PAPER INDUSTRY IN KERALA

AN EVALUATION OF LABOUR ABSORPTION, CAPACITY UTILISATION AND ENVIRONMENTAL POLLUTION

Thesis submitted

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C E R T I F I C A T E

This is to certify that the thesis "Paper Industry in Kerala: An Evaluation of Labour Absorption, Capacity Utilisation and Environmental Pollution" is a bonafide record of research work done by Shri. Sunny George under my supervision and guidance. The thesis is worth submitting for the award of the degree of Doctor of Philosophy in Economics.

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Cochin 22,
15-11-1990.

D E C L A R A T I O N

I declare that this thesis is the record of bonafide research carried out by me under the supervision of Dr. Mary Joseph T., Faculty Member, School of Management Studies, Cochin University of Science and Technology. I further declare that this has not previously formed the basis of the award of any degree, diploma, associateship, fellowship or other similar title of recognition.

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C O N T E N T S

LIST OF TABLES

LIST OF FIGURES

Chapter I

INTRODUCTION

Pulp and paper constitutes one of the most important segments of India's industrial economy. The demand for paper pervades all sectors of activity, from newspaper to bulletins and transcends the computer and nuclear domains. Its performance is crucial to the economy to the extent that the growth of the service sector has been crucially dependent on the supplies of printing and writing papers and also the newsprint in order to meet the requirements in sectors like education, communication, trade and commerce, banking and insurance, public administration etc. The industrial sector also requires paper for packaging and other communication requirements. At present most of the demand for newsprint in India is met by imports. In the case of other varieties there has been temporary shortages. With the ever increasing need of spreading ideas and knowledge and industrial development, the demand for paper is likely to go up in the years to come.

Paper industry has a special significance in the country for the educational, cultural and economic development of the people. Per capita consumption of paper is recognised as a parameter

reflecting the general economic prosperity of any country. The current per capita consumption in India is one of the lowest in the world, a meagre 9.5 kg. compared to 140 kg. in U.K., 190 kg. in Japan, 250 kg. in Sweden and 300 kg. in the U.S.A. The reasons for this are generally low economic standards, illiteracy, high cost of imported paper and limited supply within the country.

The world production of paper and paper board in 1982 was about 170 million tonnes, and output was expanding rather steadily at an average rate of about 4 per cent annually over the past two decades. More than 85 per cent of both production and consumption at present is in the industrialised countries but rates of growth are higher in developing countries.

Since the beginning of planning in 1951, the paper industry in India has been making great progress. The output of paper and paper board increased from 135,000 tonnes in 1951 to 1,232,000 tonnes in 1981: a growth of over 800 per cent over the period.[1] The number of paper mills increased from 17 in 1951 with an annual installed capcity of 137,000 tonnes to 220 units in 1984 with an annual installed capacity of 2,165,000 tonnes.

The Development Council for Paper forecast the demand for paper and paper board at 2.218 million tonnes for 1994-95 and 3.12

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[1]Thirath Gupta and Nitin Shah (1987), Paper and Paper Boards in India: Demand Forecasts and Policy Implications, Oxford and IBH Publishing Co., New Delhi, p.5.

million tonnes for A.D. 2000. The annual compound rate of growth in consumption of newsprint between 1984-85 and A.D. 1999-2000 works out to be 6.1 per cent. The consumption of newsprint in A.D. 2000 is expected to be 945,000 tonnes.[2] Although the country is self-sufficient in respect of most varieties of paper and paper board, about 42 per cent of the domestic demand for newsprint is met by imports. There is an urgent need to increase production of newsprint to cater to the increasing demand in years to come and to reduce the import bill substantially.

Statement of the Problem

Paper industry is one of the oldest and largest industries in Kerala. Despite the developments in the industry in terms of growth in output , value added and employment generation, many of the units face grave problems. Irrespective of the size of the plant, the problems of the industry are general in nature. The problems are galore in the supply, not the demand side. Amomg the problems, the important ones are: raw material scarcity, energy deficiency and obsolete technology. Further, the industry is subject to many controls by the Government - price control, product control and raw materials control - which result in the dwindling of profits and investments. Equally important are the reservations against the industry for polluting the environment by

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[2]The Economic Times (1990), Data Bank 1989, The Economic Times, p.120.

effluent disposal on the one hand and affecting ecological balance by depleting the existing forest on the other.

Apart from the large, medium and small pulp and paper mills, there are about 30 hand made paper units in Kerala which can be categorised as village and cottage industry. Almost all of these units began at the initiative and support of Khadi and Village Industries Commission. The primary purpose of these units is employment generation, and not profit making. Currently many of these units are in the red and many others are on the verge of closure. Therefore, a separate analysis of the growth performance, and problems and prospects of the hand made paper industry has also been attempted. It is analysed separately because of the very small size of the hand made paper units.

Significance of the Study

The role of industrialisation in economic development is well established.[3] The importance of industrialisation as a means of

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[3]According to Kaldor, "it is the rate of growth of manufacturing production (together with ancilliary activities of public utilities and construction) which is likely to excert a dominating influence on the over-all rate of economic growth, partly on account of its influence on the rate of growth of productivity in the industrial sector itself and partly also because it will tend, indirectly, to raise the rate of productivity growth in other sectors... And of course it is true more generally that industrialisation accelerates the rate of technological change throughout the economy." Nicholas Kaldor (1966), Causes of Slow rate of Economic Growth of United Kingdom, Cambridge University Press, London, p.18.

achieving rapid growth and prosperity has long been recognised in the thinking on development strategy for India, even before the launching of the formal process of economic planning in the country.[4] Kerala is an industrially backward state compared to other states in India. Almost all studies on the manufacturing sector of Kerala endorse the industrial stagnation in the State.[5] Through industrialisation Kerala hopes to solve, to some extent, its grave problems of unemployment and poverty.

Though there are a number of industry-specific studies highlighting the problems and prospects of the industries, and industrial sector as a whole, comparative study of a particular industry with that of its counterparts which is of crucial importance from the point of view of policy perspective, is seldom found. Therefore, the present study is an attempt in this line analysing the performance of pulp and paper industry in comparison with other industries in terms of productivity and capacity

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[4]Isher Judge Ahluwalia (1985), Industrial Growth in India: Stagnation Since Mid-Sixties, Oxford University Press, Bombay, p.1.

[5]See 1. K. K. Subrahmanian and P. Mohanan Pillai (1986), "Kerala's Industrial Backwardness: Exploration of Alternative Hypothesis", Economic and Political Weekly, Vol.XXI, No.14, pp.577-592.

2. K. K. Subrahmanian (1990), "Development Paradox in Kerala: An Analysis of Industrial Stagnation", Economic and Political Weekly, Vol.XXV.,No.37.,pp.2053-2058.

3. Alice Albin (1990), "Manufacturing Sector in Kerala: Comparative Study of its Growth and Structure", Economic and Political Weekly, Vol.XXV., No.37., pp.2059-2070.

utilisation. In view of the acute unemployment in the State labour absorption potential of the industry has also been evaluated. Further, the study also looks into the environmental pollution aspect and problems and prospects of the industry in detail.

The rationale for selecting pulp and paper industry for the study are many. First, so far no specific study on pulp and paper industry in Kerala has been found. Secondly, pulp and paper coustitute one of the most important segments of the industrial sector of India and Kerala. Thirdly, the industry raises many environmental issues since it is a forest-based industry on the one hand and the production process pollutes the environment by means of effluent disposal on the other. And finally, it is one of the largest and oldest industries in Kerala and many units are in the red due to various reasons.

Objectives of the Study

The overall objective of the study is to analyse the problems and prospects of paper industry in Kerala. The specific objectives are the following:

1. To evaluate the growth of paper industry in India.
2. To study the comparative performance of the pulp and paper industry in Kerala with the industrial sector of the State and

four groups of industries namely, basic industries, capital goods industries, intermediate goods industries which includes the paper industry, and consumer goods industries, in terms of:

a. productivity,

b. capacity utilisation, and

c. labour absorption capacity.

3. To examine the environmental pollution by the industry.

Hypotheses

The following are the hypotheses that have been formulated in view of the above-mentioned objectives.

1. Productivity of the pulp and paper industry is very low compared to the other industries and the industrial sector as a whole.
2. Capacity utilisation of the industry is very low.
3. Pulp and paper industry has high employment potential.
4. Paper industry pollutes the environment and affects the ecological balance.

Methodology

The analysis of comparative efficiency of the paper industry has been made in terms of productivity growth, capacity utilisation and employment generation. For studying productivity, three important measures have been estimated. They are Kendrick, Solow and Translog. A detailed discussion on these methods are

given in Part A, Chapter IV. The rationale for calculating three indices, instead of a single index, is that the productivity measure, perhaps, lies somewhere between these indices and if there is uniformity in variations one can safely come to a reliable conclusion.

In order to capture the labour absorption capacity of the industries a labour demand function has been estimated using Ordinary Least Square method. The methodology is explained in detail in Part B, Capter IV.

For capacity utilisation the minimum capital—output ratio method has been employed. This methodology is explained in Chapter V.

Two units have been selected for detailed study to highlight the problems and prospects of the industry and to examine the reasons behind the changes in productivity and capacity utilisation. They are Grazim Industries, Mavoor and Hindustan Newsprint Ltd., Velloor. The first one is a private company while the second, a central public sector undertaking.

The tools for analysing growth are discussed in this section. The changes in the growth of variables under the study are analysed through trends in growth. Growth rate of a variable can be defined as the rate of change per unit of time, usually a year.

For statistical estimation of trends in growth, three functional forms have been identified. They are 1) linear trend, 2) exponential trend and 3) log-quadratic trend. Acceleration/deceleration in trends in growth are captured by the log-quadratic model. Besides, discontinuous growth rate for two periods are estimated using kinked exponential model. A brief discussion of these methods are given below.

Linear Trend

If one assumes that a series will increase in constant absolute amounts in each time period the appropriate model is linear trend.[6]

The estimable equation of a linear trend is given by

$$Y = a + bt + u \qquad .....(1.1)$$

where `u' is a purely random error term which satisfies all the assumptions of the classical regression analysis. The growth rate is given by

$$Gy = \frac{1}{Y} \cdot \frac{dY}{dt} = \frac{b}{Y} \qquad ..... (1.2)$$

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[6]Robert S. Pindyck and Daniel L. Rubinfeld (1981), Econometric Models and Economic Forecats, McGraw-Hill Book Company, Auckland, p.475.

Here Y does not have a unique value. Therefore, substituting the arithmetic mean of Y ($\bar{Y}$) for Y yields,

$$Gy = \frac{1}{Y} \cdot \frac{dY}{dt} = \frac{b}{\bar{Y}} \qquad (1.3)$$

Exponential Trend

If one assumes that the growth rate is constant, then the exponential function is the appropriate one. The exponential function is given by

$$Y = Ae^{rt} \qquad .....(1.4)$$

Taking logarithms on both sides of the equation and introducing a random error term with the classical properties yields,

$$\ln Y = a + rt + u \qquad .....(1.5)$$

where $a = \ln A$

The growth rate is given by

$$Gy = \frac{1}{Y} \cdot \frac{dY}{dt} = r \qquad .....(1.6)$$

Log-Quadratic Trend

If the growth rate is changing, then the varying parameter can be modelled as a function of time postulating a linear

relationship between the rate of growth `r' and the time `t' [7]

$$\ln Y = a + rt + u \qquad .....(1.7)$$

$$r = r_1 + r_2 t \qquad .....(1.8)$$

substituting equation (1.8) in equation (1.7)

$$\ln Y = a + (r_1 + r_2 t)t + u \qquad .....(1.9)$$

$$\ln Y = a + r_1 t + r_2 t^2 + u \qquad .....(1.10)$$

The growth rate is given by

$$Gy = \frac{1}{Y} \cdot \frac{dY}{dt} = r_1 + 2r_2 t \qquad .....(1.11)$$

If r_1 and r_2 are significantly different from zero it means that the growth rate is not constant. The nature of the growth rate depends on the sign of both r_1 and r_2.[8] More specifically, the growth rate is :

i. accelerating if r_1 and r_2 are positive

ii. decelerating if r_1 and r_2 are negative

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[7] G. S. Maddala (1977), Econometrics, McGraw-Hill International Edition, Auckland, p.390.

[8] V. N. Reddy (1978), "Growth Rates", Economic and Political Weekly, Vol.XII., No.19., pp.806-813.

iii. decelerating from a positive growth rate if $r_1 > 0$, $r_2 < 0$ and $t < \frac{-r_1}{2r_2}$

iv. accelerating from a negative growth rate if $r_1 < 0$, $r_2 > 0$ and $t > \frac{-r_1}{2r_2}$.

A log-quadratic equation approximates a log-linear relationship quite well. In fact, when r_2 is close to zero the more general quadratic specification reduces to a log-linear specification.

Kinked Exponential Model

Boyce[9] has suggested a method of estimating the periodwise growth rate using unrestricted estimation which is known as kinked exponential model. The discontinuous growth for the two periods can be estimated using the dummy variable method as given below.

$$\ln Y_t = a_1D_1 + a_2D_2 + (b_1D_1 + b_2D_2)t + U_t \quad .....(1.12)$$

where D_1 = 1 for the first period,
= 0 otherwise

D_2 = 1 for the second period,
= 0 otherwise

[9]Boyce J.R. (1986), "Kinked Exponential Model for Growth Rate Estimation", Oxford Bulletin of Economics and Statistics, Vol.48., No.4., pp.385-391.

The estimation of the above equation without the intercept term will give the growth rates for the two periods. The discontinuity between the two trend lines can be eliminated via a linear restriction such that they can intersect at the break point k.

$$a_1 + b_1k = a_2 + b_2k \qquad .....(1.13)$$

substituting for a_2 in equation (1.12)

$$\ln Y_t = a_1D_1 + (a_1 + b_1k - b_2k)D_2 + (b_1D_1 + b_2D_2)t + U_t \quad ...(1.14)$$

$$\ln Y_t = a_1D_1 + a_1D_2 + (b_1k - b_2k)D_2 + (b_1D_1 + b_2D_2)t + U_t \quad ...(1.15)$$

$$\ln Y_t = a_1 + b_1(D_1t + D_2k) + b_2(D_2t - D_2k) + U_t \quad ...(1.16)$$

since $a_1D_1 + a_1D_2 = a_1$.

Obviously b_1 and b_2 are the growth rates for the two periods with a kink at k if the estimated values of the growth rates are different.

This method has two advantages over the discontinuous method:

1. the growth which is consistent with the sub-period growth rate can be calculated.

1974-75 as the base level capital stock[10]. The ASI data on fixed capital stock are available only for net fixed capital stock on book value basis. Taking changes in this capital stock between the consecutive years, a time series of net investment at current book value was obtained. When depreciation at book value for each year was added, a time series of gross was derived. The gross investment series thus obtained approximates current value series for gross investment. Deflating by the wholesale price index for machinery and equipment, a time series on gross investment at constant prices is obtained. The capital deflator is derived from the machinery prices at constant and current prices provided by the National Accounts Statistics (NAS). The deflator is the ratio of machinery prices at current prices to that of it at constant prices taking 1973-74 as the base year.

Let B_t denote the book value of fixed capital in year t, D_t, the depreciation allowance made in that year, P_t, the capital deflator and I_t, the capital goods price index, then the method can be described as

$$K_0 = 2B_{(1974-75)} \qquad \ldots(1.17)$$

$$I_t = \frac{(B_t - B_{t-1} + D_t)}{P_t} \qquad \ldots(1.18)$$

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[10]For a detailed discussion on the perpetual inventory accumulation method see B. N. Goldar (1985), Productivity Growth in Indian Industry, Allied Publishers, New Delhi, p.57.

$$K = K_0 + \sum_{t=1}^{13} I_t \qquad \ldots(1.19)$$

As a measure of replacement value, double of book value [11] for the base year (1974-75) is taken.

Value Added

ASI data on value added are available only for net values. Gross value is derived by adding the depreciation to the net value added. The gross value added thus obtained is deflated by the wholesale price index of the respective industries provided by the Department of Economics and Statistics, Government of Kerala.

Employment and Wage

Total persons employed is taken as the figure for employment and total emoluments, the wages. To bring the wages to a constant price (1973-74), it is deflated by the consumer price index provided by the Indian Labour Institute.

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[11] The rationale for taking the double of book value as the measure of replacement value is that the age of the machinery is unknown. Therefore, it is assumed that the machinery is depreciated by 50 per cent. In other words, it is assumed that the machinery is on the middle point of its life-span.

Scheme of the Study

The focus of the study is at two levels: first, it examines the efficiency of the paper industry in comparison with other industries and the state industrial sector as a whole, and secondly, it evaluates the problems specific to the industry including the social cost of production.

The present study is organised into eight chapters. Chapter two gives a brief account of the important studies that are related to the present study. Chapter three presents historical development of the paper industry from its origin to 1950 descriptively and since then onwards the growth of the industry in India by means of a detailed trend analysis. In chapter four efficiency of the industry is estimated by way of productivity and employment potential. This chapter also examines the scale economies. Since the productivity measure is not independent of the level of utilisation of capacity, chapter five examines the capacity utilisation. There has been an increasing awareness among people all over the world that the social cost of production has also to be taken into account into the economic analysis. In order to take care of this, chapter six provides a general picture of the environmental pollution aspect of the industry. The problems and prospects of the industry are analysed in chapter seven. And in chapter eight, the final chapter, conclusions and recommendations are given.

Limitations of the Study

The study is handicapped by the deficiency of the required data particularly in the analysis of externalities. In the case of externalities many of the variables are not quantifiable. And even the available data could not be made use of entirely because of the non-co-operation of the concerned authorities. In the case of hand made paper industry the units are not keeping the data regularly and the available data are found to be inconsistent in many respects. However, all possible effort has been made to make the study successful.

Chapter II

SURVEY OF LITERATURE

There are a number of studies on the industry emphasising various aspects such as demand for and supply of paper, capacity utilisation, employment potential, conservation of energy, etc. The survey of literature, however, presented here confines strictly to those studies that are relevant in the present context.

The development of paper industry in India and its concomittant problems are analysed by several authors in the past. For instance, Mahadeva Rao[1] has given a small sketch of the evolution of paper industry in India. He analysed problems relating to raw material supply, major sources of raw materials and price regulations.

As observed by him the paper industry had a good increase of production during the period when there was price control. The consumers, however, felt that there was black marketing indicating

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[1]Mahadeva Rao, K. (1983), Paper Industry in India, Ph.D. Thesis, Osmania University.

that the growth rate of production was insufficient to meet the demand. Control could also depress production because of poor profitability.

Rao[2] has analysed the growth and the structural and sectoral characteristics of the industry during the Five Year Plan period. Regarding exports and imports the study finds that India is, by and large, self-sufficient in respect of requirement of paper and paper board. The ordinary varieties of printing and writing paper are not imported in any significant quantity due to the high customs duties of nearly 140 per cent ad valorem. The main varieties of paper which are being imported are speciality papers.

After analysing the newsprint industry he comes to the conclusion that raw material scarcity and high capital cost are the two important difficulties in setting up additional capacity. In the raw material front, Rao observes that though there are a number of agro-based raw materials such as cereal straws, grass, kenaf, jute, waste paper , etc., they fail to meet the requirements of the mills. These raw materials can at best be utilised to supplement conventional raw materials, but are not capable of substituting them.

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[2]Y. A. Rao (1989), Paper Industry in India: Status and Prospects, Oxford & IBH Publishing Co., New Delhi.

The important issues involved, Rao observes, in research and development activities relating to the industry are:

1. identification of non-conventional raw materials and their development,
2. improvement of technology with a view to optimise production and reduce cost,
3. development and updating of design engineering for pulp and paper machinery, and -
4. evolving solutions to problems of effluent disposal.

In addition to these observations, Rao also gives a sketch of the industrial policy and fiscal incentives and statutory control on paper.

A study by Naik[3] has shown that there are signs of a turn around in the fortunes of the paper industry which witnessed a steady decline for nearly a decade since 1979-80. He attributes this to the scrapping of the price and distribution control on white printing paper and a significant pick up in the demand for packaging quality paper. However, the industry is not free from problems. As observed by him there was an impressive increase in the installed capacity of the industry during the Sixth and Seventh Plan periods. The addition to new capacity during the

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[3]S. D. Naik (1990), "Not Out of Woods Yet", The Economic Times, Sept. 6, p.9.

period was far in excess of the requirements leading to a fall in the capacity utilisation and a rise in the average fixed cost. Moreover, the bulk of the new capacity created is accounted for by a large number of small paper mills. Unfortunately, most of these small paper mills have been saddled with obsolete technology. Their operations have become all the more uneconomical because of inadequate availability of bagasse and other agricultural residues. Not surprisingly, the performance of small paper mills has been dismal. He opines that there is an imperative need for the government to evolve a comprehensive policy relating to the raw material requirements of the industry. The policy will have to aim at:

1. allocation of forest land to the industry wherever possible;
2. continued promotion of bagasse and other agricultural residues; and -
3. duty-free import of wood pulp.

Estimates of future demand for any good or a set of goods constitute a prerequisite for planning the expansion of the production capacity with the existing units or for setting up new units. Realising the importance and implications of demand forecasts in paper industry Tirath Gupta and Nitin Shah[4] have reviewed forecasts done by various institutes/agencies. The study

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[4]Tirath Gupta and Nitin Shah (1987), Paper and Paperboards in India: Demand Forecasts and Policy Implications, Oxford and IBH., New Delhi.

reviewed the demand forecasts made by Planning Commission, Food and Agricultural Organisation (FAO), National Council of Applied Economic Research (NCAER), Economic and Scientific Research Foundation (ESRF), Development Council for Pulp and Paper Industry (DCPPI), Indian Institute of Public Opinion (IIPO), and by Sharma.

It has been found that the demand forecasts for paper and paper boards in India are almost invariably and significantly higher than the observed levels. Demand forecasts for paper and paper boards in India during the period 1965 to 1985 have been higher by 7 to 97 per cent compared with the observed consumption levels. The major consequence of the discrepancy between actual and estimated demand has been the experience of steep decline in the capacity utilisation of the industry. One of the serious drawbacks in these forecasts was that these were done on the basis of 'requirements' rather than on 'demand'.

Observing a statistically significant decrease in the labour share in output of paper and paper board industry Ganti Subrahmanian[5] has done an econometric investigation within a production function framework. However, he did not take the explanatory assistance of biased technical change to make the facts consistent with one another. The estimated elasticity of

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[5]Ganti Subrahmanian (1980), "Factor Substitution and Relative Shares in the Paper - Paper Board Industry" The Indian Economic Journal, Vol.28., No.2., pp.76-84.

substitution exhibited an increasing trend over the sample period vitiating the fact that the labour absorption capacity has been on a decreasing trend. There was a neutral technical change. The results are fully consistent with one another in terms of the neoclassical distribution theory, that is, in the absence of technical progress the relative share of a factor input declines as its relative price rises, if the elasticity of substitution is greater than unity. One of the important advantages of paper industry has been high employment potential. A study by Sharma[6] has shown that paper industry is instrumental in generating employment opportunities and that the employment of women labour has been increasing in the paper industry.

The socio-economic effects of alternative paper manufacturing technologies and scale of production have been analysed by ILO[7]. The study finds that small plants are more suitable for developing countries on many grounds:

The medium sized and large mills may not operate profitably if the raw materials consist of agricultural residues, various grasses, waste paper or rags, which are available abundantly in developing countries. The use of agricultural residues or waste

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[6]Sharma L.C. (1981), "Paper Industry for Employment Potential" Indian Journal of Industrial Relations, October, P.245.

[7]International Labour Organisation (ILO) (1985), Small Scale Paper Making, Technology Series, Technical Memorandum No.8., ILO, Geneva.

paper by small pulp mills provides additional revenues to the farmers who do not have alternative outlets for surplus agricultural residues.

Good quality of paper - in terms of paper characteristics and uniformity - may be produced in small mills with a minimum of mechanisation. Indeed, some of the highest quality papers can only be produced by small scale mills.

Investments in small scale paper mills reduce the capital risk since a learning process takes place as the mills are being built over an extended period of time.

The establishment of micro-mills or small paper mills generates more productive employment than do large mills. For instance, small mills generate three to seven times more jobs than a large paper plant for the same output of 90,000 tonnes of paper a year. Similarly, investment per worker is considerably lower for small mills. Thus investment in these mills help save scarce capital. Moreover, small paper mills, unlike large plants, do not rely very much on foreign expertise, if at all. Thus, small paper mills benefit the local economy in terms of employment generation. Installation of large paper mills require large sums of money for improvement and expansion of the infrastructure whereas the small paper mills may use the existing infrastructure.

The establishment of small paper mills reduces transport costs because the raw materials are collected nearby and the output is marketed locally.

The establishment of several paper mills should benefit rural areas and backward regions, whereas that of one or two large plants in urban areas will further aggravate income and employment disparities between urban and rural areas.

Small mills should create substantial backward and forward linkages through collection and transport of agricultural waste, establishment of small repair shops, manufacture of some of the equipment and marketing of the output. All these activities should improve rural incomes and slow down rural-to-urban migration.

Environmental and pollution hazards are more damaging in the case of large plants than in the case of small mills. While the quantity of pollutants per tonne of paper produced is equal for both types of mills, more harm is done by large plants because large quantities of pollutants are disposed of within a limited area. On the other hand, the quantity of pollutants generated by isolated small paper mills is fairly low and can easily be disposed of without harm to the environment. Furthermore, treated effluents can be used as irrigation water, and thus benefit local

farmers. Another advantage of small paper mills is that they do not generate as much air pollution as do large mills.

The study also gives some policy measures. They are:

- limited cash subsidies for small mills established in rural or backward areas;
- a ban on imports of specific types of paper products which are already produced locally;
- duty-free import of second-hand equipment for small mills;
- excise duty rebates which are a function of the size of the mill and of the type of raw materials used;
- exemption from excise duty on power consumption by small mills for a given number of years;
- favourable credit conditions for small mills;
- reduction of the proportion of the income assessable for tax, for a number of years after the establishment of the mill; and
- quotas on imports of some types of equipment.

Observing an unprecedented growth in the number of firms in paper industry, despite the existence of considerable excess

capacity, during seventies, Alka Subramanian[8] has made an explorative study to find out the reasons behind this development. It has been found that the government policy, which discriminated heavily against the large mills and favoured the small mills sector, has been largely responsible for the numerous expansion of the units in small and medium size. The small units have been able to provide keen competition to their larger counterparts as a result of government policy in general, and excise duty reliefs in particular. As a result, the profit margins of large mills have been reduced.

Analysing the capacity utilisation, by classifying the mills into five categories, Alka found that different categories have markedly different rates of capacity utilisation. Moreover, the intermediate mills have a much lower rate of capacity utilisation. While the largest and the smallest categories have an average capacity utilisation of 71 per cent, the intermediate units have the capacity utilisation of only 57 per cent for the period 1980-85. This may happen due to two reasons: one unfavourable market condition for the intermediate units - this causes due to the large excise concessions awarded to the small units, and two increased production costs. Based on a sample of 28 paper mills, the study concluded that small mills have higher cost of

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[8]Alka Subramanian (1987), "Small is not Beautiful: A Study of the Paper Industry", Indian Industrialisation, Paper presented at the seminar organised by Planning Commission, I.D.B.I. and Centre for Development Studies, Trivandrum, pp.1-41.

production relative to the large mills. The cost of production of small mills is higher by approximately Rs.1000 per metric tonnes, one reason being the absence of chemical recovery system in the case of small mills. Chemical recovery is possible to the extent of 90 per cent to 92 per cent and it is being achieved by a few large mills in India. This is mainly due to the fact that the small mills cannot avail of the large scale economies that characterise this industry. In other words, the findings indicate that the optimal size of a paper mill lies in the region of 8000 lakh tonnes to one lakh tonnes per annum even for India.

Alka argues that if government policy is biased towards the small mills, it is in effect supporting a high cost economy and this is a direct loss to the economy. Excise concessions, put the small mills in a position to compete with the large mills as the selling prices faced by both are the same. But if the small mills are unable to lower their cost of production, there is little justification for subsidising them vis-a-vis the large mills.

It is quite possible that the intermediate units face 'special' problems regarding supply of raw materials and power and hence have low rates of capacity utilisaion. The large plants may have a more elaborate procurement plan and this problem may not be so critical for mini paper mills. However, the above hypothesis was not found true. The information on the problems faced by paper mills of different sizes concluded that the problems were

more or less, evenly distributed over the different categories. More specifically, controls on price and production were their most important problems.

Thus, it has been found that, the pricing policy of the government can explain both -

i) low rates of capacity utilisation, and

ii) the entry of numerous small mills inspite of the low rates of capacity utilisation.

Alka suggests also the perspectives for the industry. Currently, the paper and paper board industry should concentrate on utilising existing capacity rather than on capacity creation. The current installed capacity is sufficient to meet present and near term future demand. The government should help in financing the modernisation and investment plans of the large mills. This might provide the much needed boost to the industry as bigger mills can produce paper at a lower cost. The small mills can concentrate on the varieties of paper that are reserved for them.

Government policy should give maximum encouragement to mills with an optimal plant size based on unconventional raw materials. In general, a lowering of excise rates for each category of mills will go a long way in improving the capacity utilisation rate for the industry. Further, it may be better to have a proportionate tax system, such that the average tax rate is constant across all

production levels. Besides, removing the disincentive effects of the present tax system, a proportionate tax rate would be simple to administer.

