ABSTRACT OF THESIS

THE ECONOMICS OF RUBBER PLANTATIONS IN INDIA

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Degree of Doctor of Philosophy

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This is an economic evaluation of the feasibility of government investment in the rubber plantation industry in India.

The benefit-cost methodology was used. Cash flows were discounted at rates from five to fifteen per cent, with emphasis on a discount rate of ten per cent, which is approximately the marginal productivity of capital. The optimum project size is 5,000 acres, with planning horizons of 37 years, 32 years, and 27 years.

Direct benefit-cost findings, including the internal rate of return (e.g., 14.94 per cent for 37 years) and present worth, indicate that rubber plantations are a worthwhile public sector investment. This conclusion is further supported by an appraisal of important secondary benefits such as employment, import substitution, savings, government revenues, multiplier effects, and regional development.

A query has been raised about the advisability of continued tariff protection.

SHORT TITLE

ECONOMICS OF RUBBER PLANTATIONS IN INDIA

THE ECONOMICS OF RUBBER PLANTATIONS IN INDIA

A BENEFIT-COST EVALUATION

A Dissertation

Presented to

the Faculty of Graduate Studies and Research

McGill University

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy in Economics

by

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PREFACE

One of the major bottlenecks to development planning in emerging countries is the absence of adequate statistical data and pre-investment surveys. This is the prime reason why the United Nations Organization and its Agencies have stressed the importance of the standardization of data collection and the compilation of economic feasibility studies on as wide an area as possible.

The Government of India launched a comprehensive national planning programme in 1951, with a succession of Five Year Plans. During the process of execution of planned development over the last eighteen years, various Government departments have done much to improve the methods of data collection. The feasibility studies, however, have not received enough attention, but are concentrated in the traditional field of water resource development projects.

Public sector investment in India is currently branching out into areas which hitherto have solely been the preserve of the private sector. One instance is Government investment in the rubber plantation industry, which is located mostly in South India. Recently, the State Governments of Kerala and Madras established plantation enterprises on a strictly business basis. The only feasibility study available on this industry is an unpublished industrial engineering report by Dr. H. N. Nanjundiah for the Plantation Corporation of Kerala. Besides being in essence a confidential document meant for official use, Nanjundiah's evaluation looks at the

Government plantation enterprise in a purely financial context.

In contrast, this research undertakes a study of public sector investment in rubber plantations in a broad economic setting, taking into consideration the "opportunity costs" of the factors of production. Such a treatment of the problem is necessary, especially since there is considerable unemployment in India, while capital as an input factor is in extremely short supply. In a project evaluation, we have also to assess the secondary benefits like employment potential, foreign exchange savings, multiplier effects, and regional development. The benefit-cost ratios and the internal rates of return derived from this analysis would help the planning authorities in their endeavour to allocate scarce resources in an optimal manner.

The current study is claimed to be an original contribution to applied economic research and scholarship for this reason. It is hoped, however, that this will only be the beginning of a number of related studies, each contributing to a better understanding of the economy of India and the planning process.

I acknowledge with gratitude the stimulating comments of Professor D. L. MacFarlane, my research director, as well as of Professors C. B. Haver, E. F. Beach, and C. J. Kurien, at various stages of the preparation of this dissertation.

Since their number is legion, I like to record collectively, my obligation to the numerous planters, and the officials of the Rubber Board, the Plantation Corporation of Kerala, and the United Planters' Association of Southern India, for their readiness to provide me with the necessary data in the course of my field survey.

I would also like to thank the Centre for Developing-Area Studies and the Department of Economics and Political Science of McGill University, for financial assistance.

My wife has been a constant support to me, with her patience, sympathy, and encouragement.

Finally, appreciation and thanks are due to Mrs. Lillian Jones and Miss Janice Mullins, who cheerfully undertook the arduous task of typing this thesis.

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THE PROBLEM

This research undertakes an evaluation of the prospects for public sector investment in the rubber plantation industry in India, a country which is now in its eighteenth consecutive year of national planning for economic development. Rubber plays an important part in the industrial economy of India. It enters the production of a wide range of industrial goods useful in war and in peace. Although raw rubber production in India was started more than sixty years ago, the rubber manufacturing industry is of more recent origin.

Started in the 1920's, the manufacturing industry has had a phenomenal growth. The industry now consumes more than 100,000 tons of raw rubber annually, the major portion of which is from indigenous sources. India produces practically every kind of rubber goods to meet internal requirements. The major portion of India's consumption of raw rubber, however, is absorbed in tyre manufacture. The manufacturing industry consists of about 200 units scattered throughout the country, of which some 20 are highly modern plants. India is also exporting rubber manufactures to the markets of West Asia, Burma, Ceylon and Pakistan. She earned foreign exchange in the amount of Rs 31.68 million in 1965-66.[1]

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[1] Indian Rubber Statistics, Vol. 9 (Kottayam: Rubber Board, 1966), p. 37.

With the quickening tempo of development programmes in India, the consumption of rubber has risen rapidly over the last two decades. Consumption of raw rubber which was 19,854 metric tons[2] in 1950-51 (the year preceding the launching of the First Five Year Plan) rose to 95,092 metric tons in 1965-66, the final year of the Third Five Year Plan -- which shows a nearly five-fold increase during a span of 15 years. Indigenous rubber production rose from 15,830 metric tons in 1950-51 to 65,271 metric tons in 1965-66 (made up of 50,530 metric tons natural rubber and 14,741 metric tons synthetic); the deficit was met mainly from imports, and partly from reclaimed rubber.[3]

Thus, unlike other rubber producing countries in Southeast Asia, India is in the unique position of being a producer of raw rubber as well as a manufacturer of rubber goods. The production of raw rubber, however, has not kept pace with the demand from the manufacturing industry. Efforts are being made to step up domestic production through rehabilitation of existing plantations, expanding cultivation, and improvement in yields in the plantation industry as well as by the commissioning of synthetic rubber plants.

The total area under natural rubber in India was 407,014 acres in 1965-66, confined mainly to the three southern States of Kerala, Madras

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[2] One metric ton = 1000 kg. or 2,204.6 lbs.; one long ton = 2,240 lbs. Whenever the reference is not in metric tons, the figures are given in (long) tons.

[3] Indian Rubber Statistics (1966), p. 33.

and Mysore. Kerala, in the south-western part of the country, is by far the most important natural rubber producing State with over 95 per cent of the total area in India. The concentration of rubber cultivation is so heavy in Kerala that the economic well-being of a large section of the population of the State depends on the commodity. The distribution of the planted area at the end of 1965-66 is given in Table I. The rubber growing areas of India are depicted in Figure 1.

TABLE I

STATE-WISE DISTRIBUTION OF AREA UNDER RUBBER IN INDIA, 1965-66

State	Small holdings (50 acres and below)		Estates (Above 50 acres)		Total	
	No. of Units	Acreage	No. of Units	Acreage	No. of Units	Acreage
Kerala	74,445	244,614	581	138,096	75,026	382,710
Madras	1,032	6,648	41	12,676	1,073	19,324
Mysore	25	392	11	3,945	36	4,337
Andamans, etc.	2	60	3	583	5	643
Total	75,504	251,714	636	155,300	76,140	407,014

Source: Indian Rubber Statistics (1966), pp. 6-9.

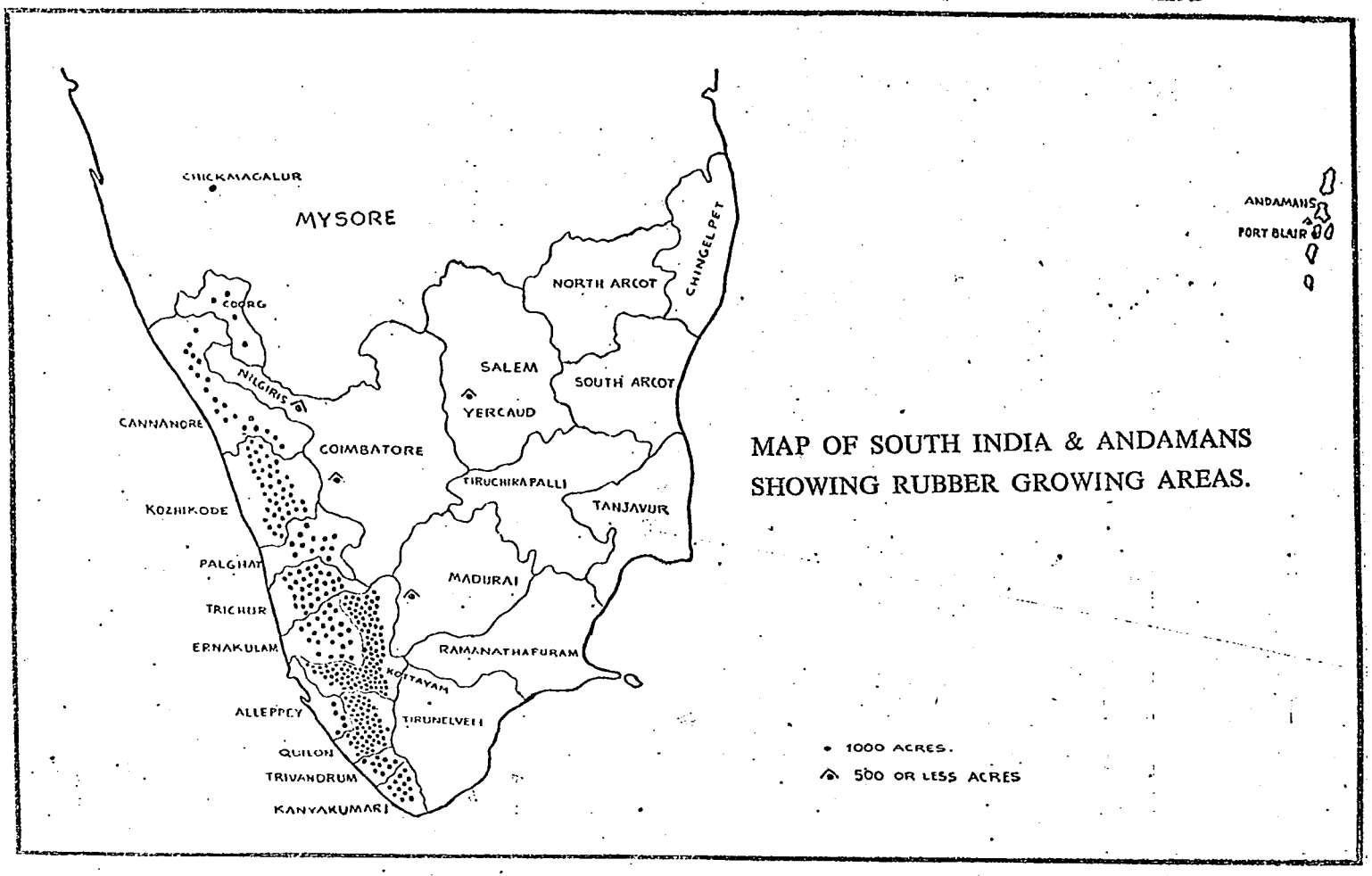
CHICKMAGALUR
MYSORE
COORG
NILGIRIS
CANNANORE
KOZHIKODE
PALGHAT
TRICHUR
ERNAKULAM
ALLEPPEY
QUILON
TRIVANDRUM
KANYAKUMARI
COIMBATORE
SALEM
YERCAUD
NORTH ARCOT
SOUTH ARCOT
CHINGELPET
TIRUCHIRAPALLI
TANJAVUR
MADURAI
RAMANATHAPURAM
KOTTAYAM
TIRUNELVELI
ANDAMANS
PORT BLAIR
MAP OF SOUTH INDIA & ANDAMANS
SHOWING RUBBER GROWING AREAS.
• 1000 ACRES.
500 OR LESS ACRES

FIGURE 1

In terms of employment, rubber plantations rank third among the plantation industries of India, the first and second being tea and coffee respectively.[4] In 1960 it was estimated that the average number of persons employed in rubber plantations was 95,000, of whom 66,000 were permanent and 29,000 were temporary workers.[5] Recently, the Central Wage Board estimated that the industry employed about 100,000 regular workers.[6] In Kerala itself, the rubber plantations provided employment to 108,796 workers in 1964 (including garden labour and outside labour -- permanent and temporary).[7]

Against this background, we may explore the problem for this study. A number of questions arise in this context. What are the social costs and benefits of producing more natural rubber in India rather than importing it? Is it economic to expand rubber cultivation at public expense? What is the impact of alternative technologies? Is a growing synthetic rubber industry a threat to the prospects of the natural rubber industry? In short, do rubber plantations represent an attractive investment when examined in the

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[4] "Plantation" is defined as any area planted with the above-mentioned crops, whatever the size.

[5] Rubber in India, 1956-60 (Delhi: Manager of Publications, 1963), p. vii.

[6] "Report of the Central Wage Board for Rubber Plantation Industry", (mimeograph) (New Delhi: Ministry of Labour and Employment, 1966), p. 95.

[7] Statistical Handbook of Kerala (Trivandrum: Bureau of Economics & Statistics, 1965), p. 81.

broad economic context? Specifically, it may be hypothesized that the marginal rate of returns for rubber plantations in India is positive.

The objective of this research is to provide answers to the above questions. This is pursued by examining various aspects of the industry. First, the methodology used in the major analysis is elaborated in Chapter II; this is essentially a discussion of the benefit-cost technique in the evaluation of public investment projects, and the concepts involved. Chapters III and IV deal with the historical and technical background, including industry structure and recent advances in technology. The prospects for natural rubber vis-a-vis synthetic rubber in India, in relation to the demand and supply conditions, are estimated in Chapter V. Chapter VI is a profitability analysis, based on the balance sheets of public limited companies in the rubber plantation industry in India; this is an index which influences the decisions of the private investor. The economic analysis is done in Chapter VII, using "opportunity costs" and the discounted cash flow method, on a hypothetical plantation of 5,000 acres. The secondary benefits emanating from the plantation project are also given appropriate consideration. Finally, Chapter VIII discusses the policy implications, including the protectionist controversy.

CHAPTER II

METHODOLOGY

One of the most urgent needs of developing countries is the scientific assessment of investment opportunities. For the rational allocation of a country's scarce resources, the necessity for project evaluation or pre-investment surveys in the context of general economic planning is now widely recognized. In such evaluation it is essential to bear in mind the distinction between technical efficiency and economic efficiency, as well as between financial profitability and economic feasibility.

Technical efficiency may be defined as the maximum output which can be produced from a given set of resources. Technical efficiency, however, does not provide for a choice between various factor combinations to produce the same product; neither does it provide for a choice between quantities of alternative products from given inputs. These choices are problems of economic efficiency, and require knowledge of relative product values and alternative factor costs.

Economic efficiency is the maximization of economic well-being. A society is endowed with a set of initial resources, and the economic problem is to allocate the limited resources among competing ends so as to maximize welfare. In sum, technical efficiency is the achievement of the greatest possible output with given (fixed) means or the achievement of a

given (fixed) output with the smallest means, whereas economic efficiency is the performance of economic institutions in conformity with the society's wishes (that is, the firm combines its factors such that it minimizes cost in terms of productive effort).[1]

Economic efficiency thus implies that the only meaningful cost of a resource from the society's point of view is its alternative cost--that is, the product sacrificed by not employing the resource in an alternative pursuit--the "economic cost" as distinguished from the "monetary cost". In project evaluation, it is not the out-of-pocket cost with which we are concerned, but rather the "opportunity cost".[2] There will thus be net benefits from a particular project only if the resources employed have a lower alternative value to society.

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[1]For an excellent discussion of these two efficiency concepts, see Tibor Scitovsky, Welfare and Competition (London: George Allen & Unwin, 1952), pp. 148 ff., and Earl O. Heady, Economics of Agricultural Production and Resource Use (Englewood Cliffs, N.J.: Prentice-Hall, 1965), pp. 95-103 and 704 ff.

[2]For an early but exhaustive treatment of the concept of opportunity costs, see H. J. Davenport, Economics of Enterprise (New York: Macmillan, 1918), pp. 60-66. Professor Tinbergen proposes the use of "accounting prices", which would be the technical instruments to ensure full use of the scarce available production factors. These prices are the intrinsic value of the factors, and using them, the supply is exactly sufficient to meet the demand. Accounting prices thus represent the value of the marginal product which they help to produce, since projects which do not show a surplus over the cost of the factors employed (at accounting prices) will be marginal between acceptance and rejection. Accounting prices for labour, for example, reflect the price of labour needed to achieve full employment under conditions of equilibrium. Tinbergen considers that a rough estimate may be sufficient for the fundamental disequilibrium affecting the market price (especially overt or disguised unemployment in under-developed countries). The project is therefore evaluated using a certain percentage of the average

First, let us examine the cost accountant's as distinguished from the economist's approach. In enterprise accounting, financial statements are compared and analyzed. There are innumerable ways of arranging the statements so that important relationships become apparent. An extended comparison over a number of years (or the appropriate accounting periods) is often presented in what is usually called a trend statement. It is common to find in corporate annual reports that while balance sheets are presented on a year to year comparison only, the income (profit and loss) statements are presented in the trend form, and financial analysts frequently use various ratios for the same purpose.[3]

The economist can, no doubt, make use of the financial data furnished by the accountant, but he must also relate these data to an assortment of other important factors such as the employment and manpower situation in the country, the question of foreign exchange, the source and availability of raw material, the cost of using capital, the choice of this project rather than some other worthy project, and ability to earn a reasonable return. The economist thus places his emphasis on the overall economic effect of the project.

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market rate for wages (60, 70, or 80 per cent). See Jan Tinbergen, The Design of Development (Baltimore: Johns Hopkins Press, 1958), pp. 39-40, and his "The Relevance of Theoretical Criteria in the Selection of Investment Plans", in Max Millikan, (ed.), Investment Criteria and Economic Growth (New York: Asia Publishing House, 1961), pp. 1-15.

[3]These include debt and liquidity ratios, asset use ratios, operating and profitability ratios and income trends.

The private investor uses various financial yardsticks to establish a minimum rate of return. Companies that set profit goals, however, caution against applying them too rigidly in determining project approval or rejection. One reason is that these are not exact, but vary according to the method used to compute them. Also, there are always some projects which, though failing to meet minimum standards, nevertheless offer side benefits not readily expressed in terms of return on investment. In such cases, it is felt, the cut-off rate of return or profit goal must be tempered by the pure business judgment of those making the decisions.

There are several ways to calculate return on investment. The simplest method is the inverse of the payback ratio, i.e., average annual income divided by total investment. Companies using the discounted cash flow method, however, claim that it overcomes the deficiencies of the simpler methods and provides management with an estimate of the real return on the project.[4] Known also as the investor's method, the profitability index, and the internal rate of return method, the discounted cash flow method is the most widely used of the more sophisticated techniques for calculating return on investment. It provides management with a dependable

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[4]For a statement from an industrial source of the case for a rate of return as compared to payout (payback) period, see John C. McLean, "How to Evaluate New Capital Investments", Harvard Business Review, 36 (November-December 1958), 59-69. See also Ray I. Reul, "Profitability Index for Investments", op. cit., 35 (July-August 1957), 116-32; Joel Dean, "Measuring the Productivity of Capital", op. cit., 32 (January-February 1954), 120-30; and Donald F. Istvan, "The Economic Evaluation of Capital Expenditures", Journal of Business, 34 (January 1961), 45-51.

measure of project desirability and a means of rating projects in order of profitability. The computation is based on the premise that cash in hand is worth more than cash in the future, and that therefore cash to be received in future years must be discounted to reflect its present worth. Each year's earnings are discounted at the interest rate (or per cent return on investment) which will cause the total net cash flow of future years, when so discounted, to be equivalent to the total original investment.

The present value method of assessing project profitability is based on the same formula. However, in this method, the interest rate at which future earnings are to be discounted, is pre-determined. It is usually set at no lower than the prevailing market cost of capital, since it would be unprofitable to invest in projects returning less than this rate, but it may also be set at the company cost of capital or a minimum acceptable rate of return.

Various notions of relative "productivity" of investments have been commonly used in the decision-making complex: interest rate, internal rate of return, marginal efficiency of capital,[5] and marginal efficiency of

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[5]Used by Keynes for the first time, this term means the rate of discount, which will equate the present value of prospective amounts of returns to the cost of capital goods, or the rate of return which one can expect to earn on a capital asset costing C_R and yielding a series of annuities $Q_1, Q_2, \ldots Q_n$. Thus supply price (C_R) = discounted prospective yields = $\frac{Q_1}{(1+r)} + \frac{Q_2}{(1+r)^2} + \ldots \frac{Q_n}{(1+r)^n}$, where r = marginal efficiency of capital, which in general, is the highest rate of return over cost expected from producing an additional or marginal unit of all types of

investment. These measures, however, are primarily appropriate as investment criteria for the private sector, and have not been deemed entirely applicable to situations where there is a divergence between private and social returns.

In contrast, economic evaluation consists of a comparative appreciation between possible uses of resources represented by investment projects. The various evaluation criteria and their relative complexity derive in turn from the definition of advantages and the type of calculation. These criteria are often expressed in terms of numerical coefficients, which are arranged such that the higher the numerical value, the higher the priority given to them.

Benefit-Cost Technique

What the private entrepreneur regards as benefits, raises no conceptual problems since his prime motive is profit, whether in absolute terms or per unit of capital (net return).[6] In the case of social

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capital goods. Cf. J. M. Keynes, The General Theory of Employment Interest and Money (London: Macmillan, 1936), Chapter 11. While Keynes' marginal efficiency of capital is synonymous with the marginal internal rate of return, Alchian argues that it is not Fisher's rate of return over cost. See Armen A. Alchian, "The Rate of Interest, Fisher's Rate of Return Over Cost and Keynes' Internal Rate of Return", The American Economic Review, 45 (December 1955), 938-43.

[6]With the managerial revolution, and the rise of giant corporations, technostructure, and organization men, however, it is now generally admitted that private enterprise has other goals besides profit maximization. See John Kenneth Galbraith, The New Industrial State (Boston: Houghton Mifflin Co., 1967), pp. 109 ff; and Joel Dean, Managerial Economics (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1951), pp. 28-29.

evaluation, the problem is much more difficult both conceptually and practically. It is important to measure the productivity of the complex of resources used according to the production formula of each project. Social prices should be used for all the magnitudes, and besides, not just the benefits and resources directly related to the project but also the so-called indirect benefits and costs must be taken into account. Criteria for selection by the public sector have therefore been broadened to include a return to society as a whole which is incapable of being captured in the usual market calculus. The various formulations of cost-benefit ratios with the inclusion of primary and secondary benefits have been an attempt to capture the social gains of such projects.[7]

Benefits of a project are the value of the project's output. Primary benefits are the value of the increment in output arising from a given investment and not the increment in value of existing assets (i.e., the purely transfer or distributional values like net rises in rents and

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[7]There is no best technique for project evaluation under all circumstances. Within the extensive literature on the subject see in particular A. R. Prest and R. Turvey, "Cost-Benefit Analysis: A Survey", Economic Journal, 75 (December 1965), 683-735, reprinted in Surveys in Economic Theory, Volume III (Toronto: Macmillan Co., 1966), pp. 155-207; H. B. Chenery, "Comparative Cost and Development Policy", American Economic Review, 51 (March 1961), 18-51; and United Nations, Manual on Economic Development Projects (New York,1958). For a fairly exhaustive treatment of the area, see Alexander Weiner, "Project Evaluation Techniques for Economic Development" (Unpublished Master's Thesis, McGill University, Montreal, August 1968).

land values). Secondary benefits are income generated in ancillary industries as a result of the project; they also include increased employment, foreign exchange and tax revenue. Primary costs are borne by the investor, secondary costs are values of resources in ancillary industries. Thus net primary benefits equal primary benefits minus primary costs. We have net secondary benefits if resources in the ancillary industries earn a greater income because of the project than they could earn elsewhere in the economy. In addition to estimates of tangible revenues and expenses, government planners have to guess at such things as external economies and diseconomies, indirect employment creation, probable import substitution, strategic value, and percentage of domestic disbursements saved by recipients.[8] Some of the secondary benefits in relation to the rubber plantation project under study are discussed in detail in Chapter VII.

The cost-benefit technique is an extremely important tool in project appraisal and investment programming. As Prest and Turvey define it,

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[8] Stephen Enke, Economics for Development (Englewood Cliffs, N.J.: Prentice-Hall, 1963), pp. 296-97. For a detailed discussion of primary and secondary costs and benefits, see U.N., Manual on Economic Development Projects, pp. 235-36. See also The Federal Inter-Agency River Basin Committee, Sub-Committee on Benefits and Costs, Proposed Practices for Economic Analysis of River Basin Projects ("The Green Book") (Washington, D.C.: U.S. Government Printing Office, 1950).

cost-benefit analysis is a:

> practical way of assessing the desirability of projects when it is important to take a long view (in the sense of looking at repercussions in the further, as well as in the nearer, future) and a wide view (in the sense of allowing for side effects of many kinds on many persons, industries, regions, etc.), i.e., it implies the enumeration and evaluation of all the relevant costs and benefits.[9]

The cost-benefit technique has had a long history from the time of the French engineer-economist Dupuit, who wrote the classic paper "On the Measurement of Utility of Public Works" in 1844--on the social benefits of such collective goods as roads, canals, and bridges--in which he stumbled upon the distinction between total and marginal utility.[10] But cost-benefit analysis as a practical concept of economic planning originated with Pigou, when he defined the concept of social costs and benefits.[11] This meant that social costs and benefits are additive in monetary terms, by asking what value people would themselves put on them. We can then express them as a rate of return on capital, and so determine our investment

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[9] A. R. Prest and R. Turvey, "Cost-Benefit Analysis: A Survey", op. cit., p. 683.

[10] J. Dupuit, "On The Measurement of the Utility of Public Works", Annales des Ponts et Chaussées, Series 2, Vol. 8 (1844), English translation in International Economic Papers, No. 2 (London: Macmillan, 1952), pp. 83-110.

[11] Cf. A. C. Pigou, The Economics of Welfare, (4th Edition; London: Macmillan Co., 1932), Part II, especially Chapters II, III, IX and X.

rationality from the community's point of view.[12] This technique became prominent in the United States, especially with the Flood Control Act of 1936 and the water development projects. Recent developments in its use clearly show that it speaks the language of welfare economics--that is to say, it is a technique which is explicitly concerned with the wide consequences of investment decisions.

As choice involves maximization, we have to specify what it is that the decision maker wants to maximize--the aim is to maximize the present value of all receipts less that of costs, subject to specified restraints.[13] The investment criterion (or decision algorithm) can be expressed in different ways:[14]

1. $\frac{b_1}{(1+i)} + \frac{b_2}{(1+i)^2} + \cdots\cdots + \frac{b_n+s}{(1+i)^n} > \frac{c_1}{(1+i)} + \frac{c_2}{(1+i)^2} + \cdots\cdots \frac{c_n}{(1+i)^n}$

2. $\dfrac{\frac{b_1}{(1+i)} + \frac{b_2}{(1+i)^2} + \cdots\cdots + \frac{b_n+s}{(1+i)^n}}{\frac{c_1}{(1+i)} + \frac{c_2}{(1+i)^2} + \cdots\cdots + \frac{c_n}{(1+i)^n}} > 1$

3. $b > c$

4. $\frac{b_1-c_1}{(1+r)} + \frac{b_2-c_2}{(1+r)^2} + \cdots\cdots + \frac{b_n-c_n}{(1+r)^n} = 0$

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[12] Prest and Turvey, op. cit., p. 728

[13] Otto Eckstein has provided a most helpful classification of constraints as physical, legal, administrative, distributional and budgetary. See "A Survey of the Theory of Public Expenditure Criteria", in James M. Buchanan, (ed.), Public Finances: Needs, Sources and Utilization (Princeton: Princeton University Press, 1961), pp. 450-53.

[14] Prest and Turvey, op. cit., p. 703.

where c_1 , c_2 ,$\ldots c_n$ = series of prospective costs in years 1, 2, ...n.

c = constant annuity with the same present value as c_1 , c_2 ,$\ldots c_n$

b_1 , b_2 ,$\ldots b_n$ = series of prospective benefits in years 1, 2, ...n.

b = constant annuity with the same present value as b_1, b_2, $\ldots b_n$.

s = scrap value

i = rate of discount for annual compounding

r = internal rate of return.

In other words, select all projects, where:

1. the present value of benefits exceeds the present value of costs;
2. the ratio of the present value of benefits to the present value of costs exceeds unity;
3. the constant annuity with the same present value as benefits exceeds the constant annuity (of the same duration) with the same present value as costs;
4. the internal rate of return exceeds the chosen rate of discount (ordinarily, the appropriate interest rate).

A project which has a conventional benefit-cost ratio of unity or greater, evaluated at the relevant interest rate, will have a rate of return equal to or greater than the interest rate. Ranking of projects by the rate of return ensures that the present value (i.e., all future benefits and costs discounted by the interest rate back to current value) of available resources is maximized--that is, no substitution in the order

of projects could improve the present value of resources.[15] The benefit-cost criterion maximizes the returns based on all costs, not just the capital costs. For society, the resources are represented by total social costs, whereas for the private entrepreneur, they are represented by his capital. Maximization of the present value of currently available resources is the optimal means of allocating resources among competing ends, including possible investments for future incomes.

From the standpoint of economic efficiency, a project may be undertaken only if it will yield benefits greater than in the next best alternative use which the resources have. The prices of the resources reflect the value of the production contributions which they make in their next best alternative use. Private decisions will carry out investment activities only up to the point where marginal private costs equal marginal private benefits, whereas optimal resource allocation requires attention being paid to the corresponding social costs and benefits. This emphasizes the significance of the one-to-one ratio as the cut-off point of uneconomic projects.

Discounting Rate(s)

While cost-benefit analysis provides an organized and disciplined approach to project evaluation, it involves the serious problem of choosing

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[15] Cecil B. Haver & Associates, An Economic Analysis of Evaluation Practices for Water Resource Development (Chicago: 1961), p. 107.

an appropriate social time preference rate for discounting cash flows. Do market rates of interest bear any close relationship to the marginal productivity of investment over time? Is the capital market functioning perfectly? An appropriate discount rate plays an important role in this method of project evaluation, expressing as it does the preference of cash now to cash in the future. The Government borrowing rate is often taken as the social opportunity cost since it is the financial cost of Government financed investment, and can be regarded as the risk-free rate of interest (abstracting from uncertainty about the price level).[16]

Otto Eckstein opines that the choice of the interest rate remains a value judgment.[17] A usual procedure is to select an interest rate or rates, on the basis of observed rates ruling at the time. Another interest rate used is the projected long-term government bond yield plus the risk premium. The U.S. Bureau of the Budget uses the average rate payable on outstanding treasury obligations at the end of the fiscal year preceding calculations which upon issue have maturities not more than 12 months longer or shorter than the economic life of the project.

The present worth of a sum of money in the future will be higher, the lower the rate of interest and the nearer the time horizon. Again,

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[16] Prest and Turvey, op. cit., p. 698

[17] Eckstein, op. cit., p. 460.

the annual amortization charges will be higher, the higher the discount rate, the nearer the time horizon, and the lower the salvage value. The higher discount rate discriminates against the projects with increasing benefit flows over time, the lower against those with declining benefit streams. High discount rates operate strongly against long gestation periods, and against long-lived assets. And since long-lived projects usually cost substantially more than short-lived projects, a high discount rate militates against their acceptance. By the same token, investments with long gestation periods become very difficult to accept when a high discount rate is used.

The structure of interest rates at any point in time reflects the entire range of expected values of all maturities in the future; it is an index of the value of capital resources in alternative investments (as measured by time preference and the marginal productivity of capital). The interest rate distinguishes among projects with respect to the time shape of the costs and benefits and the level of benefits to capital inputs. The price of capital goods must reflect their value at the time the resources are committed. The costs of year to year variability of benefits may be accounted for by using a higher discount rate than the official bank rate, just as in the real world risky ventures pay higher rates for capital. The appropriate rate of interest or discount to use in investment is the rate foregone in alternative investment opportunities of similar riskiness.

