A STUDY ON THE SUPPLY RESPONSE AND MARKETING OF NATURAL RUBBER IN KERALA

By

VIJU IPE C.

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 - Trichur

1986

DECLARATION

I hereby declare that this thesis entitled "A study on the supply response and marketing of natural rubber 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 other University or Society.

Vellanikkara,
July, 1986.

VIJU IPE C.

CERTIFICATE

Certified that this thesis entitled "A study on the supply response and marketing of natural rubber in Kerala" is a record of research work done independently by Mr. VIJU IPE C. 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.

T. Prabhakaran

Dr. T. Prabhakaran,
Chairman,
Advisory Committee,
Professor,
Department of
Animal Production Economics,
Kerala Agricultural
University

Vellanikkara,
July, 1986.

Approved by:

Chairman

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

Members

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

2. Dr. K. MUKUNDAN,
~~Associate~~ Professor,
Department of
Agricultural Economics,
Kerala Agricultural
University.

3. Sri. N.RAVINDRANATHAN,
Assistant Professor,
Department of
Agricultural Statistics
Kerala Agricultural
University

ACKNOWLEDGEMENT

I would like to place on record my complete indebtedness to Dr. T. Prabhakaran, Professor and Head, Department of Animal Production Economics, College of Veterinary and Animal Sciences, Kerala Agricultural University and Chairman of my Advisory Committee for the valuable guidance given to me in the preparation of this thesis.

I am greatly thankful to Dr. V. Radhakrisnan, Professor and Head, Department of Agricultural Economics, Kerala Agricultural University for many useful suggestions I received from him throughout the progress of this work.

I am also much obliged to Dr. K. Mukundan, Associate Professor, Department of Agricultural Economics and Mr. N. Ravindranathan, Assistant Professor of Agricultural Statistics, for the help they offered me at various stages in the course of this work.

I am grateful to Mr. V.K.G. Unnithan, Associate Professor of Agricultural Statistics and Mr. K.L.Sunny, Assistant Professor of Agricultural Statistics for providing insights into the statistical analysis of data.

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

VIJU IPE C.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

INTRODUCTION

Agriculture in Kerala is characterised by mixed cropping dominated by perennial crops. A variety of crops are grown side by side in small areas and specialised cropping is confined largely to plantations. Most perennials grown in the state are cash crops while almost all the annuals/seasonals are food crops. During 1980-'81, the major perennials like coconut, rubber, arecanut, cashew, pepper, coffee, tea and cardamom together accounted for 61.15 per cent of the net area sown. Among the above eight perennials rubber alone accounted 16.35 per cent of the total and was next only to coconut. During 1983-'84 the state's shares in the total area and production of natural rubber in the country were 90.14 per cent and 92.53 per cent respectively. The rubber plantation industry provided daily employment to 1,95,000 labourers during 1981 indicating the vast direct employment potential. This shows the relative importance of rubber as a cash crop in Kerala's agricultural economy.

Rubber (*Hevea brasiliensis* Muell. Ary) is the most important commercial source of natural rubber. It is a native of Brazil and was introduced into tropical Asia during 1876. The rubber tree is a quick growing sturdy tree with a gestation period of 7 to 8 years and an economic life of 25 to 30 years. The tree grows well in many types of deep well drained soils. A warm humid equable climate with a temperature ranging from 21 to 35°C and a fairly distributed annual rainfall of not less than 200 cms are necessary for the optimum growth of the crop.

Rubber cultivation in India is at present mainly confined to a narrow belt from Kanyakumari district of Tamil Nadu in the South to the Coorg district of Karnataka in the North, to the West of the Western Ghats and parallel to them for approximately 400 kms between 8°N and 13°N latitudes. The other areas where rubber is cultivated are Assam, Tripura and West Bengal. But Kerala State alone accounted for more than 90 per cent of the total area and production on natural rubber in India.

The bark of the tree on tapping yields a white liquid called latex which is collected and processed into various saleable products, the principal one being sheet rubber. Natural rubber is a high molecular weight polymeric substance with visco-elastic properties. As in developed countries 48.46 per cent of the total rubber consumption during 1982-'83 in the country was for the manufacture of automobile tyres and tubes. Uses of natural rubber in homes, foot wear, battery, boxes, foam matresses, balloons, toys etc. are well known. The acute shortage of natural rubber during the second world War period lead to the development of synthetic rubber which is a petroleum based product. In India at present there are two synthetic rubber plants. Under the existing level of technology and cost of raw material the synthetic rubber does not pose any threat to the natural rubber industry, mainly because of the high cost of production of synthetic rubber. But a sudden spurt in cost-effective technologies or fall in raw material prices may endanger the future of natural rubber production.

Eversince its introduction to Kerala, the area and production of rubber have been rising rapidly. The rapid expansion in rubber cultivation was by bringing in new areas under this crop either through expansion to unused land or by substitution for less remunerative crops. It is interesting to note that during the past two decades, there has been appreciable increase in rubber cultivation in the small holdings (below 20.23 hectares). During 1960-'61 the percentage shares of the small holdings in the total area and production of natural rubber were 53.79 per cent and 25.4 per cent respectively, while the corresponding figures for 1980-'81 were 73.52 per cent and 70.1 per cent respectively.

Demand for rubber has been fast increasing whereas the domestic supply was insufficient to meet the demand of the manufacturing industry necessitating the import of natural rubber. For instance during 1983-'84 the total production of rubber (natural and synthetic together) was 207550 metric tonnes against the demand (consumption) at 264505 metric tonnes, creating a deficiency of 56955 metric tonnes and the import was 35940 metric tonnes. To close the gap between domestic demand and supply the production need be augmented so that the country becomes self sufficient in its raw rubber requirements. With this end in view the Rubber Board is implementing many development schemes for the rapid expansion and modernisation of the rubber plantation industry.

The most important among the development schemes is, perhaps, the replanting subsidy scheme started in 1957 with the object of rehabilitating the old and uneconomic rubber plantations with high yielding planting materials on modern scientific lines. The scheme originally provided for grant of cash subsidy ranging from Rs.605 to Rs.968 per hectare. In 1960 the subsidy rate was revised to Rs.3,050 to Rs.7,500 per hectare based on the size of holding. This scheme also provided for grant of additional assistance to small holders for procurement of high yielding planting materials, recommended fertilizers and soil conservation measures. The above scheme was discontinued from 1980 onwards with the introduction of an integrated scheme known as the rubber plantation development scheme.

The subsidy scheme for new planting of rubber was introduced during 1979 to bring about acceleration of the rate of new planting in the small holding sector (up to 20.23 ha). The scheme provided a capital subsidy at the rate of Rs.7,500 per hectare to growers owning upto two hectares and at the rate of Rs.5,000 per hectare for growers having 2 to 20.23 hectares of rubber. The scheme also provided input subsidies to growers whose total area under rubber did not exceed six hectares. This consists of reimbursement of full cost of approved high yielding variety planting materials used, 50 per cent of cost of prescribed fertilizers applied during the first seven years and subsidy against the expenditure incurred for soil conservation work and an interest subsidy at three per cent for new planting credit availed from banks as per provisions of the above scheme.

From 1980 onwards, the Rubber Board is implementing an integrated scheme for the large scale development of rubber plantations. The new scheme known as the Rubber plantation Development Scheme is applicable to both the small holding and estate sectors. The scheme provides cash subsidy at the rate of Rs.5,000 per hectare to growers owning up to 20 hectares (including area proposed to be planted) and at the rate of Rs.3,000 per hectare to growers exceeding the above limit. Input subsidies which may work out to Rs.2,500 per hectare and an interest subsidy of three per cent on loans availed from banks are also permissible under the Rubber Plantation Development Scheme. Thus the Rubber Board is providing a good number of incentives to expand the area and production of Natural Rubber. Of late, the cultivation is being expanded and intensified in some of the North-Eastern states like Assam, West Bengal and Tripura.

In the light of the demand situation and supply efforts for natural rubber, it may be useful to probe into the reactions of rubber growers to changes in prices and policy variables. Being a cash crop, its cultivation is purely market oriented and should be highly responsive to market associated stimuli. But, sudden or quick responses through capital adjustments may not be possible in the short run owing to the perennial nature of the crop with a long gestation period and an extended period of output flowing from the initial investment. The short run responses will be through changes in the intensity of cultivation which in turn will be reflected in the average yield or productivity. There is also the risk factor associated with the long time element and this also influences the cultivation and supply of rubber.

The supply response studies deal with the responsiveness of farmers to expected changes in economic variables. The farmers do respond to risk and policy variables and so these should also be included in the supply model. Because of the perennial nature of the rubber crop, the response may be slow. Commenting on the time period Galbraith and Black (1938) stated that "for most individual farm products, the evidence is that their output is highly responsive to price if a little time is allowed for adjustment. But if the response is that of total output of a given group of farmers then indeed it is slow". Being a perennial crop the production of rubber must be distinguished from that of annual crops by

1. the long gestation period between initial input/investment and first output
2. an extended period of output flowing from the initial investment and
3. a gradual declining of the productive capacity of the plants after a certain period.

Thus a perennial crop model must explain not only the planting process but the removal and replanting of plants and must explicitely consider the lags between input used and output obtained. The price responsiveness will be measured in terms of the elasticity of supply estimated at the mean levels.

The supply response of producers and the market structure may be interrelated. A low price elasticity of supply may be a result of imperfections in the market structure. Moreover it is a widely held belief that the prices received by the rubber growers are not commensurate with the prices in the major markets and that the intermediaries make exploitative profits. Researches conducted elsewhere showed that there is some amount of downgrading of the producer's sheet rubber in the producers' market. So the present study also attempts to probe into structure, conduct and performance of the rubber market. The structural shifts, if any, of the rubber market will also be studied. The hypothesis here is that the market is imperfectly competitive with a few big manufacturers and traders in the terminal markets exerting their market power.

Eventhough the non-institutional agencies were dominating the rubber market till 1970, the institutional agency namely the Kerala State Co-operative Rubber

Marketing Federation entered the market from 1971 onwards. The progress and the role played by the Federation will also be reviewed.

The specific objectives of the present study are:

1) To understand the short-term (tapping) and long-term (planting) decisions through estimation of supply response of natural rubber to various factors

2) To evaluate the market structure, market conduct, the pricing mechanism and performance of the rubber market, and

3) To review the progress and role of the Kerala State Co-operative Rubber Marketing Federation.

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 main findings is presented in the fifth chapter.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Literature has been reviewed under two sections viz: Supply response studies and marketing of natural rubber.

2.1 Supply response studies

Eversince the appearence 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.

In view of the large volume of literature on supply response of individual crops, a few important studies on seasonal/annual crops only have been reviewed followed by a more detailed review of those studies pertaining to perennials. Those studies which incorporates an explicit treatment of the risk variables have been reviewed separately.

2.1.1 Supply response studies - Annual crops

Nerlove (1956) in his pioneering work, estimated the supply response of cotton, wheat and maize in United States over the period 1909-1932. 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 the price elasticities were positive and significant.

Rajkrishna (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 United States. All crops except Jowar showed positive and significant responses. The coefficients ranged from 0.1 in case of wheat and bajara, 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.

Using three alternative forms of the Nerlovian model Rao and Jaikrishna (1965) estimated the response of wheat in Utter Pradesh over the period 1950-1962. The long run price elasticities were as high as 0.72 and found significant.

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.

Nowshirvani (1962) in his study on the supply elasticities of rice, wheat, barley and sugarcane in Bihar and Utter Pradesh used a modified form of the Nerlovian model. The long run elasticities were positive and significant for sugarcane whereas for rice, wheat and barley, the coefficients were 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 trends in prices, absolutely as well as in relation to non-agricultural prices, the increase in production lagged behind the demand.

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 tabacco. Positive elasticities were obtained for the four largest rice states like West Bengal, Andra-Pradesh, Tamil Nadu and Assam. For wheat the state level elasticities were positive but insignificant in Punjab and Rajasthan. While barley showed positive response, the response was negative for cotton in Assam and Southern regions including Tamil Nadu.

Gardner (1976) used future prices and lagged prices to estimate the United States soya bean 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.

Combining the features of both annual and perennial crops, Dowling and Jessadachar (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 2 to 5 times that for the short-run.

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.

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 results 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.

2.1.2 Supply response studies - Perennial crops

The earliest work on supply response of perennials to price changes detes back to 1949 when Ady analysed the data on cocoa for the period 1920-1940 in Ghana. She hypothesised that planting in any one year is determined by the price of cocoa deflated by the price index of imported consumer goods. The form of relationship established was log linear and an elasticity of 0.36 was obtained. When climatic factors were included in the model, the short-run price elasticity declined considerably, thereby indicating the dominant role of climatic factors influencing the production of cocoa.

Chan (1963) studied the supply response of natural rubber in Malaysia over the period 1948-1961. Output in any one year was postulated as a linear function of prices, age composition of trees, mature acreage and a trend variable. The analysis was carried out separately for the estate and small holdings using both annual and monthly data. The annual data showed that the price elasticity of output for the estates was negative but insignificant while that of small holdings was positive and significant. The short-run elasticities estimated for the monthly data were insignificant in case of the estates while that for the small holdings was positive and significant.

Bateman (1965) worked out the supply response of cocoa in Ghana. He postulated that the area planted in any year 't' is a function of the mean value of the discounted future prices of cocoa and coffee that the farmer expects to prevail. The price expectations were assumed to follow the Nerlovian adjustment model. By appropriate transformations, the area planted in any one year was expressed as a function of prices and the lagged dependent variable. He also derived an output-planting function which was combined with the planting decision model to get the final estimating equation. The above model was estimated for the five main cocoa growing regions of Ghana. The results showed that the elasticity was positive and significant for all the five regions.

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. He concluded that the increase in area under rubber and cashew was the result of a relative increase in their prices. Similarly, the decline in area under tapioca both in absolute and relative terms was due to the fall in its relative prices. 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.

Stern (1965) analysed the price response of Malayan Rubber supply over the period 1953-1960 using quarterly production data after eliminating seasonal and cyclical factors. The model used was output as a function of weighted average prices of RSS I and III grades deflated by an index of wage rates, a trend variable and the ratio of inventories in the beginning of a year to sales in the preceeding year. In the case of small-holdings output was assumed to be a function of deflated prices (deflator being the index of wages) of rubber and rice and the trend variable. The results showed that the regression coefficient of the deflated rubber price was significant and positive in the case of small holdings while in the case of estates, the price coefficient was insignificant.

Stern (1965) in his work on the determinates of cocoa supply in West Africa over the period 1919-'20 to 1944-'45, the five year moving average of planted area was regressed against the moving average of prices. The long-run price elasticity of area supply was 1.29 at the mean levels. He also estimated an output function for Ghana with the output as a function of harvested area, real price and trend variable but the model lacked sufficient explanatory power. So the above model was estimated on a first-difference basis for Ghana, Nigeria, Ivory Coast, Brazil, Equador and Republic of Cameroon. The short-run elasticity at the mean levels was 0.15.

In her study on the supply functions for coffee in Uganda and cocoa in Ghana Ady (1968) putforth a model using planted area as the dependent variable but somewhat different from the Bateman model. The model explicitly took into account the perennial nature of cocoa and the change in the structure of price expectations. She hypothesised that the actual output differed from the potential output due to agronomic and economic factors. A capital stock model was also developed in which the size of the existing stand of trees was assumed to be an important determinant as to further planting. The ordinary least squares estimates of the above models showed positive response both for coffee in Uganda and cocoa in Nigeria. But cocoa in Ghana showed strong inverse relationship between output and current prices.

Behrman (1968) estimated supply functions for cocoa in the major producing countries over the period 1947-'48 through 1963-'64. The estimated supply function was based on the premise that desired area under cocoa is a function of producers real price expectations for cocoa and the main alternative crops during the period. His model differed from that of Bateman in that while Bateman assumed actual planted area as a function of expected prices Behrman used desired area. The weighted average of all past actual prices were taken as the expected producer prices. The results showed that the estimates did not explain the variance in production as well as did Bateman's estimates for regions in Ghana, possibly due to failure to include important weather variables.

Bateman (1968) developed an econometric model for cocoa in Ghana over the period 1946-1962. The basic model used by Bateman was the one developed by Behrman which postulated the changes in output to be a function of lagged values of prices and outputs. The short run elasticities for the major cocoa growing regions ranged from 0.31 to 0.53 while the long run elasticities from 0.68 to 1.28.

French and Bressler (1970) analysed the cob-web cycle in California lemon industry over the period 1947-1960. Their supply model consisted of two components: an equation to explain the area planted and one which explains the crop removals. The new plantings model hypothesised the ratio of new plantings to bearing area as a function of long run profit expectations and a variable to account for the age composition while the explanatory variables in the crop removals function were the short-run profit expectations, proportion of bearing trees exceeding a certain age and that for urban expansion. A net response model was derived by combining the above two models. Ordinary least squares estimates of the above model yielded positive and significant elasticity coefficients.

French and Mathews (1971) developed a model to explain the new plantings, replantings, crop removals, year to year changes in area, and the yield relationships. Basically the model postulated that the desired production in any one year is a function of the profitability expected out of it. The model explicitly considered the lags in the production of perennials and the desired production relationship was converted into an area relationship. The new plantings and replanting relationships were derived based on the premise that the farmers in the long run will adjust actual bearing area to the desired area. The average yield was assumed to be a function of non-bearing area, and the trend variable. The model thus developed was applied to the U.S.asparagus industry in the three principal producing areas. Since continuous data series relating to the profitability variables were not available, it was approximated by the output price relative to an index of wage rates. The producers expectations were derived by the adaptive expectations model and also by the moving average model. But the latter performed better. The results showed positive and significant response coefficients.

Employing ordinary least squares Olayide (1972) developed three types of price elasticities of supply for six cash crops, viz. cocoa, palmoil, 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.

Williams (1972) tried distributed lag functions, linear in logarithms, for coffee supply in Jamaica. The output of coffee produced by a farmer was expressed as a function of his potential to produce the crop in the year measured as the number of bearing trees and the intensity with which the potential is exploited, measured as the number of labour days employed during the year. The results confirmed that supply of coffee is positively related to the price paid to the growers.

Parikh (1974) using the production data over the period 1950 through 1968 developed a model for the world coffee economy. He postulated the word exportable production as a function of the world price and the stationary price of coffee. The results showed that both the short-run and long-run responses to price were asymmetric. An increase in price lead to an increase in production capacity and vice-versa. The cultivators were found to wait for better years (in respect of price) to come which made production response asymmetric in the long-run. The short-term response was also found to be asymmetric.

Saylor (1974) developed alternative measures of supply elasticities for Sao Paulo coffee, fitting Nerlovian supply functions to the post world war II data. Supply shifts were permitted through the use of dummy variables and irreversible functions were also tested. The modified Nerlovian functions performed best from both economical and statistical points of view.

The relative supply approach was developed by Ghosal (1975) to quantify the price responsiveness of Liberian rubber growers using the quarterly production data over the period 1969-1972. In addition to the relative supply model, those developed by Bateman (1965), Stern (1965), Nerlove type model, Ady model and the Naive model were also tried. The quantity of latex sold relative to the total quantity of rubber was hypothesised to be a function of price of latex relative to the total price of rubber. The measured elasticities obtained from the standard models were low and consistent with the earlier studies, while that from the relative supply approach was quite high ranging from 0.91 to 1.71 indicating that Liberian rubber growers do respond to changes in relative prices.

Olayemi and Olayide (1975) studied the pattern of output response to product prices among the Nigerian rubber producers between 1952 and 1972. The short-term response was defined as the immediate effect of price changes on output and the long-run response in terms of new planting. A modified version of the Almon's scheme of polynomial lag which assumes a finite distributed lag was used. The short-run and long-run responses were found to be positive.

In deriving supply functions for Indian Natural Rubber Umadevi (1977) used the data over the period 1948-'49 through 1972-'73 and estimated the long-term response. The basic model developed by Bateman which hypothesised gross investment as a function of prices was used. The above model was estimated similar to

Gwayers (1971) estimate of the response of Tanzanian Sisal. The investment (New plantings) function was finally estimated through both, the method of compound variables put forth by Fisher (1937) and through the stage least squares method. The Fisherian compound variable technique yielded long-run elasticities ranging from -0.163 to -0.812 while those obtained from the stage least squares ranged from 0.176 to 1.04. The negative coefficients in case of the coefficients obtained from the Fisherian model may be due to the omission of an important explanatory variable namely the age composition of trees. To estimate the short-term response separate functions were estimated with average yield, output and monthly production as the dependent variables. The short-run elasticities estimated from the annual data ranged from 0.59 to 0.814 while that from the monthly data was -0.203.

Chowdhary and Ram (1978) analysed the price response of Indian tea separately for the three major tea growing zones. Basically three models were used: the first, change in area as a function of relative price, trend variable and the lagged dependent variable, the second, yield as a function on non-bearing area, current relative price, rainfall and a trend variable and the third, employment as a function of current relative price, bearing areas, and trend variable. The above models were estimated by ordinary least squares after logarithmic transformation. In case of the area model, the price coefficient was negative but insignificant. The non-bearing area turned out to be significant with a negative sign in the case of the yield model. One year lagged price had more influence on yield than the current prices. But the price of tea significantly and negatively influenced the labour employment in North India and all India level.

Parikh (1979) suggested a theory on production function for tree crops and estimated the model for coffee on the basis of the data available for nine countries over the period 1946-'47 to 1975-'76. The final estimating function included lagged prices and production as explanatory variables. The function was then estimated based on the distributed lag model. A simple equation without polynomial nature of the lag coefficients best explained the data. All the estimated coefficients had the expected signs and they clearly reflected the two year bearing cycle.

Alson <u>et al</u>. (1980) using the data for the period 1938-'39 to 1975-'76 estimated the supply response of

Australian orange growing industry. The plantings model with the number of trees planted as the dependent variable and expected profitability measured as the ratio of the product of yield per hectare and the price to the wage rate in period 't-1', non-bearing trees in the previous year, bearing trees and removals in the previous year as explanatory variables was estimated. The elasticities of plantings and output to changes in prices were in the range of 0.02 to 1.0.

The area response of Spanish oranges and mandarins was analysed by Albisu and Blandford (1983). The capacity utilisation and expected profit investment theories have been jointly used to provide the theoritical framework. The net effect of plantings and removals were estimated through a single aggregation equation. The model when applied to the area of five orange and mandarin varietal groups in Spain showed a high consistency of signs and acceptable statistical performance.

The Sri Lankan rubber planters response to price was analysed by Ramamurthi (1984). The analysis covered a period of 27 years from 1954 to 1980. The results showed that the price variable which was declining over the reference period influenced the rate of replantation in the same direction.

