significance

*** Significant at 0.10 level of significance

**** Significant at 0.15 level of significance

Use of moving average price substantially improved the explanatory power of the regressions. Model Ib had an R^2 value of 0.7599. The Durbin-h statistic indicated absence of auto correlation among the random terms. Past yield and rainfall were positively related with yield but the coefficients were not significant. Price continued to exhibit the negative relationship and the estimated elasticities were slightly higher. The deterrent effect of yield risk was evident from the significantly negative coefficient. In model IIb price risk coefficient was positive and significant as was the case with model IIa. However, yield risk continued to exert a negative influence on yield.

With trend prices, coefficent of lagged yield turned out to be positive and significant at one per cent level, indicating that past yield levels exerted significant influence on current yield. Price, rainfall and yield risk were all negatively related with yield but the coefficient of only price was significant. In model IIc price risk continued to exhibit the positive relationship and yield risk, the expected negative influence.

Overall, the results point in the direction of a significant negative yield response to price. However, such a relationship do not stand to reason and the only conclusion that can be drawn is that the farmers were not much responsive to price. Under such a situation, the gradually declining yield levels (probably due to the lack of technological advancement and also due to the continued cultivation on the same tract of land with traditional methods; year after year) when regressed upon the continually rising prices would show a negative relationship. Thus the observed negative response need not necessarily express a causal relationship. Not much sensitivity was shown towards price risk also, which is to be expected in a set up in which there is no response to price. The influence of yield risk was consistently negative and this together with the earlier results points towards traditional agriculture where the farmers are more conscious about yield instability than about the disturbances in the market forces. This observation is further confirmed by the significant positive influence exerted by lagged yield on current yield.

Summerising the discussion on area and yield responses, it can be concluded that response of aggregate sesamum area to price though not significant, appeared positive. However non-price factors like presowing rainfall and lagged yield seemed to exert much more stronger influence on aggregate acreage. Adjustment was found slow, indicating the existence of techno-institutional constraints. Among the major sesamum growing districts significant positive price response was noticed in the districts of Ernakulam, Palakkad and Malappuram. In Ernakulam the short run elasticity ranged between 0.06 and 0.26 and the long run elasticity between 0.50 and 0.87. However, due to institutional constraints adjustment was rather slow. Weather and yield expectations were also found to exert significant positive influence on acreage. For Palakkad adjustment coefficient came near to one so that the long run and short run elasticities were not much different and came around 0.45. Positive influence of rainfall on area was also evident in the district. For Malappuram district also, where the short run elasticity ranged from 0.29 to 0.60 while the long run value came between 0.59 and 0.69. Positive, but non significant, price coefficient was obtained for Alappuzha district. The short run elasticity came around 0.02 and the long run between 0.02 and 0.06. For Thrissur district, the fitted area response functions gave contradictory and unclear results and as such there is no evidence of any definite area movement with respect to price changes. Kollam was the only district where significant negative area response to price was noticed. However, the estimated elasticities were low with the short run elasticity coming around -0.14 and the range of long run elasticity being -0.38 to -0.50. Thus, in general, the estimated elasticities were low, indicating that changes in price brought about only less than proportionate changes in area.

Of the three alternate price formulations tried in the area response models, three year moving average price was found slightly better than price lagged by one year, judging by certain criteria such as overall explanatory power of regressions and the proper sign and significance of the coefficients.

At the state level, there was some evidence of positive yield response to price for sesamum. However, the magnitude of response was low as indicated by the elasticity values of 0.05 for the short run and 0.12 for the long run. Lagged yield was found to exert a strong influence on current yield. Yield risk also showed a positive relationship with yield which may perhaps be due to the fact that yield instability becomes more pronounced at higher yield levels. Among the districts, only Alappuzha exhibited significant positive influence of price on yield. The estimated elasticities ranged from 0.23 to 0.36 for the short run and from 0.52 to 0.69 for the long run. Weak negative response was found in Thrissur and Ernakulam. In the remaining districts not much significance was noted.

For groundnut, there was no indication of any significant relationship between area and price movements. The estimated price elasticities of acreage were very low also. Movements in yield were observed to be in the opposite direction to that of price. However, yield risk appeared to exert a negative influence on the yield increasing effort of farmers.