Essentially, the discount rate used in cost-benefit analysis should be a measure of the marginal productivity of capital. In principle, the interest rate (minimum attractive rate of return) used in an economic study ought to be the return obtainable from the opportunity foregone. The actual discount rates used in the cost-benefit work underlying decisions in power and irrigation projects in India range around five per cent.[18] Conventionally, the upper limit for a minimum attractive return in public utilities is rarely much greater than the cost of capital. The "fair return" on investment permitted under the policies of many regulatory commissions is based on the over-all cost of capital to the utility. When the return that the regulatory authorities allow on a utility's investment is used as the minimum attractive return in the utility's economic studies,

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[18]The large amount of work dealing with the theoretical aspects of investment and water rate fixation, as well as with specific irrigation projects includes D. R. Cadgil, Economic Effects of Irrigation (Poona: Gokhale Institute of Politics & Economics, 1948), K. M. Mukerji and K. J. Mammen, The Economics of River Basin Development in India (Bombay: Vora & Co., 1959), National Council of Applied Economic Research, Criteria for Fixation of Water Rates and Selection of Irrigation Projects (Bombay: Asia Publishing House, 1959), K. N. Raj, Some Economic Aspects of the Bhakra Nangal Project: A Preliminary Analysis in Terms of Investment Criteria (Bombay: Asia Publishing House, 1960), N. V. Sovani and Nilkanth Rath, Economics of Multipurpose Dams: Report of an Inquiry into the Economic Benefits of the Hirakud Dam (Bombay: Asia Publishing House, 1960), Agricultural Economics Research Centre, Economics of Irrigation and Water Rates under Cauvery-Mettur Project (Madras: University of Madras, 1961), S. K. Basu, and S. B. Mukherjee, Evaluation of Damodar Canals (1959-60): A Study of the Benefits of Irrigation in the Damodar Region (Bombay: Asia Publishing House, 1963), and K. S. Sonachalam, Benefit-Cost Evaluation of Cauvery-Mettur Project (New Delhi: Planning Commission, 1963).

these studies are in effect being made from the point of the utility's customers. That is, decisions between alternative types of plant are made in a way that will minimize the rates charged for the utility's service.[19]

However, a rate of ten per cent has been suggested as the "accounting price" of capital in India, as reflecting the scarcity of capital as well as the productivity of investment.[20] We may defend a ten per cent or higher rate of discount as a conservative estimate of the marginal productivity of capital in India. There must be in any year a number of opportunities for investment in India where capital has a marginal productivity of 20 or 30 per cent, and progressively more opportunities at lower rates of marginal productivity. The experience of the first three Five Year Plans of the Government of India gives a ratio of incremental net output to incremental capital of around 0.20.

But available evidence points to the use of a rate of discount of around ten per cent for cost-benefit work. It is easy to show that for a wide range of investments in the Indian economy, the productivity of capital

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[19] Eugene L. Grant and W. Grant Ireson, Principles of Engineering Economy (fourth edition; New York: Ronald Press Co., 1960), pp. 149-50.

[20] I. M. D. Little, "Atomic Bombay: A Comment on the Need for Atomic Energy in the Under-developed Countries", The Economic Weekly, X, Nos. 46 and 47 (November 29, 1958), p. 1485, and Arnold C. Harberger, "Cost-Benefit Analysis and Economic Growth", op. cit. (Annual Number, February 1962), pp. 215-17. Tinbergen also recommends the use of 10 per cent as the social discount rate in countries where disequilibrium in the capital market is especially pronounced. See The Design of Development, p. 39.

is much higher than four or five per cent, which is the discount rate used by official agencies. What is important is that for a project to be acceptable, the capital used in it should prove to be as productive as in the general run of alternative investments. If the rate of productivity of "reasonable" investments, in this sense, is ten per cent per annum, then we should discount the expected stream of benefits, and accumulate the expected stream of capital costs of a project using this rate of discount, in order to see whether it is worthwhile undertaking (discounted benefits greater than accumulated costs) or inferior to the general run of alternative investments (accumulated costs greater than the discounted benefits).

Some economists feel that rural labour is a free good--because its marginal product in agriculture is supposedly zero--and that public investment criteria should therefore ignore all monetary costs of hiring labour.[21] In cases of particular scarcity of one of the factors of production, say capital, the accounting price of that factor may possibly be so high as to make the priority figure coincide approximately with the ratio: net returns per unit of that scarce factor. But ranking of projects by the incremental capital-output ratios is meaningless unless all inputs save capital are free goods. A standing rule in economics, assuming there is more than one scarce factor involved, is never to maximize output divided by a single input.[22] Before extensive estimates are made, therefore, a logical

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[21]Prominent among them are P. N. Rosenstein-Rodan, Doreen Warriner, Rugnar Nurkse and Harvey Leibenstein.

[22]Enke, op. cit., pp. 290-91.

investment criterion needs to be examined, based on the resource limitations of the economy. There is usually no warrant for assuming that capital is scarce and labour is free.

The "investment only" position, as a description of the growth process in the Indian economy and as a basis for setting cost-benefit norms, assumes that the alternative product of labour employed in almost any activity is at or near zero. When measuring the benefits of a project, this is taken into account by attributing all value added to capital, and none to labour. Its principal underlying assumption that the wages paid to labour in the operation of projects do not really represent a "social cost" has a good deal of plausibility and appeal in an economy with such abundance of labour as India. Thus the three plantation industries listed in Table II stand up quite well under the benefit-cost criterion implied by the "investment only" view, at least when the critical ratio of gross value added to capital is taken to be about 0.20. Given the present tax structure, we are in effect reduced under the "investment only" view to looking at the ratio of gross value added net of tax to total capital employed. This is given in column (2) of Table III. For comparison, column (3) of Table II is reproduced as column (1) of Table III.

TABLE II

GROSS VALUE ADDED/CAPITAL[23] (ratios for companies in India, 1959)

Industry	With capital = net fixed assets[a] (1)	With capital = net fixed assets plus inventories[b] (2)	With capital = gross fixed assets plus inventories (3)
Tea plantations	.81	.57	.43
Coffee plantations	.60	.43	.36
Rubber plantations	.44	.39	.35

[a] allowing for depreciation

[b] stocks and stores

The available funds for investment in the Indian economy (represented by private and public savings and foreign aid) are extremely limited.[24] Then the question of promoting maximal growth amounts to getting the most out of a given amount of available capital resources. However, investable funds are just as much "spent" when they are paid out to labour services as

[23] A. C. Harberger, op. cit., p. 219, based on Reserve Bank of India Bulletin, September and October 1961. Gross value added is defined here as the sum of salaries and wages, employees' welfare expenses, excise duty, interest and managing agents' commission, depreciation provision and profits.

[24] For the public sector, the total of government revenue after current expenditure, domestic borrowing, admissible deficit financing, and foreign assistance, represents the upper limit of investment. Of the total investment in development projects during the Three Five Year Plan periods, 80 per cent of the capital was raised from internal sources and only 20 per cent came from external aid, mostly in the form of loans.

to capital services. Maximizing the rate of growth from given investable funds therefore entails getting the most per rupee of the capital resources, regardless of to which services the payment is made.

TABLE III

ALTERNATIVE RATIOS OF PRODUCT TO CAPITAL, 1959[25]

Industry	With product = gross value added (1)	With product = gross value added less excise duty (2)	With product = gross earnings of capital plus capital's share of excise duty[a] (3)	With product = gross earnings of capital (4)
Tea plantations	.43	.43	.15	.15
Coffee plantations	.36	.36	.12	.12
Rubber plantations	.35	.34	.16	.15

[a]This share is the ratio of profits, gross of company income tax, to value added net of excise tax. This allocation assumes that the materials used in production bear a fixed proportionate relationship to the quantum of output.

For a wide range of investments in the Indian economy, the marginal productivity of capital is much higher than four or five per cent, which is

[25]Harberger, op. cit., p. 221. Capital is defined in this table as gross fixed assets plus stocks and stores. Columns (3) and (4) accept the assumption made in current cost-benefit procedures that the wages and salaries paid in an activity represent the alternative product of the labour involved, i.e., the wages represent a "social" as well as a "financial" cost.

accepted by the official cost-benefit position in the country for certain investments by the government. Thus column (3) of Table III can be compared with column (1) to see how much difference is made in the measure of the marginal product of capital in moving from the assumption that the social cost of labour is zero to that it is 100 per cent of the wage bill, when excise duties are included in the measure of the marginal product. And column (4) can be compared with column (2) to see the results when the excise duties are excluded. In all these instances, we find that the calculated ratio of value added to capital is above ten per cent. We can thus defend a ten per cent rate of discount as a conservative estimate of the marginal productivity of capital. When discount rates in the range of ten per cent are used, there is much less pressure against long-lived projects and against long gestation periods than when discount rates of 20 or 25 per cent are used.

Opportunity Costs of Labour

A number of market prices, particularly of the factors of production, often diverge from the "intrinsic value" or "accounting prices" that would prevail if the investment pattern under discussion were actually carried out, and equilibrium existed on these markets.[26] In other words, there are two reasons why market prices do not truly reflect the "intrinsic values". First, the realization of the investment pattern itself will influence these values, but only after some time, since investment processes are essentially

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[26]Tinbergen, The Design of Development, p. 39.

time-consuming. Second, there exist in developing countries a number of "fundamental disequilibria", the most important being widespread unemployment--open and disguised.[27] The basic reason is the lack of complementary means of production, i.e., land and capital. In all probability, the equilibrium level of wage rates will be considerably less than the market wages.

Recent estimates of unemployment in India run to several tens of millions. There is also considerable unemployment in South India, especially Kerala, where the rubber plantation industry is concentrated.[28] If we take labour's marginal productivity as zero, then wages paid to labour are in the nature of transfer payments rather than measures of the product foregone. Following this line of argument, it is easy to see that the capital cost of labour intensive projects as rubber plantations would be substantially reduced, and on this much lower capital base, the ratio of value added to capital cost might be very high. It cannot, however, be true

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[27] According to economic theory, there are three kinds of unemployment: frictional unemployment, technological unemployment and secular unemployment. Two associated concepts also require reference: under-employment and disguised unemployment. Disguised unemployment which is often confused with under-employment, is a rather sophisticated notion that we originally associated with the impact of the trade cycle on the employment pattern. Very simply, it is considered that if a person has to take up a job which is inferior to his qualifications, ability and physical capacity, then although he has some kind of a job, he is really unemployed. See Joan Robinson, "Disguised Unemployment", Economic Journal, 46 (June 1936), 225-37.

[28] According to the 1961 census, 14.14 per cent of the labour force in Kerala was unemployed. This is obviously an underestimate owing to the discrepancies in reporting.

that labour of all types and skills is so abundant in the Indian economy as to have a marginal productivity of zero. It is now widely recognized that even in agriculture where the "zero marginal product" hypothesis has its roots, the marginal productivity of labour is significantly higher than zero. Professor K. N. Raj's study of the Bhakra Nangal irrigation project[29] contains evidence that even common labour is sometimes not easy to obtain in large numbers. T. W. Schultz has also disputed the doctrine of labour of zero value in underdeveloped countries, with particular reference to India.[30] After an extensive review of literature bearing on the issue of over-population and underemployment in agriculture, Kao, Anschel and Eicher conclude that there is little empirical evidence to support the view that zero marginal product is frequent.[31]

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[29] Raj, op. cit.

[30] T. W. Schultz, Transforming Traditional Agriculture (New Haven: Yale University Press, 1964), Chapter 4.

[31] Charles Kao, Kurt Anschel and Carl Eicher, "Disguised Unemployment in Agriculture: A Survey", in Carl Eicher and Lawrence Witt (eds.), Agriculture in Economic Development (New York: McGraw-Hill, 1964) pp. 129-44.

However, the controversy around the disguised unemployment hypothesis is continuing. While there is strong temptation to conclude from casual observation that surplus labour exists in some underdeveloped countries, the information available to the investigators of the nature of agricultural employment in these countries is too scanty to be used to provide conclusive answers to whether or not surplus labour exists, or what part of the labour force can be regarded as surplus. For most parts of Asia, it is possible to question the existence of under-employment in the sense that the "marginal product of labour in agriculture is zero" (or close to zero). Cf. Harry T. Oshima, "Underemployment in Backward Economies: An Empirical Comment", Journal of Political Economy, 66 (June 1958), 259-64, and

The question here is what allowance should we make, in economic terms, for the giving of employment. It is a controversial one. First, we must see how this unemployment comes about. Wages may be pushed above the equilibrium level which permits full employment for a number of reasons, which include minimum wage legislation and powerful trade union activity. Thus in contrast to capital, the "real" price of labour is lower than its actual price.

There are obvious limitations to considering unemployed labour as costless. In the calculus of economic growth, consumption is a cost.[32] What then should the community do, if it is not prepared to wait 20 or 30 years to absorb the unemployed? In fact the rest of the community would be giving up something by undertaking the project. There is more to giving an unemployed person a job as a tapper or a field labourer than opening up a rubber plantation. Sometimes the employees need training, which is tantamount to additional investment. Further, if the jobs are in a remote area as is usually the case in rubber plantations, food has to be transported,

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J. W. Mellor, The Economies of Agricultural Development (Ithaca: Cornell University Press, 1966), p. 157. For a succinct treatment of the problem, see Yesufu S. M. Abdulai, "The Doctrine of Zero Marginal Productivity in Agriculture in Underdeveloped Countries" (Unpublished Master's Thesis, McGill University, April 1968), and Stanislaw Wellisz, "Dual Economies, Disguised Unemployment and the Unlimited Supply of Labour", Economica, 35 (February 1968), 22-51.

[32] A. C. Harberger, "Accounting Prices" (mimeograph) (EDI Reading No. 9, University of Nigeria, (n. d.)) p. 7.

and housing, sanitation and other essential services provided. Part of this additional cost may be reflected in the wages.[33]

What then is the true cost of labour used in industry and the public sector enterprises? Does it lie between 50 per cent and 100 per cent of the wages and salaries paid? Those who would consider only 50 per cent of the wage payments to be the true social cost would favour labour-intensive projects, while those who consider the alternative product of labour to be measured by 100 per cent of wage payments, would not allow considerations of labour intensity to affect their judgments as to the relative merits of the different projects. The opportunity costs of labour in India for the purposes of this analysis are developed in Chapter VII.

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[33]Even if the marginal product of labour were zero, its opportunity cost would thus include the transportation, housing, training and additional consumption that would be incurred in its employment. In this respect, H. B. Chenery's formulation that "the cost to society of employing unemployed labour . . . is only the increase in consumption that results" ("The Application of Investment Criteria", Quarterly Journal of Economics, February 1953, p. 82), is questionable. The usual solution is to set the accounting price of unskilled labour at some fraction of its wage rate (U.N., Manual on Economic Development Projects, p. 205).

CHAPTER III

THE RUBBER PLANTATION INDUSTRY IN INDIA

Historical Background

While historical considerations of the industry are important, the particular focus or objective of the present work requires only a brief treatment of this area. Certain historical aspects of the industry which are not dealt with in this chapter, namely area, production, and prices, are detailed adequately in subsequent chapters, especially Chapters IV and V.

Of the three main plantation crops in India--tea, coffee, and rubber--rubber belongs to the most recent period.[1] Rubber was planted in South India on an experimental scale by the end of the nineteenth century. The first plantations of Hevea rubber in India were in the Periyar estate in Travancore (a former native State, now part of the State of Kerala) and the Poonoor estate in south Malabar (a district in the former Madras Presidency, and now part of Kerala). Rubber plantations on a large scale could be said to have commenced from 1902, when 500 acres at Thottakad,

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[1]For a description of the early phase (pre-World War II) of the historical development of the rubber plantation industry in India, see P. V. S. Sarma, A Short Note on Rubber Plantation Industry in India (Kottayam: Indian Rubber Board, 1947), A. V. George, The Rubber Plantation Industry in India (Kottayam: Rubber Growers' Association of India, 1948) and "Report on the Price of Raw Rubber" (mimeograph) (Bombay: Tariff Board, 1951).

north Travancore, were leased for rubber cultivation. Five hundred acres in the Koney forest reserve were granted in 1903 and 400 acres in 1904 in the Periyar valley. Lands were brought under rubber cultivation in Cochin, Malabar, Coimbatore, Coorg and Mysore during this period. By 1910, the area had risen to 29,500 acres.

Rubber production as a major industry in India saw its development about the years 1917 to 1924. It was mostly European initiative that interested itself in the industry. The plantations were well-organized and thoroughly planned with fairly large capital investment. About the years 1923 to 1925, with the knowledge they acquired, Indians also started rubber plantations, some as joint-stock ventures and others as individual private enterprises. By 1925, the area under rubber cultivation increased to 71,499 acres. Between the years 1925 and 1928, rubber saw a boom period admitting of phenomenal profits, and this gave a fillip to native enterprise. In the next 22 years, during which the industry went through a world-wide depression and a war, the area increased to 170,506 acres.

From about three Malayan (Straits) dollars a pound in the beginning of the century, the world price of rubber declined considerably during the first two decades but rose again to 80 cents in 1926. This temporary rise in price led to the establishment of a number of small plantations in South India. During the great depression of the 1930's, however, the price plummeted to the low level of eight Straits cents in 1933. Consequently, many estate owners had to suspend production. It was feared at that time

that rubber production as an economic proposition would go out of the picture altogether. In 1931, when the world economic depression was at its nadir and rubber as a commodity of international trade suffered most grievously, the total area under rubber in India (excluding Burma) was only 67,200 acres.[2]

The year 1933 was the most critical one in its history. It was then that most of the rubber producing countries felt that an organization essentially to look after the interests of producers should be constituted to stop the deteriorating situation. Thus came the International Rubber Regulation Agreement and its national counterpart, the Indian Rubber Licensing Committee in 1934. The rubber industry slowly showed signs of revival. The Indian Rubber Licensing Committee, an organization of primary producers, rendered a great service by gathering comprehensive statistics and drafting a long-term plan. As a pre-requisite for an assured price to meet the cost of production, output and export were controlled, and prices were stabilized on a basis generally remunerative to producers.

Pearl Harbour and the subsequent occupation by Japan of most of the important rubber producing areas of the world, namely Malaya, the Netherlands East Indies, Indo-China and Siam, which together were responsible for 90 per cent of the world production of natural rubber, brought the Indian rubber

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[2] Indian Rubber Statistics (Calcutta: Directorate General of Commercial Intelligence and Statistics, 1934). The new series is published by the Rubber Board, Kottayam.

industry into considerable prominence. Since rubber was a valuable strategic commodity and as Allied requirements of rubber were considerable, attempts were made not only to conserve available supplies but also to increase output to the utmost degree. Indian planters were asked to produce as much rubber as possible, even by resorting to slaughter tapping. The Indian Rubber Control Order 1942 was promulgated in March 1942 re-constituting the Indian Rubber Licensing Committee. Later in the year the Indian Rubber Control and Production Order, 1942 established the Indian Rubber Production Board. All available supplies had to be sold exclusively to the Central Government or to parties nominated by them at prices fixed by the Government from time to time.

The monopoly purchase by Government was terminated in April 1946. Thereafter manufacturers were allowed to purchase rubber directly from producers and dealers in accordance with the terms of permits issued by the Government. The Rubber Control and Production Order lapsed on 30 September 1946. The above Order having been issued under the Defence of India Rules, the Indian Rubber Production Board constituted under its provisions, formally ceased to exist within six months of the termination of hostilities. The Government of India had meanwhile convened a conference of rubber producing interests to examine the necessity of creating a suitable organization to look after the interests of the rubber industry on the abolition of the Board. The Ad Hoc Committee of the Conference recommended the creation of a new Board having a preponderant representation of producers and with

powers, inter alia, to recommend prices for various grades of rubber and to control the import into and export of rubber from India.

The Central Government passed the Rubber (Production and Marketing) Act, 1947, which came into force from 19 April 1947. The Act provided for the development under control of the rubber industry. The Indian Rubber Board constituted under the Act was not a predominently producers' organization. The inclusion of representation for manufacturers helped to ensure a more lasting and satisfactory organization. In the Act there was a provision authorizing the Board to appoint a Price Advisory Committee to advise the Government on the question of fixing rubber prices. Elaborate provisions were made for the licensing of estates and dealers and the regulation of sales through licences.

The Rubber Production and Marketing (Amendment) Act of 1954 made certain changes in the constitution of the Board, whose name was changed to the "Rubber Board". This Act came into force in August 1955. The Rubber Act of 1947 was further amended by the Rubber Amendment Act of 1960 which made certain changes in the rate and procedure of collection of cess on rubber. Rubber is now a controlled commodity and its production, sale and manufacture have to be carried out under licence.

Though the rubber plantation industry in India is nearly 70 years old and has progressed considerably, the present output of natural rubber in India of 52,355 long tons (1966) is only a little over two per cent of the world total. As Table IV below shows, more than 92 per cent of all

natural rubber comes from south and south-east Asia. The rest comes from Africa and Latin America. If we trace a line about 700 miles on either side of the equator, we have in between, that part of the world where rubber is grown, the only area with the right combination of heat and humidity for the proper growth of rubber trees--the so-called "rubber belt", which the world wears around its waist. Table IV shows the area under and the production of natural rubber in the major producing countries of the world. Figure 2 shows India's share in world natural rubber production.

TABLE IV

AREA AND PRODUCTION OF NATURAL RUBBER IN PRINCIPAL TERRITORIES

Country	Year	Area (in acres)	Production in 1965 (tons)
Malaysia	1966	4,901,457	934,251
Indonesia	1965	4,910,000	705,667
Thailand	1965	1,816,000	213,065
Ceylon	1966	571,264	116,442
India	1966	423,193	48,607
Nigeria	1965	592,500	67,170
Viet Nam	1965	250,000	60,000
Liberia	1965	264,971	48,442
Congo	1959	229,897	20,000
Burma	1964	154,482	N.A.
Cambodia	1965	117,933[a]	48,144
Rest of the world		308,303	80,712[b]
Total		14,540,000	2,342,500

N.A.: Not available. [a]Estate figure only. [b]Includes Brazil's 27,827 tons.
Source: Indian Rubber Statistics, Vol. 9 (1966) and Rubber Statistical Bulletin, Vol. 23 (1968).

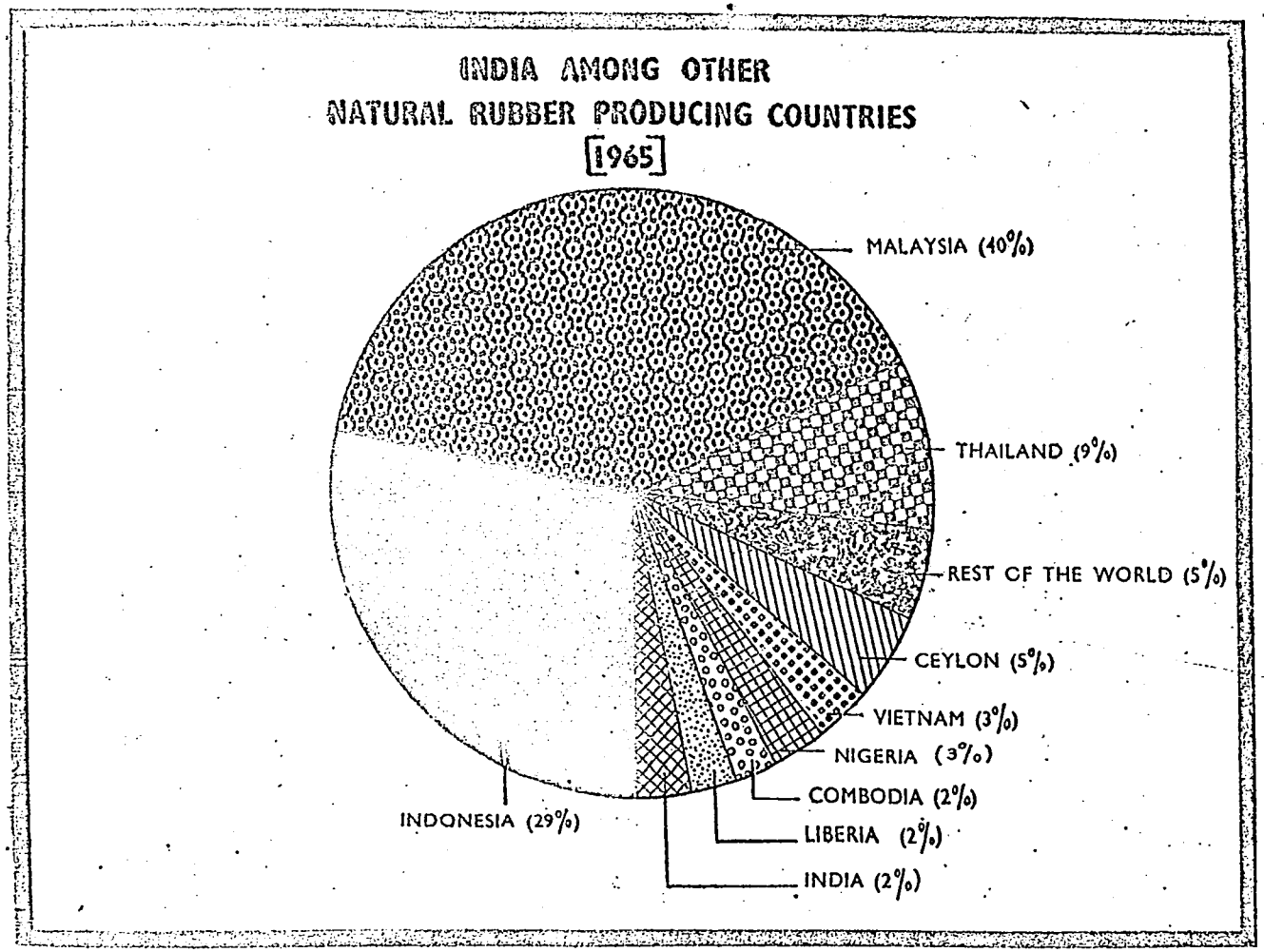
INDIA AMONG OTHER
NATURAL RUBBER PRODUCING COUNTRIES
[1965]
MALAYSIA (40%)
THAILAND (9%)
REST OF THE WORLD (5%)
CEYLON (5%)
VIETNAM (3%)
NIGERIA (3%)
COMBODIA (2%)
LIBERIA (2%)
INDIA (2%)
INDONESIA (29%)

FIGURE 2

Industry Structure

Rubber plantations in India range in size from holdings of a fraction of an acre to estates over 4,000 acres. Although under the Rubber Act, 1954, a "small grower" is defined as one having 50 acres or below, all plantations with an area of 100 acres and below may be considered small holdings for all practical purposes. Thus, plantations of over 100 acres are usually termed "estates" and those whose area ranges up to 100 acres termed "holdings". Table V presents the change in the organizational structure of the industry from 1955 to 1965.

TABLE V

SIZE-DISTRIBUTION OF RUBBER PLANTATIONS IN INDIA

Size-group (acres)	1955 No.	1955 Area (acres)	1955 Per cent of total area	1965 No.	1965 Area (acres)	1965 Per cent of total area
A. Small holdings						
0- 5	23,364	45,193	22	65,477	127,093	31
6-10	1,948	14,083	7	6,175	45,099	11
11-50	1,475	30,394	15	3,852	79,522	20
51-100	209	16,756	8	325	23,612	6
Total	26,996	106,426	52	75,829	275,326	68
B. Estates						
101- 500	179	37,182	18	248	50,597	12
501-1000	33	23,666	11	30	21,130	5
1001-1500	15	18,566	9	19	23,228	6
1501-2000	4	6,826	3	4	6,663	2
Above 2000	6	14,573	7	10	30,070	7
Total	237	100,813	48	311	131,688	32
Grand Total	27,233	207,239	100	76,140	407,014	100

Source: Indian Rubber Statistics (1966), pp. 18-19.

A marked development during the last quarter of a century has been the extension of cultivation by small holders. Though the rapid increase in the number of small units was not marked by the same proportion of change in area, there has nevertheless been a significant change in the relative weight of small holdings in the industry. Estates over 100 acres formed only one per cent of the total number of estates and holdings in 1955 but they accounted for 48 per cent of the total acreage and about 67 per cent of the total production of 23,356 tons. In 1960 they comprised 0.5 per cent of the total number of units and 35.3 per cent of the acreage. In 1966 they formed 32 per cent of the total acreage.

Holdings of 50 acres and below numbered 26,787 units covering 89,670 acres and 44 per cent of the total area in 1955. The corresponding figures in 1965 were 75,504 units, 251,174 acres and 62 per cent of the total area. Holdings up to and including five acres form the largest group of 65,477 units covering 127,093 acres in 1965. Among the small holdings, those with 15 acres or less are a class by themselves because of their special problems. Formerly there was a heavy concentration of small holdings in the Kottayam district of Kerala. Recently, however, there has been a tendency for the small holdings to become more and more dispersed in the rubber growing areas of South India. One factor to be noted in the economics of small holdings is their reliance on mixed crops of rubber, coconut, pepper, tapioca and ginger.

It has been argued that the International Regulation Scheme which was in operation from 1934 to 1942 was inimical to the interests of the small holders.[3] As evidence, it is adduced that during the regulation period, the area of new plantings by small holders was less than that by estates although in an earlier period (1925-28) and some later years (1943-48), the small holders had shown more plantings. But it would be unjustified to exaggerate the deterrent effect of the International Agreement on the small holders. In this connection, it should be recognized that the elasticity of the supply of rubber from small holdings is greater than from estates, principally because of the ability of the small holder to turn to alternative sources of earnings.[4] Thus the small holder plants rapidly when the prospects are good and suspends all planting activities when the market is poor. Tapping on a small holding may be increased or decreased as prices rise or fall. The estates with large overheads, on the other hand, are less capable of this adjustment. In addition, the small holding statistics compiled by the Rubber Board before 1955 are not entirely reliable since a large number of units claiming new planting were declared only in that year when the possibility of obtaining subsidy became clear.

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[3]Ministry of Commerce & Industry (Government of India), Report of the Plantation Inquiry Commission: Rubber, Part III (Delhi: Manager of Publications, 1956), pp. 98-100. The same opinion is held by K. E. Knorr, World Rubber and its Regulation (Stanford: Food Research Institute, 1945), p. 111, and P. T. Bauer, The Rubber Industry: A Study in Competition and Monopoly (Cambridge, Mass.: Harvard University Press, 1948), pp. 208-13.

[4]Bauer, op. cit., p. 30.

This is not to underrate the small holders' problems. Among the major plantation crops in India, rubber claims as great a proportion of small holdings as coffee, but the small holder in rubber operates under greater disadvantages. His crop does not reach as large a consuming public as coffee but a small body of organized manufacturers. In Malaysia the small holders' sector accounts for over 50 per cent of the total acreage under rubber cultivation; in Indonesia, the percentage of area under small holders' rubber is 72; and in Thailand it is as high as 90 per cent.[5] In India, though the holdings account for 68 per cent of the total area, their production is proportionately much less, owing to lower yields.

One of the main problems of the small holder is insufficiency of land. According to the Report of the Development Committee appointed by the Government of India (1951), an average family of three workers is able to manage a holding of 12½ acres. The Report of the Committee on the Size of Holdings of the Planning Commission came to the same conclusion using the income criterion to define a family holding.[6] An economic family holding should thus consist of 10 to 15 acres.[7]

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[5]M. J. 't Hooft Welvaars, The International Organization of Commodity Trade: Case Study of Natural Rubber (Geneva: UN Conference on Trade and Development, 1966), p. 29.

[6]Quoted in Ministry of Commerce & Industry, op. cit., pp. 102-3.

[7]Often in official reports, the term "subsistence holding" is used synonymous with "family holding", and this leads to errors of interpretation. For a rigorous definition of "subsistence", see Clifton R. Wharton, Jr., "The Economic Meaning of 'Subsistence'", The Malayan Economic Review, VIII (October 1963), 46-58.

The minimum area for a single tapper is calculated at four acres. This obviously means that a rubber holding should comprise an area of at least about four to five acres since all holdings of smaller area do not give full employment to at least one worker and hence may be termed uneconomic from the individual point of view. It may be mentioned, however, that there is an acute pressure of population on land, especially in Kerala, where the population density is 1,127 per square mile and the per capita land holding is 0.57 acre.[8] Table VI shows how much the average rubber holding in India of five acres and below fell short of the required minimum average.

TABLE VI

AVERAGE SIZE OF HOLDINGS AND ESTATES

Size-group (acres)	1946			1965		
	No.	Area (acres)	Average size (acres)	No.	Area (acres)	Average size (acres)
0- 5	13,136	19,082	1.5	65,477	127,093	2
6- 10	1,290	8,595	7.0	6,175	45,099	7
11- 50	1,311	24,881	19.0	3,852	79,522	21
51-100	187	12,458	67.0	325	23,612	73
Over 100	215	93,904	434.0	311	131,686	423

Source: Ministry of Commerce & Industry, op. cit., p. 103, and Indian Rubber Statistics (1966), p. 19.

[8] Season and Crop Report for Kerala State, 1963-64 (Trivandrum: Bureau of Economics & Statistics, 1966), p. 3.

Resources are more specific in the production of rubber by the estate method than in its production by small holdings. Detailed knowledge of the process of substitution is necessary to solve the small holders' problems accurately. The questions that arise in this connection are: How does a small holder's output per day compare with that of a paid tapper (there are many people with holdings of three to four acres)? Is he more or less able to shift to alternative occupations? These are considerations that affect the opportunity costs at the margin of transfer. The output per tapper on a small holding is roughly half that on estates, assuming the number of trees per man per day and the number of trees per acre about the same.

The critical point is transfer between occupations. A large number of small holders have mixed holdings and a variable labour force, while the estates are more specialized to one occupation. What then is the relative competitive strength of the big planter and the small holder? We can know it only by estimating the supply prices. In the estimate of the supply prices, however, we must recognize the importance of the official attitude to the various classes of producers. There are wide differences in costs between different producers in the rubber industry where the technique of the thousands of small holders differs considerably from that of the estates managed by a few managing agency houses and plantation companies. However, the identification both in the popular mind and by civil servants of a few of the largest firms with the "industry" is a familiar phenomenon, resulting in the application of estate standards to small holdings.

Capital Structure

Although initial rubber cultivation in India is attributable to the British planters, the greater part of the increase in area under rubber is a result of the enterprise of a large number of Indian planters, who came into the field later. Rubber plantations in India can be broadly classified as follows:

i) Indian proprietary and partnership concerns

ii) Non-Indian proprietary and partnership concerns

iii) Rupee companies under Indian control

iv) Rupee companies under non-Indian control

v) Sterling companies.

