STAGGERED REPLANTING AND INCOME STABILISATION:
A CASE STUDY OF SMALL RUBBER HOLDINGS IN KERALA

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I hereby affirm that the research for this dissertation titled "**Staggered Replanting and Income Stabilisation: A Case Study of Small Rubber Holdings in Kerala**", being submitted to the Jawaharlal Nehru University, New Delhi for the award of the degree of Master of Philosophy in Applied Economics was carried out by me at the Centre for Development Studies, Trivandrum.

Trivandrum,
15-07-1994.

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Certified that this dissertation is the bonafide work of Sri.Jom Jacob and has not been considered for the award of any other degree by any other University. This dissertation may be forwarded for evaluation.

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C O N T E N T S

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CHAPTER I

INTRODUCTION

1.1. Nature and Significance of the Study

Rubber plantation industry of India has registered a dynamic growth during the last four decades. The area under this crop has grown from 74,900 hectares during the year 1950-51 to 499,000 hectares by 1992-93. Over this period, the production of natural rubber registered an increase from 15,800 tonnes to 393,000 tonnes. The productivity, measured as the yield per hectare of tapped area, has gone up to 1154 kg by 1992-93 from 284 kg during 1950-51. The increase in production was contributed by the increase in the area under the crop coupled with increase in productivity. Although the movement of the real price of natural rubber is no exception to the cyclicality characteristic of primary commodity prices, it ruled more or less at a remunerative level throughout the period. The sharp increase in productivity together with remunerative level of price should have resulted in an increase in the level of income of growers.

In the background of this remarkable growth in area, production and productivity , the stability of growers' income is an important issue. Stability in producers' income is essential for the sustained growth of the sector. But, we expect a certain degree of instability owing to two reasons. Firstly, natural rubber is a perennial tree crop and has got certain specialities like long gestation period and age-related yield profile. These crops, once planted, yield a flow of output continuously or discretely over a number of years. They mature several years after planting and the

yield varies according to age of trees and inputs applied. For different age-cohorts (called vintages) yield will be different; input-output relationship will be different. The productive life span of these crops have got three phases. Initially the yield will be increasing steadily. Then it reaches a maximum level and remains more or less steady at this level for a number of years. Then the level of output comes down and a stage would be reached at which retaining the tree would be no longer economic. On expiry of the economic life, a decision to cull uneconomic old trees should be taken. Once replanting is executed, the grower has to wait for a number of years, called gestation lag, for the replanted trees to start giving yield. So perennial crops exhibit a kind of income instability which is different from seasonal and annual crops. The specific instability results from the variations of output stream arising out of age related yield profile and the gestation lag.

Secondly, the holding structure is an important factor determining the stability of output stream and income. The choice of replanting of the entire area of a holding in one stretch or in multiple steps over a number of years depends upon the structure of the holding. For a holding having trees of more than one age group, a situation to replant the entire area in one stretch does not arise. But in the case of a holding having trees of only one age group of trees, the situation is different. Once replanting is carried out in the entire area in one stretch, there is no output from this holding for a number of years and consequently the grower's income shows high degree of instability.

For a given long term behaviour of the price of rubber, there are two likely responses from growers towards the problem of income instability. One response is staggered replanting, in which the replanting of the total area under rubber is carried out in parts. When one batch of trees are replanted, the surviving batch of trees provides output so that the grower always has a continuous output stream. Adjusting the output stream in relation with the cyclicality of price is another response. Small holdings, numbering more than eight lakhs,account for 83% of the production of natural rubber in the country. The average size of a small holding is less than 0.50 hectare and hence small holdings cannot influence the market individually. But for executing replanting, these small holdings may take the advantage of cyclical behaviour of the price of rubber. If replanting is carried out during the declining phase of price, then the gestation period of the replanted trees coincides with the trough of the cycle and the loss of income during the gestation period will be less. As the trees reach peak yielding stage prices would also be rising. This is an approach of income stabilisation by adjusting the output stream in accordance with the cyclicality of price. In actuality both the responses may overlap.

1.2 Objectives and Scope of the Study

For all holdings, after a certain stage replanting of trees is inevitable and the consequent gestation lag is unavoidable. Besides, the grower cannot influence the yield profile beyond certain limits. Given these constraints, which of the above two approaches do growers usually adopt to counter the problem of

income instability? Does staggered replanting take place? If so, how does it affect the output stream? This is an issue which needs detailed investigation and it is the main objective of this study. To be more specific, the objectives may be listed as follows:

(1) A review of relevant studies on newplanting and replanting strategies in the case of different perennial crops and examining to what extent the problem of producers' income instability has been addressed.

(2) Developing a suitable analytical framework to examine the newplanting and replanting responses of rubber growers of Kerala.

(3) An overview of salient features of Indian rubber economy and a detailed study on the macro-level behaviour of newplanting and replanting by using the framework developed.

(4) A micro-level study of the newplanting and replanting behaviour of small holders of rubber in Kerala with the following intentions:

   (a) Exploring whether there is any empirical evidence of the prevalence of the two responses, viz., staggered replanting and adjusting of output stream in relation with the cyclicality of price.

   (b) Examining whether staggered replanting is constrained by the size of the holding.

   (c) Measuring the extent of income stability that could be realised in the case of staggered planting.

1.3 Database

The study is based on a sample of rubber small holdings suitably chosen. In the selected sample, there are holdings having trees with only one age group as well as holdings having trees with more than one age group.

The sample chosen is Poonjar South village in Meenachil Taluk.[1] This region was purposively chosen. The macro-level data on yearwise newplanting of rubber in India, exhibited a boom from the late seventies and a slow-down from the mid-eighties.[2] This macro-level phenomenon is reflected in the chosen region and hence the region is a good representative of the population. Moreover, different size classes of holdings have got representation in the region, so that the problem could be examined across different size groups.

During 1992-93, Rubber Board had carried out a survey in this region as part of a census on rubber in Kerala and Tamil Nadu. Areas as on 31st March 1992 and other particulars corresponding to the year 1991-92 have been collected during the survey. Area owned by each grower with disaggregation into years of planting, pre-mature and mature, new planted and replanted and planting materials used are important entries in the schedule of the survey. The

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1 The largest rubber producing district in Kerala State is Kottayam. Poonjar south village comes under Meenachil Taluk of Kottayam district. The village is located about 60 kms. away from Kottayan town in the north-east direction.

2 To be discussed in detail in Section 3.7.

format of the schedule is given as Appendix 1.1. The above primary level data were collected from these reports.

Age-wise yield profile of planting materials of rubber is another important data required. The Agricultural Economics Division of the Rubber Research Institute of India undertakes continuous evaluation of different planting materials of rubber. The latest report, based on yield statements furnished by 40 large estates, covers 21 planting materials including RRII-105. Though RRII-105 is the most popular variety in the sample region, its yield profile is available only for the first 10 years of tapping. Among this, the last two figures are based on single observation only. Due to this limitation, we have used mean yield of all the 21 varieties instead of taking the yield profile of RRII-105.

Small growers sell rubber mostly in the form of ungraded sheets.[3] So average market price of ungraded sheet rubber at Kottayam market is used for the study. This was collected from various issues of Indian Rubber Statistics, published by the Rubber Board.

1.4 Outline of the Study

This dissertation is organised as follows: Following this introductory Chapter, a review of related studies and the development of a suitable framework to understand the macro-level newplanting and replanting behaviour is carried out in Chapter 2. Chapter 3 is an overview of the Indian Rubber Economy with special

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[3] Unny and Jacob (1972).

reference to the newplanting and replanting behaviour. The two likely responses of growers towards output instability are staggered replanting and postponement of replanting to the downward phase of price.In Chapter 4, using primary-level data, these responses are examined and income stream corresponding to different strategies are discussed. Finally Chapter 5 presents the summary and findings.

CHAPTER 2

AN ANALYTICAL FRAMEWORK OF THE STUDY

2.1 Introduction

Income instability arises out of instabilities in output and price. In the case of perennial crops, output is determined by producer's long-run responses like newplanting and replanting decisions as well as short-run responses like harvesting strategies and utilization of factor inputs. An understanding of the behaviour of these long-run and short-run responses is of importance when studying variations in output. Economic literature is rich with studies on these aspects of perennial crops. In this chapter a selected review of the studies is followed by formulating the key issues.

The Chapter is organized into four sections. Section 2.2 carries out a critical review of the inter-relationship between newplanting, replanting and price, observed by earlier studies in the case of different perennial crops and raises the issue of producer's income instability. Based on these studies, an analytical framework to visualise the newplanting and replanting behaviour in relation to price in the case of rubber small holdings of Kerala is developed in Section 2.3. Section 2.4 is the conclusion.

2.2 Selected Review and Key Issues

Hartley et.al. (1987) analysed the replanting responses of growers against price movements, in the case of natural rubber in Sri Lanka. While taking a decision to replant rubber trees of a given age, rubber growers compare the current net revenue and present value of expected net revenue per unit area from the existing trees to the corresponding figure of the proposed replanted area, over some planning horizon.

The replanting response was analysed by expressing its rate as a function of actual price of rubber, long-term expected price of rubber and area eligible for replanting during each year. The empirical analysis led to the conclusion that replanting response with respect to long-run expected normal price is significant and positive with elasticity +1.7. If the current price is high, the loss in income due to the uprooting of trees would be high and hence growers are likely to prolong the replanting activity. So one should expect a significant negative replanting response to current price. The relationship obtained was, however, negative but small and insignificant. The replanting response may be different for different holding-sizes. In Sri Lanka around fifty percent of the total area under rubber is shared by large estates of size 40 hectares and above. The insignificant replanting response to current price can be due to this specific structure. But in India the production of natural rubber is predominated by small holdings, the average size of which is only 0.50 hectare. So a different replanting behaviour is expected in the case of India.

Factors governing newplanting and replanting decisions were separately studied by Trivedi (1991) in the case of Brazilian cocoa. The period covered by the study is 1966 to 1985. The analysis was based on the first-order condition of revenue maximisation that present value of net marginal expected revenue from additional investment equals the marginal cost of investment. The elasticity of newplanting with respect to price is +1.60.

The dynamics of replanting is more complex than that of newplanting. The elasticity of replanting with respect to price of cocoa was decomposed into the following three factors:

(i) Due to an increase in price, trees which were uneconomic earlier become economic even without any increase in output. This encourages producers to increase the economic life of trees by postponing the replanting. The corresponding short-run elasticity is -4.4.

(ii) Higher price encourages producers to raise yields on all existing capital and this tends to depress replanting. The resulting short-run elasticity is -1.3.

(iii) There is a long-term positive effect due to improved yield and profitability. The elasticity of this is +7.4.

The above three elasticities produce a total replanting elasticity of +1.7, which is almost equal to the newplanting elasticity. Though replanting is related negatively to price in the short-run, the long-term positive effects of improved profitability dominates the short-run negative effects. So in effect the newplanting and replanting responses to price movements are equal.

Umadevi (1981) studied the short-run and long-run supply responses to the price in the case of natural rubber in India, covering the period 1955 to 1980. The short-run supply elasticity refers to harvesting decision, while the long-run supply elasticity refers to planting decision. In the case of small holdings, the short-run elasticity of supply is only 0.578, which is positive and less than 1. This observation is in line with what we expect in the case of perennial crops. But the corresponding figure in the case of estates is -0.345, which is negative and very small. In the case of estates, trade unions and other rigidities render it uneconomical to withdraw any labour force to reduce production in response to a fall in price. Long-run supply elasticities were estimated by taking both estates and holdings together. In the case of long-run supply (planting decisions), there is positive response to price only if prices, as far back as seven years are taken into consideration. Otherwise there is a significant negative relationship between price and newplanting activity. But the study did not cover the replanting behaviour, which is the major issue in the present study.

For different age group of trees, replanting response to price movements may be different. This was examined in the case of Cling Peach Trees of California, by French and King (1985). The period covered by this study is 1956 to 1980. Peach tree starts bearing fruits at the age of two, but comes to the full-yielding stage only at the age of four or five years. The normal life of the tree is about twenty years. The study concluded that when current returns are increased, the rate of replanting was reduced in all age

groups, but more significant reduction was observed among trees of age sixteen years and above.

French and King also examined the rate of newplanting of cling peach trees, with reference to market intervention programmes. The elements of risk and uncertainties involved in the production of perennial crops are high. Uncertain market condition is not a favourable climate for prospective investors. Market intervention programmes are aimed to ensure a guaranteed minimum price for the produce. It has been observed that the rate of newplanting was higher when market intervention programmes were in effect, compared with those after the termination of the programme.

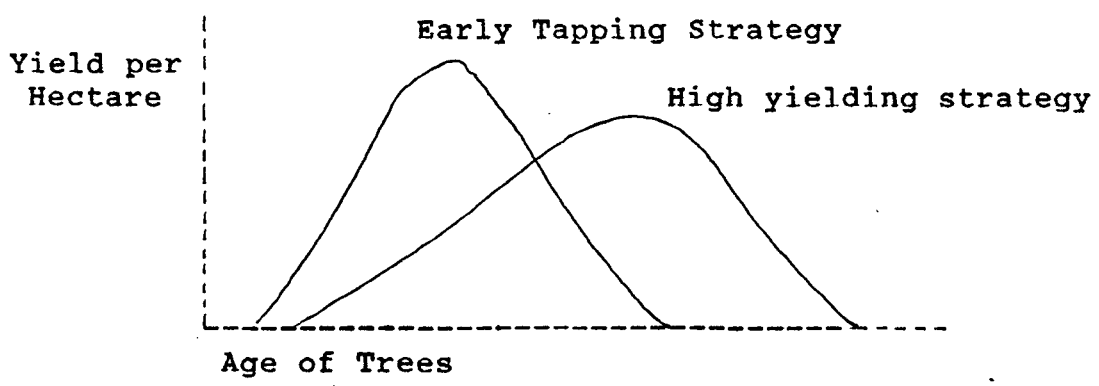
Positive acreage response to price was observed in the case of cardamom plantations of Kerala by Nair et.al. (1989). Cardamom plant starts yielding by the third year and reaches the normal level of yield by the 5th or 6th year. The analysis of the price of cardamom over the period 1954 to 1986 depicted cyclical behaviour with the length of upswing being about six years. Once farmers ascertain an upswing in price, they respond to it by bringing new areas under the crop by replanting or newplanting. Since data on planted acreage in terms of newplanting and replanting was not available, the observation was based on production figures with suitable adjustment for the gestation lag. Due to the limitation of the data, the study did not examine the newplanting and replanting responses separately.