Summary

SUMMARY

The two major seasonal oilseed crops of Kerala are sesamum and groundnut. Sesamum is grown mainly in the southern and central regions of Kerala while groundnut cultivation is confined to Palakkad district. In the state the production of both these crops has been falling over the years. The present study proposes:

i) To examine the trends in area, production and productivity of oilseeds (sesamum and groundnut) in Kerala, and

ii) To estimate short run and long run supply elasticities of oilseeds (sesamum and groundnut) in Kerala.

Time series data on area, production, productivity (of sesamum and groundnut), rainfall (presowing and crop period) and crop price over the 1961-'62 to 1987-'88 period provided the data base for the study. For sesamum, six districts which together accounted for nearly 94 per cent of the total of the state's area under sesamum in 1986-'87 were subjected to study. These districts were Kollam (14 per cent), Alappuzha (28 per cent), Ernakulam (15 per cent), Thrissur (8 per cent), Palakkad (9 per cent) and Malappuram (20 per cent). For groundnut, the study was confined to Palakkad district which alone accounted for over 98 per cent of the area under the crop in Kerala state in the year 1986-'87.

Trend analysis was carried out for two sub-periods (viz. 1961-'62 to 1974-'75 and 1975-'76 to 1987-'88), as well as for the whole period, using simple indices and three functional forms viz. the linear (which assumes constant absolute increment per time period), the log-linear (which assumes a constant compound rate of growth) and the quadratic (which allows for varying growth rate over time). To measure the relative contributions of area and productivity towards the changes in output (relative to that of the base period) decomposition model of Narula and Vidyasagar was employed. Variability was measured using the coefficient of variation with the deviations per time period measured from the trend values, (rather than from the overall mean) so as to eliminate the effect of secular trend. The determinants of area and yield were examined both at the district and state levels by fitting response functions of the Nerlovian (lagged adjustment) type for the whole period.

The growth rates of area, production and productivity of sesamum and groundnut during the 1961-'62 to 1974-75 period, and the 1975-'76 to 1987-'88 period are presented in Tables 6.1 and 6.2 respectively.

During the first period sesamum output increased in all the districts examined, except Palakkad. The growth was quite rapid in Alappuzha and Thrissur districts and this was purely due to increase in productivity. Sesamum area was, in fact declining during this period in both these districts. In Kollam, output rose mainly through expansion of cultivated area, the

Table 6.1 Growth rates of area, production and productivity of sesamum and groundnut in Kerala during the 1961-'62 to 1974-'75 period

	Growth rates of		
	Area	Production	Productivity
<u>Sesamum</u>			
State	-0.13	3.58	3.71
Kollam	1.54	1.93	0.38
Alappuzha	-1.00	14.24	13.24
Ernakulam	-1.16	0.70	1.88
Thrissur	-0.008	6.48	6.48
Palakkad	-8.73	-7.29	1.16
<u>Groundnut</u>			
Palakkad	1.01	0.63	-0.39

growth rate of productivity being very low. In Ernakulam, the growth of productivity was almost offset by the decline of area and consequently output growth was rather slow. The decline of output was severe in Palakkad, which, however, was caused by the transfer of sesamum growing tracts to the newly created district Malappuram. At the state level, sesamum output showed appreciable growth. With area remaining almost stagnant this output growth was possible solely because of the increase in productivity.

Table 6.2 Growth rates of area production and productivity of sesamum and groundnut in Kerala during 1975-'76 to 1987-'88

	Growth rates of		
	Area	Production	Productivity
Sesamum			
State	-2.31	-2.03	0.28
Kollam	-6.36	-1.99	4.58
Alappuzha	-3.87	-2.89	1.05
Ernakulam	-0.51	-5.19	-4.29
Thrissur	-2.40	-4.88	-2.60
Palakkad	0.42	3.10	2.67
Malappuram	5.22	4.85	-0.24
Groundnut			
Palakkad	-2.06	-6.40	-4.09

The 1975-'76 to 1987-'88 period was characterised by decline in sesamum output in most of the districts. This decline was severe in Ernakulam and Thrissur districts while in Alappuzha and Kollam it was at a lower pace. In Ernakulam decline in productivity was the main reason for the lower output level while in Thrissur output was affected by decline in both area and productivity. In Kollam and Alappuzha though productivity grew, this was offset by the decline in area. Growth in output was experienced only in Palakkad and Malappuram. In Palakkad output rose primarily due to the rise in productivity while in Malappuram area expansion was the main impetus for output growth. At the state level, productivity growth was negligible whereas decline in area was appreciable. Consequently aggregate output declined at a rate of 2.03 per cent.