In 1963 a study team of the National Productivity Council[9] visited Japan, Mexico, Venezuela, U.S.A., U.K., Canada, Finland and Sweden and made a comparative study of capacity utilisation and productivity of Indian and foreign paper industries. The team was impressed by the high productivity of Japanese workers. According to the study the wage rate in that country is comparatively low, and the productivity very high with the result that the overall cost of production of pulp and paper in Japan is lower than that in India. Even with the relatively high cost of wood, Japanese paper industry can manufacture and sell paper at much lower cost than the paper industry in India. The reasons are high productivity of labour, utilisation of best and most economical techniques and high standard of operational efficiency in the Japanese mills.

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[9]National Productivity Council (NPC) (1963), Paper Industry in Japan Mexico Venezuela, USA., UK., Canada, Finland and Sweden, NPC., New Delhi.

Ferguson[10] has evaluated the financial status and profitability of the paper industry and came to the conclusion that there has been a declining trend in profitability. The poor performance of the industry has been attributed to the inadequate availability of raw materials, the impact of controls, the demand recession, lack of infrastructural support, high cost of inputs, high incidence of taxation and lack of managerial skills. Ferguson argues that modernisation and technology upgradation in the existing units and expansion of the units to economically viable levels wherever necessary, and appropriate plans to ensure adequate and continued raw material supply could mitigate the problems of sickness in the large paper mill sector.

Industrial uses of agricultural and agro-industrial residues have been emphasised upon by policy makers in recent past for accelerating the country's economic development. Among the unconventional materials, the use of bagasse has been emphasized through fiscal incentives including excise duty exemptions and duty free imports of integrated pulp and paper mills. In this context, Tirath Gupta and Vinod Ahuja[11] have made a study on the

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[10]A. F. Ferguson and Co. (1986), A Study of Large Paper Mills in India, Proceedings of Seminar in Declining Financial Health of the Paper Industry.

[11]Tirath Gupta and Vinod Ahuja (1989), "Bagasse Based Paper and Newsprint in India: Economic and Political Issues", Vikalpa, Vol.14,No.3.

possibilities of releasing more bagasse for the pulp mills. The main objectives of the study were:

-to esimate the annual quantities of residual bagasse without planned action by sugar/paper mills, and to assess the financial and managerial feasibility of using that material for pulping;

-to estimate the annual potential for residual bagasse due to improved thermal efficiency and bagasse drying at the sugar mills, and to assess the financial and managerial feasibility;

-to assess the relative economics of surplus bagasse due to replacing bagasse fired boilers with coal fired boilers at the sugar mills; and

-to review the policies to encourage bagasse use for paper/newsprint making and suggest necessary and feasible modifications.

It was estimated that, on an average, sugar factories above 1200 tonnes per day (TPD) capacity would have 60 per cent of bagasse as residual. Thus around one million tonnes of residual a year would be available for pulping without any planned action by the sugar or the paper industry.

Assuming an 80:20 ratio of bagasse and other cellulosic materials, these quantities could support around 12 per cent of the observed output of paper/paper board and newsprint with chemical pulp process, and around 19 per cent with mechanical bagasse pulp process.

One of the major observations of the study is that drying bagasse before firing the boilers of sugar factories can economically increase the residual bagasse for paper and pulp mills, rather than substituting coal or power for bagasse. Since sugar factories above 1200 tonnes per day (TPD) capacity burn around 20 million tonnes bagasse a year, their total energy consumption is nearly 3,6500,000 million k.calories. This energy can be had from about 8.6 million tonnes bone dry bagasse. Thus a maximum of 17.2 million tonnes bagasse, agaist 20 million tonnes at present, could meet the total energy requirements of the sugar mills if bagasse was bone dried prior to feeding the boilers. This residual on this account can, thus, be around 2.8 million tonnes. Once again, about 80 per cent of that may reach paper/newsprint mills. Thus the total residuals may be 3.2 million tonnes a year. This would suffice for 662,000 tonnes of chemical pulp based paper and newsprint. Based on this, it is estimated that, by the turn of the century, at least 30 per cent of the estimated demand for paper/paper boards and newsprint can

be based on residual bagasse due to its drying at sugar mills with capacity at 1200 TPD or higher.

The study concludes that a feasible and self-sustaining long term policy would be to gradually internalise the cellulosic materials production with paper and newsprint production process through:

-encouraging integrated sugar-paper complexes to enhance the quantity of residual bagasse through drying and densification,

-according preferential treatment to the existing paper/newsprint mills for setting up new sugar mills,

-assessing the feasibility of new paper/newsprint units along with new sugar mills or other well defined and sustainable sources of cellulosic materials.

Leslie Allan, Eileen Kohl Kaufman and Joanna Underwoods[12] of the U.S.A. have conducted a study on pollution in the pulp and paper industry in 1972. The objective of the study was to analyse different polluting aspects of the industry. Important among them are air pollution and water pollution. It has been found that

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[12]Leslie Allan, Eileen Kohl Kaufman and Joanna Underwoods (1972), Paper Profits: Pollution in the Pulp And Paper Industry, The MIT. Press.

particles emission of chemicals and carbons can aggravate respiratory and lung diseases such as emphysema and asthma. Plant life can be damaged by sulphur dioxide from the pulp mill emissions. If the bio-chemical oxygen demand (BOD) of pulp mill effluents is too high, it adversely affects the complicated life chain in natural waters from bacteria to plankton to plants to fish life.

Andrew. J. Ewing[13] has made a study on energy efficiency in the pulp and paper industry with emphasis on developing countries. The objectives of the study were to quantify the consumption of energy in the paper industies of industrialised and developing countries, to show the extent and nature of energy saving which have been achieved in the industrialised countries and to suggest some preliminary approaches to encourage the transfer of energy saving technology to the paper industries of developing countries. Ewing found that the production of paper is relatively energy intensive and industrialised countries have been measurably successful in reducing the energy consumption in paper production. The problems of the developing countries in reducing energy consumption in paper production are small plant size, the technology employed, the operational employment and the skill level of the operational management and personnel.

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[13]Andrew J. Ewing (1983), Energy Efficiency in Pulp and Paper Industry with Special Emphasis on Developing Countries, World Bank Technical Paper No.34., Washington.

Despite the problems, there is great scope for improving energy efficiency in the paper industries of many developing countries. Such improvement requires that issues be addressed at three levels:

1. a review of rational policies to identify and modify those which encourage inefficient energy use by the industry and introduce others which would encourage improved energy efficiency,

2. initiatives at the sectoral level to improve energy-efficient sectoral planning, and to collect information and publicize the nature and extent of the benefits to be had through improving energy efficiency, and

3. the development of mill-specific action programmes beginning with an energy audit which would identify specific short-term and long term actions leading to improved energy efficiency.

The foregoing discussion of studies on pulp and paper industry reveals that though there are a number of studies on paper industry, emphasizing different aspects of the industry, so far no comprehensive study covering different aspects of the industry has been attempted. Hence the importance of the present study which emphasizes productivity, labour absorption, capacity utilisation and environmental pollution aspects of the industry.

Chapter III

HISTORICAL DEVELOPMENT OF PAPER INDUSTRY

Before attempting to analyse the performance of the paper industry in Kerala, the historical development of the industry and the growth of it in India, particularly during the Plan period, are discussed in this chapter. The historical review is descriptive in general; however, the growth of the industry in India during the Plan period is studied at length by trend analysis.

In the earliest stages of man's history when no writing materials were known, he committed to memory poetry, literature, philosophy, etc., and the stock of such knowledge was carried by word of mouth from generation to generation.[1] However, the knowledge transferred through word of mouth was confined to a close circle of people. Thus, it had been man's burning desire, right from the time he appeared on earth, to record his achievements and transmit his thoughts, experience and creations to the coming generation in an effective and consistent manner.

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[1]Podder V. (1959), Paper Industry in India, National Printing Press, Delhi, p.1.

Neolithic man expressed himself laboriously through pictures and symbols on stones, bones and walls of caves. However, in more advanced societies at that time, sheets of brass, copper and bronze, ivory plates, wood, clay tablets, cured animal skins and silken fabrics were employed for preserving philosophical creations, wills, laws, treatises and agreements among peoples and nations.[2]

Etymologically the word 'paper' owes its origin to 'papyrus', a plant which grew on the banks of the Nile in Egypt.[3] The barks and leaves of this plant were woven and pressed into a sheet to be used as writing material by the ancient Egyptians.

In some countries, 'papyrus' and 'parchments' appeared as writing materials. Documents written on 'papyrus' dating back to 3000 B.C. to 2000 B.C. have been found in Egypt. Persians and Greeks used 'parchments' to write upon.

Though in ancient times 'papyrus' was the most commonly used writing material, its defibring, an essential element in modern paper making, did not take place for a long time.

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[2]Kulshrestha N. K. (1972), Analysis of Financial Statements of Indian Paper Industry, Navman Prakashan, New Delhi, p.1.

[3]Mahadeva Rao (1983), Paper Industry in India, Ph.D. Thesis, Osmania University, p.4.

Paper denotes a deposit of vegetable fibre prepared from an aqueous suspension. Paper can be defined as a sheet or continuous web of material formed by the deposition of vegetable, animal, mineral or synthetic fibres or mixtures such a way that the fibres are intermeshed together.[4] The Encyclopaedia Americana defines paper as "a matted or fetted sheet of vegetable fibres formed on a screen from a water suspension"[5].

In the light of the available evidence it is believed that the Chinese have discovered the art of paper making about the beginning of the Christian era.[6] In A.D. 105 Ts'ai Lun, an official attached to the Imperial Court of China, created a sheet of paper using mulberry and other fibres along with fishnets, old rags and hemp waste. Ts'ai Lun's name was for long afterwards, revered as the 'God" of paper making. Even the modern paper making is based on the Ts'ai Lun's method. The art of making paper was, however, kept a closely guarded secret in China, for a long time, almost till 8th century A.D.[7]

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[4]Kulshrestha N. K. (1972), op. cit., p.2.

[5]Encyclopedia Americana (1976), Vol.21, p.258.

[6]John A. Guthrie (1972), An Economic Analysis of the Pulp and Paper Industry, Washington State University Press, Washington, p.1.

[7]Ahuja S. P. (1980), Paper Industry in India: Retrospect and Prospects, The Institute of Economic and Market Research, New Delhi, p.33.

The art of paper making travelled very slowly westward, and reached Samarkhand, in West Asia, in A.D. 751 during the time of Harun-al-Rashid. This became possible after the capture of some Chinese paper makers at Samarkhand. In Egypt the art of paper making developed around A.D.890 and thereafter in the entire Middle East.

Paper mills were originally located on the banks of rivers and streams close to the cities. The rivers provided ample supply of fresh water necessary for paper making, and the proximity to the cities allowed easy access to the population centres which constituted both the markets for paper and the sources of the principal raw material, rags.

The art of paper making reached Morocco in A.D. 1100. From Morocco it reached Spain. Spain had the distinction of setting up the first paper mill in Europe. Historical records show that a paper mill was in operation, at Xativa, in or about A.D. 1150.[8] Some 40 years later, a paper mill was established at Hernault in France. Paper making spread to Fabriano, in Italy, in 1260 and Nuremburg, in 1389. Paper making entered England via Switzerland and the Netherlands, when the first paper mill was set up in Hertfordshire in 1490. It is believed that a paper mill was functioning in Sweden in 1532. It took well over a hundred years for paper making to be introduced into Norway, as the earliest

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[8]Ibid., p.33.

record of Norwegian paper mill refers to 1698. Slightly earlier, the paper making was introduced in the American continent in 1690.[9]

Thereafter, paper making underwent revolutionary changes, as the technology of pulping processes was gradually developed. This relieved the paper industry of its crucial dependence upon cotton and linen rags. It may be noted that all along the westward journey of paper making, particularly its discovery route from Samarkhand to Morocco, there was virtually a lack of attention to forest land. Therefore, the use of raw materials for pulp making, which included mulberry and other softwoods, gradually shifted to rags and cloth. By the time paper making spread all over Europe and the Europeans were ready to make paper, the art of using wood pulp was lost and was not discovered until the middle of the 19th century.

The demand for paper soon outgrew the capacity, essentially because the art of making paper did not undergo any change to keep pace with the changing demand levels. The paper making continued to depend upon linen and cotton rags as its raw materials and paper manufacturers widely solicited these raw materials from such limited sources as could make these available. The need for a more abundant raw material for paper manufacturing was being

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[9]John Overton (1955), Paper for Book Production, The Cambridge University Press, London, p.1.

increasingly felt and this resulted in the use of wood pulp as base raw materials for paper making.

In 1880 a book was published which described some practical methods for paper making from wood pulp and vegetable pulp.[10] Gradually innovations in manufacturing process took place which reduced the dependence of paper industry on cotton and linen rags. These technological developments followed two distinct path ways. In one, fibre and fibre fragments were seperated from the wood structure by mechanical means. In the other, the wood was so treated through chemical solutions that it dissolved and removed lignin and other wood components leaving cellulose fibres behind. The pulp produced by former methods largely shares the character of wood and this makes paper produced from this pulp unsuitable for white and bright paper. Therefore, for good quality paper, chemical wood pulps such as soda and sulphite pulp are used when high brightness, strength and performance are required.

The ground wood pulp was first manufactured in Germany in 1840, but the process took sometime to come into extensive use. In 1852 soda pulp was first manufactured in England. The first patent for pulping by sulphite process was issued in the U.S.A. in 1867. Later on, in 1884, Carl-P-Dahl invented sulphate (kraft) pulp in Danzing, Germany.

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[10]Ahuja S. P. (1980), op. cit., p.34.

Two other major developments in the paper manufacturing are vatsizing and chlorine bleaching. Before 1800, to make paper resistant to moisture absorption and good for writing with water based inks, paper sheets were impregnated with animal gums or vegetable gums. These were expensive processes. In 1800 it was discovered that paper could be sized in vats with rosin and alum.

The discovery of chlorine in 1774 led to its use for the bleaching of paper stock.[11] In 1798, Nicolas-Louis Robert in France constructed a moving screen belt that could receive a continuous flow of stock and deliver an unbrocken sheet of wet paper to a pair of squeeze rolls. This considerably altered the perspective for paper production which was hitherto being produced as one sheet at a time, the size of the sheet being limited by the size of the mould or frame that a man could lift from a vat of stock.

In 1807, this effort was improved upon by two engineers, Henry and Sealy Fourdrinier in England, who built a machine which was an improved version of the one made in France. Two years later a cylinder type machine was devised by another English paper maker John Dickinson. The mechanisation of paper industry involved immense sophistication of material handling equipment as well as finished products that were required to be moved to feed the paper machines.

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[11]Ibid., p.34.

But inspite of subsequent sophistications in machinery and equipment the basic steps in paper making remain the same. These are:

1) a suspension of cellulosic fibre is prepared by beating it in water so that the fibres are thoroughly seperated with water;
2) paper stock is filtered on a woven screen to form matted sheet of fibre;
3) the wet sheet is pressed and compacted to squeeze out a large proportion of water;
4) the remaining water is removed by evaporation; and
5) depending upon use requirements the dry paper sheet is either compressed, coated or impregnated.

Another development running parallel to the increased mechanisation of paper industry has been product diversification. More and more paper came to be manufactured catering to different specific requirements. By now, several hundred varieties of paper are in use all over the world.

World Consumption of Paper

Even though there are differences from grade to grade, and from country to country, world demand for paper has grown more or less apace with economic growth. Paper has maintained a

relatively constant share of economic activity over the past 30 years.[12] Table 3.1 gives the world demand for paper.

As shown in the table the decline in the rate of growth of demand can, more or less, be directly attributed to the slowing rates of economic growth.

In the industrialised countries, the income elasticity of demand for newsprint has remained fairly constant at 0.8 to 0.9 per cent over the past 30 years. The principal determinant of newsprint consumption in the industrialised countries are the overall expenditure on advertising and the proportion of the expenditure allocated to newspapers. In the United States, the early days of television saw some erosion of expenditures on newspaper advertising, but since the 1960s, an almost constant proportion of around 28 per cent of all advertising expenditures has been in newspapers, compared with around 22 per cent on television.

In Europe, althogh there are significant differences from country to country, typically one half of all advertising expenditures are for newspapers and magazines. Since advertising expenditures are rather closely tied to the overall level of

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[12]Andrew J. Ewing and Raymond Chalk (1988), The Forest Industries Sector: An Operational Strategy for Developing Countries, World Bank Technical Paper No. 83, Industry and Energy Series, Washington, p.11.

Table 3.1 : Development of World Demand for Paper, 1955-85

	Apparant Consumption (million tonnes)				Average Annual Increase (percentage)		
	1955	1965	1975	1985	1955-65	1965-75	1975-85
Developing Countries							
-newsprint	0.50	1.70	2.40	3.80	6.20	3.20	4.80
-printing/writing	0.70	1.90	4.10	8.30	10.90	8.30	7.20
-other grades	1.20	4.50	9.90	20.50	13.80	8.30	7.50
Industrial Countries							
-newsprint	10.30	14.90	20.10	25.10	3.80	3.00	2.20
-printing/writing	9.60	17.10	26.80	43.30	6.00	4.60	4.90
-other grades	33.40	55.90	79.10	93.50	5.30	3.50	1.70
World							
-newsprint	11.20	16.60	22.50	28.90	4.00	3.00	2.50
-printing/writing	10.30	19.00	30.90	51.60	6.40	5.00	5.20
-other grades	34.60	60.00	89.00	114.00	5.70	4.00	2.50
World Total	56.10	96.00	142.40	194.50	5.50	4.00	3.20

Source: Andrew J. Ewing and Raymond Chalk (1986) The Forest Industries Sector: An Operational Strategy for Developing Countries, World Bank Technical Paper No.83, p.12.

economic activity, the income elasticity of demand for newsprint has remained close to unity.

Paper Industry in India

The history of paper making in India can be divided into four distinct phases. The first phase covers the period when paper had been made without any machine, i.e., upto 1882. The second phase in the growth of the Indian paper industry began in 1882 and ended in 1925. This was a period of introducing machine made paper. The third phase - 1925-1950 was marked by Bamboo Protection Act of 1925 and World War II. The fourth phase began in 1951 with the beginning of planning.

First Phase (upto 1882)

Early Aryans who settled in North India used `tamrapatra', `tada patra', `loh patra', etc. for written communication. They also employed the art of carving on stones inside and outside the caves, and carvings on trunks of big trees by cutting flat surfaces.

The art of making paper reached India through Arabs. Some Indian muslims might have also learnt it directly when they visited Mongolia. But the art of making paper was kept a fairly guarded secret by a few families that initially learnt it. These

paper making families were known as 'kagzis'[13] These kagzis were largely settled in Punjab and Kashmir and flourished under the patronage of the Moghul empire.

Before the advent of machine made paper, a sizeable handmade paper industry flourished in India. Paper was observed to be in common use almost all over India at the close of Akbar's reign.

Earliest efforts at mechanising Indian paper industry were made by William Carey in the beginning of 19th century. William Carey started a paper mill in 1812 with the help of local kagzis. The mill was located at Sorampur, West Bengal. In 1832 a steam engine was introduced for operating beaters.

In 1867 a fourdrinier machine was installed in the Royal Paper Mills at Bally near Calcutta. This mill increased the number of paper machines to four raising the mill capacity to 5000 tonnes per year. The raw materials used were rags, jute cuttings, waste paper, moonj and sabai grass. The mill was eventually absorbed by Titaghur paper mills.

The Upper India Couper Paper Mills, the third in the series of modern paper mills, was started in Lucknow in 1879 and is the

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[13]Podder V. (1980), Paper Industry in India: Retrospect and Prospects, The Institute of Economic and Market Research, New Delhi, p.35.

oldest of the existing mills. This mill started production in 1882.

Second Phase (1882 - 1925)

The second phase of paper manufacturing in India began in 1882 with the establishment of first machine made paper mill, the Upper India Couper Mill, at Lucknow, and the second, Titaghur Paper Mill, at Colaba, in 1884. These mills used 'moonj' and 'sabai grass' as raw materials. The other mills that came up subsequently were Deccan Paper Mills, at Poona, in 1887, the Bengal Paper Mills, at Raniganj in 1891, and the Industrial Paper Mills, at Kakinara, in 1892. By the year 1900 the production of paper rose to 1900 tonnes.

Great relief in the raw material front came with the technological development in using bamboo, an abundant species at that time as the raw material. Research in these line was carried out by the Indian Forest Research Institute, Dehradun. In 1912 Titaghur Paper Mills modified its machinery to use bamboo on a limited scale. However, it was not till 1918 that the first mill to manufacture completely from bamboo was established at Naihatti near Calcutta. The mill, India Paper Pulp Company, was a unique venture that it was the first mill in India to use sulphite process in the manufacture of pulp from bamboo.[14]

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[14]John A. Guthrie (1972), op. cit., p.4.

During this period the paper industry had to struggle hard for existence due to stiff competition from cheap, imported paper. To give a fillip to the development of the industry the government of India, on the recommendations of the Tariff Board, passed the Bamboo Paper Industry (Protection) Act in 1925 . The Act created congenial atmosphere for the growth of the industry. The growth of the industry from 1911 to 1924 is presented in Table 3.2.

Third Phase (1925 - 1950)

The third phase in the growth of paper industry began in the year 1925 and ended in 1950. The Bamboo Protection Act of 1925 gave a major fillip to the industry. The production of paper increased from 26,280 tonnes in 1923 to 48,000 tonnes in 1937 (Table 3.3). Just before the outbreak of the Second World War, a number of new paper mills started operation, and they had to work under the pressure of the Second World War. The mills not only kept up their production but increased it substantially during the war period, in spite of the fact that it was almost impossible to get spare parts imported from foreign countries. After the war every country was busy in reconstruction and it was hardly possible to get more machinery for the expansion of the industry. Since the existing plants had worked at more than hundred per cent capacity during the War, they needed immediate replacements. As a result, the efficiency was declining during the period immediately

Table 3.2 :Annual Production of Paper From 1911 to 1924 (in tonnes)

Year	Production
1911	26792
1912	27217
1913	27021
1914	28107
1915	29509
1916	31106
1917	30270
1918	32561
1919	27795
1920	27052
1921	24327
1922	23629
1923	26280
1924	35000

Source: Podder.V., (1959), Paper Industry in India, National Printing Works (The Times of India Press), Delhi, P.8.

Table 3.3 : Annual Paper Production From 1931 to 1950 (in tonnes)

Year	Production
1931-32	39384
1932-33	40100
1933-34	43513
1934-35	44276
1935-36	47622
1936-37	48228
1937-38	55800
1938-39	59200
1939-40	70800
1940-41	87700
1941-42	95500
1942-43	91000
1943-44	101000
1944-45	106000
1945-46	108000
1946-47	103000
1947-48	93700
1948-49	98200
1949-50	104400

Source: Podder.V., (1959), Paper Industry in India, National Printing Works (The Times of India Press), Delhi, pp.9-10.

after the war. To ensure a healthy growth of the paper industry in India, a Development Wing was formed in 1945 under the Ministry of Industry and Supply. This was equally conducive to the growth of paper industry in India and in 1949-50 the annual production touched the level of 104,400 tonnes. In 1950 the production further increased to 108,907 tonnes. It is, therefore, clear that the production increased by 311 per cent in 1950 over the figure of 35,000 tonnes in 1924.

Development During the Plan Period

Since independence there has been a sustained growth in the paper industry in India with positive and significant trends in output and installed capacity. As a result of the phenomenal growth of output, the paper and paper board sector of the industry - the core sector of the paper industry - is now capable of meeting almost the entire domestic demand, barring certain speciality papers. On the other hand, in the case of newsprint, the other part of the industry, the story is entirely different and disappointing. Despite apparent increase in output the newsprint sector is not capable of meeting the domestic demand and about 42 per cent of the domestic requirement is met by imports.

However, one need not be carried away with the impressive growth of the industry in terms of the trends in output growth. It was more the increase in the number of units and the consequent increase in capacity that resulted in the increased output growth. In fact, there has been a progressive decline in capacity utilisation in paper and paper board, and newsprint. Viewed in another dimension, the industry manifests its inefficiency in terms of a more than proportionate increase in inputs per unit of output. In a developing country like India, where the available resources have nosedived in the face of competing demands, this kind of developments would prove to be a drag on the economy. It

appears that many factors including raw material scarcity, obsolete technology, policy decisions of the government, etc., have adversely affected the efficiency of the industry.[1] In what follows in this chapter, it is proposed to analyse the growth trends of the two sectors of the industry - paper and paper board and newsprint - in terms of installed capacity, output, capacity utilisation and number of units, taking two time periods: the first period - 1951 to 1985 for paper and paper board and 1956 to 1985 for newsprint, captures the overall growth of the industry since independence, while the second period - 1973-74 to 1985-86 highlights the recent trends in the industry. The second period is more important, since our time frame of analysis, as noted earlier in the introductory chapter, is 1973-74 to 1985-86. The analysis of trends in growth is made estimating log-quadratic equation which gives not only growth rates at different time points but provides a test of the specification success of the model.[2] The quadratic equation can be interpreted as: if the quadratic term is not statistically significant the functional form is assumed to be log-linear, not log-quadratic form, and concludes safely that there is neither acceleration/deceleration in growth ,i.e., the growth rate is constant over the entire reference period. Whenever a significant change in trends of

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[1]S. D. Naik (1990), "Not Out of Woods Yet", The Economic Times, Sept. 6, p.9.

[2]For details of the methodology of trend analysis see chapter I.

growth is observed, to see if the change is statistically significant, the kinked exponential model is employed.

Paper and Paper Board

The performance of paper and paper board sector of the paper industry presents a mixed picture. It is mixed in the sense that, while the output grew significantly, the capacity utilisation slumped to as low as 56 per cent (see Table 3.4). There had been a phenomenal growth in output, installed capacity and the number of units. For instance there were only 17 units in 1951 with an annual installed capacity of 1.37 lakh tonnes which increased to 271 units with an annual capacity of 26.55 lakh tonnes in 1985. Between 1952 and 1985, the output recorded an increase of over 1031 per cent, i.e., from 1.32 lakh tonnes in 1952 to 15 lakh tonnes in 1985. Figure 3.1 shows the capacity utilisation. Evidently, it appears, prima facie, that there has been a disjunction between the growth of output and capacity. The capacity utlisation (as a percentage of installed capacity) declined from 92.57 per cent in 1952 to 56.5 per cent in 1985. The results of trend analysis for the periods 1951-85 and 1973-85 are summarised in Table 3.5 and Table 3.6. respectively.

From Table 3.5 it appears that taking the entire period, the growth rate in production had first been increasing and then

TABLE 3.4: PAPER AND PAPER BOARD : Number of Units, Installed Capacity, Production and Capacity Utilisation, 1951-1985

Year	Number of Units	Installed Capacity (lakh tonnes)	Production (lakh tonnes)	Capacity Utilisation (percentage)
1951	17	1.37	1.32	96.35
1952	19	1.48	1.37	92.57
1953	20	1.57	1.40	89.17
1954	21	1.74	1.55	89.08
1955	21	1.86	1.85	99.46
1956	19	2.15	1.97	91.63
1957	19	2.52	2.50	99.21
1958	21	2.69	2.53	94.05
1959	26	3.21	2.94	91.59
1960	28	4.00	3.45	86.25
1961	31	4.10	3.64	88.78
1962	38	4.34	3.88	89.40
1963	42	5.02	4.63	92.23
1964	55	5.56	4.91	88.31
1965	56	6.44	5.37	83.39
1966	57	6.44	5.85	90.84
1967	57	7.01	6.09	86.88
1968	57	7.30	6.39	87.53
1969	57	7.30	7.01	96.03
1970	59	8.80	7.50	85.23
1971	59	8.80	7.85	89.20
1972	59	9.54	7.85	82.29
1973	74	9.67	7.75	80.14
1974	75	10.09	8.27	81.96
1975	74	10.68	8.29	77.62
1976	75	11.37	8.80	77.40
1977	86	12.65	9.37	74.07
1978	106	13.80	10.06	72.90
1979	121	15.38	10.47	68.08
1980	136	15.56	11.12	71.47
1981	197	16.56	12.35	74.58
1982	175	18.16	12.36	68.06
1983	220	19.15	11.98	62.56
1984	249	21.65	13.60	62.82
1985	271	26.55	15.00	56.50
Growth Rates		8.2	6.9	-1.2

Source Industrial Credit and Investment Corporation of India (ICICI) Report, 1985. Reproduced in Alka, (1987), op. cit., pp. 7-9.

Note : Growth rates are estimated by fitting an exponential trend.