Harvesting strategy adopted by growers availing credit facilities from government and financial institutions has been

examined by Gersovitz (1992). The study is based on the amortization schedule of such credit facilities for small holdings of natural rubber in Indonesia. In the light of this amortization schedule, the study compared two different tapping strategies, viz., high-yielding tapping strategy and early tapping strategy.

In the high-yielding tapping strategy, growers are interested in maximising the total yield which could be obtained over the whole life span of trees. In the sample study, the output over the whole life-time in this strategy is 24,250 kg. per hectare. In early tapping strategy, growers are interested in heavy early tapping without concern about the latter yield. They tap rubber trees more frequently to extract maximum yield at the earliest. Due to this excessive tapping, there is more production upto the 12th year of tapping, compared with the high-yielding strategy. But from 12th year onwards, output is substantially less than the corresponding output of high-yielding tapping strategy. The total life-time yield in this strategy is only 70% of the corresponding figure in the former case. Diagramatically the outputs corresponding to the two cases are as depicted in Figure 2.1.

Figure 2.1: Output stream of Two Different Tapping Strategies



Though the early tapping strategy provides only 70% output of the high yielding strategy, the discounted present value of income in this strategy is higher than that of the latter. So the study concludes that early tapping strategy is more beneficial for growers.

In the early tapping strategy, the life length of tree is less. Since replanting is done more frequently, occurance of gestation gaps (which is a period having no output) is also frequent. So when examined over a long-run, the grower has more number of years having no output and hence income instability is likely to be more severe. In addition to the two replanting strategies specified, there is a third option, viz., the staggered replanting. in which replanting is done in steps. In the light of the amortization schedule, is staggered replanting more beneficial than the other two strategies? Consider the case of a grower who is completely dependent on rubber. Will he opt for maximising the present value of net income which involves frequent gestation gaps, or will he go for a replanting strategy which ensures a stable level of income throughout?

In sum, the studies bring out interrelationships between newplanting, replanting and price of different perennial crops. In almost all the studies, positive newplanting response to price has been observed. But in the case of replanting behaviour, studies on different crops gave different results depending on the structure of the particular crop economy. The problem of producers' income instability was not addressed by any of these studies, though they have addressed income maximisation taken as present value. In the

light of this, we seek to develop a framework to study the newplanting and replanting behaviour of rubber small holdings of Kerala in relation to the price movement of rubber. This is discussed in Section 2.3.

2.3 A Framework of the Study

Two likely responses of rubber small holdings to the problem of their income instability were pointed out in Section 1.1. One is adjusting the output stream by the grower in accordance with the price cycle and the other is staggered replanting. 83 per cent of the production of natural rubber in India is shared by small holdings, the average size of which is less than 0.50 hectare. Staggering is expected to be constrained by the size of the holding and hence for holdings of very small size, the likely response should be the former.

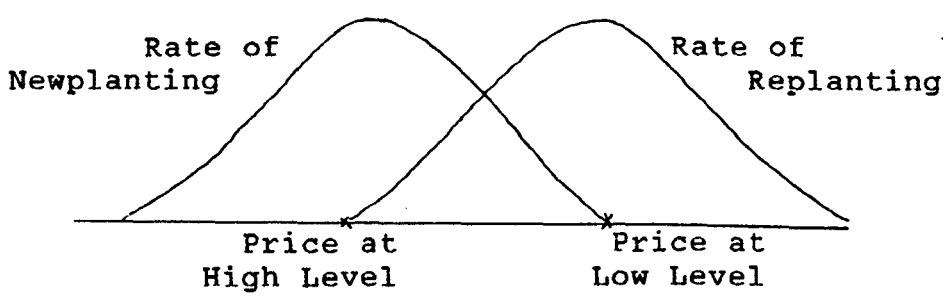
If the long-term movement of rubber price is cyclical, growers can take advantage of it by adjusting the newplanting and replanting activities suitably. An increase in the price of rubber increases the profitability of growers and hence it is an incentive for bringing more areas under rubber. So the newplanting activity is expected to be at a higher rate during the phase of an upswing in price.

In the case of replanting, an entirely different pattern is expected. An increase in price, increases the profitability of the farmer and hence it is an incentive for him to retain aged trees by postponing the replanting and continue tapping for some more years.

The grower will be better off, if this replanting is done during the low phase of the price cycle. Because of this, growers are likely to postpone replanting from an upward phase of price to a downward phase. So, when an upswing happens in the price cycle, the replanting activity is expected to be at a low level. The postponed replanting is likely to take place when the price comes down to a lower level. Consider a situation where the price is ruling at a low level and is expected to increase at a later date. Growers may make use of this opportunity to replant their low-yielding areas so that when the expected phase of upswing in price comes, this would be yielding. This will take care of loss of income arising out of price falls. So, at the low phase of the price cycle, a higher rate of replanting is likely to take place.

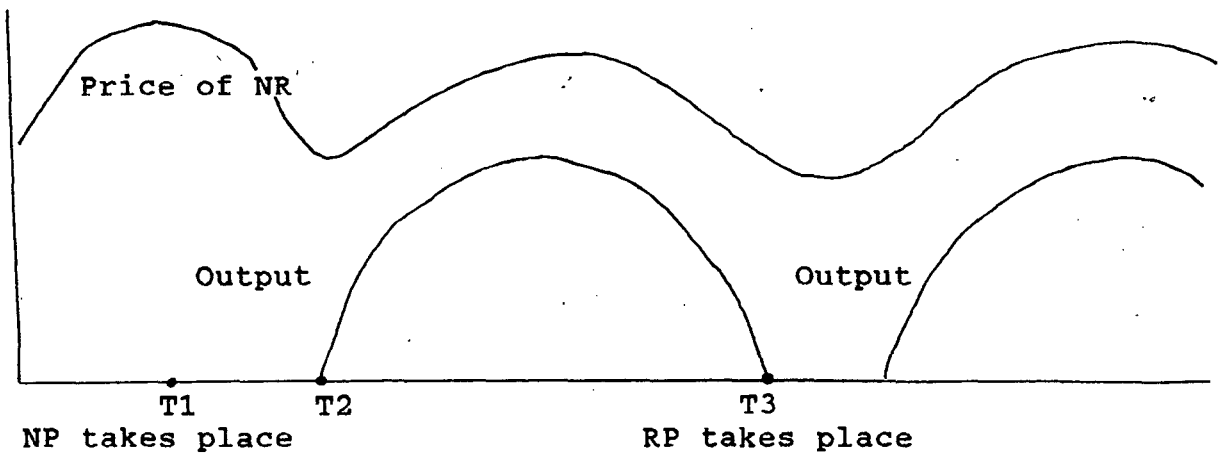
The conclusion is that newplanting and replanting activities are likely to take place in two different phases and the two activities are not expected to move synchronously. A boom in newplanting is expected during the upward phase of the price cycle and during this period the replanting activity should be at a low rate. Replanting boom is likely to occur a few years later, coincident with the trough of the price cycle. The expected pattern of newplanting and replanting activities in relation to the output price is depicted as Figure 2.2.

Figure 2.2: Phases of Newplanting and Replanting



In such a situation, the movement of output and price will be as shown in Figure 2.3.

Fig. 2.3: Output Stream Adjusted According to Price Cyclicality



At time T1 the price is at the upward phase of the cycle which is incentive for bringing new areas under rubber. For trees newplanted at this point of time gestation period coincides with the downward phase of the price cycle and start yielding by the time T2, when the price improves . For these trees when the yield comes down, a suitable time for executing replanting is a declining phase of the price cycle (T3). If replanting is carried out at this point of time, the gestation period of the replanted trees coincides with the low phase of the price cycle and the trees start yielding by the time price improves again. This way of newplanting and replanting enables the grower to guard against losses arising out of price falls and to take the advantage of increases in price.

2.4 Conclusion

A new entry into the field of rubber cultivation takes place by way of newplanting and the entry condition is the high level of

rubber price. But, once entered, in the next round the grower postpones the replanting to take advantage of the cyclical price movement. But, does this take place among rubber growers in Kerala? An empirical examination of this question at the macro-level, using acreage data on newplanting and replanting during each year is carried out in Chapter 3.

CHAPTER 3

NATURAL RUBBER ECONOMY OF INDIA
Some Macro Level Observations

3.1 Introduction

A discussion of major characteristics of rubber tree and the important features of Indian natural rubber economy is useful for a clear understanding of the newplanting and replanting behaviour. The next Section discusses the important characteristics of rubber tree as a perennial crop. Following a brief account of the World rubber economy in Section 3.3, the present size and structure of the Indian rubber economy and its special features in the international arena are discussed in Section 3.4. Section 3.5 discusses the regulatory framework of the Indian rubber market. An analysis of the long-term trend of the real price of rubber is carried out in Section 3.6. Following this, the macro-level behaviour of newplanting and replanting of rubber is empirically examined in Section 3.7. Section 3.8 is the conclusion.

3.2 Rubber Tree as a Perennial Tree Crop

Natural Rubber (NR) is an important agricultural commodity produced from Hevea Brasiliensis, which is a perennial tree crop.[1] It is a major raw material of over fifty thousand varieties of manufactured products. NR is obtained in the form of latex from

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[1] Natural Rubber is found in the latex of over 895 species of plants. But Hevea Brasiliensis is the most important commercial source of natural rubber.

the bark of the tree by tapping. It is a process of "controlled wounding" during which thin shavings of barks are removed. The latex is processed mostly in the form of dried sheets, which are of different grades depending on quality. In India these sheets are called RMA sheets.[2]

Rubber tree has got a gestation lag of five to ten years. For polybagged planting materials of high yielding varieties (HYV), the gestation lag is only five to seven years. If trees are well cared during their pre-maturity period, fertilised and weeded, they reach the tappable girth more quickly. During the initial yielding stage, over a period of three to five years, yield shows an increasing trend. For the next six to eight years it remains more or less steady at a maximum level. Thereafter, the yield begins to decline and reaches an uneconomic level. The increasing phase, stabilisation phase and the declining phase vary from clone to clone and agro-climatic conditions. It is also determined by planting density, tapping system followed and tapping skill.

3.3 World Rubber Economy

Indian rubber economy has got some distinct features compared with the International rubber economy, a discussion of which may be useful as a background.

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[2] More than 70% of the crop is processed in the form of dried sheets. Grading of sheets is done according to the standards published by Rubber Manufacturers Association (RMA) Inc., Washington in the Green Book. RMA IX, RMA 1, RMA 2, RMA 3, RMA 4 and RMA 5 are the six grades of sheets.

Three-fourths of the world production of NR is shared by three countries, viz., Thailand, Indonesia and Malaysia. The country-wise shares during 1992 were Thailand (27%), Indonesia (25%) and Malaysia (22%). For the three major producing countries NR is an export commodity and a major source of foreign exchange earnings. During 1992, Thailand and Indonesia exported 92% of their production of NR and for Malaysia, the corresponding figure was 77%.

As per the statistics of 1991, USA shares 15% of the world consumption of NR and it is the largest consumer of NR in the world. Other prominent consuming countries are Japan (13%), China (12%), India (7%) and the Republic of Korea (5%).

Synthetic Rubber (SR) is a substitute for NR in many end uses. (In the international market, there is a competition between NR and SR and hence the price of NR and the cost of production of SR are not much different.) The main raw material for the production of SR is petroleum and hence variations in petroleum price has an impact on the cost of production of SR, which inturn affects the demand for NR due to the substitution effect. Hence, the extent of production of SR and its price influence the price of NR in the international market. During 1993, the share of NR in the total elastomer consumption of the world was only 38%. The remaining 62% was shared by SR. It has been observed that the share of NR is gradually going up over the years.

3.4 Structure of Indian Rubber Economy

Commercial production of NR started in India during 1902. During the early period, production was largely contributed by estates. But later the number of small holdings increased and from 1968 onwards production is predominated by small holdings.[3] During 1992-93, 83% of the production was shared by small holdings, numbering more than eight lakhs.

Kerala and Tamil Nadu are the traditional rubber growing areas in India. These two states account for 97% of production of NR in the country. Expansion of the area outside the traditional belt, especially in the North-Eastern region is a recent phenomenon. The geographical distribution of the area under rubber, production and productivity during 1992-93 is shown below:

Table 3.1 : Geographical Distribution of Area and Production

	Total Area under Rubber (Hect.)	Tapped Area (Hect.)	Production (tonnes)	Productivity (kg/ha/year)
Kerala	428864 (85.9)	316760 (92.9)	368648 (93.7)	1164
Tamil Nadu	17260 (3.4)	12310 (3.6)	14250 (3.6)	1158
Karnataka	14650 (2.9)	7872 (2.3)	7910 (2.0)	1005
Others	38600 (7.8)	4038 (1.2)	2682 (0.7)	664
India	499374(100.0)	340980(100.0)	393490 (100.0)	1154

Note : Figures in the parenthesis represent percentages
Source: Indian Rubber Statistics, Vol. 20.

In the early period, the entire rubber produced in the country was exported because there was no domestic demand. Due to the

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[3] A rubber growing unit having an area of less than 20.23 hectares (50 acres) is called small holding. But the average size of a small holding in India is less than 0.50 hectare.

implementation of the International Rubber Regulation Act (IRRA) in 1934 and the consequent curb on export, a large quantity of rubber got accumulated in the country and this created a favourable climate for the growth of rubber-based manufacturing industry in the country. The expansion of the manufacturing industry after independence was so rapid that by 1948 the demand exceeded production. The trend in production and consumption from 1950-51 onwards is given in Appendix 3.1.

In major producing countries, barring China, rubber-based manufacturing industry has not developed to the extent it has developed in India. While NR is largely exported in major producing countries, in India production is only sufficient to meet the industry's growing demand.

More than 60% of the consumption of NR is shared by a limited number of big manufacturers, which includes tyre as well as non-tyre units.[4] These large units have a very powerful role in

Table 3.2 : Productwise Consumption of NR

Product	% to total consumption of NR
Automobile tyres and tubes	45
Cycle tyres and tubes	14
Footwears	10
Tread Rubber (Camel Back)	7
Belts and Hoses	7
Latex Foam	5
Dipped Goods	4
Others	8
Total	100

Source: Indian Rubber Statistics, Vol. 20.