French <u>et</u> <u>al</u>. (1985) developed estimates of functions that relate the planting and removal of cling peach trees to measures of past profitability, potential future production from existing acreage and structural changes associated with market intervention programmes. The analysis also provides indications of useful forms of these functions, patterns of yield variation by age of trees and the non-linear relation of removal response to age of tree. Ordinary least squares estimates of the above functions provided coefficients which had signs consistent with the theoritical expectations. The results showed that at the mean value of average net returns per tonne, a unit increase in net returns per tonne is associated with a 0.00146 increase in new plantings expressed as a proportion of total net areas.

2.1.3 Risk response studies

The study of the decision maker's behaviour towards risk began as early as 1948 with the works of Friedman and Savage and later by Markowitz and Tobin.

Just (1974) formulated a risk response model by assuming the decision makers would form their risk expectations by geometrically weighting past observations similar to the way in which price and yield expectations were formed and the above model was applied in the analysis of California field crop supply response. Risk was defined as the squared deviations of expected values from the actual observations. The results obtained from Just's multivariate adaptive expectations model indicated risk to be significant in acreage response.

Tyagi (1974) in his study on the price responsiveness of major field crops in Meerut district of Western Uttar Pradesh, represented price risk by a moving standard deviation of prices. Results showed that the risk term had a positive and significant coefficient.

Trail (1976) used a polynomial lag to measure the United States onion acreage response at the national level. He used an iterative procedure to first estimate the distributed lag effects of the past price variables and then formulated the risk observations by quantifying the absolute deviations of actual and expected prices. The expected risk was then specified as a distributed lag function of past observations on risk. He found that a simple two year moving average standard deviation of the past actual prices performed equally well as the iterative procedure.

Swarup (1978) analysed the impact of risk and technology on the supply response of wheat in Madhya Pradesh over the period 1957-1971. A five year moving coefficient of variation of absolute prices depicted the price risk while an arithmetic weighted index of residual wheat yields eliminating the trend represented the yield risk. The results showed that the risk elasticities were insignificant.

2.2 Marketing of natural rubber

Past works on rubber marketing will be reviewed under two heads: Studies conducted in India and studies conducted in other rubber producing countries.

2.2.1 Studies conducted in India

The Reddy Committee Report (1950) commented on the exploitative nature of Indian rubber trade but did not provide any empirical evidence. The plantation enquiry committee (1950) expressed the need for improvement of the small holder's rubber market.

The Government of India appointed the rubber small holdings economic inquiry committee in 1968 to identify the major constraints in small holder's rubber production. The committee identified the following problems in the marketing of small holders rubber: downgrading by the buyers, non-realisation of notified prices, accumulation of stocks at peak production periods, and inadequacy of rubber prices. To improve the processing of the small holders produce, the committee recommended to subsidise strainers, dishes, purchase of rollers, and construction of smoke houses and group processing centres in the co-operative sector.

Unny and Haridasan (1974) studied the impact and working of rubber marketing societies during the period 1968-'69 through 1971-'72. The profit and loss accounts indicated that a number of societies incurred losses mainly due to wide fluctuations in prices.

Jacob (1977) identified the various intermediaries and traced the channels in the marketing of small growers' rubber in India.

The structure of rubber prices over the period 1961 to 1978 in Kerala was analysed by George and Kunju (1978). The trend, cycles and seasonal fluctuations in prices and the relationship if any between production, consumption and prices were explored. The results indicated that the seasonality in prices was not pronounced in the months in which production change is predominant. The prices were found to decline as the seasonal rubber consumption falls while a rise in consumption showed little response in respect of price which according to the authors, may be due to the oligopolystic structure of the market demand. The changes in demand was found to occur independent of the supply.

Based on the analysis of rubber price series in Kerala over the period 1960-1977, George and Velayudhan (1979) put forward a rational approach for stabilisation of rubber prices. The analysis showed that the prices exhibited three peaks and four troughs during the above period which made difficult the supply management, demand satisfaction and optimum allocation of resources. So they called for a rational and stable price policy based on both the cost of production and parity approaches. They also recommended to establish a price stabilisation board as a machinery for price stabilisation.

In his analysis of the Indian natural rubber market Mani (1983) worked out the gross marketing margin and the producer's share in the manufacturer's rupee. The gross margin was worked out to be six per cent of the manufacturer's price which was equally shared by the primary and secondary level dealers. The producers share in the manufacturer's rupee was about 94 per cent. He also analysed the intra-year variations in rubber prices during the 1970's taking consumption, production and share of manufacturer's stocks to total stocks as explanatory variables. The analysis showed that the market underwent an important change after 1973-'74.

Krishnankutty (1985) identified the following four institutional agencies in the rubber market: large growers, licensed dealers, brokers/commission agents, and other agencies. Based on the data collected from 93 dealers in 1981-'82, he found that a major percentage of the sheet rubber was purchased as ungraded lot by the primary dealers.

2.2.2 Studies conducted in other rubber producing countries

Among the rubber producing countries Malaysia stands first in total production and productivity. The Malayan rubber market has been subject to economic analysis right from the early 1950's.

Cook (1950) analysed the performance of co-operative societies in Malaysia dealing with the purchase and bulk processing of smallholders latex. The study showed that these co-operatives performed well in increasing the small holder's returns and improving the quality of their produce.

After investigating 145 dealers in eight states of Malaysia , Bevan (1956) found that the small holders selling unsmoked sheet were subject to under-estimation of grade, and excessive deduction for moisture content. So he expressed the need for an accurate method of grading.

Wharton (1962) established monopsonistic tendencies in the Malayan rubber market. He putforth the following four observations to establish the existence of monopsony: the market is insulated, producers are heavily specialised in rubber production, the number of dealers per total volume of rubber produced and sold in the market is low and finally the dealers practise multiple economic activities (marketing, merchandising and money lending).

The economic performance of the central processing factory at Meru, Malaysia, was analysed by Barlow (1967) and found that, the factory was neither successful in raising the small holder's income nor in influencing upward the price of rubber offered by the first level dealers.

Salim (1967) studied the market competition and price rigidity in each district of Malaysia by calculating the concentration ratio or the Hirchman's index. He found that the concentration ratios were low which indicated the occurrence of monopsonistic or oligopsonistic situation in the market.

In a comprehensive study of 150 first level dealers in Malaysia Lim (1968) estimated the marketing margins and the nature of competition. He observed that the dealers penalised small holders by deducting excessive margins and by under estimating the dry rubber content. The small holders were found to receive below average prices when they are indebted. The margins were found to be relatively lower for good quality sheets. Similarly the margins were inversely related to the volume of trade due to economies of scale.

Cheam (1972) reviewed the performance of the group processing centres and small holders rubber market in Malaysia. These group processing centres were fecilitating the small holders to produce high quality rubber and offered fair prices in line with the quality.

Food and Agricultural Organisation (1974) on the basis of the study on marketing margins in Thailand, identified the following imperfections in the small holders rubber market: opportunities of monopsony gains, price inelasticity of supply, malpractices in the market and inadequate grading and processing methods.

Sepien (1975) investigated monopsony and oligopsony in the small holders rubber market in the east coast of Peninsular Malaya, by regressing dealers average buying prices on the concentration ratios.

Stifel (1975) established imperfect competition in the Thailand sheet rubber market. The market performance was evaluated by the degree of monopsony profits and progressiveness. He analysed three elements of market structure: concentration ratios, supply elasticities and conditions of market entry. The market performance in terms of marketing margins revealed that the average per unit profit rates on ordinary sheet trading are low and excess profits if any must be derived from related operations such as creape production or price speculation.

The existence of economies of scale in the Malayan rubber market has been established by Sepien (1976). While studying the costs of marketing, he found that the average cost declined with the increase in volume of trade up to a certain stage and thereafter it was constant over a wide range.

Elfner (1983) evaluated the buffer stock arrangements in the world rubber market as per the natural rubber market agreement. A highly disaggregated dynamic non-linear quarterly econometric model with the data covering the period 1955-1979 was used for the analysis. The effects of the agreement were isolated by working out simulations with and without the agreement in force.

MATERIALS AND METHODS

MATERIALS AND METHODS

The methodology adopted in the present study have been presented under five 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, productivity and prices of natural rubber have been presented. Section three deals with the analysis of supply of rubber using time series data published by the Rubber Board. Section four deals with the analysis of production behaviour of the sample of rubber growers. The fifth and the last section deals with the analysis of rubber market in Kerala.

3.1 A general discussion regarding the analysis of agricultural supply

Theoretical discussion and past empirical works on agricultural supply distinguishes two different approaches in its analysis: Normative methods and econometric analyses of time series data.

3.1.1 Normative methods

These are constructive methods which involve derivation of supply functions from available farm managment data. However, the analyst encounters difficulties in aggregation due to interfarm differences in managerial input, technology, presence of multiple products, heterogeneity of land and problems in measurement of input and output levels. Farm budgeting and programming methods are other approaches in supply analysis at the micro level. The above methods involve the derivation of supply functions by programming with variable prices or by price mapping.

3.1.2 Econometric analysis of supply based on time series data

These are positive approaches 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. But supply studies like most other econometric studies with time-series data suffer from problems of multicollinearity and autocorrelated 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 autocofrelated disturbances.

Problems in adequate representation of risk, producer expectations, changing technologies and government policies are also important. However, the present study attempts to incorporate risk following the procedures laid out by Just (1974). Technological factors are accounted by a trend variable which acts as a 'catch all' variable to account for all other factors not included in the model.

Most empirical studies on supply response of individual crops use area as a proxy for production since the farmers have little or no control over the planned production. As land is the major input in agricultural production it is a reasonably good proxy for production. Besides area allocation, farmers also respond to economic stimuli, through the allocation of variable inputs like fertilizers, pesticides etc. which will result in increased productivity or average yield. Thus the total production response is the sum total of the yield response and area response.

The approach and the models used in the present study

The response of rubber producers to changing prices were analysed both at the micro and macro levels. At the micro level, the data collected from a sample of 80 farmers from four selected villages in Kottayam district was used.

To analyse the production response at the macro level, time series data on area, production, productivity and price of natural rubber over the period 1953-1983, published by the Rubber Board were used.

3.2 Trend analysis

Linear trend curve as in equation 3(1) was fitted to the time series data on area, production, productivity and prices of natural rubber.

$$Y_t = a + bt \quad \text{----} \quad 3(1)$$

where Y_t = area/production/productivity/price of rubber in year 't'

a = the Y-intercept

b = the simple annual growth rate and

t = the time period

To work out the compound growth rates, equation 3(2) was fitted to the time series data.

$$Y_t = ab^t \quad \text{----} \quad 3(2)$$

Taking logarithms, $\log Y_t = \log a + t \log b$ ---- 3(3)

$$Y'_t = A + tB \quad \text{----} \quad 3(4)$$

Where

$Y'_t = \log Y_t$, $A = \log a$ and $B = \log b$

Thus, the compound growth rate is given by (antilog B) - 1

3.3 Econometric analysis of rubber supply using time series data

Rubber is a perennial crop with a gestation period of 6 to 7 years and an economic life extending up to about 35 years. Production of perennial crops is distinguished from the production of annual crops by

1. The long gestation period between initial planting and the first output

2. A long period of continuous output resulting from the initial investment

3. A gradual deterioration in yield after a certain period and the removal and replacement of old and unproductive trees.

Thus a perennial crop supply response model should explicitly consider the lags in production arising out of the long gestation period, new plantings and removals and the replanting function which results in year to year changes in tappable area.

Economic theory distinguishes between two production periods: Short-run and the long-run periods. Short-run is the period within which some factor(s) (area) is fixed while in the long-run all factors become variable. Accordingly in supply analysis, it is assumed that in the short-run suppliers can increase or decrease the supply within their existing productive capacity, based on acreage allocated while in the long-run supply can be adjusted by changes in area allocations. So, the supply models should consider both the short-run and long-run responses separately, though it is difficult to demarcate the long-run and short-run effects clearly.

3.3.1 Short-run supply response

As stated earlier producers can adjust the supply in the short-run, only within their existing productive capacity. Thus the short-run response is purely an yield response. The per hectare yield of a crop varies with the short-run price expectations through more intensive cultivation and also by adjusting the tapping frequency. The other important variables which affect the yield are age composition of tapping trees, levels of technology, climate and other biological factors.

The effects of changing technology which acts as supply shifters are represented by a trend variable while the weather and other biological factors are represented by the random disturbances. Thus the yield model becomes

$$Y_t = \sum_{i=k}^{H} a_i \; A_{it} + b_1 \; PR_t^{*} + b_2 \; PR_{t-1}^{*} + b_3 T_t + u_t \quad \text{---- } 3(5)$$

where Y_t = the average yield per hectare of tappable area in year 't'

A_{it} = the area under 'i'th age in year 't'

k = the initial gestation period = 7

M = the economic life of the tree

PR_t^s = the short-run expected price of rubber in year 't'

T = the trend variable

u_t = the random disturbance term

If we consider all the 'i's in equation 3(5) it may involve a good number of variables such that the degrees of freedom for the variables may be more than the degrees of freedom of the observations. Typically, a perennial crop is characterised by three stages of yielding period. The initial stage is a period during which the average yield increases, the second stage is a long period of stable yield levels and the final declining stage. Thus the whole tappable area during a particular year may be grouped into three age groups and then the yield equation becomes

$$Y_t = a_0 + a_1 A_{1t} + a_2 A_{2t} + a_3 A_{3t} + b_1 PR_t^s + b_2 PR_{t-1}^s + b_3 T_t + u_t \quad \text{---} \quad 3(6)$$

where

A_{1t} = area under first age group in year 't'

A_{2t} = area under second age group in year 't'

A_{3t} = area under third age group in year 't'

Equation 3(6) is a reasonable yield model which can be estimated if time-series data pertaining to age distribution of trees are available. Since such a series is not available, the above equation is approximated as

$$Y_t = b_0 + b_1 PR_t^s + b_2 PR_{t-1}^s + b_3 T_t + u_t \quad \text{---} \quad 3(7)$$

During the short-run the expectations may be the same as the actual observation. Thus the yield model becomes

$$Y_t = b_0 + b_1 PR_t + b_2 PR_{t-1} + b_3 T_t + u_t \quad \text{---} \quad 3(8)$$

where

Y_t = the yield per hectare of tappable area in year 't'

PR_t = the price per quintal of sheet rubber(lot) in year 't'

PR_{t-1} = the price per quintal of sheet rubber(lot) in year 't-1'

T_t = the trend variable and

u_t = the random disturbance term

So long as the variations in yield due to age cycle are not projected as trends equation 3(8) is a reasonable approximation of equation 3(6).

The short run price elasticities were calculated by multiplying the first derivative of the yield function with respect to the relevant price variable with ratio of mean price to mean yield. Thus the short-run elasticity

$$e_s = \frac{\partial Y_t}{\partial P_r} \left(\frac{\bar{P}_r}{\bar{Y}_t} \right)$$

where e_s = the short run (yield) elasticity

$\bar{P}_r$ = the arithmetic mean of the relevant price

$\bar{Y}_t$ = the arithmetic mean the average yield computed over the reference period

3.3.2 Long term supply response

A long-term supply response model for a perennial crop like rubber must explicitly consider the new plantings, replantings, removals and thus changes in tappable area. A modified form of the French and Mathews model (1971) will be used in the present study. The orientation of the model is aggregative and it attempts to explain the behaviour of the producers as a whole. The model rests on the following assumptions:

1. All the producers are operating on similar production functions with the same level of technology

2. All the producers attempt to maximise profits

3. They are faced with similar factor prices and product prices and that their behaviour is conditioned by expectations regarding similar behaviour of the other producers.

3.3.2.1 Desired production and area

The major variables influencing desired production and thus area are, expected price of rubber, expected price of the competing crop, viz. coconut, the different policy factors and the expected price and yield risks. Given the price and yield expectations, the producers will attempt to adjust their actual production to the desired level of production in the long-run. The following equation represents the above adjustment process.

$$Q_t^* = Q_{t-1}^e + b_1 PR_t^e + b_2 PC_t^e + u_t \quad \text{----} \quad 3(9)$$

where

Q_t^* = desired production of rubber in year 't'

$Q_{t-1}^e = Y_{t-1}^e A_{t-1}$ = expected production of rubber in year 't-1'

PR_t^e = the expected price of sheet rubber (Rupees per quintal) in year 't'

PC_t^e = expected price of coconut (Rupees per 1000 nuts) in year 't'

A_{t-1} = tappable area in year 't-1'

Y_t^e = the expected yield per hectare of tappable area in year 't-1'

u_t = the random disturbance term

but $Q^*_t = A^*_t Y^e_t$ and $Q^e_{t-1} = A_{t-1} Y^e_{t-1}$

where A^*_t = desired tappable area in year 't'

Substituting the above relationships in equation 3(9)

$$A^*_t = \frac{Y^e_{t-1}}{Y^e_t} A_{t-1} + b_1 \frac{PR^e_t}{Y^e_t} + b_2 \frac{PC^e_t}{Y^e_t} + \frac{u_t}{Y^e_t} \quad \text{---- } 3(10)$$

Equation 3(10) can be estimated by ordinary least squares if the expected yields remain constant or can be measured by a single observable variable. However, the possible heteros cedasticity of the disturbance terms with Y^e_t variable may pose problems in estimation. A linear expansion (similar to Tayler series) of equation 3(10) around the mean values of A^*_t, A_{t-1}, Y^e_t and Y^e_{t-1} yielded equation 3(11)

$$A^*_t = A_{t-1} + b_1 PR^e_t + b_2 PC^e_t + b_3 \Delta Y^e_t + u_t \quad \text{-- } 3(11)$$

where

$$\Delta Y^e_t = Y^e_t - Y^e_{t-1}$$

The desired tappable area, A^*_t in equation 3(11) is an unobservable variable and so could be transformed to an observable variable.

3.3.2.2 New plantings*

Equation 3(11) gives the desired tappable area in year 't' and the desired new plantings is the amount necessary to bring the actual tappable area to the desired level. But it requires 'k' years (k = 7, is the gestation period) from initial planting to reach the final tappable stage. Thus operationally, A_t may be replaced by A_{t+k} in equation 3(11). Thus equation 3(11) becomes

$$A^*_{t+k} = A^*_{t-1} + b_1 \, PR^e_t + b_2 \, PC^e_t + b_3 \, \Delta Y^e_t + u_t \quad \text{---- } 3(12)$$

Then the desired new planting becomes

$$N^*_t = A^*_{t+k} - A_{t-1} + R^e_{kt} - R_{kt-1} \quad \text{---- } 3(13)$$

$$N^*_t \geq 0$$

Where

N^*_t = desired new planting in year 't'

k = 7 = the gestation period

R^e_{kt} = area expected to be removed during the next 'k' years including year 't'

---

* New planted area refer to the sum total of areas newly planted and replanted with rubber

$N_{kt-1} = \sum_{i=1}^{k} N_{t-i}$ = total area planted after the year 't-k-1' i.e. non tappable area in year 't-1'

The term R^e_{kt} in equation 3(13) is an unobservable variable and so it should be approximated. Crop removal (R^e_{kt}) involves two components: Removals because of disease and other climatic factors and removals because of old age. Removals because of former are proportional to the total area and due to the latter are proportional to the total area exceeding the age at which productivity begins a significant decline.

Thus

$$R^e_{kt} = b_1 A^o_{t-1} + b_2 (A_{t-1} + N_{kt-1}) + u_t$$

$$R^e_{kt} = b_1 A^o_{t-1} + b_2 A_{t-1} + b_2 N_{kt-1} + u_t \quad \text{---} \quad 3(14)$$

Where

A^o_t = area exceeding a certain age at which productivity begins a significant decline.

The value of b_1 should be such that $0 < b_1 < 1$ and b_2 should be a very small proportion.

The desired new planting N^*_t in equation 3(14) is an unobservable variable which will differ from actual planting, N_t, due to capital restrictions, non-availability of planting materials and such other constraints. Thus the relationship between N_t and N_t^* can be specified by a partial adjustment relationship.

$$N_t - \beta(N_{t-1}) = \propto(N_t^* - \beta N_{t-1}) + e_t$$

Thus

$$N_t = \propto N_t^* + \beta(1-\propto) N_{t-1} + e_t \text{ ---- } 3(15)$$

Where

$0 < \propto < 1$, is the co-efficient of adjustment and

$0 < \beta < 1$, is a term introduced to allow for some dampening of the residual effects of unattained past desired plantings and

e_t = the error term.

Equation 3(15) reduces to the commonly used Nerlove type adjustment model if, $\beta = 1$, that is as $N_t - N_{t-1} = \propto(N_t^* - N_{t-1})$. if $\beta = 0$, it implicitly assumes that the dampening effects due to the failure to achieve the desired levels in the past does not have any residual effects on future plantings. In a developing economy like ours characterised by potential resource restrictions β may be assumed to be 1. The co-efficient $\propto$ in equation 3(15) reflects the effects of short run resource constraints. Thus the final new plantings equation can be derived by substituting equations 3(12) and 3(14) in to 3(13) and 3(13) into 3(15) with $\beta = 1$.

The subsidy scheme for replanting of rubber introduced during 1957 might have accelerated the pace of new plantings. To represent the effects of subsidy a dummy variable (Z_t) with values 0 up to 1957 and 1 thereafter was introduced in the model. Thus the final new plantings model becomes

$$N_t = b_1 PR_t^e + b_2 PC_t^e + b_3 \triangle Y_t^e + b_4 A_{t-1}^o + b_5 N_{kt-1} + b_6 A_{t-1} + b_7 N_{t-1} + b_8 Z_t + u_t \text{ ---- } 3(16)$$

where

bi's are the regression coefficients.

3.3.2.3 Risk response

Area response of producers to price changes may be conditioned by their subjective expectations of yield risk and price risk. So a new plantings model must include a variable to represent the observations on risk. Incorporating the risk variables, the new-planting function becomes

$$N_t = b_1 PR_t^e + b_2 PC_t^e + b_3 \triangle Y_t^e + b_4 A_{t-1}^o + b_5 N_{kt-1} + b_6 A_{t-1} + b_7 N_{t-1} + b_8 Z_t + b_9 RY_t^e + b_{10} RPR_t^e + u_t \text{ ---- } 3(17)$$

where

bi's are the regression coefficients

where

Z_t = the dummy variable with $Z_t = 0$ up to 1957 and $Z_t = 1$ thereafter

RY_t^e = the expected risk in yield per hectare of tappable area

RPR_t^e = the expected risk in rubber prices.