Figure 3.1 PAPER AND PAPERBOARD
Capacity Utilisation

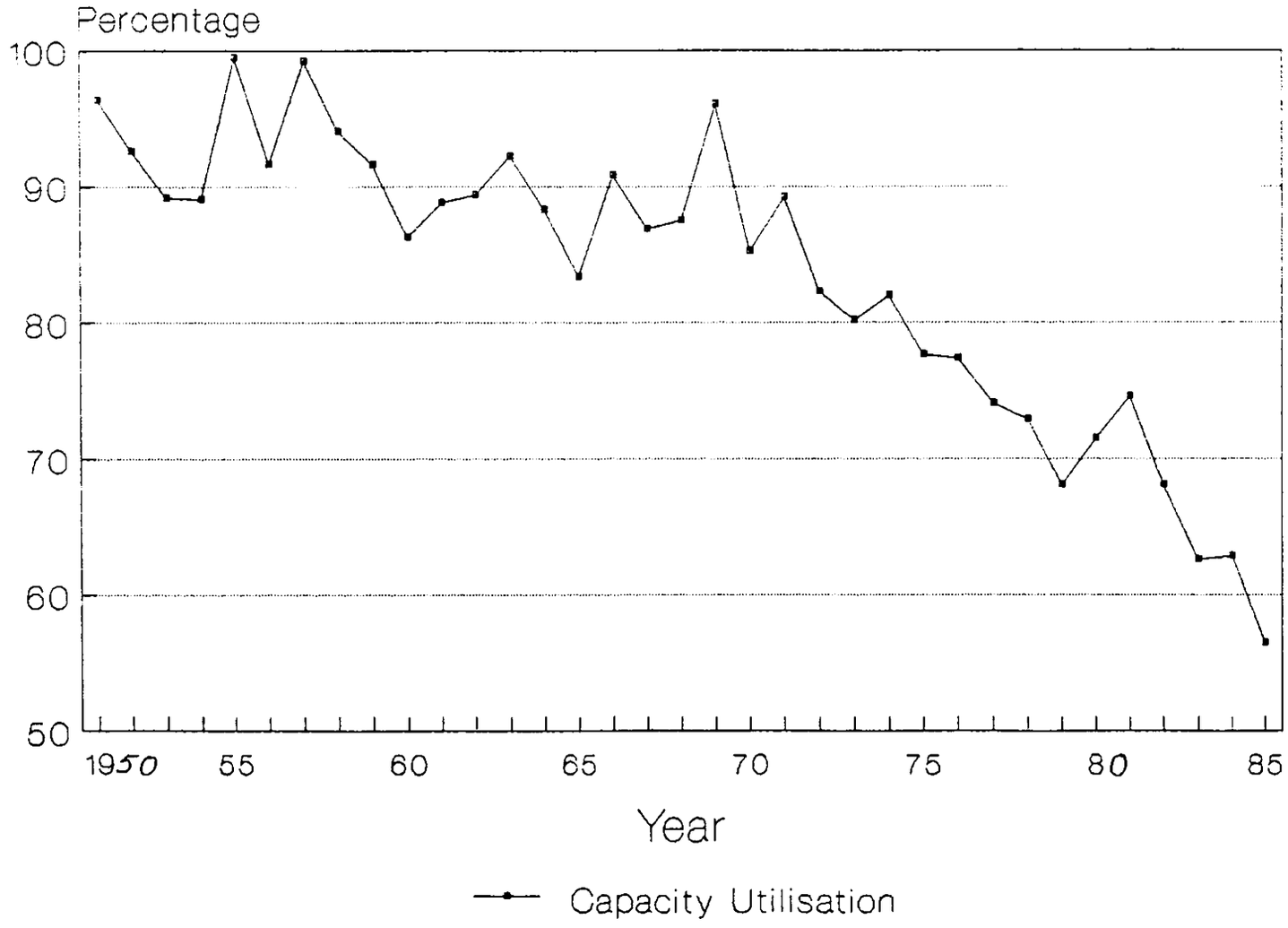


Table 3.5 Paper and Paper Board : Growth Rates of Output, Installed Capacity, Number of Units and Capacity Utilisation, 1951 to 1985

	Year							
	1951	1961	1971	1981	1985	t	t^2	R^2
Output	6.60	3.80	0.60	-2.40	-4.00	0.07 (56.9)	0.00 (-11.6)	0.92
Installed Capacity	7.90	6.10	4.10	2.10	1.10	0.08 (58.3)	0.00 (5.56)	0.93
Number of Units	7.80	9.30	11.00	12.70	13.50	0.08 (27.33)	0.00 (2.7)	0.96
Capacity Utilisation	-1.20	-2.20	-3.20	-4.20	-4.80	-0.12 (-15.2)	-0.01 (-6.4)	0.89

Note 1. The estimated equation is $\ln Y = a + bt + ct^2 + u$

2. All the estimated coefficients are significant at 5 per cent level.

Table 3.6 Paper and Paper Board : Growth Rates of Output, Installed Capacity, Number of Units and Capacity Utilisation, 1973-74 to 1985-86

	Year									
	1973-74	1974-75	1976-77	1978-79	1980-81	1982-83	1985-86	t	t^2	R^2
Output	5.00	5.00	5.00	5.00	5.00	5.00	5.00	0.05* (19.7)	0.37 (0.37)	0.97
Installed Capacity	8.20	8.80	9.60	10.30	11.00	11.70	12.48	0.08* (25.3)	0.01 (2.02)	0.94
Number of Units	12.90	14.70	16.50	18.30	20.10	21.90	23.70	0.12* (16.09)	0.00 (1.95)	0.96
Capacity Utilisation	-2.82	-3.50	-4.10	-4.70	-5.40	-6.02	-6.70	0.03* (-8.54)	0.00 (-1.86)	0.88

Note The estimated equation : $\ln Y = a + bt + ct^2 + u$
* Significant at 5 per cent level.

declining around 1975. But when one takes the time period as 1973-74 to 1985-86 (Table 3.6) the growth rate has been found to be uniform at 5 per cent per annum. However, in both the time references the capacity utilisation has been declining at an increasing rate. Alarmingly, the decline in the rate of growth has been found to be more in recent years. Similarly, the rate of increase in number of units has also been substantial. As shown in the table the number of units increased by 12.90 per cent per year in 1973-74 which further increased by 23.7 per cent per year in 1985-86. As expected, the rate of increase in installed capacity has been positive and significant, i.e., 8.2 per cent in 1973-74 and 12.48 in 1985-86.

Now it is worthwhile to examine whether there is any turn around in the trend movements recently by estimating a kinked exponential model. The coefficients of the estimated equation are given in Table 3.7. In general, the results reinforces the earlier findings that between 1973-74 and 1985-86 the output has been growing at an annual percentage rate of 5 per cent per annum, the growth rate has been accelerating in the case of installed capacity and number of units, and there has been a progressive decline in capacity utilisation. The output registered a constant growth rate of 5 per cent per annum for the entire period - before the kink (at 1978-79) and after the kink. The growth rate of

Table 3.7 Paper and Paper Board : Growth Rates of Output, Installe Capacity, Number of Units and Capacity Utilisation, Using Kinked Exponential Model, 1973-74 to 1985-86

	Constant	B	C	R^2
Output	1.99	0.05 (7.7)	0.05 (9.6)	0.97
Installed Capacity	2.17	0.07 (8.09)	0.09 (11.9)	0.98
Number of Units	4.10	0.09 (4.69)	0.15 (9.678)	0.96
Capacity Utilisation	4.40	-0.02 (-2.06)	-0.03 (4.89)	0.86

Note : The estimated equation: ln Y = A+B(D1t + D2k)+c(D2t - D2k)+e
The kink at 1978.
All the estimated equations are significant at 5 per cent level.

installed capacity increased from 7 per cent to 9 per cent between 1973-74 to 1978-79 and 1978-79 to 1985-86. While the number of units registered 9 per cent and 15 per cent growth rates for the two periods respectively, the estimated growth rates for the capcity utilisation for the two time periods were -2 per cent and -3 per cent respectively.

From the above analysis it emerges that there has been an increase in total output which stabilised at 5 per cent per annum since 1973, that the rate of growth of capacity and number of units have been on the increase, and that the capacity utilisation has been declining at an increasing rate.

Newsprint

Compared to paper and paper board, newsprint industry is very young in India. Production commenced only in 1955-56 with a very low quantity of 11,000 tonnes per annum. As in the case of paper and paper board, there has been a remarkable growth in production and installed capacity. The installed capacity for newsprint has increased from 0.75 lakh tonnes in 1971-72 to 2.8 lakh tonnes in 1985-86. Production has shot up from 0.4 lakh tonnes to 2.7 lakh tonnes over the same period. However, the newsprint sector is not able to meet the requirements of the domestic demand. In 1972-73 domestically produced newsprint met only 20 per cent of total

consumption of newsprint. In 1983-84, the share of the Indian newsprint in total consumption had gone upto 58 per cent. Imports of newsprint peaked in 1980 being 3.2 lakh tonnes, but have been declining since then (Table 3.8).

Installed capacity, production and capacity utilisation of newsprint from 1956 to 1985 are given in Table 3.9. It can be observed that the installed capacity remained the same at 0.3 lakh tonnes till 1969. In the seventies also the capacity had been more or less constant. The eighties witnessed a spurt in installed capacity. It appears that there has been wide fluctuations in output and capacity utilisation, and it is more spectacular in capacity utilisation.

The coefficients of the estimated equations and growth rates are presented in Table 3.10 and Table 3.11. In both of the time frames - 1956 to 1985 and 1973 to 1985 - installed capacity and production have been increasing at an increasing rate, and the rate of growth has been more pronounced in the latter period. Apparently, there is not any significant trend in capacity utilisation (the estimated coefficients are statistically insignificant) as a consequence of wide fluctuations (see Figure 3.2 also).

Table 3.8 : NEWSPRINT INDUSTRY: Production, Imports and Consumption (Lakh Tonnes)

Year	Production	Imports	Consumption
1972	0.42	1.54	1.96
1973	0.35	1.17	1.52
1974	0.55	1.41	1.96
1975	0.52	1.09	1.61
1976	0.57	1.25	1.82
1977	0.57	1.68	2.25
1978	0.48	2.32	2.80
1979	0.48	3.13	3.61
1980	0.48	3.18	3.66
1981	0.64	3.06	3.70
1982	1.19	2.00	3.19
1983	1.63	1.93	3.56
1984	1.90	2.40	4.30
1985	2.70	1.96	4.66

Note : Consumption of newsprint is estimated by adding production and imports

Source: Directorate General of Technical Development. Reproduced in Alka Subramanian, (1987), "Small is not Beautiful: A Study on the Paper Industry". Indian Industrialisation, Centre for Development Studies, Trivandrum, pp. 7-9.

Table 3.9: NEWSPRINT INDUSTRY: Production, Installed Capacity and Capacity Utilisation (Lakh Tonnes)

Year	Production	Installed Capacity	Capacity Utilisation (%)
1956	0.110	0.305	36
1957	0.147	0.305	48
1958	0.221	0.305	73
1959	0.225	0.305	71
1960	0.226	0.305	74
1961	0.257	0.305	84
1962	0.249	0.305	82
1963	0.304	0.305	100
1964	0.288	0.305	94
1965	0.305	0.305	100
1966	0.293	0.305	96
1967	0.310	0.305	102
1968	0.308	0.300	103
1969	0.353	0.300	118
1970	0.773	0.440	85
1971	0.401	0.750	53
1972	0.421	0.750	56
1973	0.345	0.750	46
1974	0.548	0.750	73
1975	0.520	0.750	69
1976	0.574	0.750	77
1977	0.566	0.750	75
1978	0.481	0.750	64
1979	0.484	0.750	65
1980	0.475	0.750	63
1981	0.643	0.750	86
1982	1.189	2.300	52
1983	1.632	2.300	71
1984	1.900	2.300	83
1985	2.700	2.800	96
1986	2.750	2.880	96
1987	2.870	3.320	90
1988	3.100	3.320	95

Source:(1) Directorate General Tecnical Deevelopment, Annual Report, Variou Issues.
(2) "Paper and Paperboards", Data Bank 1989, The Economic Times, p.121.

Table 3.10 Newsprint : Growth Rates of Output, Installed Capacity, and Capacity Utilisation, 1956 to 1985

	Year							
	1956	1961	1971	1981	1985	t	t^2	R^2
Installed Capacity	7.70	10.70	16.70	22.70	25.10	0.071* (13.5)	0.003* (4.7)	0.88
Production	0.81	7.50	9.10	12.40	15.70	0.0719* (10.85)	0.002** (1.9)	0.81
Capacity Utilisation	0.09	NS	NS	NS	NS	0.001 (0.17)	-0.001 (-1.14)	0.09

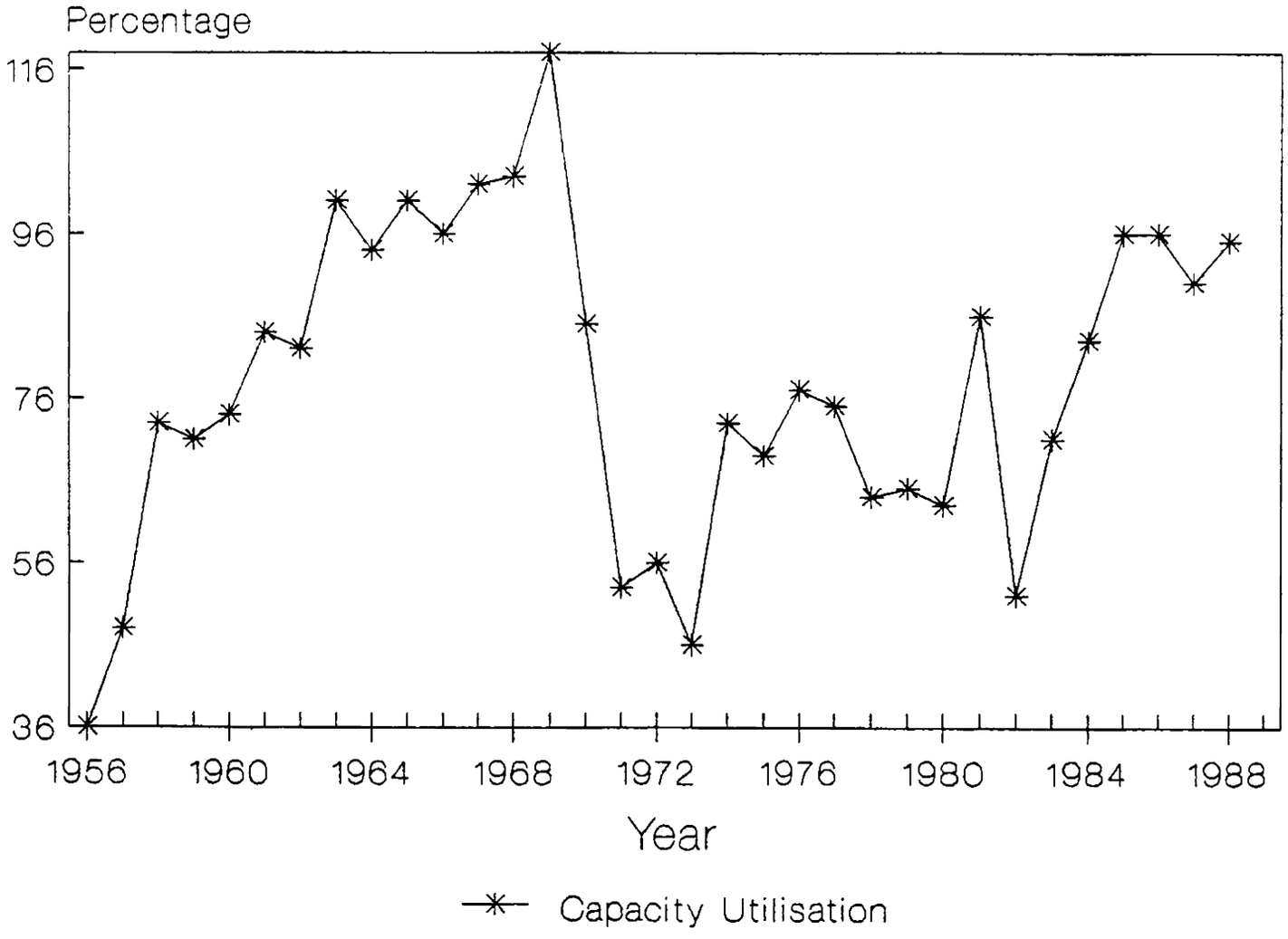
Note : The estimated equation : $\ln Y = a + bt + ct^2 + u$
* Significant at 5 per cent level.
** Significant at 1 percent level.
NS - No significant trend.

Table 3.11 : Newsprint: Growth Rates of Installed Capacity, Production and Capacity Utilisation 1973-74 to 1985-86

	Year									
	1973-74	1974-75	1976-77	1978-79	1980-81	1982-83	1985-86	t	t^2	R
Installed Capacity	15.30	22.50	29.70	36.90	44.10	51.30	58.50	0.117* (6.49)	0.018* (3.47)	0.8
Production	17.90	25.90	33.90	41.90	49.90	57.90	65.90	0.139* (8.19)	0.020* (3.9)	0.8
Capacity Utilisation	NS	NS	NS	NS	NS	NS	NS	0.023 (1.61)	0.001 (0.221)	0.2

Note : The estimated equation : $\ln Y = a + bt + ct^2 + u$
* Significant at 5 per cent level.
NS - No significant trend.

Figure 3.2 NEWSPRINT
Capacity Utilisation



Thus, the growth pattern of newsprint sector of the paper industry has also been subjected to wide fluctuations. While the output fluctuates around a positive trend, there is no trend at all in the rate of capacity utilisation due to erratic movements.

The results of the estimated kinked exponential model to see whether there is any significant difference between the growth rates of seventies and eighties are presented in Table 3.12. The results show that there is a discernible difference between the growth rates of output between the two time periods: the growth rates being 2.8 per cent per annum during seventies and 38 per cent per annum in eighties. The coefficient of the equations estimated for installed capacity and capacity utilisation are not statistically significant.

A comparison of the performance of paper and paper board and newsprint taking 1973 to 1985 as the reference period would evince that the capacity and production growth rates in newsprint have been much higher than that of its counterpart, the paper and paper board. However, in the case of capacity utilisation, while the former showing a decreasing trend the latter has no trend at all, tending to suggest that there has been a great level of inefficiency in the resource use.

Table 3.12 : Newsprint :- Growth Rates of Output, Installed Capacity, Capacity Utilisation, Using Kinked Exponential Model, 1973-74 to 1985-8

	Constant	B	C	R^2
Output	-0.57	0.028*	0.38*	0.89
		(1.35)	(10.08)	
Installed Capacity	-0.35	0.02	0.32	0.87
		(0.69)	(6.2)	
Capacity Utilisation	4.13	0.01	0.05	0.24
		(0.38)	(1.17)	

Note : The estimated equation : ln Y = A + B(D1t + D2k) + c(D2t - D2k) + The kink at 1980

* Significant at 5 per cent level.

Targets and Achievements of the Industry During Five Year Plans

Achievement of self-sufficiency and increase in the per capita consumption of paper have been the major planks of the Government's policy regarding the paper industry. The Planning Commission has been estimating the anticipated demand for paper and the capacity and the production targets required for the various Five Year Plans. The actual achievements in terms of both installed capacity and production have generally fallen short of the plannned targets except at the end of the Sixth and Seventh Five Year Plans. During the First Five Year Plan period, targets of 2.14 lakh tonnes of capacity and 2.03 lakh tonnes of production were fixed for the industry. As it turned out, the capacity target was fully achieved while the production at the end of the First Plan period was 1.90 lakh tonnes, an achievement of 93 per cent of the target (Table 3.13). During the Second Five Year Plan period capacity and production targets were 4.57 lakh tonnes and 3.56 lakh tonnes respectively, against which achievements were 4.30 lakh tonnes for capacity and 3.50 lakh tonnes for production. For the Third Five Year Plan capacity target was fixed at 8.53 lakh tonnes while the achievement was 6.69 lakh tonnes. Production target for this period was 7.11 lakh tonnes while achievement was 5.88 lakh tonnes.

Table 3.13. : Targets and Achievements Under Five Year Plans in Indian Paper Industry (in lakh tonnes)

At the end of	Capacity			Production		
	Target	Achiev-ement	Surplus/ Shortfall	Target	Achiev-ement	Surplus Shortfal
First Plan (1951-56)	2.14	2.14	*	2.03	1.90	-0.13
Second Plan (1956-61)	4.57	4.30	-0.27	3.56	3.50	-0.06
Third Plan (1961-66)	8.53	6.69	-1.64	7.11	5.88	-1.53
Annual Plan (1966-67) to (1968-69)	7.50	7.30	-0.20	6.35	6.58	0.23
Fourth Plan (1969-74)	*	9.92	*	8.50	8.25	-0.25
Fifth Plan (1974-79)	13.00	11.37	-1.63	10.50	9.00	-0.50
Sixth Plan (1980-85)	16.50	18.16	1.66	12.50	12.36	-0.14
Seventh Plan (1985-90)	23.17	25.00	1.83	NA	NA	NA

Note: * Specific Figures are not fixed
Source: Dr. C.Sivarami Reddy and P. Mohan Reddy (1989), "Indian Pape Industry Problems and Prospects, Indian Journal of Marketing Vol.XIX, No. 6-7, New Delhi, p.27.

Achievements in proportion to the targets at 80 per cent for capacity and 78 per cent for production in the Third Five Year Plan were lower than in the First and the Second Plans. These shortfalls were due to the imposition of price control on the industry by the Government subsequent to rising prices of paper. During this period the paper industry also faced a shortage of raw materials. The imposition of price control reduced the profitability and hence the attraction for new private investments in paper industry.[3]

During the period of Annual Plans, 1966-67 to 1968-69 capacity target of 7.50 lakh tonnes was fixed for the paper industry, against which the actual capacity created at the end of this period was of the order of 7.30 lakh tonnes. Production target for this period at 6.35 lakh tonnes was surpassed, the actual production at the end of this period being 6.58 lakh tonnes.

While no capacity target was fixed for the paper industry in Fourth Five Year Plan, the production target was 8.50 lakh tonnes. At the end of the Fourth Plan capacity was 9.92 lakh tonnes and production was 8.25 lakh tonnes.

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[3]Commerce Research Bureau (1982), "Paper Industry: A Profile", Commerce, Vol.145, No.3725, October 30, P.4.

For the Fifth Five Year Plan the Planning Commission had fixed the capacity target at 13 lakh tonnes, whereas for production the target was 10.50 lakh tonnes. Achievements in the Fifth Plan were, for capacity 11.37 lakh tonnes or 87 per cent of the target and for production 9 lakh tonnes or 86 per cent of the target. The Sixth Plan had fixed the targets at 16.50 lakh tonnes for capacity and 12.50 lakh tonnes for production. During the Seventh Plan period, the target of capacity was 23.17 lakh tonnes, against which achievement was 25 lakh tonnes, a surplus of 1.83 lakh tonnes.

In sum, though the history of the paper industry in India dates back to a very long period, its development took a dynamic path with the introduction of the Five Year Plans. During the plan period, output of the industry increased substantially. As a result, the paper and paper board sector of the industry at present is capable of meeting almost the entire domestic demand. But in the case of newsprint sector, the output is still short of domestic demand. An important feature of the development of the paper industry in India is the progressive decline in capacity utilisation.

Chapter IV

PRODUCTIVITY, LABOUR ABSORPTION AND ECONOMIES OF SCALE

The survey of literature and the historical review provide necessary background for one to focus attention on the comparative performance of the paper industry. The performance evaluation is made in terms of productivity and employment potential. Therefore, the present chapter is divided into two parts - part A deals with productivity and part B analyses labour absorption. Part B also examines the scale economies.

A. Productivity

Efficiency of the paper industry with that of the group of industries, namely, intermediate goods industries, is attempted here in terms of productivity. The intermediate goods industries have been identified by grouping the industries of the State on the basis of use-wise classification into basic industries, intermediate goods industries, capital goods industries and consumer goods industries. Before going to analyse the productivity a brief account of the concept, measurement and limitations of productivity is in order since the concept of productivity is not unambiguous.

Productivity may be defined as a measure of the efficiency with which resources are converted into commodities and services. Higher productivity is a means to better levels of economic well-being and greater national strength. Therefore, productivity change is both the cause and the consequences of dynamic forces operative in an economy - technological progress, accumulation of human and physical capital, entrepreneurship, and institutional arrangements.[1] Indeed, in one way or another, productivity enters virtually every broad economic problem, whatever form current or new the problem takes - industrialisation, or research and development, or automation, or tax reform, or cost-price squeeze, or improvement factor, or wage inflation, or foreign dollar shortage.[2]

The nation's product or real income may be said to have grown either through increases in the volume of resources available for use in production or through increases in productivity, or the efficiency with which these resources are turned into product. Adam Smith gave a classic expression to the role of productivity advance in national economic growth when he wrote: "The annual produce of the land and labour of any nation can be increased in

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[1]M. Ishaq Nadiri (1970), "Some Approaches to the Theory and Measurement of Total Factor Productivity: A Survey", Journal of Economic Literature, Vol.2., p.1137.

[2]Solomon Fabricant (1961), "An Introduction by Solomon Fabricant" in John W. Kendrick (1961) Productivity Trends in the United States, NBER, No.71., Princeton University Press, Princeton, p.I.

its value by no other means, but by increasing either the number of its productive labourers, or the productive powers of those labourers who had before been employed... in consequence either of some addition and improvement to those machines which facilitate and abridge labour; or of a more proper division and distribution of employment".[3]

The measure of productivity has many applications. These relate to productivity indices as measures of performance and thus as a means of motivating improved efficiency; their use in the analysis of factors that promote productivity advance as a basis for production and policy formation; and their use in the analysis of dynamic economic relationships, again as a background for prediction and policy decisions.

Sources of Factor Productivity

Numerous forces are involved in the changes in productivity and the task of sorting them into well-specified categories is a difficult and hazardous one. Nonetheless, two major sets of factors have been suggested as the determinants of factor productivity: the technical characteristics of production process

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[3]Adam Smith (1937), An Inquiry Into the Nature and Causes of Wealth of Nations, Random House, New York, p.326.

and the movement of the relative factor prices.[4] The often mentioned technical characteristics are:

1. efficiency of production, i. e., reducing the unit cost of all factors of production equally by applying better techniques;
2. bias in technical change, i.e., the nature of the new techniques is such that it leads to a greater saving in one input than in the other;
3. elasticity of substitution, which measures the ease of exchanging the factors of production in the course of the production process;
4. scale of operation of the production process, i.e., economies (diseconomies) that arise due to changes in the scale of operation, i.e., whether the returns to scale are evenly distributed among all factors of production.

Productivity and Technological Change

Among the factors that influence productivity, technical change is the most important one. Indeed, in empirical analysis, productivity is synonymous with technological change - in estimating productivity a number of assumptions are being made which set productivity as technological change.

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[4]Ishaq Nadiri (1970), op. cit., p.1141.

Generally, industrial technology can be defined as the knowledge regarding the industrial arts existing at a point of time. Given the amount of input, the prevailing technology sets limit on how much can be produced. Therefore, technological progress is the improvement in the knowledge about the industrial arts and implies that either a greater output can be got with the same volume of inputs or the same output with lesser inputs.[5]

Measures of Productivity

Partial Productivity

Ratios of output to particular inputs may be termed as "partial productivity" measures.[6] There are as many indices of partial productivity as there are factors of production. While each index has its own use, the most important and most often used are the partial productivity indices of labour and capital respectively. Symbolically, these indices are:

$$AP_L = \frac{Q}{L} \qquad \ldots\ldots(4a.1)$$

$$AP_K = \frac{Q}{K} \qquad \ldots\ldots(4a.2)$$

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[5]S. S. Mehta (1980), Productivity, Production Function and Technical Change - A Survey of Indian Industries, Concept Publishing Co., New Delhi, p.13.

[6]John W. Kendrick (1961), Productivity Trends in the United States, NBER, No.71, Princeton University Press, Princeton, p.6.

where AP_L and AP_K are average productivity of labour and capital, Q is the total output/value added, L, labour and K, the capital.

The partial productivity ratios, while useful for measuring the saving in particular inputs achieved overtime, do not measure over-all changes in productive efficiency, since they are affected by changes in the composition of input, i.e., by factor substitutions.

Total Factor Productivity

While the partial productivity indices of labour and capital are simply the average product of labour and capital, the total factor productivity, often referred to as the 'residual' or index of "technical progress", is defined as output per unit of all factors of production combined. It is useful to have a composite measure of productivity which relates output to all the conventional inputs simultaneously. The concept of total factor productivity defined as the ratio between real product or output and real factor input (a weighted sum of the different inputs) was introduced by Tinbergen in 1942 when he attempted an international comparison of productivity growth.[7]

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[7]K. L. Krishna (1987), "Industrial Growth and Productivity in India" in P. R. Brahmananda and V. R. Panchamukhi (ed.) (1987), The Dvelopment Process of the Indian Economy, Himalaya Publishing House, Delhi. p.365.

There are many methods to measure the total factor productivity and the measures differ on account of the differences in the underlying production function. However, the three indices most often used in empirical research are Kendrick's arithmetic measure, Solow's geometric measure and Translog productivity index. The Kendrick index of total factor productivity corresponds to the production function linear in inputs; the Solow index is based on Cobb-Douglas form; and the Translog productivity is estimated as a discrete approximation to the continuous changes in 'divisia quantity index'.