According to the Plantation Inquiry Commission, which reported for the year to June 1954, the total capital investment in the corporate sector of the rubber plantation industry was estimated at Rs 7.1 crores,[9] of which Rs 4.76 crores (67 per cent) was Indian and Rs 2.34 crores (33 per cent) non-Indian.[10] The total capital invested in the proprietary and partnership sector was estimated to be Rs 2.82 crores, of which Rs 2.80 crores was Indian and the balance non-Indian.[11] Thus the total capital investment in the rubber plantation industry (in 1954) covering estates of over 100 acres was as follows (in crores of rupees):

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[9] "Crore" is an Indian unit meaning 10 million; another term "lakh", used later in this study, indicates 100 thousand.

[10] Ministry of Commerce & Industry, op. cit., p. 16.

[11] Ibid.

Corporate sector		Proprietary and partnership concerns		Total		
Indian	Non-Indian	Indian	Non-Indian	Indian	Non-Indian	Total
4.762	2.338	2.80	0.02	7.562 (76%)	2.358 (24%)	9.920

The net fixed assets worked out to Rs 1,061 per acre as against the Tariff Board's 1951 estimate of Rs 1,200. While the share capital and fixed assets per acre in sterling companies were lower than those in Indian companies, the sterling and non-Indian companies as a rule had more long-term funds.[12]

Corporate ownership in the rubber plantation industry, however, covers only a relatively small segment of the planted area, as shown by the following figures (for 1960):[13]

Total area under rubber	321,002 acres
Company-owned plantations	83,353 acres
Per cent of corporate sector to total	26

In 1953 the total area under sterling and non-Indian ownership and control was 40,000 acres constituting about 23 per cent of the total area under rubber. The production controlled by this sector was nearly 30 per cent

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[12] The term "long-term funds" is used to denote the excess of net worth over net fixed assets, which represents the sum available for long-term needs.

[13] Memorandum to the Central Wage Board (Coonoor: United Planters' Association of Southern India (UPASI), 1963), p. 16. Percentage of company-owned properties in size-groups is: 0-100 acres 0.18 per cent; 101-500 acres 19.84 per cent; above 500 acres 6.01 per cent.

of the total output of rubber or nearly 42 per cent of the production of all estates over 100 acres. Four sterling companies covered an area of 26,000 acres and accounted for 4,000 tons of production (20 per cent of the total output).[14] Of the 100 rubber companies operating in 1953, 11 were non-Indian, and of the 37 managing agents, seven were non-Indian.[15]

There has, however, been a noticeable shift in investment from non-Indians to Indians in recent years. Three sterling companies have since sold practically all their assets to Indian interests. This means that the only remaining sterling company is Malayalam Plantations Ltd. (managed by Harrisons & Crosfield, London) with approximately 20,000 acres of rubber accounting for less than seven per cent of the total acreage and ten per cent of the total output (at 5,000 tons in 1965). Among the non-Indian rupee companies, two (Travancore Rubber & Tea Co. and Vaikundam Rubber Co.) have since been taken over by Indian interests. Thus, predominant non-Indian ownership of rubber companies no longer exists.

The managing agency system prevalent in the industry has come in for a good deal of criticism in recent years. The managing agency is a private partnership of three or four persons, usually related to each other. The ownership of the agency was till recently governed by the hereditary principle with the result that management often passed into incompetent hands.

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[14] Ministry of Commerce & Industry, op. cit., p. 9.

[15] Planting Opinion on the Reports of the Plantation Inquiry Commission (Coonoor: UPASI, 1960), pp. 4-5.

The managing agents hold a large number of shares in the companies and are responsible for the financing and the management of the plantations, the purchase of supplies and the sale of rubber. Some of the methods of remunerating the agents were apt to lead them into action which was prejudicial to the interests of the plantation. They have often been charged with taking secret commissions in the course of their buying and selling transactions. Managing agents having no technical expert on their staff may blunder into wrong decisions. The system may foster indifference and ignorance on the part of the Board of Directors who have no real responsibility. Shareholders are powerless and therefore unwilling to make sacrifices or invest more money. It favours conservatism and lack of enterprise. There is no concentration in a particular industry and so efficiency is affected. The Amended Indian Companies Act, 1956, has some provisions such as limiting the term of office of the managing agency and the extent of its remuneration, to remove the basic evils of the system.[16]

However, the managing agents have been performing in India those services which in the developed countries are done by banks, issue houses, and financial companies. In cases where the managing agents did not raise the capital from the public, the task was undertaken by individuals of varying degrees of ability and integrity not always with happy results.

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[16]The Patel Committee which was appointed by the Government of India in January 1965 to enquire into the question of continuance of managing agents in established industries did not actually consider managing agencies covering plantations as such but their general recommendations as a measure of long-term reform are aimed at discouraging the managing agency system.

These men sometimes were lacking in business or financial experience, and the capital was so inadequate that the businesses collapsed. This obviously scared away investment in a profitable line of business activity. There is thus need for an effective machinery to advise the public in regard to industrial securities, to raise capital in various forms and to be in touch with the needs and difficulties of the industry. One of the factors which retard the progress of the rubber plantation industry is the supply of managerial labour. Unless management becomes much more efficient and progressive, the industry will be hampered in its progress.[17]

Marketing

With the exception of certain large estates which sell directly to the manufacturers, the sheet rubber is packed in the godowns of the dealers. These dealers bring loose or unpacked smoked sheet from estates for which they act as agents, from other estates from which they have purchased it, and from smaller up-country dealers who in turn have bought it from even smaller dealers or direct from small holders. Rubber is then graded and packed and usually offered for sale f.o.b. Cochin through the brokers who in turn are in touch with the local buyers, representing a consumer. There were 608 dealers in 1965, of whom 505 were in Kerala.

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[17]For a discussion of the origin and development of the managing agency system in India, see P. S. Lokanathan, Industrial Organisation in India (London: George Allen & Unwin, 1935), Chapters I, VI, VIII, and IX. For a review of its working and prospects for the future, see National Council of Applied Economic Research (NCAER), The Managing Agency System (Bombay: Asia Publishing House, 1959).

It has been suggested that there are elements of monopsony or oligopsony in the marketing of small holders' rubber. The supply of small holding rubber is inherently price inelastic though it is more elastic than estate rubber. Legally, rubber purchasing is licensed and regulations tend to reduce entry and to foster market sharing. Economically, dealers may often control some of the factor inputs of the small grower, especially capital (loans) and food supplies, sometimes by the provision of multiple economic services. Other factors are: poor price information and communication, as well as lack of sophistication among sellers as to prices, grades, etc. Evidence of large unexpected price differentials and strong price rigidities could also be adduced as indirect verification of monopsony or oligopsony.[18]

Co-operative marketing of rubber, especially small holders' rubber, has often been suggested as a means to eliminate the middleman and the attendant waste. Co-operation can take roots in the industry because the regularity in the tree's yield and in the process of production and the comparatively less perishable nature of rubber make it suitable for efficient handling. In addition, the area under rubber being confined to a few districts more or less homogeneous in language and education, suggests suitable conditions for organizing on a co-operative basis.

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[18]For a description of the oligopsony situation in the major natural rubber producing country in South-east Asia, see C. L. Wharton, Jr., "Marketing, Merchandising and Moneylending: A Note on Middleman Monopsony in Malaya", The Malayan Economic Review, VII (October 1962), 24-44.

Co-operative processing and marketing, especially for the small holders, were recommended by the Plantation Inquiry Commission[19] as well as by an earlier report of a one-man committee appointed by the Rubber Board.[20] In this connection, India might well emulate certain steps already taken by Malaya. In order that small holders get the benefit of higher prices from dealers--by providing rubber of better quality and by improving their effective bargaining power--great efforts have been made by the Rubber Research Institute of Malaya Smallholders' Advisory Service to encourage the formation of group processing centres. These are places where small groups, ranging from ten to 30 small holders, can make use of common facilities for processing and smoking their rubber. Another approach to this problem of marketing small holders' rubber in Malaysia, has been the setting up of central latex processing factories, serving 300 to 600 small holders.[21]

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[19] Report of the Plantation Inquiry Commission - Rubber, Part III, pp. 105-15.

[20] D. Viswanatha Reddi, Report on Marketing Organisation for Rubber (Kottayam: Indian Rubber Board, 1950).

[21] C. Barlow, "N R Production and Marketing Economics", Rubber Developments, 19, No. 1 (1966), p. 8, and "The Economics of Production and Marketing", Planters' Bulletin, No. 82 (January 1966), p. 5.

CHAPTER IV

YIELD AND TECHNOLOGY

Productivity

Though the per acre yield in India has been rising steadily, it is still below the average yield in other rubber producing countries in South and South-east Asia, e.g. Malaysia and Ceylon. The trend of production and yield per acre is given in Table VII.

TABLE VII

PRODUCTION AND YIELD PER ACRE OF RUBBER IN INDIA

Year	Total area (acres)	Tapped area (acres)	Production (tons)	Yield per acre (lbs.)	Index of yield per acre (1951=100)
1951	171,191	149,600	17,782	266	100.00
1952	172,786	159,000	20,173	284	106.76
1953	173,643	163,300	21,247	291	109.39
1954	176,647	165,000	21,432	291	109.39
1955	207,239	166,000	23,356	315	118.42
1956	234,351	178,500	23,681	297	111.65
1957	261,998	175,500	24,148	308	115.78
1958	286,567	173,600	23,788	307	115.41
1959	305,452	172,500	23,792	309	116.16
1960	321,002	173,600	25,292	326	122.55
1961	348,121	183,600	27,014	330	124.06
1962	361,142	207,700	31,731	342	128.57
1963	377,938	236,000	36,897	350	131.57
1964	383,813	268,000	44,898	375	140.97
1965	407,014	278,500	49,734	400	150.37

Source: Indian Rubber Statistics (1966), p. 20.

There has no doubt been a steady increase in the average yield in India, but it is still far behind that of Malaysia (790 pounds per acre)[1] and even less than that of Ceylon (500 pounds). The variation in yield is partly due to differences in soil, climate and distribution of rainfall. In Malaysia and Indonesia conditions are better suited for rubber cultivation. In view of the even distribution of rainfall, tapping is possible in those countries almost throughout the year, while in India many tapping days are generally lost every year owing to heavy rains during the monsoon period of June to August. In India, production of rubber is not uniform throughout the year. It varies from month to month, September to January yielding the highest quantities; the yield tapers off during February-March owing to "wintering" of trees. In Malaysia it rains usually only in the afternoon causing much less interference with tapping, and since there is even rainfall throughout the year, tapping continues in the winter season. Further, the rubber tree there grows faster and begins to yield from the sixth year as against the seventh or eighth after planting in India.

As a result of many decades of research in Malaya, trees with hereditary high yielding qualities have been discovered, and vegetative propagation through budding or budgrafting has been evolved. The clones thus selected are said to yield about three times the unselected seedling trees. In India there is only a limited supply of clonal seeds. The rubber

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[1] Official forecasts indicate a figure of about 1300 pounds per acre by 1980 for Malaysia.

trees in India are also prone to diseases to a greater degree because of variations in climate and rainfall. The two main leaf diseases in India are powdery mildew (oidium heveae) and abnormal leaf fall (phytophthora palmivora). In short, one of the most important problems of rubber cultivation in India is that of increasing the yield per acre. The promotion of scientific research as in Malaysia and the application of the results through technical advice should receive the attention of the (Indian) Rubber Board, because the lower yields in India are partly due to obsolete methods of production. Though the average yield per acre in India is 400 pounds, there are no doubt particular well-managed estates which yield as high as 1,500 pounds per acre. A large number of estates have yields between 700 and 1,000 pounds.

The yield per acre in India varies between the major growing areas as shown in Table VIII. Primacy of Madras in yield per acre is due to the excellent climatic conditions in the Kanyakumari district, where most of Madras State's natural rubber is grown and where rainfall is more evenly distributed. Kerala, however, accounts for more than 90 per cent of the total production of natural rubber in India. The area under rubber in Kerala has nearly doubled since 1955 (from 193,872 acres to 382,710 acres in 1965). The production of rubber in the State which stood at 21,680 metric tons in 1955 also more than doubled by 1965. The annual increase was about 4.79 thousand metric tons during the Third Plan period compared to 0.370

thousand metric tons during the Second Plan Period.[2] The average yield in kilograms per hectare of rubber in India for the years 1950-51 to 1965-66 is shown in Figure 3.

The fact that climactic conditions in South India are less favourable than in some other rubber producing countries and that diseases require greater expenditure on control must be taken into account if production of this strategic material is to be improved. In this case the Rubber Board has great potential usefulness. It may afford a means of creating a better understanding between producers, manufacturers and the Government.

The general belief that the average yield per acre has not shown any remarkable improvement owing to the progressive exhaustion of the soil may be partly due to the fact that with the increase in demand for the product,

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[2]Some indices of productivity compiled by the Government of India give a rather misleading picture of the situation. See Growth Rates in Agriculture, 1949-50 to 1964-65 (New Delhi: Ministry of Food & Agriculture, 1966), pp. 85 ff. and appendices 2.16 to 2.21 and 2.43 to 2.45. The index number of productivity for all-India (base: agricultural year 1949-50 = 100) is shown as having risen to 114.3 in 1964-65. While the index numbers for Madras and Mysore (base: agricultural year 1956-57 = 100) rose to 134.3 and 115.4 respectively, that for Kerala showed a decline to 89.9 with the linear and compound growth rates at -3.29 per cent and -3.94 per cent respectively (ibid., appendices 5.12, 5.27, 6.16 and 6.31). However, these indices are not dependable measures of productivity, since the low rate of increase in the index of productivity, particularly in Kerala, is partly due to the young trees planted during the period which do not contribute to production but are at the same time included in the area. The index of productivity should be the ratio of the index of production and the index of tappable area, to be of any practical value.

TABLE VIII

AVERAGE YIELD PER ACRE BY STATES OF INDIA

(in lbs.)

Year	Kerala	Madras	Mysore	Andamans & Others
1953	286	421	253	246
1954	285	428	245	233
1955	310	447	251	253
1956	289	494	225	240
1957	299	516	262	187
1958	301	461	252	138
1959	300	508	259	260
1960	316	551	272	243
1961	321	538	239	243
1962	330	617	261	324
1963	337	657	281	266
1964	362	710	305	-
1965	393	604	250	-

Source: Indian Rubber Statistics (1966), p. 20.

cultivation has been extended to poorer lands. With the exception of a limited area, the soils of which are only deficient in phosphates, the old cultivated land has long since reached its maximum state of impoverishment. Manuring does not directly stimulate the secretion of latex, but only improves the general condition of the tree. Immature re-planted rubber generally needs complete fertilizers (nitrogen, phosphate and potash), while immature new planted rubber requires comparatively less. As the amount of plant food included in the annual latex flow is negligible, the manuring of rubber presents features altogether different from those of annual crops, which each year remove large quantities of plant nutrients from the soil.

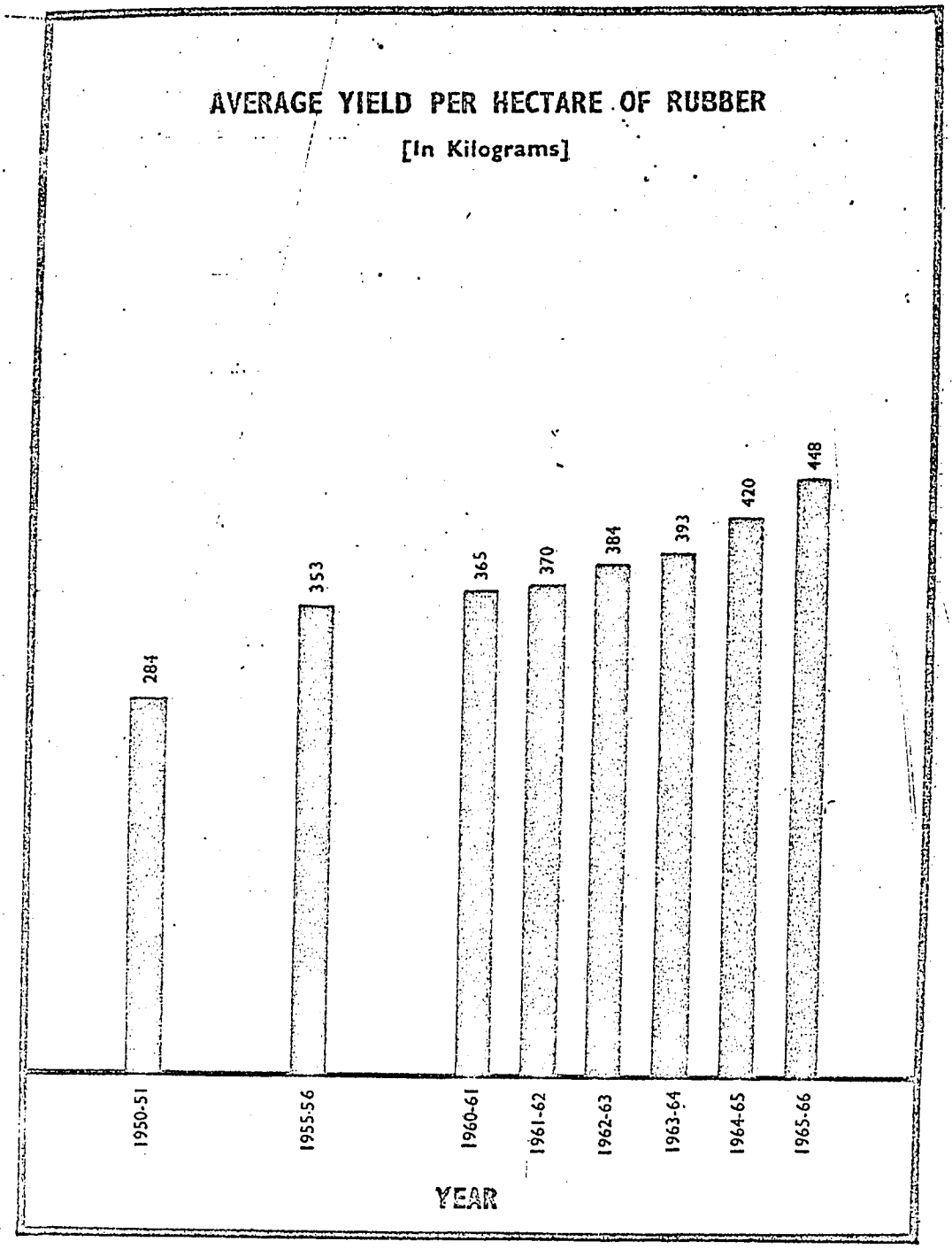
AVERAGE YIELD PER HECTARE OF RUBBER
[In Kilograms]
284
353
365
370
384
393
420
448
1950-51
1955-56
1960-61
1961-62
1962-63
1963-64
1964-65
1965-66
YEAR

FIGURE 3

But while the latex crop does not make substantial demands on plant nutrients, the growth of the tree absorbs appreciable amounts of plant food. The annual leaf formation also uses plant food, and if the leaf-fall is washed away by monsoon rain-fall, the nutrients are not returned to the soil. The plant food requirements of rubber are much less than those of annual crops, and the main task therefore is to prevent the loss of plant food through causes other than the annual harvest. Manuring of mature trees is not very common in India. Unless, however, nutrients removed from the soil by the trees and other causes (leaching, weeds, etc.) are replaced, the trees will starve and consequently the yield will fall. In manurial trials 30 per cent increases in yield have been obtained.[3]

There are wide differences in yield rates between the estates and the small holdings (below 100 acres) in India.[4] The low productivity of small

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[3] Rubber Growers' Companion (Kottayam: Rubber Board, 1966), pp. 26, 69. Experiments with old rubber, which did not receive any fertilizer treatment earlier, indicated the usefulness of 8:10:12 NPK mixture at the rate of four pounds per original planting point. The increase in rubber yield ranged from 12.5 per cent to 35.6 per cent over the control plots. With well-maintained stand, high yields are expected from nitrogen application alone, provided soil phosphates and potash levels are adequate. However, some phosphate is essential in most areas to maintain mature rubber trees in a healthy state, and potassium is required in areas where the natural supply from the parent rock is deficient. It has been the experience of other rubber growing countries that phosphates improve deficient bark renewal and the applications of potash on deficient soils check die-back of branches and restore the crowns of the trees.

[4] The yield pattern of units of different size groups is not available for this industry, but an indication of the difference in yield is provided by the Report of the Plantation Inquiry Commission, Part III (Table X, p. 10). The average yield derived from this table showed that units above 100 acres produced 337 pounds as against 154 pounds per acre by units of and below

gardens in India is due to inefficient and unscientific farm management and inadequate resources. Good management requires manuring, periodic renewal of trees, clearance of undergrowth, control of soil erosion and other measures--necessitating a large fund of working capital. Besides, small holders sometimes resort to premature tapping and slaughter tapping,[5] both of which are injurious to the trees; and they also grow undercovers like tapioca when rubber plants are young, a procedure which is harmful to the soil. Application of fertilizer mixtures (NPK), soil conservation measures, and regulated tapping may be adopted along with the increase in the size of the holdings, especially the ones with less than 15 acres. There is considerable scope for amalgamating the small units into an economic size and working on co-operative lines.

Many of the problems of the industry in general arise from under-plantation and inadequate re-plantation, low yield rates, lack of funds for growers for re-plantation and new plantation, and inadequate supplies of inputs, especially fertilizers. The Central and State Governments as well

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100 acres in 1955. The National Council of Applied Economic Research estimated it for Kerala at 486 pounds and 162 pounds respectively for 1958. (Techno-economic Survey of Kerala, p. 46). There is no reason to believe that this difference has been narrowed substantially in subsequent years.

[5]Term used to indicate all-out bleeding of the rubber trees without regard to the welfare of the trees. In well-managed estates, this is normally adopted only one or two years before re-planting or replacement with other crops.

as the Rubber Board should work on measures to solve these difficulties. Some measures such as the provision of technical guidance, long-term and short-term loans at low interest rates, and the supply of improved varieties of planting materials, have been in operation for more than a decade now. The various forms of financial aid given to rubber growers are described in this Chapter as well as in Chapter VIII.

Productivity could be increased by re-planting old deteriorated and uneconomic areas with improved planting material but much capital expenditure would be involved. It is estimated that plantations in nearly 120,000 acres (i.e., more than a quarter of the total area of 407,000 acres) exceeded their economic life in 1965. A contribution in the form of a subsidy from the Government for every acre re-planted is now helping the producers to carry out a regular programme of expansion. The Rubber Board's experiment station at Puthupally and nurseries at various other centres, where the best planting materials and methods are used, should enable alert planters to copy up-to-date techniques of planting. An Extension Service of the Rubber Board has been set up to undertake the work of dissemination of scientific knowledge and improved methods of cultivation among 76,000 and odd rubber growing units in the country, the majority of whom are small growers. The effectiveness of technical services depends upon a continuous flow of the results of research through extension workers to the planters in the field. Plant protection and pest control raise several problems, especially to the small growers.

Technology

The establishment of superior planting material is perhaps the most important single branch of plantation research, since the development of high yielding material affects the constitution of the trees. For each individual planter, the choice of the planting material is the most important--and irrevocable--decision. The planting of clonal seedlings (genetically propagated offspring of high yielding clones) requires no more attention than ordinary seedlings.[6] Though the coefficient of variability of size in a population of clonal seedlings is much greater than in a population of budgrafts, it is now generally acknowledged that the number of high yielders is certain to be sufficiently great to ensure that selective thinning out would raise the yield to that of the best budded rubber. Whatever be the commercial planting material of the future, therefore, scientific development will proceed along both the lines--vegetative as well as sexual (genetic) propagation of improved planting material.

According to the Rubber Board's figures, as much as 50 per cent of the rubber acreage in 1965 was under unselected low yielding strains as against about 80 per cent of the 207,237 acres ten years earlier. This is seen from Table IX.

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[6] A recent review by the Rubber Production Commissioner stressed the importance to be given to the popularization of polyclonal seeds in India. See Malayala Manorama (Kottayam), October 11, 1966.

TABLE IX

AREA UNDER DIFFERENT PLANTING MATERIALS

(in acres)

Year	Ordinary	Budded	Clonal	Total
1954	137,183	26,682	12,782	176,647
1955	163,860	27,731	15,648	207,239
1956	177,367	30,637	26,347	234,351
1957	187,023	36,301	38,674	261,998
1958	197,399	40,250	48,918	286,567
1959	203,467	44,661	57,324	305,452
1960	205,965	48,123	66,914	321,002
1961	214,054	52,675	81,392	348,121
1962	216,072	55,235	89,835	361,142
1963	214,050	59,528	104,360	377,938
1964	210,374	62,836	110,603	383,812
1965	202,886	73,052	131,076	407,014

Source: Indian Rubber Statistics (1966), p. 16.

The importance of a re-planting provision was recognized by the Government of India as far back as 1946 and the need for separately funding it by 1951 when a rehabilitation allowance was included in the price structure. A re-planting subsidy was brought into operation from 1957. This scheme marked the beginning of an organized attempt at re-planting, five years after the Development Committee (appointed by the Government of India) had reported. The subsidy scheme emphasizes that it is only a measure of assistance and the planter should bear the major proportion of the cost of re-planting. In the past, however, new planting has been on a larger scale than re-planting, resulting in large areas comprising old rubber. Unless the rubber growers scattered all over south-west India are

made to feel the need for re-planting in their own interests, and provided the necessary help and guidance by the Rubber Board's technical and extension services, the re-planting scheme cannot take on life.

The amount of subsidy granted initially under the re-planting scheme of 1957 ranged from Rs 325 to Rs 400 per acre in the case of small growers and Rs 250 to Rs 300 for large growers having more than 50 acres. The overall target under the scheme for a period of ten years was 70,000 acres at the rate of 7,000 acres per year. In 1960 the rate of subsidy was enhanced to Rs 1,000 per acre, applicable to all planters irrespective of their area under rubber. Under the revised scheme the target fixed for 1960 was 7,500 acres, to be increased progressively by 500 acres every year. The subsidy amount is paid in seven instalments, the first instalment being Rs 400 and the subsequent instalments being Rs 100 each. Small holders whose area does not exceed 15 acres are given further concessions like free planting materials and manure at half the cost. Table X shows that re-planting has fallen much short of the target. Unless re-planting is done on a large scale with high yielding materials, average productivity will lag.

Re-planting has been more widely accepted on estates than on small holdings for economic and technical reasons. There is one principal reason for the small holders' unwillingness or inability to re-plant. Primarily, there is the lack of capital required to pay not only the heavy expenses

TABLE X

PROGRESS OF RE-PLANTING SCHEME

Year	Target (acres)	Area re-planted (acres)
1957	7,000	3,360
1958	7,000	3,692
1959	7,000	3,602
1960	7,500	3,017
1961	8,000	5,284
1962	8,500	5,664
1963	9,000	5,202
1964	9,500	5,201
1965	10,000	1,090

Source: Indian Rubber Statistics (1966), p. 14.

involved, but also to bridge the loss of income during the gestation period.[7] A tree is tappable only six or seven years after planting, and fully mature in another four or five years. The re-planting of a stand of trees thus involves at least six years' loss of income and possibly further years of reduced income, depending on the relative yields. Re-planting thus can be undertaken only by producers with ample working capital, which most of the estates do and small holders do not possess. Besides the subsidy mentioned above, another source of rehabilitation finance is the rehabilitation allowance incorporated in the price structure. The United Planters' Association of Southern India, however, complains that the financial assistance offered for re-planting is lower in India than in

[7]The cost of re-planting has increased considerably since 1951 when the Tariff Board estimated it at Rs 1,200 per acre. The Plantation Inquiry Commission put it at Rs 1,400 (Report, p. 87). Present-day cost of re-planting is upward of Rs 3,000 per acre.

Malaya and Ceylon.[8] Both Malaysia and Ceylon have a separate development administration, and India may adopt the same procedure to expedite the replanting and development programmes.

In 1960 it was estimated that there were about 206,000 acres of unselected seedling rubber in India, of which 56,000 acres belonged to the 40-year and over group. In 1965, the acreage under ordinary planting material was 202,886, of which 70 per cent was on small holdings.

In most of the South-east Asian countries, particularly Malaysia, the increases in rubber production over the last two decades have been large. For example, the production of natural rubber in Malaysia rose from 698,000 tons in 1957 to 990,000 tons in 1966, representing a 42 per cent increase.[9] For years the Malaysian natural rubber industry has been forecasting that it would be producing 1,000,000 tons per year by 1970. The million-ton year now seems to be 1968. From a median of 350 to 400 pounds per acre in 1946, today's average production in Malaysia is about 790 pounds per acre. An average yield of 1,000 to 1,200 pounds per acre is commonplace among estates planted with high-yielding rubbers.[10] These increases represent responses on the part of the farmers to new economic opportunities.

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[8] Memoranda on Rubber Replanting and Coffee Marketing (Coonoor: UPASI, (n.d.)), p. 7.

[9] Natural Rubber News, January 1967, p. 1.

[10] News release from the Natural Rubber Bureau, Washington, May 1966, p. 1.

These opportunities in general have not come from the opening up of new farm land nor primarily from a rise in the relative price of the product. They have originated predominantly from more productive factors.

Economists now divide the productive agents into two parts, one consisting of land, labour and capital, and the other "technological change".[11] The latter represents an array of (new) factors of production. Thus the compound of factors embedded in technology or "state of the arts" becomes an important variable of economic growth. The upward shift of the production function requires the effect of at least one new factor. Thus economic growth in the agricultural sector of a poor country depends mainly on the availability and cost of modern (non-traditional) agricultural factors.[12]

Greatly increased yields through the use of high-yielding planting material are likely to lead to significant reduction in costs. It is

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[11]Under the ceteris paribus assumptions of Alfred Marshall and other economists trained in the equilibrium tradition, technology was held constant. See Principles of Economics (8th edition; London: Macmillan, 1949), Book IV. For the current view on the impact of technological change, see Zvi Griliches, "Sources of Measured Productivity Growth: United States Agriculture, 1940-60", Journal of Political Economy, 71 (August 1963), 331-46, and W. W. Cochrane, "Conceptualising the Supply Relation in Agriculture", Journal of Farm Economics, 37 (December 1955), 1161-76. The literature on the general topic of technological progress is now substantial. See in particular, the pioneering article by R. M. Solow, "Technical Change and the Aggregate Production Function", Review of Economics and Statistics, 39 (August 1957), 312-20, as well as his subsequent paper, "Technical Progress, Capital Formation, and Economic Growth", American Economic Review, Papers and Proceedings, 52 (May 1962), 76-86.

[12]T. W. Schultz, op. cit., p. 145.

estimated that some 55 per cent of all f.o.b. costs would be reduced in inverse proportion to higher yields.[13] Moreover, an additional reduction would follow in tapping costs, when the tapper was receiving a fixed daily wage or whenever piece rates varied inversely with productivity, as is usually the case in India. Generally, if yields per acre trebled, cash costs per pound of rubber would be approximately halved.[14] These costs, though, have no common basis--having different impacts on a large estate and a small holder, and varying considerably from country to country with different labour rates, duties and other charges. However, by way of illustration of the effect of yield per acre, published records of companies operating in Malaya suggest that at 400 pounds per acre, the actual production cost averages 60 cents (Malayan) per pound and that this is on the way to being halved at yields of 1,000 pounds per acre.[15] It was stated at a recent symposium organized by the International Rubber Study Group that the cost of production on an estate in Malaya obtaining 1,500 pounds per acre would be about 25 Straits cents per pound.[16] Another estimate is that increasing by 100 pounds per year the production of acreage producing 1,000 pounds, reduces per-pound production cost 1 1/3 to 1 2/3 U.S. cents.[17]

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[13] P. T. Bauer, op. cit., p. 273.

[14] Ibid., p. 274.

[15] L. C. Bateman, Natural Rubber and South-east Asia, (Kuala Lumpur: Malayan Rubber Fund Board, (n.d.)), p. 7.

[16] Ibid.

[17] News Release from the Natural Rubber Bureau, May 1966.

When it is remembered that (a) yields of 2,000 pounds per acre are now possible under commercial conditions, (b) yields in excess of this have been realized on experimental plantings, (c) that new tapping procedures and tree treatments can markedly increase the output of established trees, (d) manurial and other agronomic practices are improving growth and vigour, and (e) advances which promise to reduce the time from planting to tapping by some 15 per cent are now being used, then the power and potentialities of the natural rubber industry are abundantly evident. Important technical economies which may prove essential to the survival of the rubber plantation industry also include radical changes in the plantation technique, mechanization of important phases of the operations, careful choice of tapping methods,[18] and the adoption of selective clean weeding.[19]

It is essential for the prosperity of the industry that the material planted should have a certain minimum standard of production. As per the Rubber Rules, it is now obligatory to plant only with high yielding material.

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[18] I. Watson, "The Economic Evaluation of Tapping Systems", Planters' Bulletin, No. 80 (September 1965), 236-45, and "The Economic Evaluation of Tapping Systems: A Further Explanation", op. cit., No. 83 (March 1966), 28-34. Study of the forecast profits over a seven-year period shows that the s/2 d/2 system is marginally superior to the s/2 d/3 system. (The different tapping systems are described in Appendix A).