The area exceeding a certain age at which productivity begins a significant decline (A^o_{t-1}) is proportional to the total tappable area (A_{t-1}) as so the term A^o_{t-1} in the above equation may be replaced by A_{t-1}. Thus the final new planting equation becomes

$$N_t = b_1 PR_t^e + b_2 PC_t^e + b_3 \triangle Y_t^e + b_4 A_{t-1} + b_5 N_{kt-1} + b_6 N_{t-1} + b_7 Z_t + b_8 RY_t^e + b_9 RPR_t^e + u_t \text{ —— } 3(18)$$

where

bi's are the regression coefficients

3.3.2.4 Producer expectations

The models developed above, involves price and yield expectations which are unobservable. These expectations are derived on a priori hypothesis that the long run future expectations are derived from actual past observations and the behavioural process regarding the expectations is similar to the rational expectations theory of Muth (1961).

Two expectation models were tried in the present study. In the first model the expectations were derived by the declining geometric lag weighted scheme. The weights decline in geometric fashion such that the recent past observation receives the maximum weight while the distant past observation receives the minimum weight.

Thus the expected value

$$X_t^e = \sum_{i=0}^{n} \beta_i \; X_{t-i} \quad \text{----} \; 3(19)$$

where

$$\beta_i = \theta (1- \theta)^i \qquad 0 \leq \theta \leq 1$$

X_t^e = the expectations for the period 't'

X_t = the observed value for the period 't'

The second model tried was the moving average model, which assigns equal weight to all the actual observations to derive the expected value.

Thus the expected value

$$\bar{X}_{t-3} = \frac{1}{\sum_{i=1}^{k} \propto} \sum_{i=k-1}^{t} \propto X_i \sim \propto = 1 \quad \text{----} \; 3(20)$$

where

$\bar{X}_{t-3}$ = the expectations for the period 't-3' derived by the moving average model

X_t = the observed value for the period 't'

k = the period of the moving average.

The period of the moving average considered here is seven years, being the gestation period.

3.3.2.4 Expectations on risk

The supply response model developed assumed that the major variables influencing the desired production and thus area are expected price and expected yield. But the prices and yields expected by the producers may differ from their actual values. Thus the squared deviation of actual prices and yields from their expected values may be treated as an observation on risk.

Thus the observation on risk

$$R_t = (X_t - X_t^e)^2 \text{ ---- } 3\ (21)$$

Given the observations on risk, farmers will derive the corresponding expectations.

Thus the expected risk

$$R_t^e = \sum_{i=0}^{n} \sigma_i \; R_t \text{ ---- } 3(22)$$

where R_t^e = the expected observation on risk for the period 't'

R_t^t = the actual observation on risk for the period 't', and

$$\sigma_i = \phi(1-\phi)^i \qquad 0 \leq \phi \leq 1$$

The subjective risk terms thus derived were also included in the supply response model.

3.3.2.6 Long-run elasticities

The elasticity of new plantings were calculated from the first derivative of the new planting function (with respect to the relevant price variable) as

$$e = \frac{\partial P_t}{\partial P_t^e} \left(\frac{\bar{P}_r}{\bar{P}_t} \right)$$

where

e = the elasticity of new planted area

P_t = the new planted area in year 't'

$\bar{P}_r$ = the arithmetic mean of the relevant price variable computed over the reference period

$\bar{P}_t$ = the arithmetic mean of the new planted area computed over the reference period

3.4 Analysis of sample rubber growers

To study the behaviour of producers at the micro level, a stratified random sample consisting of 80 rubber growers was selected for the present study. Kottayam district which accounted for 24.37 per cent of the total area under rubber in Kerala during 1982-'83 was selected as the primary unit. Three taluks were selected from among the list of taluks in the district with probabilities proportional to the area under rubber. The selected taluks were Meenachil, Kanjirappilly and Kottayam. Of the three selected taluks, Meenachil taluk ranked first with respect to the area under rubber immediately followed by Kanjirappilly and Kottayam. Two villages were selected randomly from among the list of villages in Meenachil taluk which accounted for 42.27 per cent of the area under rubber in the Kottayam district. The two villages selected from the Meenachil taluk were Punjar and Barananganam. Two more villages, one each from Kanjirappilly and Kottayam taluks were also selected. The selected villages were Kanjirappilly and Anikkadu from Kanjirappilly and Kottayam taluks respectively.

A stratified random sample of 80 rubber growers was selected from the four selected villages. The growers were stratified into four different strata based on the area under rubber. The four different size groups were up to 0.82 hectares, 0.82 to 2.1 hectares, 2.1 to 4.14 hectares and above 4.14 hectares.

A sample of 20 growers were selected from each of the four strata. Data on the cropping pattern, planting behaviour and the selling practices followed were collected through interview method using a pre-tested questionnaire (a specimen form of the questionnaire used is given in Appendix I). The survey was conducted during April - May, 1985.

3.5 Marketing of natural rubber

To study the marketing aspects a sample of 30 rubber dealers was selected from the selected villages and the major markets of Kottayam and Kanjirappally taluks. Data on all aspects of marketing were collected from the sample dealers using a pre-tested questionnaire (a specimen form of the questionnaire used is given in Appendix-II). The rubber marketing system was analysed by taking the different channels and traders through which the produce flows till it reaches the ultimate industrial consumer.

To compute the marketing margins the concurrent method of analysis was used. The margins were computed from the weighted average selling prices of the various intermediaries during April - May, 1985 with the quantity as the weights.

3.5.1 Concepts used in the study of marketing

1. Market structure

Market structure means the organisational characteristics which determine the relations of sellers in the market to each other, of buyers in the market to each other, of sellers to buyers and of sellers estabilished in the market to other actual or potential suppliers of goods including potential new firms which might enter into the market (Clodius and Mueller, 1961). Market structure for practical purposes mean those characteristics of a market which seem to influence strategically the nature of competition and pricing within the market. The characteristics of market structure are the degree of seller and buyer concentrations, the degree of product differentiation and the conditions of entry into the market.

2. Market conduct

Market conduct refers to the patterns of behaviour which enterprises follow in adopting or adjusting to the markets in which they sell or buy (Clodius and Mueller, 1961). It refers to the policies and practices designed to stabilise market relationships and reduce the significance of price competition.

3. **Market performance**

Market performance refers to the economic results that flow from the industry as an aggregate of firms in terms of efficiency, progressiveness, stability and the like. (Clodius and Mueller, 1961).

4. **Gross margin**

Gross marketing margin is the difference between the prices paid by the industrial consumer (manufacturer) per unit quantity of the produce and the price received by the farmer for an equivalent quantity and quality of the produce.

5. **Net margin**

Net margin at each stage of marketing is obtained by deducting the marketing costs from the marketing margin.

6. **Market concentration**

Market concentration refers to the share of an industry or product accounted for by the largest firms in the industry of producing the product.

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

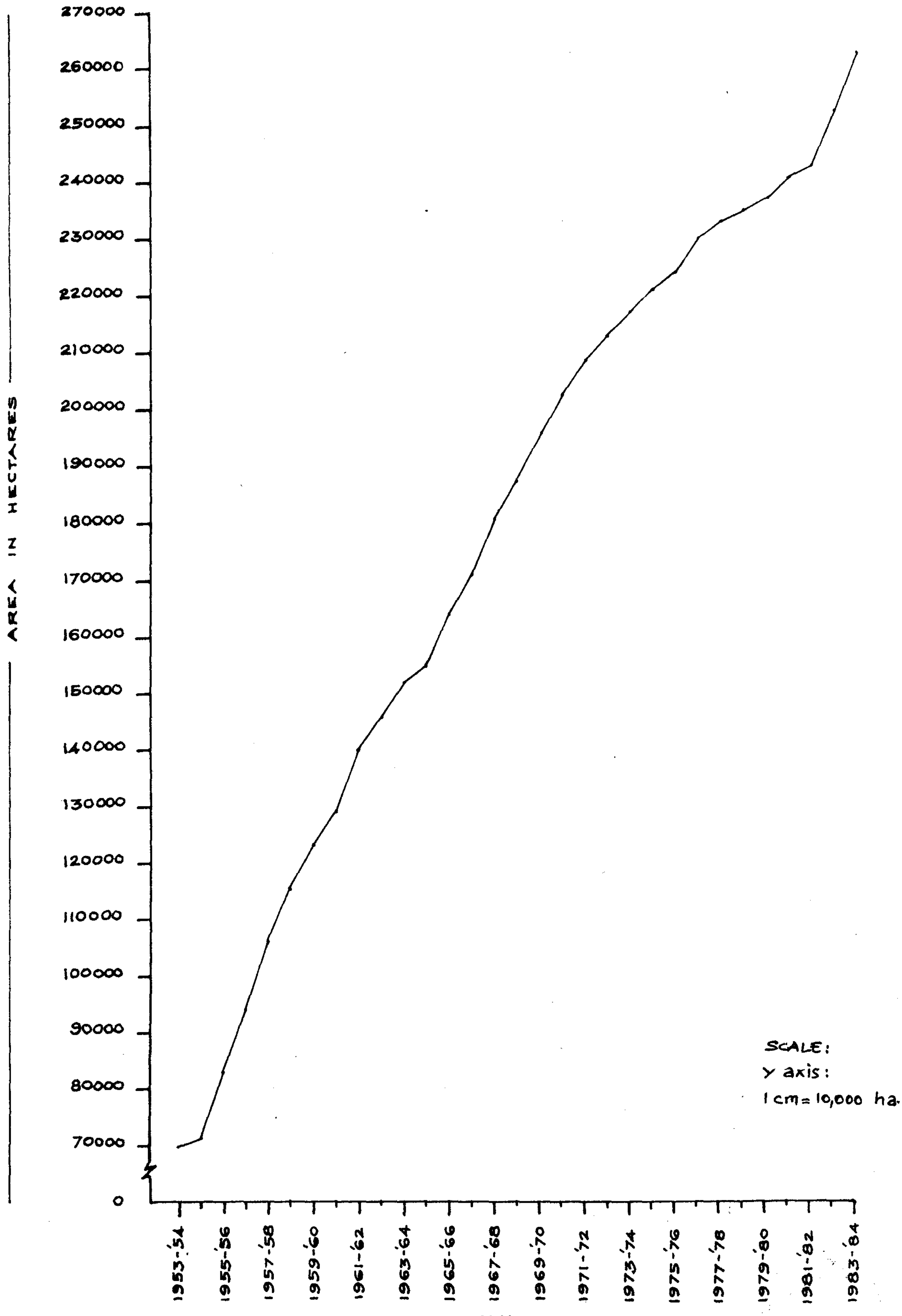
The results and discussions of the present study have been presented in four main sections. Section one deals with the analysis of trends in area, production productivity and prices of natural rubber in India. In section two the results of econometric analysis of supply response at the macro level have been presented. Section three deals with analysis of production behaviour of the sample of rubber growers at the micro level. The last section deals with the marketing of natural rubber in Kerala.

4.1 Trends in area, production, productivity and price of natural rubber

The original rubber statistics on area, production, productivity and prices have been graphically presented in figures 4(1) to 4(5). In Fig. 4(6) the index numbers of the data presented in these figures have been graphed.

The total area under rubber is shown in Fig. 4(1). The area had been increasing throughout the reference period. No distinct cycles could be identified and the simple linear growth rate was worked out for the whole period. The total area recorded a simple growth rate of 6256 hectares per annum and the compound growth rate was 4.06 per cent.

FIG. 4(1). TREND IN TOTAL AREA UNDER RUBBER. (1953 - 1983)



Tappable area is the area available for tapping and it is the difference between total area and area under young trees. In Fig. 4(2) the tappable area over time has been plotted. The curve shows two distinct periods, the first up to 1960-'61 and the second thereafter. Linear and compound growth rates were worked out separately for the two periods and also for the whole period. The whole period analysis showed that the linear growth rate in tappable area was 5477 hectares per annum. The linear growth rates and compound growth rates in tappable area for the first period were 5059 hectares per annum and 0.90 per cent respectively; the corresponding figures for period II being 5948 hectares and 4.35 per cent respectively. Thus tappable area increased at a much higher rate since the early 1960's than earlier. In the aggregate, tappable area increased by less than three per cent per annum.

The trend in the production of rubber plotted in Fig. 4(3) appear to follow the same pattern as that of tappable area. Here also two distinct periods can be observed viz. up to 1960-'61 and after 1960-'61. Linear growth rate for the whole period was 5818 tonnes per annum whereas the compound growth rate was 8.07 per cent. The growth rate during the first period was 5001 tonnes per annum and that during the second period

FIG. 4(2). TREND IN TAPPABLE AREA UNDER RUBBER.
(1953 - 1983)

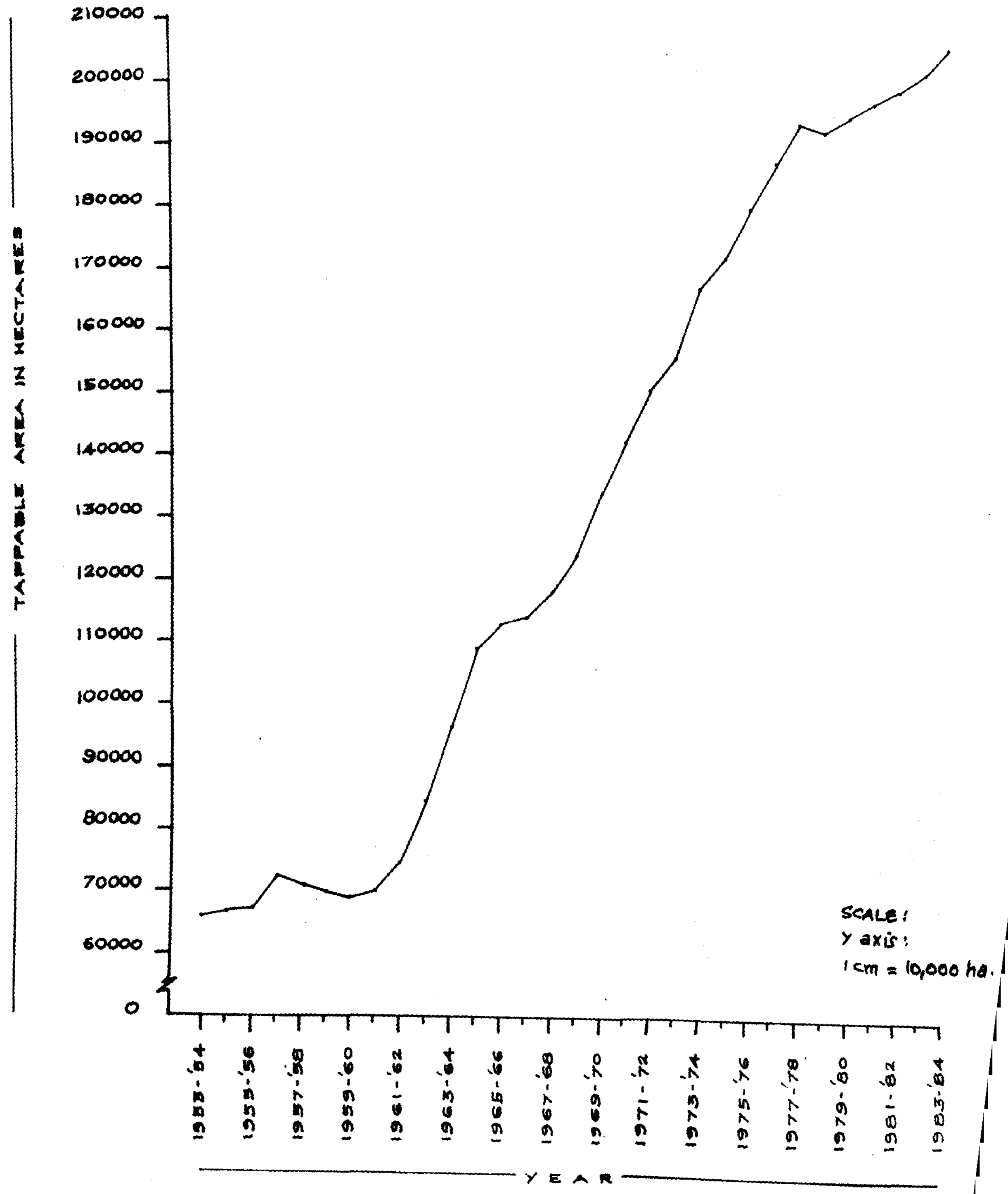
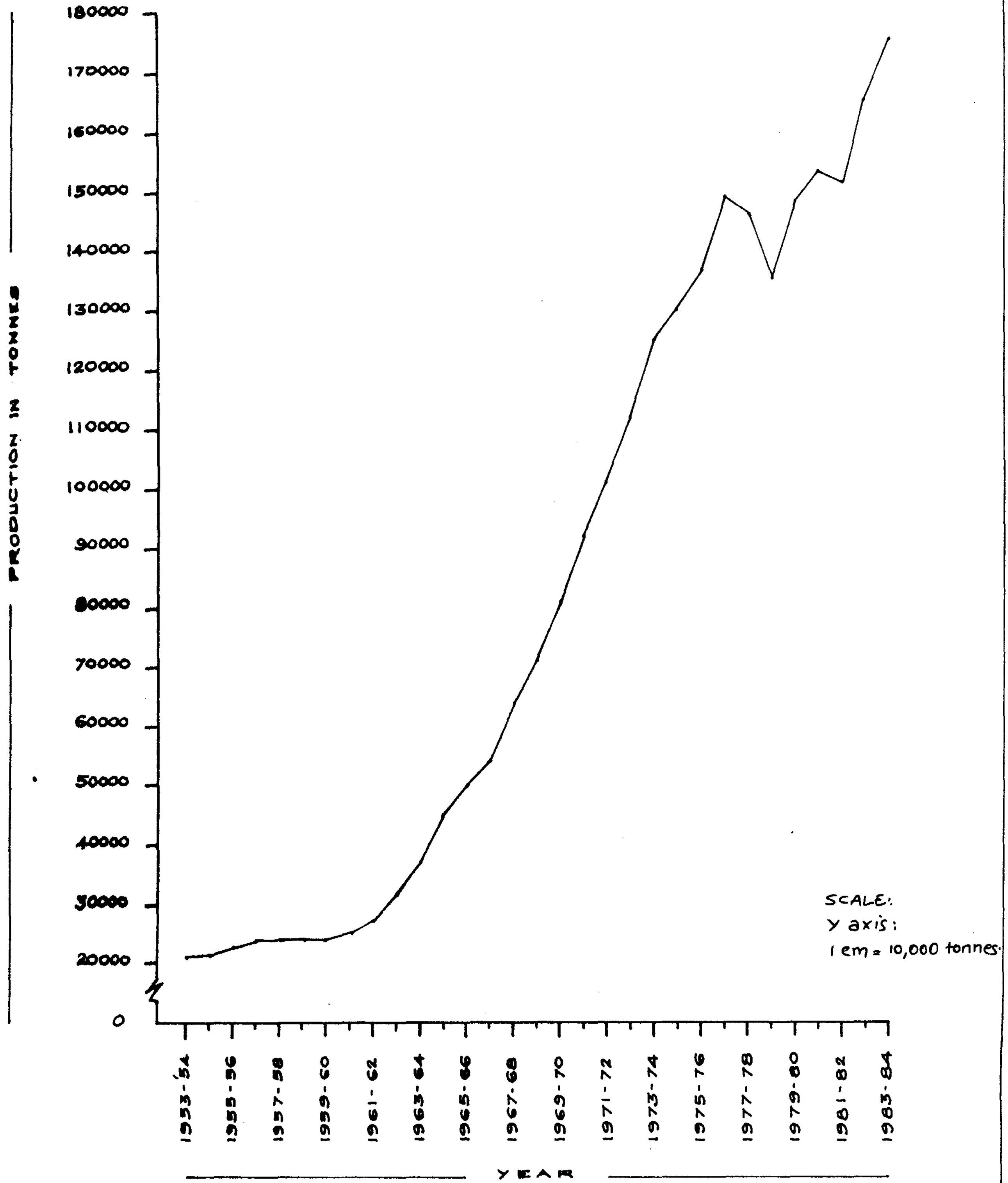


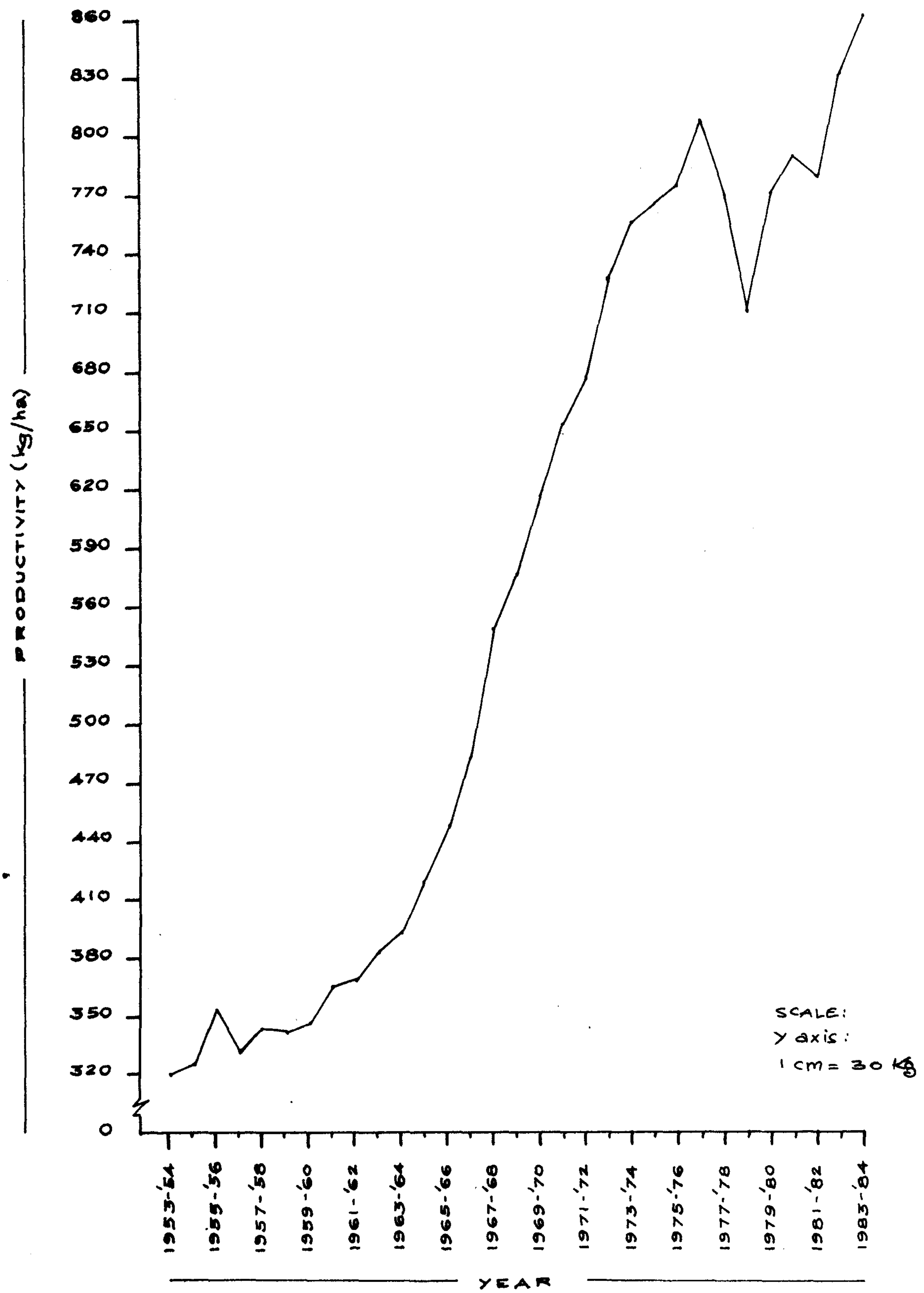
FIG. 4(3). TREND IN PRODUCTION OF NATURAL RUBBER (1953 - 1983)



was 6940tonnes per annum. As in the case of tappable area, production also recorded a much higher linear growth rate during the second period. The compound growth rate for the first and second periods worked out to 2.16 per cent and 8.40 per cent .

