THE ECONOMICS OF CHEMICAL INDUSTRY IN KERALA

Thesis submitted to the University of Cochin
for the award of the Degree of
Doctor of Philosophy in Economics
under the Faculty of Social Sciences

By

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CERTIFICATE

Certified that the thesis "The Economics of Chemical Industry in Kerala" is the record of bonafide research carried out by Mrs. Mary Joseph, T., under my guidance. The thesis is worth submitting for the degree of Doctor of Philosophy in Economics.

(Dr. K.C. Sankaranarayanan)

DECLARATION

I declare that this thesis is the record of bonafide research carried out by me under the supervision of Dr. K.C. Sankaranarayanan, Professor and Head of the Department of Applied Economics, University of Cochin. 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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INTRODUCTION

0.1 Industry can be broadly defined as any productive organisation in which skilled labour, mechanical and managerial power and intermediate products are progressively used involving complex technology and increased capital labour ratio which thereby leads to an upward shift in the production function implying both quantitative and qualitative changes in the structure of input and output. This involves not merely one or two factors, but a whole host of interrelated economic and social factors which can act and interact upon each other in such a way as to bring about a radical change in the existing economic and social structure. The inter-dependence and interrelations between the different firms in the industry is termed as the "industrial structure" and the inter-industrial economics is termed as the "Structure of the Industrial Sector".[1]

0.1.1 The process of industrialisation, therefore, involves a transformation of traditional agriculturally-oriented economy into a modern mechanised one leading to a substantial change in the structure of output and occupation in favour of manufacturing industries and the service activities at the

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[1] Chenery H.B. and Clark Paul G., Inter-industry Economics John Wiley & Sons, New York, 1966.

expense of the hitherto predominant sector in terms of the relative share of employment and output. As Harry, G. Johnson observes,

> "industrialisation properly speaking involves the organisation of production in business enterprise characterised by specialisation and division of labour both within and among themselves; this specialisation is based on the application of technology and of mechanical and electrical manpower to supplement and replace human effort and motivated by the objective of minimising cost per unit and maximising returns to the enterprises. The continuous pursuit of these objectives by the enterprise in a competitive environment leads to the accumulation of capital and to the development and application of new technology, new managerial and marketing methods and new labour skills thereby building economic growth automatically into the functioning of the economy . . . . So conceived, industrialisation is an economy-wide phenomenon applying to agriculture and the service trades as well as to manufacturing; the essence of it is not the production of products typically considered as industrial but the rational approach to the productionprocess itself that it embodies".[2]

Herein lies the crux of the process of industrialisation. It

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[2] Johnson Harry, G., Economic Policies Towards Less Developed Countries; The Brookings Institution, Washington, D.C., 1967, pp.45-46.

is the rationalisation of the production process that paves the way for modernising the economy and leads it on the road to progress.

0.1.2 Industrialisation, thus initiates a massive change which brings about innovations and alterations in economic life. The most visible among this has been "the application of increasingly intricate and sophisticated technology to the production of goods. Machines have replaced crude manpower. And increasingly as they are used to instruct other machines, they replace the cruder forms of human intelligence."[3] Technology means, "the systematic application of scientific or other organised knowledge to private tasks. Its most important consequence is in forcing the division and sub-division of any such task into its component parts".[4] Changing technology alters progressively and radically what can be obtained from any given supply of factors. As Samuelson observes, "the output that can be obtained from a given stock of factors depends on the state of technology. But at any time there will be a maximum attainable amount of the product for any given amounts of factor inputs".[5]

0.1.3 With the industrial revolution sweeping through the world and gaining momentum, technological innovations have

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[3]Galbraith John Kenneth, The New Industrial State, Houghton Mifflin Company, Boston, 1967, p.1.

[4]Ibid., p.12.

[5]Samuelson Paul A., Economics (Sixth Edition), McGraw Hill Co., New York, 1964, p.516.

increased by leaps and bounds and large scale capital intensive industries have come to occupy an important place in the industrial map. Among the large scale industries which have established themselves the chemical industry occupies an important position.

0.1.4 Chemical industry has been defined differently by different authors. The Standard Industrial Classification (SIC) Index of the United States Bureaux of the Census divides chemical and allied products as comprising of three general classes of products:

1. Basic chemicals such as acids, alkalies, salts and organic chemicals;

2. Chemicals to be used in further manufacture such as synthetic fibres, plastics, materials, dry colours and pigments.

3. Finished chemical products to be used for ultimate consumption such as drugs, cosmetics and soaps or to be used as materials or supplies in other industries such as paints, fertilisers, explosives etc.

0.1.5 Chemical industry has also been defined from the product point of view and the process point of view. From the product point of view the definition adopted by the U.S. Bureau of the Budget for Chemical and Allied Products includes the following broad classes:

a) industrial organic and inorganic chemicals;

b) plastic materials and resins, synthetic rubber, synthetic and other man-made fibres except glass;

c) drugs;

d) soaps and detergents;

e) paints, varnishes, lacquers;

f) gum and wood chemicals;

g) agricultural chemicals; and

h) miscellaneous products.

0.1.6 From the process point of view the definition adopted by the Manufacturing Chemists Association for the chemical process industries includes all manufacturing processes which employ chemical change at one or more stage of their activity.

0.1.7 According to the first schedule of the Indian Industries (Development and Regulation) Act 1951, Chemicals other than fertilisers cover the following items:

i) Inorganic heavy chemicals;

ii) Organic heavy chemicals;

iii) Fine chemicals including photographic chemicals;

iv) Synthetic Resins and Plastics;

v) Paints, Varnishes and Enamels;

vi) Synthetic Rubbers;

vii) Man-made fibres including regenerated cellulose rayon;

viii) Coke-oven byproducts;

ix) Coal-tar distillation products like naphthalene, anthracine;

x) Explosives including gunpowder and safety gases;

xi) Insecticides, fungicides, weedicides and the like;

xii) Textile Auxiliaries;

xiii) Sizing materials including starch and miscellaneous chemicals, fertilisers, dye stuffs, drugs and pharmaceuticals - are classified independently while petrochemicals are covered under the category of heavy organic chemicals.

0.1.8 The National Committee on Science and Technology has adopted the following schedule for the various sectors of the chemical industry:

1. Petrochemicals (Bulk organic chemicals), Polymers, elastomers and fibres.
2. Fertilisers and plant nutrients.
3. Inorganic chemicals and Electro chemicals.
4. Organic fine chemicals, drugs and pharmaceuticals, perfumery, aromatics, photo chemicals, biochemicals and carbo-hydrates.
5. Dyes and intermediates for dyes, drugs and pharmaceuticals.
6. Oils, fats, surfactants, resins and varnishes.
7. Pesticides.
8. Marine chemicals.

0.1.9 Thus the chemical industries constitute a group of heterogenous and feeder industries and cover a wide range of industries from the giant petrochemical and heavy chemical industries to the smaller light industries such as paints, varnishes and fine chemicals.

0.1.10 Covering such a wide spectrum of products and involving highly sophisticated technology, the chemical industry soon made its mark on the industrial map of the world. The last twentyfive years could be considered as an era of unprecedented development in the chemical industry. The impact of this development has had very wide ramifications on other correlated and inter-dependent industries.

0.2 Chemical industry in other countries - an overview

0.2.1 On the whole the chemical industry has made a record of steady progress. Total production and consumption have increased severalfold over the span of a few years. The world production of chemical products more than doubled between 1960 and 1970 increasing in value from $73 billion to $153 billion. However, the share of developing countries has not yet been very appreciable, accounting for only about 5 per cent per capita. The world-wide expansion of the industry, however, slowed down in the latter half of the seventies, the average annual growth being 6.5 per cent, whereas it was 9.2

per cent before. The developing countries appear to be in a better position as their growth rates in the two halves of the seventies were 6.1 per cent and 11.2 per cent respectively. The share of the developing countries in the total production is also estimated to have risen from 4.7 per cent to 5.2 per cent. Consumption, however, has been steadily higher than production in the developing countries. The share of the developing countries excluding China was 7.2 per cent of the total consumption in 1960 (production was 4.7 per cent) and 7.6 per cent in 1965 (production = 5.2 per cent). The average per capita consumption for all developing countries is about 12.5 per cent of the world average with production constituting 8.5 per cent of the world average.

0.2.2 The world trade in chemicals amounted to about $129 billion in 1979. Production and export of chemicals is still heavily concentrated in the developed world. The OECD and CMEA countries account for about 90 per cent of the world production, while the 1976 shares were about 65 per cent and 25 per cent respectively. About 50 per cent of the chemical trade takes place among the west European countries.[6]

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[6] UNCTAD 1979 - The Structure and Behaviour of Enterprises in the Chemical Industry and Their Effects on the Trade and Development of Developing Countries, UNCTAD/ST/MD/23. C.F. Isaak David T., Basic Petrochemicals in the 1980s, a Global Perspective, East West Centre, Hawaii, 1980, p.8.

Regarding the pattern of inter-regional trade, western Europe is, by far, the world's dominant exporter of chemicals. Another feature is that the developing world forms the largest importer of chemicals taking about half of the inter-regional imports. Although not all of the developing world's imports are from western Europe, it emerges as a surprising conclusion that Western Europe's surplus in chemicals is almost of the same size as that of the developing world's deficit.

0.2.3. Although the chemical industry forms an important input to agriculture, textiles, manufacturing and medicine and many other industries, the developing countries have not yet been particularly successful in establishing chemical industries. About 70 per cent of the Third World Chemical consumption comes from imports. [7] Modern chemicals still remain the domain of the developed free market economies. One of the reasons for the dominance of the developed world in chemicals is attributed to the sheer capital intensiveness of the industry. In 1966 the investment per new job created in chemicals ranged from $20,000 to $100,000. [8] This range seems to have held more or less constant in real terms.

0.2.4 Despite the high capital-intensiveness, the chemical industry is characterised by a high degree of economies of scale. The cost of a plant is assumed to follow a 0.6

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[7] UNCTAD 1979, Ibid., p.8.

[8] Mercier, C., Petrochemical Industry and the Possibilities of its Establishment in the Developing Countries, Paris edition Techniq 1966, C.F.Isaak David, T., opcit. p.9.

power law with respect to capacity i.e. doubling the capacityonly increases cost by 50 per cent.[9] This generally accounts for the advantageous position of the developed countries.

0.2.5 The role of innovation is another critical factor in the success of the chemical industry and the comparative advantage in research and development accounts for a substantial portion of the OECD'S lead in chemicals. International marketing infrastructure is another pre-condition for the success of the chemical industry.

0.3 The Chemical Industry in India.

0.3.1 In view of the ever-increasing importance of chemical industryes, it was only inevitable that they came to be established in India also. The modern chemical industry in India had a slow and halting start. Progress in the early stages was laboured and painful. Most of the concerns were the off-springs of individual attempts and even basic issues like proximity to the source of raw materials and other relevant economic considerations did not influence the size and location of factories. Sulphuric acid - the basic substance in modern chemical manu-

9 UNIDO 1973 - The Petrochemical Industry, E.73, II B.T. Ibid.

facture was one of the first chemicals to be produced in India. Although the industry depended totally on imported supplies of raw sulphur it recorded steady progress. Coal tar distillation was likewise started on a small scale at the beginning of the present century. Production of magnesium chloride was started in 1915, in Saurashtra. Oxygen plants were installed in Bombay and Calcutta but the production of dissolved acetylene gas materialised only in 1926-27. The alkalie industry had yet to be established and the pharmaceutical industry had not gained any strong footing till 1929.

0.3.2 In 1935 there were 23 large chemical factories with a total labour population of 4,183. By 1939 the number of major chemical factories had risen to 38 with a working population of 7,968. By 1950 the chemical industry had grown to the status of a major industry with 233 major chemical units. These units had a total investment of Rs.133 million, whereas the total investment for all industries was Rs.2,353 million. The chemical industry ranked eighth in the list of major industries with a gross output valued at Rs.199.5 million out of a total industrial output of Rs.9,760.7 million. By 1951 the gross output of basic chemicals alone reached Rs.377.2 million and the rank of the chemical industry advanced to the fifth position.

0.3.3 The development of the chemical industry after 1951 is very much linked with the success of plans in India. In the first plan a distinction was made between private and public sectors and the main responsibility was laid on the private interests. There were only seven chemical factories in the private sector with a total capital investment of Rs.143.3 million. The second plan which gave priority to industrialisation gave a great fillip to the chemical industry. There was a great increase in the output of basic chemicals, fertilisers, sulphuric acid, caustic soda, soda ash and organic chemicals recording a compound rate of growth of 18.5 per cent. The annual rate of growth during the second plan was 14 per cent, nearly double the rate of growth of the first plan. Production of basic chemicals and chemical products increased from Rs.1,027 million to Rs.5615 million. The Third Plan aimed at increasing this to Rs.13,495 million. The average rate of growth during the third Plan at 11 per cent, though less pronounced, was impressive. The decade 1960-70 witnessed the emergence of many petrochemical and polymer-based industries as also the diversification and expansion of production capacities in basic and alkalic chemicals, fertilisers, pesticides and drugs and pharmaceuticals. The chemical industry ranked high among the top industries in India with an aggregate investment of Rs.22,000 million which is neraly 2/5 of the total investment of Rs.53,000 million in the organised industrial sector. The value of production increased from Rs.1,200 million at the end of the first plan to Rs.20,000 million at the commencement of the fourth plan.

0.3.4 The fourth Five Year Plan gave added importance to the chemical industry. Chemical industry, including petro-chemicals and fertilisers and minerals, received an outlay of Rs.14,000 million. The rate of growth of output and value added over the fifth Plan for the chemical industry was about the highest among all the other sectors of the economy. As per the sixth plan fertilisers and chemicals were allotted Rs.16,880 million and the petroleum industry Rs.25,500 million out of a total outlay of Rs.11,62,400 million. Fertilisers and pesticides have been given high priority on the grounds of striving for agricultural self-sufficiency. The plan for petro-chemicals envisages production targets primarily on the basis of schemes already under implementation. As for the other sectors, the Planning Commission had little to offer even by way of projections except for caustic soda and soda ash. If the investment programme for fertiliser expansion is excluded, the chemical industry plan for 1980-85 is of relatively micro-dimensions and does grave injustice to the status that the chemical industry occupies in the economy.

0.3.5 **Fertilisers**

0.3.5.1 The use of chemical fertilisers was initiated in India when imported nitrate from Chile was applied to the soil. Synthetic ammonia production and its conversion to ammonium sulphate was started in the year 1938 in a plant established in Belagule with a rated capacity of 6,600 tonnes of ammonium sulphate per annum. Later in 1947 a larger plant with a rated capacity of 46,000 tonnes of ammonium sulphate per annum was put up near Alwaye in Kerala.

0.3.5.2 The growth of the fertiliser industry has been remarkable during the three decades of planning. As against a fertiliser plant in 1950 there were in 1972, 27 single super phosphate plants, one triple super phosphate plant, 15 nitrogenous and complex plants. The total investment in the fertiliser industry which was of the order of Rs.200 million in 1950-51 had risen to Rs.18,000 million at the end of the fourth plan and Rs.25,000 million at the end of the fifth plan. However, this increase has not been commensurate with the consumption requirements of the three major nutrients. Nearly 70 per cent of India's nutrient consumption is in the form of nitrogen. Consumption of N has risen more than ten times from less than 0.3 million tonnes in 1962 to nearly 3 million tonnes in 1977-78, which means a compound growth rate of 15 per cent per annum. Nevertheless, this is much low compared to the consumption levels in other countries. India's current nitrogen consumption of 18 kg. per hectare is much low compared to the optimum levels attained in other countries such as 44.6 kg./hectare in China, 58.8 kg. per hectare in Soviet Union and 76.7kg. in U.S.A.[10] By the late 1980s India's fertiliser consumption should rise from the current 4 million tonnes to around 11 million tonnes, nitrogen consumption increasing from the 3 million level to 7 million tonnes, that of phosphates from 0.8 million tonnes to 2.5 million tonnes and that of K_2O to 1.5 million tonnes.

0.3.5.3 Despite the increased consumption requirements anticipated production has not materialised. Total production in 1979-80 registered a drop of 89,000 and 26,000 tonnes of N and P_2O_5 respectively. Capacity utilisation during the year came down to 61 per cent and 65 per cent for N and P_2O_5. During 1980-81 it even slumped to as low as 50 per cent, though it picked up later.

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[10] Editorial, Chemical Industry News, Vol.23, No.5, October 1978, p.343.

0.3.5.4 Sixth Plan Targets During the sixth plan total fertiliser capacity is expected to increase from 5.12 million tonnes to 7.76 million tonnes. The production increase has been targeted from 2.98 million tonnes to 5.60 million tonnes. Consumption is also expected to increase from 5.26 million tonnes to 9.65 million tonnes, leaving a total shortfall of 4.05 million tonnes.

0.3.6 Pesticides

0.3.6.1 The pesticides industry had its genesis in India with the commencement of the production of B.H.C. in 1952, though the use of its products goes back to 1947-48 when D.D.T. formulations were imported into India. The use of pesticides in India has increased several-fold in the past years. From a base level of 8,000 tonnes at the end of the second plan in 1960-61 it had gone up to 30,000 tonnes in 1971-72. By 1973-74 there were 18 units in the organised sector and over 160 units in the small scale sector providing basic pesticidal chemicals as well as formulations. The demand estimate for technical grade pesticides for 1977-78 was placed at 47,790 tonnes. This was expected to rise to 64,290 tonnes by 1983-84. The installed capacity of the pesticide industry would have to rise to 80,000 tonnes to meet the increased consumption requirements. The corresponding level of production is expected to be 65,000 tonnes representing a capacity utilisation of 81 per cent. This would require a foreign exchange allocation of 8.45 crores. Despite the substantial increases envisaged, consumption of pesticides in India is still on the low side. A great deal of leeway has to be made to reach the required standards.

0.3.7 Heavy Inorganic Chemicals

0.3.7.1 Until the beginning of the planning era heavy inorganic chemicals were not given the attention it deserved. Sulphuric acid was among the first heavy chemical to be made in India followed by hydrochloric acid, nitric acid, alum, copper sulphate, ferrous sulphate etc. Caustic soda, soda ash, fertilisers like ammonium sulphate, chlorine and bleaching powder were manufactured on a large scale.

0.3.7.2 Soda ash is one of the most important heavy inorganic chemicals manufactured. Production of soda ash in 1950 was 43,788 tonnes which increased to 5.42 lakh tonnes in 1975. With an estimated growth in demand of 8 per cent the indigenous demand for soda ash can be estimated at 7.95 lakh tonnes.

0.3.8 Caustic Soda

0.3.8.1 The caustic soda chlorine industry is one of the oldest industries with almost 40 years standing in the field of chemicals in India. Production of caustic soda in 1951 was 14,727 tonnes. The production of 33,120 tonnes of electrolytic caustic soda in 1955-56 created a severe problem of disposal of 31,000 tonnes of liquid chlorine. Unlike the western countries, where the demand for chlorine outran the demand for caustic soda, in India the disposal of chlorine proved to be a difficult task. Production of caustic soda showed spectacular increases to 93,000 tonnes in 1960 and 5.50 lakh tonnes in 1978-79. There was an unforeseen and unprecedented rise in the demand for caustic soda due to a sudden spurt of industrial activity in consuming sectors such as paper, textile, soaps, rayon etc. Constraints on capacity utilisation, primarily due to the inadequacy of raw materials like power and salt, restricted the increase in production. Imports to the extent of 25,000 tonnes had to be made to meet domestic requirements.

0.3.8.2 Chlorine utilisation A very heartening feature of the industry is that the gainful utilisation of chlorine over the years has shown an increasing trend. The percentage of utilisation increased from 79 in 1970 to 90 in 1978. The expansion of many consuming industries has been basically responsible for the increase in chlorine utilisation.

0.3.9 Organic Chemicals

0.3.9.1 Much of the growth in the organic chemical industry has come about in the last fifty years. Production of benzene, butyl acetate, diethylene glycol, ethylene, monoethyleneglycol and polyethylene glycol registered over 100 per cent increase in 1970-78. The industry also expanded into new avenues and production of D.M.T. ortho oxylene, vinyl chloride and caprolactum has gained momentum.

0.3.10 Oil Reserves and Prospects

0.3.10.1 India was a relatively late starter in the field of petrochemicals. "With just 0.1 per cent of the world oil reserves, (prior to Bombay High recovery) India's known reserves are very poor".[11] As pointed out by the Planning Commission, "oil production which stood at a meagre 0.51 million tonnes in 1961 rose to about 5.6 million tonnes by the end of the Third Plan, 7.9 million tonnes by the end of the Fourth Plan and 10.63 million tonnes in 1977-78.[12] In 1979 oil production increased to 12.84 million tonnes".[13]

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11 Wallace E. Tyner, Energy Resources and Economic Development in India, Martinus Nijhoff Social Sciences Division, Lieden/Boston, 1978, p.23.

12 Planning Commission, Draft Sixth Plan 1978-83, Government of India, p.33.

13 Mahatme, D.B., "Oil: who cares for Tomorrow", Commerce, October 18, 1980, p.750.

0.3.10.2 Notwithstanding the slow increase in production, consumption of oil increased from 3.9 million tonnes in 1953-54 to 30.03 million tonnes in 1979-80.[14] The inevitable consequence of this was that imports had to be stepped up from 13.97 million tonnes in 1974 to 15.46 million tonnes in 1979. Indigenous production during the same period was equal to 7.49 million tonnes and 12.84 million tonnes. About 2/3 of our indigenous consumption is met from imports.

0.3.10.3 The burden of the massive imports has been aggravated by the hike in international oil prices. The posted price of Saudi Arabian light crude oil which remained at $1.80 per barrel since 1960 increased to $2.18 in February 1971. It was raised to $5.14 in November 1973 and to $11.65 in January 1974.[15] In December 1979 Saudi Arabia raised the price to $.24.00 per barrel, and some of the members of the OPEC raised it to as much as $30.[16]

0.3.10.4 This consequently led to an increase in the administered price of fuel oil in India. The price of fuel oil per kilo litre increased from Rs.232.78 on July 1st 1972

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14 *Ibid.*, p.749.

15 Sinha, S.L.N., Oil International Payments and Reform IFMR, Madras, Table 3.3, p.54.

16 Dohner Robert, S., "Energy Prices, Economic Activity and Inflation, A Survey of Issues and Results" in Knuf Anton Mark (ed.), *Energy Prices, Inflation and Economic Activity*, Baltinger Publishing Co., Massachussets, 1981, p.123.

to Rs.604.2 on July 1st 1974.[17] Prices were again raised in June 1980 and again in January 1981 to adjust to the international prices. Another unprecedented hike was made on July 11, 1981.[18]

0.3.10.5 The most significant impact of the oil price hike has been on the balance of payments in the country. While the total import bill increased from Rs.1,634.2 crores in 1970-71 to Rs.11,300 crores in 1980-81, that of petroleum, oil and lubricants increased from Rs.135.9 crores to Rs.5,600 crores. The percentage of POL imports to total imports increased from 8.26 in 1970-71 to 25.81 in 1974-75 and to 49.5 in 1980-81. This means that this item accounts for half of the total import bill. Hence it becomes all the more important to step up indigenous production and to tap all available sources of energy.

0.3.11 <u>Petrochemicals</u>

0.3.11.1 The annual compound rate of growth of major petrochemical products such as LDPE, HDPE and synthetic fibres during the year 1965-77 ranged between 12 per cent and 25 per cent. According to the Reconstituted Working Group on Petrochemicals, deficits appeared in many items in the petrochemicals. In order to reduce deficits the working group

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17 Annual Report of the Reserve Bank of India, 1973-74, p.32.

18 Government of India, <u>Economic Survey 1980-81</u>, p.3.

took stock of the availability of domestic raw materials such as naphtha, ethane and propane gas, olefins and diolefins. The increasing price of naphtha from Rs.1,050 in 1979 to Rs.2,521 in 1980 had a crippling effect on the industry. For fertilisers the same increase was not evidenced as prices remained steady at Rs.602 per tonne. Such discriminations are bound to stunt the growth of petrochemicals. The importance of this industry cannot be undermined in a country's development policies.

0.4.1 However, the chemical industry had a very late start in the state of Kerala. It was only in the early forties that the first fertiliser plant was started, which paved the way for the setting up of the organised chemical industry in the State. The reason why it had such a late beginning was probably because it is primarily a highly capital-intensive industry, requiring also very sophisticated technology and infrastructural facilities. Kerala, lying at the southernmost corner of the country, was in a very dis-advantageous position so far as capital and technological developments were concerned. Being a highly populated state with the density of population being much higher than in any other part of the country, the inevitable tendency was to go in for labour-intensive technologies. Cottage and small scale industries have been in existence in the state from time immemorial. They have received more attention, because they were in a better position to tap the labour potential of the State. Capital requirements were low, while at the same time providing employment to larger numbers. Hence large scale industry which required large amounts of capital had a relatively late start. In such a setting it becomes important to examine the scope for chemical industry in Kerala.

0.5 Problems

0.5.1 The problems posed in this study are listed below:

1. Has the chemical industry made any significant contribution to the industrialisation of the State?

2. How far has it been effective in terms of augmenting productivity and efficiency of the factors used?

3. Has it been successful in generating any linkage effects among the units under study?

4. What are the prospects for the future growth and diversification?

5. Are the individual chemical units in the State working efficiently? If not, what were the reasons and what are the suggestions that can be provided to effect a more efficient working?

0.6 Hypothesis

0.6.1 Chemical industry has recorded a high degree of productivity at the international and national level. But this has not been evidenced in the case of major chemical enterprises set up in the State.

0.6.2 The high degree of capital intensity has not contributed to a proportionate increase in output.

0.6.3 A capital-intensive technical change as necessitated by the chemical industry is warranted only when the growth in capital is greater than the growth in labour. For a labour-abundant economy like that of Kerala technological progress should be such as to guarantee an increase in output and employment.

0.6.4 The chemical industry is characterised by high input-output linkages. If these linkages are put to maximum utilisation by the setting up of sub-industries, the industry could make a larger contribution to the State economy.

0.6.5 The individual large scale chemical units set up in the public sector, except those enjoying monopoly, appear to be working at low levels of efficiency. Their levels of utilisation of the factors leave much room for improvement.

0.6.6 The social costs of the chemical industrial units are increasing in magnitude in terms of the effluents which are thrown out of them. The increasing degree of pollution is causing great harm to the ecological system and human efficiancy.

0.7 Purpose of the Study

0.7.1 The main purpose of the present study is to examine the growth and development problems of a new industry - the chemical industry - in the State of Kerala. Problems of productivity and efficiency are studied with respect to the different branches of the industry such as fertilisers and insecticides, basic inorganic and organic chemicals, drugs and pharmaceuticals and miscellaneous chemicals. A study of partial input-output linkages between the different chemical units is also attempted. The chemical industry is generally characterised by high linkage effects. These linkages could be used to generate subsidiary industries and thereby help in the growth and diversification of the industry. The efficiency of the working of individual units is also studied to understand the problems involved and to suggest remedial measures.

0.8 Methodology

0.8.1 The study is partly descriptive and partly analytical. It is descriptive insofar as it traces the growth and development of the industry at the national and State level. It analyses the output and factors and estimates the productivity of the factors involved and the efficiency of the working of enterprises. In order to analyse the productivity of the factors of production in the chemical industry in Kerala, secondary data as given in the Annual Survey of Industries for Kerala has been made use of. A twelve-year period from 1962 to 1974 was selected, upto which only the Annual Survey of Industries for Kerala was available during the study. To study the efficiency of the working of the individual units in the chemical industry a survey was conducted among the medium and large scale chemical units. Fourteen out of 45 large scale chemical and allied units were surveyed.

0.9 Data Collection

0.9.1 Data for the study were collected through schedules and in-depth interviews with the managerial personnel of the units under study. Data so collected were supplemented wherever necessary from the following sources:

(i) Published Government documents.