Kendrick Measure of Total Factor Productivity

Kendrick approaches measurement of productivity growth (dA/A) using a distribution equation. He implicitly assumes a homogeneous production function and the Euler condition to obtain the following measure.[8]

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[8]The weights in this measure changes over time and the aggregate production function consistent with this index is

$$Q = \frac{tKL}{(cL^{\rho} + dK^{\rho})^{\frac{1}{\rho}}}$$

which is a linear homogeneous production function with constant elasticity of substitution, $\sigma = \frac{1}{(1 + \rho)}$, c and d are the efficiency parameters, and t is the disembodied neutral technical change. See Ishaq Nadiri (1970), op. cit., p.1138-1139.

$$\frac{dA}{A} = \frac{Q/Q_0}{(wL_1 + rK_1)/(wL_0 + rK_0)} \qquad \ldots\ldots(4a.3)$$

where w and r are wage rate and the rate of return on capital respectively, and variables with subscript '1' refer to the current period and those with the subscript '0' refer to the base period. In empirical esimates the weights for calculating (4a.3) are often permitted to change smoothly over time. Under the assumption of competitive equilibrium the Kendrick measure (4a.3) can be stated as:

$$\frac{dA}{A} = \frac{Q_1/Q_0}{\alpha_0(L_1/L_0) + \beta_0(K_1/K_0)} \qquad \ldots\ldots(4a.4)$$

In the present study the estimable equation for the Kendrick measure of total factor productivity growth is given by

$$\frac{\Delta A_t}{A_t} = g_V(t) - w_0\, g_L(t) - r_0\, g_K(t) \qquad \ldots\ldots(4a.5)$$

where $g_V(t)$ = growth of value added,
$g_L(t)$ = growth of total employees,
$g_K(t)$ = growth of capital.

$$w_0 = \frac{W_0}{L_0} \qquad \ldots\ldots(4a.6)$$

$$r_0 = \frac{V_0 - W_0}{L_0} \qquad \ldots\ldots(4a.7)$$

Where W = total emoluments

And growth of a variable, X , is approximated by

$$g_X(t) = \ln\left(\frac{X_t}{X_{t-1}}\right) \quad \ldots\ldots(4a.8)$$

The total factor productivity index ($\bar{g}_t$) is derived by taking $A_0 = 1$ and employing

$$\ln\left(\frac{\Delta A_t}{A_t}\right) = \bar{g}_t \quad \ldots\ldots(4a.9)$$

The Solow Measure of Total Factor Productivity

Solow[9] has devised a measure of total factor productivity by specifying a simultaneous equation system. He has used the production function approach by taking the following assumptions:

i. the production function is of Cobb-Douglas type[10],
ii. the factors are paid according to their marginal products,
iii. there is constant returns to scale, and
iv. the technical change is of neutral type.

$$Y = A(t)\, f(K, L) \quad \ldots\ldots(4a.10)$$

where K and L represent capital and labour respectively and the multiplicative factor A(t) measure the cumulated effects of shifts

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[9]Solow R. M. (1957), "Technical Change and Aggregate Production Function", Review of Economics and Statistics, Vol.33., No. 3., pp.312-320.

[10]A detailed discussion on various production functions is given in Appendix I.

in the function. Taking the total differential of equation (4a.10) with respect to time and dividing by Y yields,

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \left[\frac{Af_k.K}{Y}\right]\frac{\dot{K}}{K} + \left[\frac{Af_l.L}{Y}\right]\frac{\dot{L}}{L} \quad ...(4a.11)$$

Where Y is physical output and the dots are time derivatives. While Af_k and Af_l represent the marginal products of capital and labour respectively, the terms in the square brackets are the elasticities of value added with respect to the two factor inputs, respectively. Assuming the economy is in a competitive equilibrium so that the factors are paid the value of their marginal products, output elasticities become equal to the income shares of the respective factors of production, i.e., SL and SK, and thus

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \left[SK.\frac{\dot{K}}{K} + SL.\frac{\dot{L}}{L}\right] \quad ...(4a.12)$$

Solving the equation (4a.12) for $\frac{\dot{A}}{A}$,

$$\frac{\dot{A}}{A} = \frac{\dot{Y}}{Y} - \left[SK.\frac{\dot{K}}{K} + SL.\frac{\dot{L}}{L}\right] \quad ...(4a.13)$$

The above equation shows that the total factor productivity can be measured as a difference between the rate of growth of value added and the rate of growth of total factor input.

In the present empirical estimation the Solow measure of total factor productivity is obtained by the following equation.

$$\frac{\Delta A(t)}{A(t)} = g_V(t) - SL(t)\, g_L(t) - (1 - SL(t))\, g_K(t) \quad \ldots\ldots(4a.14)$$

where V is gross value added, L, total persons employed, K, gross fixed capital, SL, share of labour ($\frac{W}{L}$), where W is the total emoluments, and t represents time reference.

Now growth may be approximated as

$$g_X(t) = \ln\left(\frac{X_t}{X_{t-1}}\right) \quad \ldots\ldots\ldots(4a.15)$$

The total factor productivity index ($\bar{g}_t$) is derived by taking $A_0 = 1$ and employing

$$\ln\left(\frac{\Delta A(t)}{A(t)}\right) = \bar{g}_t \quad \ldots\ldots\ldots(4a.16)$$

Translog Measure of Total Factor Productivity

Christensen, Jorgenson and Lau[11] developed the total factor productivity from explicitly specified Translog Production

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[11]Christensen L. R., Jorgenson D. W. and Lau L. J. (1973), "Transcendental Logarithmic Production Frontiers", Review of Economics and Statistics., Vol.55., No.1., pp.25-45.

Function. It provides a second order approximation to an arbitrary twice - continuously - differentiable production function and also accommodates varying elasticity of substitution ranging from 0 to ∞. In fact, it is a discrete approximation to the continuous changes in divisia quantity index.[12] Its specification, with two inputs is given by

$$\ln Y = \alpha_0 + \alpha_K \ln K + \alpha_L \ln L + \alpha_T T + \frac{1}{2}\beta_{KK}(\ln K)^2 + \beta_{KL}(\ln K \ln L) + \frac{1}{2}\beta_{LL}(\ln L)^2 + \beta_{KT}(\ln K)T + \frac{1}{2}\beta_{TT}T^2 + \beta_{LT}(\ln L)T \quad \ldots\ldots\ldots(4a.17)$$

where Y, K and L represent output, capital and labour respectively and T denotes time trend as a proxy for technical change. When one imposes the assumptions of competitive equilibrium, Hick's neutral technical change, and differentiating (4a.17) totally with respect to time and rearranging the term, one has

$$A_T = (\ln Y_T - \ln Y_{T-1}) - SL(\ln L_T - \ln L_{T-1}) - SK(\ln K_T - \ln K_{T-1}) \quad \ldots\ldots(4a.18)$$

where $SL = (SL_T + SL_{T+1})/2$

$SK = (SK_T + SK_{T+1})/2$

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[12]For derivation see Goldar (1986), Productivity Growth in Indian Industry, Allied Publishers, New Delhi., pp.15-20.

The expression in (4a.18) is the average rate of technical change for the period (T-1, T). It is the difference between successive natural logarithm[a] of output minus a weighted average of the differences between successive logarithms of inputs, weights being the corresponding average value shares. Moreover, sources of growth of output can be computed as follows; contribution of labour to output growth is

$$[\ SL(\ln L_T - \ln L_{T-1})\ ] \ /\ [\ \ln Y_T - \ln Y_{T-1}\ ] \qquad .....(4a.19)$$

contribution of capital to output growth is given by

$$[\ SK(\ln K_T - \ln K_{T-1})\ ] \ /\ [\ \ln Y_T - \ln Y_{T-1}\ ] \qquad .....(4a.20)$$

The contribution of total factor productivity to output growth is arrived at the residuals of the contributions of labour (L) and capital (K) to output growth.

In the present study the translog measure of the total factor productivity growth is given by

$$\frac{\Delta A(t)}{A(t)} = g_V(t) - \frac{SL(t) + SL(t-1)}{2}\ g_L(t) - \frac{(1 - SL(t) + (1 - SL(t-1)}{2}\ g_K(t) \qquad .....(4a.21)$$

where $\frac{\Delta A(t)}{A(t)}$ is the, total factor productivity growth, V, value added, L, total persons employed, K, gross fixed capital, SL, share of labour ($\frac{W}{L}$), where W is the total emoluments, and t

refers to time reference. The total factor productivity index ($\bar{g}_t$) is derived by taking $A_0 = 1$ and employing

$$\ln \left(\frac{\Delta A(t)}{A(t)} \right) = \bar{g}_t \quad \ldots\ldots(4a.22)$$

Before analysing the productivity performance of the industries certain limitations on the use of productivity measures must also be noted. Such measures are not precision tools of analysis, but are subject to unknown and probably not inconsequential margins of error.[13] Their meaning must be interpreted carefully in the light of knowledge as to their construction. Their relationship with other variables must likewise be interpreted cautiously, particularly regarding inferences of causality. They are clearly not "all-purpose" indices, but must be used in conjunction with other measures in order to assess progress in the broader realms of social and economic efficiency as contrasted with the narrower realms of technological efficiency. In the first place, it bears that the partial productivity ratios, somewhat misleadingly labelled "labour productivity" or "capital productivity" do not measure changes in the efficiency of a particular resource nor changes in productive efficiency in general. They are influenced not only by the other factor, but also by factor substitutions.

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[13]John W. Kendrick (1961), op. cit., pp.18-19.

An even cruder fallacy is to confuse productivity with production or capacity measures. Total productivity measures provide an index of efficiency in the use of resources, but do not allow for the degree of utilisation of available resources. Productive efficiency may be rising, but if part of the output potential is lost by underutilisation, this is an offset which must be taken into account in any over-all appraisal of the economic system.[14] Actually, productivity indices are affected by cyclical fluctuations; but this is only part of the waste involved in lapses from relatively full employment of resources.

Measures of productivity also do not provide an index of "economic efficiency" as such. That is, one cannot tell from productivity measure whether or not the various types of resources are employed in their most productive uses at each given stage of technology, resource development, and wants. To the extent that there are monopolistic practices or impediments to the mobility of resources, the relative prices of products differ from those that would prevail under perfect competition; the allocation of the factors is somewhat distorted; and the factors do not review the exact value of their marginal products. Changes in economic efficiency affect productivity measures only indirectly.

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[14]The question of utilisation of capacity is taken up in chapter V for detalied analysis.

In order to analyse the comparative performance of the paper industry against the group of intermediate goods industries which include this industry as well, productivity indices have been estimated for the paper industry, the four groups of industries and for the industrial sector of the State. For partial productivities, labour productivity and capital productivity are estimated, and for total factor productivity, the measures estimated are the Kendrick, Solow and Translog.

The estimated productivity indices show that the performance of pulp and paper industry has been very poor compared to the average industrial productivity of Kerala. The decline in productivity of the industry is not only in partial productivity but in total factor productivity also. Moreover, all the productivity measures have been declining at a rate greater than that of the intermediate goods industries and the industrial sector of the State. It can be seen, from the estimations, that all the three measures of total factor productivity are giving consistant results, though there are differences in absolute values.[15] This reinforces the appropriateness of the methodology that has been adopted for the empirical study.

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[15]An index of productivity gives only a relative measure of efficiency. Inter-industry comparison with absolute values of these indices is invalid.

An attempt has been made to draw some inferences on the productivity of the paper industry based on the empirical findings. The partial factor productivity estimates for the paper industry, the four groups of industries and the industrial sector of the State are presented in Table 4a.1.[16]

From the table, it can be seen that for the industrial sector as a whole and for the four industrial groups labour productivity has been increasing while the paper industry witnessed a steep decline in labour productivity upto 1983-84. The growth rate is estimated at -5.26 (see Figure 4a.1. also). For the industrial sector as a whole the labour productivity index remained more or less same until 1982-83 and since then it increased to 149. Between 1973-74 and 1985-86 the growth rate is estimated at 3.97. Among the four groups of industries the highest rate of growth in labour productivity is recorded in capital goods industries (3.8) followed by consumer goods industries (2.55), basic industries (2.37) and intermediate goods industries (1.44). In sum, the labour productivity in the paper industry has been declining while, on the whole, the industrial sector of the State witnessed an increase in labour productivity.

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[16]For detalied tables on productivity estimates see Appendix II

Table 4a.1: LABOUR PRODUCTIVITY INDEX (1973-74 = 100)

Year	Pulp and Paper	Basic Industries	Capital Goods Industries	Intermediate Goods Industries	Consumer Goods Industries	The Stat Industria Secto
1973-74	100	100	100	100	100	100
1974-75	139	100	129	98	96	99
1975-76	107	32	120	103	93	77
1976-77	43	57	144	45	96	85
1977-78	68	54	114	92	87	86
1978-79	44	67	159	81	85	98
1979-80	52	64	187	106	110	114
1980-81	61	73	157	71	95	103
1981-82	33	84	200	66	71	100
1982-83	10	91	171	94	106	124
1983-84	19	74	186	86	124	123
1984-85	128	86	159	90	138	133
1985-86	171	91	153	148	132	149
Growth rates:	-5.26	2.37	3.8	1.44	2.55	3.97

Note : Growth rates are estimated by estimating an exponential trend.

Figure 4a.1 LABOUR PRODUCTIVITY INDEX
(1973/74 = 100)

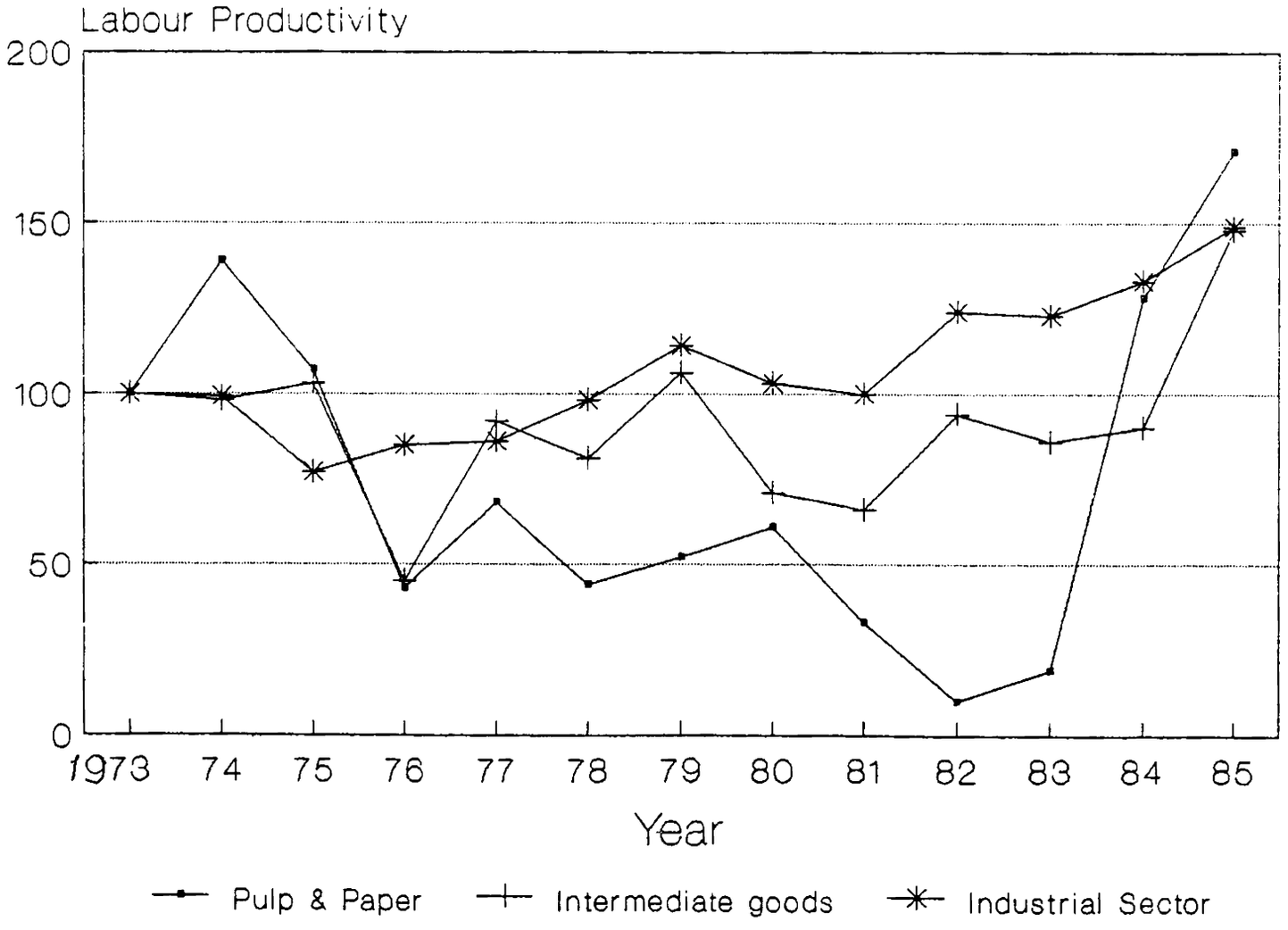


Table 4a.2 presents capital productivity estimates. In contrast to the trend of increasing labour productivity, there has been a decline in capital productivity and all the estimates show similar trends in this respect (see Figure 4a.2.). However, it is interesting to note that the highest decline is found in the paper industry. In the case of the industrial sector as a whole of the State the index had fallen to a trough of 64 in 1985-86 and the estimated growth rate between 1973-74 and 1985-86 is -4.1. Capital productivity in the paper industry met a trough of 5 in 1982-83 and since then improved but only upto 33 in 1985-86. The growth rate is estimated at -14.17 between 1973-74 and 1985-86. It is important to note that this decline is greater than that of the intermediate goods industries (-9.5) which includes the paper industry. Among the four groups of industries the highest decline in capital productivity is found in intermediate goods industries (-9.5) followed by consumer goods industries (-7.5), capital goods industries (-3.7) and basic industries (-0.8). Thus, in general, there has been a decline in capital productivity and the decline in the paper industry in particular is found to be discernibly higher than that of the four groups of industries and the industrial sector of the State.

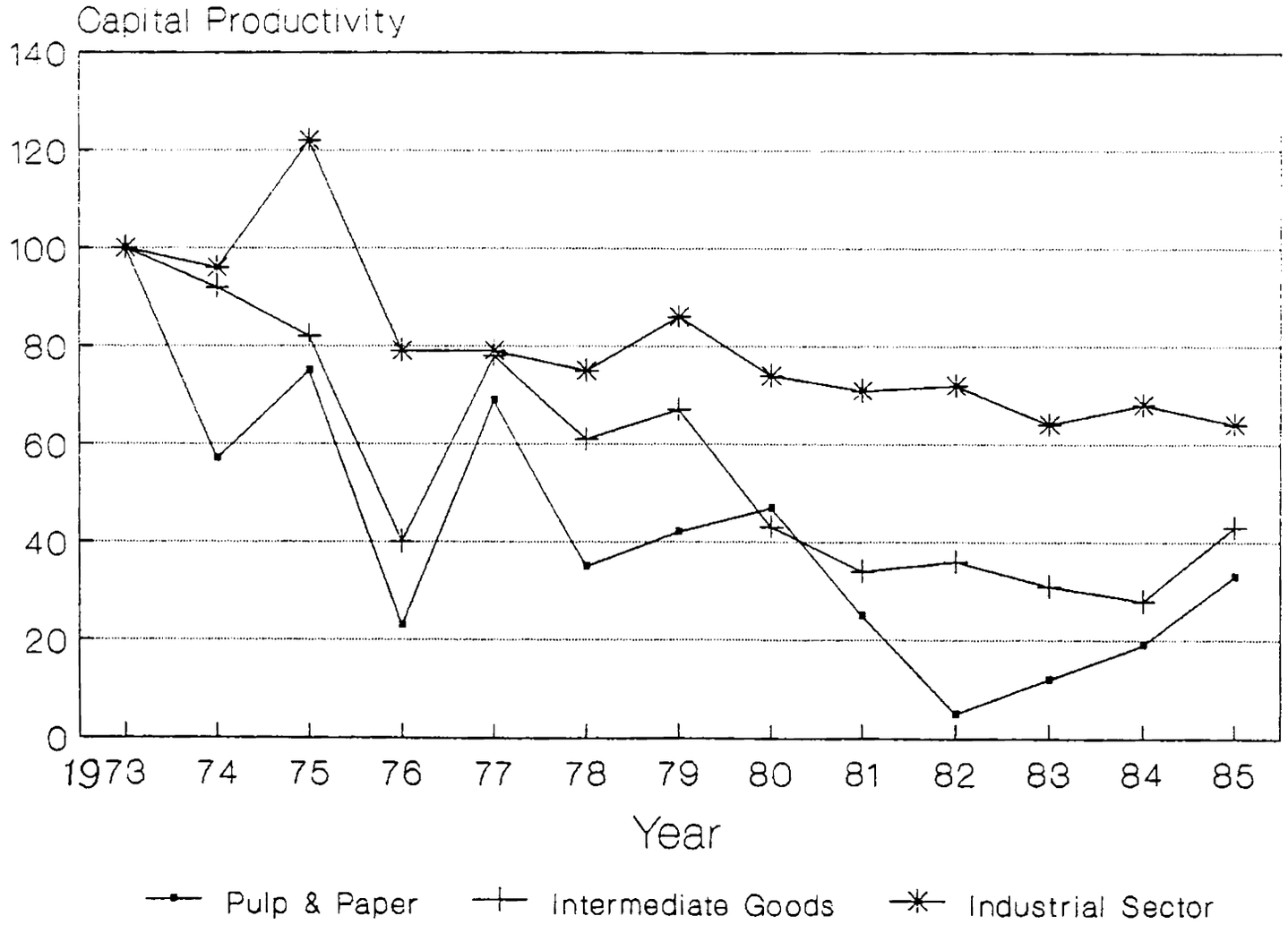
From the above analysis of partial productivities of labour and capital one can conclude , generally, that while there has been an increasing labour productivity and a declining capital productivity in rest of the categories, both the partial

Table 4a.2: CAPITAL PRODUCTIVITY INDEX (1973-74 = 100)

Year	Pulp and Paper	Basic Industries	Capital Goods Industries	Intermediate Goods Industries	Consumer Goods Industries	The State Industria Secto
1973-74	100	100	100	100	100	100
1974-75	57	94	120	92	97	96
1975-76	75	104	120	82	84	122
1976-77	23	95	56	40	90	79
1977-78	69	89	47	78	76	79
1978-79	35	96	60	61	62	75
1979-80	42	102	74	67	72	86
1980-81	47	102	60	43	54	74
1981-82	25	100	81	34	44	71
1982-83	5	104	63	36	48	72
1983-84	12	82	70	31	48	64
1984-85	19	95	59	28	53	68
1985-86	33	82	61	43	41	64
Growth rates:	-14.17	-0.8	-3.7	-9.5	-7.5	-4.1

Note : Growth rates are estimated by estimating an exponential trend.

Figure 4a.2 CAPITAL PRODUCTIVITY INDEX
(1973/74 = 100)



productivities in the paper industry have been declining which is clear indication of inefficiency[17].

Having analysed the partial productivity estimates, a glanc at the total factor productivity measures is worthwhile. As ha been noticed earlier, all the total factor productivity measure are giving consistent results. Therefore, for the purpose o analysis, translog measure of total factor productivity is taken The estimated total factor productivity index shows a stagnation if not a fall, in the industrial sector of the State as the inde does not have any marked fluctuations as can be seen from th Table 4a.3 (see Figure 4a.3. also). On the other hand, the declin of total factor productivity in the paper industry is found at rate of -8.1 per cent per annum which is found to be greater tha that of the intermediate goods industries (-3.6). The tota factor productivity index of the paper industry met a trough of in 1982-83. Of the four groups of industries the greatest declin in total factor productivity index is observed in intermediat goods industries (-3.6) followed by consumer goods industrie (-2.3) and capital goods industries (0.22). However, in basi industries there is a positive growth rate in total facto

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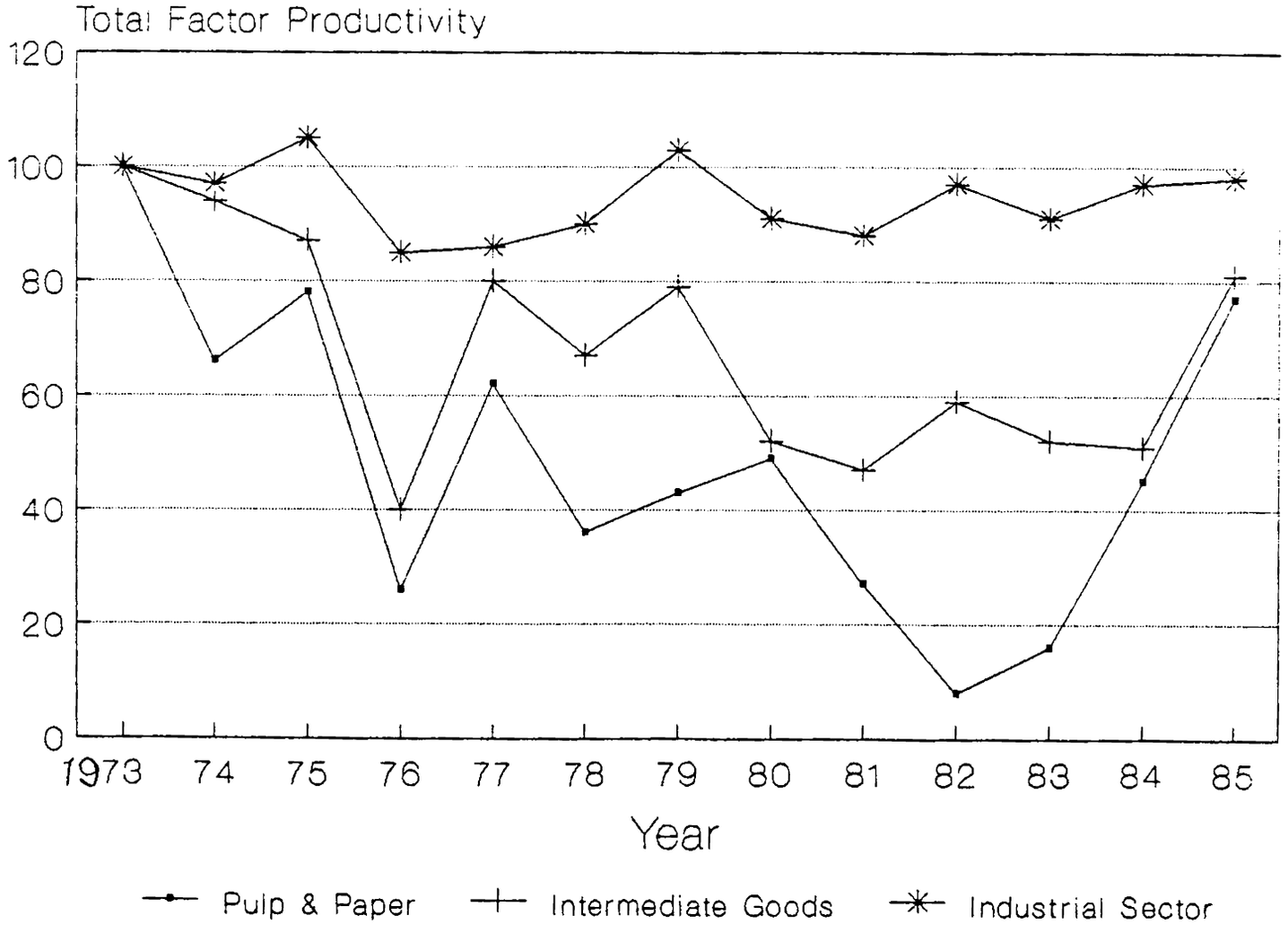
[17]A common criticism against the measure of partial productivit measure is that an increase in one measure may be due to th substitution of factor in question by another factor o production; but the fall in all partial productivity indices mean a decline in efficiency.

Table 4a.3: TOTAL FACTOR PRODUCTIVITY INDEX (1973-74 = 100)

Year	Pulp and Paper	Basic Industries	Capital Goods Industries	Intermediate Goods Industries	Consumer Goods Industries	The St Indust Sector
1973-74	100	100	100	100	100	100
1974-75	96	95	124	94	97	97
1975-76	78	76	120	87	88	105
1976-77	26	89	89	40	92	85
1977-78	62	83	72	80	80	86
1978-79	36	96	97	67	72	90
1979-80	43	98	116	79	89	103
1980-81	49	103	96	52	71	91
1981-82	27	108	126	47	56	88
1982-83	8	114	102	59	72	97
1983-84	16	91	112	52	79	91
1984-85	45	105	95	51	87	97
1985-86	77	99	95	81	74	98
Growth rates:	-8.1	1.31	-0.22	-3.6	-2.3	-0.13

Note : 1. Growth rates are estimated by estimating an exponential trend.
2. The Productivity estimates are based of Translog measure.

Figure 4a.3 TOTAL FACTOR PRODUCTIVITY
(1973/74 = 100)



productivity index (1.31). In sum, while the industrial sector as a whole and captial goods industries witnessed stagnation in total factor productivity, it has been declining in intermediate goods industries and cosumer goods industries. The only group of industries which shows a positive growth rate in total factor productivity is basic industries. On the contrary, there has been a marked decline in total factor productivity in the case of the paper industry.

Now drawing together the results of the partial and total factor productivity analysis it can be seen that while the industrial sector of the State witnessed an increase in labour productivity and a decline in capital productivity, the paper industry shows a significant decline in both the partial productivities. In the case of total factor productivity, there has been stagnation in the industrial sector as a whole, basic industries and capital goods industries. But significant decline in total factor productivity has been found in intermediate goods industries and consumer goods industries. Surprisingly, the paper industry has shown the greatest fall in total factor productivity. These results are confirmed by all the three total factor productivity measures.