Productivity, is defined as the yield per hectare of tappable area. The increase in productivity may be due to more intensive cultivation and/or by improvements in technology of cultivation. Fig. 4(4) shows the trends in productivity over the reference period and, as can be expected, the pattern is similar to those of tappable area and production. For the whole period, productivity increased at the rate of 21 kilogrammes per hectare annually. The linear growth rate during the first period was 4.67 kilogrammes per hectare against 22.43 kilogrammes per hectare during the second period. The compound growth rate analysis also showed similar growth patterns. During the whole period the compound growth rate was 3.90 per cent while that for the first period was 1.40 per cent and second period 3.80 per cent. Thus the compound and linear growth rate analysis showed that the productivity of rubber rose at a faster rate after 1960-'61 than the period prior to 1960-'61.

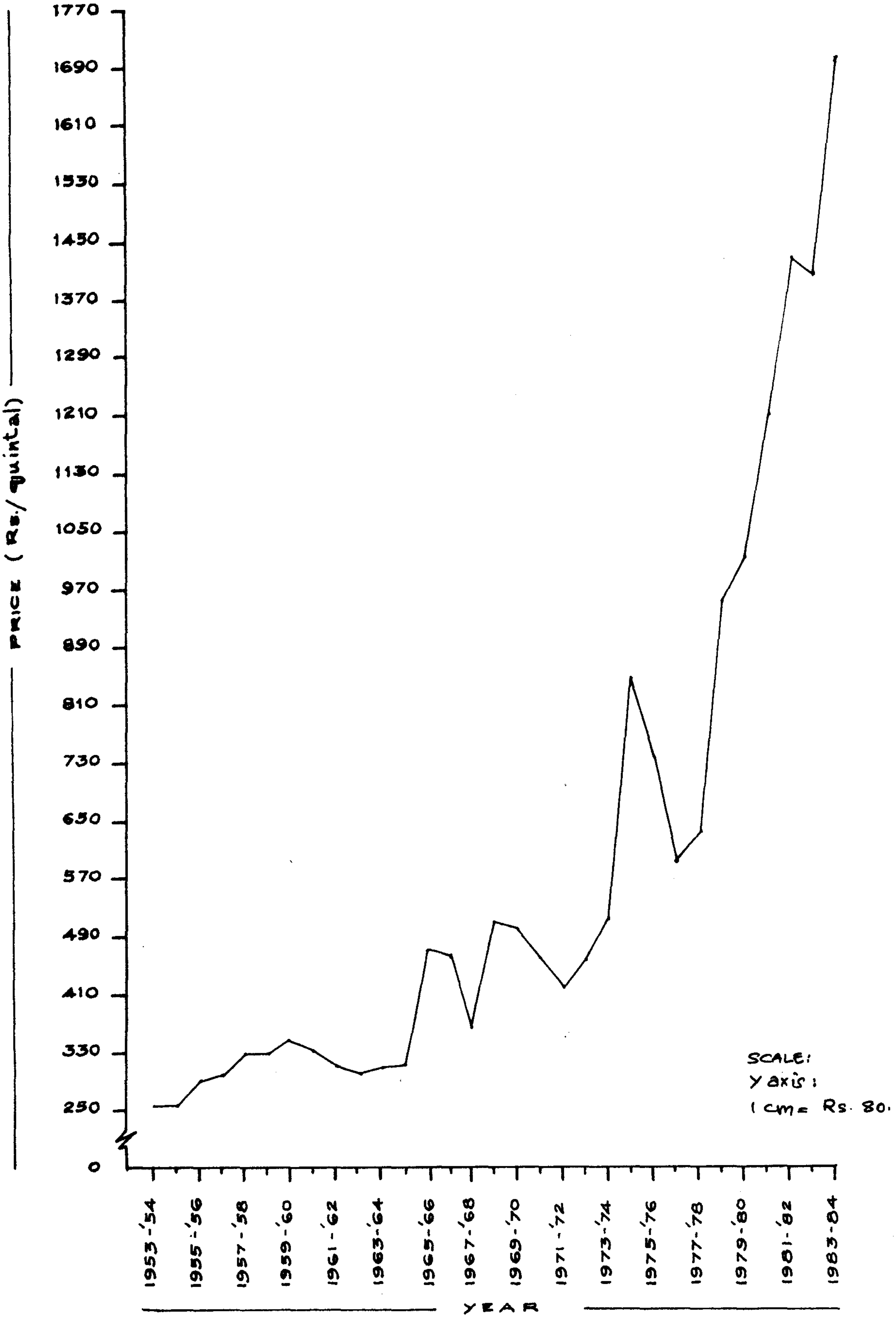
FIG. 4(4). TREND IN PRODUCTIVITY OF NATURAL RUBBER (kg/ha) (1953-1983)



Prices generally influence area, production and productivity and rubber may be no exception. Fig. 4(5) shows the trend in prices of natural rubber over the period analysed. This curve does not show fairly smooth trends observed for the other variables. Two distinct periods could be identified, the first period being up to 1976-'77 and the second period from 1976-'77 to 1983-'84 unlike the early 1960's being the turning point for tappable area and production. The prices showed more fluctuations during the first period than the second period. The linear growth rate analysis showed that over the whole period the prices rose at the rate of Rs. 36.25 per quintal. During the initial period price rose at the rate of Rs. 17.86 per quintal against Rs. 158.24 per quintal during the second period. During the whole period, the compound growth rate in price was 5.75 per cent while that during the first and second periods were 2.94 per cent and 16.42 per cent respectively.

Thus the trend analysis showed that over a period of 30 years from 1953-'54 to 1983-'84, the tappable area, production, productivity and prices of natural rubber showed two distinct periods. The growth rate analysis showed that during the later period, the growth rates were higher than those in the first period.

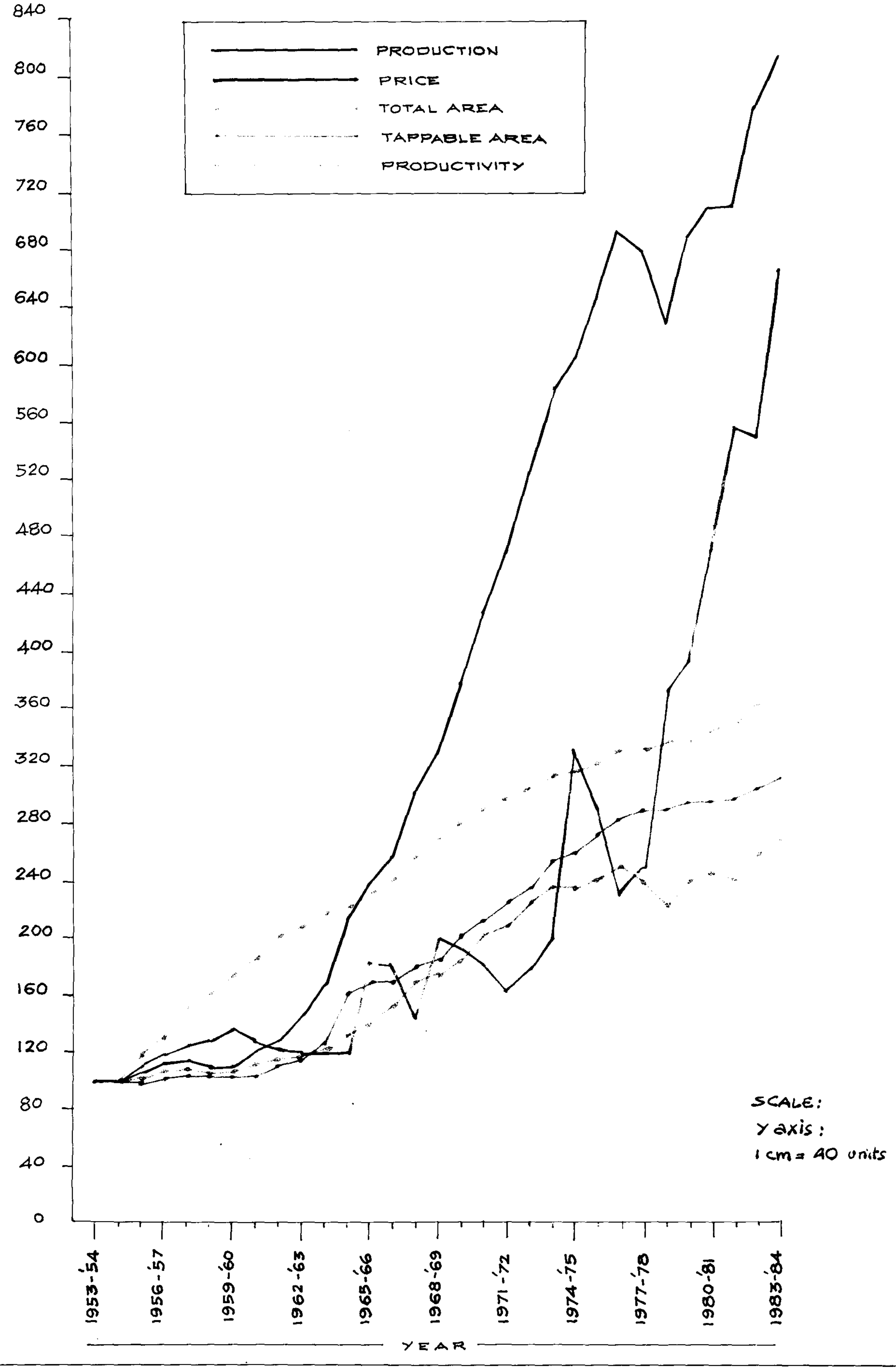
FIG. A(5). TREND IN PRICES OF NATURAL RUBBER (Rs/quintal) (1953 - 1983)



The various development schemes implemented by the Rubber Board towards the end of 1950's might have contributed to the higher growth rates in area, production and productivity of rubber during the second period. The subsidy scheme for new plantings was started in 1957 with the object of rehabilitating old and uneconomic plantations and the loan scheme for new plantings was started in 1962 to assist the registered small growers with loans to expand their holdings to a minimum of 2.02 hectares and up to a maximum of 20.23 hectares. The subsidy scheme for new plantings was introduced in 1979 to bring about acceleration of the rate of new planting of rubber in small holding sector. Under the integrated plantation development scheme, introduced in 1980-'81, the Board provides cash subsidy, input subsidy, long term credit from banks, interest subsidy on bank loans and free technical support to its registered growers. It is possible that the spurt in prices of petroleum after 1973 might have increased the prices of synthetic rubber, which in turn might have accelerated the growth in area, production and productivity of natural rubber.

To analyse the simultaneous changes in area, production, productivity and prices of natural rubber,

FIG. 4(6). INDEX NUMBERS OF AREA, PRODUCTION, PRODUCTIVITY AND PRICES OF NATURAL RUBBER.
(1953 - 1983)



simple index numbers were worked out with 1953-'54 as the base year. Fig. 4(6) shows the growth in total area, tappable area, production, productivity and prices of rubber. Except for the total area two distinct periods were observed in case of all the variables. The above indices remained almost stagnant up to 1960-'61 and thereafter showed noticeable increases. The index number of prices appeared to show some cyclical pattern with about 4 to 5 years duration.

The analysis has revealed positive and appreciable growth rates in all the parameters studied and it is possible that there is some relationship between the price and non-price variables. These may also be due to the influence of technology in production and productivity. The various incentive measures like cash subsidy for replanting and new plantings, input subsidies, interest subsidy and the long term loan schemes could also exert positive influence on growth of non price parameters.

4.2 Supply response of natural rubber - Econometric analysis of the time-series data

Hevia braziliensis is a perennial rubber yielding crop with a planting to tapping period of 7 to 8 years and an economic life 25 to 30 years thereafter.

The seedlings planted in year 't' can be classed as tappable in the year t+7, though the yield will be stabilised by the tenth year only. The tree becomes tappable when it attains a girth of 50 centimetres at a height of 120 centimetres from the ground level.

4.2.1 Short-term supply response - Yield model

Being a perennial crop requiring 7 to 8 years for initial production, adjustments in tappable area in response to price changes are not possible in the short-run. In the short-run production adjustments are possible through changes in the intensity of cultivation, which in turn will be reflected in the average yield. The short-run supply response model developed in chapter 3 was

$$Y_t = b_0 + b_1 PR_t + b_2 PR_{t-1} + b_3 PC_{t-1} + b_4 PT_{t-1} + b_5 T_t + u_t$$

where

Y_t = the yield per hectare of tappable area in the year 't'

PR_t = the price of rubber in rupees per quintal of sheet rubber in the year 't'

PC_{t-1} = the price of coconut in rupees per 1000 nuts in the year 't-1'.

PT_{t-1} = the price of tapioca in rupees per quintal in the year 't-1' and

T_t = the trend variable

One year lagged prices were also included in the above model based on the presumption that at least one year lag is required for the manifestation of the effects of cultural operations on the yield in case of both mature rubber and its assumed competitive crop, coconut. The short-run supply models developed, used the current yield of sheet rubber expressed in Kilogrammes per hectare of tappable area as the dependent variable.

Ordinary least squares estimates of the yield response models are presented in Table 4.1. In the first model, current prices of rubber per quintal, prices of rubber lagged by one year along with the time trend formed the explanatory variables. Only the trend variable showed highly significant relationship

Table 4(1) Yield relationships for natural rubber (1953-1983) the dependant variable is the yield in kilogrammes per hectare of tappable area

Eq. No.	Constant term	Explanatory variables							
		PR_t	PR_{t-1}	PC_{t-1}	PT_{t-1}	PR_{t-1}/PC_{t-1}	T_t	R^2	d
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I	251.3886	-0.1188 (0.0810)	0.0485 (0.0941)				24.0457*** (1.9946)	0.9424	0.2844
II	272.0795	-0.2017 (0.0892)	0.0124 (0.0831)	0.0514 (0.1017)	6.3810 (2.0916)		16.2087*** (3.4847)	0.9592	0.3997
III	350.6240					-54.8261* (31.2883)	18.8145*** (1.6098)	0.9404	0.4993

Figures in parentheses are standard errors

* Significant at 0.1 level of significance

** Significant at 0.05 level of significance

*** Significant at 0.01 level of significance

d Durbin-Watson statistic

with the current yield supporting the high annual growth rate in productivity observed earlier. The Durbin-Watson statistic showed significant autocorrelation among the disturbance terms and the R-square value indicated over 94 per cent of the variance in the yield per hectare having been explained by the explanatory variables considered. Although not significant, the current prices showed a negative relationship while the prices lagged by one year showed positive relationship with productivity. Since cultural practices require at least one year to show the results it is possible that the rubber cultivators might have been influenced by prices perhaps motivating them to use more inputs and thus the productivity showing a positive although very low relationship with prices lagged by one year. The significant trend variable might be indicative of the technological changes taking place in rubber cultivation. The significant 'd' statistic along with high R-square values were obtained by Umadevi (1977) in her study on Indian rubber over the period 1948 to 1972.

In model II in addition to the explanatory variables taken in model I, prices of coconut and tapioca, both lagged by one year were included. This model also indicated significant autocorrelation among the disturbance terms but there was a slight improvement in the R-square value from about 94 per cent in model I to over 96 per cent in this model. In this model also, the significant explanatory variable was the trend variable. But its value was much less than that in model I. The current prices and the prices lagged by one year continued to show negative and positive signs respectively but showed no significance. The lagged prices of coconut and tapioca showed positive relationship with productivity of rubber. Such behaviour of prices do not stand to reasoning and the only conclusion that can be drawn is that they had no influence worth mentioning. Contrary to the above results Umadevi (1977) in her study on the price response of Indian rubber over the period 1948 - 1972 obtained positive relationship between productivity of rubber and the current prices. Chowdhury and Ram (1978) in their study on the price response of Indian tea using the prices of tea lagged by one year and deflated by the corresponding index of input prices (considered as a proxy for profitability) observed negative relationship with productivity. Although not deflated, the lagged price in this study showed positive relationship which appears to be more rational in the light of the production process of a perennial crop.

The third model considered only the relative price, that is the ratio of price of rubber lagged by one year to the price of coconut also lagged by one year besides the trend variable. This relationship also showed significant autoregressive schemes among the disturbance terms. The R-square value showed that the equation explained about 94 per cent of the total variation in average yield. The trend variable continued to be highly significant and the relative price explanatory variable showed significance at 10 per cent level of probability. It showed a negative relationship with productivity indicating an increase in productivity with the decrease in price ratio. In other words, the result only confirms the results of model two where the price of coconut lagged by one year had a positive sign. Thus although not individually, some influence, though negligible is seen between productivity and ratio of rubber prices to coconut prices lagged by one year. The highly significant trend variable continued to show the influence of technology.

4.2.1.1 Short-run price elasticities

The short-run elasticities were worked out by multiplying the first derivative of the yield function with respect to the relevant price variable by the ratio of mean price to mean yield. Thus the elasticity of yield with respect to current price of rubber (PR_t)

$$e_s = \frac{\partial Y_t}{\partial PR_t} \cdot \frac{\overline{PR_t}}{\overline{Y_t}}$$

where

$\overline{Y}_t$ = the arithmetic mean of the average yield per hectare calculated over the period under reference

$\overline{PR}_t$ = the arithmatic mean of the current rubber price calculated over the reference period (or the other relevant variable)

e_s = the elasticity of yield with respect to current rubber price (or the relevant variable)

The elasticities of yield with respect to the relevant price variable were as presented in Table 4.2.

The estimated elasticities with respect to the current price of rubber (PR_t) were -0.2116 and -0.1247 indicating practically no response of yield. This is only to be expected as perennial crops take longer time, than seasonal crops to respond to inputs used. The elasticity coefficients with respect to previous year's prices of rubber (PR_{t-1}) were 0.012 and 0.0468. While Umadevi (1977) obtained positive elasticities (0.54 to 0.814) with respect to the current price of rubber for the period 1948 to 1972, the results of the present study showed positive elasticities with respect

Table 4(2) Estimated elasticity coefficients of yield of natural rubber in relation to different price variables

Price variable	Model No.	Elasticity coefficient
(1)	(2)	(3)
Current price of rubber (PR_t)	I	-0.1247
Current price of rubber (PR_t)	II	-0.2116
Price of rubber lagged by one year (PR_{t-1})	I	0.0468
Price of rubber lagged by one year (PR_{t-1})	II	0.0120
Price of rubber relative to price of coconut lagged by one year (PR_{t-1}/PC_{t-1})	III	-0.1135

to the price of rubber lagged by one year. Ghosal (1975) working on monthly data and with a slightly different model obtained positive short-term response of production to prices for Liberian rubber.

Although no significant relationship could be established, the analysis has, to some extent, revealed the positive role of market prices in rubber production particularly the lag effects, which may be important in planning price as a tool to production. The elasticity of relative lagged prices of rubber with respect to coconut (PR_{t-1}/PC_{t-1}), though negligible as in the case of current and lagged prices, showed negative relationship to yield. Till fairly recently the prices of coconut rose faster than rubber, thus putting the latter in a comparatively less favourable position, price wise. Being a perennial crop and less amenable to quick changes, the relative price would appear to be less important in the output decisions of rubber cultivators.

To sum up, the highly significant positive time trend would appear to indicate, the role of other factors, notably technology in influencing yield. With the introduction of high yielding varieties and improved cultural and tapping practices, rubber production technology has undergone considerable change over time. Although all the equations have showed existence of autocorrelation among the disturbance terms, the high R-square values would suggest that the autocorrelation may not be due to the omission of some important explanatory variables. The magnitudes of the elasticity coefficients were small compared to earlier studies and this may be due to the longer time span considered in this study. However, the general direction of the coefficients, in many cases, are in agreement with those of earlier studies, particularly those of Chan (1963), Stern (1965) and Umadevi (1977).

4.2.2 Long-term supply response

Theoretically, long-run is the period within which all factors of production can be varied. In rubber production, new planting, removals and replanting which bring about changes in tappable area are long-run activities. An analysis of long-term supply response of rubber, therefore, involve primarily response of plantings to actual and relative prices of rubber and other relevant variables.

4.2.2.1 Estimates of plantings response functions for natural rubber (Producer's expectations derived by geometric lag weighted method).

The plantings response function developed in chapter 3, hypothesise total plantings (new areas planted and areas replanted) in year 't' as a function of expected prices, change in yield expectations, lagged values of tappable area, non-bearing area, subsidy variable and the risk variables.

Thus the plantings response function is

$$P_t = b_1 PR_t^e + b_2 PC_t^e + b_3 \triangle Y_t^e + b_4 A_{t-1} + b_5 Nk_{t-1} + b_6 P_{t-1} + b_7 Z_t + b_8 RY_t^e + b_9 RPR_t^e + u_t$$

where

P_t = the total planted area in year 't'

PR_t^e = the expected price of rubber in year 't'

PC_t^e = the expected price of coconut in year 't'

Y_t^e = the expected yield in year 't'

A_{t-1} = the tappable area in year 't-1'

Nk_{t-1} = non-tappable area in year 't-1)

Z_t = the dummy variable to indicate the effects of subsidy with values 0 for the period upto 1957 and 1 thereafter

RY_t^e = the expected yield risk in year 't'

RPR_t^e = the expected risk in prices in year 't'

Because of the wide variability within a set of data, the regression coefficients were estimated after standardising each variable around its mean value. Thus the standardised variable

$$X_t' = \frac{X_t - \bar{X}}{\sigma x}$$

where

X_t' = the standardised value of the variable

X_t = the original value of the variable

$\bar{X}$ = the arithmetic mean of the variable X

σX = the standard deviation of the variable x

Ordinary least squares estimates of the plantings response function with the producer expectations derived by the declining geometric lag weighted method are presented in Table 4.3.