[4] See Rubber Statistical News, Vol. 51, No.6, p. 4. During 1991-92, 33 units accounted 60% of the consumption of NR.

influencing the market and hence the market is oligosponic. About 59% of the consumption of NR in the country is for the manufacturing of tyres and tubes of automobiles and cycles. The consumption pattern of NR during 1992-93 is shown in the above Table (Table 3.2).

The very high degree of concentration observed in the geographical distribution of production of NR is not seen in the case of consumption. Major consuming states and their share in the total NR consumption of the country during 1992-93 were Kerala (13%), Punjab (13%), Maharashtra (12%), Uttar Pradesh (11%) and West Bengal (9%). Though Kerala accounts for about 94% of the country's total production of NR, its share in the consumption is only 13%.

In India, the share of NR in the total consumption of NR and SR is 79% and over the years there is no substantial change in it. This feature is contrary to the world phenomenon, in which the share of NR is only 38%. In India, the price of SR is almost twice that of NR and hence substitution of NR by SR is not economic. Import of SR to India is regulated with barriers in the form of heavy import duty. Thus, India's rubber economy is distinct from the other producing countries and the structure and behaviour of the domestic market is distinct from the world market.

3.5 The Regulatory Framework of Indian Rubber Market

As part of an overall import control regime, several import restrictions have been in effect as a policy of price protection

given to NR. In 1956 Government of India had ordered that the manufacturers should pay to the Rubber Board the price differential between imported and domestic rubber so that the manufacturers would get NR at the same cost in India. Manufacturers of rubber goods were allowed to import rubber directly to the extent indicated in the licence issued to them. The system continued upto the close of 1960s. But this resulted in the untimely import of rubber by manufacturers and hence it was discontinued. During 1968 the State Trading Corporation of India Ltd. (STC), a public sector undertaking of the Government of India was entrusted with the responsibility of import of NR and to regulate the supply so that the gap between supply and demand is bridged and growers are not adversely affected.[5] This was done by adjusting the import duty in such a way that STC's release price of rubber is much higher than the domestic price.

Thus, it is seen that high import duties, both for synthetic and natural rubber, import licensing, foreign exchange shortages and the presence of STC have effectively isolated the Indian rubber economy from the world market. It may be concluded that the Indian rubber market is distinct from the world market and is insulated from the rest of the world.

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[5] From 1982 onwards a separate scheme called export promotion scheme has been operated. Under this scheme, duty-free import of raw materials required for the purpose of export production would be permitted. This facilitates exporters of rubber products to direct duty-free import of rubber to the extent used for manufacturing the product exported.

3.6 Price Movement of Rubber

This Section is devoted to an analysis of the long-term behaviour of real price of rubber. It was mentioned in Section 1.3 that small growers usually dispose of their rubber in the form of ungraded sheets. Their farm-gate price is likely to be slightly

Table 3.3: Price of Ungraded Sheet Rubber (Rs./Qntl.)

Year	Deflator (WPI)	Current Price(Rs.)	Real Price(Rs.)
1964-65	23.6	301	1275
1965-66	25.4	301	1185
1966-67	28.9	301	1042
1967-68	32.3	347	1074
1968-69	31.9	466	1461
1969-70	33.1	501	1514
1970-71	34.9	464	1330
1971-72	36.9	421	1141
1972-73	40.6	459	1131
1973-74	48.8	515	1055
1974-75	61.1	849	1390
1975-76	60.4	744	1232
1976-77	61.7	596	966
1977-78	64.9	632	974
1978-79	64.9	953	1468
1979-80	76.0	1016	1337
1980-81	89.9	1212	1348
1981-82	100.0	1431	1431
1982-83	104.9	1409	1343
1983-83	112.8	1708	1514
1984-85	120.1	1587	1321
1985-86	125.4	1661	1325
1986-87	132.7	1592	1200
1987-88	143.6	1726	1202
1988-89	154.3	1745	1131
1989-90	165.7	2057	1241
1990-91	182.7	2023	1107
1991-92	207.5	1975	952
1992-93	228.7	2420	1058
1993-94	250.7	2437	972

WPI:Wholesale Price Index(All Commodities), Base:1981-82=100
Source:Indian Rubber Statistics (Various Issues) and Index Numbers of Wholesale Prices in India (Various Issues)

less than the published price of ungraded rubber. But data on farm-gate price is not available for sufficiently long period.

Hence the analysis is based on data corresponding to ungraded sheet rubber.Average price of ungraded sheet rubber at Kottayam market for the last 30 years is given in Table 3.3. Corresponding to each year, real prices are obtained using wholesale price indices (all commodities) as deflator.

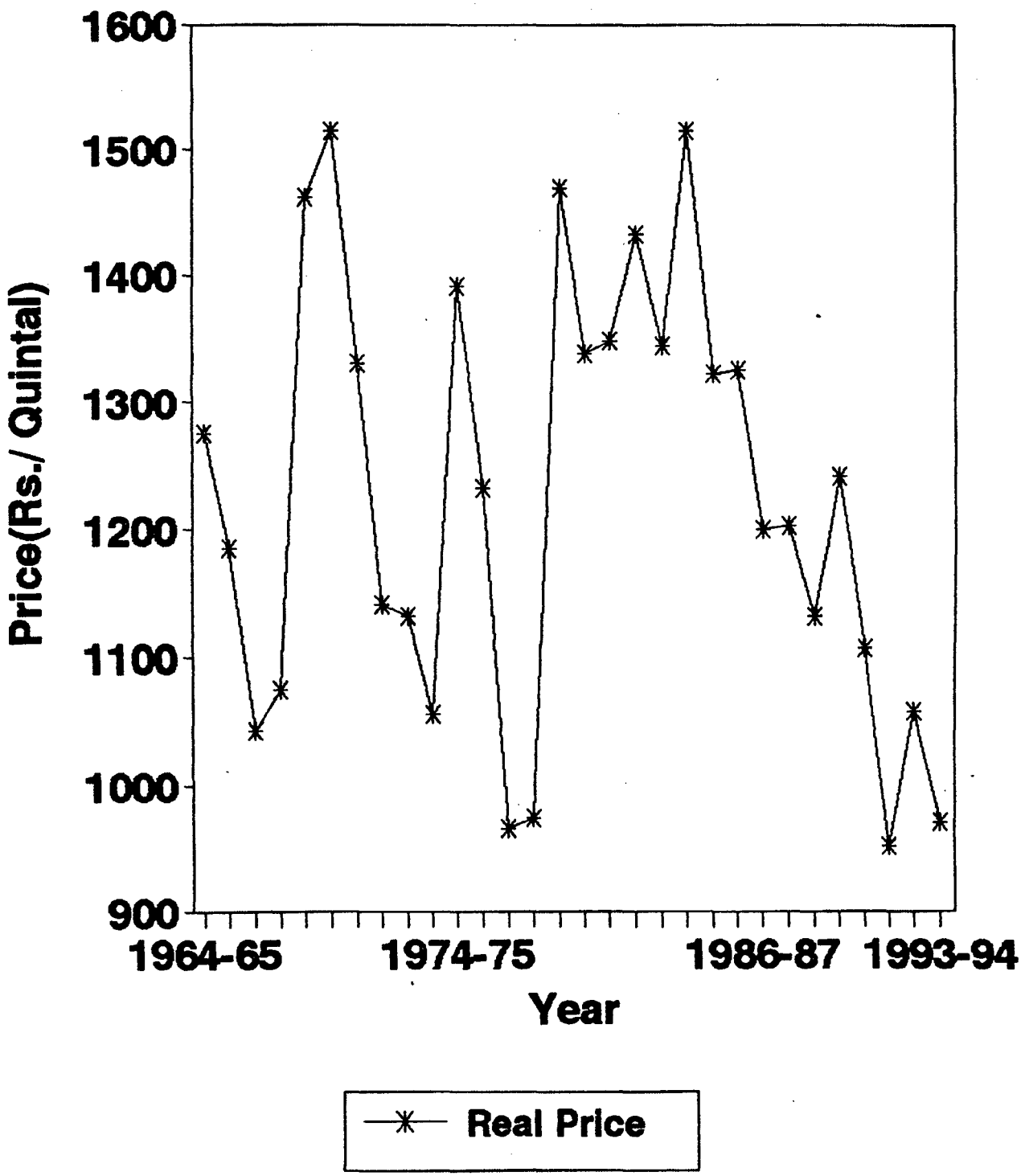
The long-term behaviour of real price is depicted as Figure 3.1. A cyclical movement of price may be seen in the Figure. Accordingly, the period from 1968-69 may be divided into the following four phases.

Phases	Period	Average Real Price (Rs.)	Level of Price
I	1968-70	1435	High
II	1971-77	1127	Low
III	1978-85	1386	High
IV	1986-93	1127	Low

Though there are low as well as high phases in the price movement, the extent of price variation is not so high. The coefficient of variation of the yearly average price from 1968 to 1993 is only 13%.

Inorder to avert abnormal falls in rubber price and to ensure a guaranteed minimum price for farmers, various price supporting mechanisms have been operated in India. During the period from 1942 to 1946 it was in the form of monopoly procurement of rubber by the government at a statutory price. From December 1947 to September 1981 it was in the form of statutory minimum notified price based on Tariff Commission's various reports. Together with the minimum price, maximum price was also notified. At least the

Fig 3.1:Price Movement
(Real Price of Ungraded Rubber)



prevention of extreme decline of prices and thereby provision of an income guarantee for growers seems to be the important goal. The mere fact that minimum prices have been effective almost continuously suggests a higher priority for maintaining minimum prices. During the 1970s, when there was a glut and consequent pessimism in the domestic market of NR, price support operations were carried out by STC by procuring NR from the market and exporting it. In the mid-eighties the domestic price of NR registered a sharp decline and as a remedy Government of India introduced a buffer stocking scheme for NR for the first time in India. The scheme, after several revisions, was under operation till May 94. Under the buffer stocking schemes, the fair prices and its upper and lower bands announced for RMA-4 grade of sheet rubber at various occasions are given below:

Table 3.4 : Fair Prices under Buffer Stocking Scheme

Effective from	Fair Price (Rs. per Quintal)	Upper Band	Lower Band
Feb. 1986	1650	1700	1600
May 1987	1700	1750	1650
Sep. 1988	1780	1830	1730
Jan. 1991	2145	2195	2095
Jan. 1993	2345	2395	2295
Feb. 1994	2490	2540	2440

Source: Statistics & Planning Department, Rubber Board.

The objective of the bufferstocking scheme is to stabilise the price at a level which is remunerative to growers and fair to consuming industry. The movement of market price of rubber during this period is depicted as Figure 3.2. It is seen that the market price did not fall below the lower band. But in several occasions

Fig 3:2

Market Price & Buffer Stock Price
(Rs./ Quintal of RMA-4)