[19] The disadvantages of clean weeding, particularly its effect on soil fertility, principally through erosion, are now well known. An increasing number of estates are adopting a policy of selective weeding, eliminating only noxious growths; this is usually cheaper and has direct beneficial results. The arguments in favour of the forestry methods of cultivation have now been discounted.

The two main classes of approved material are clonal seedlings and budgrafts. In the past, India relied mainly on foreign clones, primarily because Indian research was still in its infancy. The main source of indigenous supply of Tjir clonal seed so far was the private estates in the Kanyakumari district of Madras State.

Recently, however, the Rubber Board has taken the initiative of ensuring an adequate supply of high quality planting material to rubber growers. Supply of clonal seedlings, budded stumps and budwood of high yielding clones is now being arranged from the 50-acre central nursery at Erumely and the four regional nurseries at Alakode, Kadakkanon, Manjeri and Neringamangalam. Besides Tjir I, certain other seedling families like PBIG, which have proved popular in Malaysia, are also raised in these nurseries. There are proposals to start new nurseries in other parts to meet the increasing demand from planters. Seeds collected from approved collection centres are distributed by the Board at the cost price of Rs 35 per 1,000.

Improvement in tree crops like rubber is relatively slow and laborious. It has been estimated that in rubber more than 17 years are required before a new clone can be recommended for general use, excluding the years of breeding tests leading to the first establishment of the clone.[20] In Malaysia, the phenomenal increase in yield of rubber has been achieved after years of repeated selection of high yielding mother trees,

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[20] Rubber Growers' Companion, p. 66.

followed by their vegetative multiplication, controlled hand pollination and further selection among the high yielding progeny. One clone in its large scale trial at the Rubber Research Institute of Malaya has given as high a yield as 3,000 pounds per acre in its eighth year of tapping; and further experiments with 4,000 pounds as the goal are in view. There are other clones which can easily pass the 2,000 pound-mark. But most of the high yielders are susceptible to almost all the common rubber diseases. Therefore, it is felt that more emphasis should be given now to exploring the possibilities of combining high yield with some degree of resistance to or tolerance of diseases like oidium and phytophthora.

When protective measures against diseases are carried out, say by spraying, there is more leaf retention, and avoidable losses in yield caused by defoliation are prevented. In many of the trials conducted in different regions of India, the yields have doubled when sprayed with Bordeaux mixture. Another method of increasing yield in trees over 20 years of age is the application of yield stimulants; these can be treated at six-monthly intervals. The exact level of increased yield depends on the quality of the trees and other general conditions. The response is significant in buddings and clonal seedlings with increases up to 40 per cent.[21]

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[21] Ibid., p. 69; "Stimulation of the Yield of Rubber Trees as a Routine Estate Practice", Planters' Bulletin, No. 45 (November 1959), 127-42; P. D. Abraham and R. S. Tayler, "Stimulation of Latex Flow in Hevea Brasiliensis", Experimental Agriculture, 3 (January 1967), 1-12.

Investigations are in progress in Malaysia to determine how yield stimulation can be more widely applied in combination with modified tapping practices and labour usage to obtain maximum productivity in output and cost. Some simple initial results may be quoted. Trees tapped on the common half-spiral alternate daily system gave a yield per acre per year of 1,100 pounds and a yield per tapper per day of 25 pounds. On stimulation, both these figures increased by 50 per cent. But on stimulation with a reduction in tapping intensity to third daily, the yield per acre increased by 25 per cent while the yield per tapper increased by 50 per cent.[22] Thus, by controlled yield increases in this way, decided economies in collection costs may be achieved.

Empirical investigations by Hopper[23] and Chennareddy[24] adduce evidence in support of the opinion of Schultz[25] that in a traditional and technologically stagnant agriculture, farmers are aware of efficient use of traditional inputs. This lends support to the conclusion that agricultural production in India may not be increased simply by increasing all inputs in the traditional state of the arts; this can be achieved only by breaking

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[22] L. C. Bateman, "Natural Rubber Takes the Strain" (Talk delivered to the Annual General Meeting of the International Institute of Synthetic Rubber Producers, Tokyo, May 1964), p. 5.

[23] David W. Hopper, "Allocation Efficiency in a Traditional Indian Agriculture", Journal of Farm Economics, 47 (August 1965), 611-24.

[24] Venkareddy Chennareddy, "Production Efficiency in South Indian Agriculture", op. cit., 49 (November 1967), 816-20.

[25] T. W. Schultz, op. cit., pp. 8, 15, 28.

through the traditional state of the arts and introducing modern technology in a package. The package should consist of new inputs, agricultural education, special skills and techniques, and competent guidance in farm planning.

CHAPTER V

PROSPECTS FOR NATURAL RUBBER

Profits depend on cost, the amount of sales and prices received. Thus demand projections become one of the focal points of the analysis; the long-run prices likely to be received for the product must also be estimated.

Supply and Demand Conditions

It is said that the supply of natural rubber is price inelastic, i.e., production does not respond to changes in price.[1] Most comments on the inelasticity of supply of rubber are based on the fact that it takes six to seven years for the rubber tree to come into production, and that production cannot be increased much beyond the technical maximum. But such statements have to be assessed in the context of the Marshallian distinction between the short-run and the long-run. Given the technology of rubber, the fixed productive capacity for an individual firm or country is the stand of mature rubber trees. The short-run, therefore, is the period during which the firm or country is unable to change the number of tappable trees. The long-run is a sufficiently long period to allow new trees to come into tapping. In the short-run, a firm or country can change rate of output with the existing stand of trees only by (i) changing the area or the number of trees being tapped; (ii) changing the frequency of tapping; (iii) changing

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[1] Clifton R. Wharton, Jr., "Malayan Rubber Supply Conditions", in T. H. Silcock and E. K. Fisk (eds.), The Political Economy of Independent Malaya (Canberra: Australian National University Press, 1963), Chapter 6, pp. 131-62.

the size of the cut and the number of cuts; and (iv) using stimulants. In the long-run, a firm or country can increase or decrease total output by changing total acreage--by new planting or refraining from planting--or it can increase yields per unit area tapped by re-planting with higher yielding varieties.

Replacement of old low yielding trees should take place when the annual net income of the present stand drops below the present discounted value of income from the replacement trees, that is, when marginal cost exceeds marginal revenue. The age when re-planting should take place is consequently affected by changes in prices, costs, discount rates and technology (new varieties). Due to re-planting, the future supply of rubber is likely to be characterized by shifting supply curves. It can be assumed that in the long run, the supply of rubber is more elastic than in the short run. However, long run price instability which is characteristic of perennials will continue to plague the plantation rubber industry owing to the rigid factor and resource immobilities.[2]

The instability of natural rubber prices in the world market has been greater than that of some other major agricultural commodities.[3]

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[2] Ibid., p. 149.

[3] Although there are obvious limitations to the use of mechanisms such as international commodity agreements to influence prices of natural materials competing with synthetics, the possibility might be explored of introducing supplementary stabilization devices to further limit fluctuations in prices. The International Rubber Study Group which replaced the International Rubber Regulation Agreement in 1944, continues to keep under review

Essentially, this seems to have stemmed from variations in demand rather than from developments on the supply side. When demand strengthens, producers may, as a short term measure, increase their rate of tapping, although the scope for such action is limited. Any long term reaction takes more time to work itself out, if only because the rubber tree normally requires seven years before tapping can begin. Should demand fall off, producers may again vary the rate of tapping, in this case down to the point of discontinuing production. However, it would require a really drastic fall to force such action, particularly on estates where supply tends to be extremely inelastic.

Since Hevea braziliensis takes six to seven years to reach the productive stage and thirteen to fourteen years until the full bearing stage is reached, investment decisions now must be taken in the light of the outlook around 1975 and beyond. To look into the future is an interesting exercise, which may be of value in planning national and commercial strategies, provided the limitations inherent in the operation are understood.

There are essentially two approaches. On the one hand, we may attempt to take into account all the factors (economic, social and political) which may be expected to influence the course of events. An intermediate and not too ambitious stage in this approach may be broadly described as "forecasts", which attempt to assess a future situation as it may in fact

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suggestions for stabilizing the price of natural rubber but there are still differing views among the member countries regarding the practicability of achieving this by means of an international stabilization scheme.

develop. The alternative approach is to predict the future from a set of defined assumptions which adequately describe the past. These "projections" necessarily reflect the basic assumptions on which they were made, revealing possible imbalances and difficulties only insofar as they may arise from a situation defined by the assumptions. This approach has a scientific flavour, but it is not thereby infallible. Both forecasts and projections differ from targets, which describe a future situation held to be desirable. All attempts to foresee the future have to face the effects of unpredictable changes in public tastes and fashions; the longer the time span, the greater the uncertainty.

The growth of total demand for rubber is dependent on the absolute level of national income of any country. The basic assumption about the future rate of consumption increase in India is that it is a function of the past rate modified by expected changes in the country's economy. It should be appreciated, however, that raw rubber is an intermediate product, and that the inhabitants of a country consume rubber in the form of manufactured goods. It is this type of consumption that would be expected to correlate with the size of the population and the national income.

Income elasticity of demand is defined as the percentage change in the quantity demanded that would result from a one per cent change in the money income, other quantities and prices being held constant. This income elasticity will vary according to the type of goods and the income of the buyer. For most commodities, income elasticity eventually decreases as

income increases. Thus highly developed countries have a lower income elasticity for rubber than the world average. The income elasticity for rubber for the world as a whole is certainly greater than one (this is true even for some highly developed countries).[4]

The ratio r_c/r_e, where r_c is the growth rate of rubber consumption and r_e is the growth in GNP, is approximately equal to the income elasticity of demand as defined above. For the poorer, developing countries, rubber consumption grows two to three times as fast as the growth of GNP; for developed countries this ratio declines to around unity.[5] Thus the income elasticity for rubber in India is calculated to be greater than three, and that in Canada and the United States about unity.[6] The income elasticity for rubber in India is quite high as the country is developing transportation facilities and the citizens start to possess cars. The average annual growth rate for rubber consumption during 1952-62 was 11.2 per cent in India as against 4.0 per cent in Canada and 2.6 per cent in the United States of America.[7]

Because of the scarcity of reliable time series data, much less information is available on price elasticity than on income elasticity.

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[4] M. J. 't Hooft Welvaars, op. cit., p. 37.

[5] P. W. Allen, "Rubber in 1970", Rubber Journal (August 1964), and Natural Rubber News (February 1967), p. 1

[6] Allen, loc. cit.

[7] Ibid.

Moreover, the concept of elasticity is more complex for prices than for income; a distinction has to be made between direct and substitution price elasticity. In the case of agricultural raw materials like rubber, therefore, substitution between natural and man-made commodities raises problems. As a rule of thumb, however, it can be assumed, that where there are close substitutes, the price elasticity is in absolute terms higher than income elasticity.[8]

The production, import and consumption of raw rubber in India from 1952 to 1965 (in metric tons) are given in Table XI. It is seen that the gap between total consumption of all types of rubber (natural, synthetic and reclaimed) and the production of natural rubber in the country has widened from 7,823 metric tons in 1955 to 44,562 metric tons in 1965. The gap has been bridged mainly by imports and a rising production of synthetic rubber. The average annual rate of growth of natural rubber production during 1954-64 was 7 per cent whereas the average annual growth of demand for raw rubber was 11.4 per cent. The Fourth Five Year Plan production target for natural rubber envisages a step-up in output from 50,000 metric tons in 1965-66 to 72,000 metric tons in 1970-71.[9] Demand for natural

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[8] Agricultural Commodities--Projections for 1970 (Rome: Food and Agriculture Organization (FAO), 1962), p. A-21. For a given commodity, the sum of the algebraic values of the income elasticity, the direct price elasticity and cross elasticities is equal to zero. Thus if a commodity has no close substitutes, the direct price elasticity has the opposite sign to income elasticity and about the same absolute value. If close substitutes exist, the absolute value of price elasticity is higher than that of income elasticity.

[9] Planning Commission, Fourth Five Year Plan--A Draft Outline (New Delhi, 1966), p. 277. During the Fourth Plan period, 85,000 acres would be

TABLE XI

PRODUCTION, IMPORT AND CONSUMPTION OF RUBBER IN INDIA

(metric tons)

Year	Production		Import		Reclaimed rubber (RR)	Total	Consumption			
	Natural (NR)	Synthetic (SR)	NR	SR			NR	SR	RR	Total
1952	20,496	-	2,841	14	1,864	25,215	20,344	18	2,023	22,385
1953	21,588	-	25	19	2,224	23,856	24,142	15	2,336	26,493
1954	21,774	-	3,425	22	2,399	27,620	26,332	21	2,267	28,620
1955	23,730	-	4,428	1,201	2,853	32,212	28,445	461	2,647	31,553
1956	24,060	-	7,341	3,134	3,774	38,309	29,998	2,866	3,543	36,407
1957	24,534	-	11,357	3,014	4,287	43,192	33,074	3,161	4,131	40,366
1958	24,169	-	12,538	4,229	3,973	44,909	35,767	3,477	4,102	43,346
1959	24,173	-	15,287	5,718	5,177	50,355	40,491	4,964	4,969	50,424
1960	25,697	-	23,125	8,097	5,183	62,102	48,148	7,397	5,453	60,998
1961	27,446	-	22,528	10,121	6,422	66,517	48,410	10,186	6,046	64,642
1962	32,239	-	23,360	10,297	6,839	72,735	55,553	10,723	6,850	71,126
1963	37,487	8,075	26,275	8,812	8,251	88,900	61,155	11,959	7,982	81,096
1964	45,616	11,633	15,003	3,315	9,349	84,916	61,057	15,285	9,369	85,711
1965	50,530	14,741	16,357	2,735	9,764	94,127	63,765	21,553	9,774	95,092

Source: Indian Rubber Statistics (1966), p. 33.

rubber, however, has been rising much faster than the annual increase in production. According to manufacturers, the demand for natural rubber is likely to increase to 85,000 tons by 1971. It is reported that the total demand for raw rubber (all types) has already exceeded the 100,000 tons-mark. The gap between domestic production of and demand for natural rubber is unlikely to narrow in the foreseeable future.

In spite of the fact that the consumption of raw rubber in India has been growing at an annual rate of around 12 per cent over the last decade, the Indian per capita consumption in 1966 was one of the lowest in the world at only 0.4 pound compared to 25.7 pounds in the United States of America, 17.6 pounds in Canada, 15.2 pounds in the United Kingdom, 9.8 pounds in Japan and 4.8 pounds in Eastern Europe.[10] This significantly illustrates the scope for increasing consumption in the years to come with the momentum given to economic development. The National Council of Applied Economic Research rather conservatively estimates the 1970-71 demand for rubber at 125,000 tons.[11] The Rubber Manufacturers' Association estimates it at 172,000 tons.[12] This estimate comes close to Allen's projection of

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newly planted with rubber. Out of this, 5,000 acres will be in Madras State, 4,000 acres in Mysore, 5,000 acres in Andaman Islands and 5,000 acres in Assam and Tripura.

[10] Natural Rubber News, July 1968, p. 3. For earlier figures see L. C. Bateman, Natural Rubber and South-east Asia, p. 6, and Welvaars, op. cit., p. 81.

[11] Techno-economic Survey of Kerala (New Delhi: 1962), p. 47.

[12] The Malayala Manorama Plantation Supplement, August 27, 1966.

175,000 tons for 1970, assuming a 12.2 per cent average growth rate for rubber consumption during 1960-70.[13] However, based on an estimated annual per capita income of Rs 466 by 1970-71 (Rs 363 in 1964) and various other considerations of estimated demand for finished products, it is now felt that the total elastomers required by the end of this decade may be around 150,000 tons.[14] The availability of natural rubber from indigenous sources is visualized at 72,000 tons, leaving a deficit of 78,000 tons, to be met by imports and accelerated production of synthetic rubber.

The length of the projection period obviously depends on the nature of the decision to be taken; for example, in a problem of investment allocation, the length of the projection will be determined by at least the gestation period of the investments to be made.[15] It is true that projections of economic growth and population are not infallible but they have an objectivity that would be lacking in ad hoc estimates of rubber consumption growth. The Planning Commission's Working Group tentatively estimated the 1975 demand for rubber at 273,600 tons.[16] But one may have reservations as to whether the rather high projected rate of economic growth can in fact be

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[13] Allen, op. cit.

[14] V. C. Nanavati, "Future Elastomers for India" (Paper read at the Institute of the Rubber Industry, Calcutta, 30 July 1966).

[15] L. M. Goreux, "Economic Growth and Commodity Projections", Monthly Bulletin of Agricultural Economics & Statistics, 10 (July-August 1961), 1-17.

[16] Tariff Commission, Report on the Revision of Raw Rubber Prices (1960), pp. 55-56.

achieved; the per capita income in India has not so far risen by the targeted rate.[17]

Rigorous projections of various agricultural commodities have been made by the Food and Agriculture Organization of the United Nations in a recent study.[18] Projection of industrial demand for all elastomers (natural and synthetic) were made on the basis of assumed population and income growth, using elasticity of demand coefficients derived from time series covering the years 1954 to 1965, adjusted in the light of structural changes in demand where data on end-uses were available. It was generally assumed that technological progress in the manufacture and processing of synthetic elastomers would continue during the coming decade, and synthetic rubber would continue to increase its share of the total market. At the same time, it was assumed that further improvements in the grading, processing and presentation of natural rubber, implicit in the development of such products as Heveacrumb, oil-extension and plastic-wrapped rubbers would stimulate preference for natural rubber and thus slow down the rate of displacement by synthetic rubber.[19] Existing synthetic rubber capacity, and plans for extending or setting up synthetic rubber plants, have also

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[17] In fact, the launching of the Fourth Five Year Plan has been postponed to April 1969 owing to the tardy progress of the Third Plan.

[18] Agricultural Commodities - Projections for 1975 and 1985 (Rome: FAO, 1967).

[19] The recently developed Heveacrumb process, which enables the latex coagulum, cup coagulum and other so-called "scrap" rubber to be made into Standard Malaysia Rubber Scheme (1965) grades on the same machinery, is also particularly adapted to dealing with newer constant-viscosity and oil-extended forms of rubber.

been taken into account. Projections were made on the assumption of 1961-63 prices. In the case of rubber, demand was first projected for all elastomers, including synthetic rubber. The probable demand of natural rubber was then estimated on the assumption of past trends, adjusted in the light of the 1961-63 price assumptions. Thus, based on an assumed compound rate of growth per year of 2.4 per cent in population, 5.0 per cent in Gross Domestic Product, and 2.6 per cent in per capita Domestic Product between 1965 and 1975, the demand for raw rubber in India for 1975 is projected at a total of 210,000 tons, composed of 105,000 tons of natural rubber and 105,000 tons of synthetic rubber.[20]

It can be seen that though the share of natural rubber in total rubber consumption in India is expected to decline in 1975 to 50 per cent from about 75 per cent in 1965, the demand for natural rubber is still substantial, which can be met partly by considerable addition to indigenous productive capacity. The Indian conditions are different from the average world pattern in two respects--(i) manufacture of predominantly truck tyres, and (ii) availability of some natural rubber from indigenous sources. It is therefore in this context that future polymers for India have to be carefully selected to obtain a judicious balance of all elastomers between natural and synthetic rubber, keeping in mind the prerequisites for specific end-products.

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[20] Agricultural Commodities - Projections for 1975 and 1985, Vol. I, p. 315.

A recent development in the raw rubber market has been the establishment of a synthetic rubber plant at Bareilly in North India with a capacity of 30,000 tons per year. It started production in 1963 and has been steadily increasing output. The styrene-butadiene rubber (SBR) produced at Bareilly--called "synaprene"--is manufactured by the emulsion polymerization method. The Bareilly plant is at present producing seven grades of SBR for the manufacture of different types of rubber goods. There are proposals for the expansion of this project as well as for the setting up of a few more synthetic rubber plants in the country. It is envisaged that polybutadiene and butyl rubbers can be manufactured in India in the near future. The major raw materials for these rubbers are obtained from the by-products of petroleum refineries.

The styrene-butadiene rubber which is now indigenously manufactured meets only a part of the deficit between the total demand for all rubbers and the indigenous production of natural rubber. Already a usage of 25 per cent of SBR in total rubber consumption has been achieved, and some 30 per cent can easily be attained in the near future. The projected consumption of SBR on the present pattern should therefore leave no doubt regarding the possibility of 50,000 tons being consumed by 1971. The emergence of the synthetic rubber industry, however, need not be construed as a threat to the natural rubber industry unless it can produce raw rubber in adequate quantities and at a lower cost than that of the natural product. Currently, the cost of production of synthetic rubber in India is higher than that of natural rubber, primarily because of the scale of the Indian SBR plant and

the cost of petrochemical feedstocks. It is doubtful whether synthetic rubber costs will meet natural rubber costs in the foreseeable future in India, even though important gains have been scored in the petrochemical industry in recent years.

Natural rubber is considered to be a general-purpose rubber. It was due to the acute shortage of natural rubber during World War II that synthetic rubbers were developed and marketed. Thus, the most striking feature of the world rubber market in recent decades has been the way in which synthetic rubber production has been growing. Not governed by cycles of rubber tree planting, synthetic production is more flexible than the output of natural rubber. The elasticity of substitution between natural and synthetic rubber has recently been made even higher owing to technological developments. The appearance of the new synthetic rubbers, such as polyisoprene which some consider a perfect substitute for natural rubber, may one day eliminate the zone where no competition takes place due to technical non-substitutability enjoyed by natural rubber for about one-fourth of the uses.[21]

But it would be misleading to conclude that synthetic rubber is bidding to supercede natural rubber. The fact remains that consumption of natural rubber has continued to rise (even outside India where natural rubber has been costlier than synthetic) because consumers find it necessary for many uses. For example, natural rubber is required to provide the

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[21] T. R. McHale, "The Competition Between Synthetic and Natural Rubber", Malayan Economic Review, VI, No. 1 (1961).

properties desired in such articles as heavy commercial vehicle, aeroplane and even passenger car tyres. These properties of natural rubber include high resilience, low heat build-up, good natural tack and adhension, high green stock strength, excellent reworkability, tear and cut growth resistance, pure gum and non-black strength and good retention of physicals at elevated temperatures.[22] In the United States and Canada where the use of synthetic rubber has been most advanced, a ceiling to its use has been found at 70-75 per cent of the total rubber consumption.[23] In most of the other Western countries, synthetic rubber consumption is only about half of the total. The proportion is rising and will continue to do so until something like the North American ratio will likely be reached.

The fall in the proportion of natural rubber use has been partly due to technical improvements in synthetic rubber production, which have extended the area of its useful application, though the price stability of synthetic rubber in contrast to the price fluctuations and higher average price of natural rubber has also been of importance in wooing consumers away from the use of natural rubber. The ratio of passenger cars to commercial vehicles has been a critical one in determining the respective shares of the market held by natural and synthetic rubbers, since SBR has failed to challenge natural rubber for usage in heavy duty tyres.

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[22] Natural Rubber News (January 1967), p. 3.

[23] M. J. 't Hooft Welvaars, op. cit., p. 81, and Natural Rubber News, August 1968, p. 2.

Thus part of the explanation for the very heavy proportionate usage of synthetic rubber in North America lies in the relatively large number of passenger cars in the total vehicle output compared to other countries. Even then one cannot buy in the United States or Canada a passenger tyre that does not contain some natural rubber. The percentage may be small, but it is an essential component of the finished tyre. In the new radial tyres natural rubber is used to meet required physical properties. Thus, until some notable technical development makes synthetic rubber as satisfactory in all respects as natural rubber, natural rubber's place in the market is assured.[24] Taking the world as a whole, all the natural rubber produced has been consumed mostly at prices higher than that of its competitor, SBR, which has essentially supplemented rather than supplanted natural rubber. What all this means is that nature did a superb job in endowing the original rubber factory--the rubber tree; man has yet to catch up.

A consumer has three choices now: he can use natural rubber, synthetic rubber, or blends of the two. There is a continuing pattern of sophistication in the blending of different rubbers to get end-products to meet particular needs. Generally speaking, synthetic rubber producers are no longer aiming at producing a rubber which will meet all purposes, but rather at improving their product to meet specific usages. In the developed countries, although they use a lot of natural rubber, the growth

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[24] "Resilient Market in Rubber", The Financial Times (London) October 24, 1959.

rate of consumption of total rubber is increasing much faster than the growth rate of their consumption of natural rubber.[25] However, in the less developed countries where technical know-how and sophistication in manufacture are much less, natural rubber is still being used to a great extent. As these countries become industrialised, they will need more rubber, both natural and synthetic.

Price Trends

When supplies of rubber from the Far East were cut off after 1942, the Government of India imposed rigid control on the use of natural rubber. With the upward trend in commodity prices, which became pronounced after May 1942, Indian growers asked for an increase in the price of rubber. Before the War, natural rubber was sold at Rs 42-7 annas- 4 pies[26] per 100 pounds. From this level, it improved to Rs 61 at the beginning of 1943. In the middle of 1944, the price was pegged at Rs 77-5-0. The Government also announced a production bonus scheme. Throughout 1945, the planters secured the revised price but in March 1946, the Government announced that they would no longer undertake the responsibility of buying rubber directly from the producers, as envisaged by the Rubber Control and Production Order, 1942. However, they maintained indirect control by issuing authorizations to manufacturers to purchase rubber from approved dealers. In April 1946

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[25]The rate of growth of the consumption of synthetic rubber has been about six per cent while that of natural rubber is three per cent per annum.

[26]Until the metric system of coinage was introduced in India in the early sixties, the rupee was divided into 16 annas, and one anna into 12 pies. Now in metric usage, 100 paise make a rupee.

the basic price was raised by Rs 10 to Rs 87-5-0 per 100 pounds primarily to enable the planters to devote necessary labour, effort and expense to the re-planting and regeneration of estates, the productive capacity of which had deteriorated owing to slaughter tapping during the War. The Rubber (Production and Marketing) Act of 1947 provided for the appointment of a Price Advisory Committee and the fixing of both minimum and maximum prices. The rubber price has since been based on the results of the periodic cost investigations undertaken by the Government of India. The controlled prices of Group I sheet rubber in operation since 1947 are given in Table XII. The controlled prices for synthetic rubber in India are presented in XIII for comparison.

It is seen that from 19 December 1963, the ceiling on prices of natural rubber was removed, and for nearly four years (until October 1967) there remained only minimum prices for the various grades and qualities of rubber and latex of different concentrates. Following the removal of the ceiling, there were many sudden and unexpected variations in the selling price. There was, especially, a drastic increase in the price of rubber after the inception of the Cochin rubber auctions in September 1965.[27] Thus, prices raced away from Rs 322 per 100 kilograms[28] in 1965 to Rs 671 in August 1966--that is, prices more than doubled within a year. While

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[27]Owing to the 1967 notification by the Government stipulating the minimum and maximum prices for the various grades of natural rubber, public auctions have been suspended.

[28]100 kilograms = 220.462 lbs.

TABLE XII

CONTROLLED PRICES OF GROUP I SHEET RUBBER SINCE OCTOBER 1947

Period	Price f.o.b. Cochin per 100 lbs (Rs. paise) Maximum	Minimum
8-10-1947 to 14-12-1947	-	72.00
15-12-1947 to 7- 6-1948	73.50	72.50
8- 6-1948 to 31-10-1948	79.50	78.50
1-11-1948 to 27- 5-1949	91.50	90.50
28- 5-1949 to 6- 3-1951	90.50	89.50
7- 3-1951 to 20- 5-1951	122.50	121.50
21- 5-1951 to 27-10-1952	128.00	127.00
28-10-1952 to 14- 2-1955	138.00	137.00
15- 2-1955 to 23- 9-1955	150.00	149.00
24- 9-1955 to 31- 3-1961	155.75	154.75
	Price f.o.b. Cochin per 50 kilograms	
1- 4-1961 to 27- 4-1962	164.80	163.70
28- 4-1962 to 18-12-1963	162.60	161.50
19-12-1963 to 19-10-1967	-	161.50
20-10-1967 to -	208.00	207.50

Source: Indian Rubber Statistics (1966), p. 31, and Government of India (Ministry of Commerce) notification of 20 October 1967.

TABLE XIII

PRICES OF INDIGENOUS STYRENE-BUTADIENE SYNTHETIC RUBBER

(Ex-Bareilly in Rs. per 50 kilograms)

Grade	27-6-63 to 30-9-63	1-10-63 to 31- 7-64	1-8-64 to 20-6-66	From 21-6-66 onwards
S-570	...	...	192.50[a]	217.50
S-1006	...	...	198.50[b]	223.50
S-1500	220.00	202.50	192.50	217.50
S-1502	220.00	202.50	192.50	217.50
S-1712	205.00	175.00	170.00	195.00
S-1714	...	...	162.50[c]	187.50
S-1958	...	...	282.50[d]	307.50

[a]Effective August 1965
[b]Effective February 1966
[c]Effective July 1965
[d]Effective June 1965.

Source: Synthetics and Chemicals Ltd., and Indian Rubber Statistics (1966), p. 32.

many producers welcomed this occurrence, surely such a sharp rise in prices is not in the interests of the producers, consumers, and the country.[29] It is often speculative demand which creates such unrealistic price levels. The rubber plantation industry in India already has certain definite

[29]Similar views were expressed by the Chairman of Cochin Malabar Estates (managed by Peirce, Leslie & Co., Ltd.) in his annual address to the shareholders on 27 August 1966.

advantages over foreign competitors through tariff protection, foreign exchange import restrictions, and transportation costs. The manufacturers therefore were naturally alarmed at the rise in prices, and there were suggestions to persuade the authorities to reintroduce the ceiling on rubber prices.

Natural rubber producers should remember that natural rubber is by no means free from competition and synthetic rubber is just waiting for an opportunity to exploit any price or quality differential. What is to be aimed at is a reasonable price for rubber which will enable the producers to make a reasonable margin of profit, and at the same time enable the manufacturers to produce consumer goods and exports at reasonable price levels. On the recommendations of the Tariff Commission, the Government of India announced on 18 August 1967 that the fair selling price for natural rubber be fixed at Rs 4150 per metric ton (i.e., Rs 415 per quintal or 100 kilograms) f.o.b. Cochin.

Since the beginning of 1967, prices of natural rubber have tended to find their levels, and currently (end of 1968) they have stabilized around Rs 400 per quintal. Devaluation of the Indian rupee in June 1966 and the 27½ per cent ad valorem import duty had reduced the difference between internal and external prices so that imported rubber and indigenous rubber are now selling at practically the same price. The current import price of rubber ranges between Rs 4,500 and Rs 4,800 per metric ton. Even though the manufacturers have to pay a cess of Rs 300 per metric ton, the

internal price is slightly lower ranging between Rs 4,400 and Rs 4,500 per metric ton. With import liberalization and the winding up of the Rubber Board's import equalization pool, the prolonged saturnalia is tapering off.

World prices of rubber will have a definite impact on prices of rubber in India in years to come. Food and Agriculture Organization analyses show that expansion in rubber consumption proceeds at a relatively high rate, not only as compared with other major agricultural commodities but also in relation to expansion in the non-agricultural sector of most economies. On the assumption that growth rates in the past ten to fifteen years in that sector will be more or less maintained, projections indicate that global consumption of all rubber will be in the region of eight million tons in 1975 and possibly ten per cent higher, thus approaching double the volume consumed in 1960.[30]

At the same time, rapid increases in production are also projected. These suggest that at 1961-63 prices, some 18 per cent of the natural rubber produced in 1975 would be in excess of requirements by the low GDP assumption, and 16 per cent by the high GDP assumption.[31] A surplus of this magnitude indicates a definite tendency to over-supply which would be

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[30] Agricultural Development in Nigeria, 1965-80 (Rome: FAO, 1966), p. 82. It is estimated that natural rubber will be meeting 30 to 35 per cent of the total world elastomer demand in 1975.

[31] Agricultural Commodities - Projections for 1975 and 1985, Vol. I, p. 321. The high projections assume a high rate of increase in GDP and therefore of technological advance; the low projections assume a slower rate of economic growth.

reflected in the accumulation of heavy stocks and/or severe pressure on natural rubber prices to fall from their 1961-63 level. Again, at 1961-63 prices, 24 per cent of the total exportable supplies in developing countries would be in excess of import demand on the low assumption and 17 per cent would be surplus on the high assumption.[32]

Such a degree of imbalance points to considerable pressure on natural rubber prices during the next decade, so that the downward trend in prices apparent in the sixties is likely to continue. In 1966 natural rubber prices were already 15 to 16 per cent lower than they had been in 1961-63. The unit value of rubber averaged about 55 Malaysian cents a pound in 1967 compared with an average of 66 cents a pound in 1966, a decline of nearly 17 per cent. Subsequently, however, prices have risen to levels more in keeping with the natural rubber/synthetic rubber price structure, and have remained remarkably stable since May 1968. With natural rubber currently in short supply, it is expected that this price stability is likely to be maintained for the better part of 1969. In order to make natural rubber more competitive with synthetic rubber (producers of which can be expected to benefit from increasing economies of scale as oil refineries and rubber plants expand), prices may well fall further.