In model I, the explanatory variables considered were expected price of rubber (PR_t^e) change in expected yield (ΔY_t^e), previous year's tappable area (A_{t-1}), non-tappable area (Nk_{t-1}) and new planted area (P_{t-1}), subsidy variable (Z_t) and expected yield risk (R^eY_t) and price risk (RPR_t^e). The explanatory variables explained about 82 per cent of the total variation in area planted during the year and there was significant autocorrelation among the disturbance terms. The previous years' tappable and non-tappable areas showed

Table 4(3) Plantings response functions for natural rubber 1953-1963 (dependent variable is total area planted during the year and price expectations are derived by the declining geometric lag weight method)

Variable	Model No		
	I	II	III
(1)	(2)	(3)	(4)
PR_t^e	-0.1214 (0.2285)	-	-0.1002 (0.2453)
PC_t^e	-	-	0.4200 (0.9004)
PR_t^e/PC_t	-	-0.0339 (0.2171)	-
ΔY_t^e	0.0563 (0.5579)	0.0550 (0.1875)	-0.9205 (1.4253)
A_{t-1}	0.3751*** (0.1379)	-0.1460 (0.1726)	0.3536** (0.1024)
Nk_{t-1}	0.9468** (0.4017)	0.8507* (0.3500)	1.2286* (0.7978)
P_{t-1}	-0.0087 (0.1276)	0.0349 (0.1153)	-0.0103 (0.1370)
Z_t	0.0522 (0.2180)	0.0557 (0.1915)	0.0552 (0.2266)
RY_t^e	-0.4550 (0.3766)	-0.2053 (0.2197)	0.2777 (0.4151)
RPR_t^e	-0.2360 (0.2386)	-	-0.2101 (0.2511)
RPR_t^e/PC_t	-	-0.2583 (0.3866)	-
R^2	0.8216***	0.8633***	0.8267***
d	1.0082	1.2775	0.8978

Figures in parentheses are standard errors
* Significant at 0.10 level of significance
** Significant at 0.05 level of significance
*** Significant at 0.01 level of significance
The superscript e refer to the expected value
d Durbin-Watson statistic

significant influence over the new planted area. None of the other variables were statistically significant. The non significance of the explanatory variables may be due to the possible effects of multicollinearity among the explanatory variables considered. The expectations of price risk and yield risk indicated negative relationship with planted area, whereas change in expected yield, the subsidy variable and the two significant variables mentioned earlier indicated positive relationship. Umadevi (1977) through the compound variable technique observed negative regression of discounted prices of rubber on change in total area under rubber whereas through the process of stage least squares technique observed positive influence on the new planted area. Working on data on cocoa production, Bateman (1968) using discounted prices of cocoa as expected prices observed positive relationship with newly planted area under cocoa. Olayemi and Olayide (1975) observed positive influence of lagged prices of rubber on new planted area in Nigeria. Thus with regard to response of new planted area to the various explanatory variables, the various studies have indicated conflicting results and although some positive influence were observed in some cases, the coefficients were not significant.

The subsidy for rubber cultivation was extended from 1957 onwards and overtime the rates of subsidy have been gradually increasing. But there was no indication in the analysis to conclude that the subsidy had influenced expansion in area under rubber. The regression coefficients of expected yield and expected price risks bear the expected negative signs since cultivators tend to restrict expansion in area wherever risks are involved. But these explanatory variables had no significant influence. The significant autocorrelation among the disturbance terms calls for additional investigation and additional variables in the analysis. The significant influence of previous years tappable area and non-tappable area is only to be expected.

In the second model, the expected price of rubber was dropped and the expected price of rubber relative to coconut price was added and the risk variable to represent price risk was also modified accordingly. With these modifications, the R-square value slightly improved to over 86 per cent and the Durbin-Watson statistic showed no evidence of first order autoregressive schemes among the disturbance terms. But among the explanatory variables only the previous year's new planted area had showed some significance, that too at 10 per cent probability level only. The regression results showed that the newly added variables namely, the expected relative price and the corresponding price risk variable had negative influence on the current planted area. As in the case of model I it can be concluded that these variables lack sufficient explanatory power in explaining the behaviour of new planted area in a year. The variables representing yield risk and the new planting subsidy had similar influence as in model I. The studies reviewed do not appear to have considered the type of variable used in this model. Hence in the absence of any significant regression coefficient no definite conclusion can be drawn as to the behaviour of new planted area.

In the third model, the two newly added variables namely the expected price of rubber relative to coconut price and the corresponding expected price risk variable were dropped. The variables added were expected prices of rubber and coconut. As in the case of model I, this model also had R-square value of over 82 per cent and indicated the presence of first order autoregressive schemes among the disturbance terms. Again the significant variables were the same as in the case of model I namely previous year's tappable area and new planted area. None of the other variables were significant. Except for the explanatory variables like changes in expected yield and expected yield risk all other variables had the same sign as in the case of model I. In the case of change in expected yield (ΔY_t^e), the regression coefficient had a negative sign as against positive in model I. Similarly the expected yield risk had a positive influence on current planting as against negative in model I. The behaviour of previous years tappable and new planted areas are on expected lines since these are expected to show some positive influence on the area planted during the current year.

It can be summed up that out of the three models, although, the second model had the highest R-square value, the variables considered least explained the behaviour of new planted area. In the case of models I and III which showed no autocorrelation of the error terms, had lesser explanatory power and this power seems to be largely represented by the areas tappable and non tappable.

4.2.2.2 Estimates of plantings response functions for natural rubber (Producer expectations derived by the moving average model)

In this section, the analysis was carried out by deriving the expectations using the moving average method, the procedure of which has been explained in Chapter-3. The dependent variable was the same as in the previous analysis namely the area planted during the year. The explanatory variables comprised of the expected price of rubber ($\overline{PR}_t$) change in expected yield ($\overline{\Delta Y}_t$) previous year's tappable area (A_{t-1}) and non tappable area (NK_{t-1}), area new planted in the previous year (P_{t-1}), subsidy variable (Z_t) and the variables representing expected yield risk ($\overline{RY}_t$) and expected price risk ($\overline{RPR}$). Ordinary least squares estimates of the plantings response function with the producer expectations derived by the moving average method are presented in Table 4.4.

All the three models worked out had R-square values around 0.80 and none showed any significant autocorrelation among the disturbance terms. Unlike in the previous set of three models, the three models considered here showed significant positive influence of previous year's new planted area (P_{t-1}) as explaining significantly the behaviour of the succeeding year's planted area. This is only to be expected in as much as the area that can be newly acquired for new plantings as well as the area from

Table 4(4) Plantings response function for natural rubber 1953-1983 (dependent variable is total area planted during the year and price expectations are derived by the moving average model)

Variable	Model No. I	Model No. II	Model No. III
(1)	(2)	(3)	(4)
$\overline{PR}_t$	0.6394 (1.2913)	0.0720 (0.2972)	-
$\overline{PC}_t$	-0.6721 (1.4862)	-	-
$\overline{PR}_t/\overline{PC}_t$	-	-	0.2758 (0.4432)
$\overline{\Delta Y}_t$	-0.0954 (0.1198)	-0.1038 (0.1153)	-0.1270 (0.1295)
A_{t-1}	-0.0849 (0.2055)	-0.0997 (0.1977)	-0.0403 (0.2067)
Nk_{t-1}	-0.1239 (0.1592)	-0.1404 (0.1510)	-0.0835 (0.1466)
Z_t	-0.0619 (0.2095)	-0.0781 (0.2012)	0.03212 (0.1969)
P_{t-1}	0.4595** (0.2372)	0.5108** (0.2030)	0.3740* (0.2476)
$\overline{RY}_t$	0.1576 (0.2029)	0.1479 (0.1900)	-0.0091 (0.1947)
$\overline{RPR}_t$	-0.3615 (0.2868)	-0.4568** (0.1900)	-
$\overline{RPR}_t/PC_t$	-	-	-0.2683 (0.2596)
R^2	0.8086***	0.8060***	0.7869***
d	1.9678	1.9771	1.9659

Figures in parentheses are standard errors

* Significant at 0.10 level of significance

** Significant at 0.05 level of significance

*** Significant at 0.01 level of significance

d Durbin-Watson statistic

where old plants can be removed and replanted are conditioned by the overall holding sizes of cultivators and the areas newly planted during every year will bear positive relationships among themselves.

In the first model the expected rubber price ($\overline{PR}_t$) and yield risk variable ($\overline{RY}_t$) had positive influence on the current plantings while the variables like expected prices of coconut, ($\overline{PC}_t$) change in expected yield ($\overline{\Delta Y}_t$) previous year's tappable area (A_{t-1}) and non tappable area (Nk_{t-1}) subsidy variable (Z_t) and price risk variable ($\overline{RPR}_t$) had negative signs for their regression coefficients. But none of these were significant. The positive sign of the regression coefficients relating to prices of rubber is keeping in line with prior expectations. Similarly the negative sign of the variable representing price risk can also be considered as in expected lines since it is possible that cultivators may become cautious in expanding the area under rubber in presence of significant price risk.

In model II also the expected price of rubber ($\overline{PR}_t$) as well as the price risk variable had positive and negative coefficients respectively. Interestingly the coefficient of the price risk variable ($\overline{RPR}_t$) was significant at 5 per cent level of probability in model II which had almost the same R-square value as for model I but differed from the latter in that it excluded the variable on expected price of coconut. All the other variables in model II appeared to exhibit the same influence as indicated in model I.

In model III the expected prices of rubber ($\overline{PR}_t$) and coconut ($\overline{PC}_t$) were omitted and instead the expected relative price of rubber to that of coconut ($\overline{PR_t/PC_t}$) as well as the expected risk in relative prices ($\overline{RPR_t/PC_t}$) were included. While the former showed a positive sign, the latter (risk in relative price) showed negative sign for their respective regression coefficients. Although not significant, the behaviour of these two variables seem to be on expected lines, in their influence on area new planted. The subsidy variable showed positive sign for its regression coefficient as against negative in the first two models.

The non significance of the relevant explanatory variables may be due to the possible effects of multicollinearity among the variables considered. The sharp decline in productivity of coconut (due to root wilt disease) as against the increase in productivity of rubber might have increased the per hectare income from rubber cultivation. Thus in addition to the rising prices, the producitivy might have also contributed to the rapid expansion of area under rubber. In the small holding sector a major portions of the areas newly planted is by planting rubber as an intercrop in old and uneconomic coconut plantations for which subsidy is not available. So to some extent subsidy scheme might have influenced only the replantings in the small holding sector rather than the areas newly planted with rubber.

To sum up it can be concluded that although, the second set of models had only slightly lesser explanatory power in terms of their R-square values, there was no autocorrelation among the disturbance terms unlike that observed in the earlier set of models. Further among the explanatory variables, the expected price of rubber and the expected price risk had the logical and rational signs to their regression coefficients in the second set of models when compared to the first set of models. It was also observed that the lagged areas tappable and non-tappable that showed significant influence on new planted area in the first set of models not only did not show any significant influence on the area new planted in the second set of models but also carried negative sign to their regression coefficients as against positive in the first set of models. On the whole it can be said that even with a slightly less explanatory power, the second set of models computed and analysed using the expectations derived by the moving average model were more logical than the analysis carried out with the price expectations derived by the declining geometric lag weighted method.

4.2.2.3 Elasticities of new planted area

The elasticities were worked out by multiplying the first derivative of the new plantings function with respect to the relevant price variable by the ratio of the mean price to mean new planted area. Thus the elasticity of yield with respect to current price of rubber (PR_t^e)

$$e = \frac{\partial P_t}{\partial PR_t^e} \left(\frac{\overline{PR}_t}{\overline{P}_t} \right)$$

where

e = the elasticity of new planted area with respect to the relevant price variable

PR_t^e = the expected price of rubber in year 't' (or the relevant price variable)

$\overline{PR}_t$ = the arithmetic mean of the current expected price of rubber calculated over the reference period (or the relevant price variable)

$\bar{P}_t$ = the arithmetic mean of the current new planted area calculated over the reference period.

The long run elasticities of new planted area with respect to the relevant price variable were as presented in Table 4.5.

The estimated elasticities of new planted area with respect to the expected price of rubber, PR_t^*, (expectation derived by the declining geometric lag weighted method) were -0.0866 and -0.0729 indicating practically no response of new plantings. Umadevi (1977) through the compound variable technique also got negative elasticities of new planted area under rubber in India. The negative sign of the elasticity coefficients may be due to some mis-specification of the expectations model. The producers may not consider all the past observations to arrive at the expectations for the current period. French and Mathews (1971) while working on the supply of United States asparagus, found that the moving average model performed much better than the adaptive expectations model, in deriving the producer's expectations. The elasticity with respect to the expected price of coconut (PC_t^*) was 0.2295 which does not stand to reasoning. The elasticity with respect to the expected

Table 4.5 Estimated elasticity coefficients of new-planted area in relation to different price variables

	Form of the price variable	Model No.	Elasticity coefficient
I	Declining geometric lag weighted method		
	Expected price of rubber (PR_t^e)	I	-0.0886
	Expected price of rubber (PR_t^e)	III	-0.0729
	Expected price of coconut (PC_t^e)	III	0.2295
	Expected price of rubber relative to price of coconut (PR_t^e/PC_t)	II	0.0393
II	Moving average model		
	Expected price of rubber ($\overline{PR}_t$)	I	0.5492
	Expected price of coconut ($\overline{PC}_t$)	I	-0.4309
	Expected price of rubber ($\overline{PR}_t$)	II	0.0618
	Expected price of rubber relative to price of coconut ($\overline{PR_t/PC_t}$)	III	0.3430

price of rubber relative to coconut prices showed a negative relationship to new planted area.

The estimated elasticities with respect to the expected prices, derived by the moving average model had the expected signs. The elasticities of new planted area with respect to the expected price of rubber ($\overline{PR}_t$) were 0.0618 and 0.5492, which is only to be expected. The elasticity with respect to the expected prices of coconut ($\overline{PC}_t$) was -0.4309 indicating a negative relationship. Umadevi (1977) through the stage least squares technique also got elasticities ranging from 0.176 to 1.04 in the case of Indian rubber over the period 1948 - 1972. Similar results were also obtained by Ady (1968) for cocoa in Ghana and coffee in Uganda, Bateman (1968) for Ghanian cocoa and French <u>et al</u>. (1985) for cling peaches in California. Olayemi and Olayide (1975) employing a modified version of the Almon's scheme of polynomial lag also got positive elasticities for Nigerian rubber. The estimated elasticity with respect to the expected price of rubber relative to price of coconut was 0.3430.

To sum up, it can be concluded that the second set of elasticity coefficients (estimated with the producer expectations derived by the moving average model) had logical and rational signs. On the whole it can be said that there is some positive though not significant relationship between the expected price and new planted area.

4.3 Analysis of sample rubber cultivators

The rubber plantation industry consists of a large number of rubber growers with holding size from about 0.4 hectares and upwards to large estates with over 800 hectares. Rubber growers with holdings up to 20.28 hectares under rubber are classed as holdings and those above as estates. As per the rubber statistics published by the Rubber Board there were 1,71,857 holdings and 511 estates during 1982-'83.

The sample of 80 small growers selected were analysed to obtain information on the following aspects namely the total size of holdings, cropping pattern, total area under rubber cultivation, production and cost of production of rubber and method of marketing rubber. The findings have been presented in various subsections.

4.3.1 Size of holding

The 80 sample cultivators had an aggregate of 331.52 hectares with an average of 4.14 hectares per holding. The distribution of sample cultivators categorised into different size groups of holdings is presented in Table 4.6.

The average size of the holding was 4.14 hectares. The average size of holding of the lowest size group was 1.15 hectares. This group accounted for 6.95 per cent of the total area. The average size of holding of the fourth size group was 8.77 hectares and the group possessed 52.93 per cent of the total area. The second and third size groups constituted 14.3 per cent and 25.85 per cent of the total area with average holding sizes 2.37 hectares and 4.28 hectares respectively.

4.3.2 Cropping pattern

Cropping pattern of the 80 sample rubber cultivators is presented in Table 4.7. The major crops grown by the sampled rubber cultivators were perennials like rubber, coconut, and cocoa and annuals like banana and tapioca and miscellaneous crops which include both annuals and perennials. When all the size groups were combined, perennial crops like rubber, coconut and cocoa accounted for 85 per cent of the total cropped area and rubber alone accounted for 58.55 per cent. The groupwise cropping pattern shows that, in case of the first and

Table 4.6 Distribution of sample according to the size of the holding

Group No.	Category of holding based on area under rubber	Holdings		Total cropped area held		Average size of holding ha
		No.	Percentage	Area ha	Percentage to the total	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
I	Up to 0.83 ha	20	25	23.03	6.95	1.15
II	0.83 to 1.65 ha	20	25	47.39	14.30	2.37
III	1.65 to 4.13 ha	20	25	85.68	25.85	4.28
IV	Above 4.13	20	25	175.42	52.93	8.77
Total	–	80	100	331.52	100.00	4.14

Table 4.7 Cropping pattern of sample rubber cultivators during 1985-'86 (area in hectares)

Size of group	Area under different crops during 1985-'86						
	Rubber	Coconut	Tapioca	Banana	Cocoa	Miscellaneous crops	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I	10.44 (45.33)	5.79 (25.14)	2.00 (8.68)	1.32 (5.73)	1.38 (5.99)	2.10 (9.11)	23.03 (100.00)
II	24.96 (52.64)	9.87 (20.82)	4.21 (8.88)	2.41 (5.08)	1.97 (4.16)	3.98 (8.39)	47.39 (100.00)
III	49.00 (58.03)	20.10 (23.41)	4.92 (5.75)	3.52 (4.11)	2.73 (3.18)	4.72 (5.52)	85.61 (100.00)
IV	109.52 (62.15)	42.04 (23.96)	6.32 (3.60)	5.87 (3.33)	6.02 (3.43)	6.15 (3.51)	175.42 (100.00)
Total	194.10 (58.55)	77.80 (23.47)	17.45 (5.26)	13.12 (3.96)	12.10 (3.65)	16.95 (5.11)	331.52 (100.00)

Figures in parentheses are percentages to the total fourth size groups, rubber alone accounted for 45.53 per cent and 62.15 per cent of the total cropped area.

Thus the analysis shows the relative importance of rubber in the cropping pattern of the sampled rubber growers and also the relative rigidity in the cropping pattern as perennial crops constituted not less than 85 per cent of the total cropped area.

4.3.3 Total area under rubber

The total area under rubber and the changes between 1979 and 1985 among the sampled cultivators are presented in Table 4.8. All the four size groups together recorded 42 per cent increase in total area under rubber from 136.0 hectares in 1979 to 194.1 hectares in 1985, an average of seven per cent per annum. Area under rubber per holding rose from 1.7 hectares to 2.43 hectares between 1979 and 1985. Among the four size groups, the fourth group recorded the highest percentage increase in area under rubber (59 per cent) in 1985 over 1979, while the first group recorded only 4.5 per cent overall increase. The second and third size groups recorded a little over 30 per cent increase in total area under rubber in 1985 over 1979. Thus in general, the total area under rubber among the sampled cultivators increased

Table 4.8 Total area under rubber and changes between 1979 and 1985 among sampled cultivators

Size group	Total area under rubber in ha		Percentage increase in 1985 over 1979	Average area under rubber in ha	
	1979	1985		1979	1985
(1)	(2)	(3)	(4)	(5)	(6)
I	9.98	10.44	4.59	0.50	0.52
II	19.14	24.96	30.38	0.96	1.25
III	37.65	49.69	31.98	1.88	2.48
IV	68.27	109.01	59.69	3.41	5.45
Total	136.04	194.10	42.67	1.70	2.43

significantly between 1979 and 1985 particularly among growers with larger size holdings.

Total area, tapped area, and area under young trees for the aggregate of 80 sampled rubber growers over the period 1979-1985 are presented in Table 4.9 Over the period 1979 to 1985 the total tapped area remained fairly stable (around 120 hectares) but the area under young trees rose from 6.7 hectares in 1979 to 71.8 hectares in 1985. The increase in total area under rubber from 136 hectares in 1979 to 194 hectares in 1985 is only to be expected as the area under young trees has been increasing throughout the period with the tapped area remained almost stable around 120 hectares. Similar to tapped area, the tapped area per holding also remained stable at around 1.5 hectares over the period considered.

The new planted, replanted and the total planted area under rubber for the aggregate of 80 sample rubber growers over the period 1979 to 1985 are presented in Table 4.10. Over the period of six years from 1979 to 1985, the total planted area was 51.6 hectares, of which the new planted and replanted area were 25.23 hectares and 26.42 hectares respectively. New plantings accounted for 56.67 per cent of the total plantings in

Table 4.9 Total area, tapped area and area under young trees for the aggregate of 80 sampled rubber growers over the period 1979-1985 (area in hectares)

Year	Area under young trees	Tapped area	Total area	Tapped area per holding
(1)	(2)	(3)	(4)	(5)
1979	6.74	129.31	136.04	1.62
1980	15.49	120.63	136.12	1.51
1981	15.94	123.94	139.88	1.55
1982	24.68	120.94	145.62	1.51
1983	31.72	118.58	150.30	1.48
1984	45.66	118.85	164.50	1.49
1985	71.84	122.26	194.10	1.53

Table 4.10 New planted, replanted and total planted area under rubber for the aggregate of 80 sample rubber growers over the period 1979-1985 (area in hectares)

Year	New planted area	Replanted area	Total planted area	New planted area as a per cent of total planted area during the year
(1)	(2)	(3)	(4)	(5)
1979	3.51	2.69	6.21	56.67
1980	2.90	5.59	8.48	34.15
1981	4.78	3.26	8.03	59.47
1982	4.03	6.64	10.67	37.39
1983	5.48	4.84	10.32	53.11
1984	3.41	0.41	3.83	89.18
1985	1.12	3.00	4.12	27.13
Total	25.24	26.42	51.66	48.45

1979, but declined to 27.13 per cent by 1985. The total plantings had been very irregular over the reference period with an increasing trend up to 1982 and declining thereafter. While new plantings are by bringing in new area under rubber cultivation, most of which may be through substitution for other crops-since there is limitation to get new lands - the replantings are by removal of old and unproductive rubber trees. It is possible that the scope for new planting and/or replanting is declining over the period considered.