In sum, all the indices of productivity, including partial and total, estimated for the paper industry have been declining sharply and hence the industry's performance in terms of

efficiency has been well below the average industrial productivi of Kerala. Since the productivity measures are not independent the utilisation of the available capacity the low productivi may, perhaps, be due to low capacity utilisation. Before going examine this aspect, labour absorption potentiality and returns scale are examined in part B of the present chapter.

B. Labour Absorption and Scale Economies

This section analyses the labour absorption capacity and returns to scale of the paper industry. The analysis is strictly confined to the framework of a production function analysis. The demand for labour is gauged in terms of elasticity of labour demand with respect to wage rate and output. Both short-run and long-run elasticities have been estimated. For the estimation of these elasticities a constant elasticity of substitution (CES) production function has been identified. Since our analysis is strictly confined to the framework of a production function a proper understanding of the functional forms is a prerequisite for understanding the implications of the results. Production function shows the relationship between the quantities of input employed and output produced. In the case of a two variable input model the function can be written as

$$Q = f(X_1, X_2) \qquad \ldots\ldots(4b.1)$$

where Q is the quantity of output, X_1 and X_2 are inputs.

The classical economists consider land, labour and capital as the three principal agents of production. But later on with the evolution of a comprehensive concept of capital, land lost its

empirical autonomy. Thus the underlined production function in the neoclassical framework can be written as

$$Q = f(L, K).....(4b.2)$$

where Q is output, L, labour and K, capital

The important functional forms of the production functions which are being employed in empirical studies are presented in Appendix I.

Labour Demand Function from CES Production Function

As has been noted in the outset of this chapter, the demand for labour in the paper industry has been studied by deriving the following labour demand function from the CES production function. This model has been suggested by Diwan and Gujarati.[1] Considering overpopulation and large scale unemployment and a general assumption that the marginal product of labour is almost zero, it is believed that the Kerala economy is one of surplus labour. But in a technologically determined productive sector, the labour force needed may have to acquire skills making the supply of labour short of demand. Hence it is realistic if an assumption is

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[1]Romesh K. Diwan and Damodar N. Gujarati (1968) "Employment and Productivity in Indian Industries - Some Questions of Theory and Policy", Artha Vijnana, Vol.10., No.1., pp.29-67.

made that the labour supply can be increased only with a time lag. Hence the following Nerlovian adjustment is assumed in the labour demand function.

$$\frac{Ld_t}{Ld_{t-1}} = r \frac{Ls_t}{Ls_{t-1}} \quad \ldots\ldots(4b.3)$$

where Ld_t refers to labour demanded and Ls_t labour supplied at time t. Thus it is seen that supply of labour adjusts to demand at an elasticity of $\frac{1}{r}$. Further,

$$Ls_{t-1} = Ld_{t-1} \quad \ldots\ldots\ldots(4b.4)$$

Thus under the assumption of the model the labour supply can be increased with a time lag and therefore the following relation can be hypothesised.

$$L_t = A\, W_t^{\alpha_1}\, V_t^{\alpha_2}\, L_{t-1}^{\alpha_3}\, U_{2t} \quad \ldots\ldots(4b.5)$$

Taking logarithms on both the sides,

$$\ln L_t = \ln A + \alpha_1 \ln W_t + \alpha_2 \ln V_t + \alpha_3 \ln L_{t-1} + \ln U_{2t} \quad \ldots\ldots(4b.6)$$

where U_{2t} is a random error term and can be assumed to be log normally distributed with mean equal to unity and standard deviation, s. (α_1) and (α_2) can be interpreted as short-run

elasticity of labour demand with respect to product wage and employment elasticity of output respectively, while $\frac{\alpha_1}{1-\alpha_3}$ and $\frac{\alpha_2}{1-\alpha_3}$ can be taken as long term elasticities. L_{t-1} is the average number of persons employed in time t-1. W_t and V_t are wage rate and value added at constant price in time 't'.

The returns to scale (η) is computed by the following formula using parameters obtained from the labour demand function.[2] The longrun elasticity is given by

$$\eta = \frac{1 + \alpha_1 - \alpha_3}{\alpha_1 + \alpha_2} \quad \ldots\ldots(4b.7)$$

As in the case of the productivity analysis, the estimates are made for the paper industry, the four groups of industries and for the industrial sector of the State. In general, the results tend to suggest that the demand for labour in the paper industry is greater than that of the industrial sector and intermediate goods industries. Both short-run and long-run elasticities are showing a similar trend, though there are minor variations. Moreover, the industries in Kerala have been subjected to high

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[2]K. Rajalakshmi (1985), "Productivity Comparisons of the Manufacturing Sector of All-India and Rajastan", Artha Vijnana, Vol.27., No.1., p.62.

returns to scale. The paper industry is not an exception in thi regard.

The estimated elasticities, namely, (1) short run elasticit of wage rate, (2) long-run elasticity of wage rate, (3) short-ru elasticity of output (4) long-run elasticity of output and return to scale are presented in Table 4b.1. This shows that th short-run elasticity of labour demand of paper industry wit respect to wage rate (0.737) is greater than that of th industrial sector of the State (0.088) and the intermediate good industries (0.243). Of the four industrial groups, the highes elasticity is recorded in basic industries (0.78) followed b capital goods industries (0.358), intermediate goods industrie (0.243) and consumer goods industries (0.168). The only group o industry which has a greater elasticity than that of the paper i the basic industries. Therefore, one can observe a discernibl higher labour demand in the paper industry. However, it i important to note that all the estimated short-run elasticities o labour demand with respect to wage rate in all categories are les than unity.

Similarly, in the long-run elasticity of labour demand wit respect to wage rate also, the paper industry's position is foun to be well above the industrial sector of the State, intermediat goods industries and capital goods industries. The estimate elasticities are 0.758, 0.344, 0.269 and 0.326 respectively

Table 4b.1 Estimated Elasticities and Returns to Scale

	Short-run Elasticity w.r.t Wage	Short-run Elasticity w.r.t. Output	Long-rn Elasticity w.r.t. Wage	Long-run Elasticity w.r.t. Output	Retur Sca
State Industrial Sector	0.088	0.300	0.344	1.167	1.63
Intermediate Goods Industries	0.243	0.009	0.269	0.010	4.90
Consumer Goods Industries	0.168	0.203	2.131	2.568	7.15
Capital Goods Industries	0.358	0.146	0.326	0.133	2.89
Basic Industries	0.780	0.759	0.821	0.799	8.74
Pulp and Paper	0.737	0.349	0.758	0.359	4.40

Among the four groups of industries, consumer goods industries stood first at an estimated elasticity of 2.131 followed by basic industries (0.821), capital goods industries (0.326) and intermediate goods industries (0.269). Even though the estimated elasticity of basic industries is greater than that of the paper, the difference between the two is marginal. Therefore, in the case of long-run elasticity of labour demand with respect to wage rate also there is a discernible difference between the estmates of the paper industry and the industrial sector. Thus, the analysis of demand for labour in terms of elasticity of labour demand with respect to product wage rate, both short-run and long-run, tend to suggest that the paper industry has a greater demand for labour.

The short-run output elasticity of labour demand of the paper industry is found to be more or less in line with the industrial sector of the State as a whole; the estimated elasticity being 0.349 and 0.3 respectively. Among the four groups of industries the highest elasticity is found in basic industries (0.759) followed by consumer goods industries (0.203), capital goods industries (0.146) and intermediate goods industries (0.009). Only basic industries have a greater elasticity than that of the paper industry. However, the magnitude of the estimated elasticities are less than unity, that is to say, a less than proportionate increase in labour demand.

However, looking at the the long-run elasticity of labour demand with respect to output the results are somewhat disturbing. The paper industry's elasticity is found to be lower than that of the industrial sector of the State. Nevertheless, it is still higher than that of the intermediate goods industries and capital goods industries. Of the four groups of industries consumer goods industries stood first with an elasticity of 2.568 followed by basic industries (0.799), capital goods industries (0.133) and intermediate goods industries (0.01).

The examination of the returns to scale clearly shows that the paper industry has, as in the case of other industries in the State, high economies of scale. The estimated figure of the paper industry, 4.405, is greater than that of the industrial sector of the State (1.632) and capital goods industries (2.891). Of the four groups of industries the highest scale economy is found in basic industries (8.746) followed by consumer goods industries (7.159), intermediate goods industries (4.902) and capital goods industries (2.891). Thus, the analysis of the scale economy vindicates high returns to scale in the paper industry as in the case of other industries in the State.

In sum, the labour demand in the paper industry is greater than that of the industrial sector of the State and intermediate goods industries. However, the magnitude of all the estimated elasticites are less than unity except long-run elasticity of

labour demand with respect to output. In other words, there is a less than proportionate change in demand for labour with respect to wage rate and output. Nevertheless, the demand for labour in the paper industry is well above the industrial sector of the State and intermediate goods industries.

Thus, in this chapter, the efficiency of the industry in terms of productivity and labour absorption are examined. Since the productivity measures are largely affected by the level of utilisation of capacity an examination of capacity utilisation would be more illustrative. Therefore, in the following chapter the capacity utilisation has been analysed.

Chapter V

CAPACITY UTILISATION

The productivity analysis in the previous chapter is not independent of the utilisation of capacity. That is to say, the productivity measures might have been influenced by the underutilisation of capacity. Moreover, capacity utilisation itself is an important parameter in determining the efficiency of an industry. As there is some ambiguity and vagueness in the concept of capacity utilisation and since there are various methods for its measurement, a brief discussion on the concept, measurement and limitations of capacity utilisation seem to be in order.

In a developing economy, where the resources are scarce and scanty, the need for optimum utilisation of the resources can hardly be overemphasised. Generally, growth is associated with new investments which should contribute the maximum possible yield to the economy. Better utilisation of the existing capacity enables an economy to improve capital-output and captial-labour ratios and will consequently result in more employment, income and output without additional capital investment. Indeed achieving

higher rates of growth of output, employment and income, and increasing the supply of industrial products commensurate with the investments made by industries depends largely on capacity utilisation.[1] Moreover, the effective utilisation of existing capacity would give the necessary impetus to fresh investment, making the process of industrial development proceed smoothly. Besides, if the productive capacity is not fully utilised, the cost of production and the price of products tend to rise which also add to inflationary forces.

The volume of excess capacity also indicates the extent to which the economy is failing to make the best use of its scarce capital resources. It also adversely affects the task of stepping up the saving rate. Maximum production through full utilisation of the capacities already created would help further captial formation.

Further, information about the amount of available industrial capacity and about the degree of its utilisation are employed in many forms of economic analysis. Data on utilisation - operating rates - have proven useful in explaining price movements and in forming projections of the future course of business capital investment. Less directly, operating rates can help explain the

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[1]A. P. Srinivasamurthy (1979), "The problem of Underutilisation of Productive Capacities in Indian Industry" in P. R. Brahmananda et. al., (ed.) (1979), Indian Economic Development and Policy, Essays in honour of Prof. V. L. D'Souza. p.149.

cyclical behaviour of productivity and through that, changes in profits and income shares.[2]

The Concept

Full capacity has been variously defined as a minimum point on a cost function, a full input point on an aggregate production function, and a bottleneck point in a general equilibrium system.[3] Full capacity should be defined as an attainable level of output that can be reached under normal input conditions - without lengthening accepted working weeks, and allowing for usual vacations and for normal maintenance.

In discussions of capacity, a distinction that is commonly made in the literature is between the machine capacity and economic capacity. The difference between the two is that while the latter includes in its understanding the costs incurred by the individual firms at different levels of utilisation, the former does not. Thus, from the economist's viewpoint, the maximum possible output that is economically feasible under conditions of competition is given by the lowest point on the average cost curve. As opposed to this, capacity output in the engineering sense refers to the production flow that can be obtained from the

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[2]George L. Perry (1973), "Capacity in Manufacturing", Brooking Papers on Economic Activity, Vol.3., p.701.

[3]Lawrence R. Klein and Virginia Long (1973), "Capacity Utilisation- Concept, Measurement and Recent Estimates", Brooking Papers on Economic Activity, Vol.3., p.746.

full utilisation of the existing capital equipment. In practice, most studies referring to the developed economies have adopted a more "synthetic" concept of capacity, in which "the production flow associated with the input of fully utilised manpower, capital and other relevant factors of production".[4] The assumption underlying this definition is that unutilised resources of all kinds exist essentially because of deficiency of aggregate demand. According to Morris Budin and Samuel Paul, capacity in its broadest sense refers to "the potential output per unit of time that a plant can yield under given process and conditions".[5] Maximum capacity as defined by micro level studies computes total capacity on the basis of total amount of productive time available per year on capital equipment. Bergson feels that capacities must be defined with reference to product lines and technical characteristics as well as interrelationships among different groups. He, therefore, estimates maximum capacity of manufacturing facility using linear programming techniques.

From the above discussion one can see that in examining the question of capacity utilisation two specific questions emerge: the first deals with the problem of measurement of capacity (potential) and its utilisation and the second with the

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[4]Lawrence R. Klein (1981), quoted in C. P. Chandrasekhar (1981), Growth and Technical Change in Indian Cotton Mill Industry,1944-77, Ph.D., Thesis, JNU, New Delhi, p.159.

[5]Budin Morris and Samuel Paul (1961), "The Utilisation of Indian Industrial Capacity, 1949-59", Indian Economic Journal, Vol.9, No.1., p.20.

identification of factors influencing capacity utilisation Generally, capacity utilisation can be expressed as:

$$\frac{\text{Actual Utilisation}}{\text{Potential Capacity}} \times 100$$

Since there are various methods for measuring the potentia capacity, there are a number of capacity measures also. As n single measure appears entirely satisfactory, it is both necessar and desirable to consider alternative methods and evaluate the before framing a judgement on the extent of capacity utilisation Perhaps the actual rate of utilisation lies somewhere within th broad spectrum revealed by alternative estimates.

The important measures that have been identified for capacit utilisation are:

1. The Wharton Index,
2. The RBI Index,
3. Measures based on machine hours, and
4. Minimum Capital Output Ratio Measure.

These measures can be classified into three distinc categories:

The Wharton Index

The Wharton index is based on time series of output.[6] The first step in the estimation of Wharton index is to identify peaks in output. The identified peaks are considered as full capacity. Capacity output between the peaks is estimated by joining successive peaks by a straight line and hence it is called the Trend Through Peaks Method. Such piecewise linearisation is not valid if the successive peak is lower than the previous one. That is to say, once capacity is built up it will not decline in the subsequent periods. From the period preceding the first peak and that succeding the last, capacity is estimated by extrapolation of the trend line. Capacity utilisation is obtained as a ratio of actual production to capacity output.

Several problems arise in this approach, such as the choice of the series - monthly or quarterly -, identificaition of peaks and piecewise linearisation. In the short-run, capacity of the firm/industry is given by the maximum sustainable level of output under normal working conditions and the period when the firm is operating its existing capital stock at its customary level of intensity. It is argued that peaks which are identified may not truely reflect capacity output of the industry. In an economy like India which is characterised by supply constraints and other

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[6] L. R. Klein and R. S. Perston (1969), "Some New Results in the Measurement of Capacity Utilisation" The American Economic Review, Vol.LVII, No.1, p.34.

rigidities due to market intervention through controls and regulations, peaks which are identified may, in fact, be lower than true peaks. The consequence of this would mean that capacity is underestimated and utilisation overestimated. Furthermore, the Trend Through Peaks Method presupposes that capacity expansion takes place in a smooth and gradual manner, which may not be true. The straight line segment also implies a uniform rate of net investment between peaks for a given marginal capital output ratio, which goes against the standard acceleration principle. There is also the problem of aggregation. When industrial units are aggregated, peaks of one unit may not synchronise with peaks of other units. Not only this, the levels and direction may also change in aggregation. Capacity expansion may also take discrete jumps when observed at the individual firm level. But when it is aggregated over several firms, it could appear as smooth and continuous.

Srinivasamurthy[7] points out three fundamental weaknesses of the Trend Through Peak Method. They are:

(1) When the level of peak output itself is low in spite of the availability of large installed capacities, the peak output cannot be taken to represent the "optimal" output. "Excess capacity" based on this concept of industrial capacity will then be an underestimation.

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[7]A. P. Srinivasamurthy (1979), op. cit., p.154.

(2) If the earlier peak production level is not exceeded or replaced by new higher levels of peak production evenwhen the installed capacity is increasing, an incorrect impression may be created that new investments are not taking place in these industries.

(3) In the case of industries whose production schedules are not on a monthly basis, a monthly peak does not have much significance as representing industrial capacity. It may be possible that the finished product may come out in a particular month though it has been in the process for several months. However, the peak output takes into account only the finished output of the month.

The RBI Index

The index of potential utilisation which is estimated by RBI is a modified version of the Wharton School measure of capacity.[8] However, some differences exist between the two measures. The important ones are:

(1) the RBI index makes use of monthly output indices for locating peaks unlike the Wharton measure where quarterly series are considered,

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[8]RBI (1970), "Index of Potential Production and Potential Utilisation Ratio for the Manufacturing Industries in India", RBI Bulletin, Apr., 1970, p.574.

(2) such monthly peaks are treated as potential output for each year in the RBI index. In other words, no attempt is made here to connect successive peaks by linear interpolation as is done in the case of Wharton Index, and

(3) the RBI monthly idices of output are not deseasonalised. In the case of industries like sugar, tea and salt, annual peak is considered to indicate potential output rather than the monthly index to take account of seasonality.

Despite these differences, the RBI index of potential utilisation is very much in the intellectual tradition of Wharton School procedure. Some points may be raised about the RBI index. First, it is unlikely that monthly indices meet the sustainability criterion. Secondly, capacity expansion may take descrete jumps as implied by the RBI measure, which is perhaps a more faithful description of reality at the individual firm level. But this may not be so when several firms are aggregated at the industry level. Capacity expansion may look like a smooth curve as suggested by Wharton measure. Finally, it does not take account of the seasonality.

Measures Based on Machine Hours

The National Productivity Council[9] has estimated capacity utilisation in the cotton textile industry on the basis of machine hours. The capacity utilisation is given by the ratio of actual machine hours worked to total machine hours available.

The concept of machine hours is undoubtedly appealing not only because it is a physical measure, but the sole problem of capital vintage is ignored. Moreover, it completely skirts the difficult measurement problems of both capital and output. Increase in machine hours used do not necessarily imply increase in ouput. It depends on efficiency of resource use. It is not clear how these problems can be taken care of in this measure.

Minimum Capital-Output Ratio Method

This method takes, the output of the industry for which the capital-output ratio has the minimum value, as the maximum capacity.[10] The first step in the method consists of calculating

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[9]D. U. Sastry (1984), The Cotton Mill Industry in India, Oxford University Press, Bombay, p.29.

[10]Vijay K. Seth (1986), "Concepts and Measures of Capacity Utilisation", The School of Economics, Vol.2., No.1, p.56.

the ratio of output to capital for each year for the different industries. That is

$$(Y/K)_1, (Y/K)_2, \ldots\ldots\ldots (Y/K)_n \quad \ldots\ldots (5.1)$$

where Y = industrial prices at constant prices,

K = capital stock at constant prices, and

n = number of annual observations in time series used.

Now to obtain an index of capacity utilisation the highest (peak) of the output-capital ratio [say $(Y/K)_t^*$] is taken which indicates the highest degree of capacity utilisation.[11] From the actual and potential (peak) output-capital ratios one can work out the index of capacity utilisation corresponding to time point 't' as:

$$U_t = \frac{(Y/K)_t}{(Y/K)_t^*} \times 100 \quad \ldots\ldots (5.2)$$

where $(Y/K)_t$ is the actual output-capital ratio and $(Y/K)_t^*$, the highest peak output-capital ratio, both at time point 't'.

It is clear that the index of utilisation formulated above cannot exceed 100. But this does not imply that it would be

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[11] V. Nanda Mohan (1988), Capacity Utilisation in Manufacturing Industries of Kerala, Unpublished Ph.D. Thesis, Kerala University, pp. 99-101.

impossible, under different circumstances, to obtain a higher output from the existing capacity. It simply means that when the index reaches 100 it should be taken to indicate no more than the highest degree of capacity utilisation hitherto observed. In other words, capacity utilisation of 100 per cent refers to the highest pressure on resources recorded.

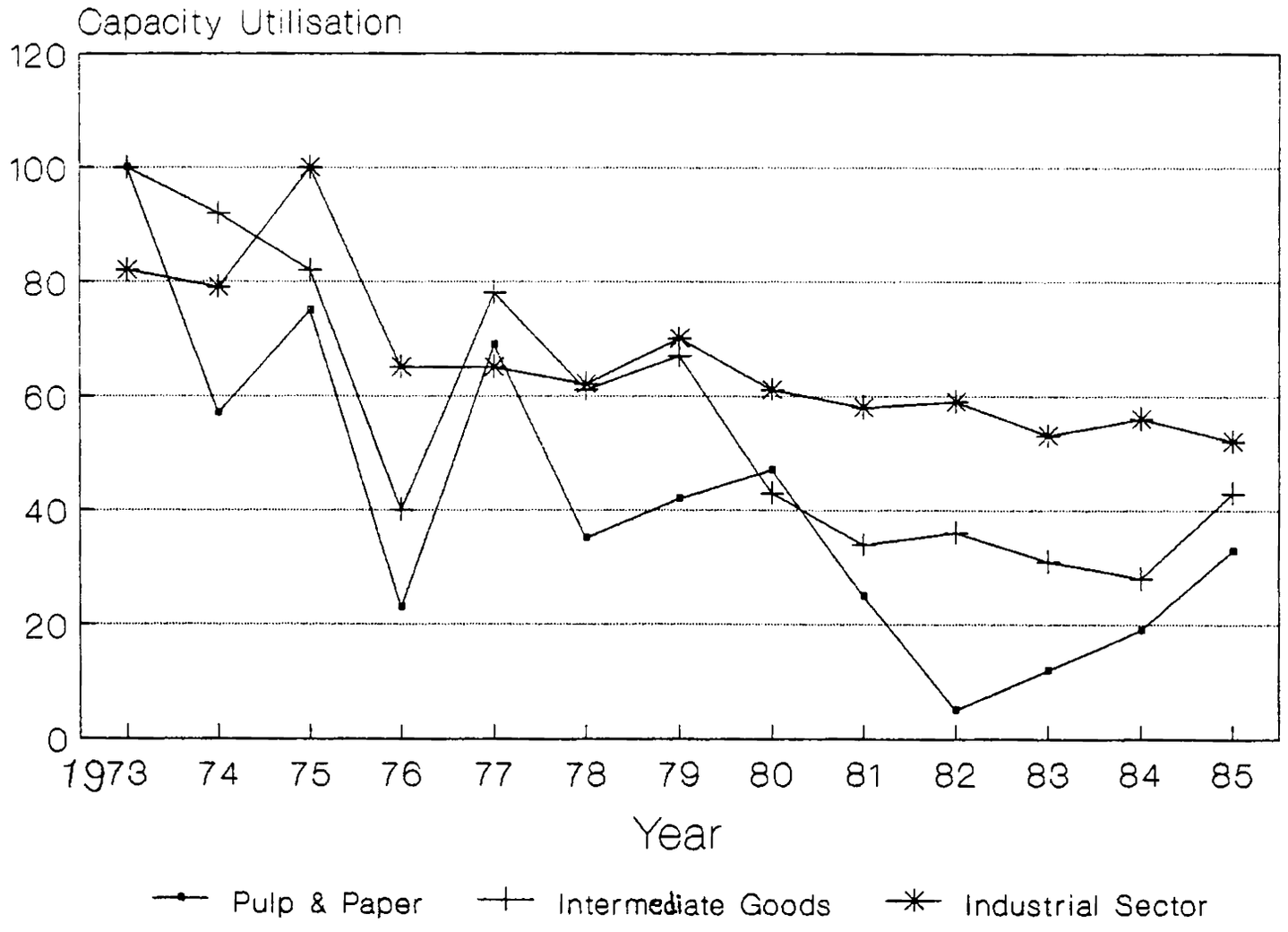
For the empirical analysis of the capacity utilisation of paper industry, the minimum capital-output ratio method has been employed. The capacity utilisation indices have been estimated for the paper industry and for the four groups of industries - basic industries, intermediate goods industries, capital goods industries and consumer goods industries -, and also for the industrial sector of the State. As the minimum capital-output ratio method assumes away technological changes, the variations of the capital-labour ratio over the period of study has been examined. This is because significant variations in the capital-labour ratio indicate technological changes. During the period of study there was no significant variations in the capital-labour ratio. The estimated capacity utilisation indices are presented in Table 5.1. A perusal of the table would evince the fact that the capacity utilisation has been declining for all the estimates. However, there have been wide fluctuations around this declining trend (see Figure 5.1). The capacity utilisation of the paper industry has been lower than that of the intermediate goods industries and that of the industrial sector of the State.

Table 5.1 : CAPACITY UTILISATION: Minimum Capital-Output Ratio Method

Year	Pulp and Paper	Basic Industries	Capital Goods Industries	Intermediat Goods Industries	Consumer Goods Industries	The State Industrial Sector
1973-74	100	96	83	100	100	82
1974-75	57	90	100	92	97	79
1975-76	75	100	100	82	84	100
1976-77	23	91	47	40	90	65
1977-78	69	85	39	78	76	65
1978-79	35	92	50	61	62	62
1979-80	42	98	62	67	72	70
1980-81	47	98	50	43	54	61
1981-82	25	96	67	34	44	58
1982-83	5	100	52	36	48	59
1983-84	12	79	58	31	48	53
1984-85	19	91	49	28	53	56
1985-86	33	79	51	43	41	52
Growth rate	-14.70	-0.81	-4.00	-9.47	-7.54	-4.14

Note : The growth rates are estimated by estimating an exponential trend.

Figure 5.1 CAPACITY UTILISATION
(Minimum Capital-Output Ratio Method)



Further, it is important to note that of all estimates, the highest decline in the cpacity utilisation is recorded in the paper industry, -14.7 per cent per annum. The capacity utilisation of the industry declined from 100 per cent in 1973-74 to 33 per cent in 1985-86, while the respective figures for the intermediate goods industries were 100 per cent and 43 per cent. During the same period the utilisation index of the State industrial sector declined from 82 per cent to 52 per cent.

Of the four groups of industries, the highest rate of decline is recorded in intermediate goods industries (-9.47) followed by consumer goods industries (-7.54), capital goods industries (-4) and basic industries (-0.81).

From the above analysis one can conclude that the capacity utilisation of industries in Kerala have been declining and the decline in the paper industry has been discernibly greater than that of the intermediate goods industries and the State industrial sector.

Chapter VI

EXTERNALITIES OF PAPER INDUSTRY

Analysis of productivity and capacity utilisation reveal the fact that the industry is working at a very low level of efficiency. Apart from this another phenomenon that has been receiving attention has been the externalities/social cost of production. To take this issue also into account important aspects of environmental pollution caused by the paper industry are discussed in the present chapter. Specific issues relating to the paper manufacturing units in Kerala are dealt with in the next chapter.

Technical Characteristics of the Industry

Ever since the invention of paper industry two millenniums ago, the basic paper making process remains unchanged. The process of production, in general, involves fibrous raw material preparation, pulping and paper making. Of these the pulping process deserves particular interest, from the point of view of externalities. In the process of pulping, wood is separated into its individual fibres. This can be done either by chemical

process or by mehanical process or by a combination of the two, i.e., chemi-mechanical process.

In the purely mechanised process, the raw material is broken down by physical means into aqueous suspension of fibrous particles. This is done by grinding of wood against a revolving abrasive stone in the presence of water. Though the groundwood pulp has a lower strength than chemical pulp, the pulp yield is very high - more than 70 per cent of the bone dry weight of the wood processed. In the production of chemical pulp the barked logs are put through a chipper. The chips are then carried to a digester where they are cooked under pressure in chemical solutions. The several chemical pulping process - soda, sulphite and sulphate - receive their names from the chemicals used in the digester. The yield of chemical pulp is low; between 40 per cent and 50 per cent of the bone dry weight of input fibre. In the alkaline pulping process (sulphite and soda) it is possible to recover and reuse the relatively expensive pulping chemicals from the black liquor. The mechanical process and chemi-mechanical process - the mixed chemical and mechanical process - have some very specific advantages in terms of product characterised by higher yields and lower chemical costs than full chemical pulping.

The pollution load of the pulp production depends, to a greater extent, on the type and quantity of chemicals employed, the amount of water utilised and the rate of recovery of

chemicals. Thus, if the accent is more on the chemical process the higher will be the level of pollution.

The environmental pollutants emitted from paper industry ma be classified into mainly three categories, namely, air pollutant (emissions), water pollutants (effluents) and solid waste (wastes).

Air Pollution

The amount of air pollutants emitted from a pulp mill depend upon what method of pulping is being used and what fuel is burne to produce steam for generating electrical power and heating i various types of the production process. Almost all mills bur some sort of fuel (coal, oil, natural gas) or waste (bark unusable wood scraps) and thus emit some amount of carbon ash soot and dust. All mills using chemical pulping methods (kraft or sulphite) cook wood chips in a solution containing sulphur This process causes the mills to emit sulphurous gases, mists an water vapour. Many mills burn the "spent" cooking solutions afte the pulp has been extracted to recover chemicals for reuse and t generate further heat for the production process. These mill commonly emit still greater amount of chemicals, mists and gase as well as salts and dust particles. Particles of dust, chemical and carbon are of serious nuisance. In high concentration the

aggravate respiratory and lung diseases such as emphysema an asthma.