Where nature stopped, the natural rubber industry has started with a research and development programme that, despite competition, perhaps because of it, is keeping natural rubber a commodity essential to today's

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[32] Ibid.

fast moving world. Natural rubber can undoubtedly remain fully cost-competitive with any synthetic rubber in the foreseeable future. The selling price of natural rubber will be related henceforth to that of a comparable synthetic rubber, being either the same or a little higher or lower as quality and consumer preferences dictate--a differential which though small may well prove very significant profit-wise. It is crucially important to the plantation industry that this imposed selling price be above, preferably well above, the production cost of natural rubber. What this selling price will or can be is difficult to specify, but the range of 50-60 Straits cents a pound for best sheet rubber is not unreasonable. As has been explained in Chapter IV, considerable reduction in cost of production is possible owing to the tremendous technological developments that have been taking place in recent years. It is likely that Malaysia will be able to produce a great part of its output profitably at something like 12 U.S. cents[33] per pound (producer price) by 1980, equivalent to an f.o.b. export price of around 18 U.S. cents.[34]

The price of natural rubber in New York remained around 25 U.S. cents a pound during 1963-65. The year 1967, however, saw a sharp decline to 20 U.S. cents. What happens to price over the years to come is out of the producers' hands. Natural rubber is sold in a completely free market,

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[33]The Malaysian dollar is worth 32 3/4 U.S. cents or 2s. 8 2/3d. sterling. 55 Malaysian cents/lb. f.o.b. is equivalent to about 19.5 U.S. cents/lb. c.i.f. U.S.A. and about 19 pence/lb. c.i.f. Europe.

[34]Synthetics and Their Effect on Agricultural Trade. (Commodity Bulletin Series 38; Rome: FAO, 1964), p. 25.

subject only to the laws of supply and demand. While the growers cannot control price, they can and have worked at lowering their costs. Although prices on the international market are now close to 20 U.S. cents a pound, the growing technical efficiency of synthetic rubbers is expected to result in increased competition over the next two decades with the resultant fall in natural rubber prices. Currently, various types of polybutadiene and cis-polyisoprene are quoted in the United States at 25 and 23 cents a pound, and it would be prudent to aim to produce and sell natural rubber in competition with these prices.

The average price of natural rubber in the London market was 20 pence a pound in 1966 as against 32 pence in 1960. It is now hovering around 19 pence. Prices in Singapore also show a definite declining trend. Despite the belief in some diehard quarters that the present rubber price has found the bottom, it does seem more likely that synthetic rubber, now in plentiful supply, will in fact provide quite a low ceiling for natural rubber price in the long term. Times have changed a lot since the raw material scramble which accompanied the Korean War 16 years ago. Factors likely to influence future world rubber price trends show that prices are likely to fall, even if fluctuating, and a figure of 55-60 Straits cents per pound for RSS I is often mentioned for the 1970's.[35] Projections of rubber exports made in Malaysia in 1966 assume a 1975 export price of

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[35] "Prospects for Natural and Synthetic Rubber Prices in the Sixties", Rubber Trends, 27 (Economic Intelligence Unit, London, 1965); Colin Barlow and Ng Choong Sooi, "Some Principles of Estate Budgeting", R.R.I.M. Planters' Conference, Reprint No. 14, July 1966.

55 Straits cents per pound against 70 cents in 1965.[36] This assumption implies a fall of 29 per cent from the 1961-63 level. It has been further estimated that Malayan f.o.b. prices for RSS I grade rubber will decline continuously to about 50 Straits cents around 1990.[37] In view of these developments in the international market, it may be assumed that the prices of natural rubber in India will not rise much further but will rather stabilize around Rs 200 per 100 pounds in the long run.

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[36] Agricultural Commodities - Projections for 1975 and 1985, Vol. I, p. 321.

[37] Colin Barlow and Ng Choong Sooi, "Budgeting on the Merits of a Shorter Replanting Period", Planters' Bulletin, No. 87 (November 1966).

CHAPTER VI

PROFITABILITY ANALYSIS

In this chapter an attempt is made to analyze the profitability pattern in the rubber plantation industry on the basis of published balanced sheets of public limited companies in recent years. There has been controversy as to what is a "fair" or "reasonable" rate of return on capital.[1] The Tariff Commission reports on natural rubber consider it reasonable to allow a gross return[2] of 12 1/2 per cent on paid-up capital. In the Tariff Commission enquiry on the prices of rubber tyres and tubes, ten per cent return on the capital employed was deemed to be fair.[3] In the same report a "reasonable" dividend to ordinary shareholders is given as ten per cent free of tax. In none of the subsequent enquiries, however, has the Commission explained what they consider a reasonable dividend. With regard to Government undertakings, the Planning Commission has indicated that a "return of 12 per cent on the invested capital must be an appropriate criterion for determining price policy".[4] At one stage the return was

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[1] S. N. Dalal, "Concept of a Fair Rate of Return on Capital", Reserve Bank of India Bulletin, XX (July 1966), 724-31.

[2] The return is expected to provide for managing agency commission, dividend on paid-up capital, subject to tax, profit-sharing bonus, and reserves.

[3] Tariff Commission, Report on the Fair Prices of Rubber Tyres and Tubes (Delhi: Manager of Publications, 1955), p. 91. "Capital employed" is shareholders' capital plus reserves used in business and borrowings for business.

[4] Planning Commission, Memorandum on the Fourth Five Year Plan (New Delhi, 1964), p. 21.

sought to be linked to the yield on the long-dated securities. A return equivalent to the Bank rate held the field for some time. At present "reasonable return" is defined as the Bank rate plus two per cent on the capital base.[5]

Various estimates of financial profitability in rubber plantations have been made from time to time. In 1951 the Tariff Board estimated a gross return at the rate of 12 1/2 per cent on a paid-up capital of Rs 1,200 per acre.[6] Cost included interest on working capital, at five per cent, rehabilitation fund instalment of Rs 6.82 per 100 pounds and a sales tax provision of Rs 1.90 at a price of Rs 128 per 100 pounds of R.M.A. 1 grade rubber. In 1952 also the Tariff Commission enquiry estimated a return of 12 1/2 per cent on fixed capital at a price of Rs 138 per 100 pounds (after covering cost of production, interest on working capital, and provision for sales tax at Rs 2.04).[7] To ensure the same return, the price of R.M.A. 1 rubber was later raised to Rs 150 per 100 pounds in February 1955 and Rs 155.75 in September 1955. The former increase of Rs 12 was partly to meet the rise in cost of production and partly to enable the producers to put aside adequate funds for replanting. The latter increase was to cover the enhanced rate of cess to be collected under the Rubber Act, 1954, which

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[5] Dalal, op. cit., p. 730.

[6] Strangely enough, the paid-up capital was taken as the fixed capital. See "Report on the Price of Raw Rubber", pp. 35-40.

[7] Tariff Commission, Report on the Revision of Prices of Raw Rubber (Delhi: Manager of Publications, 1952), p. 22.

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[7] Tariff Commission, Report on the Revision of Prices of Raw Rubber (Delhi: Manager of Publications, 1952), p. 22.

was raised from 0.5 rupee to Rs 6.25 per 100 pounds from August 1, 1955. Again, in 1960 the Tariff Commission, taking depreciation at three per cent of invested capital, worked out the price to Rs 146.06 per 100 pounds or Rs 160.94 per 50 kilograms. This was on the basis of an average yield of 408 pounds per acre for 30 years.[8]

Appendix B gives the profit position of a selected number of medium and large public limited rubber plantation companies (each with paid-up capital of over Rs 5 lakhs) for the years 1960-61 to 1965-66. These statements relate to 20 rubber companies with a coverage of about 75 per cent of the total paid-up capital in the corporate sector of the rubber plantation industry. The main profitability ratios are the profit margin (proportion of gross profits[9] to sales), return on capital employed (proportion of gross profits to total capital employed), return on shareholders' equity (profits after tax as a percentage of net worth[10]), dividends as percentage of net worth, and dividends as percentage of paid-up capital. The profit margin or profitability as related to sales helps to appraise the efficiency of the operations. We find that the profit margin in rubber

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[8]Tariff Commission, Report on the Revision of Raw Rubber Prices (Delhi: Manager of Publications, 1960), p. 47. A recent study of 17 balance sheets undertaken by the United Planters' Association of Southern India (on a per acre yield of 400 pounds) shows a cost of Rs 136.10 per 100 pounds and a net profit of Rs 161.92 per acre.

[9]Gross profits are sales minus cost of sales, and are equivalent to sum of profits before tax, interest charges and managing agents' remuneration.

[10]Net worth is the sum of paid-up capital, reserves and earned surplus, and is thus equivalent to owned funds.

plantations is thrice as much as that in all industries combined; it is around 30 per cent. Likewise, return on capital employed is much higher than that in all industries and return on shareholders' equity is as much as in all industries at around 10 per cent. Dividends declared also compare favourably with the average performance of all industries; dividends as percentage of paid-up capital have all along been higher than 10 per cent.

Appendix C tells a similar story. For the years 1950-63, the profit margin hovered around 30 per cent, return on capital employed around 15 per cent, and return on shareholders' equity around 10 per cent. Gross profits as a percentage of net worth rose from 15.4 to 20.2, and gross profits as percentage of paid-up capital rose from 21.1 to 33.4. The dividend distribution likewise is highly encouraging. Total gross profits of the ten companies studied in Appendix C show a rise of 137 per cent, and net profits of 67.8 per cent over a period of 13 years. Net profits per acre rose by 39.2 per cent, and dividends per acre by 60 per cent.

Financial analysts have adopted several ratios as rough, but sometimes useful, measures of the liquidity position of firms. Widely used is the current ratio, which compares current assets to current liabilities. Most analysts say that minimum safety requires that current assets should be at least twice as large as current liabilities.[11] From the data in

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[11] How to Read a Financial Report (revised edition; New York: Merrill Lynch, Pierce, Fenner & Smith, Inc., 1967), p. 17. The elements of financial analysis are discussed briefly and simply in this booklet.

'Current assets' are floating assets, i.e., cash, inventories,

Appendix C we find that this ratio was 6:1 in 1950 and 6.6:1 in 1963 for all the ten companies studied. Generally, companies that have a small inventory and easily collectible accounts receivable can operate safely with a lower current ratio than those companies having a greater proportion of their current assets in inventory and selling their products on credit.

Retained profits have formed one of the main sources of increase in internal resources of the corporate sector of the rubber plantation industry. It is axiomatic of rational business management that investment should be accommodated as far as possible within the framework allowed by internal capital accumulation and fund acquisition. It means avoiding excessive dependence on bank credits and investing in proportion to its own capitalization with the prospect of collection in mind. Enterprises, as a rule, prefer owned capital in the form of stocks or company debentures to loans, especially long-term funds. They therefore strive to increase reserve funds and depreciation funds. The basic requirement thus is to increase the earning power through savings and rationalization.

An effective utilization of the limited amount of accumulated capital is the first step towards progress. To this end, it is desirable to make supplementary investments so as to ensure perfect effectuation of the rationalization investments made so far and also to concentrate production on efficient equipment. This is a problem that concerns not only

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receivables and investments in securities. 'Current liabilities' are accounts, notes, accrued expenses and federal income-tax payable.

individual enterprises but the organization of industry as a whole. Both Appendices B and C show that the ultimate capacity of enterprises to lay aside capital fund increased considerably. It is seen that the increase in internal funds, with stock shares, of enterprises was catching up with the increase in fixed assets. Some of the old companies have availed of capitalization of reserves in the form of bonus shares. Investment in production facilities has been pretty brisk in an attempt to adjust production capacity to the rapid rise in demand.

However, credit transactions among enterprises have also much to do with their financing. Small enterprises command less trust from banks with the result that some of them are involved with debt trade transactions. The point can be illustrated by the financial structure of small holdings. The majority of the creditors for such enterprises are private money lenders. The loans are generally granted on personal security. The rate of interest is sometimes as high as 15 to 20 per cent though the existing pattern of credit service by the Reserve Bank of India provides that the rate of interest to the grower should not exceed 6 1/4 per cent. The main problem in the provision of long-term credit to small holders, especially those with 15 acres or less, is that ordinary financial institutions are unwilling to advance long-term loans on the security of their landed property. Recovery of a loan is not possible during the non-productive period of a re- or new-planted area covering six to seven years, and the full loan will take about 25 to 30 years to be repaid.

We may now take a close look at the financial performance of a typical rubber estate through the use of the operating ratios as developed by the Centre for Interfirm Comparison, U.K. This system is commonly known as the "Pyramid" method of arriving at an overall index. An index of overall performance, namely, Operating Profit/Assets Employed[12] is the "apex" of the "pyramid". Just below the apex there are two major items, namely,

a. Operating margin of profit from sales = $\frac{\text{Operating Profit}}{\text{Sales}}$

b. Turnover ratio of assets employed = $\frac{\text{Sales}}{\text{Assets Employed}}$

Therefore, a x b = $\frac{\text{Operating Profits}}{\text{Assets Employed}}$

The Malankara Rubber & Produce Company's estate is situated at Thodupuzha, Kerala State, at an elevation of 360 feet, and is essentially a rubber estate though such items as coconut, arecanut, and pepper are also grown on a limited scale. Between 1959 and 1964 the total area of the estate remained constant at 2,313 acres, but there was a slight decrease in the yielding area. The summary of statistics showing revenue, yield and operating ratios are given in Table XIV.

It is interesting to know what the operating margin of profit means and to note how this figure has changed over the years. In 1964, for example, the operating margin of profit ratio was 39.40 per cent, meaning thereby that for each rupee of sales there remained 39.40 paise as profit

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[12] Operating profits are gross profits minus operating expenses (selling, general and administrative expenses).

TABLE XIV

MALANKARA RUBBER & PRODUCE CO.: OPERATING RATIOS

		1959	1960	1961	1962	1963	1964
Sales	(Rs)	11,66,749	11,50,156	11,78,355	11,84,715	11,69,389	11,95,987
Per cent increase		-	-1.4	1.0	1.54	0.14	2.51
Yield per acre	(Kg)	233.16	247.36	258.72	263.06	297.90	304.20
Per cent increase		-	6.0	11.0	12.8	27.8	30.5
Operating profit / Sales	(%)	42.10	39.30	40.10	37.10	35.50	39.40
Total expenses / Sales	(%)	57.90	60.70	59.90	62.90	64.50	60.60
Sales/Assets	(times)	0.424	0.415	0.411	0.411	0.391	0.357
Operating profit / Assets	(%)	17.87	16.29	16.49	15.25	13.89	14.09

Source: Balance Sheets.

from operations. By itself this figure is interesting but it can be more meaningful and more significant in two ways. First, we can compare it with the margin of profit in the previous years. Changes in profit margin can reflect changes in efficiency as well as changes in products manufactured or in types of customer served. Second, we can also compare this company with other companies in the same business. If the margin of profit of this company is very low or very high in comparison with other companies in the same field, there are grounds for pessimism or optimism respectively for the investors in this particular enterprise.

The turnover ratio of assets in sales is useful as a quick, if rough, index of the efficiency of the use of assets. Those industries, which by the nature of their technology, can hope to achieve only a low turnover, can ensure a satisfactory return for their shareholders only if a high rate of profit can be achieved on sales (or revenues) and/or relatively heavy use can be made of low-cost debt money.[13] In view of the high cost of capital in India, one might expect great management pressure to achieve maximum turnover of assets. However, a high level of profit on sales partially compensates for the low turnover of its assets.

If the percentage of operating profit to the assets employed is taken as a measure of the productivity of the estate studied, it appears

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[13]Pearson Hunt, Charles M. Williams and Gordon Donaldson, Basic Business Finance: Text and Cases (Revised edition; Homewood, Ill.: Richard D. Irwin Inc., 1961), p. 115.

that the overall productivity on this estate has declined. This is in spite of the fact that better methods of cultivation have resulted in increased yield per acre of 30.5 per cent during 1959-64. It is needless, therefore, to emphasize that there is need for improving the overall productivity of the estates. Observations on existing methods of working and on the scope for improvement of major tasks may therefore be taken as pointers for introducing productivity improvement in the future.[14]

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[14] See "Report on Work Load and Related Aspects of Productivity in Plantations" (mimeograph) (Bombay: Productivity Centre, 1965).

CHAPTER VII

ECONOMIC ANALYSIS

On a public investment, it is necessary to take into account more than the profitability as measured in a financial context. Such a project must be evaluated within the "economic" context, suggesting thereby that any particular investment must not be visualised in isolation but must be seen in the general context of the economy. The appropriate procedure for this economic calculus is pricing in terms of opportunity costs, as has been explained in Chapter II.

Budgeting (in financial as well as economic analyses) consists in making forward estimates of yields and income, labour and material requirements, and cost and profit. Future costs are easier to predict than future prices in that they are more likely to follow a past trend. Deciding on relevant future prices may well be considered a difficult task, especially in agricultural production with the known instability in prices, but a decision has been made in the light of information available (see Chapter V).

Once estimates of future costs and revenue have been made, it is possible to determine the expected net profit of the enterprise concerned. Most current literature about budgeting refers to temperate agriculture, with enterprises continuing for one or perhaps two years only.[1] With short

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[1] Examples are: C. H. Blackburn, Farm Planning and Management (London: Longmans, Green & Co., 1961) and J. A. Hopkins and Earl O. Heady, Farm Records and Accounting (Ames: Iowa State University Press, 1962).

term crops, which can be grown and harvested, say, within a year, the comparison between alternatives is straightforward, with the exception perhaps of joint products. With a perennial like rubber, however, complications arise in that costs are incurred and revenue earned over a period of years. This is because profits earned in the near future are worth more than those earned in the distant future, it being possible to invest earlier profits to secure interest over a longer period. Profits earned over different periods must therefore be discounted at the appropriate interest rate or real cost of capital to get at the "present values".

The development costs involved in setting up a public sector plantation project to the productive stage and the direct operating costs during the productive period are detailed in the following pages. Costs depend much on the numerous local factors which vary from place to place. Nevertheless, the procedure outlined below shows how they could be estimated for practical purposes.

Project Life

The period of analysis or the planning horizon is the estimated life of the project, and the shape of benefit (and cost) streams over time means the pattern of benefits (costs) expected to be generated by the investment over successive time periods. Project life, however, is often a subjective estimation depending on assessment of the physical lengths of life, technological changes, shifts in demand, emergence of competing products like synthetic rubber, and so on. A rubber plantation is undoubtedly a wasting

asset. Problems of physical life apart, the economic life of the rubber tree depends not only on the shape of the yield curve, as the tree ages, but also on technical progress. The discovery and application of superior planting material obviously introduces an important element of obsolescence affecting the economic life of the plantation.

In the developing countries, dynamic growth factors and technological progress are constantly lifting the schedule of the marginal efficiency of capital. Short-term expectations of prospective yields are more stable than long-term expectations because the realised results of the recent past are a safe guide to what will happen in the future. In contrast, long-term expectations are highly unstable and hence more important in explaining the fluctuations in aggregate investment. The dynamic factors that lead to shifts in the schedule of the marginal efficiency are both endogenous and exogenous. The endogenous factors include the level of income or the rate of change in income, the level and trend of consumer demand, the existing stock of capital (especially, fixed capital), money wage rates and other factor prices, and stock exchange activity as reflected in quotations. The exogenous factors are mainly inventions and innovations, growth and composition of population, natural resources, consumer psychology, government's fiscal-monetary policies, political climate, labour movements, socio-legal institutions, foreign trade, wars, revolutions and other man-made catastrophes as also weather conditions.[2] There are doubtless many other shift parameters.

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[2]K. K. Kurihara, Introduction to Keynesian Dynamics (London: George Allen & Unwin, 1956), p. 61.

Though it is impossible to know much about the future economic condition, (especially over an extended period of time), most investment decisions are made on what Keynes calls "conventional judgment", which gives some sort of stability to the economy.[3]

It is preferable in such cases to take the shortest feasible time horizon, i.e., the minimum number of years of consecutive action for net benefits to be positive, in view of the risk and uncertainty involved in the project. The Rubber Growers' Association recommended an amortization charge of four per cent per annum for purposes of capital replacement in rubber plantations.[4] Rubber trees were thus assumed to have a productive life of 25 years. However, it is now widely recognised that the rubber tree has a conventional life of 37 years with a gestation period of seven years and an economic (yielding) life of 30 years. A recent description of the now prevalent tapping schedule by a publication of the Rubber Research Institute of Malaya also confirms the norm that the yielding period of rubber plantations is about 30 years.[5] It may be reasonable, for our purposes therefore, to assume a total life of 37 years as a norm.

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[3] J. M. Keynes, op. cit., p. 152-53.

[4] K. E. Knorr, op. cit., p. 29.

[5] "Stimulation of the Yield of Rubber Trees as a Routine Estate Practice", Planters' Bulletin, No. 45 (November 1959), pp. 138-42. The Tariff Commission also takes the economic life of a rubber tree at 30 years for depreciation purposes. See Report on the Revision of Raw Rubber Prices (1960), p. 38. H. N. Nanjundiah however, has taken an economic life of 22 years for Plantation Corporation of Kerala estates, vide "A Report on the Development of P. C. K. Estates", (mimeograph) (Kottayam: Plantation Corporation of Kerala, 1965), whereas the Plantation Inquiry Commission puts it at 33 years (see Report, p. 87).

Even this may be a conservative estimate considering that some rubber trees in India have been tapped up to an age of 45 years.

Unless we have a great deal of other information, rarely obtainable, we cannot point to the "correct" time horizon. What this suggests, therefore, is the presentation of multiple results that reflect more than one time horizon. There is danger, however, of overloading the analytical exhibits with multiple outcomes. McKean opines that it is better to show the outcomes with at least two discount rates and to use a standard middle-of-the road time horizon.[6] For purposes of comparison however, we have also taken shorter project lives of 32 years and 27 years.

Project Size

What is the optimum economic size of the rubber plantation? The economic scales have been traditionally weighted in favour of the estates. This conception rests on the belief of the inherent superiority of large producing units. It is a proposition to the effect that large farms can produce at less real cost than small or medium-sized farms. It is said, for example, that once new factors of production have been developed which are likely to be profitable in the economy of a poor country, managers of large plantations are able to perform more efficiently the function of their application and dissemination. Other advantages cited include: (1) estates have monopsony power and a preference in the purchase of many commodities,

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[6] Roland N. McKean, Efficiency in Government Through Systems Analysis (New York: John Wiley & Sons, 1958), p. 125.

e.g., production requisites and price-controlled consumption goods, and (2) estates have more access to research information. It is interesting to speculate how estates would compare with small holdings if the latter were operated by men who were less subsistence oriented, had better access to market for fertilizer, and were served by research and extension services.

It is opined that the economies of scale play only a relatively minor part in rubber production.[7] Though it may be argued that large producers are more efficient, it would appear that generalizations about the economies of large-scale production in rubber growing are rather unsafe. Secondly, only several years of free competition could establish the relative merits of the many different types and units comprising the estate and small holding sections of the industry. Strangely enough, however, the rubber plantation industry in India has been enjoying tariff and other kinds of protection for an extended period of over 25 years.

Bauer's findings in Malaya suggest that there is not much relation between costs per pound and the size of the company as measured by mature

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[7] Bauer, op. cit., pp. 11, 14. The term "scale" is a rather loosely used word in much of economic analysis. It has been variously used to denote the "size of firm" or "size of plant". A firm or a company usually consists of a number of plants or estates. Size of plant or estate can be measured in several ways - number of acres cultivated (capacity), number of employees, sales, value added, etc. In this context "economies of scale" are discussed in terms of the size of estates.

acreage.[8] On the other hand, there is a significant negative correlation between costs and yield per acre, which is according to expectations. Likewise, two measures of efficiency calculated with Indonesian data also show that even though estates are somewhat more efficient than subsistence small holdings, the arguments on behalf of the estate are rather overstated.[9] Professor Frankel's observations about the grandiose Kongwa groundnuts scheme in East Africa have relevance in this connection:

> ....that agricultural operations can be assumed to lend themselves to economies on a very large scale....runs counter to the accepted principle that agriculture is generally the least likely form of economic enterprise to yield considerable large-scale economies; its factors of production cannot be readily centred and supervised, nor, in general, are they sufficiently homogeneous to allow easily organized repetitive processes of production.[10]

Thus it appears that economies of scale, especially above 5,000 acres, are small compared to those of high yields. In other words, it is most improbable that spectacular cost reductions could be achieved by increasing the scale of operations, and probably there are no economies at all through

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[8] Correlation analyses between the size of estates and costs per pound showed a negative but no significant correlation between size and costs. The coefficient ranged between -0.17 and -0.12 for units up to 5,000 acres each. Bauer, op. cit., p. 272.

[9] D. H. Penny and M. Zulfikli, "Estates and Smallholdings: An Economic Comparison", Journal of Farm Economics, 45 (December 1963), 1017-21. Value added, i.e., value of production less value of purchased inputs and excluding direct payments to factors of production, has been related to two major resources employed, namely land and labour (in rupiahs)

	Estates	Small holdings
Value added per hectare	7,500	9,800
Value added per man employed	16,700	8,900

[10] S. H. Frankel, The Economic Impact on Under-developed Societies, (Oxford: Basil Blackwell, 1953), p. 149.

operating units over 5,000 acres.[11] We may therefore choose a hypothetical estate of 5,000 acres in size for the cash flow analysis. It may be mentioned that the largest contiguous estate of the Plantation Corporation of Kerala, a public sector undertaking (i.e., the Adirapally estate in the Kaladi group) is 4,389 acres. The Mooply estate (3,331 acres) of the Malayalam Plantations Ltd., is the largest single estate in the private sector of the rubber plantation industry in India.

Sources of Data

The data for this analysis are based mainly on extensive interviews with planters and officials of the Rubber Board and the Plantation Corporation of Kerala. The purposive sampling technique was used in view of the reluctance of most planters to divulge details on the inputs and outputs on their plantations. Such a judgment or authoritative sample may indeed yield good estimates, but the investigator has no objective method of evaluating the adequacy of the sample. Of course, a bias similar to that resulting from non-responses in mail surveys can arise in personal interview field surveys when selected members of the sample are unwilling or unable to answer certain questions. In view of this situation, a follow-up procedure was used whenever possible to estimate the properties of the missing members of the sample, and to ascertain whether these were different from the rest of the sample with respect to the characteristics being studied. Superimposed on the above considerations was the problem of whether the persons interviewed

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[11] Bauer, op. cit., pp. 272, 334. This statement may be assumed to be valid in terms of both current technology and likely improvements in the future, as envisaged at present.

gave the correct answers. Often, cross-checks were included to test the veracity of the respondent's information. In this less formal selection of farms, all that we can do is to try consciously to have them represent the different yield levels around the country in about the true proportions. However, in this case, we must depend largely on common sense and other sound knowledge of the situation we are studying, and not on statistical computation, to tell us whether or not our sample is really representative of the universe we want to study.

To appreciate both the significance and the limitations of the findings here reported calls for a brief review of the characteristics of the firms surveyed, in terms of the type of activity pursued and their size. This is given in Appendix D.

Wages and Other Input Costs

Wages represent one of the principal items of the cost of production. The incidence of labour costs on total costs varies depending on yield and other factors. A rough idea of direct wages will be about 40 per cent of the total cost. The indirect wages/benefits paid to the workers would vary from 30 to 40 per cent of direct wages.[12] So the incidence of

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[12]Major indirect wages/benefits to workers in rubber plantations are: (i) provident fund contribution of the employer; (ii) annual bonus; (iii) seven paid holidays and annual leave with wages at the rate of one day for every 20 days' work with full average pay; (iv) maternity benefit to female workers, and medical and sickness benefits to all workers; and (v) housing facilities.

labour cost may be about 52 to 56 per cent of the total cost.[13] The Tariff Commission has estimated wages (exclusive of provident fund etc.) at 50 per cent of the cost of production in the industry.[14] Since tappers constitute over 60 per cent of all employees during the productive period, the biggest item in labour costs relates to tapping.[15]

Both time and piece rates systems of payment are prevalent in rubber plantations. The workers falling under each category are roughly about half. There has been a significant upward movement of wages since the Labour Investigation Committee (chairman: D. V. Rege) conducted its inquiry in 1944. Since 1952, the wage structure has been regulated by the Minimum Wages Act. It is estimated that the average daily earnings of "all workers" in rubber plantations were Rs 2.27 in 1961. Employees in the watch and ward and other services group earned Rs 1.90 a day while the estate staff (clerical and administrative) who are paid on a monthly basis, earned

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[13] Source: Rubber Board, based on a 1963 study of plantations of 50 acres and above.

[14] Report on the Revision of Raw Rubber Prices (1960), p. 51.

[15] A sample survey of seven estates covering 8,918 acres conducted by the United Planters' Association of Southern India in 1961 shows that the number of tapping days relative to total man-days per acre is 45.08 per cent, constituting the largest proportion of labour use during the productive period of the plantation. Next in importance comes spraying and dusting, requiring 11.99 per cent of the man-days. Weeding takes 10.58 per cent, processing 9.05 per cent and upkeep and maintenance 8.78 per cent. UPASI, "Labour Utilization in Rubber Plantations" (mimeographed submission to the Rubber Wage Board, (n.d.)).

Rs 7.58 a day.[16] On the basis of data collected in respect of workers receiving Rs 300 or less a month, who constitute the substantial majority, the estimated labour cost per man-day worked out to Rs 2.87.[17]

The wage rates currently in force in rubber plantations came into force from April 1, 1966, as a result of the recommendations of the Central Wage Board for the Rubber Plantation Industry (chairman: L. P. Dave).[18] For estates of 100 acres and above, the basic daily wage is Rs 2.50 for field workers and Rs 2.70 for factory workers in Kerala and Madras. These daily wage rates are related to the average consumer price index (1960=100) for Mundakayam for the year 1965, which stood at 135. Wages, according to the Government notification, were revised on 1 April 1967 and 1 April 1968 by adding dearness allowance at the rate of 1.1 paise per day per point for the rise in the average consumer price index over the 1965 level. Tappers' wages are broken into a fall-back wage and incentive piece rates. The other field workers like those engaged in manuring, spraying, weeding and field maintenance are paid on a time-rated (daily) basis. A tapper's daily income with the minimum wage of Rs 2.50, incentive payment, free medical facilities, provident fund, subsidized accommodation, annual leave with pay (14 days) and stipend for school-going children (provided by the Rubber Board) comes to more than Rs 4. Field supervisors are time-rated, and get up to Rs 4.50, but the average wage will be around Rs 2.50 per day. For our calculations,

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[16] Labour Bureau, Ministry of Labour and Employment (Government of India), Report on Survey of Labour Conditions in Rubber Plantations in India (Delhi: Manager of Publications, 1965), p. 57.

[17] Ibid., p. 59.

[18] See Gazette of India (Extraordinary) - Part I, Section I, September 30, 1966.

we may take a shadow wage of Rs 2.25 a day for the estate workers. This will reflect the unemployment and under-employment situation in the area. And because of the character and extent of unemployment, and the slow pace of agricultural and industrial development, this assumption will likely apply over the next generation.

The general market value of land varies according to the location, ranging from Rs 500 to Rs 2,000 or more per acre in Kerala, Madras and Mysore. The land to be brought under this public sector project are cultivable waste and secondary forests, for which we may take an opportunity cost of Rs 500 per acre. The budded planting materials, if procured locally, cost Rs 150 per acre. The cover crops which cost Rs 3 per kilogram, their manuring and the labour charges for application involve an expenditure of Rs 20 in the first year and Rs 20 for the rest of the development period. Direct costs from the second to the seventh year of planting comprise of manuring of rubber plants, spraying and weeding. For the first three years, one-half to one pound of NPK 8-12-10 manure mixture per tree is applied twice a year; thereafter two pounds per application is the normal dose. The price of NPK is Rs 350 per ton.

Capital expenditure over the development period of seven years includes non-residential buildings (stores, offices and workshops), staff quarters, workers' housing, roads and culverts, and water supply and electricity. It is advisable that every estate employing over 500 coolies should have a hospital of its own with the attendant facilities. About 25 miles of good surfaced road are required on a 5,000-acre plantation, at an expendi-

ture of Rs 20,000 per mile. During the seventh year, prior to the commencement of tapping, factory facilities and processing equipment have to be installed, and tapping utensils and kits bought. Tapping utensils cost Rs 20 per tapper. Coagulating dishes are priced at Rs 8 per unit; ten such units are required per acre. The sheeting battery and roller, engine and pump together cost Rs 250,000, the coagulating tanks Rs 5,000 each and Jeeps Rs 21,000 per unit.

Cash Flow Analysis

The items of cost in the rubber plantation project over its 37-year life are detailed in Tables XV and XVI.[19]

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[19]The data for this analysis are based on extensive personal interviews with planters and officials of the Rubber Board and Plantation Corporation of Kerala, cross-checked with R. J. Johnson, Johnson's Complete Rubber Manual (Colombo: R. J. Johnson & Co., 1959), K. T. Jacob, "Andaman and Nicobar Islands Pilot Project Rubber Plantation", (mimeograph) (Kottayam: Rubber Board, 1964), H. N. Nanjundiah, op. cit., and Michael A. Kallivayalil, The Rubber Board Finance Scheme (Mundakayam: VijayaPress (n.d.)).