(ii) Annual survey of Industries for the years 1961-62 to 1974-75.

(iii) Reports of the Comptroller and Auditor General of India (Commercial).

(iv) Reports of the Public Undertakings Committee regarding the units under review.

(v) Annual Reports of the Companies studied.

(vi) Unpublished cost and financial records maintained by the companies.

0.10 Scheme of the Study

0.10.1 For the purpose of analysis the thesis has been divided into eight chapters. Chapter I traces the industrial development of Kerala and the problems of the industrial development programmes in the State.

0.10.2 Chapter-II analyses the growth of the chemical industry in Kerala. Some of the important chemical units are studied in depth to analyse the present position.

0.10.3 Chapter-III estimates the productivity of labour and the relation between labour productivity and capital intensity in the chemical industry in Kerala. The impact of labour productivity on the industry is examined.

0.10.4 Chapter-IV makes an estimate of the production function. The Cobb-Douglas production function and C.E.S. production function are estimated with respect to the chemical industry. The efficiency of technology, the degree of economies of scale and the elasticity of substitution are estimated from the parameters of the production function.

0.10.5 Chapter-V examines the linkage effects between certain important chemical industrial units in the State. The chemical industry being the major consumer of its own products can establish a strong input-output flow among the units themselves. A partial input-output table relating to the units under study is constructed, so as to find the inter-relations between them and the scope for further expansion of such relations.

0.10.6 Chapter-VI and VII analyse the general and functional problems relating to the particular units under study. Problems of factor usage, capacity utilisation and pollution control are discussed in these chapters.

0.10.7 Chapter-VIII presents the conclusions of the study. It also suggests a suitable programme for future growth and development of the chemical industry in the State.

0.11 Limitations of the Study

Secondary data from the Annual Survey of Industries could be obtained only up to the year 1974-75 during the period of study. Hence the analysis of productivity for the chemical industry as a whole in Kerala was undertaken only for the period 1961-62 to 1974-75. For the purpose of analysis, a sample of 14 units only was selected from a total of 45 large and medium chemical and allied industrial units. These units are the most prominent ones in the chemical industrial map of Kerala. They have made a major contribution towards output and employment as compared to the other units.

0.12 LITERATURE SURVEYED

0.12.1 The emergence of Chemical industry as a large scale basic industry in the Indian economy is of recent origin. Consequently only very few studies have come out with reference to this industry. Here an attempt is made to survey the available literature on the subject.

0.13.1 Desousa, J.P., has given a comprehensive summary of the growth and development of the chemical industry in India from its inception down to the plan periods.[19]

0.13.2 The UNIDO monograph on Industrial Development discusses at length the growth and development of the chemical industry and the problems and prospects of the same.[20] This monograph also highlights the importance of inter-industry linkages in the chemical industry. The chemical industry being characterised by the processing chains that involve many intermediate steps, is its own most important supplier and its own most important customer. These inter-industry linkages are seen to increase with the level of industrialisation. The input-output co-efficient will be smaller in

19 Desousa, J.P., History of the Chemical Industry in India, Technical Press Publication, Bombay, 1961.

20 UNIDO, "Monograph on Industrial Development" - Industrialisation of Developing Countries: Problems and Prospects - Chemical Industry, United Nations, New York, 1969.

the case of developing economies and increase as industrialisation proceeds.

0.14.1 The development of inter-industry analysis or what is commonly termed as input-output analysis has a long history dating back to the epoch-making work of W.W.Leontief.[21] The actual work on the empirical model was started in 1931. "In fact according to A. Nove, the work on input-output techniques first started in Russia in the early twenties but his ideas were considered bourgeois and could not be used for Russia".[22] The idea of input-output tables were developed at length for the American economy in 1941.[23] The first inter-industry work on Government level was taken up in the United States during World War II by the Bureau of Labour Statistics.

0.14.2 In India a beginning was made by individual research workers around the year 1951. M. Mukherjee first prepared a four sector summary table of the intermediate and

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21 Leontief, W.W., "Quantitative Input and Output Relations in the Economic System of the United States", Review of Economics and Statistics, 1936.

22 Nemchinov, V.S., "The Use of Mathematics in Economics", (English Translation), A. Nove (ed.), MIT Press, 1964, p.10.

23 Op. cit., Leontief, W.W., The Structure of the American Economy 1919-29, Harward University Press, 1941, Second edition, 1919-39, Oxford University Press, 1951.

final flows of the Indian Union for the year 1949-50.[24] A more elaborate attempt was made by T. Choudhuri to construct an inter-industry table referring to the year 1948-49 and consisting of 23 sectors.[25] A.K. Biswas attempted to analyse the inter-industry structure of a number of Indian manufacturing industries on the basis of data available in the Census of Indian Manufacturers.[26] However, he did not cover the entire manufacturing sector and hence his table remains only as a partial one. An inter-industry transactions table identifying 19 sectors was published by the Institute of Public Opinion.[27] Uma Dutta following the approach of Mukherjee's four sector table compiled a 15 sector table for the year 1949-50.[28] W. Malenbaum prepared a table with four rows and five columns for the years 1948-49 and 1953-54.[29]

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24 Mukherjee, M., "The technique of Social Accounting in a pre-industrial economy", Sankhya, Vol.14, Part I & II, September, 1954.

25 Choudhuri, T., Consumption levels in India (An Econometric Analysis), June 1954; Ph.D. thesis submitted to London University.

26 Biswas, A.K., Input-Output Relations among selected Indian Industries, Mimeographed paper - Centre for International Studies - Indian Project, MIT, July, 1954.

27 Indian Institute of Public Opinion, The Structure of Indian Economy, Economic Report of the Indian Institute of Public Opinion, October, 1954.

28 Uma Dutta, A Preliminary Study of Inter-industry Relations in India, Working Paper Series of the Planning Division, Indian Statistical Institute, December, 1954.

29 Malenbaum, W., "India's Domestic Product 1951-52 to 1953-54", Indian Economic Journal, Vol.II, No.3, January, 1955.

0.14.3 The Planning Division of the Indian Statistical Unit presented a twelve sector table for 1950-51.[30] Following the efforts made by Choudhuri and Goodwin an inter-industry unit was set up in the Planning Division. This division prepared three tables relating to the years 1951-52, 1953-54 and 1955-56.[31] The entries of these tables were at market prices (producers prices + indirect taxes net of subsidies). These tables consisted of 36 sectors. D.V. Ramana's study entitled 'National Accounts and Input-output Accounts of India mainly used the ISI tables to obtain a set of tables for 1948-49 to 1958-59. These tables contained 50 sectors.[32] During the same period two tables for the years 1953 and 54 were prepared by B. Dey and K. Biswas. This was mainly for mining and the large scale sector. These tables were at

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30 Choudhuri, T.P. and Goodwin, R.M., Transactions matrices for the Indian Union 1950-51, Inter-Industry Unit Working Paper Series, Planning Division of the Indian Statistical Unit, January, 1955.

31 (i) "Inter-Industry Transactions of the Indian Economy 1951-52", Inter-Industry Unit of the Planning Division of the ISI published in the papers on National Income and Allied Topics, Vol.I, 1960.

(ii) "Inter-Industry Relations in the Indian Economy 1953-54", published in Formulating Industrial Development Programmes - Development Programming Techniques Series No.2, U.N., 1961.

(iii) Chakravarthy, A.K., Structure of the Indian Economy, Statistical Publishing Society, 1968.

32 Ramana, D.V., National Accounts and Input-output Accounts for India, Department of Applied Economics, Cambridge University, 1961 (Mimeo).

market prices and identified 40 sectors. But these tables were not perfect and at best were only partial tables.[33]

0.14.4 Inter-industry tables were later prepared by the ISI Planning Unit, Delhi. The first table for the year 1960-61 consisted of thirty sectors and the entries were in producer's prices of 1959-60.[34] Later another table relating to 1964-65 was also prepared which consisted of 77 sectors at 1960-61 producer's prices.[35] Another table with 144 sectors was also prepared at the planning unit of the I.S.I.[36]

0.14.5 The Economic Division of the Planning Commission also prepared a table at producer's prices relating to the year 1959 and consisting of 29 sectors.[37]

0.14.6 The Gokhale Institute of Politics and Economics compiled two input-output tables. The first one was compiled

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33 Dey, B. and Biswas, K., "Inter-industry relations for 1953 and 1954 for Mining and Large Scale Manufacturing Sectors", Papers on National Income and Allied Topics, Vol.III, 1965.

34 Manne, A.S. and Rudra Ashok, "A Consistency Model of India's Fourth Plan", Sankya Series B, Vol.27, Part I & II, 1965.

35 Saluja, M.R., "Structure of the Indian Economy, 1964-65", Sankya Series B, June, 1968.

36 ______, "Structure of the Indian Economy, 1964-65", Input-output Relations Among 144 Sectors", Sankya Series B, Vol.34, Part 4, December, 1972.

37 Planning Commission, "Input-output Flow Table 1959", prepared by the Economic Division of the Planning Commission & published in Economic Analysis in Input-output Framework Vol.II, Input-output Research Association, 1967.

for the year 1963 and consisted of 32 sectors.[38] The second table relating to the same year and consisting of 85 sectors was prepared by the Institute. Input vectors corresponding to large scale manufacturing was also given for 238 sectors.[39]

0.14.7 Regional Tables Apart from the national tables regional tables have also been prepared for the years under review. The tables for West Bengal as a whole and also for Calcutta Metropolitan Area for the year 1958 were prepared by R. Dhar with 18 sectors and using producer's prices.[40] Another table consisting of 18 sectors and five regions were also prepared for the Indian economy for the year 1953-54. This table contained information regarding flows from all regions to the different sectors of a specific region.[41] A partial table for the year 1965 giving the inter-industrial flows for the manufacturing industries for 23 sectors was also attempted by Bhanwar Singh.[42]

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38 Mathur, P.N., et. al., "Input-output Flow Table 32 x 32, 1963" published in Economic Analysis in Input-output Framework. Vol.II, Input-output Research Association, 1969.

39 ______, "Input-output Table 1963", Artha Vijnana, March 1972.

40 Dhar, R., "An Input-output Table for West Bengal and Calcutta Metropolitan District", Calcutta Research Studies No.13, Institute of Public Administration, New York.

41 ______, "The Study of Inter-regional Inter-sectoral Relations of the Indian Economy 1953-54", published in Economic Analysis in Input-output Framework. Vol.I, Input-output Research Association, 1967.

42 Singh Bhanwar, "West Bengal's Industrial Economy: An Analysis in Input-output Framework", Anvesak, Vol.II, No.2, December, 1972.

0.14.8 Analysing a state economy in India was first systematically attempted by G.S. Bhalla. Using a 17 sector input-output table for the Punjab economy for 1959 constructed by S.B. Ragnekar, he computed sectoral income multipliers for Punjab and argued that the total effect of investment on different sectors were very different from the initial direct effects. A 20 sector input-output model for the industrial sector of the Gujarat economy for 1964 has been prepared, followed by a 24 sector model for the entire economy.[43]

0.14.9 Input-output tables were later prepared for Bihar, Haryana, Punjab, Gujarat and Maharashtra.[44] Apart from these,

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43 (i) Bhalla, G.S., Sectoral Income Multipliers in Punjab and India, IX Indian Econometric Conference, Patna, 1969.

(ii) Alagh, Y.K. & Kashyap, S.P., "Structure of Gujarat's Economy - some Experiments with the input-output Approach", Proceedings of the First Gujarat Economic Service, Ahammedabad, 1970: Problems & Uses of Regional Input-output Tables, Third All India Input-output Conference, Bombay, 1970; Anvesak, June, 1971, pp.16-30.

44 (i) Koti, R.K., Input-output Tables for Maharashtra, Tata Economic Consultancy Services, Bombay, (Mimeo), 1973.

(ii) Kashyap, S.P., & Alagh, Y.K., Structure of Gujarat's Economy - Inter-industry Flows at Producer's Prices 1964-65, Sardar Patel Institute of Economic and Social Research, Ahamadabad, 1971.

(iii) Bhalla, G.S., Structure of Haryana Economy - Inter-Industry Flows and Patterns of Final Demand 1969-70, 1974.

(iv) Bhalla, G.S, Structure of Punjab Economy & Inter-industrial Flows and Patterns of Final Demand 1969-70, 1975.

(v) Ghosh, P.P., A Regional Planning Model for Bihar in an Input-output Frame-work, A.N. Sinha Institute of Social Studies, Patna, 1977.

partial tables exist for Karnataka and Madhya Pradesh.[45] P.P. Pillai has also prepared a partial input-output table for Kerala.[46]

0.15 Productivity Studies

0.15.1 In the arena of productivity studies, production functions and consequent estimates of productivity have been postulated by many. The Cobb-Douglas Function estimated the marginal product of capital and labour and returns to scale.[47]

0.15.2 Douglas collected together estimates of the Cobb-Douglas function from a wide range of countries and for different time periods for both industry level and plant average data.[48] The plant average data was obtained by dividing industry data on labour, capital and output by the number of plants in that industry. Nerlove discusses the Cobb-Douglas

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45 (i) Panchmukhi, V.R., Structure of the Industrial Economy of Karnataka, V All India Input-output Conference, Ahamadabad, 1975.

(ii) Sri Prakash & Patnaik, Structure of the Industrial Economy of Madhya Pradesh, V All India Input-output Conference, 1975.

46 Pillai, P.P., "Industrial Economy of Kerala", Economic Times, January 6, 1976.

47 Cobb, C.W. & Douglas, P.M., "A Theory of Production", American Economic Review Supplement, March, 1928.

48 Douglas, P.M., "Are there laws of production?", American Economic Review, Vol.38, 1948, pp.1-14.

function in detail and examines the problems involved in estimating it from cross-section data and also from time-series data. He derives a dynamic model of production where 'profit' maximisation overtime is assumed.[49] Feldstein changed the specifications of the input variables in the Cobb-Douglas function and concluded that a cross section study will avoid difficulties of autocorrelation and multicollinearity. From a cross section data on the U.K. he finds that the output elasticity with respect to hours per man is about twice the output elasticity with respect to the number of employees.[50]

0.15.2 In 1953 Markowitz and Rowe published a set of engineering estimates intended to represent the number of pieces per day that can be produced by a worker utilising alternative machine tools to perform a variety of metal removing tasks.[51]

0.15.3 Shortly after this, Hollis Chenery suggested that by assigning an investment cost to each machine tool it would be possible to use the data, so as to construct capital-labour

49 Nerlove, M., Estimation and Identification of Cobb-Douglas Production Functions, (Amsterdam: N. Holland, 1965).

50 Feldstein, M.S., "Specifications of the Labout Input in the Aggregate Production", Review of Economics and Statistics, Vol.49, 1967, pp.375-386.

51 Markowitz, H. and Rowe, A., An Analysis of Machine Tool Substitution Possibilities, R M 1412, Rand Santa Monica, 1952.

substitution functions for each individual task.[52] With such functions it would in turn be possible to make ceteris paribus predictions as to how methods of production might vary from one point of time or space depending on the relative prices of capital and labour.

In 1957 R.M.Solow on the assumption of competitive equilibrium estimated production functions from time series observations on labour's share of the product.[53]

K.J. Arrow, H. Chenery, B.S. Minhas and R.M.Solow popularised the C.E.S. Function or A.C.M.S. function known after them. They deducted in 1961 the form of such production functions from inter-country observations on wage rates and man-hour inputs. They estimated the marginal productivity equation for labour to obtain the elasticity of substitution and found that σ is significantly different from 1 in 14 out of 24 industries studied.[54] Zarembka criticises their

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[52] Chenery Hollis, "Capital Working Substitution in Metal Working Process, Patterns of Industrialism", American Economic Review, Vol.50, 1960.

[53] Solow, R.M., "Technical Change and the Aggregate Production Function", Review of Economics and Statistics, Vol.39, August, 1957, pp.312-320.

[54] Arrow, K.J., et. al., "Capital Labour Substitution and Economic Efficiency", Review of Economics and Statistics, Vol.43, August 1961, pp.225-250.

results.[55] Bodkin and Klein explore the assumptions about the error term with the Cobb-Douglas and C.E.S. functions. Both multiplicative and additive errors are assumed and the resulting estimates from U.S. time series data are surprisingly close together.[56]

0.15.4 Hiedlebrand and Liu used cross-section data on two digit U.S. industries to estimate several versions of a simultaneous model consisting of a production function in which the labour input is split into production and non-production employees' man-hours and in which technical progress is embodied in the capital measure. Bridge provides a summary and criticism of their work.[57]

0.15.5 Sato and Hoffman derive a function for which the elasticity of substitution is a linear function of the K/L ratio. They estimate the marginal productivity conditions using time series data for U.S. and Japan and conclude that their V.E.S. specification is more realistic than the C.E.S.[58]

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55 Zarembka, P., "On the Empirical Relevance of the C.E.S. Production Function", Review of Economics and Statistics, Vol.52, 1970, pp.47-53.

56 Bodkin, R.G. & Klein, L.R., "Non-linear estimation of Aggregate Production Functions", Review of Economics and Statistics, Vol.49, 1967, pp.28-44.

57 Bridge, J.L., Applied Econometrics, N. Holland Publishing Co., Amsterdam, 1971, pp.381-393.

58 Sato, R. & Hoffman, R.F., "Production Functions with variable Elasticity of Factor Substitution - Some Analysis and Testing", Review of Economics and Statistics, Vol.45, 1963, pp.1-65.

0.15.6 Mordecai Kurz and Alan, S. Manne in 1963 used the Markowitz Row data and improved on the methodology and developed three alternative models, model 1 using the Cobb-Douglas function, model 2 a refinement of model 1 and model 3 based on the C.E.S. function.[59] They concluded that a Cobb-Douglas function with capital and labour exponents of 0.5 provided a good fit to the Markowitz Row data. If the metal machining industries were indeed characterised by a Cobb-Douglas production function with capital and labour co-efficients of 0.5 and if this sector purchased its inputs and sold its products in the competitive markets, the equilibrium share of capital and labour employed should each be 50 per cent of the value of the product. The engineering estimates of these co-efficients were, in fact, checked again, the relative shares actually recorded using the data available from the U.S. Census of Manufacturers. There appeared to be a close agreement between the accounting data gathered by the census and the engineering estimates based on the M.R. data.

0.15.7 Blair and Kraft have estimated the production function equation as

$$\text{Log } V/L = \log a + b \log w + C_2T_2 + C_3T_3 + C_4T_4 + u$$

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59 Kurz, M. and Manne, A., "Engineering Estimates of Capital Labour Substitution in Metal Machining", <u>American Economic Review</u>, Vol.53, No.4, September, 1963, pp.662-682.

where T_2, T_3 and T_4 are dummy variables representing the years 1958, 1963 and 1967 introduced for accounting technological change.[60]

Donges has used the form:

$\log V/L = a + \sigma \log w$.[61] Girgis (1974), Hoffman and Weber (1976), Kazi, et. al. (1976), Roskamp (1977), Griliches & Ringstad (1971), Ryan (1973), Tyler (1974) have mainly used the marginal productivity of labour condition. Girgis has developed the form to study the aggregation and mis-specification biases for the manufacturing industries of Europe.

0.15.8 Asher and Krishnakumar (1973), Desai (1976), Griliches and Ringstad (1971), Ryan (1973), Tsurumi have used the C.E.S. form of the equation.[62] Except for Desai very few

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60 Blair, R.D. & Kraft, J., "Estimation of the Elasticity of Substitution in American Manufacturing Industry from Pooled Cross Section and Time Series Observation", Review of Economics and Statistics, V/56 August, 1974, pp.343-347.

61 Donges, J.B., "Returns to Scale and Factor Substitutability in the Spanish Industry", Review of World Economics, Vol. 108, 1972.

62 (i) Asher, E. & Krishnakumar, T., "Capital-labour substitution and Technical Progress in Planned and Market oriented Economics - A comparative study", Southern Economic Journal, Vol.40, No.1, July, 1973, pp.103-109.

(ii) Desai Padma, "The Production Function and Technical Change in Post-war Soviet Industry - A Re-examination", American Economic Review, Vol.66, June, 1976.

(iii) Griliches, Z. and Ringstad, Economics of Scale and the form of the Production Function, Amsterdam N.Holland Publishing Co., Amsterdam, 1971.

(iv) Ryan, T.M., "C.E.S. Production Function in British Manufacturing Industry", Oxford Economic Papers, July, 1973.

(v) Tsurumi, M., "Non-linear Two stage Least square estimation of the C.E.S. Production Function applied to the Canadian Manufacturing Industries (1926-39), 1949-67", Review of Economics and Statistics, Vol.52, May, 1970.

studies have used raw material as the input. Desai has used the C.E.S. function with constant returns to scale, raw materials specified and Hicks' neutral technological change.

0.15.9 Behrman and Roemer have used the partial adjustment model.[63] Roemer has assumed that firms adjust to the prevailing real wage such that if the desired long run productivity changes by 1 per cent in any given period, then firms adjust factor proportions sufficiently to change productivity by 2 per cent in that period. Behrman has attempted to abstract from short-run fluctuations and concentrate upon the long-run structure. Hence the capacity of real value added is used instead of current real value added and the weighted average of wages to prices is used instead of the current wage price rates.

Philpot has attempted to deal with two problems: (a) biases due to differences in the labour quality, (b) non-constant returns to scale.[64]

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[63] (i) Behrman, J.R., "Sectoral Elasticities of Substitution between Capital and Labour in a Developing Economy: Time Series Analysis in the case of Post-war Chile", Econometrica, Vol.40, No.2, March, 1972, pp.311-325.
(ii) Roemer, M., "The Neo-classical Employment Model Applied to Ghanian Manufacturing", The Journal of Development Studies, June, 1975.

[64] Philpot, G., "Labour Quantity, Returns to scale and the Elasticity of Factor Substitution", Review of Economics and Statistics, Vol.52, No.2, May, 1970, pp.194-200.

0.16 Production Function Estimates for India

0.16.1 Most of the studies with respect to the Indian industrial sector have shown a decline in overall efficiency constant returns to scale, increased capital intensity of technology and absence of technological change.[65]

0.16.2 Reddy and Rao came to similar conclusions through a study of total productivity trends for the period 1946-57. This study showed a mild decreasing trend over the period.[66]

0.16.3 Singh concluded that during the period 1951-63 the percentage rise or fall in both the total input and the output were almost of the same order. The productivity of

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[65] (i) Banerji, A., "Productivity Growth and Factor Substitution", Indian Economic Review, April, 1971, (Vol.6 New Serie pp.1-24).

(ii) Zarembkha Paul, Towards a Theory of Economic Development, San Holden Day Inc., San Francisco, 1972, pp.32-33.

(iii) Gujarati, D., "A Test of the ACMS Production Function Indian Industries 1958", Indian Journal of Industrial Relations, 2, 1966.

(iv) Dutta, M.M., "Production Function for Indian Manufacturers", Sankya, Vol.15, 1955.

(v) Murty, V.V. & Sastry, V.K., "Production Function for Indian Industry", Econometrica, Vol.25, 1957, pp.205-221.

(vi) Datta Mazumdar, D., "Productivity of Labour and Capital in Indian Manufacturing", Artha Niti, June-July, 1966.

(vii) Narasimhan, G.V.L. and Fabryey, M.Z., "Relative Efficiencies of Organised Industries in India 1949-1958", The Journal of Development Studies, January, 1974.

[66] Reddy, M.G. & Rao, S.V., "Functional Distribution in Large Scale Manufacturing in India", Artha Vijnana, Vol.4, 1962, pp.189-197.

all inputs taken together did not show any appreciable rise. It was further observed that the rate of capital expansion over-stepped the expansion of value added with a consequent fall in capital productivity. He also traced most of the increase in labour productivity (V/L) to increasing capital intensity.[67]

0.16.4 Similar conclusions were arrived at by Shivamaggi, Rajgopalan and Venkatachalam (1968) for the period 1951-1961 and Rajkrishna and Mehta for the period 1946-1966.[68] The latter showed that labour productivity had almost continuously declined over the period and that most of the gains in V/L were due to increasing capital deepening. They found V/K to be decreasing and found that future increases in output would require more than proportionate increases in capital deepening.

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67 Singh, R.R., "Productivity Trends and Wages", Eastern Economist, April, 1966.

68 (i) Shivamaggi, Rajagopalan and Venkatachalam, "Wages, Labour, Productivity and Costs of Production", Economic and Political Weekly, May 4, 1968.

(ii) Raj Krishna & Mehta, "Productivity Trends in Large-scale Indian Industries", Economic and Political Weekly, October 26, 1968.

0.16.5 While comparing the perfomance of the Indian economy with that of Japan Fei and Ranis also noted the tendency towards increasing capital deepening in the Indian manufacturing sector.[69]

0.16.6 Dadi, Hashim and Dadi alone find constant returns to scale with a shift in the production function in the case of Indian manufacturing sector during 1946-1964.[70]

0.16.7 A pioneering study by G.C. Beri estimates partial and total productivity indices for cement, cotton textiles, iron and steel and sugar for the period 1948-1955.[71] The studies covering the period 1946-58 have found evidence of increasing returns to scale, high relative efficiency, increased capital intensity, presence of technological change and low elasticity of substitution.[72]

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69 Fei John, C.H. and Ranis Gustav, Development of the Labour Surplus Economy, Yale University, 1964, pp.131-135.

70 Dadi, M.M., Income Share of Factory Labour in India, Shri Ram Centre, New Delhi, 1973; Hashim, S.R. and Dadi, M.M., Capital Output Relations in Indian Manufacturing 1946-64, M.S. University of Baroda, Baroda, 1973.

71 Beri, G.C., Measurement of Production & Productivity in Indian Industry, Asia Publishing House, New Delhi, 1962.

72 Diwan, R.K. & Gujarati, D., "Employment and Productivity in Industries", Arthavijnana, Vol.10, 1968, pp.29-67.

0.17 <u>Estimation of Elasticity of Substitution</u>

0.17.1 Elasticity of substitution has been estimated using both cross-sectional and time series data. B.S.Minhas in 1963 estimated the coefficients of elasticity of capital/labour substitution using the same international cross section study used by Arrow, K.J. et. al. as 0.72 to 1.01.[73]

0.17.2 Jora Minasian, based on data from U.S., estimates the elasticity of substitution with a higher range with the median around 0.90.[74] Minhas and Minasian have estimated the elasticity of substitution from regressions of the form $L/Va = A + \beta \log w$, where w is the wage rate, L is the labour input, Va is the value added, A the constant and the elasticity of substitution. The high R^2 typically obtained from these regressions shows that labour productivity and wage rates are highly correlated. However, Clague has pointed out that this correlation may be due to many factors and the interpretation of 'β' as elasticity of substitution may be open to question.

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73 Minhas, B.S., <u>An International Comparison of Factor Costs and Factor use</u>, N. Holland Publishing Co., Amsterdam, 1963, p.20.

74 Minasian Jora, "Elasticities of Substitution and Constant Output Demand Curves for Labour", <u>Journal of Political Economy</u>, June, 1961.

0.17.3 Stigler estimated elasticity of substitutions by comparing capital receipt ratios and wage rates for large and small firms. His estimates of elasticity were very high averaging around 4.0. However his assumption that capital costs are the same for large and small firms gives his estimates an upward bias. Allowance for the effect of size on mechanisation would reduce the estimates drastically.[75]

0.17.4 Dhrymes has obtained elasticity of substitution in an inter-state cross-section study in which he used capital figures from the U.S. Census of manufacturers.[76] He uses a somewhat complicated model and runs regressions of labour requirements on wage rates giving a median estimate of 0.94. Oommen and Evenson have calculated the elasticity of substitution for agro-based industries in India. According to them the elasticity of substitution between capital and labour are generally below one except for tobacco and textiles.[77]

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75 Stigler George, C., "Capital and Rates of Return in Manufacturing Industries", NBER, Princeton, N.J., University Press, 1963.