The most annoying pollutants in terms of human comfort ar hydrogen sulphide and the methyl mercaptans, produced by chemica reactions in the production process.

Another sulphur gas formed in chemical pulping is sulphu dioxide, a highly irritating toxic compound. While not toxic t man in concentrations ordinarily found in the atmosphere, i causes accute crop damage in relatively small concentrations. I industrial regions it causes nickel to corrode twentyfive time faster and copper five times faster than in ambient air in an non-industrial area. Plant life can also be damaged by sulphu dioxide pulp mill emissions. The tolerant level of air pollutio is given in Table 6.1.

Water Pollution

All types of pulp mills use vast amounts of water. Dependin on the process, pulp mills use a maximum of 34,650 gallons o water per tonne of kraft pulp and 62,700 gallons per tonne o sulphite pulp. Logs may be debarked by high pressure hydrauli jets. The pumps and machines are cooled by a constant flow o thousands of gallons of water which is also used in cooking washing and as a method of transporting fibres throughout th

Table 6.1. Tolerant Level of Air Pollution

Particulate matters	250 mg/Nm^3
H_2S	10 mg/Nm^3

Source : Kerala State Pollution Control Board (1991), Effluents, Emissions and Environmental Standards, Kerala State Pollution Control Board, Thiruvananthapuram, p.14.

processing. Between each of the phases of the pulping process, the fibres are diluted upto 99 per cent with water and then reconstituted. Although in the production process water is not "consumed" but only "used" the let out effluents contain a variety of pollutants. There are heavy solids like fibres, bark, cooked wood chips, and dirt; there are dissolved solids like carbohydrates and soluble wood matter; and there are the cooking and bleaching chemicals. Although they are not pathogenic, these pulping pollutants have disastrous effects on our waterbodies.

Solid wastes in effluents sink into the bottom of slowly moving streams and lakes, where they form beds of sludge that are not only unpleasant but also ruin the quality of water and acquatic life. They destroy the bottom habitat of fish, they blanket existing calm system beds, and as they decay, they use up the oxygen in the water and release toxic gases.

Carbohydrates dissolved from wood in the cooking process and derived from the pulp are even more polluting than solid wastes. These materials (sugars and sugar derivatives) are decomposed by the microorganisms in the water as long as there is oxygen present. However, if the concentrations of waste are too high, bacteria overfeed, overpopulate and consume the available oxygen in the stream, often diminishing to a level insufficient to support acquatic life. The biological decomposition process is further hampered by the chemicals dumped, leaked, or spilled from

the water to form new chemical compounds. This reduces the amoun of oxygen available for bacterial break down of organic mil wastes. The quantity of oxygen consumed in reactions which is no mediated by bacteria or other organisms is called Chemical Oxyge Demand (COD).

Two other water pollutants, foam and discolouring matter ar more annoying than damaging. The foam results from small amount of resin, fatty acids and chemicals in the effluent. The dar colour in the mill-effluent can be both distressing and harmful when it spreads over the surface of rivers and lakes. It ca block out sun light, thereby reducing the rate of photosyntheses and upsetting the ecological balance.

Mercury is another pollutant from pulp and paper manufacture It was used as a fungicide to preserve pulp or chips in war weather, as a slimicide, and as a catalyst in the manufacture o bleaching chemicals. Table 6.2 gives measures of variou parameters which limit the effluent to the tolerant level.

Solid Wastes

Truckloads of wastes are generated in the production of pulp The polluting load of waste material dumped from a pulp mill i measured in terms of biological oxygen demand (BOD). Pulp an paper wastes are characterised by extreme variation in biologica

Table 6.2. Tolerant Level of Water Pollution

Parameter		Unit	Tolerance Limit
1.	PH	mg/l. Max	5.5 to
2.	BOD 5 days at 20^0c	mg/l. Max	30.00
3.	COD	mg/l. Max	250.00
4.	Suspended Solids	mg/l. Max	100.00
5.	Dissolved Solids (Inorganic)	mg/l. Max	2100.00
6.	Sulphate (as So_4)	mg/l. Max	1000.00
7.	Suphide (as S)	mg/l. Max	2.00
8.	Mercury (as Hg)	mg/l. Max	0.01
9.	Oil and Grease	mg/l. Max	10.0
10.	Phenolic Compounds	mg/l. Max	1.0
11.	Total Residual Chlorine	mg/l. Max	1.0
12.	Colour	APC	X+100 units where X is t colour of intake water

Source Kerala State Pollution Control Board.

oxygen demand depending on the pulp production process, high tot organic carbon (TOC), variations in organic fibre, inorgan fillers, and colour concentrations depending upon the pap production process.

Technique of Pollution Control

Pollution control techniques fall into two categorie internal preventive measures applied to the manufacturing proce in the mill itself reducing the pollutant load which must finally handled; and external techniques for treating efflue before they are discharged into the environment. External metho consists mainly of primary sedimentation with or without additi of chemical coagulants and secondary biological treatments and a few cases treatment to remove colour. Considerable reduction pollution load can be achieved by merely applying chemic coagulants combined with efficient internal measures without usi any secondary biological treatment. With repect to intern techniques of pollution control, the burning of waste liquor the method most commonly used to reduce water pollution. Anoth important measure of internal control is to reduce the amount fresh water used in manufacturing processes. This is achiev principally by recycling a portion of used water which wou otherwise go out as effluents. The development thermo-mechanical pulps would have a significant effect reducing or even eliminating the chemicals needed for maki

newsprint and this would have an impact on the effluent disposa problems of a newsprint factory.

There are several methods to treat the paper mill wastes Sedimentation and floatation remove suspended matter. Chemica precipitation removes colour. Activated sludge reduces the BOD And lagooning is used for the purpose of sotrage, setting equalisation and sometimes for biological degradation of organi matter. The cost of treatment is considered high in relation t the cost of production and consequently there is greater emphasi on recovery rather than treatment.

Pollution Control and Energy Conservation

The paper industry can reduce the level of energy consumptio considerably using its waste product as fuel. In OECD countrie the paper industry consumed 58 million tonnes of oil equivalen (toe) of purchased energy in 1981 or about 7 per cent of tota industrial energy consumption. In terms of its importance a energy consumer, the paper industry thus ranks below the stee (174 million toe), chemical (123 million toe) and petro-chemica (122 million toe) industries, but significantly above the cemen industry (49 million toe).[1]

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[1] Andrew J. Ewing (1984), Energy Efficiency in the Pulp and Pape Industry with Emphasis on Developing Countries, World Ban Technical Paper No.34., p.1.

In India the industry ranks only next to primar metals such as aluminium, copper and steel in terms of energ consumed. The energy cost in paper making constitutes 20.25 pe cent of the total cost of production.[2]

The projected energy consumption of paper industry fc 2000 A.D based on 4.25 million tonnes of installed capacity at 7 per cent capacity utilisation, will require additional coal t the tune of 3 million tonnes and about 1.82 billion kw/h (electrical energy. This means an addition to the tune of abo 76 per cent of coal and 139 per cent of electrical ener requirement. This is a substantial figure and it will crea tremendous pressure on our resources. Thus conservation of ener requires utmost care. Efforts to reduce energy consumpti for paper production in the industrialised countries have be measurably successful over the past decade. In the U.S. the tot amount of energy consumed per tonne of paper produced has declin by about 10 per cent. More importantly, the amount of purchas energy consumption has declined by about 28 per cent in Swed (where energy consumption is already very low).[3]

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[2]Parkhe.P.M. (1985), "Conservation of Energy in Paper Industry Commerce, (Supplement), Vol.50., No.3854., p11.

[3]Andrew.J.Ewing (1984), op. cit., p.3.

Indian paper mills consume 1300-1950 kwh/t of paper and 10 to 17.4 tonnes of steam per tonne of paper produced. This is relatively higher than the average of 1200 to 1400 kwh/t per tonne of paper and 8 to 10 tonnes of steam per tonne of paper produced in the modern and efficient paper mills in developed countries.

From the technical characteristics explained earlier, it is obvious that there are many ways to produce energy and reduce environmental pollution. For instance, burning of the black liquor to recover chemicals and to generate steam and electricity are a major advantage of the common process. When the pulp is cooked in digesters along with the chemicals and then washed, black liqour emerges as effluent water. This effluent water contains cooking chemicals in dissolved form which are recoverable on burning in boiler. However, burning liquor has so far been possible only in respect of large scale mills. Only recently efforts have been made to produce the chemical recovery system for mini and medium size paper mills.

Most paper mills in India are using hardwoods for pulping. Bark comprises of at least 20 per cent of the weight of the wood log, ie., about 10 per cent of the total biomass of the whole tree. Generally, debarking operation is carried out in the forest and bark is left behind as waste. The average heating value of bark is around 2200 k.cal/kg. with 50 per cent

moisture content in it. Bark has a greater potential to substitute fossil fuels currently used in the paper industry. A similar waste fuel is hogged fuel which comes as waste from lumber operations. Firebamboo, dust obtained during chipping and saw dust from wood sawing are further available. For efficient burning of these materials and generating steam, sloping grate boilers can be used.

Sludge is the byproduct from effluent treatment plants. Normally sludge is thickened and disposed of as land fill, but it consists of organic material which are biodegradable. Anaerobic decomposition of cellulosic material is a common natural process occurring in lake sediments, land fill waste disposal sites and in the stomachs of ruminating animals. A 150 tonnes per day (TPD) paper mill discharges a minimum of 3 TPD of organic sludge (on dry basis) from its effluent treatment plant. By anaerobic digestion under mesophilic or thermophilic conditions, this sludge produces 60 per cent methane gas. By digesting one tonne of sludge, 200 m^3 of biogas equivalent to 1000 kw/h can be produced. This gas can be used to obtain thermal energy. The slurry obtained after digestion is very good as manure.

Utilisation of Hydrogen Gas

Many of the integrated pulp and paper mills own their own caustic chlorine plants, a 150 TPD mill with a 20 TPD caustic

chlorine plant produces 250 nm3/hr. of hydrogen gas. The caloric value of this gas is 29000 k.cal./kg. Due to its hazardous nature, this highly valuable gas is vented out as waste. But it can be used for generating energy.

The impressive ahievements in improving energy efficiency in industrialised countries have come about as a result of activities in three main areas: (1) reduction in actual energy consumption at the point of use together with improved energy reuse and recovery, (2) increase in the energy generated internally from waste, and (3) co-generation of electric power and low pressure steam.

Externalities of Paper Industry in Kerala

The paper industry in Kerala is considered to be one of the major industries which pollutes the enviornmental media - air, water and land. The impact of pollution on the regional economy is manifested in many ways. It reduces income from agriculture, fishing, and coir-manufacturing.[4]

In general, the intensity of pollution of the paper industry is high since the major part of pulping process involves extensive use of chemicals. The process of production involves the use of

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[4] A detailed discussion on the impact of pollution is given in Chapter VII.

trillions of gallons of water. Since water is not consumed bu only used and returned to the waterways a great amount and variet of matter is discharged into the rivers.

Monitoring of pollution control measures by the Pollutic Control Board in Kerala is limited to effluents only. The air ar solid wastes are not treated before letting out. And the existi pollution control measures - both internal and external - ar found to be inadequate, particularly in the private sect enterprises. The internal methods involve the burning of was liquor. It also reduces the amount of fresh water requir because a major portion of the used water is recycled which wou otherwise go out as effluent. The external methods reduces t BOD, colour, etc.

The internal control measures in Kerala have not been ful developed. The burning of black liquor completely, which considered to be essential to control the water pollution, is y to be introduced and though there have been attempts to burn t black liquor, it is not yet developed in a full-fledged manne Further, the attempt to reuse the used water also has not be developed fully.

In the case of external controls also the technique pollution control is found to be inadequate. The BOD is t primary measure of pollution. If it is too high it adverse

affects the complicated life chain. In Kerala it seems that the industry has succeeded to some extent in controlling the BOD. However, the other pollutants from paper mills are causing damages to the environment. For example, the dark colour in the effluent is both distressing and harmful when it spreads over the surface of rivers and lakes. This can block out sun light thereby reducing the rate of photosynthesis and upsetting the ecological balance. Mercury is another pollutant from the paper mills.

To sum up, the pollution control measures of the paper industry are found to be inadequate to keep the ecology on balance. The effort to reduce the pollution impact can be made economical by upgrading the technology in such a manner as to produce additional energy and to recover the valuable chemicals.

Chapter VII

CASE STUDIES

The measures of efficiency particularly productivity and capacity utilisation indicates the poor performance of the industry. They do not, however, reveal the underlying reasons behind the same. It is because the problems of a larger magnitude and general nature, involving a very vast area, and are far too diffuse, varied and complex to be easily studied and generalisations arrived at. Therefore the issues discussed in the previous chapters are highlighted through case studies of the specific units namely, Grazim Industries Ltd., Mavoor and Hidustan Newsprint Ltd., Velloor, and the hand made paper industry in the State as a whole. The case studies were conducted by collecting primary data from the companies, by conducting interviews with the officials and the workers of the factories and by collecting information from the people of the locality.

Grazim Industries, Mavoor

Grazim Industries, Mavoor, one of the oldest and largest indstrial units in Kerala, was established in 1959 at Mavoor, near Kozhikode. The factory is located on the banks of the river

Chaliyar. The Mill produces rayon grade pulp from bamboo, eucalyptus and other hard woods. The installed capacity of the unit is 72,000 tonnes per annum and the company employs about 3000 people.

The technology of making rayon grade pulp from bamboo was developed indigenously. However, the machinery was imported from aborad - Digester from Sweden, Washing from Finland and Boilers from England. But in the case of effluent treatment the technology and the machinery are Indian.

The factory went into production in 1963. During the early period there was a paper plant also. Subsequently, the paper production became uneconomic and now there is no paper production. According to the factory officials, high labour intensity together with high wage rate made the paper plant uneconomic. The employment absorption capacity of the unit as presented in Table 7.1 gives employment figures for staff and workers from 1963 to 1990. It might be observed that, though at the initial period there had been some increase in employment - from 261 staff and 1074 workers in 1963 to 406 staff and 2067 workers in 1966 - after stabilising production the employment did not increase considerably. However, the total number of employees in the Company at present comes around 3000.

Table 7.1 Employment

Grazim Industries, Mavoor, 1962-63 to 1984-85

Year	Staff	Workers	Employment
1962-63	261	1074	1335
1963-64	316	1479	1795
1964-65	348	1530	1878
1965-66	406	2067	2473
1966-67	418	2155	2573
1967-68	412	2117	2529
1968-69	464	2049	2513
1969-70	484	2071	2555
1970-71	480	2107	2587
1971-72	495	2088	2583
1972-73	512	2081	2593
1973-74	513	2078	2591
1974-75	520	2036	2556
1975-76	511	2042	2553
1976-77	511	2042	2553
1977-78	488	2013	2501
1978-79	458	2808	3266
1979-80	450	2819	3269
1980-81	450	2789	3239
1981-82	480	2723	3203
1982-83	383	2544	2927
1983-84	388	2440	2828
1984-85	388	2441	2829
1985-86	388	2441	2829
1986-87	388	2441	2829
1987-88	319	1844	2163
1988-89	328	2051	2379
1989-90	358	2040	2398

Source: Grazim Industries, Mavoor.

Table 7.2 pesents production and net profit/loss of the company from 1962-63 to 1984-85. A perusal of the production figures in the Table 7.2 and Figure 7.1 would reveal that production had been increasing until 1970-71 and then began to fluctuate until 1980-81 until it touched a trough in 1982-83. Similarly, profit had been on the increase with the highest peak recorded in 1974-75. And then it began to shrink (see Figure 7.2). From 1981-82 onwards it has been incurring losses. Alarmingly, the loss has been increasing at an increasing rate.

The performance of the unit in terms of labour productivity from 1963-64 to 1984-85 is given in Table 7.3 and Figure 7.3. It can be seen that the labour productivity had been on an increase from 1963-64 to 1972-73 during which the productivity index increased from 100 to 137. Since then the index began to decline sharply. It touched a trough in 1982-83 with an index of 11. In 1984-85 the index increased only upto 44. Further, the estimated growth rate between 1971-72 and 1984-85 is -9 per cent per annum. From the above observations one can infer that the efficiency of the Mill has been declining. This has happened on account of the deficiency of forest-based fibrous raw materials and consequent decline in capacity utilisation.

Table 7.2 Production and Profit/Loss
Grazim Industries, Mavoor, 1962-63 to 1984-85.

Year	Production (in tonnes)	Net Profit (Rs.Lakhs)
1962-63	560	-163.99
1963-64	31921	-103.62
1964-65	42189	30.87
1965-66	49573	173.12
1966-67	52842	175.19
1967-68	58118	141.01
1968-69	60914	308.50
1969-70	60940	331.88
1970-71	64120	439.42
1971-72	42493	180.76
1972-73	63227	249.37
1973-74	34408	312.29
1974-75	60921	1055.08
1975-76	46749	697.61
1976-77	57536	1021.09
1977-78	38845	489.97
1978-79	27945	-38.08
1979-80	45234	139.63
1980-81	45888	-24.29
1981-82	45840	-80.57
1982-83	5890	-213.28
1983-84	35425	-379.39
1984-85	22184	-476.12

Source: Grazim Industries, Mavoor.

Figure 7.1 Grazim Industries, Mavoor.
Production

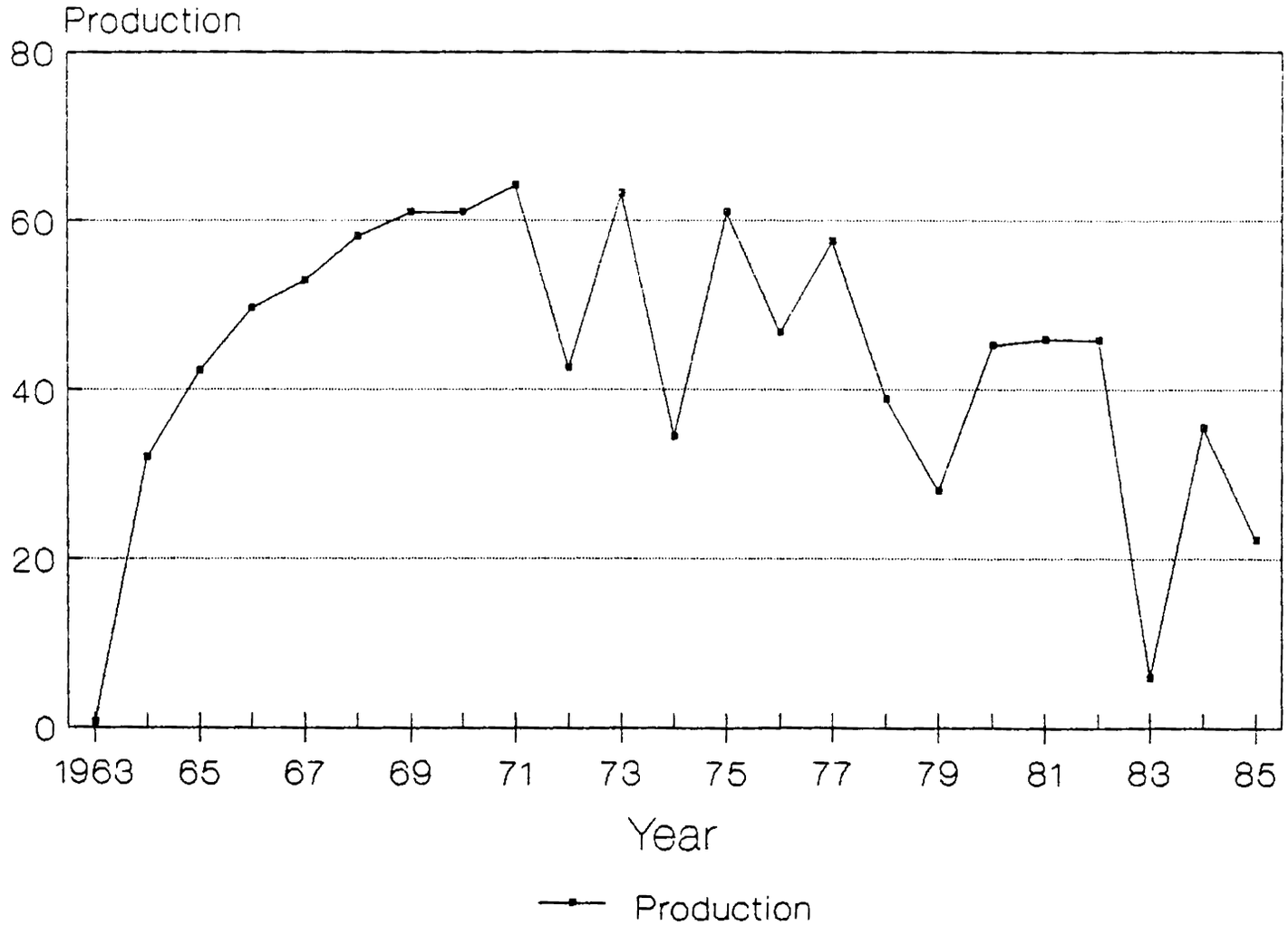


Figure 7.2 Grazim Industries, Mavoor
Profit/Loss

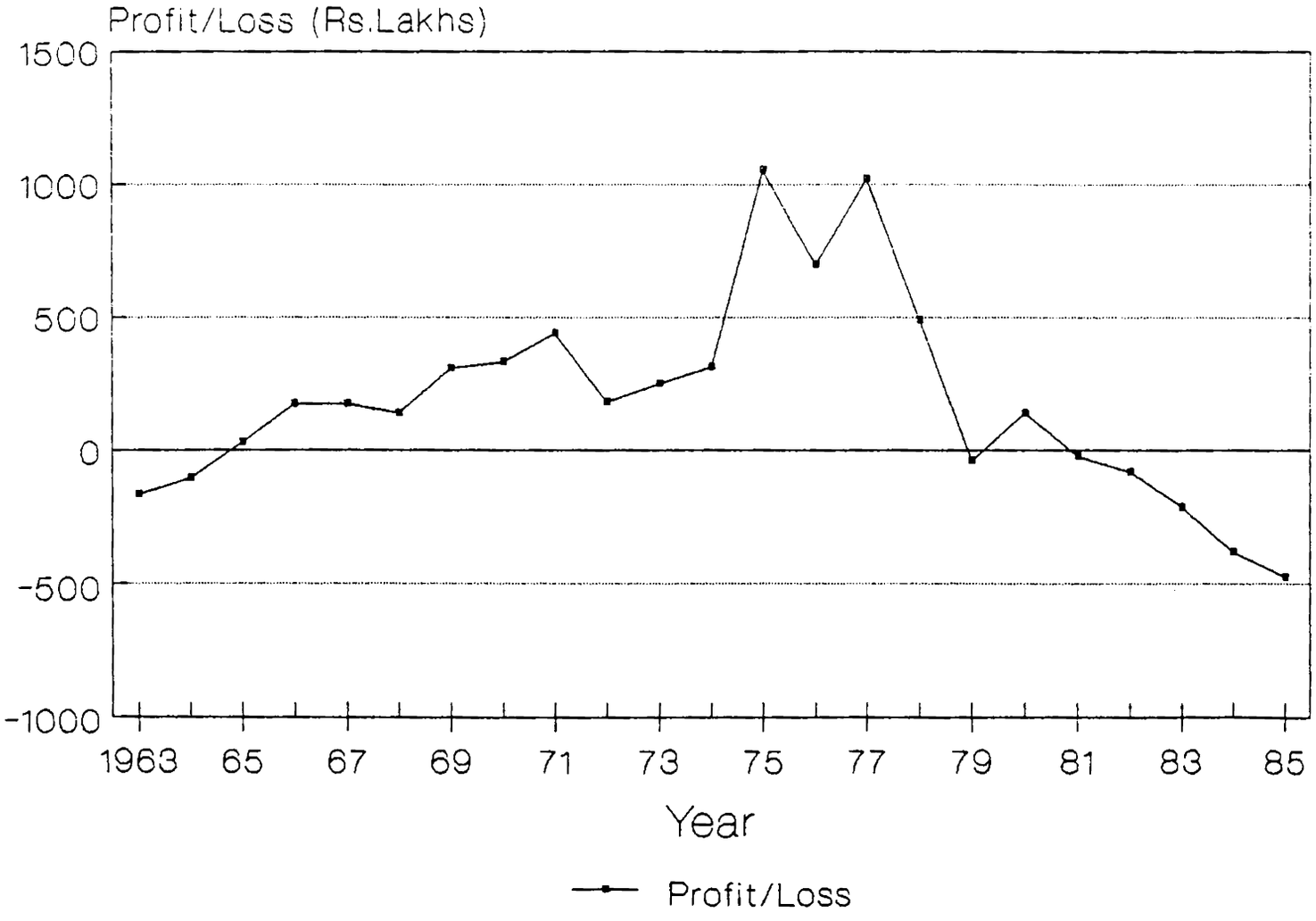
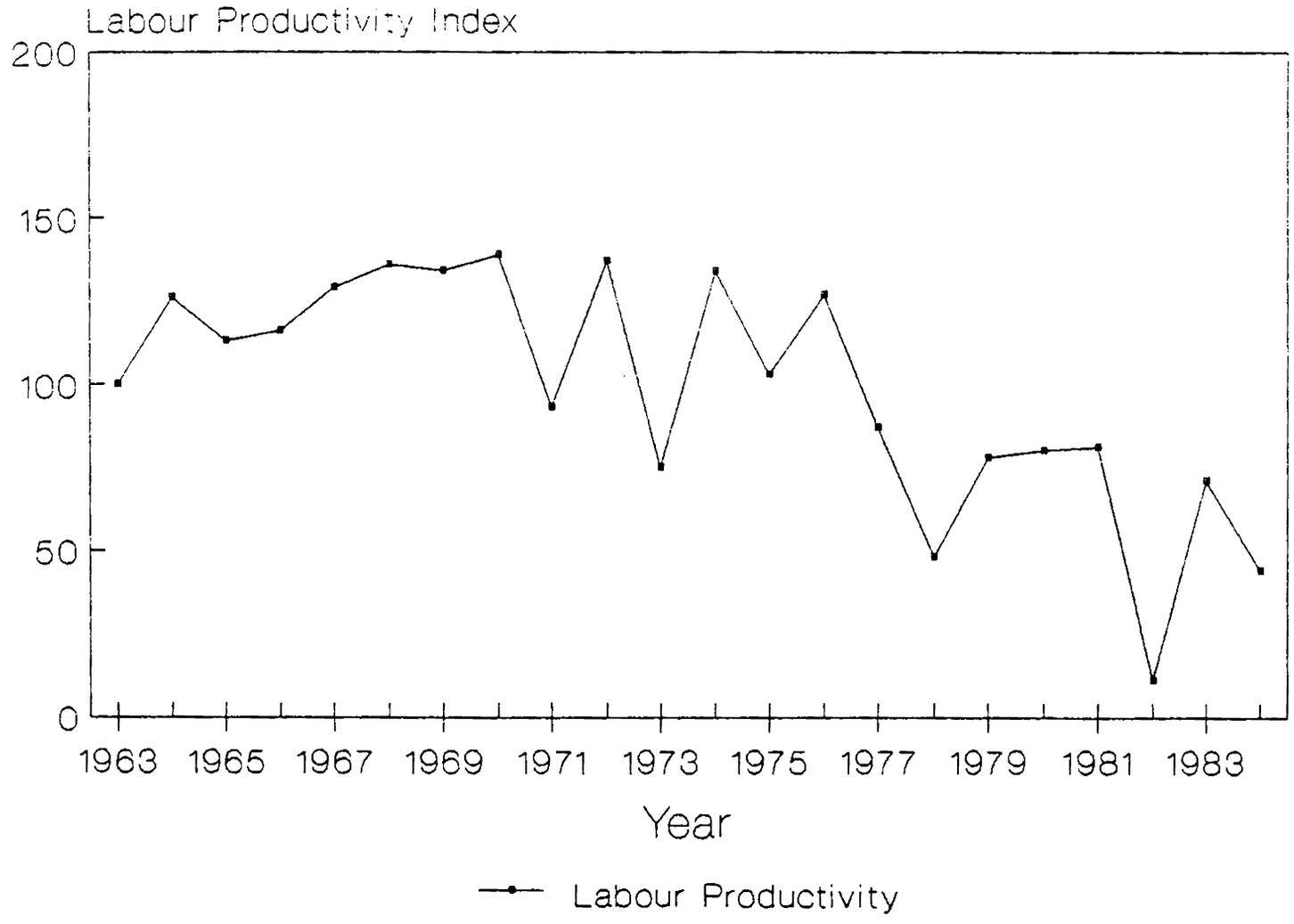


Table 7.3 Labour Productivity Index
Grazim Industries, Mavoor, 1962-63 to 1984-85.

Year	Labour Productivity (1963/64 = 100)
1963-64	100
1964-65	126
1965-66	113
1966-67	116
1967-68	129
1968-69	136
1969-70	134
1970-71	139
1971-72	93
1972-73	137
1973-74	75
1974-75	134
1875-76	103
1976-77	127
1977-78	87
1978-79	48
1979-80	78
1980-81	80
1981-82	81
1982-83	11
1983-84	71
1984-85	44

Note: Labour productivity is computed by dividing total output by number of employees.