TABLE XV

COST OF PLANTATION DEVELOPMENT PER ACRE (in rupees)

Particulars	First year	Maintenance six years	Total
1. Cost of land	500	--	500
2. Cost of plants and seeds	100	50	150
3. Felling, clearing and planting	225	135	360
4. Weeding and pruning	30	270	300
5. Forking and manuring	25	555	580
6. Spraying and dusting	--	250	250
7. Cover crops	20	20	40
8. Fences and boundaries	50	60	110
9. Buildings, roads, culverts	125	750	875
10. Vehicles, machinery, utensils	50	500	550
11. Miscellaneous and overheads	60	250	310
Total	1,185	2,840	4,025

The direct operating costs during the productive period of the plantation include the following:

i) Upkeep of mature areas (including manuring, weeding, control of pests and diseases, maintenance of drains and roads and bridges)

ii) Tapping and collection (including transport of latex to the factory, yield stimulation and tools)

iii) Manufacture (including factory labour, power, repairs)

iv) General charges (e.g., estate supervision, housing and other indirect labour costs, medical services)

v) Packing and dispatch to Cochin, the port of delivery.

Tapping begins from the eighth year onwards. One tapper's task is taken as 350 trees (one block) a day. Since tapping is done on alternate days, each tapper is entrusted with 700 trees, which would be equivalent to a little over four and one-half acres. Each tapper is expected to work an average of 307 days a year. There should also be a small reserve of tappers since a shortage of one cooly per diem for say, 300 days, means a loss of over 3,000 pounds in the year. This would work out to a total of about 1,075 tappers. There should also be tapping supervisors at the rate of one for every 20 tappers and also vehicle drivers and helpers. The total number of operatives when the plantation is in full production will be about 1,635 - including field workers for maintenance and upkeep, factory operatives, estate staff for operation and administration and the head office and warehouse (Cochin) staff.[20]

On account of seasonal rainfall in the rubber growing areas of India, it would be preferable to attach rainguards to the rubber trees to protect the latex. This will cost Rs 105 per acre per year. The difference in

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[20]The break-down of the total number of operatives (workers and staff) at maturity of the plantation is given below:

Tapping and collection	1,130
Field maintenance and upkeep	250
Factory operatives	150
Estate operation & administration	70
Head office (and warehouse)	35
Total	1,635

yields with or without rainguards is approximately Rs 150 per acre per year. Thus, obviously there is definite advantage in installing the polythelene skirts; the annual recurring costs would work out to 10 paise per pound on an average production of 1,000 pounds per acre. Estate operation and administration costs include salary of staff, maintenance of vehicles, labour amenities - school and dispensary - and plantation and land tax (ten rupees per acre). There are obvious advantages in producing smoked sheet, one being that the actual outturn of dry rubber from latex is about three per cent more than with crepe. The proportion of scrap rubber to latex is usually about 15 per cent; this is converted into estate brown crepe. The charges for transporting rubber sheets to Cochin work out to 1.6 paise per pound (at 50 paise per ton-mile).

The average expenditure required each year for raising and maintaining an acre of rubber plantation is given in Table XVI.

TABLE XVI
CAPITAL, MAINTENANCE AND OPERATING COSTS PER ACRE OF RUBBER PLANTATION

Year of planting	Amount (in rupees)
1	1,185
2-6 (Rs 390 each year)	1,950
7	890
Total development period	4,025
8-37, each year	
Mature acreage maintenance	200
General upkeep 100	
Fertilizing 60	
Spraying 40	
Estate operation and administration	100
Tapping and collection	232
Processing, packing and transportation	98
Head office expenses	20
Total per year (8-37)	650

Production of rubber which starts from the eighth year of planting, reaches its maximum in the thirteenth year, and continues at that level for the next 19 years after which it will gradually decline until the area is re-planted or planted with other crops. Nanjundiah (op. cit.) gives an average yield of 1,000 pounds per acre per annum during the most productive period whereas Kallivayalil (op. cit.) estimates the average yield at 1,200 pounds and Jacob (op. cit.) estimates a yield of 1,500 pounds per acre. Since plantings under the project will be done with high yielding materials, and maintenance will be carried out in a systematic way, we may certainly expect a minimum of at least 800 pounds per acre.[21] We may therefore take the rather conservative estimate of a yield of 1,000 pounds per acre during the years 13-32 of first planting. The yield for the entire production period of the 5,000-acre plantation is as given in Table XVII.

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[21] Scheme for Long-term Loan to Rubber Planters (Kottayam: Rubber Board, (n.d.)). This is for an individual planter; for companies, the yield should be much higher and therefore around 1,000 pounds.

TABLE XVII

YIELD OF RUBBER FROM THE PLANTATION PROJECT

Year of planting	Yield per acre (lbs)	Total yield (lbs)
8	500	2,500,000
9	600	3,000,000
10	700	3,500,000
11	800	4,000,000
12	900	4,500,000
13 - 32, each year	1,000	5,000,000
33	900	4,500,000
34	800	4,000,000
35	700	3,500,000
36	600	3,000,000
37	500	2,500,000

The income from the project is estimated at the projected price of Rs 200 per 100 pounds, which is considered to be the long-term price.[22] The receipts and the disbursements and the net cash flow from the hypothetical project are now discounted at the opportunity cost of capital of ten percent to arrive at the current values.[23] The results are given in Table XVIII.

[22] See Chapter V for the price projection.

[23] The estimation of ten per cent as the appropriate discounting rate is discussed in Chapter II.

Thus discounting the flows of receipts and disbursements at the opportunity cost or real cost of capital, the resultant present values are as follows:

Receipts	Rs 45,831,824
Disbursements	Rs 33,123,006

These data yield a benefit-cost ratio of 1.384, which indicates that the project is viable in economic terms. A benefit-cost ratio of 1.0 means that the project earns exactly enough to cover its opportunity cost. This analytical device provides a basis for a general ordering of possible projects when the same general analytical methods and discounting rates are used.

The net cash flow discounted at 14.5 per cent yields a present value of Rs 728,522; then employing a discount rate of 15 per cent, the present value is shown to be -Rs 93,890. From a linear extrapolation, we conclude that the internal rate of return or the expected rate of earning on the investment is 14.94 per cent.[24]

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[24] As has been explained in Chapter II, the rate of return is the interest rate at which the present worth of the net cash flow is zero. The internal rate of return is chosen as the test of rank whenever an independent ranking is meaningful. This criterion of rank is useful only in selecting projects of a given budget. If independent projects are to be compared and it is appropriate to seek the best set of investments to which a national budget should be devoted, the internal rate is a suitable ranking device. That is, its use will point to the set which yields the greatest expected worth for a given amount invested by the nation when the streams are discounted at the marginal internal rate of return (McKean, op. cit., pp. 212-13).

TABLE XVIII

DISCOUNTED CASH FLOW ANALYSIS

Year	Receipts (Rs)	Disbursements (Rs)	Net Cash Flow (Rs)	Discounting Benefits and Costs at 10% Factor	Receipts (Rs)	Disbursements (Rs)	Discounting Net Cash Flow at 14.5% (Rs)	15% (Rs)
1	-	5,925,000	- 5,925,000	1.000	-	5,925,000	- 5,925,000	- 5,925,000
2	-	1,950,000	- 1,950,000	0.909	-	1,772,727	- 1,703,057	- 1,695,652
3	-	1,950,000	- 1,950,000	0.826	-	1,611,570	- 1,487,386	- 1,474,480
4	-	1,950,000	- 1,950,000	0.751	-	1,465,064	- 1,299,027	- 1,282,157
5	-	1,950,000	- 1,950,000	0.683	-	1,331,876	- 1,134,522	- 1,114,919
6	-	1,950,000	- 1,950,000	0.621	-	1,210,797	- 990,849	- 969,495
7	-	4,450,000	- 4,450,000	0.565	-	2,511,910	- 1,974,819	- 1,923,659
8	5,000,000	3,250,000	1,750,000	0.513	2,565,791	1,667,764	678,266	657,890
9	6,000,000	3,250,000	2,750,000	0.467	2,799,045	1,516,149	930,870	898,980
10	7,000,000	3,250,000	3,750,000	0.424	2,968,685	1,378,318	1,108,619	1,065,985
11	8,000,000	3,250,000	4,750,000	0.386	3,084,348	1,253,016	1,226,420	1,174,128
12	9,000,000	3,250,000	5,750,000	0.351	3,154,447	1,139,106	1,296,605	1,235,925
13	10,000,000	3,250,000	6,750,000	0.319	3,186,310	1,035,551	1,329,347	1,261,624
14	10,000,000	3,250,000	6,750,000	0.290	2,896,645	941,410	1,161,002	1,097,065
15	10,000,000	3,250,000	6,750,000	0.263	2,633,314	855,827	1,013,975	953,969
16	10,000,000	3,250,000	6,750,000	0.239	2,393,922	778,025	885,568	829,539
17	10,000,000	3,250,000	6,750,000	0.218	2,176,293	707,295	773,422	721,338
18	10,000,000	3,250,000	6,750,000	0.198	1,978,448	642,996	675,478	627,251

19	10,000,000	3,250,000	6,750,000	0.180	1,798,589	584,541	589,937	545,435
20	10,000,000	3,250,000	6,750,000	0.164	1,635,081	531,401	515,229	474,292
21	10,000,000	3,250,000	6,750,000	0.149	1,486,438	483,092	449,982	412,428
22	10,000,000	3,250,000	6,750,000	0.135	1,351,307	439,175	392,997	358,633
23	10,000,000	3,250,000	6,750,000	0.123	1,228,461	399,250	343,229	311,854
24	10,000,000	3,250,000	6,750,000	0.112	1,116,783	362,954	299,763	271,178
25	10,000,000	3,250,000	6,750,000	0.102	1,015,257	329,958	261,802	235,807
26	10,000,000	3,250,000	6,750,000	0.092	922,961	299,962	228,648	205,049
27	10,000,000	3,250,000	6,750,000	0.084	839,055	272,693	199,693	178,304
28	10,000,000	3,250,000	6,750,000	0.076	762,778	247,903	174,404	155,047
29	10,000,000	3,250,000	6,750,000	0.069	693,434	225,366	152,318	134,823
30	10,000,000	3,250,000	6,750,000	0.063	630,395	204,878	133,029	117,238
31	10,000,000	3,250,000	6,750,000	0.057	573,086	186,253	116,182	101,946
32	10,000,000	3,250,000	6,750,000	0.052	520,987	169,321	101,469	88,649
33	9,000,000	3,250,000	5,750,000	0.047	426,262	153,928	75,491	65,666
34	8,000,000	3,250,000	4,750,000	0.043	344,455	139,935	54,461	47,170
35	7,000,000	3,250,000	3,750,000	0.039	273,998	127,213	37,553	38,382
36	6,000,000	3,250,000	2,750,000	0.036	213,505	115,648	24,051	20,649
37	5,000,000	3,250,000	1,750,000	0.032	161,746	105,135	13,367	11,427
Total	270,000,000	117,625,000	152,375,000		45,831,824	33,123,006	728,522	- 93,890

The benefit-cost ratio is not recognized as the only piece of information which is relevant to investment decisions by public agencies. It is only one measure of the national and public worth of the project. Nevertheless, cost-benefit analyses clearly play an important role in the determination of budgets and in the selection of particular projects. In designing effective policies, however, different combinations of measures should not be neglected. The addition (or removal) of extra features creates alternative courses of action that are highly relevant. In other words, whether they are for the use of the recommender or the decision maker, correct quantitative "results" should be multi-valued to show "reasonable" outcomes, or supplemented with other clues to the uncertainty that is associated with such estimates.[25] One of the exhibits concerning any particular project should be the present worth of the venture (present value of the receipt stream minus the present value of the cost stream) calculated for a range of discount rates and the same time horizon. Of two investments costing the same amount, the one which has the larger excess of benefits over costs would

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[25] McKean, op. cit., p. 68. Uncertainty is a pervasive and fundamental aspect of investment decisions stemming from erroneous economic forecasting and from inherently unpredictable phenomena like wars, international conditions, natural disasters, or technological breakthroughs. (A. K. Sen, Choice of Techniques: An Aspect of the Theory of Planned Development, Oxford: Basil Blackwell, 1962, p. 86). The three procedures for correcting for uncertainty in project evaluation that were recommended in the "Green Book" (pp. 22-23) continue to be employed: conservative estimates of benefits and costs; conservative estimates of project life; and the addition of an uncertainty premium to the social discount rate.

bring us closer to "economic efficiency".[26]

The findings of the analysis are given below in Tables XIX, XX, and XXI, for project lives of 37 years, 32 years, and 27 years respectively. The shorter planning horizon of 32 years assumes that the plantation enters its declining phase of productivity after that period, and is due for replantation or abandonment of the enterprise. Even with the shorter life of 32 years, we find that the present worth is Rs 11,934,121 compared to Rs 12,708,818 for 37 years, and the benefit-cost ratio 1.367 against 1.384, using a discount rate of 10 per cent; the internal rate of return is 14.83 per cent against 14.94 per cent. For a project life of 27 years, the corresponding figures are a present worth of Rs 9,786,656, benefit-cost ratio of 1.311 and an internal rate of return of 14.402. Thus, we can conclude that taking the direct costs and benefits into consideration, this project is an economically viable one, whether the project life is the conventional 37 years or the smaller 32 years, when the plantation enters its phase of declining productivity, or even the still shorter planning horizon of 27 years.

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[26] If this is to be used for comparison of this project with private investment, property and income taxes paid on private investment should be allowed for; a rough allowance could be made by reducing the present worth estimates by 50 per cent. If such taxes are deducted from the public project's stream of benefits, the estimate should be relevant to, though not decisive in, the comparison of government proposals with private investment (McKean, op. cit., p. 165).

TABLE XIX

BENEFIT-COST FINDINGS: PROJECT LIFE 37 YEARS

Discount Rate (per cent)	Discounted Receipts (Rs)	Discounted Expenditures (Rs)	Present Worth[a] (Rs)	Benefit-cost Ratio
5	101,935,371	54,969,400	46,965,970	1.854
6	85,787,241	48,813,089	36,974,152	1.757
7	72,679,124	43,758,782	28,920,341	1.661
8	61,962,838	39,571,563	22,391,273	1.566
9	53,141,521	36,072,211	17,069,309	1.473
10	45,831,824	33,123,006	12,708,818	1.384
11	39,736,043	30,617,345	9,118,697	1.298
12	34,621,494	28,472,104	6,149,391	1.216
13	30,305,174	26,622,007	3,683,166	1.138
14	26,642,227	25,015,417	1,626,811	1.065
15	23,517,305	23,611,195	- 93,890	0.996

[a] Present worth is discounted total receipts minus discounted total expenditures. Discrepancies are due to rounding.

TABLE XX

BENEFIT-COST FINDINGS: PROJECT LIFE 32 YEARS

Discount Rate (per cent)	Discounted Receipts (Rs)	Discounted Expenditures (Rs)	Present[a] Worth (Rs)	Benefit-cost Ratio
5	95,164,937	51,869,160	43,296,086	1.835
6	80,866,250	46,565,535	34,300,988	1.737
7	69,091,750	42,124,379	26,967,348	1.640
8	59,339,816	38,379,484	20,960,316	1.546
9	51,218,105	35,200,230	16,017,863	1.455
10	44,417,539	32,483,398	11,934,121	1.367
11	38,693,344	30,146,934	8,546,410	1.283
12	33,850,789	28,125,250	5,725,543	1.203
13	29,734,180	26,365,668	3,368,524	1.128
14	26,218,254	24,825,558	1,392,694	1.056
15	23,201,773	23,470,277	- 268,493	0.988

[a] See note in the previous table.

TABLE XXI

BENEFIT-COST FINDINGS: PROJECT LIFE 27 YEARS

Discount Rate (per cent)	Discounted Receipts (Rs)	Discounted Expenditures (Rs)	Present[a] Worth (Rs)	Benefit-cost Ratio
5	82,988,562	47,911,801	35,076,945	1.732
6	71,606,625	43,556,105	28,050,617	1.644
7	62,030,629	39,829,512	22,201,086	1.557
8	53,940,766	36,624,801	17,315,957	1.473
9	47,078,992	33,855,027	13,223,965	1.391
10	41,236,101	31,449,437	9,786,656	1.311
11	36,241,773	29,350,183	6,891,601	1.235
12	31,956,933	27,509,754	4,447,191	1.162
13	28,267,566	25,889,019	2,378,552	1.092
14	25,079,766	24,455,555	624,207	1.025
15	22,315,910	23,182,379	- 866,457	0.963

[a] See note in Table XIX.

Indirect Benefits

There are many secondary benefits which a project like this may bring to the economy of the country or region. These include (i) use of unemployed or underemployed labour; (ii) training of labour and management for industry and business, thereby relieving what may be one of the serious shortages impeding economic development of the country; (iii) earning or conserving foreign exchange; (iv) creation of markets or services for other industries; (v) modernization of the economy; (vi) attraction of capital from less productive uses; (vii) creating competition in the supply of the product, thereby benefiting consumers; (viii) addition to national income; (ix)contribution to the public exchequer; (x) strengthening of national security by ensuring continuity of supply of an essential product, since rubber is a strategic commodity useful in war and peace; and (xi) creation and maintenance of economic and political order.

Secondary benefits are defined as "the values added by incurring secondary costs in activities stemming from or induced by a project".[27] The evaluation problems posed by secondary (indirect) and intangible costs and benefits are theoretically intriguing and of considerable practical significance.

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[27]Federal Inter-Agency River Basin Committee, Proposed Practices for Economic Analysis of River Basin Projects, p. 10. The logic of the "secondary benefit" concept is also exhaustively analysed in McKean, op. cit., pp. 51-67, and Otto Eckstein, Water Resource Development (Cambridge, Massachusetts: Harvard University Press, 1958), pp. 202-14.

Next to the problems of cost allocation, such evaluation raises the most controversial problems of benefit-cost analysis.[28] The major class of secondary benefits arises from an expansion of economic activity "induced by" the project. The argument for including this class of secondary benefits is supported on the academic level through analysis based on Keynesian economics. For instance, "structural" (sometimes called "hard core") unemployment is generally concentrated in particular regions. Public resource development can, under such conditions, help in making use of such underemployed services.[29]

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[28] S. V. Ciriacy-Wantrup, "Benefit-Cost Analysis and Public Resource Development", Journal of Farm Economics, 37 (November 1955), 678-79.

[29] Secondary benefits could also be discussed within the framework of the theory of external economies. The conventional formulation of Marshallian external economies and diseconomies is to restrict them to the changes in the supply prices of factor inputs to a firm as the industry expands. It is common to extend the frame of reference beyond firm-industry relationships to firm-local area or industry-national economy relationships. Cf. Julius Margolis, "Secondary Benefits, External Economies and the Justification of Public Investment", Review of Economics and Statistics, 39 (August 1957), 284-91. This article is a penetrating analysis of secondary benefits in the light of economic theory.

See also J. E. Meade, "External Economies and Diseconomies in a Competitive Situation", Economic Journal, 62 (March 1952), 54-67, and Tibor Scitovsky, "Two Concepts of External Economies", Journal of Political Economy, 62 (April 1954), 143-51. Jacob Viner has made the distinction between "technological" and "pecuniary" spillovers in his famous article, "Cost Curves and Supply Curves", Zeitschrift fur Nationalokonomie, Vol. 3 (September 1931), 23-46, reprinted in K. E. Boulding and G. J. Stigler (eds.), Readings in Price Theory (Chicago: Richard D. Irwin, 1952), pp. 198-232. Compare A. O. Hirschman on backward and forward linkages, in his The Strategy of Economic Development (New Haven: Yale University Press, 1958), pp. 100-117.

The secondary benefits of this project can be assessed in terms of employment potential, foreign exchange savings, additional savings on wage and salary payments and government revenues. Perhaps the most important of these is in the creation of employment, and particularly where this is measured in terms of capital investment per worker. One of the main objectives of economic planning is to eradicate unemployment as quickly as possible as well as to "provide for a balanced emphasis on increase in production and employment and the attainment of economic equality and social justice".[30] To quote the Planning Commission,[31]

> A plan for economic development implies the utilization of available resources in a manner which would maximize the rate of growth of output. This is essentially a long-term task; so is any policy intended to ensure conditions of full employment. Over a sufficiently long period a policy of full employment does not conflict with that of stepping up the rate of development. It is now widely recognized that the problem of unemployment, especially in an under-developed country like ours, can only be solved after a period of intensive development.

Employment. Unemployment is an acute problem in India as a whole, and particularly in South India. According to the 1961 census, 14.14 per cent of the labour force in Kerala is unemployed. As of December 31, 1965, there were 142,000 applicants on the live register of the employment exchanges

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[30] Planning Commission, Third Five Year Plan: A Draft Outline (New Delhi, 1960), p. 2.

[31] Planning Commission, Second Five Year Plan (1956), p. 109.

in Kerala as against 141,000 a year before.[32] The unemployment situation must be much more serious than that indicated by these figures since only about 25 per cent of the unemployed persons are registered with the exchanges. Besides, there is considerable under-employment and disguised unemployment in the area. The 1961 census also shows that the working force formed only 33.31 per cent of the total population of Kerala whereas for the Indian Union as a whole it was 43 per cent. Kerala and West Bengal are at the bottom of the list among the 16 States in this respect; in other words, the lack of employment opportunity is the lowest in these two States.[33]

The percentage of cultivated area to cultivable area in the State of Kerala works out to 84.6.[34] Though the land-man ratio is low, there is still scope for creating additional employment in the agricultural sector. Rubber is an important primary product whose cultivation can be expanded both in the private and public sectors. Rubber plantations are considered to be labour intensive. The UPASI study of seven estates, mentioned earlier, shows that the ratio of workers per acre was .32 in 1958 and 1960 and .31 in 1961. The Report of the Productivity Centre gives the following figures of the average number of workers employed per acre for two plantations:[35]

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[32] Kerala 1965: An Economic Review (Trivandrum: Bureau of Economics and Statistics, 1966), pp. 12-13.

[33] As a political aside, it may be mentioned that these are the two States where the Communists were voted to power in the 1967 elections. The conclusion in obvious.

[34] Season and Crop Report for Kerala State, 1963-64, p. 11.

[35] "Report on Work Load and Related Aspects...", pp. 23, 27.

Estate	1959	1960	1961	1962	1963	1964
Mooply	.37	.35	.34	.36	.38	.40
Malankara	.38	.38	.38	.39	.39	.37

The Plantation Corporation of Kerala estimates that when its estates covering 15,000 acres come into full production, it will be able to give steady employment to 5,000 people - that is, at the rate of one worker for three acres.[36] It has been estimated that our hypothetical plantation of 5,000 acres will give direct employment to 1,635 persons and indirect employment to many others engaged in transportation, supply of estate materials and sale of rubber.[37] Through increased spending, more jobs will be created than those on the direct payroll; estimates of the size of this effect usually range from one to two new jobs created outside the project for every job inside the industry.[38]

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[36] K. C. Sankaranarayanan, "Plantation Corporation: Work and Achievements", Malayala Manorama Plantation Supplement, August 27, 1966. This includes 4,000 tappers and 1,000 other workers. Nanjundiah (op. cit.) estimated the total personnel at full maturity at 5,196.

[37] The employment potential as a secondary effect was formally analysed for the first time by R. F. Kahn when he presented his theory of the employment multiplier ("The Relation of Home Investment to Unemployment", Economic Journal, XLI, June 1931, 173-198). This theory was later amplified to deal with the income multiplier and is an important factor in Keynesian and post-Keynesian theories.

[38] Murray D. Bryce, Policies and Methods for Industrial Development (New York: McGraw-Hill, 1965), p. 272. In the final analysis, income effects have to be translated into terms of employment and unemployment, i.e., in terms of "employment multiplier". Above all, multiplier effects in "real" terms can occur only under conditions of less than full employment. In the present case, such conditions are found to prevail in actual fact. If in the absence of the project, certain resources would be unemployed, then the incomes of these (manpower) resources can be viewed as a gain due to the project.

It is found that the total investment (excluding the price of land) in the development of the plantation project to maturity (tapping stage) is Rs 17.625 million. The capital outlay per man for the employment of 1,635 persons during the production period of 30 years thus works out to Rs 10,780, based on expenditure during the development period. These data suggest that rubber plantations are relatively labour intensive and thus suited to India's developmental needs.[39]

Foreign Exchange. The secondary benefits can be seen in part in terms of import substitution as a tool in economic development, and the role of the rubber plantation industry in India in this context. According to Chenery's findings, the major source of growth in industrial production is import substitution in respect of intermediate and

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[39]The Fei-Ranis theory of economic development deals with the problems of an under-developed economy with unusually high unemployment. The central problem of such an economy, as they see it, is to transfer labour into productive employment faster than the population increases. They measure success primarily in terms of what happens to employment rather than to output. This approach leads to a policy favouring "labour using" technical changes. They contend that India's failure to give this policy adequate emphasis has aggravated its unemployment situation. See John C. H. Fei and Gustav Ranis, Development of the Labour Surplus Economy: Theory and Policy (Homewood, Illinois: R. D. Irwin, 1964).

Even though land is not capital, it is generally agreed that plantations expected to last for a number of years--rubber trees, oil palms and the like--constitute capital. Colin Clark opines that the growth of the plantation tree and bush crops--rubber, coconut, coffee and the like--although practised in low income countries, is nevertheless one of the most capital demanding forms of agriculture. The depreciated values of the capital, according to him, represent on the average about two years' output, and the value when newly planted about twice that amount. See Colin Clark, "Capital Requirements in Agriculture: An International Comparison", The Review of Income and Wealth, 13, No. 3 (September 1967), 205-22.

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capital goods.[40] Most developing economies are open, and they cannot avoid allowing for the openness of their investment decisions. The issue often is not whether to have import substitution or not, but what kind of import substitution to have. Import substitution means producing at home goods that were once imported, and economic development will occur only if investments produce profits over their life time (or at least avoid losses). Thus import substitution by itself is not an operational concept, but profitability is, even though profitability considerations are likely to lead to import substitution.[41]

Whether an agricultural project can actively assist general economic development depends on: (i) a rapid improvement in agricultural productivity to increase per capita income in agriculture and to furnish savings; (ii) a rapid increase of export earnings to provide foreign exchange (or alternatively, an increase of agricultural import substitution to reduce foreign exchange expenditure); and (iii) the effective use of increased income or saving and foreign exchange thus obtained for development. One difference between import substitution and export is that while products for import substitution may be above the world prices, export cost must be competitive

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[40] H. B. Chenery, "Patterns of Industrial Growth", American Economic Review, 50 (September 1960), 624-54. Chenery has called the question of import substitution "the most important and most difficult aspect of development programming". See his "Development Policies and Programmes", Economic Bulletin for Latin America (March 1958), 51-77.

[41] W. F. Stolper, Planning Without Facts: Lessons in Resource Allocation from Nigeria's Development (Cambridge, Massachusetts: Harvard University Press, 1966), p. 62.

in the world market. On the other hand, import substitution is possible only up to the point of satisfying the whole domestic demand for the product. Either way, the channeling of foreign exchange earnings for developmental imports is necessary.

Average annual imports of raw rubber into India cost more than ten crores of rupees worth of foreign exchange.[42] The value of imports of crude rubber, including reclaimed and synthetic rubber, was Rs 94,323,000 in 1961-62, Rs 100,085,000 in 1962-63 and Rs 88,134,000 in 1963-64.[43] With government investment in the rubber plantation project under evaluation, considerable saving in foreign exchange can be effected. This is estimated at some Rs 180 million during the economic life of the plantation at a price of around Rs 3,000 per ton on the total output of 135 million pounds of rubber. This works out to an average of Rs 4.8 million a year during the 37-year period, and may be considered good performance.

Additional Savings on Wages and Salaries. Many writers on economic development contend that savings are low in under-developed countries.[44]

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[42] Techno-economic Survey of Kerala, p. 233.

[43] Indian Agriculture in Brief (seventh edition; Delhi: Manager of Publications, 1966), p. 187.

[44] E.g., Benjamin Higgins, Economic Development (New York: W. W. Norton, 1959), pp. 11, 240; W. Arthur Lewis, The Theory of Economic Growth (London: George Allen & Unwin, 1957), pp. 227-29; Ragnar Nurkse, Problems of Capital Formation in Underdeveloped Countries (London: Basil Blackwell, 1957), pp. 65-70.

However, an exhaustive study by Panikar shows that rural families in India save a much larger proportion of their income in normal times than is ordinarily believed.[45] On the basis of family budget studies and national sample survey data, he estimates that there is a net (cash) saving-income ratio of at least eight per cent.[46] Taking the incidence of labour cost on total cost at 50 per cent, the total payments to workers and staff of the project will be Rs 58.8 million, and savings on wages and salary payments will thus be Rs 4.7 million at an annual average rate of Rs 1.27 lakhs.

Government Revenues. The net cash flow of Rs 152,375,000 over the 37-year period is a receipt to the government and should be regarded as a saving to the economy. These include the agricultural income tax (collected by the State Government) of Rs 500 per acre per year in Kerala and Rs 900 in Madras, assuming that the average yield per acre is 1,000 pounds per year, and the sale price is two rupees per pound of rubber. The excise duty of Rs 300 per metric ton, collected by the Central Government from the manufacturers, however, is returned to the Rubber Board to support re-planting and research in natural rubber.

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[45] P. G. K. Panikar, "Rural Savings in India", Economic Development and Cultural Change, X (October 1961), 64-85.

[46] Ibid., p. 84. However, the income elasticity of saving for urban households is much higher. Wheras for the rural sector, Milton Friedman's theory of 'permanent' or 'normal' income is somewhat substantiated, other factors like 'transitory' income, prices and assets appear to influence urban consumption behaviour. See Uma Datta Roy Choudhury, "Income, Consumption and Saving in Urban and Rural India", The Review of Income and Wealth, 14, No. 1 (March 1968), 37-56.

Regional Development and Income Redistribution. In general, it would seem plausible to argue that regional redistribution of income through direct transfers or governmental expenditures would have positive efficiency effects. There is widespread apprehension in India that in the course of planning, relatively more advanced States have progressed faster than the backward States; in other words, regional disparities have tended to be accentuated instead of being remedied. Kerala is often regarded as one of the States which have suffered in the process. In fact, Kerala is one of the poorer States in terms of per capita income, as is evident from Table XXII. The per capita income in the State was estimated at Rs 314.86 for 1960-61.

TABLE XXII

RANKING OF STATES ACCORDING TO PER CAPITA INCOME, 1960-61

Rank	State	Per capita income (Rs.)	Index (All-India=100)
1	Maharashtra	468.54	140.0
2	West Bengal	464.62	138.9
3	Punjab	451.31	134.9
4	Gujarat	393.39	117.6
	All India	334.54	100.0
5	Madras	334.09	99.9
6	Assam	333.34	99.6
7	Kerala	314.86	94.1
8	Mysore	304.71	91.1
9	Uttar Pradesh	297.35	88.9
10	Jammu & Kashmir	289.02	86.4
11	Andhra Pradesh	287.01	85.8
12	Madhya Pradesh	285.35	85.3
13	Orissa	276.22	82.6
14	Rajasthan	267.43	79.9
15	Bihar	220.69	66.0

Source: NCAER, Distribution of National Income by States,1960-61 (New Delhi: National Council of Applied Economic Research, 1965), p. 9.

This is lower than the all-India per capita income of Rs 334.54 despite the fact that the productivity of the working force of Kerala was higher than that of the working force of all-India by as much as 21.5 per cent in 1960-61 and that Kerala tops the list of States in regard to net value of agricultural output per acre and per worker.[47]

The highly unequal per capita incomes among the States imply a distance from equilibrium which is a necessary condition for the developmental types of external economies. The under-developed regions generally have a much lower capital to labour or capital to land ratio. The strategy for economic development in South India should therefore be to concentrate Government's attention on investments in large public sector projects, like the one envisaged in this study, locating them as far as possible in the industrially backward areas.[48]

The further development of the rubber plantation industry in South India will spur regional economic growth. The goal of regional economic

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[47]The index of net value of agricultural output per acre was 277.3 (all-India=100) and that of net agricultural output per worker 243.3. Vide NCAER, Agricultural Income by States, 1960-61 (Occasional Paper No. 7; New Delhi: 1963), pp. 31, 33.

[48]Since "balanced" regional development can hardly be assigned a generally valid price tag, it is an intangible. However, the desirability of balanced development is not being accepted uncritically. For a provocative examination of this question, see Marcus Fleming, "External Economies and the Doctrine of Balanced Growth", Economic Journal, 65 (June 1955), 241-56; and Dalip S. Swamy, "Statistical Evidence of Balanced and Unbalanced Growth", The Review of Economics and Statistics, 49 (August 1967), 288-303. But the majority of the people attach a positive value to something called "balanced development", especially in the "regional" sense.

growth is to increase the efficiency of factor allocation to provide for continuing growth and development. If productive factors are relatively immobile, then many of the techniques of the theory of international trade can be used in regional analysis. South India could specialize in producing those commodities in which there is the greatest comparative advantage, or the least comparative disadvantage. The entire value added to output by activities ancillary to a public project represents a contribution to regional development.