76 Dhrymes Phoepus, "Some extensions and Tests for the C.E.S. Class Production Functions", Review of Economics and Statistics, Vol.XLVII, No.4, November, 1965, pp.357-366.

77 Oommen, M.A. & Evenson Robert, "Scale Economics, Elasticities of Substitution and Productivity Charge in the Agro based Industries in India", The Asian Economic Review, Vol.XIX, No.1, April, 1977.

0.17.5 Clague estimates elasticity of substitution using both engineering and accounting data from U.S. and Peru. The methodology is the same as the ACMS. His studies reveal that elasticities are less than unity except in the case of spinning.[78] Howard Pack using the data from profiles of Manufacturing Establishments, U.N. estimates elasticity of substitution and capital-labour ratios for many production operations and concludes that for productions such as grain-milling, paints, tyres, cotton and woollen textiles, the elasticity is much above unity.[79]

0.17.6 Apart from cross-section studies using within a country data, cross-country studies have also been attempted. Estimation of the C.E.S. labour productivity condition using international data has been carried out by Schydlowsky and Syrquin. Using U.N. data for 17 countries - 7 developed and 7 less developed - they have found out that cross-country estimates of the elasticity of substitution for each industry as being below one.[80]

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78 Clague, C., "Capital-labour substitution in Manufacturing in under developed countries", Econometrica, Vol.37, July, 1969.

79 Pack Howard, "The Employment-output Trade-off in LDCs - A micro-economic approach", Oxford Economic Papers, Vol.26, No.3, 1974, pp.388-404.

80 Schydlowsky, D.M. and Syrquin, M., Estimates of the C.E.S. Production Function of Neutral Efficiency Levels using effective Rates of Production as Price Deflators, February, 1972.

0.17.7 Zarembka and Chernicoff present a set of estimates of elasticity for two digit and three digit U.S. manufacturing sector. According to them for most empirical purposes, the elasticity should be assumed to be equal to unity and the Cobb-Douglas function employed rather than the C.E.S. function.[81]

0.17.8 Girgis' findings lends support to Solow's. The results led to the important finding that small scale establishments are unmistakably characterised by lower elasticity of factor substitution than large scale establishments.[82] The Griliches Ringstad Estimates made with the data of 1963 Norwegian Census of Manufacturing Establishments also could not reject the Cobb-Douglas form since their results gave values around unity.[83]

0.17.8 Time series studies on the C.E.S. production function have been mainly concerned with estimating the

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81 Zarembka Paul and Chernicoff, H.B., "Further Results on the Empirical Relevance of the C.E.S. Production Function", Review of Economics and Statistics, February, 1971.

82 Girgis, M., "Aggregation and Mis-specification biases in Estimates of Factor Elasticity of Substitution: The Case of Egypt", Review of World Economics, Weltiverts Chaftliches Archiv.

83 Griliches, Z. and Ringstad, V., Economics of Scale and the Form of the Production Function, N. Holland Publishing Co., Amsterdam, 1971.

elasticity of substitution. The aggregate elasticity of substitution has been estimated by Kravis (1959), Arrow et. al. (1961), Diwan (1963), Kenderick and Sato (1963), Brown and Decani (1963), Kenderick (1964), Ferguson (1965), David Van de Klundert (1965) and Banerji (1971).[84]

0.17.9 Estimates of the elasticity of substitution for individual manufacturing industries based on time series data have been presented by Mc Kinnon (1962), Lucas (1969), Kenderick (1964), Ferguson (1965), Diwan and Gujarati (1968), Sankar (1970), Katz (1969) and Griliches.[85]

0.18 Choice of Technology

0.18.1 The choice of technology is another area which has received the attention of the industrial economists. It has been strongly pointed out that the choice of technology should be made in such a way as to suit the particular conditions in the economy especially for capital-scarce labour-abundant economies.

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84 Nerlove, M., "Recent Empirical Studies of the C.E.S. and Related Production Functions" in Brown, M. (ed.), The Theory and Empirical Analysis of Production, Studies in Income and Wealth, Vol.XXXI, NBER, New York, 1967.

85 Ibid.

0.18.2 Reddy of the Indian Institute of Science has put up a strong case for small scale rather than large scale technologies, intensive in the use of local materials and skills and mutually reinforcing rather than sub-ordinating and exploitative.[86]

0.18.3 Sudipto Mundle also argues that such technologies meeting the above criteria are feasible in many branches of production.[87]

0.18.4 Ranis and Saxon House has pointed out that in the Japanese Cotton textile industry during the 1880s capital-labour ratio was halved, but output-capital labour ratio also increased.[88]

Odaka has also identified a similar case in the Japanese automobile industry of the 1930s where capital augmenting technical progress brought with it quality improvements and occasional improvements in labour productivity.[89]

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86 Reddy, A.K.N., "Towards an Indian Science and Technology", Journal of Scientific and Industrial Research, May, 1973.

87 Mundle Sudipto, Technology, Labour intensity and the organisation of Industrial Production - A tentative comparison of Japan and India, Working Paper No.118, Centre for Development Studies, Trivandrum.

88 Ranis & Saxon House, Technology choice and Adaptation and Quality Dimension in the Japanese Cotton Textile Industry in Ohkawa, K. and Havami, Y. (ed.), 1978.

89 Odaka, The Place of Medium and small scale firms in the development of the Automobile industry - A study of the Japanese experience, Ohkawa and Havami (ed.), 1978.

0.18.5 However, Eckaus has pointed out that in the fifties factor endowments or relative prices were not really relevant since the available techniques seemed to be the only available techniques and were hence quite rigid in their factor proportions.[90]

0.18.6 More recently however Morawetz has proved that a whole range of technical alternatives are available not only in the discrete processing industries, but also in the continuous processing industries.[91]

0.19 Inventory Control

0.19.1 Inventory control is an important problem which firms have to tackle to achieve efficiency in the level of utilisation of resources.

0.19.2 Metzler has put forth the theory that firms have an "optimum" or "desired" stock in relation to a given output which they try to achieve. He explains the fluctuations in inventories based on the stock-flow analysis or acceleration principle.[92]

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90 Eckaus, R.S., "The Factor Proportions problem in underdeveloped Areas", American Economic Review, September, 1955.

91 Morawetz, D., "Employment Implications of Industrialisation in Developing countries", Economic Journal, Vol.84, Sept. 1974, pp.491-542.
Ranis, G., "Industrial Technology, Choice and Employment, A Review of Developing country evidence", Interciencia, Vol.12, No.1, 1977.

92 Metzler Lloyd, "The nature and stability of Inventory Cycles", Review of Economics and Statistics, Vol.23, No.3, August 1941, p.113.

0.19.3 The question whether firms actually seek to obtain such a relation in practice has been hotly debated by economists such as Abramovitz, Ruth Mack and others.[93] It is to Modigliani that we owe the basic explanation in terms of cost minimisation as desired stock-output relation.[94]

0.19.4 Goodwin feels that firms attempt only a partial adjustment of the discrepancy between desired stocks and the existing inventory levels. Hence instantaneous adjustments of stocks to output would appear to be more realistic.[95]

0.19.5 Eisner and Strotz also feel that partial adjustment is what the firms will attempt since they are not sure as to how permanent the anticipated sales can be.[96]

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93 (i) Abramovitz Moses, Inventories and Business Cycles with special reference to Manufacturers Inventories, NBER, 1950, p.317.
(ii) Mack Ruth, "Characteristics of Inventory Investment - The aggregate and its parts - Problems of Capital Formation", Studies in Income and Wealth, Vol.19, NBER, 1957, pp.417-418.

94 Modiglian Franco, "Business Reasons for holding inventories and their Macro-Economic Implications - Problems of Capital Formation", Studies in Income and Wealth, Vol.19, NBER, 1957, pp.495-511.

95 Goodwin Richard, Secular and Cyclical Aspects of the Multiplier and Accelerator - Income, Employment and Public Policy, Essays in honour of Alvin Hanson, 1948.

96 Eisner Robert and Strotz Robert, Determinants of Business Investment - Impact on Monetary Policy - The Commission on Money and Credit, 1963, pp.59-233.

0.19.6 Murty and Sastry have classified the long-run factors which influence inventory accumulation as changes in production technology, communications, business institutions and practices and the composition of output.[97] Kusnets says that technological improvements in transport and communications have helped to lower the inventory levels overtime.[98] A lowering of the capital output ratio at the later stages of manufacturing is also expected to lower inventory levels.[99] According to Boon greater mechanisation can reduce the period of production and thereby reduce inventory levels.[100]

0.19.7 In the Indian context Singh feels that inventory investments are large with the result that the rate of return on capital is still low even though capacity utilisation has increased.[101] Moreover, as Rao puts it, the major part of the working capital of our industries are locked up in inventories.[102]

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97 Murty, K.K. and Sastry, D.U., Inventories in Indian Manufacturing, Academic Books Ltd., Bombay, 1970.

98 Kusnets Simon, Capital in the American Economy - Its formation and financing, NBER, 1961, p.163.

99 ________, Introduction to Cramer, et. al., Capital in Manufacturing and Mining - Its Formation and Financing, NBER, 1960, p.41.

100 Boon, G.K., Economic choice of Human and Physical Factors of Production, North Holland, 1964, pp.31-34.

101 Singh, D.., "Inventory investment in Indian enterprises in Organisation and Management of Public Enterprises", Vol.I, Gupta, K.R.(ed.), Allied Publishers & Distributors.

102 Rao, P.S., "Inventory Control in an inflationary economy", Lok Udyog, Vol.VIII, No.4, July, 1974.

0.20 Capacity Utilisation

0.20.1 Production is considered as the joint result of the work of men, materials, machines, spare parts, customers orders etc. If any one of the factors fails to come up to the anticipated mark it can push down production levels and lead to under-utilisation of capacity. Hence under-utilisation of capacity can affect the efficiency of production.

0.20.2 A number of studies have been made to analyse the reasons behind under-utilisation of capacity and estimate the levels thereof.

The USAID study estimated that output level could be increased by 15 per cent in the case of chemical industry if an additional shift were introduced and the necessary import of materials provided for.[103]

The NCAER estimated that net output could be increased by more than 50 per cent under desirable working conditions.[104]

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[103] Pfouts Daniel, G. and Miller, B. Spangler, Effects of Import Liberalisation on increased utilisation of Industrial capacity: Economic Problems and Benefits Preliminary Study, USAID, October, 1965 (Mimeo).

[104] Raj, K.N., "Growth and Stagnation in Indian Industrial Development", Lecture given in memory of Late G.L. Mehta, delivered at the I.I.T., Bombay, February 6, 1976.

0.20.3 Mahanti has analysed the causes behind under-utilisation of capacity in industries as power shortage, inadequacies of basic raw material supply, labour unrest, power maintenance and mechanical breakdowns. The insufficient capacity utilisation in many sectors may turn out to be an important constraint inhibiting sustained growth in industrial production.[105]

0.20.4 Samuel Paul has divided all the factors that can explain under-utilisation of capacity into three as industry characteristics, policy influences and outliers.[106]

All these different issues are looked into and analysed in the light of the data available with respect to the chemical industry in Kerala.

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105 Mahanti, P.C., "Capacity utilisation in Indian Industry", Commerce Pamphlet, No.151, Bombay, 1980

106 Paul Samuel, "Growth and utilisation of Industrial capacity", Economic and Political Weekly, Vol.IX, No.49, December, 1974, pp.2025-2032.

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CHAPTER - I

1.0 THE INDUSTRIAL DEVELOPMENT OF KERALA: A REVIEW

1.1.0 The growth and development of any industry depends to a large extent on the environment in which it is placed. Before going into an analysis of the growth of the chemical industry in Kerala, it may not be out of place to review the process of industrialisation in the state and the problems encountered therein.

1.1.1 Situated in the southwest corner of the Indian Union, Kerala is a small State with an area of 38,855 sq. kms. Though relatively small in size, this State has been richly blessed by mother nature. The rich fertile soil, evergreen forests, lush green paddy fields, cascading waterfalls and a long coast line should have made Kerala rich and prosperous. On the contrary, Kerala remains an example of the fact that abundant natural resources alone is not a sufficient condition for development. It fortifies the belief that the proper utilisation of resources as well as the adequate infrastructural facilities play an equally important role in the economic development of the State as the natural resources. Chronic food deficit, high population density, acute unemployment and lack of industrial development are the major problems confronting Kerala's economy. "With the basic problems of a low level agrarian economy, high population pressure, low per-capita income, low standard of living, unemployment and under-employment and lack of industrialisation, Kerala's economy can well be characterised as under-developed".[1]

1.2 Industrial Development of Kerala - Pre-planning Phase

1.2.1 Being essentially an agricultural economy, industrialisation was very slow in the State. Whatever few industries that came up were mainly in the cottage and small scale sector. Perhaps the only industry which could be called modern in the 18th and 19th century was the tea plantation industry. This industry thrived under the support of the British.

1.2.2 The beginning of an earnest attempt to organise industries in the State was made in the year 1918. In that year a separate department for industries was started by the Travancore State Government. During 1920-21, an Economic Development Board was constituted with 20 members, with the objective of "developing the economic resources of the State,

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1 Aiyer Krishna, S., "Industrialisation of Kerala", paper presented at Seminar on Industrialisation of Kerala, Indian Institute for Regional Development, Kottayam-17, 1979, p.11.

establishing new industries and expanding old ones".[2] The industrial pattern in the State at that time was mostly confined to coir yarn spinning, handloom weaving, fibre extraction and such other cottage industries. The first attempts to establish organised industrial units were made by the German missionaries and British estate owners. The first cotton mill was set up in 1881 in Quilon by an American. It worked for about twenty years but with the outbreak of the World War I, it ceased working. Soon after this the first coir factory was set up in Alleppey. The earliest known factory in the Malabar area is the Malabar Spinning and Weaving Company at Ponniankara in Calicut. This was started with an initial investment of Rs.6 lakhs. The paper mill at Punalur was started in February 1887 with a limited capital investment of Rs.3 lakhs. At that time electricity was not available and so water power was used to run the power plants. In Cochin State a stoneware factory was started in Chalakudy in 1924-25.

1.2.3 With the organisation of the Industries Department in Travancore under Dr. S. Baker the industrial climate changed. Many new schemes were taken up and encouraged by the Economic Development Board. A large number of industries was

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[2] Messrs. Kerala Industry, Kerala State Large and Medium Industries Directory, Trivandrum, 1967, p.12.

started in the subsequent years. The first sugar factory was started in Thuckala in 1931-32. This worked for about 12-13 years and closed down with the installation of the bigger unit at Tiruvella.

1.2.4 The period from 1935-1947 saw the establishment of a number of factories engaged in the production of rayons, titanium dioxide, ammonium sulphate, ammonium phosphate etc. Preliminary work on the Travancore Rubber Works was completed in 1934-37. The Sri Chitra Mills at Alwaye, Government Ceramic concern at Kundara, Indian Aluminium Company at Alwaye, Travancore Plywood Industries at Punalur, Travancore Ogale Glass Manufacturing Company* and the Travancore Rayons were some of the major factories installed in this decade. In fact this period is still considered as "the golden age of industrialisation in the annals of Kerala's history".[3]

1.2.5 The next important landmark in the industrial development of Kerala was in the year 1947-48 when the Fertilisers and Chemicals Travancore Limited was commissioned. Preliminary works on ALIND, Forest Industries at Alwaye and West Coast Industries in Cochin were started. Also preliminary work in Travancore Titanium Products, Travancore Electrochemical Works,

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* Now under liquidation.

[3] Aiyer Krishna, S., Kerala Economy, (Mal.) State Institute of Languages, Trivandrum, 1975, p.494.

Chingavanom, and Electrical and Allied Industries at Kundara was in progress. By this time, the first electricity generation plant was completed at Pallivasal and facilitated the growth of many industries at Alwaye. Thus there grew a favourable climate for the setting up of many industries in the Alwaye-Cochin belt.

Thus the two decades preceding independence was a period of many noteworthy achievements in the industrial field as far as the Travancore region was concerned. But the Malabar and Cochin area lagged behind. This region received only little attention when the five year plans were started.

1.3 Industrial Development in the Plan Period

1.3.1 Except for four or five large industrial enterprises, most of the factories were set up during the pre-plan period. The first plan provided a disproportionately large share to agriculture and social services. Industries were relegated to the status of a residual claiment.[4] Out of the total outlay allotted for industrial development, the major share went to the development of medium and small scale industries under government management. Though the Five Year Plans gave much emphasis on the development of the necessary

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4 Gopalakrishnan, P.K., Notes Towards the Formulation of Kerala's VI Five Year Plan, State Planning Board, Trivandrum, 1978, p.161.

infrastructure such as power, transport, basic and technical education, these were not properly utilised under the plans.

1.3.2 First Five Year Plan

During the first plan out of a total capital investment of Rs.30.3 crores only Rs.1.12 crores was allotted to industry. Out of the sanctioned amount only Rs.50.43 lakhs were utilised. This meant that only 45 per cent of the allotted investment was utilised. So nothing spectacular was achieved during this period. The hydrogenation factory at Calicut and the Government Ceramics Factory at Kundara were commissioned. Sick mills such as the Sitaram Mills at Trichur, Electrical and Allied Industries at Kundara and United Electrical Industries were taken over by the Government.

1.3.3 Second Five Year Plan

The second plan gave greater importance to industry. The total outlay for Kerala during the second plan period was Rs.87 crores, out of which only Rs.80.23 crores were utilised. Rs.6.84 crores were allotted to industry which utilised Rs.6.04 crores. Out of the total amount allotted to industry large and medium scale industries received only Rs.1.02 crores. Nearly half of the outlay went to small scale and handloom industries. Though it is accepted that small scale and cottage industries have provided greater employment opportunities with smaller investments, in the long run development necessitates the establishment of large industries also. The linkage effects generated by the large scale industries can give rise to ancillary industries thus providing more employment opportunities. However, this idea seems to have eluded our planners in the early phases of planning. Table 1.1 gives the disbursement of outlay in the industrial sector in the second plan. The amount sanctioned to large and medium industries was Rs.102.33 lakhs and utilised Rs.179.47 lakhs. At the same time small industries and handloom were sanctioned Rs.310.98 lakhs and utilised Rs.243.26 lakhs.

Table - 1.1

Disbursement of Outlay in the Industrial Sector in the II Plan

(In lakhs of rupees)

Sector	Outlay Sanctioned	Outlay Utilised
1. Large and medium industries	102.33	179.47
2. Industrial estates	81.95	78.23
3. Small industries	199.03	116.23
4. Handloom	111.95	127.03
5. Cottage industries	9.81	10.11
6. Handicrafts	23.78	10.09
7. Silk industry	5.13	0.91
8. Coir industry	150.00	81.91
	683.98	603.98

Source: Op. cit., Aiyer Krishna, S., p.624.

The only noteworthy achievement appears to be the establishment of a few industrial estates during the second plan period. In the central sector the D.D.T. factory was established with a capital investment of rupees one crore. It was only after 1960 that there appeared significant change on the industrial front of Kerala.

1.3.4 Third Five Year Plan

During the third plan, industry received slightly more importance than the other two plans. Out of the total State allottment of Rs.170 crores, Rs.17.20 crores (about 10%) was allotted to industries. Large and medium scale industries received an allotment of Rs.4.55 crores, but spent Rs.7.60 crores. However, in the plantation and cottage and small scale sector achievements fell below the targetted figures. In the plantation sector out of an allotted figure of Rs.465 lakhs only Rs.44.41 lakhs were utilised and in the cottage and small scale sector Rs.628.52 lakhs were utilised from an outlay of Rs.800 lakhs. Due to this only Rs.14.37 crores were spent out of the allotted amount of Rs.17.20 crores as seen in Table 1.2.

Table - 1.2

Sectoral Outlays and Amounts Utilised During the III Plan Period

(Lakhs of Rupees)

Sector		Outlay	Amount Utilised
1. Large and Medium Industries	..	454.50	760.33
2. Plantation Industry	..	465.00	44.41
3. Mining	..	-	2.76
4. Small scale and cottage industries	..	800.00	629.52
(i) Industrial Estates	..	125.00	68.19
(ii) Small industries	..	255.00	281.30
(iii) Handloom	..	165.00	130.34
(iv) Handicrafts	..	35.00	30.91
(v) Silk industry	..	5.00	2.29
(vi) Coir industry	..	175.00	108.47
		1719.50	1437.02

Source: Op. cit., Aiyer Krishna, S., p.626.

1.3.5 Fourth Five Year Plan

The Fourth Plan allotment to Kerala amounted to Rs.258 crores, out of which Rs.22.13 crores were allotted to Industries and Mining. This was only 8.5 per cent of the total outlay. Compared to the Third Plan this outlay is proportionately lower. Large scale industries obtained an outlay of Rs.12 crores, while small scale and cottage industries received Rs.10.07 crores. Out of the Rs.12 crores allotted to large scale industries, Rs.5 crores were set apart for the working of the Kerala State Industrial Development Corporation. Table 1.3 shows the break-up of the allocation of outlay to the industrial sector in Kerala.

<u>Table - 1.3</u>

<u>Allocation of Outlay to the Industrial Sector during the IV Plan</u>

(Lakhs of rupees)

Sector		Plan Outlay	Expected Expenditure
1. Large and medium industries		1,200.00	1,319.48
2. Mining	..	5.00	3.66
3. Small industries and cottage industries	..	1,007.00	1,011.25
Total		2,212.00	2,334.39

Source: Op. cit., Aiyer Krishna, S., p.628.

1.3.6 Fifth Five Year Plan

The State five year plans have in general accorded only a low priority to the industrial development. Industrial sectoral outlay upto the fourth plan came upto only about Rs.60.3 crores, out of the total sectoral outlay of Rs.463.3 crores. Even during the fifth plan the industries allocation was only Rs.61 crores, out of a total outlay of Rs.567 crores.

The lion's share of the plan outlay went to agriculture and social services.

1.3.6.1 The problem of inadequate allocation of outlay to industry is also intensified by the fact that Kerala's share in the Central Government projects turned out to be a trickle. Kerala's share of the Central Industrial Projects came upto only Rs.247 crores (2.7%) out of a total of Rs.9,112 crores at the end of 1975-76.[5] In 1979-80 Kerala's share was Rs.746.85 crores, out of a total of Rs.18,161.14 crores (4.11%) as seen in Table 1.4.

Table - 1.4

State-wise Value of Property Gross Block in Different Stocks under the Central Public Sector

(Rs. in crores)

State		Value of property as on 31-3-1975	% of total	Value of property as on 31-3-1980	% of total
1		2	3	4	5
1.	A.P. -	269.00	3.6	775.12	4.27
2.	Assam -	198.5	2.7	490.37	2.70
3.	Bihar -	1671.8	22.5	3151.67	17.35
4.	Delhi -	222.8	3.0	501.89	2.76
5.	Gujarat -	301.3	4.1	879.80	4.85
6.	Haryana -	19.4	0.3	252.97	1.39
7.	Himachal Pradesh -	0.9	-	127.02	0.70
8.	Kerala -	202.2	2.7	746.48	4.11
9.	Madhya Pradesh	837.6	11.3	422.84	2.33
10.	Maharashtra -	306.4	4.1	2230.77	12.28
11.	Karnataka -	186.8	2.5	1313.94	7.23
12.	Orissa -	577.0	7.8	928.37	5.11
13.	Punjab -	77.5	1.1	362.52	2.00

5 Gopalakrishnan, P.K., op. cit., p.162.

1		2	3	4	5
14.	Rajasthan	180.2	2.1	337.62	1.86
15.	Tamil Nadu	384.5	5.2	747.74	4.12
16.	Uttar Pradesh	256.5	3.4	802.28	4.42
17.	West Bengal	785.3	10.6	1540.39	8.48
18.	Jammu & Kashmir	6.9	0.1	7.05	0.04
19.	Goa	2.9	0.0	6.37	0.03
20.	Union territories excluding Delhi	-	-	150.24	0.83
21.	Unallocated & others	956.4	12.9	2385.72	13.14
22.	Total	7423.9	100.00	18161.14	100.00

Source: (i) Op. cit., Gopalakrishnan, P.K., p.161.
(ii) Public Enterprises Survey 1979-80, Vol.I, B.P.E., Ministry of Finance, New Delhi.

1.3.7.0 Sixth Five Year Plan

1.3.7.1 The Sixth Plan draft for Kerala envisaged a state sector outlay of Rs.2,175 crores and a total investment outlay of Rs.4,100 crores. "On the basis of recent indications the State anticipates to have a total investment outlay of Rs.4,200 crores, the State, Centre and private sectors contributing Rs.1,550 crores, Rs.850 crores and Rs.1,800 crores respectively".[6] An overall annual growth rate of 5.2 per cent is expected to be achieved at the end of the plan period.

[6] Government of Kerala, Sixth Five Year Plan 1980-85, State Planning Board, Trivandrum, 1981, p.9.

1.3.7.2 In the Five Year Plans of India the bulk of public sector investment in large and medium industries is contemplated in the central sector. For example in the Sixth Plan an outlay of Rs.19,018.07 crores is provided for large and medium industries including minerals in the Central sector, as against a meagre Rs.1,389.08 crores for all States and Union territories together.[7] Hence the tempo of investment is invariably dependent on the quantum of Central investment. However, investment in industries in Kerala by the Central Government in the previous plans has been meagre. Out of a total Central investment of Rs.18,161.14 crores as at the end of March 1979-80 Kerala's share was only Rs.746.45 crores (4.11%).

1.3.7.3 The major objectives for the different segments of the industrial sector in the Sixth Plan have been broadly outlined as follows:

a) increasing the rate of utilisation of available capacity,

b) promotion of new industrial units based on technologies appropriate for the resource endowments,

c) setting up of new industrial units in the less developed areas,

d) setting up of certain major units in the Central sector having scope for the growth of ancillary small scale ventures,

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7 Ibid., p.16.

e) re-organisation of public sector units with a view to making them economically viable and efficient in operation,

f) prevention of the shifting of labour-intensive traditional industries such as cashew, coir and handloom,

g) enhancement of the earning capacity of rural artisans, handloom weavers, craftsmen and others employed in village and small industries,

h) promotion of village and household industries in rural and semi-urban areas,

i) developing existing small-scale industries and encouraging the establishment of high value-adding units, and

j) evolving a more rational framework of promoting private investment in the State.[8]

1.3.8 The aims and objectives are all very idealistic, but how far they will be implemented remains to be seen. The past experiences have not been very encouraging. In the past allocations in the State plans for industrial development have ranged between 2 per cent and 5 per cent. Even in the Sixth Plan the picture is not much different. Out of a total

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[8] Ibid.

State outlay of Rs.1,55,040.50 lakhs industry and minerals received a share of Rs.15,950.50 lakhs (10.3%). However, if the State economy is to receive an impetus for development, a heavy dose of investment in industries - a big push on this front - is called for. It will not only step up the industrial activities of the economy, but will also "speed up the modernisation of agriculture by tenning up the factor markets, increasing the supply of modern inputs, and revolutionising the attitude and value system of the farm population brought into contact with the modern industry".[9]

1.4.0 <u>Need for Rapid Industrialisation</u>

1.4.1 Being a State characterised by an evergrowing population living on scarce arable land, the problems of unemployment and underemployment follow as inevitable consequences. Hence the need for accelerating industrial development in the State of Kerala can never be overemphasised. "Investment in industries will lead to the formation of more productive capital which will generate continuous and steady employment as well as higher income, saving and investible surplus".[10]

1.4.2 Most of the high income countries of the world are industrial nations. This is not to say that there are exceptions to this generalisation. However, the correlation

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[9] <u>Op. Cit.</u>, Gopalakrishnan, P.K., p.166.