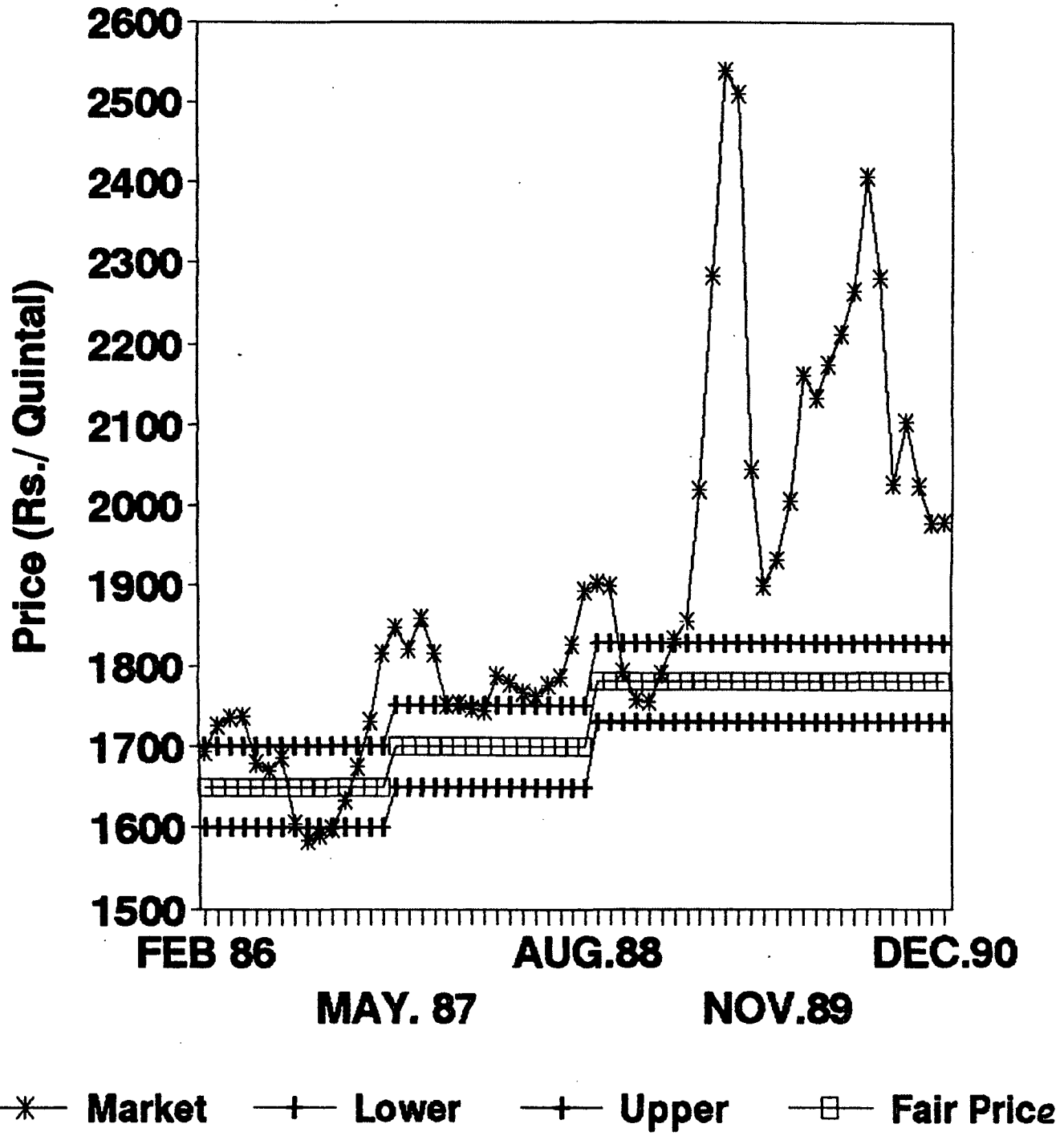
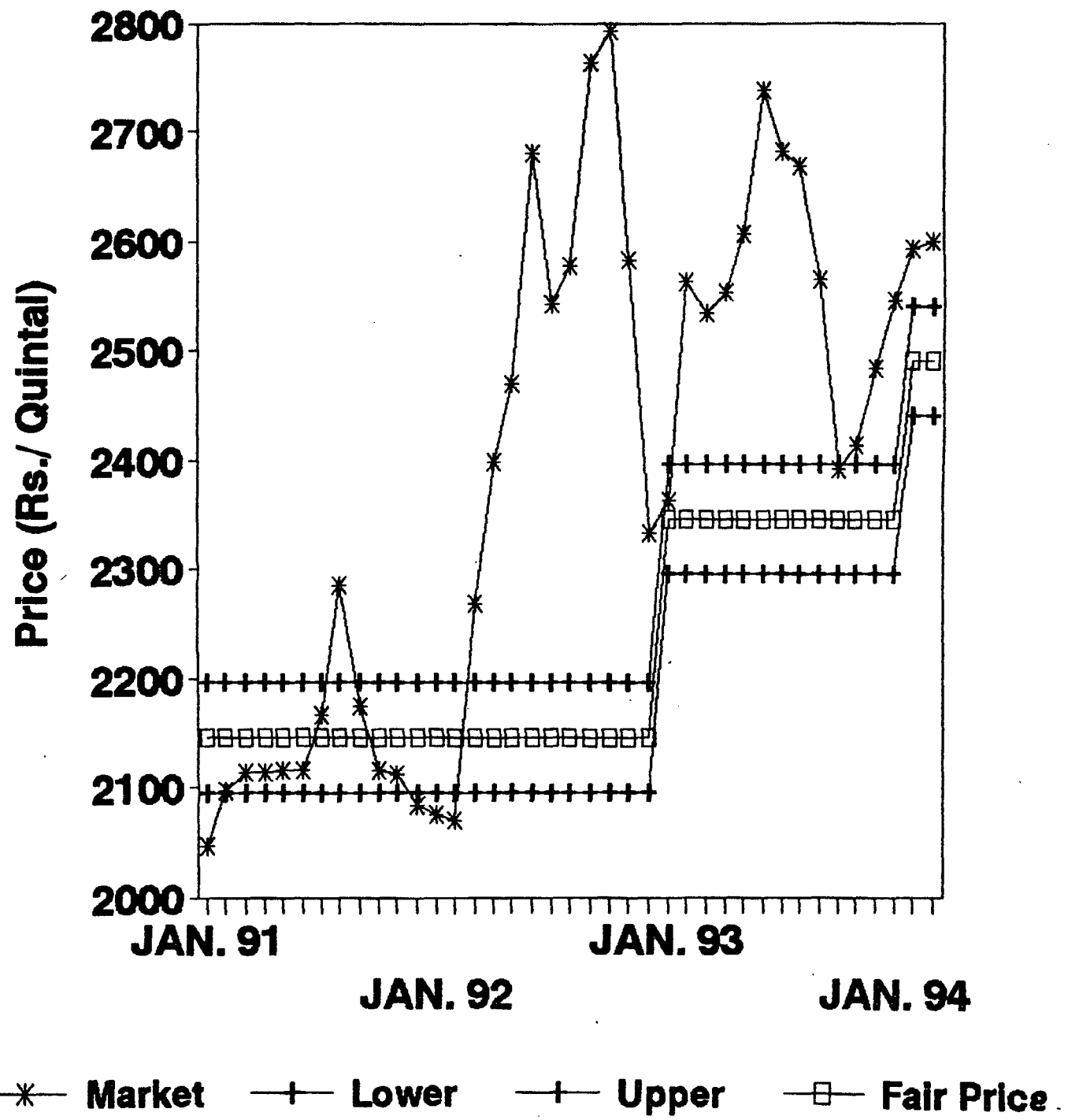


Fig 3:2

Market Price & Buffer Stock Price
(Rs./ Quintal of RMA-4)



it went far above the upper band and hence the scheme could not confine the price between the two bands. Since the price always ruled above the lower band, it may be concluded that growers were not adversely affected.

3.7 Macro-level Trend in Newplanting and Replanting

In the case of perennial crops, the short-run supply elasticity is small. The long run supply elasticity depends critically on the replanting and newplanting responses to price changes.[6] Let us examine the trend in newplanting and replanting of rubber in relation to price movements. The extent of area newplanted and replanted with rubber in each year from 1955 is given as columns (ii) and (iii) in Table 3.5. This macro-level data shows wide fluctuations in newplanting and replanting and it may be seen that the two do not always move synchronously. This suggests that the behavioural aspect behind these two activities are different.

The period from 1955 to 1992 may be classified into the following three sub-periods with reference to newplanting activity.

Period	Average Rate of Newplanting per year (Hectares)
1955-62	12,250
1963-77	5,200
1978-92	17,300

Source: Compiled from Indian Rubber Statistics, Vol. 20

[6] Newplanting means planting of rubber on virgin land or land previously used for other crops. Replanting means planting of rubber after removing the rubber trees planted earlier.

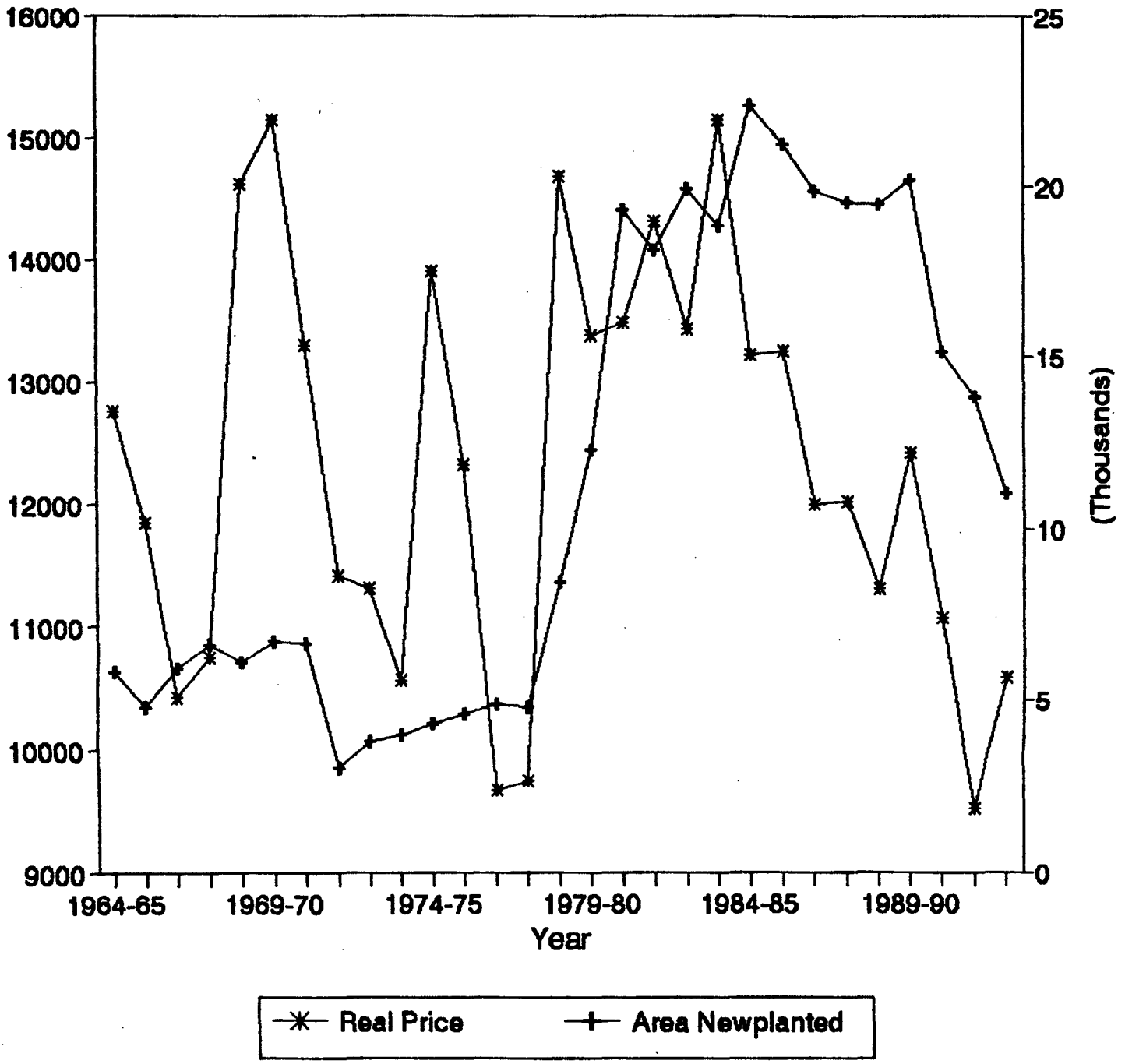
It is seen that the newplanting activity registered a sharp decline during the period from 1963 to 1977, but it recovered and registered a boom during the late seventies. The trend in the newplanting activity against the movement of real price of rubber is depicted as Figure 3.3. The Figure shows that the rate of

Table 3.5: Trend in Newplanting and Replanting

Year (i)	Area new planted (ii)	Area re planted (iii)	RP as % of NP Before 15 Yrs. (iv)	RP as % of NP Before 20 Yrs. (v)	RP as % of NP Before 25 Yrs. (vi)
1955-56	9342	719			
1956-57	12030	737			
1957-58	14278	1394			
1958-59	12605	1874			
1959-60	9963	1641			
1960-61	12104	1385			
1961-62	14485	2446			
1962-63	13222	2499			
1963-64	6551	2309			
1964-65	5800	2692			
1965-66	4749	4163			
1966-67	5886	4039			
1967-68	6614	2905			
1968-69	6079	1905			
1969-70	6709	1920			
1970-71	6655	2089	22		
1971-72	3044	1473	12		
1972-73	3775	1704	12		
1973-74	3975	1576	13		
1974-75	4310	2200	22		
1975-76	4561	3099	26	33	
1976-77	4882	3172	22	26	
1977-78	4770	3645	28	26	
1978-79	8450	4050	62	32	
1979-80	12300	4065	70	41	
1980-81	19308	5476	115	45	59
1981-82	18100	4188	71	29	35
1982-83	19884	4963	75	38	35
1983-84	18805	5641	93	86	45
1984-85	22365	5217	78	90	52
1985-86	21222	5759	87	121	48
1986-87	19856	5563	183	95	38
1987-88	19535	6517	173	99	49
1988-89	19471	6998	176	115	107
1989-90	20175	6854	159	102	118
1990-91	15143	7154	157	107	151
1991-92	13851	7400	152	243	126
1992-93	11000	7400	155	196	112

Source: Indian Rubber Statistics, Vol 20

Fig 3.3:Newplanting Response to Price
(Price of Ungraded Rubber)



newplanting is in accordance with the direction of movement of price. Attractive price is an incentive for converting virgin land and land occupied by other crops to rubber plantation and hence newplanting activity registered an increase.

Inorder to study the trend in the rate of replanting, we use an indicator which expresses the actual rate of replanting as a percentage of the expected level of replanting. The area expected to be replanted during each year is obtained by making arbitrary assumptions on life length of tree. Initially 15 years life length is assumed. The expected level of replanting during each year is the area newplanted 15 years back. If the expected values are equal to the actual values, the indicator mentioned above will take the value 100. Values of the indicator corresponding to the assumption of 15 years life length is given as column (iv) in Table 3.5. For a number of years in the beginning, the indicator takes values much below 100 and after a certain number of years it takes values much above 100. Since the assumption of 15 years life length is arbitrary, a similar exercise was carried out with assumptions of 20 years and 25 years life span. The observation was consistent with all the three assumptions (columns (v) and (vi) of Table 3.5). This brings out an important behavioural aspect of rubber growers, majority of whom are small holdings. Since the above indicator registered a value much less than 100 for a number of years in the beginning, it has two implications; either a good portion of earlier plantations went out of rubber cultivation or replanting might have been prolonged to future periods. Since the indicator took the value above 100 for a number of years at a later

stage, it supports the hypothesis of postponement of replanting activity.

Let us now examine the trend in the replanting activity against the movement of the deflated price. The indicator mentioned earlier was used for this purpose. It was observed that during the late seventies when the real price was prevailing at a high level, the rate of replanting was low. During the period from the mid-eighties, when the real price was at low level, the rate of replanting was high. The boom in replanting happened during the downward phase of the price cycle. The strength of the relationship between the real price and the rate of replanting may be estimated by using the following regression equations.

$\text{Ln } R_t = a + b \text{ Ln } P_t$ and

$\text{Ln } R_t = a + b \text{ Ln } P_{t-1}$, where R_t is the indicator representing the replanting activity during the year t and P_t is the real price of ungraded rubber during the year t. For values of R_t corresponding to 25 years life length, following relationships were obtained.

$$\text{Ln } R_t = 7.8796 - \underset{(t = 3.85)}{0.1820 \text{ Ln } P_t}, \quad R^2 = 0.5735$$

$$\text{Ln } R_t = 7.7979 - \underset{(t = 3.17)}{0.1591 \text{ Ln } P_{t-1}}, \quad R^2 = 0.5735$$

So, in both cases the coefficient of the independent variable is negative and is statistically significant at 1% and 5% levels. So the replanting trend was just opposite to the direction of movement of price.

The macro-level data on newplanting and replanting (Table 3.5) is inclusive of small holdings as well as estates. However, in India, 83% of the production of NR is contributed by small holdings numbering more than eight lakhs, and having an average size of less than half of a hectare. Since large growers share only 18% of NR production, the above observation brings out an important behavioural aspect of small holdings rather than estates.

3.8 Conclusion

To conclude, it was shown that the Indian rubber economy has got some distinct features when compared with the international rubber economy. Since the Indian rubber market is an insulated one, with tariff barriers and import restrictions, it is not integrated with the international market. Though there is cyclicality in the real price of rubber, it ruled more or less at a remunerative level over the last 30 years. There is a positive relationship between newplanting and the real price of rubber. In the case of replanting, negative relationship with the real price was observed. Empirical testing showed that the practice of postponement of replanting activity was prevalent. This phenomenon observed in the macro-level data could arise out of postponement of replanting by holdings of very small sizes as well as staggered replanting by holdings of moderate and large sizes. The macro-level picture of the rubber plantation sector includes small holdings and large estates. Small holdings themselves are a heterogeneous class; some are of very small size and some are of moderate size. The problem of income instability may differ across different size classes of holdings. If so, the newplanting and

replanting behaviour also may be different. To examine these aspects a micro-level study, using a sample of different size class of holdings, is essential and this is attempted in Chapter 4.