Income redistribution is often recognized as a policy goal in public investment planning and project selection. Planning and selecting projects on the basis of their impact on the distribution of income implies that there is a social welfare function capable of evaluating alternative distributions; and projects can be chosen which will add to social welfare by increasing aggregate income, by redistributing it, or by some combination of both.[49] Thus, also of significance are the effects of each project on the personal distribution of wealth (what group, if any, would be benefited if the project is adopted, and to what extent), and possibly on the regional distribution of wealth (to what extent would a region be developed, and to what region would resources otherwise have gone). Hence, it is deemed appropriate to have the

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[49]Myrick Freeman III, "Income Distribution and Planning for Public Investment", American Economic Review, 57 (June 1967), 495-508.

cost-benefit measurements shed light on efficiency in this limited sense of the redistributional effects.[50]

It is thus obvious that more public investment in the rubber plantation industry will augment the regional income of South India, and raise the per capita income in the area. The expenditure on such projects goes mainly to the unemployed resources. Benefits to the Government arise not only from increased tax receipts and income generated by the projects, but also from reduced transfer payments which result from employment of erstwhile idle manpower.

Multiplier Effect. At the aggregate levels of the government and the economy as a whole, it is necessary to consider the multiplier effects of gains in income attributable to a project when evaluating that project.[51]

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[50]The redistributional gains of projects ought to include the consumption afforded by the wages and profits from their construction and operation as well as from industries within the region that supply inputs to public enterprises.

[51]The multiplier concept as developed by R. H. Kahn (op. cit.) has become widely applied as a national income multiplier. In this form its central proposition is that under certain conditions, a change in expenditure in one part of the economy will have a multiplier effect on national income. The multiplier formula is $k = \frac{1}{1-mpc}$, where mpc = marginal propensity to consume. The formula shows that the larger the value of mpc, the larger the value of k. This follows because the larger the value of the mpc, the greater the proportion of income received which is passed on to create further income.

The expanded income of individuals represents the income of other subsets of individuals who form the aggregate. It is this interaction which has to be taken into account at aggregate levels.

In view of the high marginal propensity to consume in India, it can be assumed that the multiplier effects of the investment will be quite high. However, in the absence of any evidence on the appropriate multiplier value, a conservative value of two may be used to capture secondary and higher order "real" effects which can be expected to accrue at the aggregate level as a result of the project under conditions of not fully utilized resources. This value is customarily used when no induced investment is postulated.[52] We may conclude that the long-run multiplier effects to the Indian economy emanating from our hypothetical rubber plantation project will be at least of the order of about 170 million rupees, even if we take the shortest project life of 27 years.

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[52]U.S. Council of Economic Advisors, The Annual Report, 1964 (Washington: 1964) pp. 171-72. However, the possibility of pent-up consumption demand cannot be excluded, and in this light, a multiplier higher than two is plausible. It is felt that for purposes of the present exercise, it suffices to draw attention to the problem by using a multiplier of two. In other words, every rupee spent on a public investment project creates two rupees of national income.

Keynes first guessed at an income multiplier of 1.5 for the United Kingdom. In the United States, the short-run (one year or less) multiplier is nearly unity, as per the empirical studies of Goldberger and Suits. Generally speaking, for industrially developed countries, these multiplier values are modest in size and in line with econometric studies of Keynesian-type models. Since the marginal propensity to consume in an under-developed country like India is much higher than in developed countries, the parameter values and other structural characteristics will also be quantitatively different. See Lawrence R. Klein, The Keynesian Revolution (second edition; New York: The Macmillan Co., 1966), Chapters VIII and IX. However, the blind application of the multiplier theory to under-developed countries has been criticized by V. K. R. V. Rao, vide

Conservation and afforestation may be considered an intangible along with maintenance of economic and political order, strengthening of national security, and creating competition in the supply of an essential product, thus benefiting consumers. If preservation of specific values has virtue in itself, it probably must be treated as an intangible, which means that it is extremely difficult to quantify such benefits.

Essentially, what has been described above represents what may be termed a "partial equilibrium approach" to the problem of investment allocation. We have Alfred Kahn[53], Hollis Chenery[54], Jan Tinbergen[55], and the Sub-Committee on Benefits and Costs[56], who view the problem of public investment mainly as one of choosing from a number of alternative projects, each of the authors also attempting to define a measure of social productivity of investment in the alternative uses. The objective function, of course, is to maximize social welfare. It turns out, however, that "social welfare" is an inclusive concept (including factors other than the growth of the gross national product), and there is no uniform conception among the different

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his "Investment, Income and the Multiplier in an Under-developed Economy", Indian Economic Review, I (1952-53), 55-67.

[53]Alfred E. Kahn, "Investment Criteria in Development Programs", Quarterly Journal of Economics, 65 (February 1951), 38-61.

[54]Hollis B. Chenery, "The Application of Investment Criteria", Quarterly Journal of Economics, 67 (February 1953), 76-96.

[55]Jan Tinbergen, "The Relevance of Theoretical Criteria in the Selection of Investment Plans", in Investment Criteria and Economic Growth.

[56]"The Green Book".

writers as to what exactly it includes. The content of social productivity varies from merely gross national product in the case of Kahn to gross national product, employment, income distribution, balance of payments effecte etc. in the case of Chenery. It is clear from Chenery's discussion of the welfare function how the fundamental objective of rapid growth of the gross national product may be modified by the other subsidiary social objectives.[57]

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[57]For a discussion of this topic, see A. Vaidyanathan, "A Survey of the Literature on 'Investment Criteria' for the Development of Underdeveloped Countries", Indian Economic Journal, 4 (October 1956), 122-44.

CHAPTER VIII

POLICY IMPLICATIONS

The problem of growth and development is the central economic problem of our time, especially in the less developed countries of Asia, Africa and Latin America.[1] In many areas of the world, vast populations seek to transform their economies to resemble those of Western Europe and North America. This kind of economic development involves many aspects of culture and social organization.[2] One important aspect is the change from non-economic motivation. This follows a change from simple to complex forms of economic organization - from a subsistence or barter economy to a market

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[1]"Economic development" refers to the process by which an economy passes from a less advanced to a more advanced stage, and thus involves a structural change, whereas "economic growth" refers to a rising level of national output within a given stage, particularly the advanced one. Both are covered by a single definition - "the case of steadily increasing per capita income", but the primary source of the increase is different in the two cases. Obviously, the growth phenomenon is, for many countries, a blend of both elements, at least up to a point where the economy loses its capacity to adapt to changed circumstances.

[2]Charles P. Kindleberger, Economic Development (second edition; New York: McGraw-Hill Book Co., 1965), p. 3; Gardner Ackley, Macroeconomic Theory (New York: Macmillan Co., 1961), p. 506; Bert F. Hoselitz, "Non-economic Factors in Economic Development", American Economic Review, Papers and Proceedings, 47 (May 1957), 28-41, reprinted in B. Okun and R. W. Richardson (eds.), Studies in Economic Development (New York: Holt, Rinehart and Winston, 1961), pp. 337-48.

economy, using credit facilities and the capital market. The process involves the abandonment of primitive techniques of production and the adoption of more efficient techniques widely used elsewhere. There must also be the acquisition of new skills by the population in production, organization, communication and management. These and many other basic changes take place along with capital accumulation and technological change.

The elements of a theory of economic development can be discerned even in the writings of the early economists before Adam Smith. For example, both the Mercantilists and the Physiocrats gave attention to the sources of economic growth. It is interesting to note that while the Mercantilists regarded the non-agricultural sector as the strategic one, the Physiocrats assigned this role to agriculture. According to the Physiocrats, agriculture was the only part of the economy which provided a surplus, and it in turn provided the fundamental growth-generating factor in the economy as a whole.[3] Although the ideas of Smith, Richardo, Malthus, Marx, Keynes and the neo-classical economists are important in the evolution of the theories of economic growth and development, they did not reveal the full significance of the process.

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[3]Joseph J. Spengler, "Mercantilist and Physiocratic Growth Theory", in Bert F. Hoselitz (ed.), Theories of Economic Growth (New York: Free Press of Glencoe, 1960), pp. 3-64.

W. Arthur Lewis in his path-breaking article rediscovered the importance of agriculture in economic development.[4] He wrote:

> It is not profitable to produce a growing volume of manufactures unless agricultural production is growing simultaneously. This is also why industrial and agrarian revolutions always go together, and why economies in which agriculture is stagnant do not show industrial development.[5]

A number of well-known economists have, in recent years, given special attention to the relation between agriculture and economic development.[6] The concepts embodied in the second and third stages of W. W. Rostow's five stages of historical growth--the pre-takeoff stage and the takeoff stage--have also been particularly useful in understanding the role of agriculture.[7] In the takeoff stage, especially,

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[4] W. Arthur Lewis, "Economic Development with Unlimited Supplies of Labour", The Manchester School of Economic and Social Studies, XXII (May 1954), 139-92.

[5] Ibid., p. 173.

[6] Among those who have formulated agricultural growth models are N. Georgescu-Roegen, "Economic Theory and Agrarian Economics", Oxford Economic Papers, N.S., 12 (February 1960), 1-40, reprinted in Carl Eicher and Lawrence Witt (eds.), Agriculture in Economic Development, pp. 144-69; Dale W. Jorgenson, "The Development of a Dual Economy", The Economic Journal, 71 (June 1961), 309-34; Gustav Ranis and John C. H. Fei, "A Theory of Economic Development", American Economic Review, 51 (September 1961), 533-65, reprinted in Eicher and Witt, op. cit., pp. 181-94; Bruce F. Johnston and J. W. Mellor, "The Role of Agriculture in Economic Development", American Economic Review, 51 (September 1961), 566-93; T. W. Schultz, Transforming Traditional Agriculture; and W. H. Nicholls, "The Place of Agriculture in Economic Development", in Eicher and Witt (eds), op. cit., pp. 11-44.

[7] W. W. Rostow, The Stages of Economic Growth (Cambridge, England: University Press, 1960), pp. 8-24.

> new techniques spread in agriculture as well as in industry, as agriculture is commercialized, and increasing numbers of farmers are prepared to accept the new methods and the deep changes they bring to ways of life.[8]

Countries like India are entering this stage.

Agriculture's contribution will be of considerable importance in the current stage of India's economic development, where agriculture provides the largest part of national income.[9] Since agriculture is the largest industry in India, it must provide for the accumulation of capital out of agricultural savings. In other words, agricultural development is as important as industrial development.

The most obvious and essential contribution which agriculture can make to economic development is to provide the additional food requirements of the community as well as its needs for fibres and other raw materials of agricultural origin. Expanding the production of agricultural raw materials like natural rubber, however, is usually a less difficult problem than expanding the production of food. Raw materials are primarily cash crops, and their marketing is often better organized than that of food crops. There are few developing countries which could not benefit economically by more intensive efforts to meet from their own resources their growing requirements of food and agricultural raw materials.

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[8] Ibid., p. 8.

[9] Agriculture accounts for nearly one-half of India's national income.

Since labour is abundant and capital short, there is a clear case for choosing, ceteris paribus, industries and production techniques which are comparatively labour intensive. In densely populated countries like India, the marginal product of labour is low. Consequently, one of the key problems in the development process is the effective use of abundant labour in the context of the scarcity of capital. In agricultural production, combinations of improved labour intensive techniques can be developed that will result in much higher production per acre. Agricultural technology has to be developed to suit natural conditions; this limits the scope for borrowing technology from other countries.

The choice as between advanced and less advanced technology must no doubt be made in the light of the circumstances of a particular industry and of a social and economic appraisal of costs and benefits. Since there are discrepancies between private and social benefits or between private and social costs, the relevant concept in agriculture as elsewhere is the social marginal productivity of investment projects.[10] This concept, or the less sophisticated but often operational technique of estimating cost-benefit ratios, is reasonably serviceable in appraising large-scale investment projects in the agricultural sector.

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[10] Hollis B. Chenery, "The Application of Investment Criteria", op. cit.; Otto Eckstein, "Investment Criteria for Economic Development and the Theory of Intertemporal Welfare Economics", Quarterly Journal of Economics, 71 (February 1957), 56-85.

Importance of Feasibility Studies

Most of the developing countries have embarked on ambitious development programmes to bring themselves into the modern age. In the context of planned development, programming has the basic object of obtaining a wide perspective of the economic development of the country or of the area so as to establish co-ordinated production targets compatible with the stability of the system.[11] Programming is defined as rational, deliberate, consistent and co-ordinated economic policy to assure the maximum national income through time; for this purpose, it tries to optimize the composition of investment.[12]

One of the main problems of planning in the developing countries, however, is the lack of adequate statistical data and pre-investment surveys. Studies of individual projects lead to more definite information on natural resources, capital and labour requirements, location and other aspects of the creation of new productive units. Project evaluation may thus be defined as "the compilation of data which will enable an appraisal to be made of the economic advantages and disadvantages attendant upon the allocation of a country's resources to the production of specific goods and services".[13] These studies also help to define more clearly the lines of

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[11] U.N., Manual on Economic Development Projects, p. 4.

[12] P. N. Rosenstein-Rodan, "Programming in Theory and Italian Practice", Investment Criteria and Economic Growth, pp. 19-20.

[13] U.N., op. cit., p. xiii.

economic policy. Project appraisal, for example, provides the information needed to justify such decisions of economic policy as tariff protection, to convert them into specific terms, and to avoid indiscriminate or unjustified protection.[14]

Water projects (irrigation, flood control and hydro-electric schemes) and transport are the two areas where cost-benefit studies have been most common. These techniques have also been used in land-usage schemes (urban renewal, recreation and land reclamation), health, education (including labour re-training), research and development and defence. As would be expected, the literature for the developing world is not as large as in the United States and other industrial nations. The largest amount of work in India has dealt with the theoretical aspects of investment and water rate fixation as well as with specific irrigation projects.[15] Indian researchers have also been interested in the under-utilization of existing irrigation systems and the actual effects of irrigation projects.[16]

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[14] Ibid, p. 5.

[15] For example, the Sarada Canal system in Uttar Pradesh is analysed in NCAER, Criteria for Fixation of Water Rates and Selection of Irrigation Projects; the Chambal Valley project is discussed in O. P. Anand, "Some Aspects of Optimum Benefits from Utilization of Irrigation Potential of Chambal Valley Project", Indian Journal of Agricultural Economics, 15 (October-December 1960); the Hirakud Dam project in Sovani and Rath, op. cit., and K. K. Parashar, "Irrigation Criteria and the Role of Well-Irrigation in the Context of the Eastern Districts of Uttar Pradesh", Asian Economic Review, 3 (August 1961); the Damodar Canals in Basu and Mukherjee, op. cit.; and the Bhakra Nangal Project in Raj, op. cit.

[16] C. H. Shah, T. Shukla and T. K. Met, "Problems of Irrigation", Indian Journal of Agricultural Economics, 16 (October-December 1961);

The usual advantages of benefit-cost analysis are attendant on the study of rubber plantations in India. First, it enables more rational decision making by public agencies who do not operate on a "commercial" basis (i.e., where resource allocations are resolved through the pricing system). Second, it forces the planning authorities to quantify costs and benefits as far as possible rather than rest content with qualitative judgments or personal hunches.[17] The coefficient of internal rate of return or the expected earning on investment also is an appropriate guide to the Government in ranking projects and making public investment decisions.

This study indicates that returns to factors of production are favourable in terms of Indian conditions. Since there is much unemployed and underemployed labour in the country, and since natural rubber is an important agricultural product, the results of this study have definite policy implications for economic growth in the agricultural sector. However, the benefit-cost ratios of 1.384, 1.367 and 1.311, taken by themselves do not give much guidance to decision making. For an appropriate ranking of projects, there should be a number of similar economic feasibility studies on related projects. To quote Prest and Turvey,[18]

Agricultural Economics Research Centre, op. cit. Several studies have been made by the Economic and Statistical Organization of Chandigarh on the effects of the Bhakra Dam irrigation on the economy of the Barani villages in the Hissar district. See also D. Jha and S. Chandra, "Land Value as a Measure of Primary Irrigation Benefit in Tribeni Canal", Indian Journal of Agricultural Economics, 17 (July-September 1962) and K. S. Sonachalam, op. cit.

[17] Prest and Turvey, op. cit., p. 730.

[18] Ibid, pp. 730-31

> Even if cost-benefit analysis cannot give the right answers, it can sometimes play the purely negative role of screening projects and rejecting those answers which are obviously less promising...insistence on cost-benefit analysis can help in the rejection of inferior projects.

This analysis points clearly in the direction of public policy issues. One of the advantages of a cost-benefit study is that it has the "very valuable by-product of causing questions to be asked (e.g., the justification of existing pricing policy) which would otherwise not have been raised"[19] We may, for example, examine the rationale of continued tariff protection for the rubber plantation industry in India, as a related issue.

The Case for Free Trade

Since the rubber plantations are a sheltered industry, it is pertinent to ask whether the consumers have been paying too much for the natural product. The average price of natural rubber at selected foreign centres for the years 1956-60 are given in Table XXIII. The corresponding statutorily fixed prices in India are given in Table XII (Chapter V). It is seen that prices of first grade rubber in India at Rs 1.56 per pound were often higher than foreign quotations, especially at Colombo (Ceylon). The London and New York quotations are slightly inflated by the transportation charges from the South-east Asian producing areas. The devaluation of the Indian rupee

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[19] Ibid., p. 730.

TABLE XXIII

AVERAGE PRICES OF NATURAL RUBBER AT SELECTED FOREIGN CENTRES
(per lb. for R.S.S.1)

Year	London sh.d.	(Rs.P.)	New York U.S. cents	(Rs.P.)	Colombo Rupee cents	(Rs.P.)	Singapore Straits cents	(Rs.P.)
1956	2 4 19/32	(1.56)	34.17	(1.62)	147.7	(1.45)	96.76	(1.50)
1957	2 2 13/32	(1.44)	31.15	(1.48)	115.7	(1.16)	88.75	(1.38)
1958	1 11 1/2	(1.28)	28.07	(1.34)	93.5	(0.94)	80.25	(1.25)
1959	2 6 3/32	(1.66)	36.55	(1.74)	126.2	(1.26)	101.56	(1.59)
1960	2 8 5/32	(1.75)	38.16	(1.81)	123.7	(1.24)	108.08	(1.69)

Source: Rubber in India, 1956 to 1960, pp. 14-15. The figures in brackets are equivalent prices in Indian currency (Rupees and paise).

in 1966 was a temporary blessing to the plantation owners in India. As a result of the higher landed cost of imported rubber and the 27 1/2 per cent ad valorem duty, the purchaser of rubber from outside sources had to pay above Rs 4,000 per metric ton, which was higher than the minimum controlled prices in India.[20] However, the enhanced prices for indigenous rubber announced in 1967 bring prices of imported rubber (with the import levy) more or less on a par with the prices of natural rubber produced in India.

[20] "The Truth About Rubber Prices", Eastern Economist (September 8, 1967) pp. 434-35.

From the standpoint of the economy of a developing country, the most compelling argument for tariff protection is that this is a means to bring into production resources that would otherwise be idle or which would be used in less productive ways. Even if higher prices for the consumer and some reduction in quality result, it is argued, there is likely to be a net gain for the country.

Opposition to free trade based on the disparity between private and social costs is represented particularly by Manoilesco and Hagen.[21] This view holds that the existence of underemployment or disguised unemployment in one sector brings about a condition in which private cost on which the theory of comparative advantage rests, is unrepresentative of social costs. Accordingly, they recommend tariffs on imports to assist in the transfer of labour from unemployment in traditional agriculture to employment in (organized) industry. This argument rests on differing sets of factor proportions, in effect, a dual economy.[22]

However, an import substitution that requires permanent or long-term subsidies, directly or by means of tariffs or quantitative restrictions, is likely just to shift resources from relatively efficient to relatively inefficient uses. What is important is that tariffs and other import restrictions be consistent with optimizing the amount and allocation of scarce

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[21] M. Manoilesco, The Theory of Protection and International Trade (London: P. S. King, 1931); E. E. Hagen, "An Economic Justification of Protection", Quarterly Journal of Economics, 72 (November 1958), 496-514.

[22] C. P. Kindleberger, op. cit., p. 302.

resources, including foreign exchange. In cases where the industry is economically sound for the country--in normal operations it should be able to produce at costs fully competitive with similar plants in other countries--there is no argument against moderate temporary tariff protection during the infancy period. The great danger, however, is that infant industry protection is likely to become permanent or at least long-term as in the case of the rubber plantation industry in India.[23]

The development strategy that neglects economic payoff is likely to be self-defeating. Whether subsidies are given directly or indirectly through tariffs and tax benefits, they represent resources that might have been used elsewhere in the economy as investment or consumption. They are therefore justified only if they will either eventually spur growth or distribute income in a desirable manner. The economist must ask why an enterprise which possibly could be profitable needs subsidies. This will reveal current obstacles and suggest remedies. The country should therefore take the infant industry argument at its face value and establish protective tariffs only on a limited time basis.[24]

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[23]For a detailed discussion of the harmful effects of high tariff walls and prolonged protection, see M. D. Bryce, op. cit., pp. 228-251 and his Industrial Development: A Guide for Accelerating Economic Growth (New York: McGraw-Hill, 1960), pp. 80-85.

[24]The optimum tariff structure is one that will bring about the flow of goods and services which optimizes (in Pareto's sense) the nation's welfare; but the same tariff structure will also bring about the allocation of investment funds that is optimal from the national point of view. See J. de V. Graaf, "Optimum Tariff Structures", Review of Economic Studies, 17 (1949-50), 47-59.

Thus, in designing a comprehensive development programme in which incentives for investment play a part, the government must weigh the costs and benefits of the incentives. As long as the total amount of subsidies given, directly or indirectly, does not exceed the calculable benefits of the project to the economy, the subsidies can be justified on these grounds alone, without taking into account indirect and intangible benefits which it may be impossible to estimate.

The giving of subsidies to private industrial enterprises to make the projects sufficiently profitable to attract investment, is an attempt to narrow the gap between their "natural economic profitability" and their "commercial profitability". When, in fact, assistance is needed to get an industry started, however, it is better to give a direct and open subsidy for a specified period of time.[25] It will then be much easier to make the industry assume the responsibilities of adulthood. Lumpsum subsidies on overheads do not affect marginal costs and therefore do not distort the price structure and consumer choice, as import duties do. Theoretically, therefore the best policy still would be free trade, provided that income transfers take place and subsidies are accepted. In a country with significant structural unemployment, such a (lumpsum) subsidy may be equal to the difference between the market wage rate and the "accounting" rate.[26] A subsidy may

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[25] Jan Tinbergen, The Design of Development, p. 52.

[26] This argument has been developed by A. Qayum, Theory and Policy of Accounting Prices (Amsterdam: North-Holland Publishing Co., 1960).

also take the form of interest free capital for plantation or replantation, tax holiday and subsidized sale of fertilizers and planting materials.[27]

To sum up, the natural rubber industry has had the umbrella of tariff protection for over 20 years now, and there are few industries in India which need a period of price competition more than does plantation rubber. This is long overdue partly as a spur to efficiency, but also for classification of relative efficiencies in terms of long period supply of different classes of producers.

Free competition without any intervention would probably result in wide fluctuations in natural rubber in spite of the growing synthetic capacity. It may, however, be possible to reconcile price competition and a large measure of stability by means of a buffer stock or pool, while allowing for long period trends to work themselves out. There is no doubt about its practicability, provided pressure is resisted for prices higher than would be justified by long period equilibrium.[28] This buffer stock

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[27]The various forms of direct subsidy and financial assistance currently in force are: (i) subsidy of Rs 1,000 per acre for re-planting low yielding unselected rubber areas; (ii) new planting loan scheme of Rs 750 per acre (interest free) to enlarge uneconomic holdings to 15 acres; (iii) upkeep loan scheme of Rs 475 per acre (interest free) to small growers for maintenance of immature areas planted with high yielding materials; (iv) long-term loans of Rs 750 per acre (at 7 per cent interest) granted by the Land Mortgage Banks, limited to Rs 10,000 to any single planter; (v) Agricultural Refinance Corporation long-term facilities to rubber growers at Rs 1,600 per acre for individuals and Rs 2,100 for companies (at 8 per cent interest); (vi) other assistance to small growers in the form of plant protection measures and aid to construct smoke house-cum-processing facilities.

[28]Bauer, op. cit., p. 335.

could be operated by the Rubber Board, and imports could be channelled through the State Trading Corporation.

Simultaneously, unremitting efforts will be required to improve the quality and to reduce the supply price of natural rubber. The widest distribution of the results of research will have to be ensured, and high yielding material must be made available, since the answer to synthetic rubber and cheap natural rubber from abroad assuredly lies in quality plantation rubber at the lowest possible price. If the price of natural rubber were kept artificially high, this would intensify the search for better or cheaper stereo-rubbers, so that the present technological minimum demand for natural rubber would shrink. A resultant price decline would play havoc with an industry that had not reduced its production costs in time. In short, stimulation of productivity in rubber growing would have to be an essential policy objective for the Government of India as well as for the respective State Governments of Kerala, Madras and Mysore.

A massive effort is thus required to tone up productivity to high levels. Increased production and productivity should be top priority in all current schemes. In the public sector, a move has been made by the Kerala and Madras Governments in starting large scale plantations of their own in erstwhile forest areas. In South India, especially in Kerala, however, there is an obvious difficulty in implementing an extensive new plantation programme owing to the scarcity of land even though some of the forest areas, which constitute 26.45 per cent of the total area of the State, could be utilized for large scale cultivation. Even in the Malabar region of Kerala

where forest areas abound, opportunities are becoming more limited on account of the speed with which private forests are cleared for the cultivation of other commercial and food crops. It is opined that after five or six years there will hardly be any scope for extension of rubber cultivation in Kerala.[29]

However, there is immense scope for augmenting the production of natural rubber in the country by exploiting suitable lands in the Andamans and Nicobar Islands. Even though it is known that climatic conditions there are well suited for the successful growth and yield of rubber,[30] only token planting has taken place so far. The Working Group for the Fourth Five Year Plan has suggested that about one lakh acres of suitable land in Andamans and Nicobar Islands be brought under rubber cultivation during the Fourth Plan period.

The Rubber Board with the assistance of the State Governments has completed general surveys of areas suitable for rubber cultivation in Kerala, Madras, Mysore, Assam, Tripura, Maharashtra, Orissa, and Andamans and Nicobar Islands, where climatic and soil conditions are prima facie suitable for rubber cultivation. Taking a very conservative view, it is estimated that a suitable area of at least 200,000 acres may be available for future expansion of rubber cultivation in the country, thereby bringing the total area under rubber in India to more than 600,000 acres.[31]

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[29] K. C. Sankaranarayanan, op. cit.

[30] K. T. Jacob, op. cit., p. 8.

[31] Rubber Growers' Companion, pp. 82-83.

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APPENDIXES

APPENDIX A

THE ECOLOGY AND AGRONOMY OF NATURAL RUBBER

Rubber has been found in the latex of plants belonging to 79 families, 311 genera and over 895 species.[1] Among these only a few species have proved commercially feasible. The main botanical sources of the more important commercial rubbers are described below.[2]

1. Para rubber (Hevea Braziliensis) is a native of Brazil and Ecuador, where the Indians of Esmeraldas Province called it "hheve". It is a sturdy tree growing to a height of 30 to 60 feet and a girth of eight to ten feet. It thrives with wide tolerance on any moderately good, deep, loamy soil and is generally cultivated up to an elevation of 1,500 feet above sea level. A warm, humid, equable climate (85° to 100° F.) and an evenly distributed rainfall (70" to 120" or more) are necessary. The shiny, dark leaves about six inches long are three-lobed. Mature trees are deciduous, wintering in January or February in India and Ceylon. The fruits are three-seeded with a brown and black mottling, and when ripe explode with the noise of a shotgun, scattering the seeds to sixty feet away. The seeds contain an oily endosperm, but since the supply of seeds in India is only sufficient

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[1] Rubber Growers' Companion (Kottayam: Rubber Board, 1966), p. 1.

[2] H. P. Stevens and W. H. Stevens, Rubber: Production and Utilization of the Raw Product (London: Isaac Pitman & Sons, 1934), pp. 4-8, 29-38, and L. G. Polhamus, Rubber (London: Leonard Hill, 1962), pp. 31 ff.

for planting, oil is not extracted. Hevea rubber is known as Para from the port of original shipment in Brazil. Hevea is commercially the most important source of natural rubber and is grown extensively in the tropical plantations of Asia, Africa and Latin America.

2. Panama rubber (Castilloa Elastica), the Spanish name for which is Ule, is a native of Central America. It develops to a height of more than 15 feet, with a rather smooth light grey bark and large leaves. The castilla tree requires hot climate but alternating dry and wet seasons are preferable, and the soil should be deep loam. It thrives at low or medium elevations, and is tapped when eight to ten years old. From 1794 to 1850 this was the chief source of rubber, and was once extensively planted in Central America--Mexico, Panama, Costa Rica and the Honduras.

3. Ceara or manicoba rubber is obtained from manihot glaziovii, a tree of the spurge order. This tree grows rapidly to a medium height of 30 to 40 feet, and yields rubber early, say four to five years after planting, unlike in the case of Hevea, which starts to yield only after six to seven years. This rubber comes mainly from the arid province of Ceara in Brazil; hence the name. The latex coagulates rapidly without acid but the Ceara rubber is generally inferior to corresponding Para rubber. This was cultivated for rubber in the beginning of the century but was discarded later though it is still grown in parts of East Africa. In spite of considerable research, no method has so far been devised whereby the latex of Ceara can be induced to flow in a steady stream from the tree like Para

rubber; consequently, the small exudations, resulting from punctures of the bark with the knife, must be coagulated on the tree itself.

4. Rambang and Assam rubbers are derived from Ficus Elastica, a tree growing to enormous size in the jungles of Northern India. This plant which is commonly known as India-rubber, is propagated by cuttings and can be tapped only when 12 to 15 years old. The roots as well as the stem are tapped, and a large amount of the latex coagulates on the trunk, which is collected as scrap. India-rubber, however, has proved disappointing to planters, and has been completely replaced by Hevea in the plantations of South-east Asia.

5. Guayule rubber (Parthenium argentatum) is obtained from a shrub growing wild over large tracts of the arid bush prairies of Mexico to a height of two to three feet. The shrubs are harvested and worked upon in factories. This source of rubber became prominent during the boom periods. Initially, the extended planting of guayule in the southern parts of U.S.A. yielded a small quantity of rubber. The results of the project, however, fell short of expectations, and the programme was sharply curtailed after 1943.

6. Funtumia Elastica is a native of tropical Africa and occurs in Liberia, Ghana, Nigeria, the Cameroons, the Congo and Uganda. Lagos silk rubber is a product of this species.

7. Landolphia rubber is obtained from various species of a genus, popularly known as vine rubbers which are climbers, and are seen in Africa

and Madagascar. The so-called root rubber is also obtained from a species of Landolphia, i.e. Landolphia Henriquesiana.

8. Taraxacum kok-saghyz is the source of "Dandetion rubber". This is a perennial shrub yielding about 150 pounds of rubber per acre, and samll quantities of natural rubber were produced in the Soviet Union from kok-saghyz. Rubber is present in the latex tubes in the long tap roots. The plants are uprooted, dried, bleached with alkali, then ballmilled and the rubber washed from the debris and dried.

9. Pontinac rubber was once largely used in the continent of Europe for compounding with other rubber in the manufacture of cheap rubber goods. Today it is hardly used except for the manufacture of chewing gum.

Early History

The original home of the rubber tree was South America, where the native American Indians called the tree "cahuchu", which means the "weeping tree", from which the French caoutchouc was adopted as a synonym for rubber. The name "rubber" was given to the product by the English chemist Joseph Priestley, best known as the discoverer of oxygen, who in 1770 found it useful in "rubbing off" pencil marks from paper. In 1772 small rubber cubes were sold in London and Paris as erasers; this was the first practical use of rubber on a commercial scale.

Rubber was known to the natives of Central America as far back as the sixth century, as revealed by excavations.[3] According to some scientists,

[3]The story of natural rubber is told in the publications of the Malayan Rubber Fund Board, Kuala Lumpur. See for example, Story of Natural Rubber and

rubber was used by the Mayan civilization about A.D. 1050. Rubber relics have been found among the Mayan ruins in Yucatan and in Central America. Recent research points to the important role rubber once played in the three great civilizations of America that flourished before the Spanish explorers set foot in the New World. The Incas of Peru, the Mayans of Yucatan, and the Aztecs of Mexico used the rubber tree and its latex as a basic symbol in connection with religious ritual, the sacrificial customs, and in sorcery and witchcraft. However, European countries did not know about rubber at all during this period. For many centuries, there was no rubber in the "civilized" world.

The first written record of rubber is found in the accounts of Christopher Columbus's voyage to the Americas. After his second voyage (1493-96), Columbus took back with him some rubber balls used by the natives of the island of Haiti, and presented them to Queen Isabella as a novelty from the New World. Spanish explorers in Mexico saw the natives play games with a gumlike substance in 1519. The natives of South America also used rubber for clothing and religious ceremonies, and made shoes, waterjars and various other useful articles. During the succeeding colonization of South America the Spanish explorers became familiar with a more practical use of rubber, and in 1615 the Spanish troopers used garments crudely waterproofed by rubber latex.

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the People of the Plantations (n. d.). Also see Rubber: A Story of Romance and Science (New York: U.S. Rubber Co., 1960), Rubber (Akron: Firestone Tire & Rubber Co., 1963), and L. G. Polhamus, op. cit., pp. 16-30.