Variability in sesamum output was marked during the first period in the districts of Alappuzha, Thrissur and Palakkad while in Kollam and Ernakulam it was lower. Yield fluctuations were the main reason for output variability in Alappuzha and Thrissur districts as well as that of aggregate output. During the second period all the districts experienced output variability. This variation was particularly high in Kollam and Pallakkad districts and it originated mainly from random yield movements. However at the state level output fluctuations were comparatively lesser.

In the case of groundnut there was only a very mild growth in output during the first period. Productivity was declining during this period and the growth of output, though slow was possible due to the expansion of cultivated acreage. During the second period, output declined rapidly with both area under the crop and productivity declining simultaneously. However decline in productivity was more severe. Variability of groundnut output was mainly due to random yield movements and was comparatively higher in the second period than in the first period.

The area response models had lagged area, expected price, presowing rainfall, lagged yield, price risk and yield risk as the explanatory variables while lagged yield, expected price,

[redacted]

rainfall during crop period, price risk and yield risk served as the determinants of the yield response function. The trend variable, though included in the initially hypothesised models, had to be dropped during later stages of the analyses due to the serious multicollinearity problems it posed because of its strong correlation with the secularly rising oil prices. Three price expectations were tried viz. lagged price, price derived by the (three year) moving average method and price generated from the linear trend in realised price. In the absence of a continuous series of prices actually received by farmers whole sale prices were used. The absolute prices were considered in the analysis since there were no major competing crops for sesamum and groundnut in the state.

Response of aggregate sesamum area to price appeared positive, though not significant. However, non-price factors like presowing rainfall and lagged yield seemed to exert much more stronger influence on aggregate acreage. Adjustment was found slow, indicating the existence of techno-institutional constraints. Among the major sesamum growing districts, significant positive price response was noticed in the districts of Ernakulam, Palakkad and Malappuram. In Ernakulam the short run elasticity ranged between 0.06 and 0.26 and the long run elasticity between 0.50 and 0.87. However, due to institutional constraints adjustment was rather slow. Weather and yield expectations were also found to exert significant positive influence on acreage. For Palakkad both the short-run and long run elasticities came around 0.45. Positive influence of rainfall on area was also evident in the district. For Malappuram district the short run elasticity ranged from 0.29 to 0.60 while the long run value came between 0.59 and 0.69 positive, but non-significant price coefficient was obtained for Alappuzha district, with the short run elasticity coming around 0.02 and that for the long run lying between 0.02 and 0.06. For Thrissur district, the fitted area response functions gave contradictory and unclear results and as such there is no evidence of any definite area movement with respect to price changes. Kollam was the only district where significant negative area response to price was noticed. However, the estimated elasticities were low with the short run elasticity lying around -0.14 and the range of long run elasticity being -0.38 to -0.50. Thus, in general, the estimated elasticities were low, indicating that changes in price brought about only less than proportionate changes in area.

Of the three alternate price formulations tried in the area response models, three year moving average price was found slightly better than price lagged by one year, judging by certain criteria such as overall explanatory power of the regressions and the proper sign and significance of the coefficients.

At the state level, there was some evidence of positive yield response to price for sesamum. However, the magniture of response was low as indicated by the elasticity values of 0.05 for the short run and 0.12 for the long run. Lagged yield was found to exert a strong influence on current yield. Yield risk also showed a positive relationship with yield which may perhaps be due to the fact that yield instability becomes more pronounced at higher yield levels. Among the districts only Alappuzha exhibited significant positive influence of price on yield. The estimated elasticities ranged from 0.23 to 0.36 for the short run and from 0.52 to 0.69 for the long run. Weak negative response was found in Thrissur and Ernakulam. In the remaining districts not much significance was noted.

For groundnut there was no indication of any significant relationship between area and price movements. The estimated price elasticities of acreage were very low also. Movements in yield were observed to be in a direction opposite to that of price. However, yield risk appeared to exert a negative influence on the yield increasing effort of farmers.

From the foregoing, it can be seen that in spite of the favourable price structure for oilseeds, both their area and yield have been declining in the state during the last decade. Hence price incentive alone cannot be relied upon to bring about the much needed increase in production. There is only limited scope for bringing additional acreage under oilseed crops in Kerala, the pressure of population on land being very high. In these circumstances, increasing the productivity of these two crops appear to be the only feasible way to raise the level of output. However there has not been much planned effort to raise the productivity of these crops, as has been done in the case of rice and plantation crops in the state. Technological break through in these two crops has been limited, especially in terms of the evolution of high yielding varieties suited to the agro-climatic conditions of the state and that responds to the average management practices which majority of the farmers practice. Hence these aspects will have to be properly attended to if the objective of increased oilseed output is to be achieved in the state.