CHAPTER 4

INCOME INSTABILITY AND REPLANTING STRATEGY

4.1 Introduction

For a small rubber grower, price of rubber is beyond his control. For stabilising his income from rubber his only choice is that of suitably adjusting the output. For this, he can postpone the entire replanting activity in relation to the price behaviour, or can execute replanting in a staggered fashion. Chapter 3 provided empirical support to the hypothesis of postponement of replanting activity and adjusting of output stream according to price behaviour. As small holdings is a heterogenous group with respect to size, a disaggregated study of the problem is essential. With this objective, this chapter analyses the problem at a micro-level.

The Chapter is structured into eight sections. Section 4.2 brings out empirical evidence of the practice of adjusting of replanting in relation to the price behaviour. This is followed by Section 4.3, which empirically examines the prevalence of staggered planting among small holdings. Section 4.4 is an analysis of variations in tapped area and Section 4.5 is devoted to a discussion on yield profile of important planting materials of rubber. Estimation of output stream corresponding to different replanting responses is carried out in Section 4.6. Following this, Section 4.7 estimates income stream of a few types of growers and examines variability in their income. Section 4.8 is the conclusion.

4.2 Adjustment of Replanting in Relation to Price Behaviour

In the chosen region, there are holdings having only a single age group of rubber trees as well as holdings having more than one age group of trees. Let us examine the yearwise trend in newplanting and replanting by concentrating on holdings having only one age group of trees. Out of the 547 sample holdings, 247 are of this category. Among this, 138 are newplanted units and the remaining 109 are replanted units. Frequency distribution of these units according to their year of planting is given below:

Table 4.1 : Yearwise Trend in New Planting and Replanting

Year of Planting	Newplanted Units			Replanted Units	
	No. of Units	%		No. of Units	%
1950-60	7	5	6%	0	0
1961-65	2	1		0	0
1966-70	8	6		3	3
1971-75	10	7		3	3
1976-80	52	38		11	10
1981-85	41	30		38	35
1986-91	18	13		54	49
Total	138	100		109	100

Area planted during each year and surviving till 1991-92 only will come under this classification. Area planted during the period from 1950 to 1965 might have almost been replanted and hence frequency distribution corresponding to this period is not considered for obtaining the trend in planting. So using this data we could obtain the trend only from 1966 onwards. But among newplanted units, 6% of the existing holdings are planted during the period 1950-65. This shows that there are trees having more

than 30 years of age. Trees planted during these periods are low yielding variety and hence retaining them cannot be economic. The above growers are having trees of one age group only and hence replanting deprives them of any income from rubber for a number of years. So these growers are reluctant to execute replanting and hence retain the uneconomic old trees.

In the newplanting activity, a boom may be observed during the late seventies. Its intensity got reduced during the first half of eighties and registered a further decline during the second half of eighties. But in the case of replanting the trend was just the opposite. Rate of replanting registered a remarkable increase during the first half of the eighties and it got intensified and resulted as a boom during the second half of eighties.

The above trends may be explained with reference to the price of rubber which has been discussed in Section 3.6. Real price of rubber registered a sharp increase during the late seventies; a downward slide began from the mid-eighties. As is evident, the behaviour of the rate of NP has been coincident with the direction of movement of the price of rubber, but the rate of replanting was just opposite to the direction of movement of price. Hence, the newplanting and replanting trends are in agreement with the macro-level observations discussed in Section 3.7.

Let us concentrate on replanting alone and begin with holdings which have executed replanting in one stretch. But majority of them carried it out during the downward phase of the price cycle. Since replanting registered a low rate during the period of high level of

price, it is an indication that growers are hesitant to execute replanting during this period. The replanting which became due during these periods might have been postponed to the downward phase of the price cycle. Later (in Section 4.3) we shall see that holdings having only one age group of trees are smaller units when compared with those having holdings of more than one age groups.

For the very small units, when trees are coming to the replanting stage, it is practically difficult to execute it in parts and hence they are likely to do it in one stretch. Once it is carried out, due to the gestation lag, the grower will be deprived of any income from rubber for the next five to seven years. Hence, growers having very small units prefer to execute replanting when the price is declining and is likely to continue at the low level for some years. If replanting is done in this way, the gestation lag coincides with the trough of the price cycle and the grower is not adversely affected by the continuing low level of price. Besides, this enables him to have output by the time price situation begins to improve.

The very high rate of replanting during the downward phase of price and the low rate during the upward phase is evidence of this phenomenon in our sample region. This phenomenon could be a specificity of the village. But the pattern reported at the macro-level in Section 3.7 suggests that the phenomenon is not a specificity of the village, but a manifestation of the general phenomenon.

4.3 Adjusting Output Stream by Staggered Replanting

For holdings of moderate sizes staggered replanting is a solution to the problem of income instability. In this method, replanting is carried out in parts. When one part of area is replanted, the surviving part will be yielding output and the cycle continues.

Let us examine whether there is any evidence of the prevalence of this practice among small holdings. In the selected sample there are 547 holdings. The distribution of the 547 holdings according to the number of age groups per holding is given in Table 4.2.

Table 4.2 : Number of Age Groups per Holding

No. of different age-groups in a holding	No. of cases		Average size of a holding (Hectare)
	No.	%	
1	247	45	0.57
2	191	35	0.99
3	73	13	1.48
4	24	4	2.16
5	10	2	2.94
6	2	1	4.05
Total	547	100	0.96

Planting of rubber in a very small area has got practical problems. Besides, to avail subsidies and other incentives provided by the Rubber Board, the extent of area to be replanted should be at least 0.10 hectare.[1] Because of these reasons holdings of very small

[1] The Rubber Board has been implementing various schemes from 1957 onwards to increase the production and productivity of natural rubber in India. The schemes so far implemented are
(1) Replanting Subsidy Scheme (1957 to 1979)
(2) Newplanting Loan Scheme (1962 to 1967)

size are not likely to execute replanting in a staggered manner and they have to execute replanting in one stretch. But for holdings of moderate size there is no such problem. Once a holding is replanted in a staggered fashion, it becomes one with more than one age group of trees. In Table 4.2, for holdings of bigger sizes, we have observed more number of different age groups. This observation is likely to be due to staggered replanting. But this argument is not strong because it could also be due to newplanting activities at different time periods earlier.

If staggered replanting exists, then the percentage of replanted big units with only one age group should be less when compared with newplanted big units with only one age group. To examine this the data presented in Table 4.3 corresponding to holdings having only one age group of trees are used.

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(3) Newplanting Subsidy Scheme (1979-80)
(4) Rubber Plantation Development (RPD) Scheme - Phase I (1980-81 to 1984-85)
(5) RPD Scheme - Phase II (1985-86 to 1989-90)
(6) RPD Scheme - Phase III A (1990-91 to 1991-92)
(7) RPD Scheme - Phase III B (1992-93)

The last four RPD schemes are an amalgamation of all programmes existed for newplanting as well as replanting. Under RPD Scheme Phase I, financial, technical and material assistance were provided to all category of growers. But Phase II, Phase IIIA and Phase IIIB were restricted to growers having a total area of upto 5 hectares in traditional area, but to all growers in non-traditional areas. Under the RPD schemes, the minimum area to be replanted during any one year shall be either 0.10 hectare of contiguous land or part of 0.10 hectare, if that part is the only area left to be replanted in the holding. More recently, RPD Scheme - Phase IV (1993-94 to 1997-98) has been launched. Under this scheme also, the minimum area required for replantation cash subsidy, remains unaltered.

Table 4.3: Size Distribution of Newplanted and Replanted Units

Size of holding (Hectare)	Newplanted Units			Replanted Units		
	Number of units	%		Number of units	%	
0.00 - 0.20	18	13		9	8	
0.20 - 0.40	60	43		45	42	
0.40 - 0.60	19	14		21	19	
0.60 - 1.00	18	13		24	22	
1.00 - 1.50	15	11		9	8	
1.50 - 2.00	4	3	17%	1	1	9%
2.00 - 3.00	4	3		0	0	
Above 3.00	0	0		0	0	
Total	138	100		109	100	

In the case of newplanting, 17% of holdings are of size 1.0 hect. and above. But the corresponding figure in the case of replanting is only 9%. The lower proportion of large units in the case of replanted holdings is likely to be due to staggered replanting. When a holding of big unit executes staggered replanting, it becomes one with more than one age group of trees and hence the unit will not come in the above table. This resulted in the lower frequency of bigger units with replanted trees. So this observation supports the hypothesis of prevalence of staggered replanting among holdings of moderate and big sizes.

To supplement the argument, let us consider holdings having two age groups of trees. If a holding has got two age groups of trees, it should be one of the following three cases:

(i) Both batches are newplanted

(ii) One batch is newplanted and the other replanted

(iii) Both batches are replanted.

If the existence of two age groups in a holding is due to staggered replanting, the holding should be either with both batches of trees

replanted or with one batch newplanted and the other replanted. Let us initially take the cases where both batches of trees are replanted. Unfortunately we do not have data to examine whether these two batches were brought up after removing trees of the same year of newplanting earlier on. We have data of the year of planting of existing trees only. If the two batches of replanted units were brought up after removing trees of the same year of planting, then the age gap between the two batches is likely to be greater than the gestation lag. In staggered replanting the second step of replanting happens only after attainment of tapping stage of the first step of replanted trees. So if staggered replanting occurs, we expect a very high proportion of holdings corresponding to the age gap of above six years.

Out of 191 holdings having two age groups of trees, 64 are with both batches replanted. In Table 4.4 they are classified according to the age-gap between the two groups of trees.

Table 4.4 : Age Gap between two Replanted Groups of Trees

Age-gap (years)	No. of holdings	Percentage		Average size of holdings (hect.)	
1-5	25	39		0.92	
6-10	33	51		1.10	
11-15	3	5	61%	0.75	1.06
16 & above	3	5		0.90	
Total	64	100		1.00	

It may be seen that 61% of holdings are with age gap 6 years and above. For these holdings, since the age gap is sufficiently wide, output is available throughout, without any gap. More specifically, 51% comes under the age gap of 6 to 10 years, which is almost the

gestation lag of rubber tree. These holdings executed the second step of replanting only after the attainment of the tapping stage of trees replanted in the first step. This leads strong support to the hypothesis of the prevalence of staggered replanting.

Now let us consider the cases in which one age group of trees is newplanted and the other is replanted. Out of 191 holdings having two age groups of trees, 77 are with one age group newplanted and the other replanted. Their distribution according to the age gap is given in Table 4.5. It may be seen that 82% are having age gap six years and above. So whether newplanting or replanting, the majority go for staggering so that they could get a continuous output stream.

Table 4.5 : Age Gap between Newplanted and Replanted Groups

Age-gap (years)	No. of holdings	Percentage		Average size of holdings (hect.)	
1-5	14	18		0.98	
6-10	33	43		1.04	
11-15	12	16	82	1.44	1.06
16 & above	18	23		0.83	
Total	77	100		1.04	

So far we were trying to bring out evidences of the practice of staggered replanting among small holdings. If staggered replanting has occurred then it should be reflected in the output stream corresponding to each grower for a plan horizon. As a preliminary to this, a discussion of variations of tappable area and yield profile of few types of holdings is in order.

4.4 Variations in Tappable Area

Among different factors causing income instability, the one which the grower has under his control is the extent of tappable area owned by him at any time point. For a grower, instability in tappable area arises owing to replanting. Staggered replanting is actually a procedure to stabilise the variations in tappable area. In this Section an attempt is made to classify holdings according to variability in tappable area. We hypothesise that for holdings of moderate and large sizes having different age groups of trees the variability will be comparatively less.

Since holdings are of different size classes, the variations in tappable area cannot be studied using the absolute figures. Hence, we introduce a relative measure R_{it}, which we define as the ratio of tappable area to the total area of the i^{th} grower during the year t. Whatever be the the size of the holding, R_{it} can take only values from 0 to 1. If $R_{it} = 0$ it means that during the year t the i^{th} grower does not have any tapped area. But when time t varies, trees become mature and consequently R_{it} takes non-zero values. If $R_{it} = 1$, it means that during the year t the entire area owned by the i^{th} grower is under tapping. But if these trees are replanted together, R_{it} becomes zero. Though the situation $R_{it} = 1$ appears to be a comfortable one, it is not so because it cannot sustain for long. A stage will come at which $R_{it} = 0$ and the grower is left with no tapped area. Hence both $R_{it} = 0$ and $R_{it} = 1$ are undesirable situations as far as stability is concerned. These two values of R_{it} correspond to the maximum variation in tapped area. If R_{it} is a fraction between 0 and 1, the variability in tapped area

will be comparatively less. If the entire rubber area owned by a grower is of one age group of trees, and replanting of the entire area is also done in one stretch, then R_{it} will be taking only two values, 0 and 1. But if the trees are of two or more different age groups, with sufficient age-gap, then the situation of complete replanting does not arise and in this case R_{it} is a fraction between 0 and 1.

Earlier we have mentioned that for holdings of very small size, it is practically difficult to execute replanting in parts. For these units once replanting is carried out, R_{it} becomes zero. For very small units R_{it} is expected to take only two values 0 and 1. We have seen that for holdings of bigger sizes, there are trees with different age groups. For these holdings, we expect a

Table 4.6 : Values of R_{it} and its Variation

Size of holding (Hect)	No. of holdings	Frequencies of Values of R_{it}				Average value of R_{it}	CV of R_{it}
		$R_{it} = 0$	$R_{it} = 1$	R_{it} between 0 and 1			
				Freq.	%		
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
0.00- 0.20	27	10	17	0	0	0.63	76.2
0.20- 0.40	139	36	76	27	19	0.65	66.2
0.40- 0.60	82	16	33	33	40	0.62	61.3
0.60- 1.00	117	19	40	58	50	0.59	61.0
1.00- 1,50	90	11	41	38	42	0.66	54.5
1.50- 2.00	44	0	11	33	75	0.63	42.9
2.00- 3.00	30	0	5	25	83	0.59	44.1
Above 3.00	18	0	1	17	95	0.57	26.3
Total	547	92	224	231	42	0.62	-

comparatively stable value for R_{it}. In order to examine this, values of R_{it} are worked out across different size classes of holdings and is presented in Table 4.6.