3.4 Production and operational costs of production

Production and productivity of rubber among sampled, growers during 1984-85 are presented in Table 4.11. The total sheet rubber produced by all the 80 sample growers during 1985 was 1701.10 quintals with an average of 13.91 quintals per hectare of tapped area or 21.27 quintals per holding. The fourth size group contributed about 59 per cent of the total production which is only to be expected. The average production per hectare of tapped area among the four size groups showed that the fourth size group recorded the highest productivity (14 quintals per hectare of tapped area). Similarly the productivity was found increasing although, only nominally with increasing size of holding.

Table 4.11 Production and productivity of rubber among sampled cultivators during 1984 - '85

Size group	Total production in quintals	Percentage to the total	Average production in kg.	
			Per holding	Per ha. of tapped area
(1)	(2)	(3)	(4)	(5)
I	114.93	6.75	574.65	1369.14
II	186.72	10.97	933.60	1378.21
III	396.37	23.30	1981.85	1381.43
IV	1003.17	58.97	5015.85	1400.51
Total	1701.19	100.00	2126.49	1391.41

This may be due to more intensive and specialised cultivation by the relatively larger growers who had about two-third of their cropped area under rubber.

The estimated operational costs of cultivation per hectare of yielding rubber trees during 1984-'85 are presented in Table 4.12. The total costs worked out to Rs. 6,178.42 per hectare.

The major cost item was found to be the tapping labour which accounted for 67 per cent of the total costs. Each tree is tapped once in every alternate day by the skilled labourer. The farmers were found to give a tapping rest during summer months. On the average the number of tapping days in the year was found to be 127. The cost towards fertilizers and plant protection charges together accounted for 23 per cent of the total. The processing charges include cost of acid and pressing charges. The miscellaneous costs which included costs of knives, strainers, dishes etc. worked out to Rs. 121 per hectare or about 2 per cent of total operational costs per hectare. Considering the average yield of 1,391.41 kg per hectare the operational cost of production during the year worked out to Rs.444 per quintal. During 1985 the prevailing market price for rubber was Rs.1,600 per quintal.

Total 4.12 Estimated operational costs of cultivation incurred per hectare of yielding trees during 1984-'85

Sl. No.	Item	Cost in rupees per hectare	Percentage to the total
(1)	(2)	(3)	(4)
1	Clearing and weeding	111.00	1.80
2	Cost of fertilizers	690.30	11.17
3	Application of fertilizers (labour costs)	132.00	2.14
4	Plant protection charges	750.02	12.14
5	Tapping labour charges	4160.01	67.33
6	Processing charges	214.00	3.46
7	Miscellaneous expenses	121.00	1.96
	Total	6178.42	100.00

3.5 Selling practices followed by the rubber growers

The 80 sample growers followed similar selling practices. The latex obtained from the tree is processed into ribbed smoked sheets called sheet rubber. The dried sheet rubber issold to the nearby rubber dealer. The frequency of sales ranged from once in one week to once in 2 to 3 months depending on the quantum of production and cash needs of the grower. The growers also borrow money from their dealers on condition that their future production will be sold to them. But this does not result in reduction in prices received by the growers.

The growers sold their sheet rubber as ungraded lot rubber and they were found receiving prices which are uniformly less than the prices published in the newspapers.

4.4 Marketing of natural rubber

The rubber marketing system has been analysed using aggregate data and data collected from a sample of growers and traders. The findings have been presented in four sections. In section one the trading community involved in moving the produce from the producer to the consumer has been identified. Section two deals with the channels sheet and scrap rubber take in moving from producer to consumer. The general characteristics of rubber marketing relating to volume, participants, market concentration and price formulation have been discussed in section three. The fourth and the last section deals with the analysis of the functions of sample dealers and marketing margins.

4.4.1 Traders in the marketing of rubber

The traders identified in the rubber marketing system are petty merchants, primary dealers, brokers creepe millers, secondary dealers, company agents, and the co-operative rubber marketing societies, under the Kerala State rubber marketing federation. A brief description of these traders is given below:

1. Petty merchants: Rubber is a controlled commodity and so its production, marketing and manufacture require

license from the Rubber Board (a Statutory Body). But these are unlicensed merchants operating at the village level who do not open shops. They collect both sheet and scrap rubber from the producer houses, pool them and sell to the primary or secondary dealers.

2. Primary dealers (PD): They are licensed dealers operating at the village level with shops, collecting sheet rubber from the producers. They sell the produce mainly to the secondary dealers. The primary dealers have only a low volume of business.

3. Secondary dealers (SD): They are also licensed dealers but operate in larger markets with larger volumes of business. They purchase rubber from the primary dealers, large growers and estates and sell to the industrial consumers. Some of the secondary dealers have their branches in major Indian cities like Bombay, Jalandhar, Delhi, Calcutta etc.

4. Brokers: Brokers are those intermediaries who bring together the primary and secondary dealers. They do not take title to the product but receive brokerage from both the parties. They are in constant telephonic contact with the primary and secondary dealers in the major markets.

5. Company agents: Most secondary dealers are agents of one or another company. But there are also agents exclusively for big companies.

6. Creape millers: They mill the scrap rubber into creape rubber which is then sold to the industrial consumers or to the secondary dealers. They may also perform the milling function at fixed rates.

7. The Kerala State Co-operative Rubber Marketing Federation: The Kerala State Co-operative Rubber Marketing Federation started functioning in 1971 to arrange for the purchase and sale of sheet rubber, manufacture rubber goods, undertake processing of rubber and co-ordinate the working of affiliated societies. The role and progress made by the Federation has been discussed separately.

4.4.2 Market structure

4.4.2.1 Market channels

The various agencies engaged in the movement of the produce from the producer to the final consumer make up the marketing channel.

The latex obtained from the tree is processed into ribbed smoked sheets. The latex is first coagulated (by adding suitable coagulating agent) and the coagulam is sheeted to a thickness of about 1/3 cm and is finally passed through the grooved rollers. The wet sheets are then dried in smoke houses or is sundried. According to the standards published by the Rubber Manufacturers Association Inc. Washington, in the Green Book, there are six important grades of ribbed smoked sheets viz. RSS IX, RSS-1, RSS-2, RSS-3, RSS-4 and RSS-5. The above RSS grade in India are called RMA - IX, 1, 2, 3, 4 and 5. Grading is done by holding the dry sheets against light when most defects will become clear.

The channels were traced for both the sheet and scrap rubber. Fig.4(7) depicts diagramatically the market channels for sheet rubber, whereas Fig. 4(8) depicts that for scrap rubber.

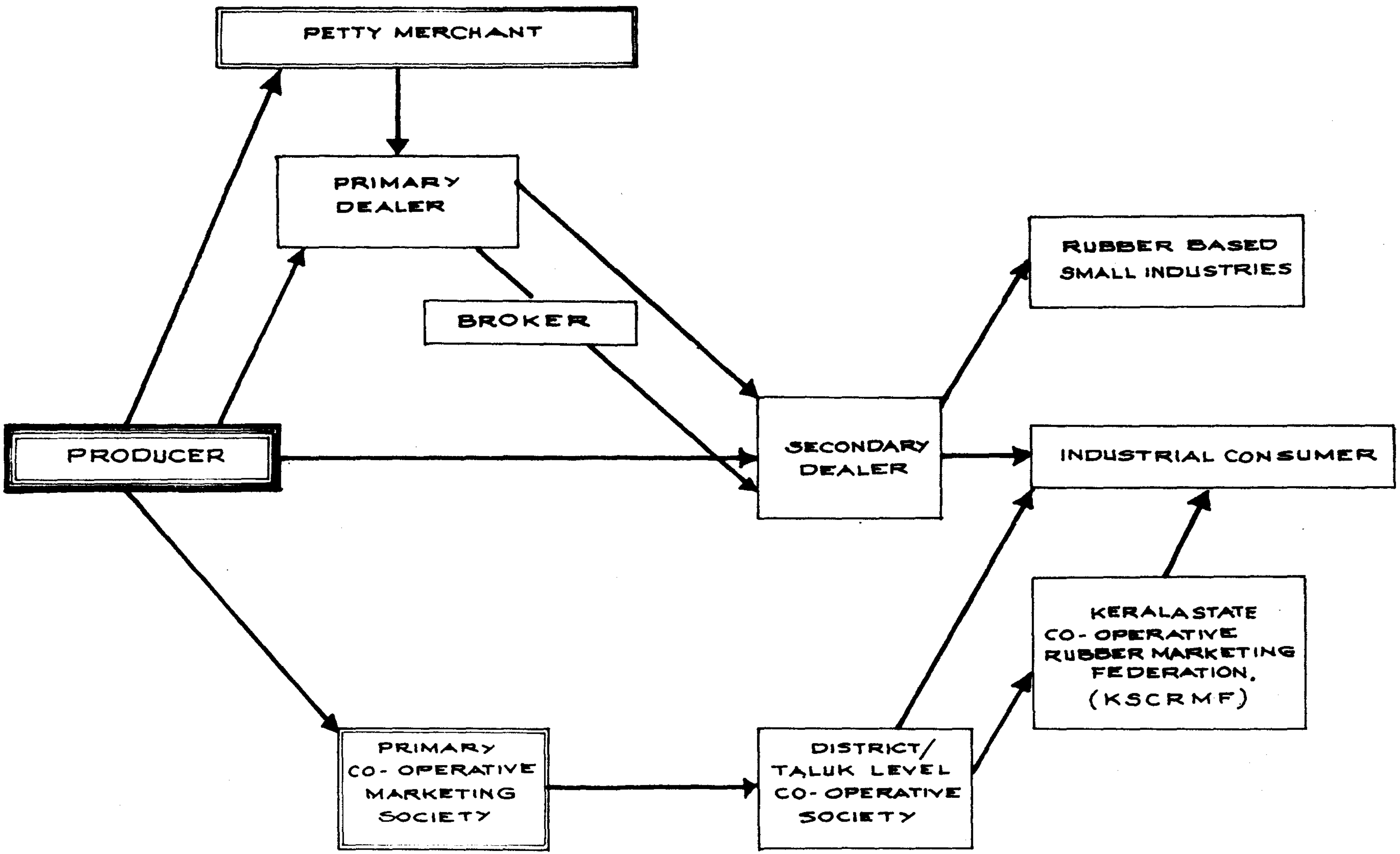
The following six channels were identified:

a) Producer ---- Primary dealer ---- Secondary dealer ---- Industrial consumer

b) Producer ---- Primary dealer ---- Broker ---- Secondary dealer ---- Industrial consumer

c) Producer ---- Secondary dealer ---- Industrial consumer

FIG. 4(7). MARKETING CHANNELS - SHEET RUBBER.



d) Producer ---- Petty merchant ---- Primary dealer ---- Secondary dealer ---- Industrial consumer

e) Producer ---- Primary dealer ---- Rubber based small industries

f) Producer ---- Primary marketing societies ---- District Co-operative Rubber Marketing Society ---- Kerala State Co-operative Rubber Marketing Federation

A brief description of the six important channels identified is given below:

Channel-I

Producer ---- Primary dealer ---- Secondary dealer ---- Industrial consumer

The smoked sheets are sold to the primary dealers at weekly, fortnightly or monthly intervals depending on the producer's need for cash. Some of the producers with a better liquidity position were found selling only when the prices reach a seasonal peak. The sheet rubber is sold as mixed lot rubber at a price equivalent to the price of RMA-5 (the lowest grade). Most producers were found selling to a particular dealer and the pricing is based on a relationship of mutual trust through which the dealer trusts the quality of the mixed lot while the seller (producer) trust the weighing and pricing policies of the buyer.

Some of the producers were found to avail short-term loans from the dealers on condition that their future produce will be sold to them. The prices received by these indebted producers were not lower than the non-indebted farmers. The dealer is benefitted by an assured supply of produce. Thus money lending was found to be integrated with marketing as observed by Wharton (1962) in Malaya.

The primary dealers sell the produce to the secondary dealers, operating at a higher level. Occasionaly they also establish forward contracts with the secondary dealers. The secondary dealer is thus benefited by an assured supply at a pre-determined price, while the contract protects the primary dealer from the risk of a price fall. The secondary dealer sorts out the mixed lot rubber into different grades which are then packed into "bails" of 50 kg each. The bailed sheets are sold to the industrial consumers. The secondary dealers will also enter into forward contracts with industrial consumers to supply a certain quantity and quality of the produce before a specified period of time.

Channel-II

Producer ---- Primary dealer ---- Broker ---- Secondary dealer ---- Industrial consumer

This channel differs from the Channel-I by the mediation of the broker in between the primary and secondary dealers. The broker charges a fixed brokerage usually Rs. 10 per tonne from both the buyer and seller. The broker neither take the title to the product nor the risk of a price fall. No primary dealer who make all his transactions through the mediation of the broker was identified. Most primary dealers sell their produce regularly to a particular secondary dealer and there is a mutual relationship of trust. Only a small proportion of the total transaction is mediated by the broker. The services of the broker are availed during periods of increased supply, need for cash, or uncertainty regarding a price fall etc. The brokers usually operate in the major markets and establish contacts among the dealers and also with the consumers.

Channel-III

Producer ---- Secondary dealer ---- Industrial consumer

The large growers and estate owners were found selling their produce directly to the secondary dealers. They have large quantities to be sold at a time and the quality is also superior. Thus large growers with larger quantities and superior quality generally do business directly with the secondary dealers. The small growers with lower quantity and of inferior quality produce cannot do business with these dealers. Thus there are advantages of bulk sales and better quality. Some of the large growers follow the practice of storing rubber sheets in the dealers store-houses (storing in trade circles) on condition that it will be sold during periods when the prices are higher. The producer is benefitted by getting higher prices while the dealer is benefitted by an assured supply of the produce. This facility is not available to the small producers. This can be compared to the case of bilateral monopoly where the trader and the large growers acts as monopolists.

Channel-IV

Producer —— Petty merchant —— Primary dealer —— Secondary dealer —— Industrial consumer

The rubber collected by petty merchant is sold either to the primary dealer or the secondary dealer. Usually the petty merchants do business with secondary dealers by which they can share a greater proportion of the gross margins. The prices paid by the petty merchants to the farmers are adjusted so as to account for the transportation costs incurred by them.

Channel-V

Producer ---- Primary dealer ---- Rubber based small industries

Only a small percentage of the rubber collected by the primary dealer is sold to these small industries and hence is not an important channel

Channel-VI

Producer ---- Primary co-operative marketing society ---- Central (District) co-operative marketing society ---- Kerala State co-operative marketing federation

The primary societies opened at the selected centres, collect sheet rubber from the producers. The sheet rubber collected by the primary societies are pooled together at district co-operative marketing society and are finally transferred to the Kerala State Co-operative Rubber Marketing Federation. The Federation arranges for the sale of sheet rubber collected by all societies affiliated to it.

The first three were the most important channels particularly for small holders since a major proportion of their rubber flows through these channels. The sixth channel involving the Kerala State Marketing Federation is gaining popularity.

Marketing channels - Scrap rubber

Fig. 4(8) shows the market network for scrap rubber in Kerala. The following important channels were identified.

1. Producer ---- Primary dealer / Secondary dealer ---- Creape miller ---- Industrial consumer

2. Producer ---- Secondary dealer ---- Creape miller ---- Creape dealer ---- Industrial consumer

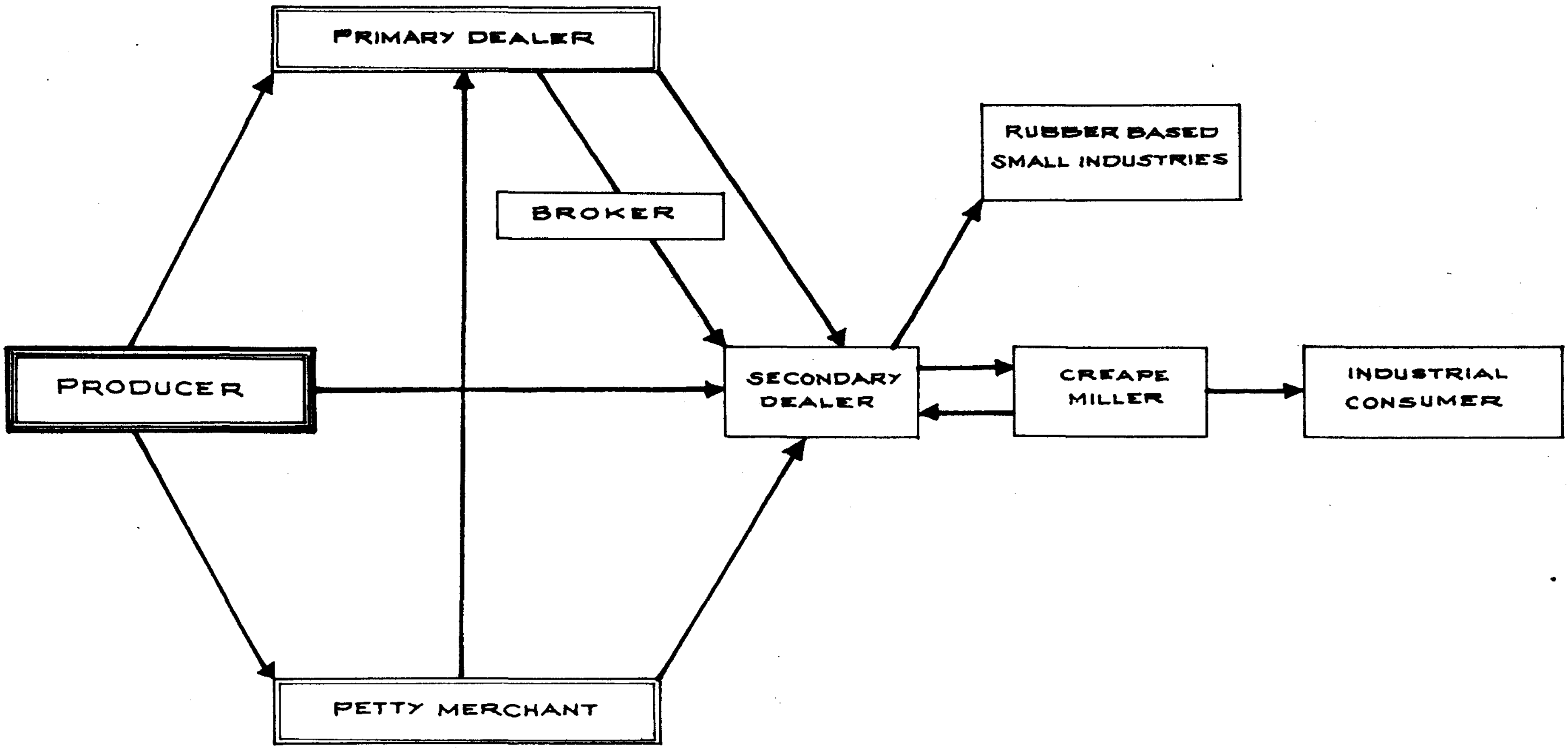
3. Producer ---- Petty merchant ---- Secondary dealer ---- Industrial consumer

A brief description of the above channels is given below:

Channel-I

The producer sells the scrap to the primary dealer or directly to the secondary dealer, the latter being

FIG: 4 (8). MARKETING CHANNELS - SCRAP RUBBER.



more frequent than the former. From the secondary dealer it reaches the creape manufacturers who mill the scrap into creape. There are different grades of creape rubber as specified in the Green Book. The creape is finally sold to the industrial consumer. The secondary dealer deals only with the scrap and does not deal in creape rubber.

Channel-II

The secondary dealer sells the scrap to the creape miller who mills it into creape. The creape is then sold to the creape dealer who in turn sells it to the industrial consumer.

Channel-III

The petty merchants operating at the village level collect the produce from the farmers. These petty merchants were found selling it to the primary or secondary dealer. The produce then follows the path listed in any of the channels described above.

4.4.2.2 Market concentration

Market concentration is an important structural variable which measures the degree of competition. Concentration refers to the proportion of industry sales or purchases made by market participants. Hence volume of trade and number of participants assume considerable importance.

Table 4(13) shows the magnitude of the five-yearly changes in production, number of producers, number of dealers and number of manufacturers, as computed from the figures published by the Rubber Board (Index numbers for the whole period, 1964-'65 to 1983-'84 are given in Appendix V.

Between 1964-'65 to 1983-'84 while the number of producers increased by about two and a half times, number of dealers increased by seven times and production by less than four times. Large increase in the number of dealers took place mostly during the first and third five year periods. The increase in the number of traders alone may not reflect the nature of competition, but it is the proportion of industry trade handled by them that becomes more important. It is possible for the number of smaller dealers to increase or remain within narrow ranges resulting in an increase in competition at the lower levels, but imperfection at higher levels. So the distribution of licensed dealers was analysed to study their concentration.

Table 4(14) gives the distribution of licensed

Table 4(13) Index numbers of production, number of producers, dealers and manufacturers in India (1964-'65 = 100)

Year	Production	Number of producers	Number of dealers	Number of manufact-urers
(1)	(2)	(3)	(4)	(5)
1964-'65	100.00	100.00	100.00	100.00
1969-'70	179.66	149.57	307.57	153.56
1974-'75	285.30	178.74	360.04	201.47
1979-'80	325.48	205.56	614.77	322.74
1983-'84	384.25	256.80	-	406.60

Source: Indian rubber statistics - Vol. 17

Table 4.14 Distribution of licensed dealers according to their total volume of purchase

Purchase in metric tonnes	1965-'66		1970-'71		1975-'76		1981-'82	
	Number	Volume of purchase	Number	Volume of purchase	Number	Volume of purchase	Number	Volume of purchase
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Below 25	319.0 (52.48)	3987.5 (5.03)	1249.0 (69.78)	15612.5 (10.56)	1080.0 (53.05)	13500.0 (5.54)	2122.0 (57.69)	26525.0 (6.98)
25-100	135.0 (22.20)	8437.5 (10.65)	263.0 (14.69)	16437.5 (11.12)	490.0 (24.07)	30625.0 (12.56)	804.0 (21.86)	50250.0 (13.23)
100-250	71.0 (11.68)	12425.0 (15.68)	124.0 (6.93)	21700.0 (14.67)	214.0 (10.51)	37450.0 (15.36)	371.0 (10.09)	64025.0 (17.09)
250-500	35.0 (5.76)	13125.0 (16.57)	77.0 (4.30)	28875.0 (19.53)	106.0 (5.21)	39750.0 (16.30)	185.0 (5.03)	69375.0 (18.27)
500-1000	27.0 (4.44)	20250.0 (25.56)	47.0 (2.63)	35250.0 (23.84)	94.0 (4.62)	70500.0 (28.91)	109.0 (29.64)	81750.0 (21.52)
Above 1000	21.0 (3.45)	21000.0 (26.51)	30.0 (1.68)	30000.0 (20.29)	52.0 (2.55)	52000.0 (21.33)	87.0 (2.37)	87000.0 (22.91)
Total	608 (100.0)	79225 (100.0)	1790 (100.0)	147875 (100.0)	2036 (100.0)	243825 (100.0)	3678 (100.0)	379825 (100.0)

Figures in parentheses are percentages to the total
Source: Indian rubber statistic - Vol.17

dealers according to the volume of their purchasesduring a year. Over the 16 year period between 1965-'66 and 1981-'82, the number of dealers with 100 tonnes or less per annum as their volume of trade increased from 454 to 2926, an increase of 544 per cent. Whereas those trading with more than 1000 tonnes increased from 21 to 87, an increase of 314 per cent. Relating to the total number of dealers, the above two categories changed from 74.5 per cent to 79.5 per cent and 3.4 per cent to 2.4 per cent respectively during 1965-'66 and 1981-'82. Thus although there has been increase in the number of dealers in all categories overtime, the proportion of small dealers in total dealers rose while that of large dealers declined. With regard to volume of trade there has been increase in absolute terms in all the categories. But relatively, while the volume traded by the first category considered changed from 15.68 per cent to 20.21 per cent, for the highest category, the volume declined from 26.5 per cent to 22.9 per cent. As the data on volume of trade used in the present analysis were imputed from the frequency distribution of dealers, no definite conclusion could be drawn from either the total or average volumes traded by each category over time. But the change in the number of dealers point to the possibility of decreasing competition among dealers with increasing volume of trade. This suggests the existence of market concentration at higher levels of trade leading to market imperfections.