[10] <u>Ibid.</u>,

between the level of industrialisation and the state of development is high. So far as Kerala is concerned, it is not the agrarian nature of the economy which makes her backward, but the pre-dominance of a low level of technology in extractive and traditional industries, leaving a big gap in teaching, applied science, production, employment and income. While 11.7 per cent of the total labour force in India are employed in the industrial sector, in Kerala 19.3 per cent of the labour force are engaged in industrial occupations. But as far as the income from this sector is concerned Kerala lags behind India, the respective shares being 16.9 per cent and 18.3 per cent. This is because 84 per cent of the industrial labour force are engaged in cottage and small-scale industries. Another reason is that the rest of the factory employees are engaged in the agricultural-oriented industries like cashew processing, which are also not very productive here. The more progressive and productive industries are very few and far between. "30 per cent of the factories in Kerala are not using power and 50 per cent of Kerala's labour force work in such industries".[11] At the same time at the all India level there are only 20 per cent of the factories which do not use power and only 10 per cent of the factory workers are employed here. Basic metal industries are very few in the State. Since most of the industries produce consumer goods, the production of basic investment goods is negligibly small. Allocation of outlays in the industrial sector was mainly in favour of

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[11] Op. cit., Aiyer Krishna, S., p.495.

village and small scale industries with less feedback capital. What the State has hitherto lacked is the presence of a large number of medium or large scale industries which could function as mother industries to several feeder or ancillary units.

1.4.3 As the Mahalanobis model emphasises, the capital output ratio of capital goods industries is generally high, so that higher investment in such industries tends to reduce the immediate increase in total output that results from a given total investment. This higher investment increases the proportion of total investment in capital goods which will increase investment in the next period. This process will help to build up the forces of acceleration in the economy. The ultimate result of this is that growth becomes faster, income increases more and in consequence consumption also increase steadily. It is only the higher rates of growth in future time periods which provides the justification for accepting lower rates of growth in the initial years. Hence it is necessary for savings to rise at an increasing rate.

1.4.4 Following this line of thought, supply is assumed to be equal to output and output to be equal to capacity. If savings or the demand for capital goods do not rise as a proportion of income, the mere creation of capacity to produce capital goods would not produce further investment. The outcome would be unutilised capacity in the capital goods sector and also inflationary pressures on the prices of consumer goods. As the fifth plan draft states, "if the development process is not to generate disproportionalities of various sorts, the needed changes in the structure of demand and of production must harmonise. If for instance the pattern of output capacity is changed in favour of investment but there is no corresponding change in the structure of gross rational expenditure in favour of investment outlays, the economy would experience under-utilisation of capacity in the industries producing investment goods and strong inflationary pressures in respect of the consumer goods sector".[12]

1.4.5 However in the case of the Indian economy in general and Kerala in particular a pushing up of the rate of investment on the basis of domestic savings could not be achieved. Political and administrative factors have been cited as the main bottlenecks. Inevitably under-utilisation of capacity and inflationary pressures have appeared. Only a structural change in the basic industrial system could bring about a sharp increase in the proportion of the labour force productively employed in industries. In the short run the capital-intensive industries may starve the wage goods industries of capital and prevent the expansion of these industries. But, in the long run forces can be set in motion which will bring

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12 Op. cit., Gopalakrishnan, P.K., p.168.

about higher levels of output, income and employment. Maximum productivity of the scarce factor - capital, in generating income and employment should guide the planner in the choice of projects.

1.5.0 Industrial Structure of the State

1.5.1 As per the 1977-78 Report of the Annual Survey of Industries, there were in Kerala 2,888 factories in the factory sector. The corresponding all India figures are 84,924. This means that the percentage share of Kerala is only 3.4. As regards invested capital, Kerala's share was only Rs.838 crores, whereas the corresponding figures for all India was Rs.29,750 crores.

1.5.2 The secondary sector in Kerala employed 19.3 per cent of the State's working force. Compared with the all India level of 9.4 per cent this proportion is more than double. But with reference to output Kerala lagged behind, the secondary sector contributing only 14.6 per cent of the national income while the corresponding all India figures were 18.5 per cent. Another noteworthy point was that the share of factory enterprises in industrial output was less than that of the non-factory enterprises. Factory enterprises contributed Rs.18 crores and non-factory enterprises Rs.32.34 crores. Though a reasonably large proportion of the working force was engaged in the secondary sector their productivity was very low - Rs.539 per worker as against Rs.1,294 per worker for all India.

1.5.3 The main weakness of the industrial structure of Kerala before the plan period was its widespread backward technology. Cottage and small scale units dominated the industrial scene. Out of a total of 9.7 lakh workers engaged in this sector in 1955-56, mining absorbed about 18,000, factory enterprises 171,000 and the non-factory sector as much as 782,000.

1.5.4 Apart from the cottage industries which is usually characterised by a high labour-capital ratio and low labour productivity, the factory sector in Kerala also had, on an average, a lower productivity per worker than in India as a whole.

State	Net value added/worker Rs.	Total net value added (Rs.crores)	Total employment (lakhs)
<u>Kerala</u>			
Non-factory Sector	413	32.3	7.8
Factory Sector	1059	18.0	1.71
<u>All India</u>			
Factory Sector	2500	780.0	31.20

Capital per worker was also much below the corresponding all-India standards. Capital per factory worker for Kerala worked out to Rs.2,737 as against the all-India figure of Rs.5,830.

1.5.5 The structure of factory enterprises in Kerala was very much the outcome of the type of raw material found in the State. The largest share of factories and workers employed was taken up by the agro-based industries in the early stages of planning -- 57 per cent of the factories and 72.7 per cent of the workers. This was higher than the all-India level of 54.8 per cent and 61.7 per cent respectively. The next in line were the forest based industries (11.8%), followed by metal based engineering industries (11.2%). Chemical and chemical-based industries and basic metal industries were way down with only 2.6 per cent and 0.2 per cent of the factories and 2.1 per cent and 0.7 per cent of the workers respectively (see Table 1.5).

The same trend seems to be continuing in the later years also. The number of factories and employment was highest in the food products manufacturing industry in the years 1961, 1976 and 1977. Agro-based industries in general had the highest percentage of registered factories and employment during this period. In the year 1961 the percentage of registered factories and employment for agro-based industries was 53.35 and 70.33 respectively. In the year 1976 and 1977 the percentage has shown a decline. In 1976 the percentage of registered factories in the agro-based sector was only 34.72 and in 1977 it was 34.61. The percentage of employment in this sector also declined from 70.33 in 1961 to 65.88 in

Table - 1.5

Resource Based Classification of Registered Factories and their Employment %

	Nature of Industry	All India 1956		1959		Kerala 1961		1976		1977	
		Fact-ories	Wor-kers	Fact-ories	Wor-kers	Fact-ories	Wor-kers	Fact-ories	Wor-kers	Fact-ories	Wor-kers
1.	Agro-based Industries	54.8	61.7	57.0	72.7	53.35	70.33	34.72	65.88	34.62	64.94
2.	Forest Based Industries	3.9	2.0	11.8	6.6	20.57	9.11	26.74	9.84	27.43	10.64
3.	Animal based Industries	1.9	1.0	0.2	0.2	-	-	0.29	0.04	0.35	0.07
4.	Petroleum, coal and chemical industries	3.5	3.2	2.6	2.1	2.83	3.94	3.94	4.14	3.97	4.7
5.	Non-metallic mineral based industries	3.9	4.2	9.8	9.9	6.99	8.06	5.06	5.42	4.63	5.09
6.	Basic metal industries	2.1	3.6	0.2	0.7	2.43	1.79	7.95	2.98	7.76	3.22
7.	Metal based engineering industries	15.7	15.6	11.2	4.9	7.68	4.42	5.90	5.15	5.94	5.12
8.	Others	14.1	8.9	7.2	3.0	4.15	2.35	15.65	6.69	15.30	0.22
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.98	

Source: (i) Techno Economic Survey of Kerala, NCAER, New Delhi, 1962.
(ii) Industries, Industrial Labour & Infrastructure, State Planning Board, Trivandrum, 1981.

1976 and again to 64.94 in 1977. The percentage of registered factories in petroleum, coal and chemicals showed a slight increase from 2.83 in 1961 to 3.94 in 1976 and again to 3.97 in 1977. The percentage of employment also showed some improvement from 3.94 to 4.14 in 1961, 1976 and 4.7 in 1977 as seen in Table 1.5.

1.6.0 Problems of Industrialisation

If we examine the Kerala industrial sector we find that the establishment and operation of a new industrial venture is confronted with the following: problems:

1.6.1 High unit cost of production

Capital is generally shy and not forthcoming to set up new enterprises. The high incidence of sickness and mortality of the existing units acts as a deterrent to industrial initiative. Many of the projects are uneconomic per se in terms of costs and prices and cannot be competitive in world markets. Basically they become high cost industry, the costs of which are high because the levels of efficiency of production and management are low. "The high cost of production in units with low capacities and low capacity utilisation ratios prove to be a heavy burden on the end use industries which become uncompetitive in world markets".[13] This sets in motion, a cumulative process, an endless chain of high costs and prices.

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[13] Op. cit., Gopalakrishnan, P.K., p.169.

This high unit cost arises in all probability from the relatively high fixed costs of the industrial units. The initial expenditure on buildings and other constructions that go in imparting an appearance to the factory is unjustifiably high in Kerala. By the time the factory is ready to be commissioned, the factory overheads will have absorbed the lion's share of the outlay.

1.6.2 <u>Shortage of capital</u>

Paucity of capital is another related problem which the entrepreneurs face in the State. The share of assistance sanctioned by the All India Financial Institutions to Kerala comes upto only 3.4 per cent of the total assistance sanctioned at the all India level. Out of a total amount of Rs.2,060.47 crores sanctioned by the financial institutions such as I.D.B.I., I.F.C.I., I.C.I.C.I., L.I.C., U.T.I., G.I.C., I.R.C.I., S.F.Cs and S.D.Cs for 1979-80, Kerala's share was Rs.98.93 crores which is only 4.8 per cent. In 1980-81 the corresponding figures were Rs.2,609.68 crores and Rs.57.71 crores respectively. That was only 2.2 per cent. The share of Kerala has inevitably declined by more than half during a period of one year as seen in Table 1.6. Hence the picture of financial assistance for Kerala does not appear very heartening.

Table - 1.6

Assistance Sanctioned and Disbursed by Financial Institutions

Institutions	Amount sanctioned				Amount Disbursed			
	1979-80		1980-81		1979-80		1980-81	
	Kerala	India	Kerala	India	Kerala	India	Kerala	India
I.D.B.I.	76.49	1060.24	38.16	1283.94	25-23	656.04	36.39	891.60
I.F.C.I.	12.75	137.87	5.78	211.68	1.51	91.01	4.54	108.72
I.C.I.C.I.	3.25	204.33	8.26	314.41	1.52	135.81	3.09	174.97
Others	6.44	658.03	5.51	799.65	4.9	469.35	6.12	597.8
TOTAL	98.93	2060.47	57.71	2609.68	33.16	1352.21	50.14	1773.09

Source: Annual Report of I.D.B.I., I.F.C.I., I.C.I.C.I. for the years 1979-80 and 1980-81.

1.6.3 Labour Problems

Though there is no problem as regards the availability of labour, managing the employees in a firm is a very difficult task, which even the best managerial techniques may not be able to handle. Labour unions which have become very powerful today are under the control of political influences. The right of the worker to strike in order to obtain their demands is exploited to the maximum possible level. Efforts to increase the workers' productivity and efficiency are very rarely made. Strikes and work stoppages are so frequent that the number of mandays lost is very high. Overtime payments have to be made regularly if work is to be done. In short, managing the labour force is creating so many problems that the entrepreneurs are not very enthusiastic in setting up new ventures.

1.6.4 Problem of Power Shortage

The availability of cheap power is generally believed to give a fillip to the rapid growth and development of the industrial sector. Kerala was one of the few Indian states where plenty of power was available at a very low cost. Over 2/3 of the total power generated was given to the neighbouring states of Tamil Nadu and Karnataka. Paradoxically the per capita consumption of electricity was one of the lowest in the country. At the beginning of the First Plan, Kerala had an installed generating capacity of only

28.5M.W. This rose to 881.5M.W. in 1975-76. The quantum of net generation of electricity rose from 110.98 million units in 1950-51 to 2784.43 million units in 1977-78 registering a compound growth rate of 12.2 per cent per annum. Power generation in 1981-82 was 5539 million K.W. as against 5242 million K.W. in the previous year. However, per capita consumption registered an increase of only 8.6 per cent per year. Consequently the surplus in 1976-77 was estimated at 303 million units. This is indicative of the lack of proper perspective on the part of planners in making complementary development programmes. "Power planning in the State remains defective to this extent even today".[14] Adequate high voltage transmission lines had not vbeen laid in the State before large chunks of hydro-electric power were generated as from Idukki. Transmission losses were as much as 1/4 of the power consumed within the State. Today the problem has become all the more severe owing to the failure of the monsoons. Kerala has turned into a deficit state in sofaras the power situation was concerned. Power-cuts had to be imposed especially high tension supply. This was a severe blow to the industries whose main attraction in the State was the availability of cheap power.

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14 Pillai, P.P., Kerala's Power Sector - Its growth and contribution to the Economy - Kerala Economy since Independence (ed.) Oommen, M.A., Oxford Publishing Company, 1979, p.75.

1.6.5 Inadequate technological know-how

It is difficult and expensive to obtain adequate technological know-how to set up new industrial enterprises. Local technological know-how is still very poorly developed. It is not only difficult to import technological know-how, but it may not be relevant to the local environment. As a result there might arise bottlenecks and hence much time and money may have to be spent in debottlenecking the plant.

1.6.6 Considering all these problems, small units would appear to stand a better chance in the economy. But considering the demand structure prevailing in the State, the small units face the threat of severe competition from products manufactured outside the State and which enjoy the economies of large-scale production.

1.6.7 In the light of this set-up industrial activity has to be so organised as to reap the economies of scale. Serious efforts should be made to take advantage of the benefits of backward and forward linkages in such a manner that the output of one unit becomes the input of another unit. A chain of industrial units serving mutual interests can be set up. Markets can thereby be assured for both inputs and outputs. This can eliminate outside competition and also reduce the cost of production of final and intermediate goods.

1.6.8 This, however, is an ideal situation the realisation of which is bound to be beset with difficulties. Economies of scale are not always determined by the adoption of relevant technology, but by the market advantages secured by those who have command over financial resources. Industrial development generally appears to be oriented to the needs of the high income group. The result is that the expected linkages may not materialise or may be different from those intended. The basic goods industry for example has not made much progress in India after the initial spurt during 1956-65. Factory production in consumer goods has been rising in the case of non-essential and luxury items. At the same time a significant part of the output of capital goods and other high priority industries has been getting absorbed by the expansion of industries catering to the requirements of the high income groups. Hence the State is forced to take up certain types of complementary investment. But the efficacy of State enterprises is not at all commendable. Misconceived huge investments, motivated largely by political considerations, have been going down the drains of public investment. Huge investment unaccompanied by anticipated levels of production proves to be a burden on the State economy and retards progress rather than accelerating it. Hence a well-thought-out plan with strict control at all levels is necessary to rejuvenate the economy and direct it on to the path of development.

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CHAPTER - II

CHEMICAL INDUSTRY IN KERALA

2.1.0 The chemical and allied units had an early beginning in the State with the starting of the Fertiliser Unit in Cochin as early as in 1945. The Fertilisers and Chemicals Travancore Ltd. was conceived at a time of critical food shortage in the country during the World War II. Dr. C.P. Ramaswamy Aiyer, the then Dewan of Travancore, recognised that chemical fertilisers were the need of the hour in raising the maximum yield out of the arable land in the State. He, therefore, sponsored the establishment of Fertilisers and Chemicals Travancore Ltd. (FACT) and Messrs. Seshasayee Brothers were invited to organise the venture. After the FACT went into commercial production in 1948, the Travancore Cochin Chemicals was established in 1950 as an adjunct to the FACT. Through the pioneering efforts of Messrs. Seshasayee Brothers Travancore Ltd. and aided by the Travancore-Cochin Government, work on the project was started in 1949. A public limited company was registered under the name of Travancore-Cochin Chemicals with the State government contributing a major share of the equity capital. The Travancore Titanium Products Ltd. was another important chemical unit incorporated in the late forties for producing pigment grade titanium dioxide. The

Hindustan Insecticides Ltd. also occupies an important position in the chemical industrial map of Kerala. It was conceived in the pre-planning phase and was incorporated in 1954. The project was commissioned in July 1958.

2.1.1 With the dawn of the planning era the number and variety of chemical units increased. A variety of products ranging from organic and inorganic chemicals, drugs and pharmaceuticals, soaps and detergents, plastics and petrochemicals are being manufactured today. There are around 45 large and medium chemical and allied units in the State. Gross value of output for chemical and chemical products increased from Rs.1,336.70 lakhs in 1961-62 to Rs.10,226.35 lakhs in 1976-77. There has been a remarkable increase in the value added in the different sectors of the industry (Tables 2.1.0, 2.1.1, 2.1.2, 2.1.3). In the case of fertilisers and pesticides value added has increased from Rs.126.09 lakhs in 1962-63 to Rs.1,448.64 lakhs in 1974-75 (an increase of 1,048.89 per cent). In real terms, however, the increase has not been so spectacular - from Rs.112.78 lakhs to Rs.482.39 lakhs (327.72 per cent). In the case of basic industrial chemicals (heavy organic and inorganic) the increase has been from Rs.89.22 lakhs in 1962-63 to Rs.951.45 lakhs in 1974-75. (966.40 per cent). In real terms the value increased from Rs.79.80 lakhs to Rs.316.83 lakhs during the same period (297.03 per cent). In the drugs and pharmaceuticals value added increased from Rs.15.22 lakhs in

Table - 3.1.0

Value Added, Fixed Capital, Working Capital, Wages and Salaries and Number Employed in the Chemical Industry in Kerala for the years 1962-1974.

(i) Fertilisers and Pesticides

(Rs. in lakhs)

Year	Value Added	Fixed Capital	Working capital	Productive capital (3+4)	Wages & Salaries	Number employed
1	2	3	4	5	6	7
1962	126.09 (112.78)	689.89 (664)	420.33 (404.94)	1110.22 (1068.94)	94.65 (91.77)	2263
1963	153.85 (134.61)	690.47 (637.55)	421.13 (382.15)	1111.66 (1019.7)	96.49 (89.33)	2702
1964	226.07 (193.39)	645.76 (577.60)	432.26 (353.43)	1078.02 (931.03)	90.02 (72.82)	2813
1965	143.20 (113.74)	610.70 (518.86)	238.98 (181.59)	849.68 (757.84)	64.59 (48.57)	2845
1968	510.18 (301.70)	1616.4 (1219.00)	363.30 (219.65)	1979.7 (1438.65)	225.57 (129.64)	2877
1969	272.23 (148.11)	2670.00 (1957.47)	385.3 (224.53)	3055.3 (2182.00)	138.78 (78.41)	3320
1970	407.71 (216.87)	1404.42 (948.93)	1089.3 (601.50)	2493.72 (1550.43)	154.3 (82.97)	2213
1971	455.73 (213.34)	1741.25 (1176.52)	906.71 (481.26)	2647.96 (1657-78)	160.73 (152.74)	3512
1973	1426.14 (648.84)	7716.71 (4203)	646.86 (254.47)	8263.57 (4457.47)	537.33 (214.93)	4811
1974	1448.64 (482.40)	7201.02 (2976.85)	1356.66 (433.44)	8557.68 (3410.29)	544.54 (171.77)	4702

Note: Figures in brackets represent deflated figures.

Source: Annual Survey of Industries, Kerala (1962-1974).

Table - 3.1.1

(ii) Basic Industrial Chemicals (Heavy Organic & Inorganic)

(Rs. in lakhs)

Year	Value Added	Fixed Capital	Working Capital	Productive capital (3+4)	Wages& Salaries	Number employed
1	2	3	4	5	6	7
1962	89.22 (79.80)	247.77 (238.48)	158.12 (152.34)	405.89 (390.82)	41.71 (40.44)	1058
1963	117.62 (102.91)	274.07 (239.79)	215.88 (195.90)	489.95 (435.69)	52.82 (51.21)	1359
1964	124.19 (106.23)	281.39 (240.72)	246.94 (201.91)	528.33 (442.63)	60.41 (48.88)	1481
1965	88.52 (66.41)	517.17 (410.64)	210.95 (160.30)	728.12 (570.94)	60.09 (26.60)	1635
1966	164.60 (114.23)	732.2 501.88)	253.42 (169.06)	985.62 (670.94)	69.77 (46.41)	1789
1967	167.89 (106.66)	633.12 (402.24)	267.35 (159.80)	900.47 (562.04)	98.47 (58.72)	1821
1968	248.75 (147.11)	744.83 (440.47)	387.97 (235.78)	1132.8 (676.25)	113.32 (65.13)	1983
1969	1172.88 (217.66)	3668.74 (527.95)	720.12 (419.66)	4388.86 (947.61)	633.66 (358.00)	2251
1970	1448.39 (770.42)	3631.75 (1623.22)	2402.37 (1326.54)	6034.12 (2949.76)	806.35 (433.52)	4476
1971	1789.79 (908.52)	4392.68 (1262.80)	2007.85 (681.48)	6400.53 (1904.28)	375.99 (327.77)	9428
1973	526.35 (239.46)	1573.94 (257.27)	551.84 (217.09)	2125.78 (1074.36)	261.36 (104.54)	2715
1974	951.45 (316.83)	2742.76 (220.10)	532.43 (170.11)	3275.19 (391.21)	362.80 (114.45)	3111

Table - 2.1.2

(iii) **Drugs and Pharmaceuticals**

Year	Value Added	Fixed capital	Working capital	Productive capital	Wages & salaries	Number employed
1	2	3	4	5(3+4)	6	7
1962	15.22 (13.62)	14.08 (13.55)	16.13 (15.55)	30.21 (29.1)	4.31 (4.18)	343
1963	10.95 (9.58)	14.95 (13.81)	15.60 (14.16)	30.55 (27.97)	4.79 (4.43)	314
1964	10.64 (9.11)	14.11 (13.38)	9.72 (7.95)	23.83 (21.33)	5.26 (4.24)	303
1973	147.60 (67.15)	94.96 (51.72)	111.74 (43.96)	206.7 (95.68)	49.13 (19.65)	1367
1974	158.72 (52.85)	83.12 (34.36)	57.31 (18.31)	140.43 (52.67)	72.07 (22.73)	1304

Table - 3.1.3

(iv) Miscellaneous Chemical Products

Year	Value Added	Fixed Capital	Working Capital	Productive capital	Wages & Salaries	Number Employed
1	2	3	4	5 (3+4)	6	7
1962	116.09 (103.84)	49.34 (47.49)	138.64 (133.54)	187.98 (181.03)	41.79 (40.58)	1911
1963	84.72 (74.13)	56.35 (52.03)	118.58 (107.61)	174.93 (159.64)	41.68 (38.59)	1251
1964	104.86 (89.70)	78.58 (70.79)	139.97 (114.44)	218.55 (184.73)	46.77 (42.41)	1219
1965	121.33 (96.37)	103.18 (87.66)	163.35 (124.13)	266.53 (211.79)	28.22 (21.22)	1528
1966	114.93 (79.76)	95.81 (75.74)	133.28 (88.91)	229.09 (164.65)	31.57 (21.05)	1582
1967	313.5 (199.17)	111.33 (84.40)	51.67 (30.88)	163.00 (136.07)	36.66 (21.82)	2019
1968	294.9 (174.39)	109.4 (82.51)	100.19 (60.57)	209.59 (143.08)	40.04 (23.01)	2363
1969	315.9 (171.87)	201.46 (147.69)	167.22 (97.45)	368.68 (245.14)	115.8 (65.42)	2581
1970	416.95 (221.78)	264.09 (178.44)	330.69 (182.60)	594.78 (361.04)	165.13 (88.78)	3496
1971	702.99 (356.84)	330.61 (207.94)	473.51 (251.33)	804.12 (459.27)	123.76 (64.46)	3347

1961-62 to Rs.158.72 lakhs in 1974-75 (942.83 per cent). Real values, however, increased only from Rs.13.62 lakhs to Rs.52.85 lakhs for the same period (288.03 per cent). Value added for miscellaneous chemical products increased from Rs.116.09 lakhs in 1962-63 to Rs.702.99 lakhs in 1971-72 (505.55 per cent). Real value figures, however, were only Rs.103.84 lakhs and Rs.221.178 lakhs (112.99 per cent).

2.1.2 The money value of fixed capital has shown very high increases in the case of all four sub-divisions of the industry. In the case of fertilisers and pesticides it increased from Rs.689.89 lakhs in 1962-63 to Rs.7,201.02 lakhs in 1974-75 (943.79 per cent). The increase in the real value of the same has not been so large from Rs.664 lakhs to Rs.2,976.85 lakhs (348.32 per cent) during the same period. In the case of basic industrial chemicals also the fixed capital increased from Rs.247.77 lakhs to Rs.2,742.76 lakhs during the same period. For miscellaneous chemicals also it increased from Rs.49.34 lakhs in 1962-63 to Rs.330.61 lakhs in 1971-72. There were similar increases in working capital also. Total employment in the industry during the period 1962-1974 has increased from 5,575 to 12,538 (124.89 per cent).

2.2 A Brief Resume of some important chemical units in Kerala

2.2.1 (i) The Fertilisers and Chemicals Travancore Limited

2.2.1.1 This was the first large scale chemical unit to be started in the State. The work of the factory set up on the banks of the river Periyar started as early as in 1944 and the factory went into commercial production in1948. The first plant with an annual capacity of about 44,500 tonnes of ammonium sulphate started commercial production and earned the distinction of being the first large-scale manufacturer of nitrogenous fertiliser in India. According to the second Annual Report for the year ended 1945 the Director's statement, "it was decided to invest in a large, modern and most efficient sulphuric acid plant as part of the Alwaye project with a production capacity of 75 tonnes of sulphuric acid daily. This is to be used with ammonia to produce ammonium sulphate, perhaps the first chemical fertiliser to be produced in the country on a large-scale".[1] It started with a capacity of 50,000 tonnes of ammonium sulphate (10,000 tonnes of Nitrogen-N_2) and using a very unique process based on gas generated out of junglewood as there was no coal or natural gas available in the area.

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[1] The Fertilisers and Chemicals Travancore Ltd., Handbook on FACT (unpublished), Udyogamandal, 1980, p.1.

The problems of organisation and management which the company faces at present are more or less the same as over thirty years ago. According to the Director's Report for 1947, "Political and economic uncertainties, industrial unrest, high cost of raw materials and labour, want of cheap transport facilities, increasing railway freight, scarcity of petrol and fuel are some of the major factors that daily engage our attention".[2]

2.2.1.2 The first expansion programme was undertaken for the manufacture of superphosphate. By September 1950, an additional 75 tonne per day sulphuric acid and one 150 tonne superphosphate plant were commissioned, the annual capacity being 22,250 tonnes of sulphuric acid and 44,500 tonnes of superphosphate. With the first Five Year Plan and the setting up of the Sindri Fertiliser Plant with a capacity of 3 lakh tonnes of ammonium sulphate, FACT thought of further expansion. A plant to absorb hydrochloric acid from Travancore Cochin Chemicals (T.C.C.) was set up in 1955 to produce ammonium chloride with an annual capacity of 8,000 tonnes.

2.2.1.3 The next step involved a two-stage expansion phase. The first stage involving an outlay of Rs.3 crores contemplated the doubling of nitrogen capacity and the introduction of a

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2 Fertilisers and Chemicals Travancore Ltd., <u>Annual Report of the Company 1947</u>, p.1.

new compound fertiliser - ammonium phosphate 16:20 grade. An electrolytic hydrogen plant to supply hydrogen to make 40 tonnes of ammonia per day was also set up. The second stage expansion costing Rs.2 crore aimed at replacing the firewood process with the modern oil gasification process and increasing nitrogen capacity to 30,000 tonnes per annum. This was completed in December 1962.