References

REFERENCES

Anon, 1980. Package of Practices Recommendations. Directorate of Extension, Kerala Agricultural University, Vellanikkara.

Anon, 1984. Proc. Symposium on oilseed production and utilisation: Constraints and opportunities, Hindustan Lever Foundation, New Delhi. Oxford and IBH Publishing Co., New Delhi.

Anon, 1985. Seventh five year plan, 1985-'90. Vol.I, Ch.3, Vol.2, Ch.1, Planning Commission, Govt. of India, New Delhi.

Askari, H. and Cummings, J.T. 1976. Agricultural supply response: A survey of econometric evidence. Praeger Publishers, New York.

Askari, H. and Cummings, J.T. 1976. Supply response of farmers with heterogeneous land. Indian J. Agric. Econ. 31(1): 13-23.

*Behrman, Jere R. 1969. Supply response and the modernization of peasant agriculture: A study of four major annual crops in Thailand, in Clifton R. Wharton Jr., ed., Subsistence agriculture and economic development. Aldine Publishing Company, Chicago.

Bhagat, L.N. 1985. Determinants of wheat acreage fluctuations in Bihar: A study of temporal - spatial variations. Indian J. Agric. Econ. 40 (2): 148-160.

Chatterji, A. 1966. A study on agricultural growth during 1950-1963 in India. Indian J. Agric. Econ. 21 (4): 192 - 200.

Chattopadhyay, M. and Bhattacharya, G. 1987. Growth of Indian agriculture: A reappraisal. *Indian J. Agric. Econ.* **42** (1): 67-75.

Cummings, J.T. 1975. The supply responsiveness of Indian farmers in the post-independence period: Major cereals and cash crops. *Indian J. Agric. Econ.* **30** (1): 25-40.

Dandekar, V.M. 1980. Introduction to seminar on data base and methodology for the study of growth rates in agriculture. *Indian J. Agric. Econ.* **35** (2): 1-12.

Dantwala, M.L. 1967. Incentives and disincentives in Indian agriculture. *Indian J. Agric. Econ.* **22** (2): 1-25.

Dayal, R. and Shian, 1963. Measurement of growth rates of agricultural production. *Agric. Situ. India* **18** (4): 177-181.

Dayal, R. 1966. Agricultural growth rates and their components. *Indian J. Agric. Econ.* **21** (4): 227-228.

Desai, D.K. and Patel, N.T. 1983. Improving growth of foodgrains productivity in the Western region of India. *Indian J. Agric. Econ.* **38** (4): 539-556.

Dowling, J.M. and Jessadachar, P. 1979. The supply response of sugarcane in Thailand. *Malayan Econ. Rev.* **24** (2): 74-88.

Durbin, J. and Watson, G.S. 1951. Testing for serial correlation in least squares regression. *Biometrika.* **38** : 159-178.

Durbin, J. 1970. Testing for serial correlation in least squares regression when some of the regressors are lagged dependent variables. *Econometrica* **38**. pp. 410-421.

F.A.O. 1984. *Production Year Book.* Food and Agriculture organisation of the United Nations **32** : 102-104.

*Flinn, J.C., Kalirajan, K.P. and Castillo, L. 1982. Supply responsiveness of rice farmers in Laguna, Philippines. Australian J. Agric. Econ. 26 (1): 39-48.

*Gardner, B.L. 1976. Futures' price in supply analysis. American J. Agric. Econ. 58 (1): 81-84.

George, M.V. 1965. Impact of relative changes in prices in the cropping pattern of Kerala. Indian J. Agric. Econ. 20 (1): 48-51.

Griliches, Z. 1961. A note on the serial correlation bias in estimates of distributed lags. Econometrica 29. pp. 65-73.

Indira Devi, P., Thomas, E.K. and Thomas, J.K. 1990. Growth and supply response of banana in Kerala. Agric. Situ. India 45 (4): 239-242.

Jhala, M.L. 1979. Farmers' response to economic incentives: An analysis of inter-regional groundnut supply response in India. Indian J. Agric. Econ. 34 (1): 55-67.