Market conduct in Indian Natural Rubber Market has resulted in deterioration of quality rather than encourage improvement in quality. The price differential between two successive grades comes to about Rs. 25 per quintal giving about 1.56 per cent of the superior quality. Thus the price differential between the best and the poorest grades worked out to 5.33 per cent of the best quality. Sheets are sold as mixed lot rubber whose price is generally kept equivalent to that of RMA-5 grade. So there is some amount of down grading of prices at the farm gate level. This practice of average pricing has resulted in a gradual deterioration in quality of the small holders' sheet rubber. The possibility of direct purchase of latex from the producers, by opening latex collection centres is being considered by the Marketing Federation. The daily radio broadcasts and the prices published in the news papers enable the producers to obtain price information. Thus the producers in remote areas are well informed about the ruling market prices. The dealers in different parts of the state are also in constant contact (through telephone) with the dealers in major markets like Kottayam, Cochin and other major cities in the country. (The telephone bills accounted for about 5.84 per cent of their total marketing costs). The correlation co-efficient between the daily prices of RMA-5 grade in Kottayam and Cochin markets during April 1985 worked out to 0.88** which shows fairly high integration between the two markets and that too without any time lag.

The secondary dealers frequently enter into contracts with the tyre manufacturers with promises to deliver a specific quantity of a certain grade of rubber within a future date at an agreed upon price. A fall in prices during this period will result in additional profits above the normal profit. They may also make losses from rising trend in price but are less likely.

The manufacturers who are few in number may temporarily withdraw from the market creating artificial fall in demand which in turn will result in a price fall and build up inventories. The secondary dealers in collusion can also reduce market prices by a temporary removal from the buying market. Similarly the secondary dealers can induce a temporary price rise by withholding supplies for two or three days.

4.4.3 Analysis of sample traders and marketing margins

A sample of 20 rubber dealers were selected and

** Significant at 0.01 level of significance data on purchases, sales and marketing costs incurred by them were collected. The reference period selected for the analysis of marketing costs and margins was April - May 1985 being one of the seasonal peaks in rubber production. Two distinct types of dealers were identified viz. the primary dealer and the secondary dealer. The primary dealer collects sheet rubber from the cultivators which is sold to the secondary dealer. The secondary dealer sells the produce to the ultimate industrial consumers. Since the market is characterised by daily fluctuations in prices and differences in quality of the produce, the weighted average selling prices of the various intermediaries were worked out and the margins were calculated with the concurrent method of analysis.

Table 4(15) shows the gradewise purchase and sales of the ten secondary dealers during the reference period.

Thable 4(15) shows that out of the total purchases RMA-5 grade (lowest quality) accounted for 83.3597 per cent, while out of the total sales it accounted only 50.39 per cent. Similarly 16.56 per cent of the total purchases was as RMA-4 but it accounted for 48.02 per cent of the total sales. These may be indicative of down grading at the buying side by both primary and

Table 4.15 Gradewise purchase and sales of secondary dealers expressed as percentage to the total

Grade	Purchase	Sales
RMA-1	-	-
RMA-2	-	-
RMA-3	0.0784	1.5708
RMA-4	16.5619	48.0300
RMA-5	83.3597	50.3992
Total	100.00	100.00

secondary dealers, since almost the whole sales by the producers is as RMA-5 rubber.

4.4.3.1 Marketing margins

Gross marketing margin is the difference between the prices paid by the industrial consumer (manufacturer) per unit quantity of the produce and the price received by the farmer for an equivalent quantity and quality of the produce.

The sales data of the secondary dealers showed that out of their total sales of RMA-4 and RMA-5 grades of sheet rubber, RMA-4 accounted for 48.79 per cent and RMA-5 accounted 51.2 per cent. So to compute the gross margin a weighted average of the selling price of RMA-4 and RMA-5 grades of sheet rubber was used with the weights being 0.4879 and 0.5120 respectively. The following terminology will be used to represent the prices at the different levels of the market channel.

1. Farmer's price - It is the price received by the rubber growers. In other words it is the selling price of the farmer.

2. Market price - It is the selling price of the primary dealer which is also the price that prevails in the major rubber markets.

3. Manufacturer's price - It is the price which the tyre manufacturers pay to the secondary dealers. It is same as the price at which the secondary dealer sells the produce to the manufacturer.

The marketing margins were worked out both functionally and institutionally.

4.4.3.1.1 Marketing margins - Functional approach

Gross marketing margin worked out to be Rs.78.95 per quintal of sheet rubber which was 4.73 per cent of the manufacturer's price. Mani (1983) in his analysis of natural rubber market in Kerala, the gross margin was found to be Rs. 74 per quintal of sheet rubber which accounted for 6 per cent of the manufacturer's price.

Table 4.16 shows the marketing costs per quintal of sheet rubber incurred by all intermediaries. Gross marketing costs per quintal of sheet rubber worked out to Rs. 28.82. Transportation costs alone accounted for 25.85 per cent of the total marketing costs.

Net marketing margins or the returns to the marketing functions performed worked out to Rs.50.13 per quintal of sheet rubber which was 3 per cent of the manufacturer's price. Producers' share in the

Table 4.16 Marketing costs incurred for the various marketing functions (Rupees per quintal)

Item	Rupees per quintal	Percentage to the total
(1)	(2)	(3)
Loading and unloading	4.3657	15.1498
Grading, bailing and weighment charges	4.4071	15.2935
Bailing materials	1.4871	5.1605
Transportation costs	7.4503	25.8540
Salaries/accounts	1.5077	5.2320
Rent	3.2696	11.3461
Insurance charges	0.0795	0.2759
Wages	0.9018	3.1294
Telephone and postal charges	2.5417	8.8202
Bank charges	1.9528	6.7766
Sales tax and license	0.3030	1.0515
Stationary charges	0.1033	0.3585
Others	0.4472	1.5519
Total	28.8168	100.00

manufacturers' rupee worked out to 95.27 per cent. Mani (1983) also got similar results in his analysis of the rubber market. His estimates of gross marketing costs was Rs. 27.05 per quintal of sheet rubber and net margin was Rs. 46.95 per quintal.

Thus, static analysis of marketing margins showed that the dealers are not making huge profits at the cost of the producers. The analysis showed that there is some amount of down grading of sheet rubber in the producers' market. Although under static conditions, net margins (profits) are low, traders were found to make additional profits from the fluctuating prices. The second alternative of downgrading the produce in the producer's market and finally upgrading the produce in the final market will also add to the profits. An experienced dealer with good market intelligence can make additional profits from the fluctuating market through inventory adjustments. In spite of low margins, the trade can be rationalised based on the high turn over and short working capital cycle.

4.4.3.1.2 Marketing margins - Institutional approach

The study of price spread of natural rubber was carried out only up to the industrial consumer. Table 4.17 shows the price spreads in the marketing of

Table 4.17 Price spread of sheet rubber

Sl. No.	Item	Rs./Qtl.	Per cent share of manufacturer's price
(1)	(2)	(3)	(4)
1.	Selling price of the producer/producer's price	1590.08	95.27
2.	Marketing costs incurred by the producer	3.82	0.003
3.	Net share of the producer	1586.26	95.04
4.	Selling price of the primary dealer/buying price of secondary dealer	1610.27	96.48
5.	Primary dealer's marketing cost	9.94	0.06
6.	Price spread between producer and the primary dealer	20.19	0.01
7.	Primary dealers profit margin	10.25	0.06
8.	Secondary dealer's selling price/buying price of the manufacturer	1669.03	100.00
9.	Secondary dealer's marketing cost	18.87	0.01
10.	Price spread between the primary dealer and secondary dealer	58.76	0.04
11.	Secondary dealer's profit margin	39.89	0.02

sheet rubber. Price spread between the primary dealer and the producer (Primary dealer's margin) was Rs.20.19 per quintal and his profit margin was Rs. 10.25 per quintal. Similarly the price-spread between the secondary dealer and the primary dealer (secondary dealer's margin) was Rs. 58.76 per quintal and the secondary dealer's profit margin was Rs. 39.89 per quintal of sheet rubber. The marketing costs incurred by the primary and secondary dealers were Rs.9.94 per quintal and Rs. 18.87 per quintal respectively. Mani (1983) observed that the gross marketing margin is shared equally by the primary and secondary dealers. His estimates of net margins of the primary and secondary dealers were Rs. 29.80 per quintal and Rs. 27.95 per quintal of sheet rubber respectively.

4.4.3.2 Suggestions and recommendations

The analysis showed that although, the margins are low under static conditions, the market conduct has resulted in a gradual deterioration in quality of the small holders produce. The practice of mixed lot pricing may deter the quality improvement programmes. The seller of a mixed lot is able to increase his returns to the extent he can include dirty, wet and poor quality sheets in the mixed lot. While the seller of a better quality sheet will receive only the price of a lower grade due to the absence of proper grading facilities. So the first and foremost step in quality improvement programmes should be to develop infrastructure facilities to grade the produce in the producers' market and price it based on the grade. There should be strict deductions for poor quality and the seller of a better quality should realise higher prices. The deterioration in quality may also be attributed to the proliferation of the small holding sector with low production per holding. The small holder with a low volume of production may not be able to operate better processing facilities profitably.

Both short-term and long-term policy measures should be introduced to improve the quality of small holders' rubber. The short-term measures should be to construct smoke houses or group processing centres in the co-operative sector. As stated earler this should be supplemented by proper incentives to produce better quality sheets through grade pricing. The long-term policy measures should be to start central processing factories to produce technically specified forms of rubbers like crumb rubber, block rubber etc. from the latex. With the production of technically specified forms of rubber, the produce can compete well in the international markets. The small holders with low per unit production and dispersed in remote areas may create problems in the collection of latex. The new programme of the Rubber Board to collect latex from the small holders through co-operatives and process it into technically specified forms in central processing factories is commendable.

4.4.3 Role of Kerala State Co-operative Rubber Marketing Federation

The Kerala State Co-operative Rubber Marketing Federation (K.S.C.R.M.F.) was registered in March, 1971 as an apex institution of the primary rubber marketing co-operative societies of the state.

The major objects of the Federation are:

1. Rubber marketing
2. Fertilizer mixing and distribution
3. Soil and leaf testing
4. Distribution of chemicals and fungicides and aerial spraying and
5. Rubber processing

The KSCRMF at present purchases rubber from the member societies and rubber growers through its own depots and sells the same to the manufacturers. It has opened sales offices at Bombay, Delhi, Calcutta, Faridabad, Jullundur, Ahmedabad and Kanpur.

The primary societies operating at the village level collect sheet rubber from the producers. The sheet rubber collected by the primary societies are pooled together at the taluk or district level and are finally sold to the manufacturers. Among the sample of growers selected only 6.5 per cent were found selling their produce through the marketing societies. They were found to receive the price of RMA-5 grade of sheet rubber. Since the producers were assured of the price of RMA-5 grade of sheet rubber they were found to include wet and poor quality sheets in the mixed lot.

Progress of co-operative societies dealing in rubber

Table 4.18 shows the progress of co-operative societies dealing in rubber. Over the period from 1971-'72 to 1979-'80, while the number of societies dealing in rubber declined from 58 to 50 the quantity of rubber marketed also declined from 14,510 tonnes to 10,200 tonnes. Similarly, over the above period, the quantity marketed as a percentage of the total production declined from 14.34 per cent in 1971-'72 to 6.86 per cent in 1979-'80. Though there were year to year fluctuation in the number of societies, quantity marketed and market share, the data indicate that the performance of the societies over the years has not been satisfactory.

Table 4.18 Progress of co-operative societies dealing in rubber over the period 1971-'72 to 1979-'80

Year	No. of societies	Quantity marketed (in tonnes)	Quantity marketed as a percentage of total production
(1)	(2)	(3)	(4)
1971-72	58	14510	14.34
1972-73	58	18513	16.47
1973-74	60	7045	5.62
1974-75	62	4350	3.34
1975-76	62	5545	4.02
1976-77	64	9866	6.59
1977-78	54	7878	5.35
1978-79	52	6875	5.08
1979-80	50	10220	6.86

Source: Indian Rubber Statistics Vol.17 pp. 85

Unny and Haridasan (1974) in their study on the co-operative rubber marketing societies also found that a number of societies dealing in rubber incurred losses due to the rapid fluctuations in rubber prices. This in addition to the low availability of liquid capital might have resulted in the poor performance of the co-operatives.

Fertilizer mixing and distribution

The federation has two fertilizer mixing units:

one at Palai and the other at Calicut. The different types and grades of fertiliser mixtures for rubber and straight fertilisers were distributed to rubber growers through these units.

Rubber processing

The federation is the most important participant in the rubber processing component of the Kerala Agricultural Development Project (KADP) being financed by the World Bank for establishing ten modern processing units for the production and marketing of technically specified rubber. The federation has establilished three crumb rubber factories.

Under the scheme, latex is collected daily from the producers at the latex collection centres operating at the village level. Prices are fixed based on the dry rubber content (d.r.c.) of the latex and the market price of sheet rubber of mixed grade. The latex thus collected is finally processed into crumb rubber and is marketed through the federation. Purchase from the growers of latex instead of sheet rubber is a recent introduction and its utility to the growers in terms of returns and to the industry in terms of efficient processing into high quality rubber can be assessed only after same time.

Soil and leaf testing

The federation conducts field campaigns for the soil and leaf testing in rubber plantations and recommends the correct dose of fertilisers on the basis of the test results.

Distribution of chemicals, fungicides and aerial spraying

Distribution of all inputs required for rubber production particularly copper sulphate and other fungicides and undertaking aerial spraying operations form another major activity of the federation.

Thus the federation undertook five activities of which the rubber marketing were found to be most important.

SUMMARY

SUMMARY

The present study on supply response and marketing of natural rubber in Kerala was conducted in 1985. The objectives were to analyse the short-term and long-term supply response of rubber, the market structure and margins and the role of Kerala State Co-operative Rubber Marketing Federation. The analysis of supply response of rubber producers was carried out at the macro-level using time-series data on area, production, productivity and prices of natural rubber over the period 1953-'54 to 1983-'84, collected from the publication of the Rubber Board. At the micro level the behaviour of a sample of 80 rubber growers were analysed to investigate the nature of their price response. The market structure and marketing margins were analysed using the data collected from the sample rubber growers and a sample of 30 rubber dealers.

The trend analysis showed that over the period of 31 years from 1953-'54 to 1983-'84, the total area, tappable area, production, productivity and prices of natural rubber showed positive and appreciable growth rates. In the case of tappable area production and productivity, the whole period was later split up into two periods viz. 1953-'54 to 1960-'61 and 1961-'62 to 1983-'84. In the case of prices of natural rubber the two sub-periods were from 1953-'54 to 1976-'77 and from 1977-'78 to 1983-'84. Simple and compound growth rate

analysis showed that during the second period all the above parameters showed higher growth rates than those in the first period.

Econometric analysis of the short-run supply response showed that the response to lagged price was positive while that to the current price was negative though both were not significant. The variables considered explained over 94 per cent of the total variation in the dependent variable considered, namely, the average yield of rubber. The data revealed significant time trend indicative of the rapid technological changes in rubber production. The elasticity with respect to the current price was -0.1247 while the elasticity with respect to the lagged price was 0.0468. The short-run elasticity with respect to the lagged price of rubber relative to that of coconut was -0.1135.

To analyse the long-term supply response, the producer expectations derived by both declining geometric lag weighted specification and moving average model were tried. But moving average model appeared to explain producer expectations better than the declining geometric lag weight model. The response of new planted area to the expected price of rubber was positive though not significant. The variables considered explained over 80 per cent of the total variation in the total new planted area. The corresponding elasticity was 0.5492. The elasticity of new planted area with respect to the expected prices of rubber relative to that of coconut was 0.3430.

The analysis of the cropping pattern of the sample of rubber growers showed that rubber alone accounted for 58 per cent of the total cropped area. Over the period 1979 to 1985 the total area under rubber and the area under young trees aggregated over the 80 sample rubber growers had been increasing. The total operational costs of production during the year 1984-'85 worked out to Rs.6,178 per hectare and Rs. 444 per quintal of sheet rubber.

The analysis of the selling practices of the sample growers and the dealers revealed six channels through which sheet rubber flows till it reaches the industrial consumer. The analysis of the dealer concentration point to the possibility of decreasing competition among dealers with larger volumes and thus the possibility of increasing share of the total market for rubber. This, however, does not seem to have appreciably affected the market margins and the element of competition is still perceptible.

Gross marketing margin worked out to Rs. 78.95 per quintal of sheet rubber which was 4.73 per cent of the manufacturer's price. Gross marketing margin consisted of marketing costs of Rs. 28.82 per quintal and net margin of Rs. 50.13 per quintal of sheet rubber. Similarly the marketing costs incurred by the primary and secondary dealers were Rs. 9.94 and Rs. 18.87 per quintal of sheet rubber respectively. Price spread between the primary dealer and the grower was Rs. 20.19 per quintal and that between the primary and secondary dealer was Rs. 58.76 per quintal of sheet rubber. Producer's share in the manufacturer's rupee worked out to 95.27 per cent. The analysis of the marketing margins and producer's share in the manufacturer's rupee showed that the producers are obtaining a fair share and that pricing efficiency of rubber markets in Kerala is quite high.

The Kerala State Co-operative Marketing Federation undertook five activities namely, rubber marketing, fertiliser mixing and distribution, soil and leaf testing, rubber processing and distribution of chemicals and fungicides for aerial spraying, of which rubber marketing was found to be the most important. The analysis of progress made by the constituent societies in terms of their number and total quantity of sheet rubber marketed showed that they declined over the period from 1971-'72 to 1979-'80.

REFERENCES

REFERENCES

*Ady, P. 1949. Trends in cocoa production. Bulletin of the Oxford University Institute of Economics and Statistics.

*Ady, P. 1968. Supply functions in tropical agriculture Bulletin of the Oxford University Institute of Economics and Statistics.

Albisu, L.M. and Blandford, D. 1983. An area response model for perennial plants and its application to spanish oranges and mandarins. European Rev. Agric. Econ. 10(2) : 175-184.

Alson, J.M., Freebairn, J.W. and Quilkey, J.J. 1980. A model of supply response in Australlian orange industry. Australlian J. Agric. Econ. 24(3) : 248-267.

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

Bain, J.S. 1956. Barriers to new competition. Harvard University Press, Cambridge pp. 12.

Bapna, S.L. 1980. Aggregate supply response of crops in a developing region. Sultan Chand and Sons, New Delhi. 106 pp

*Barlow, C. 1967. Small holders' latex marketing scheme. Rev. Agric. Econ. 1(1) : 9.

Bateman, M.J. 1965. Aggregate and regional supply functions for Ghanian cocoa. J. Farm. Econ. 47(2) : 384-401.

*Bateman, M.J. 1968. Cocoa in the Ghanian economy. An econometric model. North-Holland Publishing Co., Amsterdam.

Behrman, J.R. 1968. Monopolistic cocoa pricing American J. Agric. Econ. 50(3) : 702-719.

Bevan, J.W.L. 1956. A report on the marketing of small holders' rubber with special reference to the first level dealer. Research Archives. No.7 RRIM, Malaya.

*Chan, F. 1963. A preliminary study on the supply response of Malayan rubber estates. Malayan Econ. Rev. 7.

Cheam, S.T. 1972. Review of development in the processing and marketing of small holder's rubber. Malayan Agriculturist 11 : 57.

Chowdhury, A. and Ram, G.S. 1978. Price response of perennial crop - A case study of Indian tea. Indian J. Agric. Econ. 33(3) : 74-83.

Clodius, R.L. and Mueller, W.F. 1961. Market structure analysis as an orientation for research in agricultural economics. J. Farm Econ. XLIII(3) : 513-533.

Cochrane, W.W. 1957. The market as a unit of enquiry in agricultural economics. J. Farm. Econ 39(1) : 21-40.

Cook, J. 1950. The purchase and bulk processingof small holder's latex. Malayan Agric. J. 33(3) : 136.

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

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

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

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

*Elfner, D.W. 1983. An evaluation of rubber stock arrangements in the international natural rubber agreement in world rubber market. Dissertation abstracts International. A 43(10) : 3374.

Fisher, B.S. and Tanner, C. 1978. The formulation of price expectations. An emperical test of theoritical models. American J. Agric. Econ. 60(2) : 245-247.

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

*Food and Agricultural organisation, 1974. Report for the rubber development project, Kingdom of Thailand.

French, B.C. and Bressler, R.G. 1962. The lemon cycle J. Farm. Econ. 44(4) : 1021-1036.

French, B.C. and Mathews, J.L. 1971. A supply response model for perennial crops. American J. Agric. Econ. 53(3) : 478-490.

French, B.C., King, G.A. and Minami, D.D. 1985. Planting and removal relationships for perennial crops. An application to cling peaches. American J. Agric. Econ. 67(2) : 215-223.

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.

George, M.V. and Velayudhan, C. 1977. A rational approach for stabilisation of rubber prices (unpublished) Kerala State Planning Board, Trivandrum.

George, M.V. and Kunju, S. 1978. Structure of rubber prices in Kerala (unpublished). Kerala State Planning Board, Trivandrum.

Ghosal, A. 1975. The price response of primary producers: A relative supply approach. American J. Agric. Econ. 57(1) : 116-117.