Figure 7.3 Labour Productivity
Grazim Industries, Mavoor



The estimated capacity utilisation based on installed capacity is presented in Table 7.4. As in the case of labour productivity, the capacity utilisation also has shown a tendency to fall since mid seventies. The capacity utilisation improved from 44 per cent in 1964 to 87 per cent in 1973. Then it began to fluctuate until 1977. Since 1977 there has been a steep decline with the lowest capacity utilisation recorded in 1983 with 8 per cent. One of the important reasons that have been identified for the low capacity utilisation has been the shortage of forest-based fibrous raw materials. An estimated regression equation of capacity utilisation on the supply of raw materials is found to be significant. The estimated equation is given below.

$$Y = \underset{(1.7)}{3.94} + \underset{(16.5)}{0.00026}\ X$$

$$R^2 = 0.92 \qquad N = 23$$

where Y = capacity utilisation

X = raw material supply

N = number of observations

R = multipple correlation coefficient, and

the figures in the brackets are 't' values.

The regression results reveal that about 92 per cent of the variations in capacity utilisation can be explained by changes in the raw material supply.

Table 7.4 Capacity Utilisation

Grazim Industries, Mavoor, 1962-63 to 1984-85.

Year	Capacity Utilisation
1962-63	0.77
1963-64	44.33
1964-65	58.60
1965-66	68.85
1966-67	73.39
1967-68	80.71
1968-69	84.60
1969-70	84.64
1970-71	89.06
1971-72	59.01
1972-73	87.82
1973-74	47.79
1974-75	84.61
1975-76	64.93
1976-77	79.92
1977-78	53.95
1978-79	38.81
1979-80	62.82
1980-81	63.73
1981-82	63.67
1982-83	8.18
1983-84	49.20
1984-85	30.81

Note: Capacity utilisation is computed as percentage of actual production to installed capacity.

Inadequate supply of raw materials has been the most important problem of the Mill. Two important factors can be attributed to the present raw material crisis. First, the supply mechanism and, secondly, the price policy. Clearly, there is a dichotomy in the supply mechanism. The plantations and forests are cultivated/maintained by the State Government and the Companies are entering into contract with the State Government for the procurement of those raw materials. Always, one can observe the absence of a long term planning in view of the demand for those raw materials. The State Government has been taking the responsibility of supplying adequate raw materials to the Mill. However, many a time, the Government failed to meet the demand by the Company. The Company also collects those materials from private sources and from other states. Table 7.5 presents the raw materials procured by the Mill and the sources of supply from 1963-64 to 1985-86. It may be observed that a significant share of the supply has been coming from private sources and from other states. Dependence on those outside sources makes the Company prone to uncertainty regarding the raw materials which causes fluctuations in capacity utilisation thereby reducing the efficiency in general.

Another important point, that has to be brought under sharp focus, is the price policy relating to the forest-based raw materials. It is interesting to note that the industrial units

Table 7.5 Raw Material Supply

Grazim Industries, Mavoor, 1963-64 to 1985-86.

Year	Govt. Supply (M.T.)	Govt. Supply (%)	Private Supply (M.T.)	Private Supply (%)	Other States (M.T.)	Other States (%)
1963-64	100720	96.51	1714	1.64	1928	1.85
1964-65	104172	60.34	46643	27.02	21832	12.65
1965-66	98528	44.41	44905	20.24	78424	35.35
1966-67	49665	24.30	17474	8.55	137209	67.14
1967-68	74011	27.71	34286	12.84	158828	59.46
1968-69	75973	25.31	111797	37.24	112455	37.46
1969-70	46911	14.07	197397	59.21	89099	26.72
1970-71	38045	12.51	189763	62.42	76192	25.06
1971-72	29270	12.19	185022	77.05	25832	10.76
1972-73	40649	13.41	203677	67.20	58775	19.39
1973-74	24145	14.63	82544	50.03	58304	35.34
1974-75	60448	18.82	193217	60.15	67555	21.03
1975-76	104667	45.87	68981	30.23	54530	23.90
1976-77	129545	50.53	72317	28.21	54505	21.26
1977-78	78500	42.63	75277	40.88	30363	16.49
1978-79	73205	57.41	38824	30.45	15484	12.14
1979-80	119668	57.69	80116	38.62	7662	3.69
1980-81	128916	60.20	84781	39.59	432	0.20
1981-82	108592	48.10	117168	51.90	0	0.00
1982-83	19922	85.73	3317	14.27	0	0.00
1983-84	88767	63.67	47890	34.35	2769	1.99
1984-85	40217	39.27	58962	57.57	3243	3.17
1985-86	18441	49.77	18545	50.05	69	0.19

Source: Grazim Industries, Mavoor.
Note : M.T. - metric tonnes.

are paying a 'royalty', not a price for the procurement of the raw materials. Royalty, by definition, is a payment for a free gift of nature. The idea of royalty might have been mooted when those materials were available in plenty in the forests which required practically no maintenance. Inevitably, the price policy has come in the way of smooth supply of the raw materials when the supply becomes a costly affair, particularly the cultivation of eucalyptus. The problem can be brought to light by comparing the royalty and the open market price of those materials. The difference between the two is discernible and the royalty charged by the State Government has been very low compared to the open market price. That is to say, the industrial units have been enjoying a subsidy in purchasing the raw materials even after a very long period of time since its commencement of production. For example, in 1963 the royalty for bamboo was as low as Re.1 per tonne. Similarly, the payment at present for the eucalyptus is Rs.250 per tonne while the open market price is more than Rs.900 per tonne. Therefore, the rate of royalty is well below the economic cost of the resources. Inspite of this hidden subsidy any attempt to increase the rate of royalty, would, according to the management, affect the profitability of the Mill. Therefore, the consequence of the subsidy has two facets. First, the Mill lost its ingenuity and competitiveness in using the alternative materials available in the State such as rubber wood, bagasse, waste paper etc. It may be noted that the Company is the first of its kind in the world to make use of bamboo for the production of

rayon grade pulp. The absence of any research by the Company to use alternative resources is an example of the consequences of an unwarrented concession enjoyed by a company. Secondly, the State exchequer also lost a huge amount of revenue on account of the subsidy.

Another important problem of the Mill has been the environmental pollution. The production process of the Mill is kraft pulping. From the production process described in Chapter VI it can be seen that the process of production of the Mill has a higher pollution impact since it involves more use of chemicals. The effluent discharge from the factory is estimated to have a volume of 45,000 m^3/day and a BOD of 1000 PPM. The pollution control measures are limited to the treatment of effluents only and the air and solids are discharged without any treatment.

The Company is located on the banks of a small river, Chaliyar. The river water is being used for drinking, irrigation and navigation as well as for fishing. The effluents discharged into the river have been causing problems in using the river water.

As the company is situated far away from the sea, laying of acid resistant pipeline for such a long distance and discharging the effluent directly into the sea has been considered uneconomical. Moreover, the discharge of waste into the sea would

be just shifting the problem of pollution from the river to the bay which would be harmful to the marine ecosystem.

There have been frequent movements by the people against the water and air pollution caused by the Company.[1] People are of opinion that the effluent discharged into the river pollutes the river and it affects the life of the people in a variety of ways. First, the effluent disposal makes the water in the river unusable for drinking. Secondly, if the water is used for irrigation purposes, it reduces the fertility of the soil and thereby reduces income from agriculture. Thirdly, it affects fishing and very often fishes are dying in the river water as a result of pollution. No less is the pollution by air discharge. It also affects the health of the plants and causes reduction in agricultural income. Many people, observed: "during the time the factory was closed we had enough pretty birds here. Now, when the plant began to operate, birds are not coming to this area".

In sum, the performance of the Mill has been poor, particularly since the mid seventies. The labour productivity has been declining sharply. Scarcity of raw materials has adversely affected the capacity utilisation of the Mill and there has been a steep decline in the capacity utilisation. The inefficient raw

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[1]K. Rajagopal, (1989), "Birlakkuvendi Niyamangal Vazhimarunnu", Mathrubhoomy, May., 19., p.4.

material supply mechanism and price policy together with the absence of a long term raw material plan have drawn the Company to the brink of a raw material crisis and the Government to a loss of revenue.

The raw material problem can be solved, to a great extent, by making the Company responsible at least in part, if not fully, in raising the required raw materials. At the same time the Company has to resume the research activities and upgrade the technology so as to make use such locally available raw materials as rubber wood. Upgradation of technology would enable the Company to pay open market price for the raw materials on the one hand, and reduce the environmental pollution, on the other.

Hindustan Newsprint Ltd., Velloor

Hindustan Newsprint Ltd., Velloor, a wholly owned subsidiar of the Hindustan Paper Corporation and a Government of Indi enterprise, became operational in 1983. The Mill, one of th biggest newsprint mills in Asia, has an integrated pulp and pape mill and produces newsprint of 52 gsm.[1] The installed capacity o the Mill is 80,000 metric tonnes of newsprint per annum with total investment of Rs.160 crores.

The production process of the Mill is considered to be uniq in the sense that it manufactures newsprint using eucalyptus wo and reeds. The pulp-mix of the newsprint consists of 70 per ce chemi-mechanical pulp from eucalyptus and 30 per cent sulphi chemical pulp from reeds.

Table 7.6 gives total production and profit/loss from 1983- to 1989-90. It can be seen that production has been increasi from the inception of production in 1983-84. The Company beca profitable in 1988-89. Since it is relatively young and und public enterpreneurship, strict profitability analysis is out question. Further, the Comapany has been enjoying considerab

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[1]The measure of quality of newsprint is gsm.

Table 7.6 Production and Profit/Loss
Hindustan Newsprint Ltd., Velloor , 1983-84 to 1989-90

Year	Production (Rs. Lakhs)	Profit/Loss (Rs.Lakhs)
1983-84	2334	-932.25
1984-85	5159	-866.71
1985-86	6527	-99.96
1986-87	6172	-492.85
1987-88	7482	-174.99
1988-89	7883	199.83
1989-90	11285	2036.00

Source : Annual Report, Hindustan Newsprint Ltd., Velloor, Various Issues.

amount of indirect subsidy in procurement of forest-based fibr raw materials. However, one can observe improvements efficiency, as the loss has been declining continuously to bec subsequently profitable. Moreover, the Company has been runni at full capacity.

The production and capacity utilisation of the mill f 1983-84 to 1989-90 are given in Table 7.7. A perusal of t figures of production and capacity utilisation will reveal t fact that the Company has been running almost at full capac though there has been some fluctuations. The capacity utilisati increased from 80.23 per cent in 1983-84 to 101.89 per cent 1987-88 and it further increased to 108.56 in 1989-90. The cau for the fall in capacity utilisation in 1986-87 to 1988-89 can traced to the deficiency of the fibrous raw materials and po shortage.

An examination of partial productivity indices, to s extent, reveals the efficiency of the Mill. The estimated lab productivity and capital productivity for this purpose a presented in Table 7.8. The partial productivity indi indicated that the efficiency of the Mill has been increasi Both the capital productivity and the labour productivity indi show an increasing trend, the former having an edge over t latter. Between 1983-84 and 1988-89, the labour productivi increased from 100 to 353 and the capital productivity increa

Table 7.7 Production and Capacity Utilisation

Hindustan Newsprint Ltd., Velloor , 1983-84 to 1989-90

Year	Production (Metric Tonnes)	Capacity Utilisation (%)
1983-84	64184	80.23
1984-85	64217	80.27
1985-86	78635	98.29
1986-87	68557	85.70
1987-88	81513	101.89
1988-89	78660	98.33
1989-90	86844	108.56

Source : Annual Report, Hindustan Newsprint Ltd., Velloor, Various Issues.

Note : Capacity utilisation is computed as percentage of actual production to installed capacity.

Table 7.8 Partial Productivity Index
Hindustan Newsprint Ltd., Velloor , 1983-84 to 1989-90

Year	Labour Productivity (1983/84 = 100)	Capital Productivity (1983/84 = 100)
1983-84	100	100
1984-85	226	225
1985-86	283	308
1986-87	268	320
1987-88	329	388
1988-89	353	459
1989-90	501	745

Source : Computed.

Note : The partial productivities are computed dividing total output by capital and labour respectively.

from 100 to 459. The labour and capital productivity indi calculated for 1989-90 are 501 and 745 respectively. From partial productivity estimates, it appears that both labour capital have been used efficiently in the production proce The efficiency is found to be more in the case of capital as productivity index of capital is found to be on a higher side. sum, the performance of the Mill in terms of productivity capacity utilisation has been fairly good.

The important problems facing the Mill are shortage fibrous raw materials, shortage of power and environmen pollution by effluent disposal.

As has been noted earlier, the fibrous raw materials requi by the Mill are eucalyptus, 'eta' reeds and bamboo. These materials have been procured from the eucalyptus plantations forests of the State Government. Whenever there is a shorta the Company purchases these raw materials, particularly bamb from private agencies. Table 7.9 presents the procurement these forest-based fibrous raw materials from the State Governm and private agencies and their respective percentage shares. can be seen from the table that most of the demand for materials is met by procurement from Government sources, and share of private sources is very low. However, in the case bamboo, which accounts for about 15 per cent of the pulp-mix, major share is coming from private sources.

Table 7.9 Sources of Raw Materials

Hindustan Newsprint Ltd., Velloor, 1985-86 to 1988-89

Year	Kerala Government			Private	
	Eucalyptus (M.T.)	Eta Reeds (M.T)	Bamboo (M.T.)	Bamboo (M.T.)	Bamboo Total (M.T.)
1985-86	110759 (57)	54677.00 (29)	5948 (3)	21470 (11)	27418 (14)
1986-87	142147 (64)	69201.00 (31)	7426 (3)	4430 (21)	11856 (5)
1987-88	87900 (48)	66385.00 (37)	27867 (15)	150 (0)	28017 (15)
1988-89	148307 (61)	50945.00 (21)	20070 (8)	24088 (10)	44158 (18)

Note: M.T. = Metric Tonnes.
Source : Annual Report, Hindustan Newsprint Ltd., Velloor, Various Issues.

Apart from the collection of raw materials from Governmen and private sources, the rest of the requirement is met by importing the pulp. Table 7.10 presents the costs and sources of pulp, domestic as well as imported and their respective percentage shares. The table shows that the shares of various raw materials costs supplied domestically have been declining while that of the imported pulp has been increasing. For example, between 1985-86 and 1989-90 the share of imported pulp in the of raw materials increased from 22.81 per cent to 38.9 per cent.

The problem of raw material scarcity is expected to become acute from 1992 onwards as the availability of 'eucalyptus grandis' from the Government plantations in Pamba-Peerumedu Division reserved for the Company, will be exhausted by the end of 1991. As in the case of Grazim Industries, Mavoor, the Hindustan Newsprint Mill also enters into contract with the State Governmen and procures the fibrous raw materials. The price paid by the Company has been well below the open market price enjoying a substantial subsidy. For example, at present the Company pays Rs.110 per tonne of eucalyptus while the open market price is more than Rs.900.

Another important problem of the Mill has been the shortages of power. The steam required is met by three coal fired boilers each of 60 tonnes steam generating capacity per hour and one

Table 7.10 Cost of Fibrous Raw Materials

Hindustan Newsprint Ltd., Velloor, 1985-86 to 1989-90

Year	Hard wood (Rs.Lakhs)	Reed (Rs.Lakhs)	Bamboo (Rs.Lakhs)	Murikku (Rs.Lakhs)	Imported Pulp (Rs.Lakhs)	Total (Rs.Lakhs)
1985-86	360.68	241.64	296,82		265.68	1164.82
	(30.96)	(20.75)	(25.48)		(22.81)	
1986-87	247.30	391.24	67.7		338.17	1044.41
	(23.68)	(37.46)	(6.48)		(32.38)	
1987-88	268.78	449.60	150.24		683.00	1551.62
	(17.32)	(28.98)	(9.68)		(44.02)	
1988-89	359.88	335.99	288.41		351.67	1335.95
	(26.94)	(25.15)	(21.59)		(26.32)	
1989-90	348.90	425.96	437.84	0.88	772.5	1986.08
	(17.57)	(21.45)	(22.05)	(0.008)	(38.9)	

Note: Figures in the brackets are percentage shares.
Source : Annual Report, Hindustan Newsprint Ltd., Velloor, Various Issues.

recovery boiler provided with electro-static precipitator. the boilers produce steam at 60 to 65 kg/m2 pressure. Howe the electricity generated in the captive power plant is inadeq and the dependence on the State grid have been creating proble For example, the major reason for a setback in the operations the Mill in 1986-87 was the severe power cut. Even though Mill has a captive power generation unit it is inadequate to m the requirement. Out of the total requirement of 40 MW captive power generation unit has a capacity of 15 MW. balance power requirement of 25 MW is met from the State gr Since Kerala is a power deficient state, dependence on the St supply always involves some element of risk.

Having analysed the internal problems of the Mill, it worthwhile to examine the adverse externalities that the Mill been creating. The externalities of the Mill involves discharge of pollutants into the ecosystem. The water requirem of 1500 to 1800 cubic metres per hour is drawn from Moovattupu river, and the effluent is discharged into the same river c stream. The Moovattupuzha river is one of those few rivers Kerala which is gifted with clear water throughout the year. people of Velloor, Vaikom and other nearby areas depend on t river even for drinking purposes. With the establishment of Hindustan Newsprint, the river has been subjected to the perils industrial pollution.

still suspicious of the effluents discharged into the river. The local people raise a pertinent question: "if the water discharged into the river is pure why don't they reuse the same water?". They argue that the treatment system reduces only the BOD, but does not control the impurities.

People demand the discharge of effluents directly into the sea. They accept, at the same time, that discharging of effluents into the sea would only shift the pollution problem from the river to the sea. However, they content that nobody is using sea water for drinking and irrigation purposes.

It emerges, from the interviews with the local people, that the manifestations and impact of water pollution are mixed and varied. People are of the opinion that those having regular baths in the river are suffering from skin problems. Further, the pollution affects income from a wide variety of traditional trades such as fishing, coir-making, paddy cultivation etc. Fishes, especially the small ones, are dying in the river. Moreover, it is becoming increasingly difficult to fish under water because pollution affects eyesight and obstructs under water vision.

Another traditional trade that has been affected by the river pollution is coir-making. Coconut husks soaked in the river water disintegrate. The acid content in the effluents is said to have been the cause.

The farmers are of opinion that the leaves of paddy seedlings are rotting and becoming yellow. The water from the river increases the already high acid content of the soil, thereby making the applicaion of the manure ineffective.

From the foregoing analysis it is evident that the Mill has been running at full capacity employing labour and capital efficiently. However, the externalities it generates pose many problems to a wide area. The important potential problems of the Mill are shortage of fibrous raw materials and energy. It is identified that many of the problems relating to the supply of raw materials are caused by the distorted structure of the supply mechanism. It is suggested that, in this regard, a joint effort on the part of Government and the Mill - the Mill directly involving itself in raising the required raw materials - would improve the raw material supply position. In addition, the Mill has to explore the possibilities of other materials such as rubber wood which is available in Kerala. Further, the Mill has to make all efforts to make itself efficient enough to pay the open market price for the raw materials consumed. With regard to the energy shortage, it has to improve the capacity of the captive power generation unit and introduce technology of burning the black liquor completely which would also reduce the pollutants to tolerant levels.

To conclude, though the efficiency of the two units vary in degree, there have been uniformity in their problems. Raw material scarcity is found to be the most important problem. Lack of co-ordination in the supply mechanism together with the absence of a long term raw material planning appears to have complicated the problem further. In this regard, it is also to be noted that the industry has been enjoying huge subsidy by way of paying very low rates of royalty. In the case of Hindustan Newsprint there is some justification for enjoying the subsidy since it is under public ownership and the price of its ouput is controlled. But, in the case of Grazim Industries, there is no theoretical justification for enjoying the subsidy since its ouput prices are not subjected to any control. Yet another problem of the industry has been shortage of energy. Further, both the units are found to have been polluting the environmental media, air, water and land.

Hand Made Paper Industry

Historically, hand made paper industry has an important place in India in view of its advantage over the largescale machine made paper industry in terms of employment potential and environmental pollution. Indeed, it reduces environmental pollution consuming waste materials which pollutes the environment. It seems that a strict economic evaluation of those units is not appropriate since it is primarily meant for employment generation, rather than profit maximisation. Furthermore, the size of hand made paper units in Kerala, compared to other units, is found to be very small. As such, the performance analysis in chapters IV and V excluded the hand made paper industry. Therefore, this part gives a brief evaluation of the performance of these units in terms of output growth, employment and labour productivity. Further, the study also looks into the problems and prospects of the industry.

The success of any attempt to analyse the performance of the hand made paper industry is contingent upon the understanding of its importance in the country due to its peculiar production process. The advantages of the hand made paper over the machine made paper can be attributed to its high cellulose content and

restricted chemical treatment.[1] It has good strength, writing quality, texture and artistic feeling. Hand made paper possess surface qualities and strength which are impossible to get in machine made papers. In addition to the strength, durability etc., the hand made paper has an advantage over the machine made paper in the matter of 'natural shrinkage' which is not only substantially high but is also uniform in all directions. Another important feature in favour of hand made paper is the excellence of the water-marking, an effect that cannot even be approached in the machine made product. This is due to the fact that in hand made papers the pulp lies over the design of the water mark during the entire period of making the sheet, while in machine made paper the water mark is simply pressed into the wet pulp after the sheet has been formed.

The various outstanding qualities of hand made paper account for the multitude of uses and applications it is put to.[2] It is employed for fine book printing, etchings, engravings, wood-cuts and advertisement papers. One of the important uses of hand made paper is for fancy paper used for invitation cards, greeting cards, wedding cards, etc. Hand made papers are used for keeping

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[1]SBP (Small Business Publications) Board of Consultants and Engneers (nd) Paper, Paper Converting, Plastics and Other Packaging Industries, SBP Publications, Delhi, p.80.

[2]SBP Board of Consultants and Engineers, (n.d.), Industrial and Speciality Papers, SBP Publishers, Delhi, p.30.

records, accounts and documents. Currency notes are made from hand made papers. A variety of industrial papers such as filter papers and electrical insulation papers are hand made.

Another distinctive advantage of the hand made paper industry is that it utilises such locally available raw materials as white rags, bagasse, paper waste, straws, etc. In other words, it can be made from any kind of pulp. Low quality paper or paper board may be made from rags, jute waste, rope waste, waste papers, grasses, straw, banana fibres etc.

Development of Hand Made Paper Industry in India

Handmade paper industry is one of the traditional village industries in India. Historical records show that during the initial period a group of enthusiastic artisans started producing hand made paper without any organised network or support. During the period of the Moghul rule hand made paper was extensively used by poets, pandits, tradesmen and the state officials.[3] Later, during the Swadeshi Movement in pre-independence period, the craft gained importance. People had taken to hand made paper industry more seriously with an intention of discouraging the use of foreign made paper. The Khadi and Village Industries Act, 1957,

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[3]Y. A. Rao (1989), The Paper Industry in India: Status and Prospects, Oxford and IBH Publishing Co., New Delhi, p.17.

recognised hand made paper industry as a village industry; and the industry continued to receive assistance from the Khadi and Village Industries Commission. The hand made paper making is considered to be labour intensive with 30 to 35 per cent of the cost of production being labour cost.

Hand made paper industry has made significant progress under the protection of Khadi and Village Industries Commission. Among the varieties that were produced, Writing and Printing, Blotting, Cover and Stationery formed the major portion. Production and employment of Indian hand made paper industry is given in Table 7.11. This table shows that the ouput and employment have been increasing. Total output value in 1974-75 was Rs.131.17 lakhs with 4204 persons employed. In 1987-88 the corresponding figures were Rs.565 lakhs and 50,000 respectively.

Growth of Hand Made Paper Industry in Kerala

The development experience of hand made paper industry in Kerala has been poor and distrubing. There has been a clear stagnation in the industry in terms of production and employment. Though labour productivity has been increasing, the rate of increase in recent years has been very low.

The total output and employment from 1964 to 1988 are presented in Table 7.12, Figure 7.4 and Figure 7.5. It can be

Table 7.11 Production and employment

Hand Made Paper Industry in India.

Year	Production (Rs.Lakhs)	Persons Employed
1974-75	131.17	4204
1975-76	138.43	4244
1987-88	565.00	50000

Source: Rural Development Statistics, National Institute of Rural Development, Hyderabad, p.87.

Table 7.12 Production and Employment

Hand Made Paper Industry in Kerala, 1964 to 1988.

YEAR	Production (kg.)	Employment
1964	167612	275
1965	192878	296
1966	252148	312
1967	280696	333
1968	219748	270
1969	172408	227
1970	165928	207
1971	207043	220
1972	211834	209
1973	200708	192
1974	254013	219
1975	291953	210
1976	228232	227
1977	182034	178
1978	270976	180
1979	157043	230
1980	165576	220
1981	260878	246
1982	250131	227
1983	296077	219
1984	368232	253
1985	395059	322
1986	386921	309
1987	274302	240
1988	351344	219

Source : Khadi and Village Industries Commission, Trivandrum, (Unpublished).

Figure 7.4 Production
Hand Made Paper in Kerala

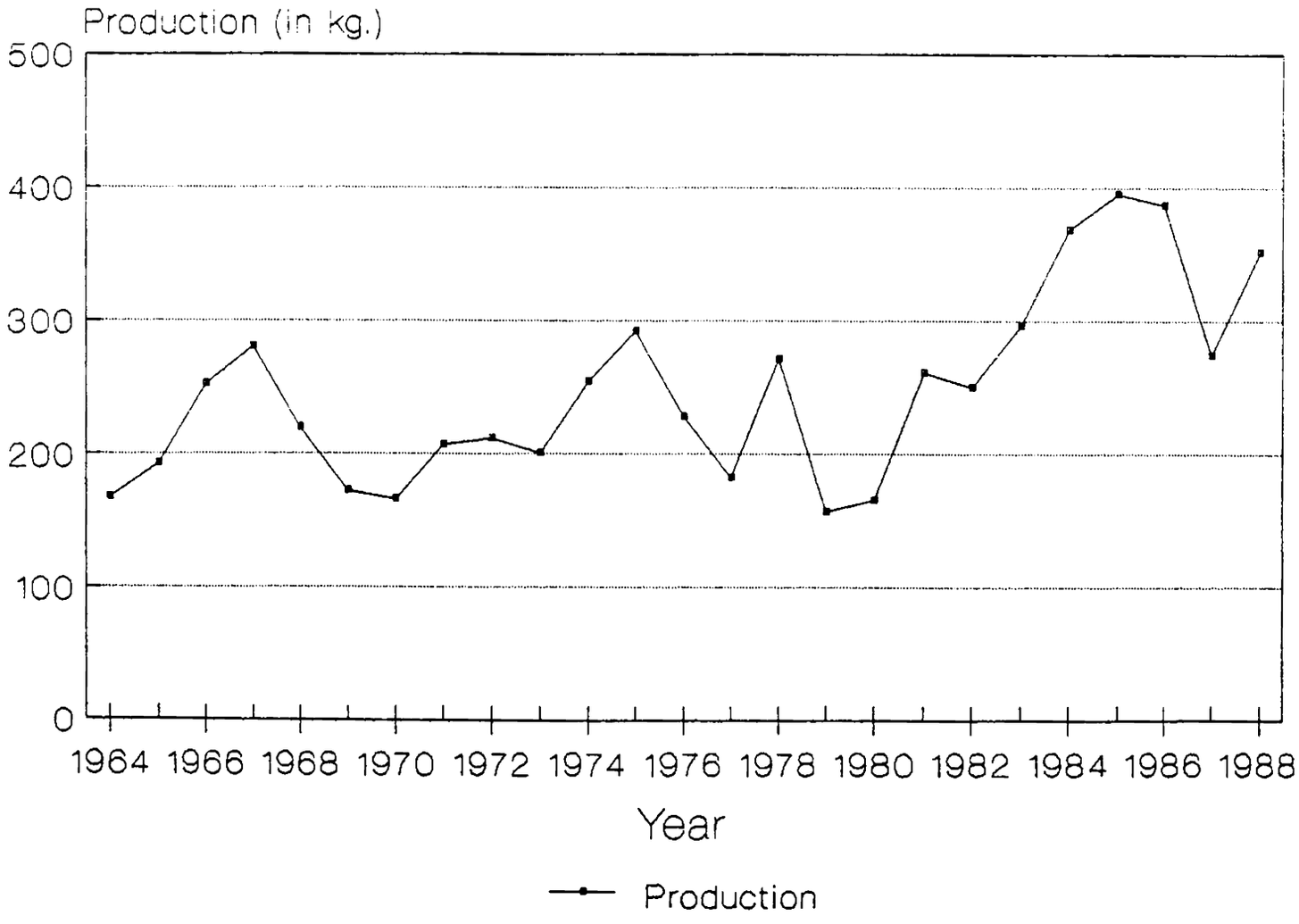
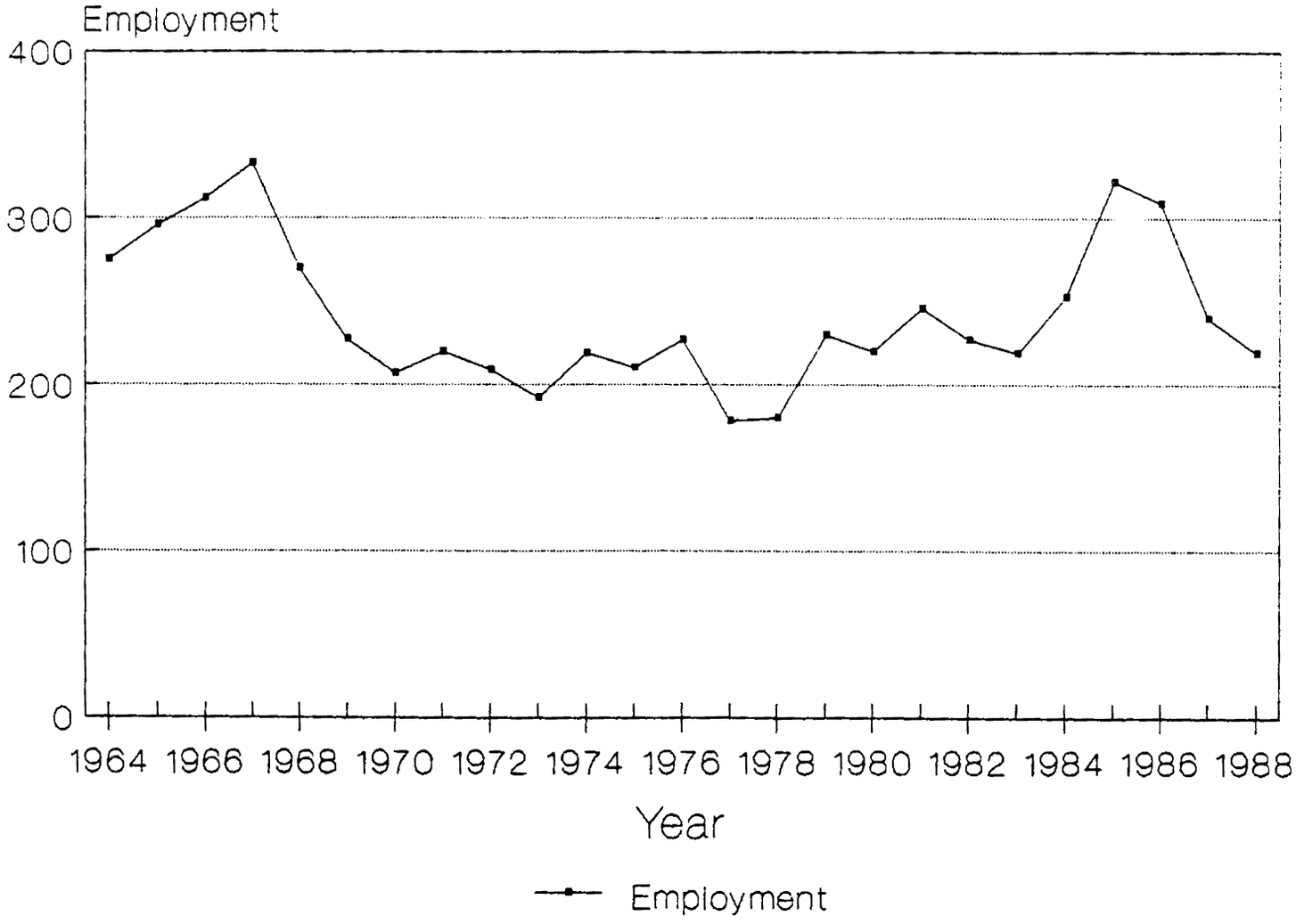


Figure 7.5 Employment
Hand Made Paper Industry in Kerala



observed that the output has not been increasing much. The total output increased only from 291,953 kg. in 1975 to 296,077 kg. in 1983. In 1988 the output was 351344 kg. There is no trend at all since the estimated growth rate is insignificant. In the case of number of persons employed also no significant trend is found during 1964 to 1988 period. But between 1964 and 1975 the employment had been declining at a rate 4.2 per cent per annum. However, there has not been much improvement as there is no trend at all in employment during 1976 to 1988.