2.2.1.3 The third stage expansion estimated at a cost of Rs.850 lakhs was completed in October 1966 at a total cost of Rs.1,307.99 lakhs. At the end of the third stage expansion, the designed capacity available with respect to the various items are listed below:

Table - 2.2

Designed Capacity at the end of the Third Stage Expansion

Ammonia	-	77,500	tonnes
Ammonium sulphate	-	198,000	"
Ammonium phosphate	-	132,000	"
Sulphuric acid	-	246,180	"
Ammonium chloride	-	24,750	"
Phosphoric acid	-	41,250	"
Superphosphate	-	44,550	"

Source: Op. cit., Handbook on FACT (unpublished), 1980, p.3.

2.2.1.4 On the completion of the third stage expansion the ammonia plant continued to show a shortage of 36 tonnes per day. But the phosphoric acid plant showed a surplus capacity of 35 tonnes per day. In order to remove these imbalances and to stabilise production at an economic level, the fourth stage expansion was launched in April 1966. Though the fourth Stage expansion was to be completed in October 1966, the date was revised to August 1969. The ammonia plant was commissioned in October 1971. In the case of the 100 TPD ammonium phosphate plant, though modifications were undertaken at a cost of Rs.3.45 lakhs to produce 20:20 ammonium phosphate, this grade was produced only upto June 1970. The daily designed and annual capacities of the plant after completion of the fourth Stage expansion was as given below:

Table - 2.3

Daily Designed & Annual Capacity at the end of Fourth Stage Expansion

Product	Daily designed capacity (M.T.)	Annual designed capacity (M.T.)
1. Ammonia -	355	117,150
2. Ammonium sulphate -	600	198,000
3. Ammonium phosphate-	400	132,000
4. Ammonium chloride -	75	24,750
5. Sulphuric acid -	746	246,180
6. Phosphoric acid -	125	41,250
7. Superphosphate -	135	44,550

Source: Op. cit., Handbook on FACT (unpublished), 1980, p.5.

2.2.1.5 However, production has been much below designed capacities in almost all the plants. Low capacity utilisation has been mainly due to a large number of multistream plants, power interruptions and consequent changes, lack of spare equipments and built-in capacity, undue interdependence of plants, lack of intermediaries, mainly sulphuric acid and, insufficient refrigeration capacity etc. Consequently a plant operating improvement programme (POIP) was envisaged by the company. As per the POIP, the attainable capacities of the Udyogamandal plant is listed below:

<u>Table - 2.4</u>

<u>Attainable Capacities of the Udyogamandal Plant as per the POIP</u>

Ammonia	-	84,000	tonnes per annum
Sulphuric acid	-	183,000	"
Phosphoric acid	-	27,000	"
Ammonium sulphate	-	105,870*	"
Amofos 16:20	-	83,720*	"
Amofos 20:20	-	39,000	"
Super phosphate	-	10,000*	"
Ammonium chloride	-	10,000*	"

*Production restricted to availability of raw materials and intermediaries.

<u>Source:</u> <u>Op. cit.</u>, Handbook on FACT, p.7.

2.2.1.6 Cochin Division

2.2.1.6.1 This is on the one hand the pride and on the other the problem of Fertilisers and Chemicals Travancore Ltd. It was conceived in the sixties as a much-needed expansion to save the two decade-old company from the problems of obsolescence and decay. In the first phase of operation, facilities for the production of 600 TPD ammonia to be used for the production of 1000 TPD of urea were planned. The estimated costs were around Rs.45 crores. Ammonia production was expected to be carried on in a single stream. Naphtha and fuel oil required by the plant were to be supplied by Cochin Refineries through direct pipeline. FEDO was responsible for the synthesis gas preparation and offsite facilities, while ammonia synthesis and urea facilities were the task of the Research and Development Division of the Fertiliser Corporation of India. The plant was mechanically completed in 1971, but was beset with a number of difficulties including design difficulties and the consequent problems of getting output to rated capacities. When Techniment of Italy supplied its first 600 TPD single stream ammonia plant, its design was not proven elsewhere. A high cost had to be incurred for experimenting with a technology that had yet to be proved. The sheer scaling up of vessel sizes could not automatically guarantee increases in production. It was a costly experiment to have attempted technological parameters which were not yet proved. On account of the delay in commissioning of the plant there was a loss of production to the extent of 1.65 lakh tonnes of urea in the first year of operation, 2.31 lakh tonnes in the second year and 2.64 lakh tonnes in the third year. The loss in production was to the extent of Rs.10 crores in 1973-74. Till 1979-80 production was estimated to have been at 50.60 per cent of the installed capacity. In 1979-80 capacity utilisation improved to 64 per cent.

2.2.1.7 Phase-II - Cochin Division

2.2.1.7.1 Phase-II of Cochin Division was designed to produce 485,000 tonnes of NPK fertilisers based on a huge 1,000 tonnes per day sulphuric acid plant and 360 tonnes per day phosphoric acid plant. The DAP, NP and NPK streams could not be worked to capacity. Also there were problems in getting granules of uniform size. All through costs have soared, affecting further viability. Capacity utilisation was restricted due to various operating problems and the congested layout of the plant. In consultation with the Technical collaborators and the World Bank, M/s. Asian Development Services, Djakarta had to be entrusted with the job of debottlenecking the plant. The initial estimated cost for this was Rs.36 crores, but the actual cost came to nearly double this amount.

2.2.1.7.2 Such a state of affairs inevitably led to mounting losses. At the end of March 1979 total losses of FACT amounted to Rs.56.04 crores. The interdependence of as many as twenty plants of different vintages with varying capacities and different process routes, all of which have to operate simultaneously to avoid constraints of raw material supply and their efficient working, is the main problem. It remains to be seen whether addition of some more plants to the chain of interdependent plants under the diversification proposal will be able to improve the situation.

2.2.1.7.3 The revamping of the old facilities at Udyogamandal to produce to rated capacities have improved production levels in the previous years. In 1979-80 Udyogamandal produced 51,000 tonnes of Nitrogen and 28,449 tonnes of Phosphorous pentoxide. The plant was seen to function at better levels within the limitations imposed by its age and tradition. However, this does not exclude the fact that there is a limit to the extent of revamping that can be done in this unit. Some of the plants and equipments are over 30 years old. The small sulphuric acid plant, an ammonia plant, and an ammonium sulphate plant may have to be scrapped in a couple of years. This might inevitably render about 1/5 of the working force surplus. Hence the very survival and growth of FACT depends on large diversifications into profitable lines. The company has started work on a caprolactum plant with a total investment of Rs.153 crores and an annual capacity of 50,000 tonnes of caprolactum. This product finds great demand in the production of nylon tyre, artificial fibres etc. It is at present produced only by the Gujarat Fertiliser Company and its demand is ever-increasing. Hence the installation of the caprolactum plant and the scrapping of many old plants may prove to be the salvation of the unit.

2.2.2.0 <u>The Travancore-Cochin Chemicals Limited</u> (T.C.C.)

2.2.2.1 The Travancore-Cochin Chemicals was established in 1950 as an adjunct to the FACT. The idea of setting up a caustic soda unit was there as early as in 1947 but it did not materialise then, the main reason being the paucity of capital. Through the pioneering efforts of Messrs. Seshasayee Brothers Travancore Ltd. and aided by the Travancore-Cochin Government work on the project was started in 1949. A public limited company was registered under the name of Travancore-Cochin Chemicals with the State Government contributing a major share of the equity capital. Production on a commercial basis started in January 1954. The plant then had a production capacity of 20 M.T. of caustic soda and an equivalent quantity of chlorine per day. T.C.C. was the first ever to employ the mercury cell process to manufacture high purity rayon grade caustic soda. Prior to the setting up of this unit the country's requirement of this chemical was entirely imported.

2.2.2.2 In 1956 a continuous caustic soda fusion plant with a capacity to fuse 20 M.T. of caustic soda lye per day was installed. This facilitated the transport and marketing of the product to distant places. A chlorine liquefection plant was also added in 1958 to meet the demands of the newly set up D.D.T. plant of Hindustan Insecticides Ltd. In 1960 production of caustic soda was raised to 30 M.T. per day.

2.2.2.3 In 1960 the company initiated further schemes for expansion. This second stage expansion envisaged an increase in the production capacity to 40 M.T. per day. Alongwith the installation of new plants and equipments for the production of caustic soda and the processing of byproduct chlorine and hydrochloric acid, the company also took up diversification schemes. Commissioning of the sodium hydrosulphite plant in 1960 with a daily rated capacity of 3 M.T. was the most important of this.

2.2.2.4 In December 1963, the company embarked on the III Stage expansion scheme which envisaged the setting up of the following additional plants:

Table - 2.5

Installed capacity on 3 shift basis

	Capacity/tonnes per day
1. Caustic soda lye plant ..	60
2. Caustic soda fusion plant..	60
3. Hydro sulphite plant ..	7
4. Salt recovery plant ..	10
5. Chlorine liquefaction plant ..	20
6. Hydrochloric acid ovens ..	60

Source: Report of the Comptroller & Auditor General of India (Commercial), Trivandrum, 1973-74, p.29.

2.2.2.5 The scheme which was estimated to cost Rs.3.50 lakhs was expected to be completed by 1965. It was, however, finally completed only in 1970-71, the actual cost going as high as Rs.602 lakhs. "Increase in the world price of mercury, imposition of higher rates of customs duty on capital equipment, devaluation of the rupee, increase in the cost of indigenous machinery and civil construction works, increase in interest charges due to delay in commissioning the plant and increase in charges for credit insurance were the reasons attributed by the management for the increase in the cost of the scheme".[3]

2.2.2.6 By 1969 even before the completion of the third stage expansion, the company initiated action for the fourth stage expansion comprising of (i) installation of 100 tonnes per day caustic soda/chlorine plant, (ii) expansion of capacity of the sodium sulphide plant from 4 tonnes per day to 7 tonnes per day, and (iii) installation of a sulphur dioxide plant of 15 tonnes capacity per day.

2.2.2.7 As per the project report of October 1971, the fourth stage project was estimated to cost Rs.950.86 lakhs (including Rs.233.20 lakhs in foreign exchange). The estimates were revised to Rs.994.82 lakhs including Rs.236.72 lakhs in 1972.

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3 Working Results of T.C.C. 1972-73. Report of the Comptroller and Auditor General (Commercial), Trivandrum, 1973-74, p.30.

The year 1974 witnessed unprecedent inflation. Consequently price of raw materials, machinery and equipment went up considerably. This resulted in a substantial increase in the project cost which went up from Rs.994.82 lakhs to Rs.1,505 lakhs. At the same time the expected ploughback from the existing plant went down from Rs.150 lakhs to Rs.60 lakhs.

2.2.2.8 Uses of Products and Byproducts

The chemicals made in T.C.C. go into the making of a wide range of articles of every day use.

Caustic Soda This has extensive use in the manufacture of rayon fabrics, paper, soaps, pulp, aluminium, rare earth chlorides, vanaspathi, etc.

Chlorine is used in the manufacture of rare earth chlorides, fertilisers, insecticides, plastics, P.V.C. and for the purification of water and as a bleaching agent in rayon and paper industries.

Sodium Hydrosulphite in its iron free form is used for dyeing, making sulphur black dyes, drugs and as a reagent for making amino acids and in leather tanning industry.

2.2.3 The Travancore Titanium Products

2.2.3.1 Another important unit incorporated in the forties was the Travancore Titanium Products Ltd. for producing pigment grade Titanium dioxide (T_1O_2). The unit was originally promoted by the then State of Travancore in collaboration with British Titan Products Company Ltd. till August 1960 when the Government of Kerala took over the administrative control.

2.2.3.2 From a production level of 5 tonnes per day in 1950, the capacity of the plant was expanded in stages to the level of 60 tonnes per day. The plant has facilities to produce both Anatase and Rutile grades of titanium dioxide. Two sulphuric acid plants with 50 TPD and 300 TPD capacity are in operation for meeting the sulphuric acid requirements. It employs around 1400 people.

2.2.3.3 Titanium dioxide is produced using ilmenite and sulphur as major raw materials, of which sulphur is an imported item. Titanium products have the major advantage since they have a monopoly in the whole country in the production of titanium dioxide. The other raw materials used in the process are zinc oxide, iron scrap, antimony oxide, glue, sodium sulphide, zinc dust etc. Sulphur comes out in the end as ferrous sulphate and dilute sulphuric acid which are dumped into the sea as effluents.

2.2.3.4 The company installed in 1967 a pilot plant costing Rs.1.91 lakhs for the production of 500 grams of titanium tetrachloride per day. In 1968 the chlorination process to produce titanium tetrachloride was tried using titanium dioxide as raw material. However, due to the highly corrosive nature of chlorine and titanium tetrachloride the plant could not run continuously and was shut down in June 1973. Another pilot plant for the production of 100 grams of butyl titanate per day and a third pilot plant for the production of 2 to 3 tonnes of potassium titanate per day was also installed in 1973 at a cost of Rs.2.50 lakhs and Rs.0.02 lakhs respectively. The company also initiated in March 1973 a scheme for the manufacture of synthetic rutile also from ilmenite utilising the waste dilute sulphuric acid.

2.2.3.5 Expansion scheme

2.2.3.5.1 The company obtained in 1961 an industrial license from the Government of India for increasing its installed capacity for producing titanium dioxide by 50 tonnes per day (i.e. from 18 to 68 tonnes). Todate the installed capacity is 24,500 tonnes per annum for a product mix of anatase and rutile grade of titanium dioxide pigment. The expansion scheme envisaged two streams of production viz. 25 tonnes anatase titanium dioxide and 25 tonnes rutile titanium dioxide per day — 18 tonnes per day either streamway depending upon the market. The total Indian demand for anatase is expected to be 12,000 per annum almost the whole of which is met by Travancore Titanium Products.

2.2.4 <u>Hindustan Insecticides Ltd.</u> (H.I.L.)

2.2.4.1 Insecticides and pesticides play very useful roles in agriculture and public health. In a country like India where Malaria was for long a primary health problem and where according to estimates Rs.1,000 crores worth of crops is lost every year due to pests and weeds, the importance of organic formulations such as D.D.T. and B.H.C. (Benzene Hexachloride) is much greater.

2.2.4.2 Until the dawn of independence insecticides were not available in adequate quantities and the country had to depend mostly on imports or gifts from various international agencies. The decision of the Government to launch a country-wide Malaria programme led to the incorporation of the H.I.L. in March 1954. The Company had two factories at Delhi and Alwaye. The factory at Alwaye with an installed capacity of 1,344 tonnes per annum of Technical D.D.T. was commissioned in July 1958. The project cost of this plant excluding township was estimated at Rs.1.58 crores involving a foreign exchange component of Rs.40 lakhs.

2.2.4.3 The company has always maintained a high standard of productive efficiency and profitability. With a net installed capacity of 1,344 tonnes per year of Technical D.D.T. production levels have varied between 1,450 tonnes in

1975-76 to 1,362 tonnes in 1979-80. In the case of formulated D.D.T. with a net installed capacity of 2,688 tonnes per year production levels were 2,784 tonnes in 1975-76, 2,695 tonnes in 1976-77 and 2,551 tonnes in 1979-80. In the case of Technical B.H.C. and formulated B.H.C. the performance has not been very remarkable. For an installed capacity of 3,000 tonnes of Technical B.H.C. output was 1,752 tonnes in 1975-76, 1,511 tonnes in 1976-77 and 2,442 tonnes in 1979-80. In the case of Form B.H.C. also for an installed capacity of 3,000 tonnes production was 2,570 tonnes in 1975-76, 3,076 tonnes in 1976-77 and 2,550 tonnes in 1979-80.

<u>Table - 2.6</u>

<u>Installed Capacity and Production Levels from 1975-76 to 1979-80</u>

Products	Net installed capacity	Production				
		1975-76	1976-77	1977-78	1978-79	1979-80
Tech. D.D.T.	1344	1450	1372	1152	1350	1362
Form D.D.T.	2688	2784	2695	2181	2228	2551
Tech. B.H.C.	3000	1752	1571	1526	1928	2442
Form B.H.C.	3000	2570	3076	2010	2018	2550

<u>Source:</u> Annual Reports of the Company for the years 1975-76 to 1979-80.

2.2.4.4 The by-products available are hydrochloric acid and spent sulphuric acid. For the year 1979-80 the quantity of hydrochloric acid produced amounted to Rs.522.357 tonnes and spent sulphuric acid 1,507.416 tonnes. These acids are supplied to T.C.C. and F.A.C.T. as per previous agreement.

2.2.4.5 In general the unit had no problem of finding a market for its products and byproducts. In recent years production levels have come down due to erratic power supply and labour unrest.

2.2.5 Cochin Refineries Ltd.

2.2.5.1 The setting up of a major refinery project in the heart of Kerala was a major landmark in the industrial development of Kerala. The refinery went on stream in September 1966 with an authorised capital of Rs.15 crores and an installed capacity to refine 50,000 barrels of crude oil per day or 2.5 million tonnes per year. The company made a profit of Rs.1.10 crores during the first year of its working. During the following years also it continued to make profits. It made a profit of Rs.574.04 lakhs in 1978-79 which rose to Rs.668.60 lakhs in 1979-80.

2.2.5.2 The Government of India has made agreements with the oil-producing companies of the middle east to supply crude oil to the Refinery. Besides crude oil was also received from Bombay high for processing by the Refinery.

2.2.5.3 The capacity of the refinery was expanded to 66,000 barrels of crude oil per day or 3.3 million tonnes per year in September 1973 at a cost of Rs.6 crores. Even though the design capacity was only 66,000 barrels per day, it has been successfully running at 70,000 barrels per day on a continuous basis.

2.2.5.4 Export quality spirit was produced by the company for the first time in 1980. The company has now initiated a secondary processing scheme involving the installation of a one million tonne fluid cracking unit with all the associated facilities, at an investment of Rs.39 crores. Apart from petroleum products this will also yield valuable aromatic feedstocks.

2.2.6 (vi) Kerala Soaps and Oils Ltd.

2.2.6.1 The Kerala Soaps and Oils was incorporated on 1st November, 1963. The authorised and paid-up capital of the company as on 31st March 1973 were Rs.2.00 crores and Rs.1.00 crore respectively. The entire paid-up capital of the company has been subscribed by the State Government. The company has been incurring a persistent trend in heavy losses.

During the years 1969-70, 1970-71 and 1971-72 the company incurred a loss of Rs.13.91 lakhs, Rs.12.57 lakhs and Rs.13.85 lakhs. Accumulated losses upto the end of March 1973 worked out to Rs.79.79 lakhs which amounted to 80 per cent of the paid-up capital. According to the management this state of "recurring losses was due to low production of the soaps and oils division, lack of funds to streamline the working of the hydrogenation division and lack of sufficient demand for the products".[4] Production was far below the rated capacity. This low capacity utilisation problem became so severe that the working of the hydrogenation unit had to be stopped from October 1971. Low production in the Soaps and Oils Division according to the Management was partly due to the insufficient build-up of demand and partly due to the low stock of raw materials due in turn to insufficient working capital. Capacity utilisation reached very low levels sometimes being as low as 18 per cent in the case of the glycerine plant. Attempts are being made now to resume the production of vanaspati and refined oil.

2.2.7 The Kerala State Drugs and Pharmaceuticals Ltd.

2.2.7.1 This is another important unit set up in the public sector in recent times. The entire share capital is owned by

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4 Report of the Comptroller and Auditor General of India (Commercial), 1972-73, Trivandrum, 1973, p.30.

the Government of Kerala. The unit went into commercial production in 1974. The project for the manufacture of Vitamin A from lemon grass oil is under active implementation. The company proposes to undertake the manufacture and trade of drugs, pharmaceuticals, radio pharmaceuticals, nutriments, cosmetics, hospital equipment etc. With the Indian Drugs and Pharmaceuticals Limited taking off the bulk of production the company has no fear of finding a ready market. The company has been showing a continuous history of profits. With a pre-tax profit of 2.5 per cent and price fixations as decided by the State Government and Kerala Health Services Department, the problem of losses is not imminent. However, the actual production levels as compared to budgeted production levels and installed capacity are low.

2.2.8 <u>Periyar Chemicals Ltd.</u>

2.2.8.1 Started under the parent company M/s. Aspinwall & Company Ltd., Periyar Chemicals had the unique position of being the only producer of formic acid in the State. It commenced production in 1971. The main products are formic acid and sodium sulphate. The installed capacity of formic acid was 1,500 M.T. and sodium sulphate 2,250 M.T. The expansion programme to enhance capacity by 50 per cent is completed.

2.2.8.2 The company has been showing more or less satisfactory levels of production except in the year 1979-80 in the case of formic acid. This was mainly due to the acute shortage of raw materials. During the years 1975-76, 1976-77 and 1977-78 the company declared a dividend of 20 per cent, 20 per cent and 15 per cent respectively. The sales value of output has increased from Rs.1.69 crores in 1978-79 to Rs.1.88 crores in 1979-80. But the profit levels have decreased mostly due to the increase in the cost of production alongwith a fall in output.

2.2.8.3 Out of the total sales, 48 per cent is within Kerala, mainly used for rubber coagulation. With the development of rubber and rubber-based industries in Kerala, the demand for formic acid is bound to increase. Apart from the amount distributed to the rubber industry, pharmaceutical companies outside Kerala take up the bulk of the output.

2.2.8.4 The important raw materials consumed by the unit are caustic soda from T.C.C., sulphuric acid from Cominco Binani Zinc Ltd. and Carbon monoxide from F.A.C.T. Ltd., Formic acid is imported into the country in large quantities. It is obtained as a by-product of petrochemicals. Indigenous production by conventional modes is in a critical situation since it has to face severe competition from the low priced imported acid. Thus it has become apparently difficult for it to sustain itself without some form of protection against the imported acid.

2.2.9 The Travancore Electrochemical Industries Ltd.

2.2.9.1 The Travancore Electrochemical Industries Ltd. located in Kottayam district produces calcium carbide and acetylene black. Calcium carbide is used in the conversion to acetylene gas, for welding, cutting and manufacture of P.V.C. and acetylene black. Acetylene black is used in the manufacture of dry batteries.

2.2.9.2 The unit commenced production in 1974 with an installed capacity of 25,000 M.T. of calcium carbide. Production for the year 1974 was 13,422 M.T. which diminished to 13,243 M.T. in 1975. There was an increase in output to 18,206 M.T. in 1976 and 18,761 M.T. in 1977. But in 1978 production fell to 13,372 tonnes. However, in the next year production reached a record level of 30,949 tonnes of calcium carbide. The company's plant for the manufacture of acetylene black went into production in 1978 with a licensed capacity of 500 tonnes per annum. It produced 39 tonnes of acetylene black in the initial year which increased to 279 tonnes in 1979-80.

2.2.9.3 The main customers of calcium carbide are the dissolved acetylene manufacturers. In Kerala the main customers are West Coast Industrial Gases and Southern Gases Ltd. Total consumption within Kerala is limited to a bare 60-75 tonnes per month. The rest of the output is mainly absorbed by the North Indian customers. Union Carbide is the single biggest customer of calcium carbide. Acetylene black is used mainly by battery manufacturers. Toshiba Anand takes up about 100 tonnes per month.

2.2.9.4 The main raw material for calcium carbide - lime shell is locally available from the Vembanad lake in abundant quantities. This has been the prime motivation for setting up the unit in the locality. Carbon is obtained in the form of coal-wood charcoal. With the stoppage of deforestation in Kerala, the availability of wood charcoal has gone down. Only 20 per cent of the total requirement is obtained from Kerala. Most of the wood charcoal requirement is currently obtained from Maharashtra. Carbonised lignite is obtained from the Neyveli Lignite Corporation, Tamil Nadu and coke from Bengal and Bihar collieries.

2.2.9.5 After surviving the initial problems the company has now started making huge profits. In 1978-79 it earned a net profit before taxation of Rs.81.513 lakhs and in 1979-80 it increased to Rs.118.54 lakhs.

2.2.10 The Travancore Chemical and Manufacturing Company Ltd.

2.2.10.1 The Travancore Chemical and Manufacturing Company Ltd. (T.C.M. Ltd.) founded in 1943 has factories in Kalamasseery, Kundara, Mettur and Tuticorin. The Kalamasseery unit manufactures copper sulphate, copper oxychloride and formulations such as fytolan, perecloud, oleop chlorocop and emalsicop used as fungicides, sodium aluminate, sulphate of alumina, iron-free and alumina ferric used in water treatment, paper manufacture and textile dyeing, sodium chlorate in bleaching and potassium chlorate used in match manufacture with an installed capacity of 3,000 tonnes per annum. The company produced 2,986 tonnes of copper sulphate in 1979-80. The quantity sold in the year amounted to 2,990 tonnes. In the case of copper oxychloride technical, with an installed capacity of 1,200 tonnes production in 1979-80 was 973 tonnes, while in the previous year it was higher at 1,188 tonnes. For sodium aluminate the installed capacity was 1,020 tonnes with an output of 478 tonnes. The capacity of sulphate of alumina iron free was 1,800 tonnes. Production amounted to only 547 tonnes. Sulphate of alumina ferric had an installed capacity of 4,200 tonnes the output in 1979-80 coming to 3,344 tonnes. Table-2.7 gives the licenced capacity, installed capacity, production and sales of the important items produced in the Kalamasseery unit.

Table - 2.7

Table showing licensed capacity, installed capacity production and sales of output for the year 1979-80

Product	Licensed capacity (tonnes)	Installed capacity (tonnes)	Production (tonnes)	Sales	
				Qty.	Value
1. Copper sulphate	3000	3000	2986	2990	36328000
2. Copper oxychloride Technical	960	1200	973	8	187500
3. Copper oxychloride dust (50%WDP)	300	480	544	580	14386075
4. Copper oxychloride dusts	300	480	241	230	499404
5. Oil Miscible Coc paste (kilo litres)	150	150	99	113	4846773
6. Sodium aluminate (tonnes)	1020	1020	478	539	2542514
7. Sulphate of alumina (iron free)	600	1800	547	544	685731
8. Sulphate of alumina ferric	3880	4680	3344	3362	2816863
9. Sodium chlorate	800	800	775	763	4381037
10. Chlorate of potash	3250	4200	3344	3362	2816863

Source: Annual Report of T.C.M. Ltd., 1979-80, p.24.

2.2.10.2 Sales of commodities are mainly operated through selling agents. Seventy to seventyfive per cent of the sales are effected within Kerala. The company gives 100 tonnes of barium carbonate per year to T.C.C.

2.2.10.3 <u>Raw Materials</u>

2.2.10.3.1 Among the important raw material copper scrap is an imported item. 1957 tonnes of sulphuric acid are obtained from Cominco Binani Zinc Ltd. and 2,292 tonnes of hydrochloric acid from T.C.C. 687 tonnes of caustic soda lye is obtained from T.C.C. The other raw material, washed carnalite, is indigenously obtained.

The Kalamassery unit has a total labour strength of 500.

2.2.11 <u>Kerala Chemicals and Proteins Ltd.</u>

2.2.11.1 This is a unique venture in the joint sector backed by Kerala State Industrial Development Corporation, the Nitta Gelatine Company Ltd. and the Mitsubishi Corporation of Japan. The project is estimated to cost Rs.320 lakhs, of which K.S.I.D.C. contributes Rs.36.4 lakhs, the Nitta Gelatine Company Rs.22.4 lakhs, and Mitsubishi Corporation Rs.14 lakhs. Term loans and public issue of shares account for the balance of the outlay.

2.2.11.2 The plant is licensed to manufacture annually 2,210 tonnes of ossein as main product and 4,250 tonnes of dicalcium phosphate as by-product. Ossein is an intermediate product in the manufacture of gelatine. Gelatine has wide and varied uses in the manufacture of photographic films, pharmaceutical capsules, foods, etc. Dicalcium phosphate is used as an ingredient in animal/poultry feeds, fertilisers, pharmaceutical preparations etc. The entire quantity of ossein produced by K.C.P.L. is exported to Japan. The by-product dicalcium phosphate has a ready market apart from good export prospects in Japan, Australlia, Thailand, East Africa, Iran, Saudi Arabia, Sri Lanka, etc.