Government of India, 1956. The plantation enquiry commission report - Part III Rubber pp. 105-110.

*Griliches, Z. 1961. A note on serial correlation bias in distibuted lag models. Econometrica 29.

*Hassan, A.H. 1977. Natural rubber prices : A forecasting model. Paper submitted to the Division of Agricultural economics, Graduate school of the University of Wyoming.

Heady, E.O. 1961. Agricultural supply functions. Iowa State University Press, Ames. Iowa.

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

Just, R.E. 1974. An investigation of the importance of risk in farmer's decisions. American J. Agric. Econ. 56(1) : 14-25.

Just, R.E. 1975. Risk response models and their policy evaluation. American J. Agric. Econ. 57(5) : 836-842.

Kahlon, A.S. and George, M.V. 1985. Agricultural marketing and price policies. Allied Publishers Pvt. Ltd., New Delhi, 1st Ed. pp. 13-55.

Kohls, R.L. and Uhl J.N. 1980. Marketing of agricultural products. Macmillan Publishing Co., New York, 5th Ed. pp. 17-32, 100-120, 264-280.

King, G.A. 1975. Econometric models of the agricultural sector. American J. Agric. Econ. 57(2) : 164-171.

Kinzine, L.D. 1983. An enquiry into the measurement of individual crop supply response - A systems approach. Dissertation abstructs - International - A.44(6) : 1868.

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

Krishnankutty, P.N. 1985. Some aspects of rubber markets in India. Planters Chronicle L. 30(1) : 16-22.

Lim, S.C. 1968. A study on marketing of small holder's rubber at the first trade in Selanger. Economic and planning division. Report No.4 RRIM, Kulalumpur.

Lim, D. 1975. Supply response of primary producers. Penerbit University, Malaya. pp. 56-76, 111-130.

Lim, S.C. 1975. Marketing of rubber by small holders in Peninsular Malaysia. Econ. Bulletin for Asia and Pacific 26 (2/3) : 58-70.

Lopez, R.E. 1984. Measuring oligopoly power and production responses of Canadian food processing industry. J. Agric. Econ. 35(2) : 210-230.

Manghas, M., Recto, A.E. and Ruttan, V.M. 1966. Price and market relationships for rice and corn in Philippines. J. Farm. Econ.

Mani, S. 1983. An analysis of Indian natural rubber market M.Phill. Dissertation, Jawaharlal Nehru University, New Delhi.

Meyanthan, S. 1983. Monthly regional supply functions of natural rubber. Developing economies. 21(3) : 225-233.

*Mueller, W.F. 1960. Changes in structure of grocery retailing 1940-1958. Research report 5. Agric. Expt. Station, University of Wisconsin.

Mueller, W.F. 1961. Emperical measurement in market structure research. J. Farm. Econ. XL 3(5) : 1369-1375.

Mueller, W.F. 1983. Market power and its control in the food system. American J. Agric. Econ. 65(5) : 855-863.

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

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

Nerlove, M. and Bachman, K. 1960. The analysis of changes in agricultural supply: Problems and approaches. J. Farm. Econ. XL (2(3) : 531-554.

Nerlove, M. 1979. The dynamics of supply : Retrospect and prospect. American J. Agric. Econ. 61(5) : 874-888.

*Nowshirvani, 1962. Agricultural supply in India : Some theoritical and emperical studies. Ph.D. Discertation, submitted to MIT.

Olayemi, J.K. and Olayide, S.O. 1975. The structure of price response in Nigerian rubber production. A polynomial lag model. Malayan Econ. Rev. 20(2) : 15-21.

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

Pandey, S. Piggott, R.R. and Aulay, T.G. 1982. The elasticity of aggregate Australlian agricultural supply : Estimates and policy implications. Australlian J. Agric. Econ. 26(1) : 202-219.

Parikh , A. 1974. A model of world coffee economy 1950-68. Applied Economics. 6 : 23-43.

Parikh, A. 1979. Estimation of supply functions for coffee. Applied Economics. 11(1) 43-45.

Prucell, D.W. 1979. Agricultural marketing - Systems, Co-ordination, cash and futures prices. Restan Publishing Co. Inc. Virgina. pp.345-357.

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

Ramamurthi, S. 1984. Efficiency in resource allocation. A study of Sri Lankan rubber planters response to changing market conditions. Rubber Board Bulletin 19(4) : 14-16.

Rubber Board, 1968. Report of the rubber small holdings economic enquiry committee. Ministry of commerce, Government of India.

Rubber Board, 1980. Hand book of natural rubber production in India. Ministry of Commerce, Government of India.

Rubber Board, 1980. Indian rubber statistics Vol.17. Ministry of Commerce, Government of India.

Robinson, J. 1936. Economics of imperfect competition. MacMillan and Company, London. pp. 17.

*Salim, A. 1967. The market of small farm rubber in Malaysia. Ph.D. Thesis submitted to the University of Wisconsin, Wisconsin.

Sayler, R.G. 1978. Alternative measures of supply elasticities: The case of Saupaulo Coffee. American J. Agric. Econ. 56(1) : 98-105.

Schultz, T.W. 1964. Transforming traditional agriculture Yale University Press.

*Sepien, A. 1975. An analysis of small holder's rubber marketing in the East Coast of Peninsular Malaysia. Master's Degree Thesis, submitted to the Australlian National University.

Sepien, A. 1976. Benefits of economies of scale in the marketing of small holder's rubber. RRIM, Kulalumpur.

Shepherd, G.S., Futrell, G.A. and Strain, J.R. 1975. Marketing of farm products. Iowa State University Press, Ames. pp. 30-182.

Shepherd, G.S. Agricultural Price analysis. Iowa State University Press, Ames, 5th Ed. pp. 4-16.

Sosnick, S.H. 1961. A theoritical scafolding for analysis of market structure. J. Farm Econ. XL 3(5) : 1346-1356.

Stern, R.M. 1965. Malayan rubber production, inventory holdings and elasticity of export supply. Southern Econ. J. 31 : 314-323.

*Stem, R.M. 1965. The determinants of cocoa supply in West Africa in I.G. Stewart and H.W. Ord. Eds. African primary products and international trade. Edinburgh University Press, 1965.

Stifel, L.D. 1975. Imperfect competition in a vertical market net work: The case of rubber in Thailand. American J. Agric. Econ. 57(4) : 631-640.

Swarup, G.S. 1978. Impact of risk and technology on supply response of wheat in Madhya Pradesh. Agric. Situ. India 33(5) : 303-306.

*Traill, B. 1976. Incorporation of risk variables in economic supply response analysis. Staff paper, Dept. Agric. Econ., Cornell University Aug. 1976. pp. 127.

Tyagi, D.S. 1974. Farmers response to agricultural prices in India - A study in decision making. Heritage Publishers, Delhi. pp. 192.

Umadevi, 1977. Perennial crop supply response: The case of Indian natural rubber. Indian J. Agric. Econ. 32(4) : 62-76.

Unny, R.G. and Haridasan, V. 1974. A study of co-operative rubber marketing societies. Economics research division, Rubber Board, Kottayam. pp. 29.

Wharton, C.R. Jr. 1962. Marketing, Merchandising and money-lending. A note on middlemen monopsony in Malaya. Malayan Econ. Rev. 7(2) : 24.

Williams, R.L. 1972. Jamaican Coffee supply, 1953-1968. An exploratory study. Social Econ. Studies 21(1) : 90-103.

* Original not seen

APPENDICES

Appendix-I Interview schedule for farmers

Date of Interview

I. Identification

1. Name of the farmer

2. Address

3. Distance from the nearest market for rubber

II. Size of operational holding (in acre)

Item	Dry	Wet	Total
Under cultivation			
Fallow (for the last one year)			
Total			

III. Cropping pattern

Crop	Total area	Young trees		Yielding trees	
		Area	No. of trees	Area	No. of trees
1. Rubber					
2. Other than rubber					
a.					
b.					
c.					
d.					
Total					

IV. Changes in area under rubber for the last 7 years

Year	Area at the begin-ing	Area cleared during	Area replan-ted	Area newly plan-ted	Area under tapp-ing	No.of trees under tapp-ing	Total

V. a. Details of production during the last year (in quintals)

Item	Month
Latex	
Sheet rubber	
Scrap rubber	

b. Production costs during the year

Items of costs	Young plants	Adult plants	Subsidy/ grant
Land preparation			
Planting material			
Other planting costs			
Mannures and fertilisers			
Plant protection			
Cover cropping			
Terracing and bunding			
Other costs			
Total			

VI. Harvesting and processing charges

Item	Area tapped/ quantity	Rate	Total	Remarks
Tapping charges				
Processing materials				
Smoking				
Others				
Total				

VII. Marketing costs incurred

Type of cost	Qty.	Rate	Total	Remarks
Handling charges				
Loading and unloading				
Bailing				
Transportation costs				
Weighment charges				
Other costs				
Miscellaneous costs				
Market cess				
Taxes if any				
Total				

VIII. Sales and prices received

Month/ date of sale	Quantity sold		Prices received		To whom sold	Place of sale and distance to the place	Remarks Grade/identity of buyer etc.
	Sheet	Scrap	Sheet	Scrap			

Appendix-II Interview schedule for traders and other intermediaries (all intermediaries between producers and consumer)

I. General particulars

1. Category of intermediary

2. Other personal details

II. Purchases and sales during the year

A. Purchases

Type/grade	Month/period/ date	From whom purchased	Qty.	Price

B. Sales

Type/ grade	Month/ Period/ date	To whom sold	Qty. sold	Sale Price	Remarks

III. Marketing costs during the year

Type of costs	Quantity	Rate	Total	Remarks
Handling charges				
Loading and unloading				
Bailing charges				
Transportation costs				
Weighment charges				
Other costs				
Wages				
Rent				
Telephone and postage charges				
Taxes if any				
Total				

Appendix-III Total area, tappable area, new planted area, production, yield per hectare and prices of natural rubber in India (1953-1984)

Year	Total area ha.	Tappable area ha.	New planted area ha.	Production M.T.	Yield per hectare Kg/ha.	Price of rubber Rs/Qtl.
1953-54	70271	66100	-	21588	321	258.13
1954-55	71487	66800	4746	21774	326	258.13
1955-56	83867	67200	10061	23730	353	289.59
1956-57	94839	72200	12767	24060	333	300.62
1957-58	106027	71000	15672	24534	345	329.15
1958-59	115970	70300	14479	24169	344	331.87
1959-60	123612	69800	11604	24173	346	346.82
1960-61	129905	70300	13489	25697	365	335.11
1961-62	140880	74300	16931	27440	370	314.65
1962-63	146149	84000	15721	32239	384	306.68
1963-64	152946	95500	8860	37487	393	310.31
1964-65	155324	108500	8492	45616	420	315.45
1965-66	164713	112700	8912	50530	448	470.35
1966-67	171260	113500	9925	54818	483	464.95
1967-68	181592	117700	9519	64468	548	365.48
1968-69	187514	123300	7984	71054	576	510.65
1969-70	196703	133100	8629	81953	616	500.70
1970-71	203098	141200	8744	92171	653	463.60
1971-72	208781	149300	4517	101210	678	420.78
1972-73	213112	154960	4126	112364	725	458.71
1973-74	217540	165600	4527	125133	756	515.30
1974-75	221265	170900	5200	130143	762	849.24
1975-76	224428	178500	6000	137750	772	743.62
1976-77	230563	185600	5600	149632	806	595.96
1977-78	233359	191000	5800	146987	770	632.11
1978-79	235910	190300	7300	135297	710	953.43
1979-80	237014	192500	11100	148470	770	1016.51
1980-81	241503	194200	12000	153100	790	1212.20
1981-82	243983	196200	14000	152870	780	1430.65
1982-83	253466	199700	14000	165850	830	1408.84
1983-84	263076	203800	13000	175280	860	1707.58

Source: Indian rubber statistics - Vol.17.

Appendix-IV   Prices of coconut and tapioca in Kerala (1953-1984)

Year	Price of coconut Rs/1000 nuts	Price of tapioca Rs/quintal
1953-54	153.72	6.91
1954-55	145.79	4.18
1955-56	142.79	4.85
1956-57	157.47	9.75
1957-58	180.39	8.46
1958-59	193.67	6.27
1959-60	192.74	8.59
1960-61	215.50	7.74
1961-62	213.99	10.20
1962-63	247.60	9.82
1963-64	239.86	8.58
1964-65	267.70	17.39
1965-66	395.10	17.49
1966-67	369.00	17.63
1967-68	455.00	22.14
1968-69	392.70	20.55
1969-70	498.40	18.42
1970-71	571.20	20.57
1971-72	420.70	20.82
1972-73	527.90	25.43
1973-74	890.10	34.83
1974-75	851.30	37.45
1975-76	668.60	40.22
1976-77	926.60	36.62
1977-78	1013.30	30.29
1978-79	1047.50	35.66
1979-80	1121.20	42.10
1980-81	1334.10	42.48
1981-82	1270.00	41.11
1982-83	1264.00	57.21
1983-84	1768.30	74.58

Source: Economic review, Bureau of Economics and Statistics, Kerala

Appendix-V Index numbers of production, number of producers, dealers and manufacturers in India (1964-'65 = 100)

Year	Production	No. of producers	No. of dealers	No. of manufacturers
1964-65	100.00	100.00	100.00	100.00
1965-66	110.7725	105.9678	115.1515	102.5672
1966-67	120.1727	114.5897	176.3257	120.4156
1967-68	141.3276	129.9685	239.2045	132.8851
1968-69	155.7655	139.3002	256.0606	142.2983
1969-70	179.6584	149.5741	307.5757	153.5623
1970-71	202.0585	155.2886	339.0151	156.6015
1971-72	221.8739	160.2057	335.6061	160.1467
1972-73	246.3258	167.3759	325.0000	170.7824
1973-74	274.3621	174.0081	338.4470	184.1076
1974-75	285.3012	178.7396	360.0379	201.4670
1975-76	301.9974	183.7764	385.6061	225.4279
1976-77	328.0252	190.0468	438.6364	244.8655
1977-78	322.2268	195.9363	478.2197	259.0464
1978-79	296.59987	201.2386	593.7500	300.2445
1979-80	325.4779	205.5642	614.7727	322.7384
1980-81	335.6278	215.7198	689.5833	345.4768
1981-82	335.1236	227.1408	695.0757	369.3154
1982-83	363.5786	239.0931	692.9924	394.3765
1983-84	384.2511	256.0029	-	406.6015

Source: Indian rubber statistics - Vol.17

Appendix-VI Producer expectations of prices, changes in yield, observations on price risk and yield risk derived by the declining geometric lag weighted model

Year	Expected price of rubber (PR^e_t)	Expected price of coconut (PC^e_t)	Change in expected yield (Y^e_t)	Observation on expected risk in absolute price (RPR^e_t)	Observation on expected yield risk (RY^e_t)	Expected relative price (PR_t/PC^e_t)	Observation on expected risk in relative price (RPR_t/PC^e_t)
1954-55	258.13	153.72	0.00	-	-	1.68	-
1955-56	258.13	150.55	2.00	-	2.5	1.72	0.01
1956-57	270.71	147.44	2.00	-	366.25	1.84	0.17
1957-58	282.68	151.45	-0.80	366.20	224.97	1.87	0.02
1958-59	301.27	163.03	4.32	561.73	182.72	1.85	0.01
1959-60	313.51	175.29	2.19	1152.95	123.17	1.80	0.02
1960-61	326.83	182.27	2.12	1072.88	86.04	1.80	0.01
1961-62	330.14	195.56	8.87	1086.49	244.22	1.70	0.02
1962-63	323.95	202.93	7.32	709.84	279.64	1.61	0.02
1963-64	317.04	220.80	9.99	536.02	413.98	1.46	0.03
1964-65	314.35	228.42	9.60	448.00	476.97	1.39	0.03
1965-66	314.79	244.13	16.56	299.00	959.19	1.31	0.03
1966-67	377.01	304.52	21.13	188.82	1673.85	1.26	0.03
1967-68	412.19	330.63	26.68	9072.70	2756.20	1.26	0.03
1968-69	393.50	380.38	42.01	8576.97	5982.75	1.08	0.05
1969-70	440.36	385.31	36.41	6210.69	6879.96	1.17	0.05
1970-71	464.50	430.54	37.84	8990.25	7689.85	1.10	0.04
1971-72	464.14	486.85	37.51	7010.87	8119.61	0.99	0.05
1972-73	446.80	460.39	32.50	4417.15	7528.13	0.99	0.04
1973-74	451.56	487.39	38.30	3478.39	8168.09	0.63	0.12
1974-75	477.06	648.48	35.38	2243.91	8033.88	0.61	0.11
1975-76	625.93	729.61	24.03	2916.85	6261.57	0.76	0.11
1976-77	670.01	705.20	18.02	53090.35	4610.82	0.90	0.11
1977-78	642.19	793.76	24.41	35643.27	4265.02	0.80	0.11
1978-79	638.16	881.58	0.25	22492.84	2801.81	0.73	0.10
1979-80	764.27	947.95	-23.85	50947.52	2973.88	0.80	0.09
1980-81	865.16	1017.25	9.69	55638.96	2042.87	0.84	0.09
1981-82	1003.99	1143.99	13.81	79613.26	1711.24	0.87	0.08
1982-83	1174.65	1194.39	4.29	117514.50	1088.87	0.97	0.08
1983-84	1268.32	1222.24	22.57	94327.28	1906.01	1.03	0.07

Appendix-VII Producers expectations of prices, changes in yield, observations on price risk and yield risk derived by the moving average model

Year	Expected price of rubber $\overline{PR}_t$	Expected price of coconut $\overline{PC}_t$	Change in expected yield $\overline{Y}_t$	Observation on expected risk in absolute price $\overline{RPR}_t$	Observation on expected yield risk $\overline{RY}_t$	Expected relative price $\overline{PR_t/PC_t}$	Observation on expected risk in relative price $\overline{RPR_t/PC_t}$
1956-57	302.05	166.65	0	2.00	27.94	1.82	0.01
1957-58	313.04	175.48	6.3	125.69	25.05	1.80	0.003
1958-59	321.12	185.22	6.3	305.39	44.48	1.76	0.01
1959-60	323.56	200.19	4.4	341.90	30.43	1.64	0.01
1960-61	324.94	211.96	8.6	689.29	63.01	1.56	0.01
1961-62	322.98	224.44	10.7	988.70	95.75	1.46	0.01
1962-63	342.77	253.21	14.8	1849.56	128.26	1.39	0.01
1963-64	359.04	278.51	19.6	2064.79	146.87	1.31	0.01
1964-65	363.98	312.72	26.1	2877.70	171.36	1.20	0.02
1965-66	391.98	338.25	29.5	3284.44	171.00	1.18	0.02
1966-67	419.70	374.08	33.1	3397.00	169.97	1.15	0.02
1967-68	441.60	421.43	37.2	3049.61	134.45	1.09	0.09
1968-69	456.64	448.29	36.8	4457.55	102.85	1.05	0.02
1969-70	454.98	462.26	-60.4	5180.91	100.85	0.89	0.10
1970-71	462.17	536.59	39.0	5453.09	127.07	0.80	0.10
1971-72	531.29	593.20	30.6	13340.57	114.71	0.83	0.10
1972-73	564.56	632.61	28.0	13532.72	143.01	0.80	0.12
1973-74	578.17	693.79	27.1	16986.24	395.28	0.75	0.12
1974-75	602.25	756.93	16.7	24248.44	394.52	0.72	0.13
1975-76	678.34	846.47	4.6	22527.40	927.41	0.71	0.12
1976-77	758.02	931.23	6.4	20979.12	902.89	0.82	0.05
1977-78	857.58	994.66	4.9	20459.32	846.91	0.87	0.05
1978-79	940.64	1054.47	2.5	17122.71	1276.36	0.89	0.02
1979-80	1035.67	1139.53	8.3	281.73	1278.50	0.89	0.001
1980-81	1194.47	1259.77	7.7	314.44	8.16	0.94	0.001

A STUDY ON THE SUPPLY RESPONSE AND MARKETING OF NATURAL RUBBER IN KERALA

By

VIJU IPE C.

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 - Trichur

1986

ABSTRACT

The present study on supply response and marketing of natural rubber in Kerala developed estimates of short-term and long-term supply response of rubber to price changes and analysed the structure and performance of the rubber market in Kerala. To analyse the supply response time-series data on area, production, productivity and prices of natural rubber published by the Rubber Board were used.

The trend analysis showed that over the period of 31 years from 1953-'54 to 1983-'84, the total area, tappable area, production, productivity and prices of natural rubber showed positive and appreciable growth rates. In the case of tappable area, production and productivity, simple and compound growth rate during the period after 1960-'61 were greater than during the period prior to 1960-'61. Similarly in the case of price of natural rubber the growth rates during the period after 1976-'77 were greater than that during the period prior to 1976-'77.

Econometric analysis of the short-run supply response showed that the response to one year lagged price was positive though not significant with an elasticity of 0.0468. The response of average yields

to current price was negative but not significant. The variables considered explained over 94 per cent of the total variation in the average yield of rubber. The analysis revealed the existence of a significant time trend indicative of the technological changes in rubber production. The elasticity with respect to the current price was -0.1247 and that with respect to the lagged price of rubber relative to that of coconut was -0.1135.

In the analysis of long-term supply response, the producer expectations derived by the declining geometric lag weighted specification and moving average models, were tried but the latter performed better. The variables considered explained over 80 per cent of the total variation in the new planted area. The response of new-planted area to the expected price of rubber was positive with an elasticity of 0.5492. The elasticity with respect to the expected price of coconut was -0.4309. Similarly the response of newplanted area to the expected price of rubber relative to that of coconut price was positive with an elasticity of 0.3430.

The analysis of market structure revealed six important channels in the sheet rubber market. The analysis of market concentration point to the possibility of decreasing competition among the dealers with larger volumes and thus the possibility of increasing share of the total market for rubber. This, however, does not seem to have appreciably affected the market margins, and the element of competition is still perceptible.

The gross marketing margin worked out to Rs.78.95 per quintal of sheet rubber and the marketing costs incurred by all the intermediaries was Rs.28.82 per quintal. The net marketing margin was Rs.50.13 per quintal. The price spread between the primary dealer and the producer was Rs.20.14 per quintal and that between the primary dealer and the secondary dealer was Rs.58.76 per quintal. The marketing costs incurred by the primary dealer and the secondary dealer were Rs.9.94 and Rs.18.87 per quintal of sheet rubber respectively. The producer's share in the manufacturer's rupee worked out to 95.27 per cent.

The analysis of progress made by the co-operative societies dealing in rubber in terms of their number and total quantity of sheet rubber marketed showed that they declined over the period from 1971-'72 to 1979-'80.