In the lowest class, for all the 27 holdings R_{it} is either 0 or 1 and there is no case with intermediate values for R_{it}. Since R_{it} takes only two values zero and 1, the variability in tapped area is maximum for growers coming under this size class. But for larger size class of holdings, it is seen that the proportion of holdings coming under R_{it} = 0 or 1 is low and those with intermediate values for R_{it} is high. In each size class the percentage share of holdings with intermediate values of R_{it} is shown in Column (vi) of the Table.

It could be seen that more than 75% of holdings of size 1.50 hect. and above, have intermediate value for R_{it}. This shows that instability in tapped area is not a serious problem for most of the holdings with area 1.50 hectares and above. As the size of the holding goes up, the percentage of holdings with less instability in tappable area shows an increase.

The data presented in Table 4.6 clearly shows that all small holdings are not alike. Most of the holdings having area above 1.50 hect. behave like estates with respect to their newplanting and replanting activity. These moderate-sized holdings execute the planting activity in such a way that they get trees of different age groups, which result in a situation with less variation in the proportion of tapped area owned by them.

Column (vii) of Table 4.6 gives the average value of R_{it} in each class. In the lowest class its value is around 0.65, which only shows a higher proportion of cases with R_{it} = 1. In this class, at a point of time in future there would be a higher

proportion of cases with $R_{it} = 0$. In such a situation, the average value of R_{it} will be much below 0.50. Consequently, in this class the average value of R_{it} is not a stable one. So, for holdings in this class, output stream would be one where there would be gestation gaps. As we move towards larger size classes, intermediate values of R_{it} begin to appear and the proportion of holdings with such values steadily increases. The average value of R_{it} approaches 0.57 with a low level of Coefficient of Variation. Hence for holdings of moderate sizes the value of R_{it} stabilises around 0.57. This shows that if a grower desires to reduce the variation in tapped area, he always has to leave a certain portion of his area under rubber as immature area. Since R_{it} registered an almost stable value 0.57, it shows that at any point of time, the grower can tap only 57% of the total area under rubber and has to keep the remaining 43% of the area with pre-mature trees. This 43% of the area is the security necessary to retain stability in output, which may be regarded as his indirect cost of output stabilisation.

In lower size classes also, a small proportion of holdings are having intermediate values for R_{it}. In each size class, let us concentrate on cases with intermediate values alone. Taking all such cases in each class, average value of R_{it} and its CV are computed(Table 4.7). It may be seen that irrespective of the size of the holding, for those who have different age groups of trees, average value of R_{it} is around 0.50 with a low value of CV. This value of R_{it} is not much different from the value obtained earlier. So it may be concluded that, irrespective of the size of the holding, growers desiring stable level of tappable area (and

output) have to keep around 50% of their area under rubber with pre-mature trees.

Table 4.7 : Holdings Having Intermediate Values for R_{it}

Size of holdings (hect.)	Percentage of holdings with intermediate values for R_{it}	Average value of R_{it}	CV of R_{it}
0.00 - 0.20	0	0	0
0.20 - 0.40	19	0.52	28.8
0.40 - 0.60	40	0.53	30.2
0.60 - 1.00	50	0.50	36.0
1.00 - 1.50	42	0.49	38.8
1.50 - 2.00	75	0.51	37.2
2.00 - 3.00	83	0.51	39.2
Above 3.00	95	0.55	20.0
Total	42	0.51	-

In sum, for holdings of very small size, there is only one age group of trees and hence, during the gestation lag they would not be getting any output from the area under rubber. But, more than 75% of holdings with an area of 1.50 hectares and above have got trees with different age groups and their tappable area is at a relatively stable level. But to maintain stability in tappable area, they have to keep around 50% of their area with pre-mature trees.

4.5 Yield Profile

For HYV planting materials, the gestation lag is usually five to seven years. Let us take this as six years. On completion of six years trees begin yielding and the yield varies with the age. This aspect is examined in this section.

In Section 3.2 it was mentioned that the productive life span of rubber tree has got three phases. Initially it will be increasing steadily. Then it remains more or less steady at a maximum level for a number of years. Thereafter it starts declining. Though the phenomenon is common for all varieties of planting materials, the extent of variation will be different for different planting materials. So, for different varieties of planting materials, the yield profile will be different.

Small holdings often grow a mixture of varieties to guard against the risk of clone-specific epidemic. In our sample region, RRII-105, RRIM-600, GT_1 and PB-235 are the different varieties of planting materials used. Since small holdings hardly keep any record of production, to estimate the yield profile we have to rely on data from estates. Joseph and Haridasan (1992) evaluated the yield profile of 21 planting materials using monthly data from 40 large estates. Yield profile of RRII 105, RRIM-600, GT1, PB-235 and the mean yield of all the 21 varieties, estimated by them are shown in Table 4.8. Though RRII-105 is the most popular variety, its yield profile is available only for the first 10 years of tapping and that is based on a limited number of observations. So, for the present study, we are using the mean yield of all the 21 varieties[2].

We make an assumption that the productive life span is 15 years. It is presumed that after giving output for 15 years trees

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[2]. The 21 varieties are PB 86, PB 6/9, PB 5/139, RRIM 605, RRIM 623, GI 1, LCB 1320, PR 107, PB 5/51, RRIM 600, GT 1, PB 28/59, RRIM 628, RRIM 701, PB 217, PB 252, PB 235, RRIM 105, RRIM 116, RRII 208 and RRII 118.

are replanted. With these presumptions on gestation lag, yield

Table 4.8 :Yield Profile of Important Planting Materials
(kg/ha./year)

Year of Tapping (i)	RRII-105 (ii)	RRIM-600 (iii)	GT_1 (iv)	PB-235 (v)	Mean of 21 Varieties (vi)
1	888	681	672	996	658
2	1376	1164	924	1001	971
3	1473	1137	1079	1271	1095
4	1651	1277	1173	1219	1193
5	1675	1387	1246	986	1237
6	1798	1430	1259	1059	1309
7	1608	1588	1780	2089	1488
8	2038	1663	1665	NA	1468
9	1365	1532	1739	"	1446
10	1687	1508	1756	"	1384
11	NA	1382	1704	"	1299
12	"	1389	1551	"	1247
13	"	1855	1650	"	1257
14	"	1527	1330	"	1180
15	"	NA	NA	"	1178

Source: Joseph and Haridasan (1992), NA - Not Available.

profile and length of productive life, it is possible to work out output stream corresponding to each grower for a plan horizon.

4.6 Output Stream under Staggered Replanting

It was hypothesised that by carrying out staggered replanting instability in output could be reduced. In order to examine this, the output stream of a holding where replanting is carried out in one stretch shall be worked out. Then the output stream of a few cases of staggered replanting will be worked out and these will be compared with the former.

In the selected sample of holdings, serial number 128 is a holding having only one age group and replanting of the entire area

Table 4.9: Output Stream of Serial No.128

Year	Output (Kg.)
1	0
2	0
3	0
4	0
5	0
6	0
7	145
8	214
9	241
10	262
11	272
12	288
13	327
14	323
15	318
16	304
17	286
18	274
19	277
20	260
21	259
22	0
23	0
24	0
25	0
26	0
27	0
28	145
29	214
30	241
Average	155
Std.Devn.	133
C.V.	86

of 0.22 hect. was carried out in one stretch during 1991. If the grower is continuing the same practice of replanting in future also, then the output stream of this holding for the next 30 year period will be as shown in Table 4.9.

It may be seen that the grower did not have any output for a number of years. The coefficient of variation of the output is 86%, which shows that instability in output is very high for this holding.

Now let us work out the output stream of a holding executing staggered replanting. In the sample, serial No. 178 is of this category.

Table 4.10: Output Stream of Serial No.178

Year	Output-1 (Kg.)	Output-2 (Kg.)	Total Output (Kg.)
1	583	0	583
2	657	0	657
3	716	0	716
4	742	0	742
5	785	0	785
6	893	0	893
7	881	559	1440
8	868	825	1693
9	830	931	1761
10	779	1014	1793
11	748	1051	1799
12	754	1113	1867
13	708	1265	1973
14	707	1248	1955
15	0	1229	1229
16	0	1176	1176
17	0	1104	1104
18	0	1060	1060
19	0	1068	1068
20	0	1003	1003
21	395	1001	1396
22	583	0	583
23	657	0	657
24	716	0	716
25	742	0	742
26	785	0	785
27	893	0	893
28	881	559	1440
29	868	825	1693
30	830	931	1761
Average	600	599	1199
Std.Devn.	318	512	464
C.V.	53	86	39

The total area of this holding is 1.45 hectare, of which 0.60 hect. was replanted during 1983 and 0.85 hect. during 1991. Table 4.10 gives the output stream corresponding to each group of trees as well as total output from both the groups. The second step of replanting was carried out only after the first replanted group

started yielding. So, for this grower there is no period without output. The coefficient of variation of output in this case is only 39%, which is a low value.

In the case of staggered replanting, if the gap between successive replantings is not sufficiently wide, then there can be situations without any output. Let us take one such case. Serial number 268 of the sample is of this category. The total area of 1.40 hect. was replanted in two stretches with a short interval of only two years between them. 0.8 hect. was replanted during 1988 and the remaining 0.60 hect. during 1990. Table 4.11 gives the output stream of this holding. It is seen that for this grower there are periods with no output, but for a shorter period compared with a case where replanting is done in one stretch. For this holding the CV of output stream is 68% which is not very low. Hence, while executing staggered replanting, the gap between successive replantings is an important factor determining the stability of output.

In some cases, replanting would be carried out in more than two steps. Serial number 536 is one such holding. For this holding, the total area under rubber is 2.60 hectares. Replanting of this holding was done in three steps; 0.80 hect. during 1982, 1.00 hect. during 1984 and 0.80 hect. during 1988. The output stream of this holding is given as Table 4.12. It may be seen that, for this grower there is no period without output. The coefficient of variation of the output stream is only 42%, which is not so high. In our sample, 20% of holdings are of more than two

age group of trees. For these units, there is little chance of coming across a period with no output.

Table 4.11: Output Stream of Serial No.268

Year	Output-1 (Kg.)	Output-2 (Kg.)	Total Output (Kg.)
1	0	0	0
2	0	0	0
3	0	0	0
4	526	0	526
5	777	0	777
6	876	395	1271
7	954	583	1537
8	990	657	1647
9	1047	716	1763
10	1190	742	1932
11	1174	785	1959
12	1157	893	2050
13	1107	881	1988
14	1039	868	1907
15	998	830	1828
16	1006	779	1785
17	944	748	1692
18	942	754	1696
19	0	708	708
20	0	707	707
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	526	0	526
26	777	0	777
27	876	395	1271
28	954	583	1537
29	990	657	1647
30	1047	716	1763
Average	663	447	1110
Std.Devn.	458	357	754
C.V.	69	80	68

It may be concluded from this section that, for holdings which do not exercise staggered replanting the problem of output instability is severe. These units even do not have any output for a number of years. But for those exercising staggered replanting, the situation is different. By suitably adjusting the gap between successive replantings it is possible to stabilise the output and

Table 4.12: Output Stream of Serial No.536

Year	Output-1 (Kg.)	Output-2 (Kg.)	Output-3 (Kg.)	Total Output (Kg.)
1	876	658	0	1534
2	954	971	0	1925
3	990	1095	0	2085
4	1047	1193	0	2240
5	1190	1237	526	2953
6	1174	1309	777	3260
7	1157	1488	876	3521
8	1107	1468	954	3529
9	1039	1446	990	3475
10	998	1384	1047	3429
11	1006	1299	1190	3495
12	944	1247	1174	3365
13	942	1257	1157	3356
14	0	1180	1107	2287
15	0	1178	1039	2217
16	0	0	998	998
17	0	0	1006	1006
18	0	0	944	944
19	0	0	942	942
20	526	0	0	526
21	777	0	0	777
22	876	658	0	1534
23	954	971	0	1925
24	990	1095	0	2085
25	1047	1193	0	2240
26	1190	1237	526	2953
27	1174	1309	777	3260
28	1157	1488	876	3521
29	1107	1468	954	3529
30	1039	1446	990	3475
Average	809	976	628	2413
Std.Devn.	426	528	467	1002
C.V.	53	54	74	42

as seen above this is possible only for holdings of sufficiently large size.

Our ultimate objective is to examine, how variations in output are transmitted as income instability. For this exercise, along with output instability, it is necessary to consider the movement of real price of rubber, which has been discussed in Section 3.6.

4.7 Income Stream and Instability

Income from rubber is the product of output and price. Output stream corresponding to each grower for a 30 year life span using the data on age-wise area and yield profile has been worked out. If the present age-wise area of each grower is assumed as that 30 years back, then the output stream worked out corresponds to the last 30 year period. Data on price of rubber for the last 30 years is available. The real price corresponding to each year has been worked out using the wholesale price index (all commodities) as the deflator. Combining the two, the instability of income streams of different categories of holdings has been examined. Holdings may be categorised into the following four groups as has been done while estimating the output stream.

(a) Replanting of a holding takes place in one stretch and hence the holding has got trees with only one age group.

(b) Replanting of a holding takes place in two steps with sufficient interval so that the grower has no period without output.

(c) Replanting takes place in two steps, but with a shorter interval between successive replantings and hence there is no output from the holding for some years.

(d) Replanting of a holding takes place in more than two steps.

In the selected sample of 547 holdings, 45% are of category (a). As a representative of this class, the holding with serial number 128 was chosen. The entire area of 0.22 hect. of this holding was replanted in one stretch during 1991 and the output stream was presented in Table 4.9. The corresponding income stream

is given as Column (a) in Table 4.13. Out of the 30 year period, the grower does not have any revenue from rubber for a period of 12 years. The instability in income, measured by coefficient of variation, is 91%, which shows that for this category of holdings, income from rubber is highly unstable.