Now it is worth noting the product-mix of the industry and the percentage share of various products to the total production. The product-mix of the industry seems to have affected the efficiency. In fact, there is no product diversification. This has to be viewed agaist the demand for various speciality papers that can be produced in hand made paper industry. The output comprises of few products; and within that spectrum of products, Card Board and Cover Paper predominate. Various products and their respective percentage shares from 1979 to 1988 are presented in Table 7.13. It can be seen that about 60 per cent or more of the total output consists of a single product, Card Board and the rest, the Cover Paper. The shares of other varieties such as High Grade, Utility and Blotting are practically negligible - ranging from 1 to 7 per cent.

Table 7.13. Product-mix

Hand Made Paper Industry in Kerala, 1979 to 1988.

Year	High Grade (%)	Utility (%)	Blotting (%)	Card Board (%)	Cover Paper (%)
1979	0	2	1	71	26
1980	0	5	0	57	38
1981	1	2	7	84	6
1982	0	1	0	86	13
1983	0	1	0	51	48
1984	0	1	0	52	47
1985	0	0	0	55	45
1986	0	1	0	55	44
1987	0	2	0	59	39
1988	0	3	0	68	29

Source: Computed.

Now it is appropriate to examine the efficiency of the industry in terms of labour productivity. The labour productivity from 1964 to 1988 is presented in Table 7.14 and Figure 7.6. It is seen that the labour productivity has been increasing. The index increased from 228 in 1975 to 263 in 1988. However, it is important to note that the rate of increase in the labour productivity in the recent years has been less than that of it in the earlier period. The estimated growth rate for the period from 1964 to 1988 is 2.65. The period between 1964 to 1975 witnessed a growth rate of 6 per cent per annum. But in the subsequent period, i.e., from 1976 to 1988 the estimated growth rate is only 2.26. Therefore, though one can observe an increasing labour productivity in general, the rate of increase has been declining.

In sum, the production and employment in hand made paper industry in Kerala present a picture of clear stagnation while the labour productivity shows a slight improvement. However, the rate of increase appears to be declining.

Problems and Prospects of the Hand Made Paper Industry

Problems of the hand made paper industry in Kerala are mixed and varied. The first and foremost one is the size of the units. The existing size of the units does not allow the producer to reap the economies of scale, on the one hand, and there is inadequate product diversification, on the other. At present,

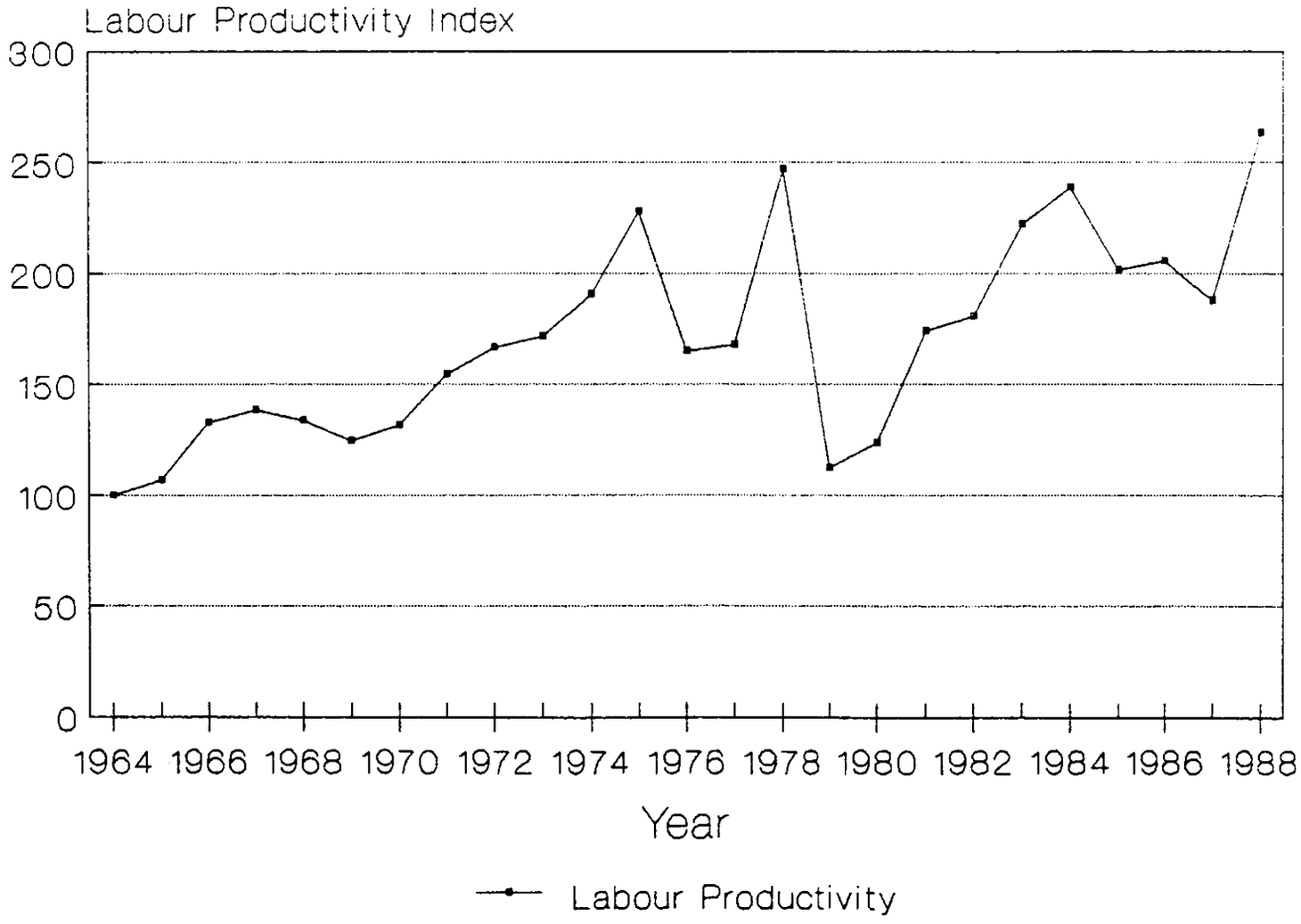
Table 7.14. Labour Productivity

Hand Made Paper Industry in Kerala, 1964 to 1988.

YEAR	Labour Productivity (1964 = 100)
1964	100.00
1965	106.91
1966	132.60
1967	138.30
1968	133.53
1969	124.61
1970	131.52
1971	154.41
1972	166.29
1973	171.51
1974	190.30
1975	228.10
1976	164.96
1977	167.79
1978	246.99
1979	112.03
1980	123.48
1981	173.99
1982	180.79
1983	221.81
1984	238.80
1985	201.29
1986	205.44
1987	187.52
1988	263.22

Note : Labour productivity is computed dividing total output by total employees.

Figure 7.6 Labour Productivity
Hand Made Paper Industry in Kerala



diversification of the products is practically nil and production is confined to only few products. This is mainly due to lack of ingenuity and marketing facilities. The existing structure of market does not create any competition among the units. The units, usually collect orders from Government agencies and produce only whatever they demand. The ownership pattern of the units is, to a greater extent, responsible for it. Most of the units are under the ownership of Kerala Khadi and Village Industries Board. It seems that the officials of the Board do not have adequate expertise in running the business.

Coming to the supply side, the important problem of the industry, as in the case of mechanised paper industry, is the scarcity of raw materials. The requirement of various raw materials depends on the type of the product. For example, the production of high quality writing paper requires cotton cuttings, whereas the production of file board requires only waste paper. The importance of the supply of appropriate raw materials emerges from the fact that the cost of production, to a greater extent, depends on the combination of raw materials.

There is sufficient potential for expansion of hand made paper industry in India. As has been noted earlier, a wide variety of products can be produced in hand made paper units. Furthermore, many products of hand made paper industry command superiority in quality. As such, there is good scope for the

development of the industry. To have some details, it is reported that Posts and Telegraphs Department needs about 1000 tonnes per year of cloth lined paper in India. The requirement of National Archives for special papers for preserving records have been estimated at about 900 tonnes per year. Filter papers are also required by various laboratories and pharmaceuitical units to the tune of about 8000 tonnes per annum. The requirements of paper for delux stationery, invitation cards and file board etc. are estimated to be of the order of 8000 tonnes per year.

In most of the above-mentioned varieties, hand made paper can cater to the needs of the market at competitive prices. In fact, many of the variety papers that are being imported can be produced in the hand made paper industry.

A distinctive advantage of the handmade paper industry over the machine made paper industy is that the production process does not involve any pollution. Indeed, it reduces pollution by consuming such locally available waste materials as waste paper, cotton cuttings etc.

From the foregoing analysis, it is clear that, though there is sufficient demand for hand made paper products, particularly because of its peculiar characteristics that make it competitive with the machine-made paper, the development experience of it in Kerala has not witnessed any dynamism. It has been suffering from

several weaknesses, among them the most important has been the size of the unit which does not allow the industry to reap the advantages of the economies of scale. Raw material scarcity is found to be another important problem on the supply side. Diversification of the product-mix together with an organised network for the raw material supply and marketing would improve the efficiency of the hand made paper industry in Kerala.

Chapter VIII

CONCLUSIONS AND RECOMMENDATIONS

Pulp and paper industry constitutes one of the important segments of India's industrial economy. Since independence, Indian paper industry has been growing in terms of number of units, installed capacity and output. However, those developments have been at the cost of efficiency. That is to say, though the installed capacity and production have increased, the capacity utilisation has shown a declining trend, particularly in the paper and paper board sector. Thus, there has been a great deal of inefficiency in resource use in Indian paper industry.

The comparative performance of the paper industry in Kerala with the four groups of industries namely intermediate goods industries, capital goods industries, basic industries and consumer goods industries, and the State industrial sector as a whole has been made in terms of productivity, labour absorption capacity, economies of scale and capacity utilisaton. As has been hypothesised, the productivity performance of the paper industry is found to be very poor. The productivity of the industry has been very low compared to the intermediate goods industries and the industrial sector of the State. Both the partial and the

total factor productivity indices of the paper industry have shown declining trends. The industrial sector of the State witnessed increasing labour productivity, but declining capital productivity and a near stagnation in total factor productivity. In the case of labour productivity there has been an increase in all the four groups of industries and the State industrial sector. As against this, the paper industry witnessed a sharp decline. The general tendency of capital productivity has been a declining one. It is interesting to note that the decline in the paper industry is found to be discernibly higher than that of the four groups of industries and the industrial sector of the State. The movement of the total factor productivity has not been uniform across the board. While the industrial sector witnessed a near stagnation, in the case of paper industry there has been a declining trend; and the fall in the industry is found to be greater than that of the intermediate goods industries.

The employment potential of the industries has been gauged in terms of employment elasticity of wage rate and ouput, both in the short-run and in the long-run. The results of the evaluation of the employment potential of the industry is fully in conformity with the hypothesis that it has high employment potential. The short-run elasticity of labour demand of the paper industry with respect to wage rate is found to be greater than that of the intermediate goods industries and the aggregate State industrial sector. The short-run elasticity of labour demand of the paper

industry with respect to output is found to be, more or less in line with the industrial sector of the State. On the contrary, the long-run elasticity of output seems to be lower than that of the industrial sector; nevertheless, it is higher than that of the intermediate goods industries. Thus, the labour absorption capacity of the paper industry is on a higher side. However, the magnitude of all the estimated elasticities are less than unity except long-run elasticity of labour demand with respect to output. In other words, only less than proportionate changes can be expected in the demand for labour due to changes in wage rate and output.

An examination of the scale economies shows that the paper industry has high economies of scale. That is to say, the more the output, the greater will be the efficiency in using the inputs.

The capacity utilisation of the industry has been analysed by means of estimating a utilisation index based on minimum capital-output ratio. As in the case of productivity analysis estimations are made for the paper industry, the four groups of industries and for the State industrial sector. The hypothesis that the paper industry has a low capacity utilisation is found to be true. The esimates of the utilisation index for the groups of indsutries, industrial sector of the State and the paper industry have shown declining trend with wide fluctuations around the

trend. The utilisation of capacity in the paper industry has been lower than that of the intermediate goods industries and the State industrial sector.

The important problems of the paper industry have been identified by case studies. There are two dimensions to the problems of the industry in Kerala: the first relates to the supply constraints which are faced by and are internal to the industry while the second involves adverse externalities on account of environmental pollution. The most important problem of the industry has been scarcity of forest-based fibrous raw materials. It has been found that the variations in capacity utilisation can, to a greater extent, be explained in terms of the fluctuations in the supply of raw materials. The distorted structure of the supply mechanism and a lopsided price policy together with the absence of a long term raw material planning seem to have complicated the problem and have drawn the industry to the verge of a raw material crisis. One can observe a lack of co-ordination in the supply mechanism of raw materials to the industry - the ownership and maintenance by the State Government while the procurement is made by the companies. Moreover, the price policy appears to have complicated the raw material problem further. The price of the raw materials charged by the State Government is found to be very low and it is termed as 'royalty'. As a result, the industry lost its ingenuity and competitiveness in finding the alternative materials available in the State. At

the sametime the State exchequer also lost a huge amount of revenue on account of subsidy. The continuous supply of raw materials can be ensured and monitored if areas are allocated to the paper industry for raising the required forest products. This would make the industry itself responsible for its own raw material supply. It is true, that many attempts in this line in the past could not succeed because of the National Forest Policy. The Forest Policy does not allow the State Government to provide forests for companies to raise the raw materials. An alternative to the leasing can be a long-term raw material planning formulated by the Government in consultation with and with the co-operation of companies which may take into account the availability of forest land, the requirements of the industry and the impact of forest depletion on the ecology. Such a planning process, would, by the very nature of its awareness on a wider spectrum, provide a rational and optimal price policy. This would bring the industry, in due course of time, to a level of efficiency at which the industry would absorb the required raw materials at the prevailing open market price.

Inspite of sufficient demand for the products the hand made paper units lack dynamism. They continue to exist with the support of heavy subsidy. The size of the units coupled with raw material scarcity does not allow the hand made paper industry to reap the advantages of the economies of scale. The production and employment levels present a picture of stagnation though the

labour productivity shows slight improvement. Diversification of the product-mix together with an organised network for the raw material supply and marketing would improve the efficiency of the hand made paper industry in Kerala.

The externalities of the pulp and paper industry can be classified into two: one relating to the clearfelling of forests and thereby affecting the ecological balance of nature and the other by polluting the environment through the discharge of the wastes. Since Kerala is already deficient in area under forests cover required to keep the ecology on balance, it is imperative to stop further demarcation of forest area for the purpose of raw material procurement. It may be pointed out that absence of externalities is a distinctive advantage of the hand made paper industry.

The paper industry in Kerala is found to have been polluting the environment through effluent disposal and air discharges which adversely affect the economy. The income from agriculture, fishing and coir-making are considerably reduced. The effluent treatment system seems to be inefficient in treating the waste adequately to preserve the ecological balance. This is all the more in the case of the private sector. An improvement in technology is inevitable particularly for conserving the use of water in the mills and for bringing the level of pollution down to the prescribed standards. This would, not only enable the mills

to reduce investment in effluent treatment plants but also lead to the recovery of valuable chemicals and the generation of additional energy.

The standards of air and water quality have already been laid down at the national and the state levels. However, the pollution control measures in Kerala are limited only to effluent treatment. It would be necessary to continuously monitor and reassess those standards on the basis of empirical experience acquired so that the standards can be altered or modified. This will ensure that the least cost alternative consistent with environmental and ecological requirements is adopted by the industry as a whole. At the same time, the pollution control measures have to be extended to the air and solid wastes.

In the perspective of regional economic development of the Kerala economy, the role played by the paper industry has been very small compared to the general industrial linkage effects. It is generally believed that industrialisation would accelerate the pace of growth of a regional economy in terms of linkage effect and agglomeration economies. In fact, there is no forward linkage in the paper industy in Kerala, so also the agglomeration effect.

In sum, the efficiency of paper industry in Kerala measured by any parameter - productivity and capacity utilisation - has been on the low side. The relatively poor performance over time

can be attributed mainly to the scarcity of raw materials. The industry also raises problems of environmental pollution. However, the industry has a high employment potential. Diversification of product-mix, upgradation of technology together with a long-term raw material planning would bring the industry back on the path of efficiency.

The conclusions that emerge from the study have many important policy implications both at the investment decision level and at the level of individual industry-specific improvements. The performance of the paper industry is well below than that of the other industries. Therefore, any attempt towards going in for additional units would amount to the suboptimal use of the available scarce resources in the State. On the other hand, increasing the utilisation of the available capacity by making available enough supply of raw materials together with technological improvements would be a prudent policy alternative.

APPENDIX I

Cobb-Douglas Production Function

Cobb Douglas Production Function (CDPF) is one of the most widely used homogeneous production functions. The mathematical formulation of it with two factors may be specified as:

$$V = A L^{\alpha} K^{\beta} \quad \ldots\ldots(1)$$

for $A > 0$, $0 < \alpha < 1$, and $0 < \beta < 1$.

where V is output and L and K are labour and capital inputs and A, α and β are constants to be determined empirically.

The marginal products of labour and capital can be obtained by differentiating the function (1) partially with respect to labour and capital.

The marginal product of labour is given by

$$\frac{\delta V}{\delta L} = \frac{\delta(A L^{\alpha} K^{\beta})}{\delta L} = \alpha \frac{V}{L} \quad \ldots\ldots(2)$$

The marginal product of capital is given by

$$\frac{\delta V}{\delta K} = \frac{\delta(A\ L^{\alpha}\ K^{\beta})}{\delta K} = \beta\ \frac{V}{K} \quad \ldots\ldots(3)$$

where α and β are equal to partial elasticity of output with respect to labour and capital respectively. α and β are given by

$$\alpha = \frac{L}{V} \times \frac{\delta V}{\delta L} \quad \ldots\ldots(4)$$

$$\beta = \frac{K}{V} \times \frac{\delta V}{\delta K} \quad \ldots\ldots(5)$$

The sum of the coefficients α and β taken together measures the total percentage change in output for a given percentage change in labour and capital. There will be diseconomies of scale, constant returns to scale and economies of scale depending on whether $\alpha+\beta$ is less than one, equal to one or greater than one. The parameter 'A' represents efficiency. For every input combination, the greater is 'A' the greater is the level of output.

One of the serious limitations of Cobb-Douglas Production Function is that it assumes unit elasticity of substitution. The returns to scale can change according to changes in the scale of

operations as well as in technology. The two cannot be separated. If the variations in the degree of returns to scale are due to technological change only, then the sum of the elasticities will change but the ratio of the elasticities will remain unaltered. The changes in the capital intensity of a technology will lead to a change in α relative to β. In Cobb-Douglas Production Function the elasticity of substitution is unity and thus unchanging.

The Cobb-Douglas Production Function can be used to find out the sources of output growth. The output growth may be due to increase in the labour force, capital stock and technical change.

For measuring the technological change through Cobb-Douglas Production Function, an exponential time trend can be incorporated. The function then may be specified as,

$$V = A L^{\alpha} K^{\beta} e^{rt} \quad .....(6)$$

Taking logarithms on both sides,

$$\log V = \log (Ae^{rt}) + \alpha \log L + \beta \log K \quad .....(7)$$

where an exponential e^{rt} has been introduced to take care of technical progress.

Constant Elasticity of Substitution (CES) Production Function

One of the serious limitations of the Cobb-Douglas Production Function, as mentioned earlier, is the unit elasticity of substitution. But elasticity of substitution is an important parameter for economic growth. High elasticity of substitution is associated with higher output and high employment.[1] The most widely used production function for determining this parameter is CES production function. The CES production function for two inputs can be written as

$$V = r \left[\delta K^{-\rho} + (1-\delta) L^{-\rho} \right]^{\frac{-v}{\rho}} \quad \ldots\ldots(8)$$

where V is value added, K is fixed capital and L is total number of employees and r, δ and ρ are constants which Arrow[2] calls as efficiency, distribution and substitution parameters respectively. v represents the scale parameter so that

$v > 1$ implies increasing returns to scale

$v < 1$ implies diminishing returns to scale

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[1]Romesh K. Diwan and Damodar N. Gujarati (1968), op. cit., p.31.

[2]Arrow K. J. et. al. (1961), "Capital-Labour Substitution and Economic Efficiency", Review of Economics and Statistics, Vol.43., No.3., pp.225-250.

$v = 1$ implies constant returns to scale

δ can be regarded as a measure of non-neutral technical change.

And the elasticity of substitution (σ) is given by

$$\sigma = \frac{1}{1+\rho} \quad ....(9)$$

APPENDIX II

Table 1. PRODUCTIVITY INDICES OF PULP AND PAPER INDUSTRY 1973-74 TO 1985-86

Year	Partial Productivity		Total Factor productivity		
	Labour	Capital	Kendrick	Solow	Translog
1973-74	100	100	100	100	100
1974-75	139	57	68	63	66
1975-76	107	75	81	73	78
1976-77	43	23	26	24	26
1977-78	68	69	69	59	62
1978-79	44	35	36	36	36
1979-80	52	42	44	43	43
1980-81	61	47	49	49	49
1981-82	33	25	27	26	27
1982-83	10	5	6	8	8
1983-84	19	12	13	17	16
1984-85	128	19	27	36	45
1985-86	171	33	45	61	77
Growth rate	-5.26	-14.17	-12.47	-8.9	-8.1

Note: Growth rates are estimated by fitting an exponential trend.

Table 2. PRODUCTIVITY INDICES OF BASIC INDUSTRIES IN KERALA

1973-74 TO 1985-86

Year	Partial Productivity		Total Factor productivity		
	Labour	Capital	Kendrick	Solow	Translog
1973-74	100	100	100	100	100
1974-75	100	94	95	95	95
1975-76	32	104	80	70	76
1976-77	57	95	84	82	89
1977-78	54	89	79	78	83
1978-79	67	96	88	89	96
1979-80	64	102	92	91	98
1980-81	73	102	94	95	103
1981-82	84	100	96	100	108
1982-83	91	104	101	105	114
1983-84	74	82	80	84	91
1984-85	86	95	92	97	105
1985-86	91	82	84	92	99
Growth rate	2.37	-0.8	-0.09	0.9	1.31

Note: Growth rates are estimated by fitting an exponential trend.

Table 3. PRODUCTIVITY INDICES OF INTERMEDIATE GOODS INDUSTRIES

1973-74 TO 1985-86

Year	Partial Productivity		Total Factor productivity		
	Labour	Capital	Kendrick	Solow	Translog
1973-74	100	100	100	100	100
1974-75	98	92	94	93	94
1975-76	103	82	87	88	87
1976-77	45	40	41	39	40
1977-78	92	78	82	79	80
1978-79	81	61	66	66	67
1979-80	106	67	76	78	79
1980-81	71	43	49	51	52
1981-82	66	34	41	46	47
1982-83	94	36	47	57	59
1983-84	86	31	40	50	52
1984-85	90	28	39	49	51
1985-86	148	43	60	77	81
Growth rate	1.44	-9.5	-6.5	-3.97	-3.6

Note: Growth rates are estimated by fitting an exponential trend.

Table 4. PRODUCTIVITY INDICES OF CAPITAL GOODS INDUSTRIES

1973-74 TO 1985-86

Year	Partial Productivity		Total Factor productivity		
	Labour	Capital	Kendrick	Solow	Translog
1973-74	100	100	100	100	100
1974-75	129	120	124	123	124
1975-76	120	120	120	119	120
1976-77	144	56	89	88	89
1977-78	114	47	72	71	72
1978-79	159	60	97	95	97
1979-80	187	74	116	115	116
1980-81	157	60	96	95	96
1981-82	200	81	126	125	126
1982-83	171	63	102	102	102
1983-84	186	70	112	112	112
1984-85	159	59	95	95	95
1985-86	153	61	96	95	95
Growth rate	3.8	-3.7	-0.18	-0.15	-0.22

Note: Growth rates are estimated by fitting an exponential trend.

Table 5. PRODUCTIVITY INDICES OF COUSUMER GOODS INDUSTRIES

1973-74 TO 1985-86

Year	Partial Productivity		Total Factor productivity		
	Labour	Capital	Kendrick	Solow	Translog
1973-74	100	100	100	100	100
1974-75	96	97	97	97	97
1975-76	93	84	88	88	88
1976-77	96	90	92	93	92
1977-78	87	76	80	81	80
1978-79	85	62	70	73	72
1979-80	110	72	85	90	89
1980-81	95	54	66	72	71
1981-82	71	44	53	57	56
1982-83	106	48	64	73	72
1983-84	124	48	68	79	79
1984-85	138	53	76	87	87
1985-86	132	41	64	75	74
Growth rate	2.55	-7.5	-3.8	-2.3	-2.3

Note: Growth rates are estimated by fitting an exponential trend.

Table 6. PRODUCTIVITY INDICES OF INDUSTRIAL SECTOR OF KERALA

1973-74 TO 1985-86

Year	Partial Productivity		Total Factor productivity		
	Labour	Capital	Kendrick	Solow	Translog
1973-74	100	100	100	100	100
1974-75	99	96	97	96	97
1975-76	77	122	106	101	105
1976-77	85	79	81	83	85
1977-78	86	79	81	84	86
1978-79	98	75	82	88	90
1979-80	114	86	94	101	103
1980-81	103	74	82	89	91
1981-82	100	71	79	86	88
1982-83	124	72	85	95	97
1983-84	123	64	78	89	91
1984-85	133	68	83	95	97
1985-86	149	64	83	96	98
Growth rate	3.97	-4.1	-1.7	-0.2	-0.13

Note: Growth rates are estimated by fitting an exponential trend.

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