Of the world's major crops, rubber is the most recently exploited. The industry, a little more than 100 years old, has created a revolution in innumerable other industrial operations. Until late in the nineteenth century, rubber was obtained to a large extent from some of the wild trees growing in the Amazon Valley. The "wild rubber" was hard to collect from the vine-entangled forests. Sometimes it was found to be of poor quality, and usually the yield was small. As the demand for rubber increased, the collectors could charge exorbitant prices, especially after the discovery of vulcanization in 1839, which was the turning point in the rubber industry, and almost overnight changed the product from a plaything into a vital raw material for which many uses were found.

The Dutch were among the first to try taming, or cultivating, rubber in plantations. In 1861, several varieties of trees were planted in cleared areas in Java in the Netherlands East Indies; but the yield was small. Though in the beginning rubber was obtained from a variety of trees, one species was found most suitable, namely, Hevea Braziliensis, and by 1914, this rubber had ousted practically all others from the market. In 1876, Henry Wickham, an English forester, smuggled 70,000 Hevea seeds from Brazil at the instance of Lord Salisbury, the then Secretary of State for India, and sent them to Kew Gardens in London, where 2,700 seeds were successfully germinated. The seedlings were then introduced to South-east Asia. Ceylon, then a British colony, received the first consignment of 2,000 seedlings to start a rubber plantation in another hot tropical area far removed from the almost inaccessible jungles of Brazil. The cost of the experiment was borne

by the Government of India, but Ceylon was selected as having a more suitable climate, and the young seedlings were planted out in a special garden at Haneratgode in the hot and moist region of the island.

A few young trees were later sent from Colombo to Singapore, and from there to other parts of the British Federated Malay States. From such humble beginnings, the rubber plantations have now become one of the biggest enterprises in South-east Asia. Strangely enough, Brazil, the original home of rubber, now grows very little rubber but has instead become the world's chief coffee grower. Wickham was knighted for this notable achievement, and became known in history as the "Father of the Rubber Plantation Industry".

Cultivation in India

Rubber is grown on two soil types in India--the laterite soils and the red soils. Small pockets of alluvial and sandy loams in the vicinity of river banks and basins, however, are also planted with rubber. Among other things, adequate depth of soil, good aeration and moisture are quite essential for successful cultivation of Hevea. On the whole, the rubber growing soils of South India are lateritic and well drained. The nitrogen content is variable according to the location and ranges from fair to medium levels. These soils are invariably poor in phosphorus, potash and other bases. Most of the soils are acidic in reaction and the pH values range from 4 to 6. The soils are highly responsive to applied fertilizers when supplied with required nutrient elements. Therefore, it is essential that

rubber should be regularly manured from the time of planting at least till the age of economic production.

Most of the rubber plantations in India are situated in low hills and hillocks of varying heights. Flat lands can be worked for planting rubber but the extent of such areas suitable for planting rubber is limited. The operations for new planting consist of felling and clearing, contour terracing on slopes, laying of roads and pathways, provision of drainage facilities etc., followed by lining, marking and pitting.

The seedlings are raised in nurseries and planted when one or two years old. Normally budgrafting on seedling stocks is done when the stock is one year old or even two years old. The new technique of green budding, however, enables the budding of seedlings two to eight months old, thus reducing the maturity period.[4] On flat and slightly undulating areas square or rectangular planting can be adopted. Contour lining is done on undulating and hilly lands. The planting distances are generally selected so as to provide about 180 pits per acre in the case of buddings and 200 or more pits in the case of seedlings. Some of the common distances adopted are:

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[4]Green budding operations, involving the budding of seedlings at say, 12 weeks of age instead of the conventional 52 weeks, are thought to be able to reduce the period between planting and tapping by almost as much as the time of advancement of budding. The maximum gain has been from green budding with five-month old seedlings. These, compared with the growth of the conventional brown buddings made on one-year old seedlings have an advantage of some six months. The shorter period of immaturity means lower upkeep costs and earlier returns. See "Current Developments in Green Budding", Planters' Bulletin, No. 85 (July 1966), 86-89.

a) buddings in hilly areas	20'x 11' = 180 plants per acre
in flat areas	16'x 16' = 170 plants per acre
b) seedlings in hilly areas	20'x 10' = 218 plants per acre
	30'x 7' = 207 plants per acre
in flat areas	14'x 14' = 222 plants per acre
	15'x 15' = 193 plants per acre

Spacing of more than 30 feet between rows and less than eight feet between plants in the row is not generally favoured now. In deciding on the optimum planting density, the choice should be influenced by assumptions about future costs and prices, as well as by such considerations as yield per acre, quality of the soil, losses through disease and the possibilities and economies of future thinning out on a selective basis.

Fertilizer application to the young rubber tree during the period of the pre-tapping stage is recommended on the basis of an 8:10:12 NPK mixture since the bulk of the rubber growing soils are deficient in available phosphoric acid and potash. A dose of 910 gm. per planting point twice a year may be continued until the area is put under tapping. One of the major factors in the maintenance of soil structure and fertility under tropical conditions is the provision of adequate supplies of organic matter. A ground cover is thus essential for a rubber plantation. Apart from supplying organic matter, the ground cover prevents soil erosion, keeps down the soil temperature, and adds mulch and nutrition to the soil. It has been found that the establishment of creeping leguminous cover like pueraria javanica and centrocema pubescens has also helped to reduce the immature period of the rubber trees. Spraying against fungal diseases like abnormal leaf-fall and dusting operations

against powdery mildew are sometimes annual features, which for effective execution in large areas, call for proper planning and mobilization of equipments, men and material.

Tapping

Tapping or "controlled wounding" by which the latex is obtained from the bark of the tree, should penetrate to within one m.m. of the cambium. The evolution of the tapping system included the herring bone and its variants, the superimposed V cuts on a half circumference and the full spiral system. Tapping on alternate days has become the standard practice now. On the whole, the trend has been to reduce the severity of tapping and thus prolong the economic life of the tree.

The criterion for opening the tapping panel is a girth of 22" at a height of 20" in the case of the seedling tree, and 20" at a height of 50" (from the bud union) in the case of the budded tree. Normally, a plantation is opened for tapping only when at least 70 per cent of the trees have attained the minimum girth required. Tapping is done early in the morning as late tapping lessens the exudation of latex. The rate of bark consumption will depend partly on the skill of the tapper and is found to be comparatively less in India than in other countries. It is reported that the monthly consumption of bark in some estates is less than half an inch. The rate and extent of bark renewal are determined by a number of factors like the inherent genetic characteristics of the planting material, the fertility of the soil, climate, planting distance, the tapping system, and the incidence of diseases.

There is a standard international nomenclature for tapping systems. Alternate daily tapping on half circumference is equivalent to an average of a quarter cut tapped per day, and is taken as standard 100 per cent in estimating relative intensity; this is represented by s/2 d/2 100%. Relative intensity is expressed as a percentage of standard intensity for which it is necessary to multiply the product of the fractions by 400. On the standard system of s/2 d/2 100%, the product of the fraction is 1/2 x 1/2 = 1/4, and as this arbitrary standard system is taken as 100 per cent intensity, multiplication by 400 is required in each case to find relative intensity. Thus,

S/2 d/2--1/2 x 1/2 = 1/4 multiplied by 400 = 100%

S/1 d/4--1/1 x 1/4 = 1/4 multiplied by 400 = 100%

S/2 d/3--1/2 x 1/3 = 1/6 multiplied by 400 = 67%

The tapping system normally practised in India is half spiral alternative daily s/2 d/2 100%. In a number of small holdings, however, daily tapping s/2 d/1 is adopted, but this is harmful leading to brown bast and early deterioration of the trees. In the beginning it is advisable to adopt third daily tapping on seedling trees and then change over to alternate daily after two or three years. The recommended system for budded trees from the beginning is alternate daily tapping. The standard tapping cycle is approximately eight years so that the bark excised is not tapped for another eight years. Estates normally work to a bark consumption limited to three quarters of an inch on half circumference every month.

The yield or "wound response" will vary with the clone,[5] age of the tree, climate, fertility of the soil and the skill of the tapper. Rubber yields at its maximum from the fourteenth year onwards. When a tree is newly tapped, the dry rubber content (d.r.c.) will be very high and the total quantity of latex obtained low, but subsequent tapping will bring down the d.r.c. and the quantity of the latex will be on the increase. The period of leaf fall or "wintering" of the rubber trees is from December to March, when the food store is at its lowest. For practical reasons, however, a rest of more than a month or six weeks can seldom be given.

Tapping being an important activity in rubber estates, involving more than 50 per cent of the total labour input, certain general observations and comments may be made here. Tapping is the only piece-rate task in rubber estates. The present norm of 250 to 300 trees per tapper is accepted through a tripartite (i.e., government, management and labour) agreement. For assisted collection[6] and ladder tapping, the norms are different. But such practices are rare, and in such situations there is no tripartite agreement.

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[5] "Clone" is collective term referring to the vegetatively propagated plants from a single mother plant. All such offspring of a given mother tree are of identical genetic constitution. A seed when collected from a clone (budgrafted tree) is called a clonal seed. In practice clonal seeds are obtained from isolated monoclonal or specified polyclonal gardens. Clonal seedlings of Tjir developed in Malaysia have given satisfactory results. Good polyclonal seeds are available in Malaysia and Indonesia; such gardens are now being established in India.

[6] In assisted collection, the unskilled job of carrying latex to the factory by the tapper is sought to be eliminated by trucks picking up the pails of latex from selected points in the estate.

It appears that time-motion study and work simplification have not been seriously attempted in the rubber plantations in India. There is considerable scope for introducing time-motion study, preferably through a collaboration of industrial engineering and rubber plantation experts. Different tappers adopt variations in the methods of tapping and as much as 50 per cent variation in the time taken for tapping was noted in a sample study undertaken by the Productivity Centre of the Government of India.[7] The average time allowed for latex flow after tapping was about four and a half hours in respect of trees with which tapping was started whereas the latex flow time for trees at the end was only about an hour. Thus there is an uneven distribution of time for latex flow for different trees with the resultant variation in output between trees. Some estates are experimenting with assisted collection, thereby utilizing the time saved for tapping a larger number of trees.

Processing

The different constituents in the field latex vary with the botanical origin of the tree and other related factors. On an average, however, it is possible to say rubber constitutes about 30 to 40 per cent and water 55 to 60 per cent. As soon as the latex is received in the factory, it is sieved for the separation of foreign matter and the d.r.c. is determined by the use of the metrolac. Then the latex is diluted to a standard

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[7] "Report on Work Load and Related Aspects of Productivity in Plantations", p. 13.

consistency of 15 per cent d.r.c. and poured out into aluminum pans or tanks. The standard coagulant for rubber is formic acid, and 300 m.l. of 0.5 per cent formic acid is required for every four litres of latex for overnight coagulation. Strainers, tables, coagulating jars and dishes require careful attention, and the standard of cleanliness in a rubber factory should rival that of a Canadian dairy. The coagulum is removed on the following day, washed thoroughly with running water and sheeted out with a sheeting battery or smooth corrugated rollers. The wet sheets are allowed to drip on reapers kept in the well-ventillated dripping shed where sunlight should be avoided. After two or three hours of dripping, the sheets are transferred to a smoke house where the temperature should be maintained between 110° and 140°F. It has been observed that under normal conditions four days' smoking is sufficient for efficient drying of rubber, but sheets may be smoked for five to six days under humid conditions. The smoked sheets are then visually graded and packed to be sold to dealers and manufacturers.

The methods of preparation of pale latex crepe and estate brown crepe differ from those used for the manufacture of smoked sheet. In this case, the sheets are thin, and they are air-dried and never smoked. In the manufacture of pale latex crepe, the latex is subjected to fractional coagulation after sieving, by the addition of a small quantity of acetic acid, preferably with a dilute solution of RPA (305), a bleaching agent. The yellow colouring matter of the latex is removed with the initial coagulum. The latex is then subjected to complete coagulation, and the coagulated mass

is sheeted out in a very thin form. The air-dried sheets are pressed to get the sole crepe. If the colour is not absolutely white, they are graded as pale latex crepe. In the manufacture of estate brown crepe, the scrap rubbers (excepting the earth scrap) are immersed in water for 24 hours and then milled into crepe, air-dried and graded. In the case of the flat bark, even the earth scrap is used and subjected to the above manufacturing processes.

Natural rubber produced in the plantations in India is marketed in the sheet form under 22 grades whereas there are 31 grades in the International Standards. Rubber produced in most of the larger estates in India compares favourably with the International Standard grades. Only in the case of Estate Brown crepe are the International Standard grades far superior to the Indian counterparts.[8] A big problem concerns "standardization" of natural rubber. It is strange that in an age of progressive technical rationalization in industry, the quality assessment of natural rubber remains an art rather than a science. Only a Lewis Carroll or Stephen Leacock could do full justice to the illogicalities of the system. However, it is realistic to envisage greater simplicity with the recent move toward one International Code of grades.

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[8] Rubber Growers' Companion, p. 44.

Latex is generally marketed in its liquid form up to 60 per cent d.r.c. or even higher. Concentration of latex is carried out by evaporation, creaming and centrifugation. Since no chemical other than ammonia is added for centrifugation by the De Laval centrifuges, almost all the manufacturers who use rubber latex prefer this product. Latex is preserved with 0.7 per cent ammonia during transportation and storage. The cost of rubber in latex form is almost necessarily higher than that of sheet rubber, because the dry rubber content of natural latex is three and a half pounds per gallon, and the freight on the d.r.c. is much higher than the equivalent amount in the sheet form.

APPENDIX B

FINANCES OF RUBBER PLANTATION COMPANIES, 1960-66[1]

a. Profitability Ratios

Year	Gross Profits as % of Sales		Gross Profits as % of Capital Employed	
	Rubber Plantations	All Industries	Rubber Plantations	All Industries
1960-61	34.7	10.3	17.1	10.2
1961-62	29.7	10.1	14.1	10.1
1962-63	27.9	10.1	13.4	10.2
1963-64	31.7	10.2	14.4	10.7
1964-65	29.0	9.9	12.9	10.4
1965-66	32.6	9.4	14.3	9.9

[1]These tables in Appendix B are based on the series of articles entitled "Finances of Indian Joint Stock Companies", appearing in the Reserve Bank of India Bulletin (June 1963, July 1964, November 1965, November 1966 and December 1967). Data relate to 20 medium and large public limited companies covering about 75 per cent of the total paid-up capital in the company sector of the industry. "All industries" include 1333 companies with paid-up capital of over Rs. 5 lakhs each covering 70 per cent in terms of paid-up capital in the non-Government non-financial corporate sector. Figures shown against each year pertain to the accounting year ended during the period of 12 months commencing from July 1 of that year. Statistics relating to the earlier two series covering the periods 1950-51 to 1955-56 and 1955-56 to 1960-61, were published in the September 1957 and June 1962 issues respectively of the Bulletin.

APPENDIX B (Continued)

Year	Net Profits as % of Net Worth		Ordinary Dividends as % Ordinary Paid-up Capital	
	Rubber Plantations	All Industries	Rubber Plantations	All Industries
1960-61	10.5	11.0	13.0	12.0
1961-62	7.4	10.0	12.0	11.8
1962-63	8.0	8.7	12.4	10.8
1963-64	9.6	9.5	12.5	11.2
1964-65	8.9	9.3	13.2	11.3
1965-66	9.0	8.7	14.1	11.3

Year	Total Dividend as % Total Paid-up Capital		Dividends as % of Net Worth	
	Rubber Plantations	All Industries	Rubber Plantations	All Industries
1960-61	11.4	11.2	7.9	6.6
1961-62	10.6	11.0	7.0	6.4
1962-63	10.8	10.1	6.8	5.8
1963-64	10.9	10.5	6.9	5.8
1964-65	11.5	10.7	6.8	5.7
1965-66	12.1	10.6	6.7	5.6

APPENDIX B (Continued)

b. Profit Allocation Ratios

Year	Tax Provision as % Profits before Tax		Dividends as % of Profits before Tax	
	Rubber Plantations	All Industries	Rubber Plantations	All Industries
1960-61	50.8	38.6	37.2	36.9
1961-62	56.5	43.7	41.1	35.8
1962-63	49.4	52.3	43.7	31.6
1963-64	43.6	51.0	39.6	30.0
1964-65	43.8	50.5	43.1	30.4
1965-66	50.5	51.0	37.0	31.4

Year	Retained Profits as % Profits before Tax		Dividends as % Profits After Tax	
	Rubber Plantations	All Industries	Rubber Plantations	All Industries
1960-61	12.0	24.5	75.5	60.4
1961-62	2.4	20.5	94.4	63.6
1962-63	6.9	16.1	86.3	66.2
1963-64	16.8	19.0	70.2	61.3
1964-65	13.1	19.0	76.6	61.5
1965-66	12.5	17.6	74.8	64.1

APPENDIX B (Continued)

Year	Profits Retained as % of Profits after Tax Rubber Plantations	All Industries
1960-61	24.5	39.9
1961-62	5.6	36.4
1962-63	13.7	33.8
1963-64	29.8	38.7
1964-65	23.4	38.5
1965-66	25.2	35.9

c. Capital Formation Rates (Per cent per annum)

Year	Gross fixed assets formation	Net fixed assets formation	Inventory Accumulation	Gross capital formation	Net capital formation
1961-62	1.1	- 0.9	- 12.3	- 0.1	- 2.1
1962-63	2.5	3.4	21.6	4.0	5.1
1963-64	4.8	3.9	- 1.5	4.2	3.3
1964-65	2.8	2.4	- 25.9	0.3	- 0.5
1965-66	3.9	3.2	38.2	6.1	5.9

APPENDIX C

FINANCIAL ANALYSIS OF TEN RUBBER PLANTATION COMPANIES, 1950-63[1]

Year	Area (in acres)				Production		Yield per acre	
	Mature rubber	Index	Total	Index	lbs	Index	lbs	Index
1950	14,577	100.0	17,357	100.0	5,701,463	100.0	391.1	100.0
1952	15,226	104.4	18,465	106.4	6,749,810	118.4	443.3	113.3
1953	15,127	103.8	18,622	107.3	6,410,820	112.4	423.8	108.4
1954	15,116	103.7	18,526	106.7	6,424,916	112.7	425.0	108.7
1955	16,166	110.9	20,356	117.3	6,979,214	122.4	431.7	110.4
1956	17,321	118.8	21,835	125.8	7,333,578	128.6	423.4	108.3
1957	17,305	118.7	22,052	127.0	7,291,147	127.9	421.3	107.7
1958	16,279	111.7	21,042	121.2	7,495,825	131.5	460.4	117.7
1959	16,302	111.8	21,035	121.2	7,688,350	134.8	471.6	120.6
1960	16,453	112.9	21,173	122.0	8,816,214	154.6	535.8	137.0
1961	16,038	110.0	20,666	119.1	8,516,840	149.4	531.0	135.8
1962	15,553	106.0	20,825	120.0	8,753,314	153.5	566.4	144.8
1963	14,996	102.9	20,993	120.5	9,300,026	163.1	620.2	158.6

[1]Based on a study made by the United Planters' Association of Southern India, Coonoor. These ten plantations are medium or large companies of considerable vintage.

APPENDIX C (Continued)

Year	Fixed Assets[a]		Current Assets		Current Liabilities	
	Rs	Index	Rs	Index	Rs	Index
1950	1,20,48,645	100.0	40,69,950	100.0	6,67,431	100.0
1952	1,33,47,302	110.8	64,35,342	158.1	7,25,503	108.7
1953	1,37,78,455	114.3	65,91,185	161.9	8,21,182	123.0
1954	1,49,44,803	124.0	61,77,368	151.8	7,86,454	117.8
1955	1,65,03,477	137.0	70,04,843	172.1	9,23,797	138.4
1956	1,83,53,772	152.3	68,05,349	167.2	9,81,290	147.0
1957	1,90,07,174	157.8	73,44,487	180.4	13,48,792	202.1
1958	1,87,83,989	156.0	72,12,440	177.2	12,23,639	183.3
1959	1,90,40,879	158.0	64,40,891	158.2	16,22,295	243.1
1960	1,93,59,334	160.7	74,22,400	182.4	14,39,697	215.7
1961	2,02,44,363	168.0	83,19,629	204.4	9,89,357	148.2
1962	2,11,35,141	175.4	76,92,754	189.0	11,38,323	170.6
1963	2,14,68,995	178.2	83,39,384	204.9	12,55,432	188.1

[a]Land, buildings, plant and machinery less accumulated depreciation except on land.

APPENDIX C (Continued)

Year	Paid-up Capital		Working Capital[b]		Net Worth		Capital Employed	
	Rs	Index	Rs	Index	Rs	Index	Rs	Index
1950	99,33,366	100.0	32,02,519	100.0	1,35,87,686	100.0	1,59,83,788	100.0
1952	1,06,51,041	107.2	57,09,839	167.8	1,59,93,140	117.7	1,99,90,344	125.0
1953	1,05,76,041	106.5	57,70,003	169.6	1,67,85,509	123.5	2,09,47,699	131.0
1954	1,13,31,141	114.1	53,90,914	158.4	1,74,72,638	128.6	2,12,51,804	133.0
1955	1,13,31,141	114.1	60,81,046	178.7	1,84,00,099	135.4	2,36,09,137	147.7
1956	1,28,86,241	129.7	58,24,059	171.1	1,97,30,938	145.2	2,54,28,404	159.1
1957	1,42,33,334	143.3	59,95,695	176.2	1,97,43,046	145.3	2,64,49,592	165.5
1958	1,44,84,764	145.8	59,88,801	176.0	2,02,25,691	148.9	2,64,44,904	165.4
1959	1,44,84,764	145.8	48,18,596	141.6	2,00,77,515	147.8	2,59,01,195	162.0
1960	1,44,84,764	145.8	59,82,703	175.8	2,07,35,186	152.6	2,75,84,880	172.6
1961	1,48,59,764	149.6	73,30,272	215.4	2,25,59,632	166.0	2,99,26,276	187.2
1962	1,48,59,764	149.6	65,54,431	192.6	2,34,80,327	172.8	3,02,48,449	189.2
1963	1,48,59,764	149.6	70,83,952	208.2	2,45,64,230	180.8	3,13,36,266	196.0

[b]Current assets minus current liabilities and provisions; normally accepted as the aggregate expenditure for a certain period (four months in the case of rubber plantations).

APPENDIX C (Continued)

Year	Sales		Profits before Tax		Taxation		Net Profits[c]	
	Rs	Index	Rs	Index	Rs	Index	Rs	Index
1950	56,69,171	100.0	20,95,149	100.0	4,33,301	100.0	16,61,848	100.0
1952	92,52,650	163.2	39,82,434	190.1	9,47,773	218.7	30,34,661	182.6
1953	88,59,071	156.3	34,87,802	166.5	9,49,615	219.2	25,38,187	152.7
1954	94,22,001	166.2	37,27,910	177.9	13,79,155	318.3	23,48,755	141.3
1955	1,11,47,657	196.6	49,23,712	235.0	18,41,567	425.0	30,82,145	185.5
1956	1,21,52,040	214.4	43,58,188	208.0	19,76,290	456.1	23,81,895	143.3
1957	1,31,62,702	232.2	38,42,329	183.4	19,89,755	459.2	18,52,574	111.5
1958	1,40,15,395	247.2	45,31,887	216.3	22,08,852	509.8	23,23,035	139.8
1959	1,37,29,015	242.2	41,36,667	197.4	23,67,978	546.5	17,68,689	105.4
1960	1,62,88,277	287.3	53,61,327	255.9	28,34,613	654.2	25,26,714	152.0
1961	1,73,06,613	305.3	48,31,195	230.6	25,54,614	589.6	22,76,581	137.0
1962	1,84,02,589	324.6	43,61,462	208.2	18,53,618	427.8	25,07,844	150.9
1963	1,73,91,998	306.8	49,68,976	237.2	21,81,200	503.4	27,87,776	167.8

[c]Profits after tax.

APPENDIX C (Continued)

Year	Dividend Paid		Retained Profits	
	Rs	Index	Rs	Index
1950	10,44,075	100.0	6,17,773	100.0
1952	18,08,444	173.2	12,26,217	198.5
1953	17,11,480	163.9	8,26,707	133.8
1954	16,63,984	159.4	6,84,771	110.8
1955	19,96,873	191.2	10,85,272	175.7
1956	16,85,950	161.5	6,96,948	112.7
1957	16,35,517	156.6	2,17,057	35.1
1958	16,60,567	159.0	6,62,468	107.2
1959	15,47,180	148.2	2,21,509	35.9
1960	17,23,420	165.1	8,03,294	130.0
1961	20,27,258	194.2	2,49,323	40.4
1962	19,46,870	186.5	5,60,974	90.8
1963	20,16,245	193.1	7,71,531	124.9

APPENDIX C (Continued)

Year	Gross Profits as Percentage of				Net Profits as Percentage of			
	Sales	Paid-up Capital	Net Worth	Capital Employed	Sales	Paid-up Capital	Net Worth	Capital Employed
1950	37.0	21.1	15.4	13.1	29.3	16.7	12.2	10.4
1951	45.6	35.4	23.6	19.0	32.9	25.6	17.0	13.7
1952	43.0	37.4	24.9	19.9	32.8	28.5	19.0	15.2
1953	39.4	33.0	20.8	16.7	28.7	24.0	15.1	12.1
1954	39.6	32.9	21.3	17.5	24.9	20.7	13.4	11.1
1955	44.2	43.5	26.8	20.9	27.6	27.2	16.8	13.1
1956	35.9	33.8	22.1	17.1	19.6	18.5	12.1	9.4
1957	29.2	27.0	19.5	14.5	14.1	13.0	9.4	7.0
1958	32.3	31.3	22.4	17.5	16.6	16.0	11.5	9.0
1959	30.1	28.6	20.6	16.0	12.9	12.2	8.8	6.8
1960	32.9	37.0	25.8	19.4	15.5	17.4	12.2	9.2
1961	27.9	32.5	21.4	16.1	13.2	15.3	10.1	7.6
1962	23.7	29.4	18.6	14.4	13.6	16.9	10.7	8.3
1963	28.6	33.4	20.2	15.9	16.0	18.8	11.3	8.9

APPENDIX C (Continued)

Year	Dividend as Percentage of Sales	Dividend as Percentage of Paid-up Capital	Dividend as Percentage of Net Worth	Dividend as Percentage of Capital Employed	Dividend as Percentage of Profits before tax	Dividend as Percentage of Net Profits	Taxation as Percentage of Profits before tax
1950	18.4	10.5	7.7	6.5	49.8	62.8	20.7
1951	19.2	14.9	10.0	8.0	42.2	58.4	27.8
1952	19.5	17.0	11.3	9.0	45.4	59.6	23.8
1953	19.3	16.2	10.2	8.2	49.1	67.4	27.2
1954	17.7	14.7	9.5	7.8	41.1	70.8	37.0
1955	17.9	17.6	10.9	8.4	40.5	64.8	37.4
1956	14.4	13.5	8.8	6.6	38.7	70.8	45.3
1957	12.4	11.5	8.3	6.2	42.6	88.3	51.8
1958	11.8	11.5	8.2	6.4	36.6	71.5	48.7
1959	11.3	10.7	7.7	6.0	37.4	87.5	57.2
1960	9.4	10.5	7.3	6.2	32.1	68.2	52.9
1961	11.7	13.6	9.0	6.8	42.0	89.0	52.9
1962	10.6	13.1	8.3	6.4	44.6	77.6	42.5
1963	11.6	13.5	8.2	6.4	40.5	72.3	43.9

APPENDIX C (Continued)

Year	Fixed Assets Per Acre		Current Assets Per Acre		Current Liabilities Per Acre	
	Rs	Index	Rs	Index	Rs	Index
1950	694.15	100.0	234.48	100.0	38.45	100.0
1951	697.18	100.4	312.41	133.2	37.14	96.6
1952	722.85	104.1	348.52	148.6	39.29	102.2
1953	739.92	106.6	353.95	158.0	44.10	114.7
1954	806.71	116.2	333.44	142.2	42.45	110.4
1955	810.75	116.8	344.12	146.6	45.38	118.0
1956	840.58	121.1	311.68	132.9	44.94	116.9
1957	861.94	124.2	333.06	142.0	61.17	159.1
1958	863.17	124.3	342.77	146.2	58.15	151.2
1959	905.19	130.4	306.19	130.6	77.12	200.6
1960	914.33	131.7	350.56	149.5	63.00	176.9
1961	979.61	141.1	402.58	171.7	47.87	124.5
1962	1,014.88	146.2	369.39	157.3	54.66	142.1
1963	1,026.11	147.8	398.58	170.0	60.00	156.0

APPENDIX C (Continued)

Year	Paid-up Capital Per Acre		Working Capital Per Acre		Net Worth Per Acre	
	Rs	Index	Rs	Index	Rs	Index
1950	572.29	100.0	196.03	100.0	782.82	100.0
1951	532.19	93.0	275.27	140.4	798.60	102.0
1952	576.83	100.8	309.23	157.7	866.15	110.6
1953	567.95	99.2	309.86	158.1	901.40	115.1
1954	611.64	106.9	291.00	148.4	943.16	120.5
1955	556.65	97.3	298.74	152.4	903.93	115.5
1956	590.17	103.1	266.74	136.1	903.65	115.4
1957	645.45	112.8	271.89	138.7	895.31	114.4
1958	688.38	120.3	284.61	145.2	961.22	122.8
1959	688.60	120.3	229.07	116.9	954.47	121.9
1960	684.11	119.5	282.56	144.1	979.32	125.1
1961	719.06	125.6	354.71	180.9	1,091.65	139.5
1962	713.55	124.7	314.74	160.6	1,127.50	144.0
1963	710.22	124.1	338.58	172.7	1,174.05	150.0

APPENDIX C (Continued)

Year	Capital Employed Per Acre		Sales Per Acre		Profits Before Taxation Per Acre	
	Rs	Index	Rs	Index	Rs	Index
1950	920.86	100.0	326.61	100.0	120.70	100.0
1951	992.55	107.8	413.35	126.6	188.56	156.2
1952	1,082.62	117.6	501.10	153.4	215.68	178.7
1953	1,124.91	122.2	475.74	145.7	187.30	155.2
1954	1,147.15	124.6	508.59	155.7	201.23	166.7
1955	1,159.82	125.9	547.64	167.7	241.88	200.4
1956	1,164.59	126.5	556.55	170.4	199.60	165.4
1957	1,199.43	130.2	596.91	182.8	174.24	144.3
1958	1,226.78	133.2	666.07	203.9	215.38	178.4
1959	1,231.33	133.7	652.67	199.8	196.65	162.9
1960	1,302.82	141.5	769.29	235.5	253.21	209.8
1961	1,448.11	157.2	837.46	256.4	233.78	193.7
1962	1,452.48	157.7	883.67	270.6	209.43	173.5
1963	1,497.72	162.6	831.25	254.5	237.49	196.8

APPENDIX C (Concluded)

Year	Taxation Per Acre		Net Profit Per Acre		Dividend Per Acre		Retained Profits Per Acre	
	Rs	Index	Rs	Index	Rs	Index	Rs	Index
1950	24.96	100.0	95.74	100.0	60.15	100.0	35.59	100.0
1951	52.51	210.4	136.05	142.1	79.51	132.2	56.54	158.9
1952	51.33	205.6	164.35	171.7	97.94	162.8	66.41	186.6
1953	51.00	204.3	136.30	142.4	91.91	152.8	44.39	124.7
1954	74.44	298.2	126.79	132.4	89.82	149.3	36.97	103.9
1955	90.47	362.5	151.41	158.1	98.10	163.1	53.31	149.8
1956	90.51	362.6	109.09	113.9	77.21	128.4	31.88	89.6
1957	90.23	361.5	84.01	87.7	74.17	123.3	9.84	27.6
1958	104.97	420.6	110.41	115.3	78.92	131.2	31.49	88.5
1959	112.57	451.0	84.08	87.8	73.65	122.3	10.53	29.6
1960	133.88	536.4	119.33	124.6	81.40	135.3	37.93	106.6
1961	123.62	495.3	110.16	115.0	98.10	163.1	12.06	33.9
1962	89.00	356.6	120.43	125.8	93.49	155.4	26.94	75.7
1963	104.25	417.7	133.24	139.2	96.37	160.2	36.87	103.6

APPENDIX D

ESTATES SURVEYED

1. Estates managed by the Plantation Corporation of Kerala Limited, a public sector undertaking of the Kerala State.

Kaladi group	acres
Adirapally	4,389
Kallala	3,393
Vettilapara	484
Kodumon group	
Kodumon	2,685
Chandanapally	4,047
Total	14,998
Authorized capital:	Rs. 7.50 crores
Paid-up capital:	Rs. 2.05 crores (in 1965)

2. Vaikundam Rubber Co., a public limited company. Estate situated in the Kanyakumari district of Madras State.

	acres
Rubber	1,143.30
Coconut	1.02
Other land	173.78
Total	1,318.10 (in 1964)
Paid-up Capital:	Rs. 8,80,010
Net worth:	Rs. 19,43,503

APPENDIX D (Continued)

3. Cheruvally Estate in Kerala, a member estate of Malayalam Plantations, a sterling public limited company, managed by Harrisons & Crosfield, Ltd., London.

	acres	
Rubber	1,403	
Tea	738	
Other land	127	
Total	2,268	(in 1966)

4. Greenham Estate, in Kanyakumari district of Madras State, a proprietary plantation, covering an area of 294 acres in 1966.

5. Other estates, who prefer to remain anonymous.