Johnston, J. 1972. Econometric methods. McGraw Hill Publishing Co., New York, 2nd Ed. pp. 121-266.

ahlon, A.S. and Gurumurti, K. 1981. Role of price policy in expanding oilseeds production. Agric. Situ. India. 36 (5): 361-364.

ahlon, A.S. and Tyagi, D.S. 1983. Agricultural Price Policy in India. Allied Publishers Pvt. Ltd., New Delhi, pp. 24-40.

amala Devi, P. and Rajagopalan, R. 1965. Price and acreage response: A case study of groundnut crop in North Arcot district. Indian J. Agric. Econ. 20 (1): 11-35.

Kapila, U. 1982. *Oilseeds economy of India*: A case study of groundnut. Agricole Publishing Academy, New Delhi.

Koutsoyiannis, A. 1978. *Theory of econometrics*. The MacMillan Press Ltd., London. 2nd Ed. pp. 179-253.

Lakshmi, K.R. and Pal, T.K. 1988. Growth of crop output in Kerala. *Agric*. *Situ*. *India*. **43** (9): 767-771.

Lal, J. and Singh, K. 1981. Determinants of Sugarcane acreage fluctuations in Uttar Pradesh. *Indian* *J*. *Agric*. *Econ*. **36** (1): 101-109.

Lim, D. 1975. *Supply response of primary producers*. Penerbit University, Malaya. pp. 10-39, 76-96.

Madhavan, C. 1972. Acreage response of Indian farmers: A case study of Tamil Nadu. *Indian* *J*. *Agric*. *Econ*. **27** (1): 67-87.

Magi, C.C., Jha, D. and Venkataramanan, L.S. 1971. Dynamic supply and demand models for better estimations and projections: An econometric study for major foodgrains in the Punjab region. *Indian* *J*. *Agric*. *Econ*. **26** (1): 21-34.

anghas, M., Recto, A.E. and Ruttan, V.M. 1966. Price and market relationships for rice and corn in Philippines. *J*. *Farm* *Econ*. **48** (3): 685-703.

cKinze, L.D. 1983. An enquiry into the measurement of individual crop supply response - A systems approach. *Dissertation* *abstracts* *international* - A. **44** (6): 1868.

inhas, B.S. and Vaidyanathan, A. 1965. Growth of crop output in India, 1951-'54 to 1958-'61. An analysis by component elements. *J*. *Indian* *Soc*. *Agric*. *Stat*. **17** (2): 230-252.

Minhas, B.S. 1966. Rapporteur's report on measurement of agricultural growth. Indian J. Agric. Econ. 21 (4): 165-182.

*Narayana, S.S. and Shah, M.M. 1984. Farm supply response in Kenya: Acreage allocation model. European Rev. Agric. Econ. 11 (1): 85-105.

Narula, S.S. and Sagar, V. 1973. Methodology for working out contribution of area and yield in increase in production. Agric. Situ. India. 28 (7): 473-477.

Nerlove, M. 1956. Estimates of elasticities of supply of selected agricultural commodities. J. Farm Econ. 38 (2): 496-509.

Nerlove, M. 1958. The dynamics of supply: Estimation of farmers' response to price. The John Hopkins Press, Baltimore.

Ninan, K.N. 1988. Factors influencing growth and instability in oilseeds production. The case of groundnut and rapeseed-mustard. Agric. Situ. India 42 (12): 1065-1075.

*Nowshirvani, V. 1962. Agricultural supply in India:, Some theoritical and empirical studies. Ph.D. Dissertation, submitted to MIT.

Olayide, S.O. 1972. Some estimates of supply elasticities for Nigerias' cash crops. J. Agric. Econ. 23 (3): 263-277.

*Rajagopalan, V. 1967. Supply response for irrigated crops in Madras State. Ph.D. Dissertation, submitted to University of Tennesee.

Rajkrishna. 1963. Farm supply response in India-Pakistan: A case of Punjab region. Econ. J. 73 (291): 447-487.

Ramesha, Y.S., Ramanna, R. and Achoth, L. 1988. Supply response of rice in Karnataka. Agric. Situ. India. 43 (1): 9-13.

Rao, C.H.H., 1968. Fluctuations in agricultural growth. Economic and Political weekly, 3 (142): 87-94.

Rao, M.S. and Jaikrishna. 1965. Price Expectation and acreage response for wheat in Uttar Pradesh. Indian J. Agric. Econ. 20 (1): 20-25.

Reddy, A.N. 1989. Farm supply response of paddy - A case study of Andhra Pradesh. Indian J. Agric. Econ. 44 (4): 444-447.