2.2.11.3 The main raw material for ossein manufacture is mainly crushed bones which is available in plenty in India. It is being obtained from Andhra Pradesh and other northern States. India has been exporting fairly large quantities of crushed bones. The change-over from the export of this primary raw material to an intermediate product like ossein is expected to increase foreign exchange earnings by over 200 per cent. Travancore Cochin Chemicals is supplying the required quantity of hydrochloric acid. With the installation of a mercury-free hydrochloric acid plant in T.C.C. arrangements have been made to sell 1,000 tonnes per annum for twenty years.

Another raw material, shell lime, is also available from Shertallai and other neighbouring places. Pure water is another essential ingredient. A daily requirement of six lakh gallons of water is met from the perennial supply of water from the Chalakudy river. The furnace oil requirement of the unit is also easily available on tap from the Cochin Refineries situated just about 60 kms. south. Thus, with all the locational advantages the unit seems to be all set off for a flying start.

Table 2.8 presents the licensed installed capacities and production and turnover for the period 1979-80.

Table - 2.8

Licensed and Installed Capacity of Production for Kerala Chemicals and Proteins Ltd.

	Casein		Dicalcium phosphate	
	Qty.	Value	Qty.	Value
Licensed capacity/annum	2210		4250	
Installed capacity/annum	2760		5310	
Production for the period 1979-80	2256		4172	
Turnover for the period	2160	2,44,13,450	3866	53,08,934

Source: Annual Report of the Company 1979-80, p.18.

2.2.12 Kerala Acids and Chemicals Ltd.

2.2.12.1 This company was incorporated in February 1972 with an authorised capital of Rs.227.8 lakhs to produce formic acid. The share of equity capital is Rs.80.0 lakhs and the balance is made up from long-term loans from financing institutions. The plant expects to bridge the gap between supply and demand for formic acid. As has been already pointed out formic acid is mainly used for the coagulation of rubber latex in the rubber industry. Consumption of formic acid by the rubber industry alone is estimated to be 12,000 tonnes per annum in 1980-81. With an increase in the production of natural rubber the demand for formic acid is bound to increase. Formic acid also finds a ready market in the drugs and pharmaceutical industry. The total demand from drugs and pharmaceuticals is about 800 tonnes per annum. The I.D.P.L. itself consumes 600 tonnes per annum. The demand from the leather industry is also very large. It consumes 15,000 tonnes per annum and the textile industry requires around 200 tonnes per annum. This shows that marketing of the product is not a problem.

2.2.12.2 The installed capacity of the plant is 4 tonnes per day of 100 per cent formic acid and 85.9 per cent formic acid at 300 stream days per year or an annual capacity of 1,200 tonnes per year. The estimated cost of production of the plant is around Rs.7,900 per tonne. The present selling price of formic acid is Rs.14,100 per tonne of 100 per cent formic acid.

2.2.12.3 <u>Raw Materials used</u>

2.2.12.3.1 Nearness to the source of raw materials used has been a strong point in locating the industry in the Edayar region. The important raw materials are:

(i) <u>Caustic Soda (rayon grade) in flakes</u> or nut size to be obtained from T.C.C. The approximate annual requirement is 1,400 tonnes.

(ii) <u>Carbon monoxide gas</u> from FACT, the annual requirement of which comes to 2,172,000 Nm^3.

(iii) <u>Sulphuric Acid</u> is obtained from FACT or Cominco Binani Zinc Ltd. Approximate annual requirement is 1,600 tonnes.

(iv) <u>Soda lye</u> is required in small quantities (about 30 tonnes) which is expected to be obtained from T.C.C.

2.2.12.4 <u>Labour</u>

The labour requirement is 78 excluding office staff.

Pollution Problem

2.2.12.5. The company does not expect any effluent problem except floor sweepings which may contain some of the chemicals used due to spill-over, overflow etc. Since this quantity is expected to be small, no specific treatment of effluents is envisaged.

In spite of the bright prospects on which the unit has launched itself, the import of low-priced formic acid may have a detrimental effect on the future of the unit. Unless controls are exercised on imports, the local products, which are of recent origin, may find it difficult to sustain themselves.

2.2.13 Petrochemical Industry

2.2.13.1 In recent years the petrochemical and other organic chemical projects have come up in different parts of the country offering various new chemicals. These developments gave a phenomenal impetus for the growth of the chemical industry. The effects of these developments have not been felt in the state to any significant extent. The main reason for the State not being able to make use of the opportunity is that due to the southernmost location of the State the chemicals serving as raw materials and very often finished products have also to be transported over long distance. More than the freight charges, the uncertainties in continuous supply is the main consideration. Hence emphasis has been laid on the development of projects either having the advantage of getting locally-available raw materials or manufacturing products having a ready market locally or possessing any other local advantage.

2.2.13.2 So far the State has not been able to take advantage of the onset of the petrochemical industry in our country mainly due to the fact that the petrochemical units are situated in far away States. The development of the plastic processing industry, chemical intermediates and end-products industry had a serious setback due to the non-availability of resins and other petrochemical raw materials. There is no doubt that a network of large, medium and small-scale industries could come up once the basic building block of petrochemicals is made available in the State.

2.2.13.3 The proposal of processing Bombay high crude at Cochin Refineries has special significance, as it offers tremendous growth potential for developing a number of basic chemicals and downstream units in Kerala. This development brings Kerala into the petrochemical map of India. Large investments in the Central, State and private sectors should be forthcoming to utilise the prospective linkage effects offered by this development. A number of downstream units and end-product units are also to be promoted by concerned agencies and entrepreneurs.

2.2.13.4 The development of rubber industries has special relevance to Kerala because of the availability of abundant raw material. Kerala has only a small base in modern rubber-based industries. It offers tremendous potential for growth.

2.3 The Constitution of the Working Group on Chemical Industry

2.3.1 The task force on large and medium scale industries set up for the formulation of the VI Plan for Kerala constituted a Working Group on chemical Industry (including plastic and rubber industries). The objectives of the Working Group are as follows:-

1. To review the present status of the chemical industry in the State.

2. To identify and draw up a list of products that may be considered for manufacture in the near future alongwith suggested plant capacities and approximate estimates of capital requirements.

3. To furnish a list of expansion/diversification schemes of the existing units and the requirement of funds.

2.3.2 According to the Working Group, 16 approved project schemes have been included under spill-over schemes where approval had been given or work had been started in the last plan and projects have to be completed in the plan period.

2.3.3 Thirtyfive new projects proposals have been identified and included in the sixth Five Year Plan for Kerala. The total investment is of the order of Rs.344 crores. The investment is estimated to generate a turnover of Rs.450 crores and offer a direct employment potential of 5,600.

2.3.4 The projects have been divided into different groups as (i) resource-based projects, (ii) demand-based projects, (iii) projects based on existing units or units under implementation, (iv) petrochemical projects, and (v) plastic units.

2.3.5 Resource-Based Projects

2.3.5.1 (a) Mini Paper Plant Due to the difficulty of getting sufficient quantities of forest raw materials it is proposed to consider mini paper plants of 10 to 20 tonnes per day capacity. A plant with a capacity of 10 tonnes per day in Malappuram/Palghat District has been proposed to be set up. The project cost is estimated at Rs.80 lakhs.

2.3.5.2 Resins and Paints from CNSL Cashew industry has been one of the main supporters of Kerala's economy. It is proposed to utilise the cashewnut shell liquid abundantly available as by-product from the cashew factories in the State. This can be used for the manufacture of epoxy resins, resins for foundry cores and moulds, brake-lining compounds, corrosion-resistant paints and varnishes. The cost of project for a plant with 500 TPD of resins is estimated at Rs.40 lakhs.

2.3.5.3 Activated carbon Kerala is a land rich in coconut palms and a variety of products have been manufactured from different parts of the tree. Currently it has been proposed to manufacture high quality activated carbon from coconut shells abundantly in Kerala. Superior grade activated carbon is still imported in India. K.S.I.D.C. has plans for the manufacture of 2,000 tonnes of pharmaceutical grade activated carbon per annum. The estimated project cost is around Rs.270 lakhs.

2.3.5.4 Sorbitol from tapioca starch Sorbitol which is an intermediate for vitamin C has also got applications in food, Cosmetics, surfactants etc. Considerable quantity of tapioca starch, the basic raw material for this product, is being produced in the small-scale sector in Kerala. Hence a unit for the manufacture of sorbitol can be set up in Kerala without much problem of raw material availability. The minimum economic capacity of the plant is about 1,000 tonnes/annum and estimated capital cost is Rs.1 crore.

2.3.5.5 Oleoresins and spice oils It is proposed to manufacture oleoresins of pepper, ginger and turmeric and spice oils of pepper, ginger and cardamom. There is a very good export market for these products in European and Middle-east countries. Hence such projects can give a boost to our traditional export items. The project cost for a plant with a capacity of 30 tonnes per annum would come up to about Rs.40 lakhs.

2.3.5.6 Fatty alcohol Another proposal is to manufacture fatty alcohol from coconut oil and hydrogen. This material, which finds use in surface active agents, is, at present, imported. A letter of intent has been obtained by a Calcutta firm to establish a plant in Kerala using foreign technology.

2.3.6 Demand-based projects

2.3.6.1 Dyes project This is to cater to the requirements of the coir industries and paper industries in Kerala. At present there is no manufacture of dyes in the State in the organised sector. The coir manufacturers have to depend partly on imports and partly on supplies from Bombay and Gujarat.

A capital outlay of Rs.82.50 lakhs is envisaged for a capacity of 90 tonnes of different types of basic and acid dyes per annum. The expected turnover is Rs.74.00 lakhs. Since most of the raw materials are indigenously available the problem of raw material availability also does not arise.

2.3.6.2 Polyol This is an intermediate chemical used in the manufacture of polyurethane foams, rollers, coatings, adhesives etc. At present the entire requirement of this material is met through imports. It is proposed to manufacture this material using technology developed indigenously by the ISRO based on castor oil derivatives. It has been proposed to set up a plant with an installed capacity of 1,000 tonnes per annum. The capital requirement is estimated to be Rs.120 lakhs. The employment potential would be about 80 and the expected turnover would be about Rs.160 lakhs.

2.3.6.3 Nylon Filament Yarn Nylon filament yarn is used for the manufacture of textiles, hosiery and industrial applications like fishing nets etc. Nylon yarn manufacture can provide assistance to the handloom, powerloom and knitting sectors and fishing net industry. It has been proposed to establish a plant producing 2,100 tonnes of nylon filament yarn with a capital outlay of Rs.1,600 lakhs. The main raw material is caprolactum. With F.A.C.T's new proposal to manufacture caprolactum the availability of raw material should pose no problem.

2.3.6.4 <u>Pesticides</u> A unit for the manufacture of 600 tonnes per annum of diuron is envisaged. Diuron is a popular weedicide and the present demand is estimated at 900 tonnes per annum. Capital cost of the plant is estimated to be about Rs.3.5 crores with an expected turnover of Rs.4.2 crores. It is also proposed to make technical grade pesticides like fenctrothion phoate. Assistance from H.I.L. in developing the product will be sought.

2.3.6.5 <u>Hydrogen cyanide and cyanic acid</u> Cyanides are required in the manufacture of heat treatment salts, electroplating, extraction of gold and silver from ores, in the floatation of ores, metallurgical industries and in the manufacture of intermediates for pharmaceuticals, dyes, plastics etc. At present there is no unit for the manufacture of these chemicals in our country and the entire requirement of about 2,000 tonnes per annum is imported. The cost of project for a plant with a capacity of 1,000 tonnes per annum is about Rs.200 lakhs. The proposed process envisages use of raw materials such as ammonia, sulphuric acid, phosphoric acid, caustic soda and hydro carbon gas, most of which can be made available within the State itself.

2.3.6.6 <u>Synthetic resins</u> It has been proposed to manufacture polyster resins and other synthetic resins to overcome the acute shortage of non-ferrous materials and special steels. The main materials required are maleic anhydride, phthalic anhydride and propylene glycol.

2.3.6.7 Sodium Tripoly Phosphate This is the basic raw material used in the manufacture of synthetic detergents. At present this is being produced only in Bombay with additional proposals under way in Hindustan Levers, West Bengal Plant and Bellapur Industries. To cater to the needs of the southern region it is suggested that a plant manufacturing STPP with an installed capacity of about 30,000 tonnes per year could be taken up in Kerala. The various raw materials required are rock phosphate, sulphur or sulphuric acid and soda ash. If the plant is located in the Edayar area it can utilise the by-product - sulphuric acid - available from Cominco Binani Zinc Ltd., the zinc smelter unit limited. This can cut down the estimated capital cost remarkably.

2.3.6.8 Sodium Carboxymethyl Cellulose This can be used in detergents, drilling muds, food products like ice cream, paints and textile sizing, pharmaceuticals etc. It functions as a thickener and stabiliser. With the development of the synthetic detergent industry there is a good demand for SCMC. Export possibilities are also wide. With only one project currently in operation in Gujarat State the southern region can avail of a plant located in Kerala. With the know-how indigenously available, the raw materials such as cotton links, chlorine and acetic acid should pose no great problem.

2.3.6.9 Polyvinyl Acetate Polyvinyl acetate has a wide range of applications in adhesives and in the paint industry. It is also used as raw material for formaline and butyral which are used in the manufacture of mouldings and sheetings. The PVA emulsions are also produced mostly in the Bombay area. Hence the need for the establishment of such units in the southern region is strongly felt.

2.3.7 Intermediates complex

2.3.7.1 A number of chemicals and intermediates are required by the pesticides, dyes and pharmaceutical industry. These always seem to be in short supply. The non-availability of these chemicals in the southern region resulted in the very slow development of the end-product industry in the State. Some of the projects tentatively considered are Hexachlorocyclopentadiene, Thionyl chloride, Ortho amino phenol, Paranitrometa cresol, Novoldiamine etc. The Indian Drugs & Pharmaceuticals and the Hindustan Organic Chemicals can be associated with these projects.

2.3.8 Projects Based on Utilisation of Products/By-Products of Existing Units

2.3.8.1 Carbide chemicals It has been proposed to manufacture dicyandiamide which finds use in the production of some drugs and in ordinance factories. This project is based on the availability of calcium carbide from the Chingavanam plant of Travancore Electro Chemicals. Other products envisaged are aminoguanidine, benzoguanidiene and amitrole, all of which are being imported now. It is expected that the cost of calcium carbide produced in Kerala would be comparatively cheaper due to the availability of power and basic raw material.

2.3.8.2 Vinyl acetate project Vinyl acetate monomer is the raw material for polyvinyl acetate used in various adhesives, emulsions etc. This it is not manufactured in India. It is expected to have a demand of 2,000 tonnes per year by 1983-84. The present demand of 800 tonnes per annum is met through imports. The raw materials required are calcium carbide and acetic acid. Calcium carbide can be made available from Travancore Electro Chemical Industries, Chingavanam or Travancore Cements. Acetic acid can be obtained from the nearby rayons factory or its manufacture can be based on acetaldehyde which can be made by the formaldehyde unit.

2.3.8.3 Pentaerythritol plant The proposal has been for a plant to manufacture 600 tonnes of pentaerythritol per annum which would be used for the production of detonators and detonating fuse. Existing demand for pentaerythritol is around 4,600 tonnes per annum which shows every sign of going up in succeeding years. This can be manufactured from acetaledehyde and formaldehyde which can be obtained from the formaldehyde plant under implementation at Alleppey.

2.3.8.4 Fine chemicals project Monochlorobenzene produced by H.I.L. for the manufacture of D.D.T. generally shows a surplus which can be used in the manufacture of products like paranitrochlorobenzene, paraminophenol, paracetamol etc. An installed capacity of 50 tonnes per year each as saleable products can be considered.

2.3.8.5 Phosgene plant Based on the availability of carbon monoxide from F.A.C.T. Ltd. and chlorine from T.C.C. it is possible to set up a plant to manufacture phosgene. Phosgene is used for the production of a number of chemicals such as toluene di-isocyanate for urethane foam, acetyl chloride, polycarbonates etc. A capacity of 1,500 tonnes/year can be considered.

2.3.8.6 Cement sulphuric acid project From the phosphoric acid unit of Cochin Division of F.A.C.T. Ltd. by-product gypsum is produced which, at present, poses a disposal problem. Based on this availability the possibility to manufacture 1,000 tonnes per day of cement and sulphuric acid is envisaged. The main deterrent is the high cost of investment involved. An alternate proposal was to convert gypsum, into ammonium sulphate and to make available the resultant calcium carbonate sludge for cement production.

2.3.8.7 Zinc oxide, zinc sulphate and other zinc chemicals
Zinc oxide which finds extensive use in the rubber industry and zinc sulphate required by the rayon factories can be manufactured from zinc hydroxide which is available as by-product from T.C.C. and zinc scrap. Manufacture of zinc oxide in the medium scale and small scale sectors can be considered.

2.3.8.8 Sodium sulphide Based on the sodium sulphate available from the Periyar Chemicals Ltd. a project manufacturing 600 tonnes per year of sodium sulphide can be planned. This chemical finds wide use in a variety of industries such as leather, textile and pharmaceutical. At present sodium sulphide is manufactured by T.C.C.

2.3.8.9 Misch metal project Based on rare earths chlorides available from Indian Rare Earths plant a project for the manufacture of misch metal can be considered. In view of the limited demand in India the project should be made export-oriented.

2.3.8.10 Synthetic cryolite Synthetic cryolite which is used in the manufacture of aluminium can be manufactured from the by-products available from the phosphoric acid plant of F.A.C.T.

2.3.8.11 Chlorine-based units The capacity of the T.C.C. plant after expansion would be nearly 200 tonnes per year of chlorine. Hence there is good scope for setting up chlorine-based units. Projects that can be considered for the manufacture are pesticides, phosphorous oxychloride, pentachlorophenol, bleaching powder, hypochlorite, ferric chloride etc. Most of these projects will fall under medium scale projects.

2.3.8.12 Butendiol Butendiol is not manufactured in our country. The value of imports of Butendiol is estimated to be around Rs.3.5 crores per annum. It is mainly required for the manufacture of endosulfan. Messrs. Hindustan Insecticides Ltd., Alwaye, have already set up an endosulfan plant. Its butendiol requirement is estimated to be 450 tonnes per annum. The demand for butendiol in the country is estimated to be 1,000 tonnes per annum. The main raw materials required for the manufacture of butendiol are formaldehyde and acetylene, both of which are available in Kerala

2.3.8.13 Cast phenolics The proposal is for the manufacture of Phenol formaldehyde resins which can be moulded into the required products. These find use in anticorrosion applications, suspension and rakes, electroplating and electrolytic baths, acid proof tiles, roofs, tubes etc. and as structural members in electrical insulators. The main raw materials are phenol and formaldehyde. The proposed plant will have a capacity of 500 tonnes per annum with a capital investment of Rs.30 lakhs.

2.3.9 Petrochemical Projects

2.3.9.1 A proposal has been mooted to process a part of Bombay High Crude at Cochin Refineries Ltd. This has tremendous significance as it offers tremendous growth potential for developing a number of basic chemicals and downstream units in Kerala. The proposal involves setting up a fluid catalytic cracker with an investment of Rs.39 crores. In addition to the petroleum products like gasoline and kerosene the processing of Bombay High crude yields valuable aromatic feedstock containing Benzene, Toluene and Xylene (9,800 tonnes per year, 20,000 tonnes per year, 25,000 tonnes per year respectively). In addition 20,000 tonnes per year of propylene would also be available. With regard to naphtha after meeting the requirements of the fertiliser unit a balance of 100,000 tonnes of naphtha shall be available for chemicals out of a total product of 340,000 tonnes.

2.3.9.2 Proposals for a number of petrochemical units are drawn upon the basis of the above aromatic feedstocks. Some of them are as follows:

2.3.9.3 <u>B.T.X. separator unit:</u> This plant, intended for the separation of the aromatic fraction into its components benzene, toluene and xylene, has an estimated capital investment of around Rs. 18 crores.

2.3.9.4 <u>Naphtha cracker</u> The Naphtha cracker unit with an estimated capital outlay of Rs.10 crores will have a capacity of 100,000 tonnes of naphtha per annum. The products of this unit namely acetylene and ethylene are the raw materials for various end-products.

2.3.9.5 <u>Caprolactum</u> The caprolactum plant which is going to be set up by the F.A.C.T. as part of their diversification programme is estimated to have a capacity of 30,000 tonnes per annum. This is the raw material used for the production of Nylon-6 which is used for producing fishing nets, tyre cords, nylon yarn for textiles etc. The approximate investment for the plant alongwith the necessary offsite facilities is estimated to range between Rs.100 and Rs.200 crores.

2.3.9.6 <u>Styrene, polystyrene</u> The capacity of the proposed polystyrene plant is 20,000 tonnes per annum which will require 18,000 tonnes per annum of benzene to be converted to styrene monomer. Polystyrene is a hard thermoplastic and because of its low cost and super qualities it is widely used in packing, manufacture of door liners, trays, sports equipments, electrical appliances, toilet fittings etc. The estimated investment is Rs.2 crores.

2.3.9.7 Phenol A 6,000 tonnes per annum phenol plant based on vapour phase oxidisation of benzene is being set up. The benzene requirement will be 5,500 tonnes per annum. Phenol is mainly used in the manufacture of phenolic resins. It is also used for the manufacture of bisphenol-A, alkyl phenols, caprolactum etc. The approximate investment for a 600 tonne per annum plant will be Rs.6 crores.

2.3.9.8 Polypropylene This is a thermoplastic resin similar to low density polyethylene and has tremendous market potential. So a polypropylene plant with 20,000 tonne per annum capacity is proposed to be set up. Tobacco, candy, baked goods, meat, drugs etc., can be packed in polypropylene films having superior tear resistance, moisture resistance and ageing properties. Polypropylene is expected to have considerable export market. The anticipated investment is around Rs.25 crores.

2.3.9.9 Dimethyl terephthalate/terephthalate terephthalic acid There is also a proposal to set up a 30,000 tonne dimethyl terephthalate (DMT) or terephthalic acid (TPA) plant.

This will require about 20,000 tonnes per annum paraxylene. DMT/TPA is the raw material for the manufacture of polyster polymer. Polyster polymer is used for the manufacture of polyster staple fibre, photographic films etc. The approximate investment is Rs.8 crores.

2.3.9.10 Plastic units With the ever-increasing importance of the plastic industry, many new plastic units are envisaged under the development programme. The proposal to start a plastic container plant, P.V.C. leather cloth unit and polypropylene corrugated sheets manufacturing units merit special mention in this connection.

2.3.10 Rubber-Based Units

2.3.10.1 These are found to have special relevance to Kerala owing to the availability of raw material. New units have been planned, so that the rubber, which forms an important item of Kerala's plantation crops, can be used within the State itself. The two main units envisaged are: (i) a conveyor belt unit, and (ii) a surgical rubber goods unit.

2.3.10.2 Conveyor belts K.S.I.D.C. has a proposal to manufacture 6,000 tonnes of belting. The products include textile conveyor belting, steel cord conveyor belting, transmission belts, fan and V belts and P.V.C. conveyor belting. Estimated capital outlay for this unit is Rs.22 crores. The unit proposed to have collaboration with Conrad Sholtz of West Germany. The proposed unit is expected to cater to the growing needs of chemical, engineering and allied industries.

2.3.10.2 Surgical rubber goods With the expansion of medical facilities in Kerala and the neighbouring regions, the demand for surgical rubber goods has increased in recent years. The proposal is to manufacture high quality specialised products with a capital investment of Rs.80 lakhs.

2.3.11 Summary of the Report of the Working Group on Chemical Industry

Thirtyfive new project proposals have been identified and listed by the Working Group (Appendix-3). The total investment required for the implementation of these proposals amounts to Rs.343.655 crores. These projects are expected to provide employment to 5,606 people. The power requirement for these projects are estimated at 23,390 kilowatts. A number of spill-over schemes of existing units have also been proposed. The employment potential of the spill-over schemes is expected to be 4,042 at a capital investment of Rs.212.84 crores.

Considering a total capital investment of Rs.556.495 crores the employment generated on all the new and spill-over schemes is only 9,648. With such a high capital labour ratio, unless the output generated is correspondingly high, it will have no justification for its installation.

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CHAPTER - III

PRODUCTIVITY IN THE CHEMICAL INDUSTRY

3.0 Adam Smith gave 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 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 and instruments which facilitate and abridge labour; or of a more proper division and distribution of employment".[1]

Following the same line of thought, productivity has been defined as,

> "the ratio between the production of a given commodity measured by volume and one or more of the corresponding input factors also measured by volume".[2]

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1 Smith Adam, An Enquiry into the Nature and Causes of the Wealth of Nations, Random House, New York, 1937, p.326.

2 Measurement of Productivity O.E.E.C. 1952. G.F.Beri, G.C., Measurement of Production and Productivity in Indian Industry, Asia Publishing House, New Delhi, 1962, p.90.

Thus productivity may be of labour, capital, power, raw materials etc., or may be a combination of two or more of these two factors. However, in actual practice measurements made by most authorities including the O.E.E.C. and the Bureau of Labour Statistics of the U.S. are concerned with labour productivity.

3.1v0 Productivity of labour can be defined as the ratio of the physical volume of output achieved in a given period to the corresponding volume of labour expended. This output depends on a large number of factors like capital invested, raw materials and fuels consumed etc. Hence productivity of labour is a function of a large number of factors. It does not as such reveal changes in the intrinsic efficiency of labour only but show the changing effectiveness with which labour is utilised in conjunction with other factors. It is not a measurement of the specific contribution of labour or of capital or of any one of the factors of production. It shows the cumulative effect of a large number of separate though interrelated influences such as technological improvements, organisational efficiency, availability and quality of supplies and the flow of materials and components, employee and employer relations, skill and effort of workers and efficiency of management.

3.1.1 The basic dilemma of wages/income policy relevant to Indian conditions consist in the rival claims of consumption and investment, the demand of labour for a higher share of productivity gains and the need of the economy for a higher rate of capital formation. Thus the first Five Year Plan stated,

> "the rate of progress has to be determined not only by the needs of the workers but also by the needs of the country's resources. . . .. on the side of labour there should be a keen realisation of the fact that an under-developed economy cannot build for itself and the community a better life except on the foundations of a higher level of productivity to which it has itself to make a substantial contribution . . . . ."[3]

The Third Plan also emphasised that,

> "neither the exercise of their organised strength in industrial conflicts nor laws nor the intervention of the State can help workers much in realising their aspirations. Their gains can arise only out of the strength and dynamism of the economies - the only enduring basis of which is the rising level of productivity".[4]

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3 Government of India, Planning Commission, First Five Year Plan, 1951, p.571.

4 Government of India, Planning Commission, Third Five Year Plan, 1961, p.261.

3.1.2 However, in a developing democratic country where a well organised trade union movement exists, wages tend to increase irrespective of whether productivity tends to warrant the rise or not. It may be conceded that till a certain level, if prices are stable, rising wages may be conducive to economic development. This is particularly true when the existing level of wages are below the need-based minimum. In such a situation rising wages help to raise the workers' efficiency through improved living conditions. At the same time it has to be remembered that growth in labour productivity, which also depends on how much profits are ploughed back into investment itself, makes way for a wage rise.

3.1.3 On the other hand we cannot forget the fact that wages are a cost to the industry and it is, therefore, important to ensure that a rise in wages matches or, at least, does not lag far behind the increase in labour productivity. Excess wage rise in relation to productivity tends to push up costs and through costs, prices. In our industrial economy while the money earnings of labour have increased steadily over the years by about 3.5 per cent per year, real earnings have barely changed. The real earnings have apparently been eaten away by the steady price increases. "The real earnings in industry have actually lagged behind productivity and have increased roughly at the same rate as the increase in per capita gross national product".[$] The quasi-automatic link between the money wage level and the consumer price level in an apparent effort to maintain the real wage level also has an element of cost-push inflation which cuts into real wages. Moreover, since labour productivity is relatively higher in the industrial sector compared to the other sectors, industrial wages tend to move faster than average productivity in the economy as a whole. This is apt to have an inflationary effect on prices.