In the sample 35% of holdings are with two age group of trees. But only 25% have sufficient gap between successive replantings so that these holdings always have some output of rubber. For these holdings, the replanting of one batch of trees has been done in such a way that during its gestation period, the other batch of trees provide output. To study the income variation of this category, serial number 178 has been taken. The rubber area of the holding is 1.45 hectare. Replanting of 0.60 hectare was done during 1983 and 0.85 hect. during 1991. In Section 4.6 we have discussed the output stream of this holding(See Table 4.10). The corresponding income stream is shown as column (b) in Table 4.13. It may be seen that the grower has income from rubber throughout the period and the CV is only 36%. The average size of a holding having two age group of trees is only 0.99 hectares. So it may be concluded that even holdings having around 1.00 hect. of rubber can stabilise income by executing replanting in a staggered manner.

Only 10% holdings come under category (c). For these holdings, the gap between successive replantings is only one to five years. As a representative case, the holding with Serial No. 268 was taken. In this holding, replanting of 1.40 hectare was executed in

two steps with a short interval of only two years. The output stream of the holding was shown in Table 4.11 corresponding to which the income stream is given as column (c) in Table 4.13. Since the staggered replanting has been with a short interval, the grower has no income during some years. But the grower is in a better position compared with cases in which replanting is done in one stretch. The CV of income stream is 70%.

Table 4.13: INCOME STREAM

Year	Real Price (Rs/qntl)	Income Stream (Rs.) (a) No.128	(b) No.178	(c) No.268	(d) No.536
1	1275	0	7431	0	19565
2	1185	0	7786	0	22817
3	1042	0	7455	0	21712
4	1074	0	7973	5655	24067
5	1461	0	11473	11348	43150
6	1514	0	13513	19235	49346
7	1330	1925	19146	20435	46809
8	1141	2437	19315	18786	40270
9	1131	2723	19911	19931	39284
10	1055	2770	18927	20395	36185
11	1390	3781	25007	27232	48564
12	1232	3547	22996	25247	41455
13	966	3162	19057	19203	32420
14	974	3145	19034	18569	22273
15	1468	4671	18048	26843	32558
16	1337	4070	15727	23863	13336
17	1348	3853	14886	22814	13557
18	1431	3926	15168	24278	13509
19	1343	3714	14351	9510	12658
20	1514	3931	15187	10702	7971
21	1321	3425	18448	0	10265
22	1325	0	7717	0	20319
23	1200	0	7882	0	23099
24	1202	0	8604	0	25056
25	1131	0	8394	5953	25335
26	1241	0	9750	9643	36668
27	1107	0	9886	14071	36100
28	952	1378	13707	14629	33511
29	1058	2260	17914	17424	37349
30	972	2342	17117	17136	33777
Average	1233	1887	14300	13302	28593
Std.Devn.	164	1711	5128	9330	11956
C.V.	13	91	36	70	42

Category (d) corresponds to holdings having more than two age group of trees. 20% of holdings in the sample are of this category. The output stream of this category of holdings, by taking the unit with serial No. 536,was shown in Table 4.12. Replanting of the total area of 2.60 hect. was carried out in three steps; 0.80 during 1982, 1.00 during 1984 and 0.80 during 1988. The income stream is given as column (d) of Table 4.13. It may be seen that the income stream has no break and the variability measured as CV is only 42%. So, for this category of holdings income instability is not a serious problem.

To examine the output stream along with the movement of price, these two variables are graphed together. The corresponding graphs of categories (a), (b), (c) and (d) are shown as Figures 4.1, 4.2, 4.3 and 4.4.

Among the four different categories discussed, it may be seen that for (b) and (d) there is no serious problem of income instability. These holdings have solved the problem by maintaining suitable age-gap between different batches of trees. For category (c), though there are two age groups of trees, there is a high degree of instability. But this is due to the narrow age-gap between successive replantings. These holdings are in a better position compared with holdings with only one age group of trees. Totally 55% of holdings come under category (b), (c) and (d). So it may be concluded that for 55% of holdings income instability is manageable due to sufficient size of holdings and the existence of different age group of trees. But for category (a), the problem is

Fig 4.1: Output & Price
(Serial No.128)

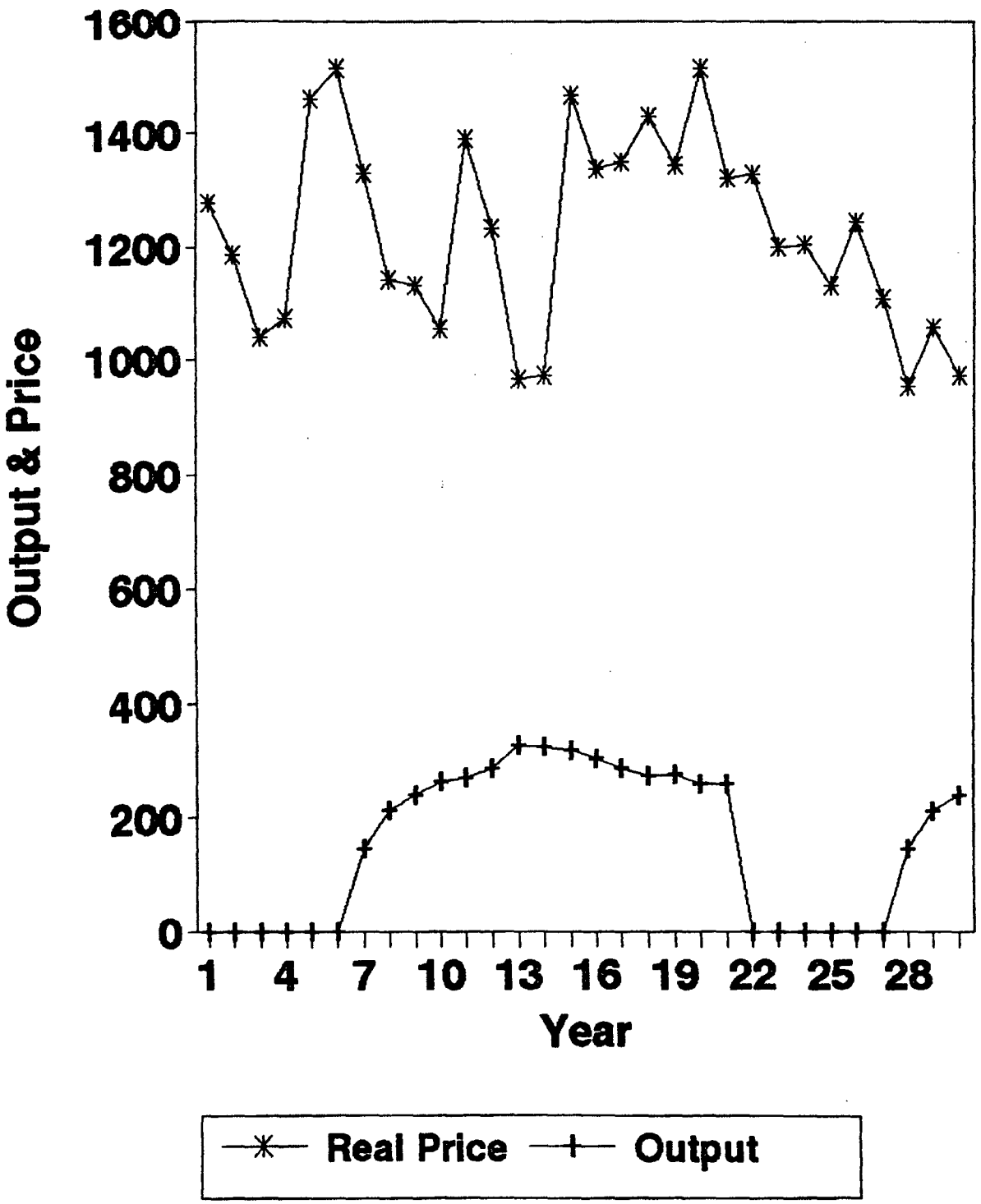


Fig 4.2: Output & Price
(Serial No.178)

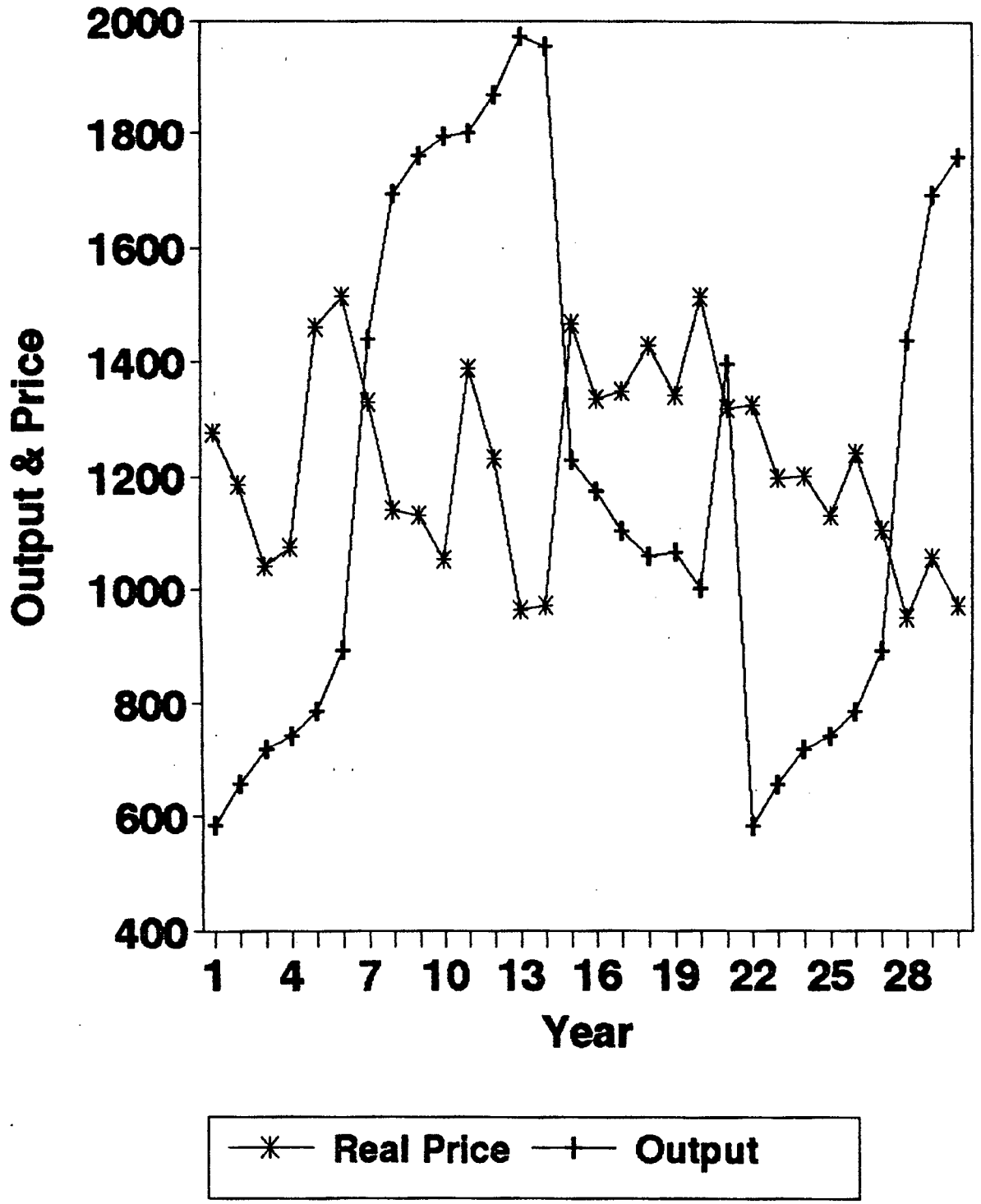


Fig 4.3: Output & Price
(Serial No.268)