Reddy, J.M. 1970. Estimation of farmers' supply response: A case study of groundnut. Indian J. Agric. Econ. 25 (4): 57-63.

Reddy, V.N. 1978. Growth rates. Economic and Political Weekly. 13 (19): 806-812.

Sawant, S.D. 1983. Investigation of the hypothesis of deceleration in Indian agriculture. Indian J. Agric. Econ. 38 (4): 475-496.

Sharma, K.L. 1977. Measurement of the effect of area, yield and prices in the increase of value of crop output in India. Agric. Situ. India. 32 (6): 349-351.

Sidhu, J.S. and Sidhu, R.S. 1988. Growth and area response of commercial crops in Punjab: Some policy issues. Indian J. Agric. Econ. 43 (3): 473-480.

Singh, I.J. and Kumar, P. 1976. Impact of price and price variability on acreage allocation in Haryana. Indian J. Agric. Econ. 31 (2): 31-37.

Singh, R.D., Singh, D. and Rao, P.R. 1974. Estimation of agricultural acreage response relationships: Some methodological issues. Indian J. Agric. Econ. 29 (1): 26-38.

Singh, R.D. 1979. Shifts in pulses acreage: An inter-regional analysis of dynamics of farmers' response, Uttar Pradesh. Indian J. Agric. Econ. 34 (3): 1-18.

*Stern, R.M. The price responsiveness of Egyptian cotton producers. Kyklos (Fasc.3, 1959).

Sud, L. and Kahlon, A.S. 1969. Estimation of acreage response to price of selected crops in Punjab state. Indian J. Agric. Econ. 24 (3): 46-50.

Thakur, J., Singh, D.K. and Roy, M. 1988. An analysis of trends, growth and technological development of oilseeds in Bihar. Indian J. Agric. Econ. 43 (3): 464-472.

Thomas, E.K., Thomas, J.K. and Indira Devi, P. 1990. Growth and output response of ginger in Kerala. Spice India. 3 (10): 12-17.

Tyagi, D.S. 1974. Farmers response to agricultural prices in India - A study in decision making. Heritage Publishers, Delhi.

Wagle, D.M. 1976. The impact of tariff protection on sugarcane acreage in India - 1921-1940: A case study of acreage response in the United Provinces. Indian J. Agric. Econ. 31 (4): 134-144.

* Originals not seen

Appendices

Appendix I. Area and production of sesamum in Kerala State (1961-'62 to 1987-'88)

Year	Area (ha)	Production (tonnes)
1961-'62	11950	2580
1962-'63	11915	2577
1963-'64	11990	2600
1964-'65	12010	2400
1965-'66	11950	2370
1966-'67	12070	2400
1967-'68	11160	2630
1968-'69	12000	3960
1969-'70	11820	3840
1970-'71	11920	3900
1971-'72	11780	3750
1972-'73	11780	3420
1973-'74	11782	3489
1974-'75	11782	3264
1975-'76	16785	4271
1976-'77	15970	4450
1977-'78	17549	4431
1978-'79	17558	4713
1979-'80	17607	4582
1980-'81	14752	3833
1981-'82	15037	4000
1982-'83	14153	3648
1983-'84	15045	3838
1984-'85	14448	3632
1985-'86	14285	3702
1986-'87	14200	3407
1987-'88	12326	3962

Source: Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

Appendix II. Area and production of sesamum in Kollam district (1961-'62 to 1987-'88)

Year	Area (ha)	Production (tonnes)
1961-'62	3008	841
1962-'63	3065	848
1963-'64	3155	874
1964-'65	3187	874
1965-'66	3220	950
1966-'67	3350	1010
1967-'68	3417	960
1968-'69	3588	1048
1969-'70	3588	1360
1970-'71	3689	1421
1971-'72	3587	1102
1972-'73	3621	1044
1973-'74	3588	1116
1974-'75	3588	811
1975-'76	3213	710
1976-'77	3055	693
1977-'78	4650	1097
1978-'79	3681	920
1979-'80	3457	864
1980-'81	2186	547
1981-'82	2883	721
1982-'83	2226	534
1983-'84	2302	547
1984-'85	2127	330
1985-'86	2157	748
1986-'87	2024	559
1987-'88	1545	1168

Source: Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

Appendix III. Area and production of sesamum in Alappuzha district (1961-'62 to 1987-'88)