3.1.4 A commonly-accepted assumption is that the price level can be held approximately stable in an industry if the money wage does not run ahead of productivity. But this cannot be accepted unconditionally, because no industry works totally independent of the others. Prices in one industry or sector invariably affect the prices in other industries. The economy of a country, even a developing country, is a more or less integrated complex such that an imbalance in any one sector is ultimately transmitted to the other sectors also. This is effected mainly through the mechanism of prices. The changes in prices and wages in the industrial sector can never be totally divorced from the prices and wages of the agricultural sector. This is especially true in a country like India where

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$ Productivity and Wages in Indian Industry 1953-63, Economic and Scientific Research Foundation, New Delhi, 1968, p.1.

two-third of the total population derive their livelihood from agriculture. Factory and industrial workers in the private and public sectors together, as a class, form only a small section of the working population. This is true in the case of Kerala also. According to the 1981 census the number of workers in organised industry and services in Kerala was 1.18 million out of the total workers of 6.74 million. This amounted to about 17.5 per cent of the labour force. Money wages in industry cannot, therefore, move very much ahead of the average incomes in the overall economy, because if it does so it will inevitably exert a demand pull on the agricultural prices, push up the general prices and depress real wages.

3.1.5 An analysis of the industrial sector indicates that both capital intensity and wages have increased much more rapidly than productivity during the plan periods. It is an obvious result that if capital investment is excessive in relation to the increase in productivity attained or if wages increase out of proportion to productivity, prices rise and vice versa.

3.2 Factors Affecting Labour Productivity

3.2.1 A country's productive capacity is determined by a whole host of factors differing very much in themselves.

The total production depends partly on the availability of the factors of production, quantity and quality of the labour force, stock of capital goods, quality of management, nature of soil and climate etc. It also depends partly on the productivity of the factors of production. The prosperity of a country is, thus, determined not only by the total national product, but by the national product per head of the population. Hence it would not be presumptuous to claim that prosperity and productivity of labour are in fairly constant relation to each other.

3.2.2 The factors that determine labour productivity can be classified as:

1. The quality of labour The extent to which a labourer exerts himself does not by itself determine productivity. His skill, knowledge and training are just as crucial factors. Human investment in this context becomes just as important as capital investment.

2. The nature and stock of capital goods This includes not only machinery and plant in business enterprises, but also the necessary infrastructure.

3. Technology Some statisticians have brought forth the idea that the whole of technical progress is manifested in the growing stock of instruments of production. Economists like

Simon Kuznets, on the other hand, profess that at least a part of technical progress is disembodied and can take place irrespective of the volume of output.

4. __Natural conditions__ Historically-speaking natural conditions were very important in determining the productivity of labour. However, their importance is gradually declining and production is becoming less dependent on natural conditions.

5. __Efficiency of firms__ The establishment of links in the internal production process, production process route undertaken by the firms, labour relations all these are factors which ultimately affect the firm's output and labour productivity.

3.2.3 Laszlo Rostas, a pioneer in the field of productivity measurement, enumerates the factors affecting productivity as geographic, metereological or climatic conditions, institutional conditions on taxation and legislation, condition of the market for manufactured goods, size of business, wage system, working hours, state of nutrition etc.[6]

3.2.4 Long-term gains in productivity mainly come from advancement in science and technology and its application to

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[6] Rostas, L., "Alternative Productivity Concepts", __Productivity Measurement__, Vol.1 (1955), European Productivity Agency, O.E.E.C., 1955.

the physical process of production. They have resulted not so much from a revolutionary discovery as from the slow and gradual improvement in technical process. This can take the form of better layout of plants, new tools and better methods of material handling.

3.3 Criticism of Labour Productivity

3.3.1 Since labour is only one of the input factors labour productivity data should be interpreted with utmost caution. "In particular one has to guard against two possible dangers in analysing such data: (i) Danger of placing undue emphasis upon what can be done by the workers to increase production. (ii) Danger of giving insufficient attention to problems of what can be done to increase production by making a more efficient use of other factors of production".[7]

3.3.2 Because of these dangers and other practical limitations, the concept of labour productivity has been criticised by some authors. Davis, pointing out the incompleteness of the concept, wonders whether total output can be completely expressed in labour terms or the efficiency of labour can be fully measured by the ratio of the physical output to

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[7] I.L.O., Higher Productivity in Manufacturing Industries, Studies and Reports, New Series No.38, ∠ O.P. Beri, G.C., Op. cit., 1954, p.95.

∠1954,

labour effort put forth including the sum of the actual and embodied labour.[8] According to Kenderick, J.W., the chief objection to output per manhour as an indicator of productivity is that it reflects interfactor substitution as well as changes in overall productive efficiency. Only by relating output to all tangible inputs can it be determined whether there has been a net savings in real costs per unit output or conversely a gain in productivity.[9]

3.3.3 Similarly Fabricant postulates the view that when other resources are used in significant volume and change occurs in the volume of such resources used, a measure of productivity based on a single resource might tell us little or nothing of the change in efficiency with which the resource was being utilised. It might not even point in the right direction.[10] Even late Rostas, a pioneer in the field of international comparisons of labour productivity had to recognise the limitations of productivity measurements. He

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8 Davis, H.S., The Industrial Study of Economic Progress, University of Pennsylvania Press, Philadelphia, 1947, Q.F. Beri, G.C., op. cit., p.96.

9 Kenderick, John, W., Productivity Trends, Capital and Labour, Occasional Papers 53, NBER, New York, 1956. Q.F. Beri, G.C., ibid.

10 Fabricant Solomon, Basic Facts on Productivity Change, Occasional papers 63, NBER, New York, 1959.

felt that in industries where this proportion (i.e. share of labour in total costs) is small and the importance of other factors in total costs is high, the measurement of labour productivity only may not lead us very far without the measurement of other factors.[11]

3.3.4 These views seem to be more relevant to underdeveloped countries where labour is cheap and is abundantly available. The utility of any concept of productivity in the underdeveloped countries should be judged in the light of the importance of one or more inputs in the economy. Tilles thinks that the choice of only one concept of the general term 'productivity' is unfortunate since it seems to imply that an increase in productivity necessarily means an increase in production (with possibly concomitant distribution problems) or less labour (with possibly serious technological unemployment). Productivity is by no means limited to this interpretation alone despite the fact that output per manhour is a convenient index when making economic comparisons.[12] The I.L.O. Productivity Mission to India pointed out that the usual method of measuring productivity in terms

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11 Rostas, L., op. cit., "Alternative Productivity Concepts", Productivity Measurement, Vol.I, European Productivity Agency, O.E.E.C.D., 1955.

12 Tilles, S., "Productivity in Undeveloped countries", International Labour Review, I.L.O., December, 1955.

of labour productivity, although the most convenient for various reasons, tends to concentrate attention on the productivity of the worker and to obscure the often greater importance of the productivity of capital equipment. Even in more advanced countries the growth of automation and the very heavy cost of new plant in many industries are rendering the full utilisation of capital equipment sometimes more important than the fullest utilisation of human ones. It may pay to have a few men to spare if by doing so, an expensive piece of plant can be more fully utilised. This is even more true in countries where unskilled labour is plentiful and cheap.[13]

3.3.5 "Thus it follows that the concept of labour productivity unaccompanied by other related measurements is not appropriate in underdeveloped countries".[14] Measurements of total productivity may appear to be more appropriate.

3.4 Productivity and Wages

3.4.1 Rising productivity leads in the long run to rising wages. This stems from the basic claim that the fruits of

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13 I.L.O., "Productivity Missions to Underdeveloped countries", International Labour Review, Vol.LXXVI, No.1, July, 1957.

14 Beri, G.C., op. cit., p.99.

productivity increase should be equitably distributed among the labour, management and the consumer who buys the products. Despite the widespread controversy, to which the marginal productivity theory has been subjected to, it has to be conceded that there is some parity between the level of wages and the marginal product of labour. However, the question arises whether it is marginal product which determines wages. Wages today are not so much the result of competition between employers as of collective agreements between employers and trade unions. It follows as a general consequence that the employers adjust to this wage level the quantity of labour they can profitably employ. The marginal productivity may then be a guide to the level of employment, since in this situation it is not marginal product that determines wages, rather it is wages which determine marginal productivity. This sequence of reasoning emphasises the increasing bargaining power in the hands of the trade union. Be it as it is, there exists a certain correspondence between wages and productivity.

This does not mean that productivity is the only factor that determines wages. The problem of wage increases hinges on three strategic points viz. productivity, employment and price level.

3.4.2 Employment and Wages

3.4.2.1 A wage increase is guaranteed under certain specific conditions. If there is full employment the supply-demand position by itself exerts forces which gradually push up wages. If the profit outlook on the horizon is bright, then a general strike would harm the profits and so employers will not resist wage increase demands. If labour becomes scarce also, wages rise automatically.

3.4.2.2 If wages alone rise, while productivity remains static, the equilibrium will be disturbed. The labour cost of an enterprise will increase, thereby increasing the cost of production. In order to avoid a decrease in its profits, the enterprise will inevitably raise the price of its products. If this generates a chain reaction in the economy, a general advance in commodity prices will emerge. When wages rise the purchasing power or real income of a wage earner will not rise if commodity prices also rise to the same extent. The inflationary process snowballs gaining in tempo and magnitude.

3.4.2.3 If a country pushes ahead with industrial programmes such that productivity in industry rises faster than in agriculture, industrial wages will also increase through the wage productivity link. This creates additional demand for agricultural products. If supply tends to lag behind demand, agricultural prices will most certainly rise and push up the consumer price level. This automatically cuts off a portion of the industrial wage increase and reduces the real wage content. Thus, if money wage rates in any one sector or industry are raised faster than the increase in overall average productivity in the economy and the monetary authorities supply the money needed to pay the increased wages without unemployment, prices will rise enough to keep wage rates from rising faster than the overall profitability.

3.4.2.4 Fritz Machlup argues that a sensible allocation of resources requires that the same factors of production are offered at the same price to all industries. It causes misallocations if industries in which technology has improved are forced to pay higher prices for the same type of labour that gets lower pay in industries where technology has not changed. Imitative wage increases lead to a brisk inflation. Any equalising wage increases would be of the cost push type and if unemployment is prevented, would lead to consumer price increases which take way from the originally privileged group some of the real gains they were first awarded.[15]

3.4.2.5 The only way of avoiding inflation according to Machlup is through price reductions in industries where

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15 Machlup Fritz, "Another view of cost push and Demand pull Inflation", Review of Economics and Statistics, Harvard University, Vol.42, May, 1960.

productivity has improved. Only if the consumers get a chance to buy more products through lower prices will the released workers get a chance to find jobs considering the absence of demand inflation. This does not however mean that the entire increase in productivity must be passed on to the consumers in the form of reduced prices. Technological unemployment will neither be perpetuated nor require a price inflationary demand expansion for its cure if wage rates are raised by the national average increase in productivity. This can permit price reductions in industries where production has increased.

3.4.2.6 The problem of industrial wage rate is further complicated so far as India is concerned. These wage rates are inevitably linked directly to the cost of living which corresponds to the consumer price index. This is heavily weighted with food articles. Hence industrial wages rise in line with the price increase of foodstuffs. Thus the net effect of compensatory wage increases not related to productivity must be inflationary. This would lead to further consumer price increases which, in turn, would lead to compensatory wage increases and so on getting in motion a chain reaction. Thus because labour productivity is relatively high in industry industrial wages tend to move faster than average productivity in the economy as a whole. This by itself has an inflationary effect on prices unless money supply is restrained. Moreover, the quasi-automatic link between money wage level and consumer price level also leads to cost-push inflation cutting into real wages.

3.4.2.7 The rapid and remarkable recovery of post-war Germany and the high growth of the Japanese economy also provide valuable lessons for us. A close restraint on wages accepted by the German labour and the provision in physical terms of extremely scarce and essential commodities by their employees were the main reasons for the recovery of West Germany. The high growth of Japanese economy was maintained under two conditions: First, wages in relation to productivity were low compared with the highly advanced countries. However, they were not so low as to prevent expansion of the local market as often seen in developing countries. Secondly the demand for employment was such that wages were lower than productivity but not so much lower as to reduce consumption. The wages did not drop because the negotiating power of trade unions in large business played a crucial role. Without such power and without the public mood for supporting it, the rise in wages in relation to productivity would have been more retarded.

3.4.3 Productivity and Prices

3.4.3.1 The central purpose of all economic activity is to increase the per capita real output. Monetary and fiscal policies are formulated in such a way that rising money incomes do not vitiate price stability. This inevitably necessitates an increase in labour productivity, but the increase should occur in such a way that wage increase does not stimulate a rise in prices.

3.4.3.2 Price is primarily a function of three factors namely capital intensity, labour productivity and wages. Labour productivity is generally linked to capital intensity since the productivity of labour is assumed to increase with an increase in the amount of capital invested per worker. But this need not always be so. Productivity can be increased within reasonable limits without increasing capital intensity. Productivity is not a sole function of capital intensity. There are a number of other equally important factors such as improving the organisational set-up, better training of the management etc. If the ratio of capital intensity to labour productivity exceeds a certain limit, prices are liable to rise. Excessive capital necessarily implies unutilised capacity and wastage of capital. This can lead to a rise in prices. A rise in prices also occurs if wage rates are pushed ahead of productivity.

3.4.3.3 Prices are thus decidedly influenced by both capital intensity and labour productivity despite the fact that capital intensity should be governed by labour productivity and is not an independent factor. This relationship has been expressed as

$$\text{Prices} \propto \frac{\text{capital intensity}}{\text{labour productivity}}$$

Prices are apt to rise directly in proportion to capital intensity and inversely in proportion to labour productivity or in other words.

$$\Delta p \propto \Delta c - \Delta l$$

3.4.3.4 Productivity should be stepped up such that it rises in line with the increase in capital intensity i.e. with as little capital expenditure as possible. If capital investment increases without a corresponding increase in labour productivity, such an increase is bound to be inflationary. As a rule wage increases must not absorb the entire increase in output. And if the additional investment were so large that capital per worker had increased at a percentage rate greater than that of output per worker, wage rates cannot even increase by as much as output per worker and still allow price stability with full employment.

3.4.3.5 Excessive capital investment pushes up aggregate demand and gives rise to a demand-pull type of inflation. The high elasticity of demand for foodgrains inevitably increases foodgrain prices in the absence of adequate supplies of foodgrains. This exerts an upward pressure on wages through the cost of living index. Unit wage costs therefore increase and prices are pushed up further. When wages increase more than in proportion to labour productivity, the unit wage costs are pushed up giving rise to a cost-push type of inflation.

3.4.3.6 The net effect of the imbalance between capital intensity and labour productivity as also between labour productivity and wages is radiated through the entire economy and is not confined to the industrial sector. As Simon Kuznets put it:

> "at the danger of stressing the obvious, one may claim that an agricultural revolution, that is a marked rise in the productivity per worker in agriculture is a pre-condition for the industrial revolution for any sizeable region in the world; more so in which the product per worker in the agricultural sector is so low as to tie the land at low income levels, a large part of the population and leave little margin for the non-agricultural sector to grow upon".[16]

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16 Kuznets, Simon, Six Lectures on Economic Growth, John Hopkins University, /Baltimore, 1959, p.59.

This argument has been further elaborated in his book, Economic Growth and Structure.[17] Hence it is vitally important to treat a growing economy as an integrated whole in which changes in one sector react rapidly on the others and the development of which is a combined result of swift inter-sectoral action and reaction.

3.5 Measurement of Labour Productivity

3.5.1 Measurement of labour productivity is a complicated exercise because of the difficulties of segregating the contribution of labour to a given rise in output from that of other equally important factors such as the quality of raw materials, condition of machinery, utilisation of capacity in industry, managerial skill, capital employed per unit of labour, production techniques etc. According to the National Commission on Labour,

> "labour productivity and changes therein are difficult to measure and there are no reliable indices available in this respect. The main difficulty in measuring labour productivity arises owing to the output not being an exclusive product of labour; capital, technology and management all contribute to it along with labour and these seldom remain constant. In consequence increases in per capita output cannot be attributed to

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17 Kuznets Simon, Economic Growth and Structure, Hein Manna, London, 1965, pp.194-236.

labour alone much less to total output. Valuation of the physical products presents another problem. All that we have is information about changes in output per worker at constant prices. These cannot of course be taken as indices of labour productivity".[18]

3.5.2 Methodology

3.5.2.1 The method adopted by N.C.L. for measuring productivity per worker by deflating VAM per worker by the index of wholesale prices for manufacturers has been accepted for a broad analysis of the relative share of workers in it. As between gross value of output and net value added, the latter is to be preferred, as it is a more reliable indicator of the contribution of labour to output. Net value added by manufacture represents that part of the value of the product which is created in the factory. This is computed by deducting from the gross ex-factory value of output the value of inputs, comprising of the cost of materials, fuels etc., amount paid for work done by other concerns, industrial and non-industrial services purchased and depreciation. Thus value added by manufacture represents wages, salaries and profit.

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18 Government of India, Ministry of Labour and Employment and Rehabilitation, Report of the National Commission on Labour, New Delhi, 1969, p.234.

3.5.2.2 Index number of labour productivity can be constructed from the figures of total value added at constant prices divided by total employment and then relating them to the base year.

3.5.2.3 Indices of real wages are worked out on the basis of data on money wages deflated by index numbers of cost of living in order to arrive at the real wage indices.

3.5.2.4 The index number of productive capital and fixed capital per worker can also be worked. Productive capital consists of fixed capital and working capital. Fixed capital consists of factory, land, buildings, plant and machinery and miscellaneous assets such as furniture, fixtures, fittings, railway slidings, automobiles, patents and trade marks etc. Working capital consists of stocks of raw materials, finished and semi finished products, cash in hand and at the bank including fixed deposits and current credits. The value of capital items is taken as in the books of the factory. As such figures of fixed capital are based on depreciated costs and the steep rise in the prices of machinery and equipment for new installations and replacements would account for the sharp increase in the amount of fixed capital. The working capital includes an increase in the valuation of stocks which accounts for a part of the marked increase in the amount of working capital. Even allowing for price changes in machinery and stock which would have inflated the amount of fixed capital and working capital respectively, there has been a considerable increase in the capital intensity of the industry in terms of the quantity of capital employed in real terms.

3.5.2.5 If we represent labour productivity by Q/L, capital labour ratio by K/L and productivity of capital by Q/K then we form the equation

$$Q/L = \frac{K}{L} \times \frac{Q}{K}.$$

Thus output per unit of labour is the product of capital-labour ratio and output-capital ratio. These ratios have been computed for the four different sub-divisions of the industry namely

(i) Fertilisers and Pesticides

(ii) Heavy Inorganic Basic Chemicals and Organic Chemicals

(iii) Drugs and Pharmaceuticals

(iv) Miscellaneous chemical products.

3.6 Empirical Results

3.6.1 Labour Productivity, Capital Intensity and Capital Productivity

3.6.1.1 In the case of fertilisers and pesticides, labour productivity ratio has shown an increase from 4.98 in 1962-63 to 10.25 in 1974-75 as seen in Table 3.1. At the same time capital intensity per worker has also recorded a substantial increase from 29.34 to 63.31 for the same period. This might be indicative of a broad correspondence between increases in labour productivity and increases in the capital-labour ratio. Labour productivity has been seen to increase as capital intensity increases. The increase, nevertheless, is nothing compared to the heavy doses of capital investment. So also in certain years heavy increases in capital intensity has not warranted an increase in labour productivity. K/L ratio increased from 42.37 in 1968-69 to 58.96 in 1969-70 while the V/L ratio showed a decline from 10.48 to 4.46. This was corrected in the following year, when it increased to 9.79, even though capital intensity fell to 42.87. The fact that substantial increases in the capital-labour ratio has not produced proportionate changes in labour productivity may be indicative of certain structural deficiencies in the industrial economy of the State. Under-utilisation of capacity is one important cause for this state of affairs. An intensive study of certain units in the industry had revealed the fact that they were all working much below their rated capacities. Marketing bottlenecks, demand deficiencies, lack of complementary resources and managerial skills have all aggravated the situation. The inevitable result of all this is that the substantial doses of capital investment has not resulted in any corresponding increases in capital productivity. The capital productivity ratio which was 0.17 in 1962 recorded

Table - 3.1

Output Labour Ratio and Capital Labour Ratio and Output Capital Ratio for the Industry Sub-Groups

Year	Fertilisers & Pesticides			Basic Industrial chemicals			Drugs & Pharmaceuticals			Miscellaneous chemical products		
	O/L	K/L	O/K	O/L	K/L	O/K	O/L	K/L	O/K	O/L	K/L	O/K
1962	4.98	29.34	0.17	7.54	22.2	0.33	3.96	3.95	1.01	5.43	2.48	0.57
1963	4.98	23.59	0.21	7.57	17.64	0.43	3.05	4.40	.69	5.93	4.16	0.46
1964	6.87	20.53	0.33	7.57	16.25	0.44	3.01	4.41	.68	7.36	5.77	0.48
1965	3.99	18.23	0.22	4.06	25.15	0.16	-	-	-	6.31	5.74	0.45
1966	-	-	-	6.38	28.05	0.23	-	-	-	5.04	4.79	0.48
1967	-	-	-	5.85	22.08	0.27	-	-	-	9.86	4.18	1.72
1968	10.48	42.37	0.25	7.41	22.21	0.33	-	-	-	7.38	3.49	1.22
1969	4.46	58.96	0.08	9.66	23.45	0.41	-	-	-	6.66	5.72	0.70
1970	9.79	42.87	0.23	17.21	36.26	0.47	-	-	-	6.34	5.10	0.61
1971	6.58	33.5	0.20	9.63	13.39	0.71	-	-	-	10.66	6.21	0.77
1973	13.48	87.36	0.15	8.82	31.57	0.27	4.91	3.78	1.29	-	-	-
1974	10.25	63.31	0.16	10.18	7.07	1.44	4.05	2.64	1.53	-	-	-

Note: O/L Value added per worker.
K/L Fixed capital per worker.
O/K Value added per unit of fixed capital.

the only increase of 0.33 in 1964-65 after which there was no substantial improvement. In fact it declined to 0.16 in 1974-75. Capital productivity index declined to 94.11 in 1974-75 from the base year index 100 of 1962-63. (vide Table-3.

3.6.1.2 In the case of basic industrial chemicals labour productivity increased from 7.54 in 1962-63 to 10.18 in 1974-75. Capital intensity as evidenced by the K/L ratio has increased from 22.20 in 1962-63 to 31.57 in 1973-74. However, it has shown a substantial decline in 1974-75 to 7.07. Capital productivity has not shown much change, but has ranged around the base year ratio 0.33, except in the years 1971-72 when it increased to 0.71 and 1974-75 when it went up as high as 1.44. This means that while the labour productivity index increased from 100 in 1962-63 to 135.01 in 1974-75 the index of productive capital per worker increased to 405.

3.6.1.3 Labour productivity in the drugs and pharmaceuticals industry has not shown much change (3.96 in 1962-63 and 4.05 in 1974-75). Capital intensity ratio increased from 3.95 in 1962-63 to 4.41 in 1964-65, but has declined to 2.64 in 1974-75. Capital productivity though declining at first showed a slight increase from 1.01 in 1962-63 to 1.53 in 1974-75.

3.7.1.4 In the case of the fourth broad group of miscellaneous/~~group~~ chemical products labour productivity ratio showed an increase from

5.43 in 1962-63 to 10.66 in 1971-72. Capital intensity ratio K/L has also shown an increase from 2.48 to 6.21 for the same period. Capital productivity, however, has shown a decline from 2.19 to 1.72. While the labour productivity index increased from 100 in 1962-63 to 196.32 in 1971-72 the capital productivity index increased only to 135.09.

3.6.1.5 An overview of the four industry sub-groups shows that heavy doses of capital investment has not resulted in any proportionate increases in capital and labour productivity. In a State in which capital resources are scarce and not freely forthcoming this might have detrimental effects on the economy. Unless stringent measures are adopted to increase capacity utilisation and improve managerial and organisational skills, the heavy doses of investment in the chemical industry will not be able to justify itself in terms of increases in labour and capital productivity.

3.6.2 <u>Productivity and Wages</u>

3.6.2.1 Table 3.3 shows a comparison between wage rates and labour productivity. The labour productivity in the four different sub-groups of the chemical industry has been seen to be consistently higher than the wage rates. The higher labour productivity it has been hypothesised may be due to the highly capital-intensive nature of the industry. In the chemical industry, as a general rule, wage rates and labour

Table - 3 - 2

Indices of Labour Productivity, Real Wages and Capital Productivity (1962 - 1974)

…ers & Pesticides			Basic Industrial Chemicals				Drugs & Pharmaceuticals				Miscellaneous Chemicals			
!	3	4	1	2	3	4	1	2	3	4	1	2	3	4
0	100	100	100	100	100	100	100	100	100	100	100	100	100	100
55	118.18	123.5	100.39	78.97	115	130.30	77	105.91	73	68.31	109.2	95.09	80.70	65.44
35	181.81	194.11	95.09	120.88	120	133.33	76	101.37	91.30	67.33	135.54	104.51	84.21	57.99
93	145.45	129.41	53.84	65.78	50	48.48	–	–	–	–	116.21	52.29	78.95	49.77
	–	–	84.61	144.77	100	69.69	–	–	–	–	92.81	51.87	84.21	47.95
	–	–	77.58	145.20	90	81.81	–	–	–	–	181.58	53.77	301.75	107.30
,26	181.81	147.08	98.27	161.06	120	100.00	–	–	–	–	135.91	56.71	214.04	96.34
,44	63.64	47.05	128.11	885.30	115	124.24	–	–	–	–	122.65	161.23	122.81	52.96
,41	127.27	135.29	228.25	1072.06	130	142.42	–	–	–	–	116.76	218.78	107.02	56.62
,44	127.27	117.64	127.72	810.53	235	215.15	–	–	–	–	196.32	158.84	135.09	78.54
,21	136.36	88.23	116.98	258.53	110	81.81	123.98	469.65	152	127.72	–	–	–	–
,18	127.27	94.11	135.01	283.02	405	436.36	102.27	541.97	217.39	151.48	–	–	–	–

, O/L Index
, Real Wage Index
, Productive Capital/Worker Index
, Fixed Capital/Worker Index

Table - 3.3

Labour Productivity and Wage Rate Comparison

Year	Fertilisers & Pesticides		Basic Industrial chemicals		Drugs&Pharmaceuticals		Miscellaneous chemicals		All Manufacturing	
	W	LP/W	W	LP/W	W	LP/W	W	LP/W	W	LP/W
1962	3.88	1.28	3.82	1.97	1.21	3.27	2.12	2.56	.61	2.328
1963	3.31	1.50	5.80	1.30	1.41	2.16	3.08	1.92	.61	2.528
1964	2.58	2.66	3.29	2.18	1.40	2.15	3.48	2.11	.54	2.852
1965	1.70	2.34	1.62	2.51	-	-	1.39	4.53	.55	2.836
1966	-	-	2.59	2.47	-	-	1.33	3.78	.56	2.893
1967	-	-	3.22	1.82	-	-	1.08	9.12	.56	2.982
1968	4.50	0.89	3.28	2.26	-	-	0.97	7.61	.58	2.966
1969	2.36	4.44	15.90	.61	-	-	2.53	2.63	-	-
1970	3.74	2.61	9.69	1.78	-	-	2.57	2.46	-	-
1971	4.34	1.52	3.47	2.28	-	-	1.92	5.55	-	-
1973	5.03	2.68	3.85	2.29	1.43	3.43	-	-	-	-
1974	3.65	2.81	3.68	2.77	1.74	2.32	-	-	-	-

productivity seemed to show some correspondence, even though there were individual fluctuations. Even though wage rates are lower than labour productivity, the wage rates in the four industry groups are much higher than in the case of all manufacturing.