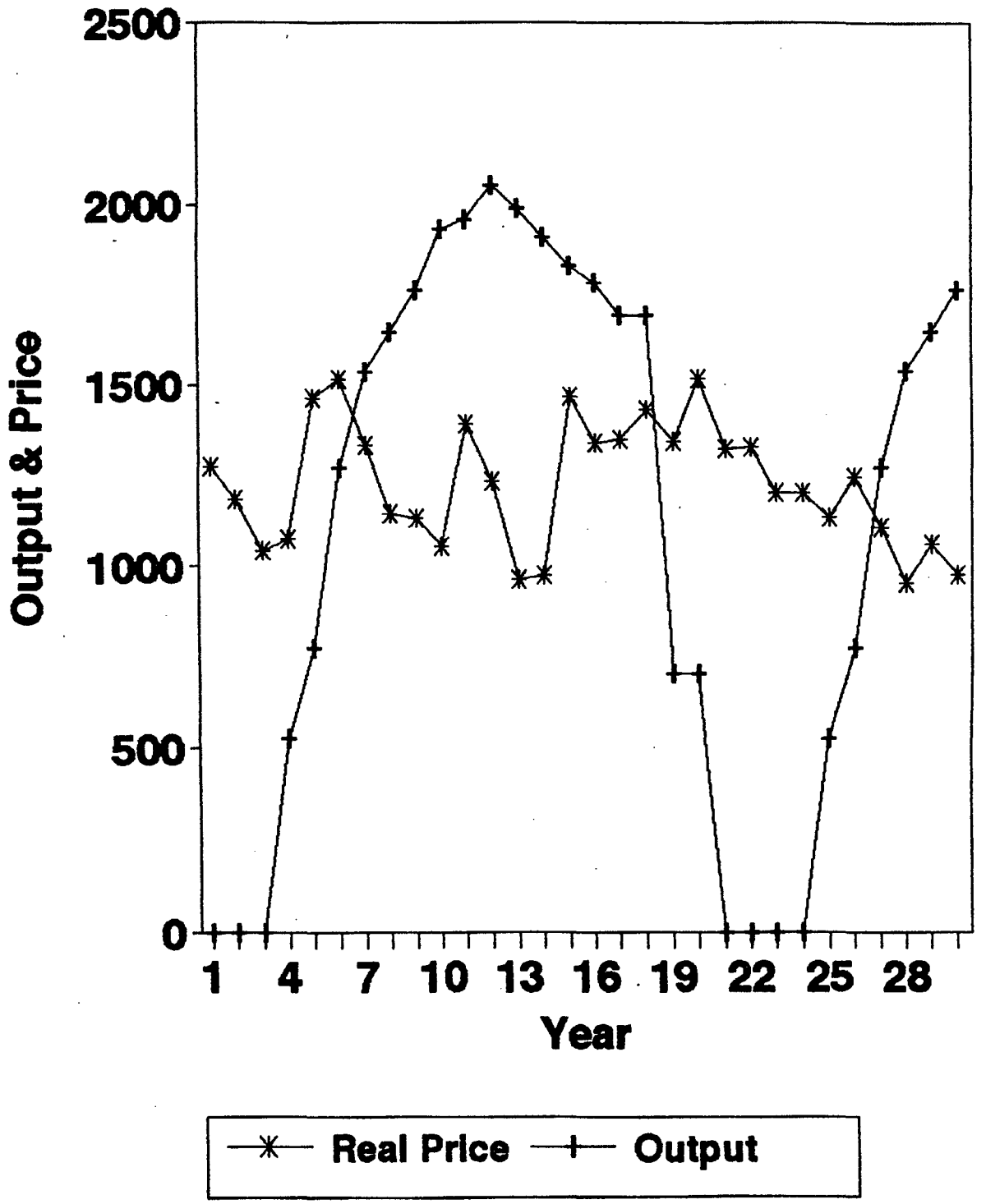
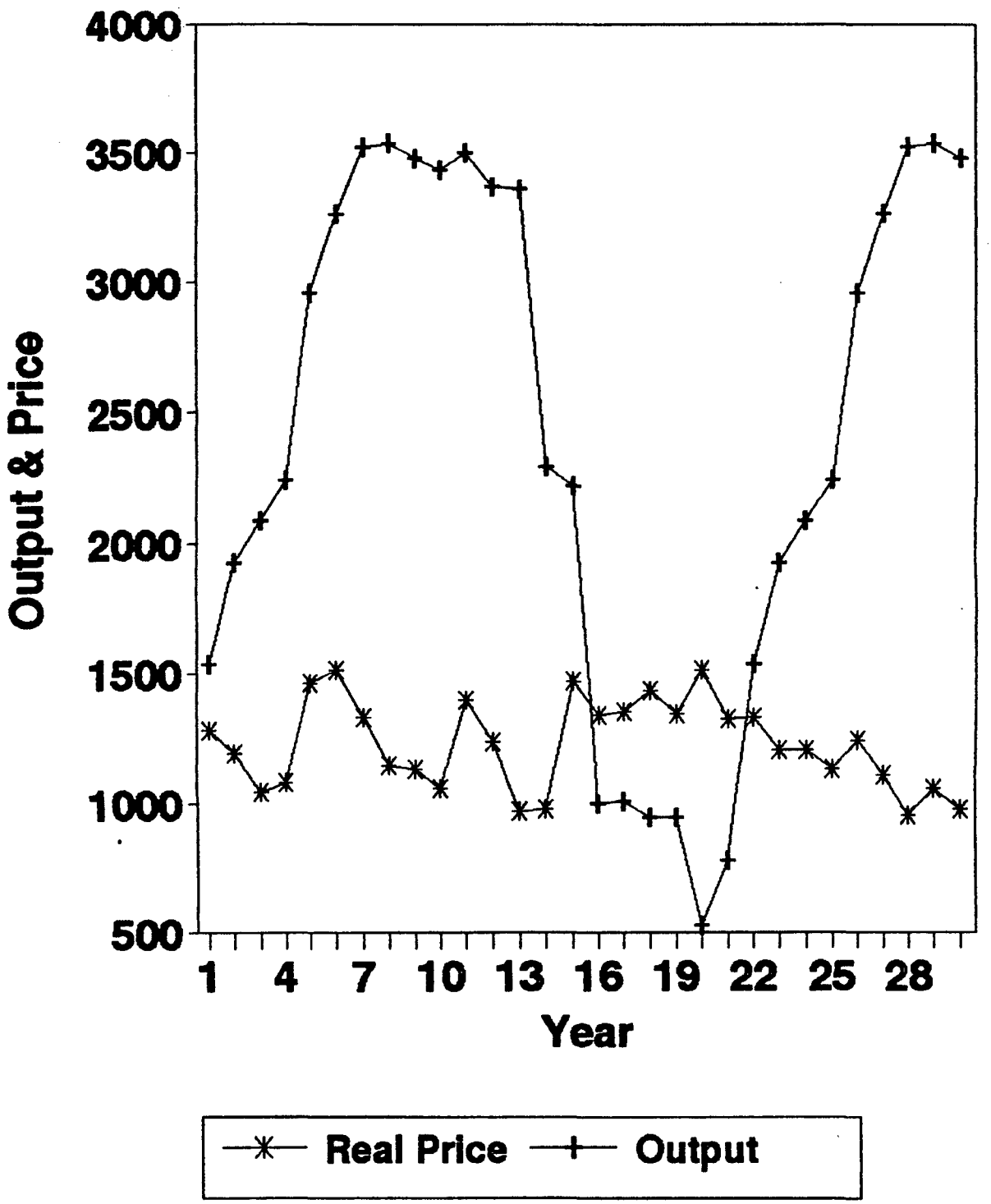


Fig 4.4: Output & Price
(Serial No.536)



acute. For a number of years, the grower is deprived of any income from rubber and this situation repeats in a cyclical fashion. Income instability is of the order of 91% in terms of Coefficient of Variation. The very small size of the holding, restricts them from executing staggered replanting and hence for them there is no way out.

4.8 Conclusion

The micro-level study carried out in this chapter supported the macro-level observations made in Chapter 3. It was empirically shown that staggered planting as well as adjusting of output stream in relation to the cyclicality in price prevail among rubber growers. The disaggregated study brought out the heterogeneity existing among small holdings. It was observed that staggering is constrained by the size of holding and hence it is not being practised among holdings of smaller sizes. Hence, for holdings of smaller sizes, tapped area as a proportion of the total area under rubber exhibited a high degree of variation. Estimated output stream of a few types of growers showed that for holdings carrying out staggered planting the variability in output stream was not high and they maintain a certain level of stability in income.But, for those having only one age group of trees, there is very high degree of instabilities in output and income. As a result, all small holdings are not alike. For different size-classes of holdings, since the replanting strategy is different,the extent of income instability is also different. This has got important policy implications. For a discussion of this, a summarisation of important findings of the study is in order. With this intention Chapter 5 provides a summary of the salient observations of the study followed by a discussion on the inherent policy implications.

CHAPTER 5

CONCLUSIONS AND SUGGESTIONS

Income instability exhibited by perennial crops is different from seasonal and annual crops because for perennial crops output varies owing to gestation lags once trees are replanted and yield varies according to the age of trees.Income instability arises due to such variations in output coupled with price changes. To counter the problem of income instability for a given long-term behaviour of price, there are two likely responses among producers, viz., staggered replanting and adjusting of the output stream in relation with the cyclicality of price. The objective of the study was to examine whether these responses take place among small holdings of rubber in Kerala and if so, to study the behaviour of the corresponding income stream.

In the background of the newplanting and replanting responses to output prices of different perennial crops,a framework was developed to examine the newplanting and replanting behaviour of rubber holdings in Kerala. Using this framework,the problem has been examined at a macro-level by making use of annual acreage data on newplanting and replanting. It has been seen that there was positive relationship between newplanting and real price of rubber,but replanting was negatively related to the real price. The analysis of macro-level data had shown that there existed the practice of postponement of replanting activity among rubber growers , which arose due to postponement of the entire area under each holding or due to staggered replanting. The macro-level study

using aggregate data has got its limitations owing to the heterogeneity among rubber holdings. A micro-level study was subsequently carried out using data from Poonjar South Village, having 547 holdings.

Estimation of the output stream and the corresponding income stream for a few types of growers for a plan horizon and examining the nature of instabilities in output and income was the methodology followed. Output stream of each type of grower in the selected sample for a plan horizon of thirty years was estimated using micro-level data on age-wise area and age-wise yield profile. This was considered as the output stream corresponding to the last thirty year period. For each grower, income stream corresponding to this period was subsequently estimated by multiplying each year's output with the corresponding year's price.

The analysis of the primary-level data showed that holdings having only one age group of trees were very small compared with those having two or more age groups. A separate analysis of holdings having only one age group of trees showed that very high degree of replanting during the downward phase of price and low rate during the upward phase was being practised. This observation, consistent with that of the macro-level data, provided the evidence to the practice of adjusting of replanting in relation with price movement of rubber.

It was further observed that, in the class of holdings having only one age group of trees ,replanted units are smaller than newplanted units. Once staggered replanting is carried out in a

large holding with only one age group of trees, it becomes one having more than one age groups of trees. Hence, this observation is a clear evidence of the prevalence of staggered replanting. Moreover, for holdings having two age group of trees where both batches are with replanted trees, the gap between successive replantings was six years and above in more than 60% cases. Among holdings having two age group of trees, with one batch replanted and the other newplanted, 82% are having age gap six years and above. For these categories of holdings, since the gap is sufficiently wide, output is available throughout. So whether newplanting or replanting, the majority of growers go for staggering so that they get a continuous output stream. For a representative holding chosen from this category, the coefficient of variation of income stream is only 36%. But, for holdings with more than one age group of trees, if the age gap is not sufficiently wide then there are periods having no output and hence income instability is severe. In the sample, only 10% of holdings come under this category.

For holdings of moderate sizes, for which there are trees of more than one age groups, the proportion of tapped area out of the total rubber area is almost stable at the value 0.57. These growers keep 43% of their rubber area with pre-mature trees, which is a security necessary to maintain stability in output and income. Since the proportion of tapped area is more or less stable, these growers are not adversely affected by instabilities in output and income. In the size class 1.50 - 2.00 hect., 75% of holdings have carried out staggered planting and maintain stability in tapped area. In the size class 2.00 - 3.00 hect., 83% come under this

category while in the class 3.00 hect. and above, the corresponding figure is 95%. It is evident that all small holdings are not alike. Almost all holdings with area 1.50 hect. and above practice staggered planting and hence they maintain stability in output and income.

Staggered replanting is size-determined. Since for holdings of very small size staggered replanting is not practicable, they have got trees with only one age group. In the sample, 45% of holdings are of this category. For these holdings, once trees are replanted, the grower is deprived of any income from rubber for a number of years. These growers are worst affected by income instability. For a representative holding of this group, the income variability in terms of coefficient of variation is 91%, which is a very high value. Variability arising out of output alone is 86%.

The study very clearly brought out that price stabilisation alone cannot ensure income stabilisation.Over a thirty year period,the variability in real price of rubber is only 13%. Income instability is mostly contributed by output variations and the role of price changes is almost negligible.

Policy Implications and Suggestions

Holdings carrying out staggered planting and obtaining a continuous output stream, income instability arises mainly due to price instability. Govérnment intervention during the post-independence period, kept the price of rubber at a more or less remunerative level. This helped moderate-sized holdings to

maintain a satisfactory level of stability in income. Even moderate-sized holdings which practice staggered planting also would have confronted the problem of income instability, had there been no price protection policies. So to maintain income stability in the case of these moderate-sized holdings, price protection and price stabilisation policies of the Government should continue.

But in the case of holdings of very small sizes, income instability arises mainly owing to output variations. For these holdings, price stabilisation alone cannot solve the problem. These holdings should be treated differently from small holdings of moderate sizes. For these holdings staggering is not practicable because it is constrained by the size of the holding. These holdings have got only one age group of trees and are deprived of any income from rubber once replanting is carried out. Under the various Rubber Plantation Development Schemes during the period from 1985-86 to 1992-93, the rate of replanting cash subsidy was uniform for all holdings having area upto 5.00 hectares in traditional rubber growing areas. Under the Rubber Plantation Development Scheme - Phase IV,growers owning upto 5.00 hectares of rubber area can avail the replanting cash subsidy for replanting upto 2.00 hectares of the area during the period from 1993-94 to 1997-98. But it was observed that holdings with area 1.50 hectares and above carry out staggered planting and they obtain an output stream throughout. So the study suggests that holdings with area below 1.50 hectares is the sector to be subsidised. If the subsidy scheme is limited only for these holdings of very small sizes, it is possible to enhance the present rate of subsidy by diverting the fund going for holdings of moderate sizes.

APPENDIX 1.1

THE RUBBER BOARD
CENSUS OF RUBBER AREA
Questionnaire for Enumerators

I. LOCATION
(i) Village____ (ii) Kara/Desam_____Ward No.___House No.__
(iii) If Registered, Reg No._____(iv) Registered Area_____
(v) Name of Holding _____
(vi) Name & Address of the Owner _____
(vii) Description of Approach Rout _____

II. RUBBER AREA (Upto 1991-92)

Year of Planting	Planting Materials Used BG/CS/US	Actual Rubber area (Hect.)	NP/RP	No. of Trees Tapped/ Not tapd.	Spacing	Tapped Area (Ha.)	Prdn. (Kg)

(a). How actual area calculated ? ----------

III. OWNERSHIP
1) Whether ownership verified ? Yes/No
2) If so, how ? ----------
3) Nature of ownership ----------

IV. TAPPING SYSTEM AND PRODUCTION (During 1991-92)
a) Tapping System: Daily/Alternate/Others
b) Production on the date of visit:Sheet/Latex___No./DRC(Kg.)
c) No. of tapping days during 1991-92:_____
d) Production during April 91 to March 92
Sheet(Kg)_____Scrap(Kg.)_____Latex(Kg.)_____

V. INTERPLANTING/INTERCROPPING (During 1991-92)

A.Intercrops	In tapped area No./Area	In immature area No./Area	B.Interplants	In tapped area (No.)	In immature area (No.)
1)Plantain			1)Coconut trees		
2)Ginger			2)Arecanut trees		
3)Tapioca			3)Pepper		
4)Pineapple			4)Jack trees		
5)Others			5)Anjili trees		
			6)Cashew trees		
			7)Cocoa		
			8)Others		
TOTAL					

APPENDIX 3.1

PRODUCTION AND CONSUMPTION OF NATURAL RUBBER (Tonnes)

Year	Production	Consumption
1950-51	15830	19854
1955-56	23730	28445
1960-61	25697	48148
1965-66	50530	63765
1970-71	92171	87237
1975-76	137750	125692
1976-77	149632	137623
1977-78	146987	144967
1978-79	135297	164524
1979-80	148470	165245
1980-81	153100	173630
1981-82	152870	188420
1982-83	165850	195545
1983-84	175280	209480
1984-85	186450	217510
1985-86	200465	237440
1986-87	219520	257305
1987-88	235197	287480
1988-89	259172	313830
1989-90	297300	341840
1990-91	329615	364310
1991-92	366745	380150
1992-93	393490	414105
1993-94	435160	450480

Source: Indian Rubber Statistics (Various Issues)

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