Year	Area (ha)	Production (tonnes)
1961-'62	4096	354
1962-'63	4020	340
1963-'64	4021	340
1964-'65	4021	231
1965-'66	3940	255
1966-'67	3940	180
1967-'68	3940	510
1968-'69	2994	1033
1969-'70	3683	840
1970-'71	3683	902
1971-'72	3683	891
1972-'73	3683	853
1973-'74	3683	832
1974-'75	3683	947
1975-'76	7127	1703
1976-'77	6448	1657
1977-'78	4384	789
1978-'79	4718	896
1979-'80	6051	1150
1980-'81	5300	954
1981-'82	4829	869
1982-'83	4602	828
1983-'84	4910	866
1984-'85	4567	1589
1985-'86	4465	857
1986-'87	3936	980
1987-'88	3583	877

Source: Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

Appendix IV. Area and production of sesamum in Ernakulam district (1961-'62 to 1987-'88)

Year	Area (ha)	Production (tonnes)
1961-'62	983	286
1962-'63	975	290
1963-'64	971	290
1964-'65	956	280
1965-'66	955	280
1966-'67	945	275
1967-'68	917	275
1968-'69	899	333
1969-'70	899	377
1970-'71	899	298
1971-'72	890	293
1972-'73	857	275
1973-'74	857	282
1974-'75	857	339
1975-'76	1867	621
1976-'77	1840	633
1977-'78	2591	808
1978-'79	2601	806
1979-'80	2703	838
1980-'81	2482	769
1981-'82	2057	761
1982-'83	2372	688
1983-'84	2303	701
1984-'85	2131	298
1985-'86	2101	464
1986-'87	2121	316
1987-'88	1920	581

Source: Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

ppendix V. Area and production of sesamum in Thrissur district (1961-'62 to 1987-'88)

Year	Area (ha)	Production (tonnes)
1961-'62	1161	326
1962-'63	1161	326
1963-'64	1161	325
1964-'65	1161	325
1965-'66	1160	325
1966-'67	1160	325
1967-'68	1160	265
1968-'69	1160	817
1969-'70	1160	587
1970-'71	1160	556
1971-'72	1160	767
1972-'73	1160	546
1973-'74	1160	568
1974-'75	1160	524
1975-'76	903	423
1976-'77	1555	788
1977-'78	1706	464
1978-'79	1929	540
1979-'80	1487	416
1980-'81	1446	405
1981-'82	1592	431
1982-'83	982	265
1983-'84	1177	318
1984-'85	1278	557
1985-'86	1218	330
1986-'87	1150	271
1987-'88	994	327

ource: Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

Appendix VI. Area and production of sesamum in Palakkad district (1961-'62 to 1987-'88)

Year	Area (ha)	Production (tonnes)
1961-'62	1598	434
1962-'63	1598	434
1963-'64	1599	432
1964-'65	1599	353
1965-'66	1600	270
1966-'67	1600	270
1967-'68	1600	280
1968-'69	1600	467
1969-'70	1568	460
1970-'71	662	186
1971-'72	662	179
1972-'73	662	179
1973-'74	662	167
1974-'75	662	179
1975-'76	1291	222
1976-'77	928	167
1977-'78	1125	297
1978-'79	1196	323
1979-'80	1304	352
1980-'81	1003	301
1981-'82	1075	312
1982-'83	945	265
1983-'84	1388	400
1984-'85	1121	219
1985-'86	1291	214
1986-'87	1207	565
1987-'88	1099	302

Source: Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

Appendix VII. Area and production of sesamum in Malappuram district (1971-'72 to 1987-'88)

Year	Area (ha)	Production (tonnes)
1971-'72	1135	306
1972-'73	1135	311
1973-'74	1135	317
1974-'75	1135	258
1975-'76	1120	218
1976-'77	1156	193
1977-'78	2158	630
1978-'79	2321	766
1979-'80	1898	645
1980-'81	1587	540
1981-'82	1842	626
1982-'83	2215	775
1983-'84	1912	656
1984-'85	2239	430
1985-'86	2039	744
1986-'87	2875	503
1987-'88	2448	478

Source: Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

Appendix VIII. Area and production of groundnut in Palakkad district (1961-'62 to 1987-'88)

Year	Area (ha)	Production (tonnes)
1961-'62	15390	13120
1962-'63	15391	12852
1963-'64	13873	20089
1964-'65	13883	21170
1965-'66	14575	24450
1966-'67	13118	22885
1967-'68	13118	24029
1968-'69	13118	24029
1969-'70	13118	19349
1970-'71	14692	16088
1971-'72	14692	16769
1972-'73	16044	16461
1973-'74	17167	18043
1974-'75	17510	19471
1975-'76	16679	35268
1976-'77	12655	17453
1977-'78	12655	13288
1978-'79	13938	13659
1979-'80	12581	11122
1980-'81	9309	8145
1981-'82	9618	8493
1982-'83	10184	8992
1983-'84	9704	8483
1984-'85	11744	11697
1985-'86	10934	5959
1986-'87	12365	5787
1987-'88	14740	13903

Source: Directorate of Economics and Statistics, Kerala, Thiruvananthapuram.

SUPPLY BEHAVIOUR OF SESAMUM AND GROUNDNUT IN KERALA

By

CHANDRABHANU P.

ABSTRACT OF A THESIS

Submitted in partial fulfilment of the
requirement for the degree of

Master of Science in Agriculture

Faculty of Agriculture
Kerala Agricultural University

Department of Agricultural Economics
COLLEGE OF HORTICULTURE
Vellanikkara - Thrissur
1991

ABSTRACT

The present study focuses on the two principal seasonal oilseed crops of Kerala viz. sesamum and groundnut. Trends in area, production and productivity as well as the determinants of area and productivity of these two crops were analysed both at the district and state levels using time series data for the 1961-'62 to 1987-'88 period. Simple indices and three different functional forms viz. the linear, log-linear and the quadratic were used to measure the trend for two sub-periods viz. 1961-'62 to 1974-'75 and 1975-'76 to 1987-'88 as well as for the period as a whole. Decomposition analysis was carried out to partition out the relative contributions of area and productivity towards the changes in output. Variability was measured using the coefficient of variation. Supply responsiveness (both in terms of area and yield) was studied using respons functions of the Nerlovian (lagged adjustment) type fitted for the whole period.

For sesamum output growth was experienced during the first period in all the districts examined (except Palakkad), caused mainly through yield growth. The growth of output was quite rapid in Alappuzha and Thrissur districts, while it was at a lower pace in Kollam and Ernakulam districts. Output decline was severe in Palakkad, which, however, was caused by the transfer of sesamum growing tracts to Malappuram. The

second period was characterised by decline in sesamum output in most of the districts. In Kollam and Alappuzha, decline in area was the main reason for this output decline, while in Ernakulam this was mainly due to the declining yield level. Growth in output was experienced only in Palakkad and Malappuram districts. In Palakkad, output rose primarily due to the rise in productivity while in Malappuram area expansion was the main impetus for output growth. Variability of aggregate sesamum output was marked during the first period and it originated mainly from random yield movements. However, in the second period output fluctuations were comparatively lesser. In the case of groundnut there was only a very mild growth in output during the first period brought about through the expansion of cultivated acreage. During the second period, output declined rapidly with both area under the crop and productivity declining simultaneously. Variability of groundnut output was mainly due to random yield movements and was comparatively higher in the second period than in the first period.

Response of aggregate sesamum area to price appeared positive, though not significant. However non-price factors like pre-sowing rainfall and lagged yield seemed to exert much more stronger influence on aggregate acreage. Adjustment was slow indicating the existence of techno-institutional constraints. Among the major sesamum growing districts significant positive price response was noticed in Ernakulam, Palakkad and Malappuram. In Ernakulam, adjustment appeared slow and weather and yield expectations were found to exert significant positive influence on acreage. In Palakkad sesamum area was positively related to presowing rainfall. Significant negative area response was noticed only in Kollam district. In general, the estimated elasticities were low indicating that changes in price brought about only less than proportionate changes in area.

At the state level yield response of sesamum to price was positive, but low. Lagged yield significantly influenced current yield. Among the districts only Alappuzha exhibited significant positive yield response to price. Weak negative response was found in Thrissur and Ernakulam. In the remaining districts not much significance was noted.

For groundnut, there was no significant relationship between area and price movements. Yield movements were found to be in a direction opposite to that of price. Farmers in general were found averse to bearing yield risk.

In view of the rather low area and yield response of the two oilseed crops, it seems that price incentive alone cannot bring about the desired increase in production. In a state like Kerala where there is little possibility of bringing additional land under oilseed crops the key to increasing production lies in raising the productivity. This calls for technological advancement in these crops mainly in the form of evolution of high yielding varieties suited to the agro-climatic situation of the state, coupled with complementary