3.6.2.2 In the case of fertilisers and pesticides, the labour productivity index has been above the real wage index as seen in Table 3.2. In certain years even though the labour productivity index increased, the real wage index showed a decline. For example in the year 1964 while labour productivity index increased to 137, the real wage index fell to 79.35. In 1968 also the labour productivity index was as high as 210.44 while real wage index was only 41.26. Only in the later years the real wage index has moved nearer to the labour productivity index.

3.6.2.3 In the case of the basic industrial chemicals, on the contrary, the real wage index has been persistently higher than the labour productivity. While the labour productivity index increased to 135.01 in 1974-75 from a base level of 1962-63, the real wage index increased to 283.02 during the same period.

3.6.2.4 In the case of drugs and pharmaceuticals also the real wage index appeared higher than the labour productivity index. While the labour productivity index showed only a slight change from the base level of 1962-63 to 123.9 in 1973-74 and to 102.27 in 1974-75 the real wage index increased to 469.65 in 1973-74 and to 549.7 in 1974-75.

3.6.2.5 On the contrary, in the case of miscellaneous chemicals the labour productivity index showed higher increase compared to the real wage increase. Labour productivity index increased to 196.32 in 1974, while the real wage index increased to 158.84.

These studies are limited by the fact that they provide us only an overview of the average productivity of the two main factors of production -- labour and capital. A more specific study is attempted in the next chapter with the help of the production function estimates.

CHAPTER - IV

PRODUCTION FUNCTION ESTIMATES

4.0 A production function shows the relationship between the maximum output obtainable from a set of given inputs and the relationship between the inputs themselves in the existing state of technological knowledge. The efficiency of technology, degree of economics of scale, degree of capital intensity of a technology and the ease with which factors can be substituted for each other can all be measured by estimating the parameters of the underlying production function. Estimates of the parameters of the production function provide valuable insights into the technology of firms and industries. "The central questions relating to technology are (1) whether production processes display increasing constant or decreasing returns to scale, (2) how technological progress affects the parameters of the production processes and (3) at what rate technological progress has occurred".[1] Estimation and interpretation of the estimates are complicated by the fact that observations on output, inputs and costs reflect not only the state of technology, but also the economic decisions made by producers and

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[1] Walters, A.A., "Production and Cost Analysis", in D.L. Sills (ed.) International Encyclopaedia of the Social Sciences, Vol.12, Macmillan and The Free Press Limited, New York, 1968, p.519.

factor suppliers. Assumptions regarding economic behaviour and competition in input-output markets often play a crucial role in the statistical analysis. Nevertheless, it may not always be easy to determine whether the results reveal the nature of technology. They may, on the other hand, serve to test the validity of the economic assumptions.

4.1 Partial Productivity Indices

The simplest indicators of productivity are the so-called partial productivity measures derived by dividing total output by the relevant input. There can be as many partial productivity ratios as the inputs. Labour productivity index is the most commonly used among them. Though the labour productivity shows the efficiency with which labour is being utilised, it cannot be interpreted as having been caused by labour alone. It is the result of a whole network of interacting economic relationships. These interactions can be estimated using some of the basic costs and productivity ratios with a view to isolate the causes behind the productivity changes. However, a statistical association between any two variables does not, by itself, represent any economic relationship. It acquires causal significance only when there are theoretical reasons to believe that it reflects some normal economic phenomenon.

4.2 Indices of Total Productivity

4.2.1 Apart from the partial productivity measures, other productivity indices based on specific production functions have been derived. These indices enable us to study the year-to-year variations in productivity. They are total productivity measures in the sense that they take account of both the capital and the labour. They are presumed to reflect the residual or technical progress which cannot be attributed to either of the two factors under the given assumptions of the model. Compared to the partial productivity indices these methods are more exact in the sense that they provide a measure of technical change. The ruling technology sets the conditions for the optimum use of the resources i.e. it sets the limits on how much can be produced with a given amount of input. Given the levels of technology there are various techniques of producing goods and services. "Technical 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".[2]

4.2.2 The total productivity index measures the output per unit of labour and capital combined. This can be calculated arithmetically and geometrically.

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[2] Mehta, S.S., Productivity, Production Function and Technical Change, Concept Publishing Co., New Delhi, 1980, p.12.

4.3 A Review of the Different Productivity Indices

4.3.1 Kenderick's arithmetical measure is based on a linear production function of the form $V = aL + bK$, where V is the output, L and K denote labour & capital inputs and a and b are the coefficients of labour and capital. Measured arithmetically total factor productivity is given by

$$P = \frac{V}{a_o L + b_o K_o}$$

where V is an index of output, K and L the index of capital and labour respectively and a_o and b_o the base year weights are generally the prices of labour and capital in the base year. The weighted inputs of labour and capital in each year are added to get the total input. Then an index of output as also of total input is prepared. The ratio of output index to that of total input will yield the total factor productivity index.[3] This represents the ratio between the actual output in constant prices and the output which the particular combination of capital and labour would have produced, working at their base year efficiency. Unlike the Solow method which

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[3] Kenderick, J.W., (1) "Productivity trends in the United States", NBER, Princeton University Press, 1961. (2) "Post-war Productivity Trends in the United States", NBER, 1970. (3) "Output Input and Productivity Measurement", Studies in Income and Wealth, NBER, Vol.XXV, Princeton University Press, 1961.

uses a changing system of weights, the Kenderick measure assumes a constant set of weights.

4.3.2 The Solow method is based on the generalised form of the production function i.e. $V = f(K, L, t)$. V, K and L measure output, capital and labour in physical terms and t is the time variable serving as a proxy for technical change. This is assumed to comprehend any kind of shift in the production function. The assumptions of the model are:

(i) The production function is homogenous of degree one in K and L.

(ii) The factors are rewarded according to their marginal products and

(iii) There is neutral technical progress implying shifts in the production function leaving the marginal rate of substitution between the factors unchanged. Under assumption (iii) the production function takes the form $V = A(t) K, L$ where $A(t)$ measures the cumulative effects of shifts overtime.

Differentiating the function with respect to time we have

$$\frac{dV}{dt} = A\left(\frac{\partial f}{\partial L} \cdot \frac{dL}{dt} + \frac{\partial f}{\partial K} \cdot \frac{dK}{dt}\right) + f(K,L) \cdot \frac{dA}{dt}$$

Dividing both sides by $V = A(t)\, f\,(K, L)$

we get $$\frac{dV/dt}{V} = A\left(\frac{\partial f}{\partial L} \cdot \frac{L}{V}\right)\left(\frac{dL}{dt} \cdot \frac{1}{L}\right) + A\left(\frac{\partial f}{\partial K} \cdot \frac{K}{V}\right)\left(\frac{dK}{dt} \cdot \frac{1}{K}\right) + \frac{dA/dt}{A}$$

Now $\left(\frac{\partial f}{\partial L} \cdot \frac{L}{V}\right) = w_L$ and $\left(\frac{\partial f}{\partial K} \cdot \frac{K}{V}\right) = w_K$

i.e. the relative shares of L and K in output.

By substitution we get

$$\frac{dV/dt}{V} = w_L \left(\frac{dL}{dt} \cdot \frac{1}{L}\right) + w_K \left(\frac{dK}{dt} \cdot \frac{1}{K}\right) + \frac{dA/dt}{A}$$

$$\text{or } \dot{V} = w_L \cdot \dot{L} + w_K \cdot \dot{K} + \dot{A}$$

From this we can obtain the time series for A given the data on V, L and K.

4.3.3 Solow's geometric measure is based on the production function of the form $\frac{V}{L} = A(t) \left(\frac{K}{L}\right)^b$

where V/L is the output per person, K/L is the capital per person and A and b are constants. Expressing this relation in incremental form:

$$\frac{d(V/L)}{V/L} = \frac{dA(t)}{A(t)} + b\,\frac{d(K/L)}{(K/L)}$$

or $\frac{dA(t)}{A(t)} = \frac{d(V/L)}{(V/L)} - b\frac{d(K/L)}{(K/L)}$

$\frac{d(V/L)}{V/L}$ is the rate of change of output and $\frac{d(K/L)}{K/L}$ is the rate of change of capital per person. b is capital's share of output. Therefore, the rate of change of total factor productivity is the difference between the rate of change of output and the rate of change of capital per person multiplied by capital's share of output. The basic procedure is to estimate the contributions made to the growth in output by the increases in the inputs of labour and capital over a period by multiplying the observed increases in inputs by the observed factor prices and deducting the result from the overall growth in output. This residual is attributed to technical progress.

4.4 The Cobb Douglas Production Function

4.4.1 The Cobb-Douglas production function takes the form $V = A(t)\,L^{\alpha}\,K^{\beta}$ where V, L and K represent output capital and labour variables, A, α & β are the constants to be determined empirically. The marginal products of labour and capital can be found by differentiating the function partially with reference to labour and capital.

The marginal product of labour = $\frac{\partial Y}{\partial L} = A\,\alpha L^{\alpha-1} K^{\beta}$

$$= \alpha \frac{Y}{L}$$

The marginal product of capital = $\frac{\partial Y}{\partial K} = A\,\beta\, K^{\beta-1} L^{\alpha}$

$$= \beta \frac{Y}{K}$$

α and β are equal to the partial elasticity output with respect to labour and capital

$$\alpha = \frac{L}{Y} \frac{\partial Y}{\partial L}$$

$$\beta = \frac{K}{Y} \frac{\partial Y}{\partial K}$$

The sum of the two coefficients α and β taken together measure the total percentage change in output for a given percentage change in labour and capital. The Cobb-Douglas production function is homogenous of degree one with constant returns to scale.

In the equation 'A' is the efficiency parameter. For every input combination, the greater is 'A', the greater the level of output. Since $\frac{\partial Y}{\partial A} = \frac{Y}{A}$, a proportional change in 'A' produces a proportionate change in output <u>ceteris paribus</u>.

4.4.2 The returns to scale is seen to change according to the changes in the scale of operations as well as in technology. However, if the variations in the degree of returns to scale are due to technological change, only then the sum of elasticities will change, but the ratio of elasticities will remain unaltered.[4] The changes in the capital intensity of a technology will lead to a change in 'α' relative to 'β'. In the Cobb-Douglas production function the elasticity of substitution is unity and hence unchanging. Hence changes in the elasticity of substitution cannot be represented in the Cobb-Douglas production function.

4.4.3 Despite this limitation, the Cobb-Douglas production function has been used to find proximate causes of the sources of output growth. Output growth may be due to increases in the labour force, capital stock and technical change. For measuring technical change through the Cobb-Douglas production function, an exponential time trend has been incorporated and the function can be expressed as

$$Y = A\, L^{\alpha}\, K^{\beta}\, e^{rt}$$

where the exponential e^{rt} is introduced to take care of technical progress.

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[4] Brown, op. cit., p.40.

4.4.4 Another limitation of the Cobb-Douglas production function is that the a priori assumption of unitary elasticity of substitution between labour and capital may not stand the test of empirical evidence. An estimate of the elasticity of substitution σ is needed to decide about the form of the production function to be used in the empirical analysis. A wrong assumption about the elasticity parameter can lead to specification errors resulting in biased estimates of the production function.

4.4.5 Moreover, the elasticity of substitution is a crucial economic parameter with important policy implications in the problem of labour absorption in the productive process in the labour intensive economies. An industry which has a relatively high elasticity of substitution will usually have a high output rate in comparison to an industry which has a low elasticity of substitution.[5] High elasticity of substitution is also associated with high employment elasticity of output. This is especially important in a country like India where higher employment and higher output are important national goals. The conflict between high employment and high output arises from low substitutability in the production structure.[6] Because of low elasticity of substitution the

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5 Brown, op. cit., p.24.

6 Diwan & Gujarati, op. cit., p.52.

production structure will be inflexible and hence such economies will be unable to exploit their dynamic comparitive advantages.[7]

4.5 The Constant Elasticity of Substitution Production FUNCTION (CES Production Function)

4.5.1 The main advantage of the CES function over the Cobb-Douglas production function lies in that it allows for a non-unitary elasticity of production. The production function takes the form

$$V = \gamma (\delta K^{-\rho} + (1-\delta) L^{-\rho})^{-1/\rho}$$

where, V, K and L refer to output, capital stock and labour inputs and γ, δ + ρ are the efficiency distribution and substitution parameters respectively.

$$= \frac{1}{\sigma} - 1 \quad \text{or} \quad \sigma = \frac{1}{1+\rho} \quad = \text{ the elasticity of substitution}$$

As per this function, the elasticity of substitution can take any constant value from zero to infinity. It allows the value of σ to be estimated rather than assuming it. The Cobb-Douglas function where $\sigma = 1$ can be taken as the special case of the CES function.

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[7] Behrman, J.R., op. cit., p.311.

The ratio of marginal products can be estimated as:

$$Y_t = \frac{\partial V/\partial L}{\partial V/\partial K} = \left(\frac{1-\delta}{\delta}\right)\left(\frac{K}{L}\right)^{\rho+1} = \left(\frac{1-\delta}{\delta}\right)\left(\frac{K}{L}\right)^{1/\sigma}$$

Under the assumption of perfect competition the ratio of marginal products will be equal to the factor price ratio w/r. Hence taking log transformation of the data we get

$$\log (w/r) = \log \left(\frac{1-\delta}{\delta}\right) + \frac{1}{\sigma} \log (K/L)$$

$$\text{i.e. } \log \left(\frac{1-\delta}{\delta}\right) = \log (w/r) - \frac{1}{\sigma} \log (K/L)$$

With data on w, r, K & L it is possible to estimate $\delta = \hat{\delta}$ and $\rho = \hat{\rho}$ Substitution of these in the production function gives the series for r_t.

$$\text{Thus } V_t = Y_t \left(\hat{\delta} \; K^{-\rho} + (1-\delta) \; L^{-\rho}\right)^{-1/\rho}$$

The time pattern of Y_t will indicate the neutral shifts in the production function.

4.5.2 Technical progress has been introduced into the ACMS function in three ways using the Hicks, Harrod and Solow type of neutral technical progress.[8] Hicks' neutral

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[8] Heathfield, D.F., Production Functions, Macmillan, London, 1971 pp 64-67.

technical change can be introduced by putting $A = A_0 e^{\lambda t}$

The function becomes

$$V = A_0 e^{\lambda t} [\delta K^{-\rho} + (1-\delta)L^{-\rho}]^{-1/\rho}$$

In the Hicksian neutral case the efficiency of both factors changes equally.

In the Harrod neutral case only labour is gaining in efficiency and the function takes the form

$$V = A [\delta K^{-\rho} + (1-\delta)(Le^{\lambda t})^{-\rho}]^{-1/\rho}$$

In the Solow type of neutrality capital gains in efficiency and may be expressed as:

$$V = A [\delta(e^{\lambda t} K)^{-\rho} + (1-\delta)L^{-\rho}]^{-1/\rho}$$

4.3.3 The main defect of these formulations is that they only test whether there is any neutral technical change. Hence the CES function has been modified to study the rate of factor augmentation and the extent to which technical progress is biased towards factor saving.[9]

$$V = (E_L L)^{-\rho} + (E_K K)^{-\rho}]^{-1/\rho}$$

[9] David, P.A. and Vande Kludert, "Biased Efficiency Growth and Capital Labour Substitution in the United States 1899-1960", American Economic Review, June, 1965. pp 357-423

where $E_L L$ and $E_k K$ are labour and capital inputs respectively in efficiency units, L and K being measured unconventionally.

4.5.4 All these formulations of the CES production function assume constant returns to scale. In order to give up the assumption of constant returns to scale Brown and de Cani introduce one more parameter 'm' which can characterise any degree of returns to scale.[10]

$$V = [A \delta K^{-\rho} + (1-\delta) L^{-\rho}]^{-m/\rho}$$

The parameter 'm' will be greater than, equal to or less than one for increasing, constant and decreasing returns to scale respectively.

4.5.6 As regards the assumption of neutral technical progress in the short period concerned there is little hope for getting an unambiguous measure of non-neutral technical progress on a clear conceptual basis. Usually the non-neutral character of technology gets deeply entangled with factor substitution. Similar difficulties arise in disentangling the returns to scale from technical progress. The assumption of

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10 Brown, M. & de Cani, "Technological Change and Distribution of Income", <u>International Economic Review</u>, Vol.4, No.3, 1963, pp-289-309.

perfect competition in the labour and capital market is also hard to defend. It is assumed that both labour and capital are being paid according to their marginal products which is an unrealistic assumption knowing the known rigidities and imperfections of the labour and capital markets in under-developed countries. Moreover, the concept of the rate of return on capital is also not very accurate. Another serious defect is the lack of a reliable source of capital utilisation.

4.5.7 Kmenta uses a least square estimate for a linear approximation of the CES Production Function.[11] Bodkin and Klein suggest a non-linear maximum likelihood estimation procedure.[12] The Baynesian estimation technique has also been used to generate directly the estimation of the C.E.S. production function. The more common approach to the estimation of the C.E.S. production function is indirect. First the substitution and distribution parameters (ρ and δ) are estimated through the ratio of the marginal productivity relations and then using these two estimates ρ and δ, the remaining parameters A + m are estimated.

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11 Kmenta, J., "On the estimation of the C.E.S. Production Function", International Economic Review, June, 1967.

12 Bodkin, R. & Klein, L., "Non-linear estimation of Aggregate Production Functions", Review of Economics and Statistics, February, 1967, p.28.

4.5.8 Salter also estimates technological change in terms of prices and costs.[13] According to this method, changes in output per head in each industry are correlated with changes in other economic variables such as prices, wages, costs, output and employment between two different points of time. Analysing prices, costs and output for British and American industries, Salter has concluded that the changes in output per person and earnings per person are not correlated. The output per person, however, is found to be negatively correlated with unit labour cost and unit material costs. He has also observed that industries with rapidly increasing output will usually also have high rates of increase in output per head. From this relationship between rate of growth of product and rate of growth of productivity increasing returns have been inferred.[14] Hence he concludes that differences in the labour productivity growth rate between industries are due to factor substitution, unequal rates of neutral technical advance and economics of scale.

4.6 Elasticity of Substitution

4.6.1 The elasticity of substitution is the ease with which factors of production can be substituted for each other.

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[13] Salter, W.E.C., Productivity and Technical Change, Cambridge University Press, Massachussets, 1969.

[14] Hahn, F.H. & Mathews, R.C.O., "The Theory of Economic Growth - a Survey", Economic Journal, 1964.

This concept was developed and brought into the limelight by J.R. Hicks.[15] The elasticity of substitution is the ratio of percentage change in the ratio of inputs to the percentage change in the marginal rate of technical substitution when the inputs are changed in such a way as to keep output constant. Under the neo-classical marginal productivity theory, the marginal product of labour and capital are equal to the wage rate and per unit rental of capital respectively. Hence the elasticity of substitution can also be defined as a proportional change in the relative factor inputs to a proportional change in the factor-price ratio.

4.6.2 If the elasticity of substitution is high, it is possible to increase output by just increasing the factor because diminishing returns sets in less rapidly. A high elasticity of substitution is labour-saving when capital is growing relatively rapidly and capital saving when labour is the fast growing factor. " σ" as estimate of the elasticity of substitution acquires importance in the context of the problem of labour absorption in the productive process in the labour economies. An estimate of the elasticity of substitution σ is also needed before deciding about the form of the production function to be used in the empirical analysis.

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[15] Hicks, J.R., The Theory of Wages, Macmillan, London, 1963.

4.6.3 Most cross sectional estimates of the elasticity of substitution between capital and labour are based on the logarithmic regression of value added per unit of labour on the wage rate. Logarithmic regressions of value added per unit of capital on the rate of return on capital have also been used in some studies to estimate the elasticity of substitution. A few estimates of the elasticity of substitution are based on logarithmic regression of capital-labour ratio on wage rental ratio. This uses the marginal rate of substitution of labour for capital relation derived from the C.E.S. function. All these studies assume constant returns to scale.

4.6.4 <u>Estimating the Elasticity of Substitution</u>

Assuming a C.E.S. production function of the form

$$V = \gamma \left(\delta K^{-\rho} + (1-\delta) L^{-\rho}\right)^{-1/\rho}$$

γ, δ and ρ are the efficiency, distribution and substitution parameters. L and K represent measures of labour and capital inputs. Differentiating the function partially with respect to labour and capital we can find the marginal productivities of labour and capital respectively:

$$\frac{\partial V}{\partial K} = \frac{\delta}{\gamma^{\rho}} \left(\frac{V}{K}\right)^{1/\sigma}$$

$$\frac{\partial V}{\partial L} = \left(\frac{1-\delta}{\gamma^{\rho}}\right)\left(\frac{V}{L}\right)^{1/\sigma}, \text{ where } \sigma = \frac{1}{1+\rho}$$

In a perfectively competitive market, the marginal product of capital and labour will be equal to the rate of return to capital (r) and wage rate (w) respectively, i.e.

$$\frac{\delta}{\gamma^{\rho}} \left(\frac{V}{K} \right)^{1/\sigma} = r \, , \quad \frac{(1-\delta)}{\gamma^{\rho}} \left(\frac{V}{L}\right)^{1/\sigma} = w$$

The marginal rate of substitution of labour for capital is given by the ratio of the marginal productivities

$$MRTS = \frac{dK}{dL} = \frac{\partial V/\partial L}{\partial V/\partial K} = \frac{(1-\delta)}{\delta} \left(\frac{K}{L}\right)^{1/\sigma} = \frac{w}{r}$$

4.6.5 Thus the C.E.S. production function can yield the following estimable relations under the assumptions that the marginal products of capital and labour are equated to the wage rate and return to capital respectively and the marginal rate of technical substitution is equated to the wage rental ratio.

$$\text{Log } V/L = \sigma \log \frac{\gamma^{\rho}}{(1-\delta)} + \sigma \log w$$

$$\text{Log } V/K = \sigma \log \frac{\gamma^{\rho}}{\delta} + \sigma \log r$$

$$\text{Log } K/L = \sigma \log \frac{\delta}{(1-\delta)} + \sigma \log \frac{w}{r}$$

These familiar SMAC relations can be used to estimate σ . Separate estimates of γ and δ cannot, however, be achieved with the help of this relation.

If a constant rate of neutral technical progress (λ) is assumed implying $\gamma_t = \gamma_0 e^{\lambda t}$, the production function takes the form

$$V = \gamma_0 e^{\lambda t}(\delta K^{-\rho} + (1-\delta) L^{-\rho})^{-1/\rho}$$

$$\log V/L = [(1-\sigma) \log \gamma_0 - \sigma \log(1-\delta)] + \sigma \log w + \lambda(1-\sigma)t$$

Thus with data on V/L and w we can get estimates of both σ and λ without using data on capital. However, estimation of γ_0 and δ would require data on capital.

4.6.6 It is a well-known fact that the estimates of the elasticity of substitution obtained in empirical work using different derived models as applied to the same data have, in fact, been different.[16] This brings up the question of choice as to the most acceptable estimate of the elasticity

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[16] (i) Maddala, G.S., "Differential Industry Effects and Differential Factor Effects of Technological Change", The Theory and Empirical Analysis of Production, Murray Brown (ed.), op. cit., 1967.

(ii) Arrow, et. al., op. cit., p.246.

(iii) Bell, F.W., "A Note on the Empirical Estimation of the C.E.S. Production Function with the use of Capital Data", Review of Economics and Statistics, Vol.XLVII, No.3, 1965, p.328.

(iv) Dhrymes, P.J., "Some Extensions and Tests for the C.E.S. Class Production Functions", Review of Economics and Statistics, Vol.XLVII, No.4, 1965, pp.357-366.

of substitution in a particular industry. The theoretical specification of a production function specifies the criteria in terms of the signs of coefficients in the estimated equations. It is also possible to test the estimates of the coefficients and their consonance with observed behaviour patterns in the industry such as factor shares.[17]

4.6.7 Assuming partial adjustment of value added per worker to its desired value V/L^* the equilibrium condition may be written as $\log V/L^* = a + \sigma \log wt + U_t$ (1)

The equation allowing for adjustment towards equilibrium can be written as:

$$\log (V/L)_t - \log (V/L)_{t-1} = \lambda[\log(V/L)^*_t - \log(V/L)_{t-1}] \qquad 0 < \lambda < 1 \qquad (2)$$

so that

$$\log (V/L)^*_t = \frac{1}{\lambda} \log (V/L)_t + (1-\lambda) \log(V/L)_{t-1}$$

Substituting for log V/L in equation (1) and transposing some terms

17 (i) Lovell, C.A.K., "Estimation and Prediction with C.E.S. and V.E.S", International Economic Review, 1970.

(ii) Solow, R.M., "Capital Labour & Income in Manufacturing" in The Behaviour of Income Shares, NBER, Princeton, 1964.

$$\log (V/L)_t = a\lambda + \sigma\lambda \log w_t + (1 - \tfrac{1}{\lambda}) \log (V/L)_{t-1} + \lambda U_t \quad .. \quad (3)$$

This equation has formed the basis of estimates of σ where the rate of adjustment is represented by λ; the ratio of the coefficients of $\log w_t$ to one minus that of $\log (V/L)_{t-1}$ will be the estimate of the elasticity of substitution.

4.6.8 To take account of the serial correlation arising out of any possible mis-specification in the error terms of the SMAC relationship

$$\text{Log } (V/L)_t = A + \sigma \log w_t + U_t$$

a first order Markov scheme is assumed $U_t = \rho U_{t-1} + \varepsilon_t$

$|\rho| < 1$

then $\log V/L_{t-1} = A + \sigma \log w_{t-1} + U_{t-1}$

Now $\log (V/L)_t - \rho \log (V/L)_{t-1} = A(1-\rho) + \sigma \log w_t - \sigma \log w_{t-1} + \varepsilon_t$

or $\log (V/L)_t = A(1-\rho) + \rho \log (V/L)_{t-1} + \sigma \log w_t - \sigma\rho \log w_{t-1} + \varepsilon_t$

4.6.9 Griliches postulates that the difference between the lagged adjustment model and the serial correlation model lies in the presence of the lagged wage rate term in the latter model. The distributed lag model implies that the coefficient of the lagged wage variable should be zero. The serial correlation model, on the other hand, implies that this coefficient should be negative and equal to the product of the coefficient of the current wage rate and lagged productivity term.

4.6.10 The following estimates of the elasticities of substitution have been formulated on the basis of derived relations from the C.E.S. Production function:

1) $\log (V/L)_t \quad = \quad A + \sigma \log w_t + U_t$

2) $\log (V/L)_t \quad = \quad A + \sigma \log w_t + \alpha_t + U_t$

3) $\log (V/L)_t \quad = \quad A + \sigma \log w_t + (1-\sigma) \log (V/L)_{t-1} + \varepsilon_t$

4) $\log (V/L)_{t-1} \quad = \quad A + \sigma \log w_t + \rho \log (V/L)_{t-1} -$

$\sigma \rho \log w_{t-1} + \varepsilon_t$

5) $\log (V/L)_t \quad = \quad A + \sigma \log w_t + \beta \log L_t + U_t$

Equation (1) is the familiar SMAC formulation relating the log of V/L with the log of the wage rate. Equation (3) is the partial adjustment distributed lag model. Equation (4) is the serial correlation model corresponding to (1). Equation (5) is the modified SMAC form with the labour variable which allows for non-constant returns to scale and releases us from the assumption of constant returns to scale.

4.6.11 The capital-labour substitution parameter achieves considerable significance in a country like India. One of the vital issues here is to bring about conformity between the pattern of factor endowments of the economy and the technology currently in use. Any solution to this problem is limited by the limits to the possibility of substituting the abundant factor viz. labour for the scarce resource viz. capital. Productivity studies relating to the Indian economy, however, reveal a marked tendency towards capital deepening of the industrial sector. It is here that the elasticity of substitution achieves crucial significance. This parameter provides a measure of the responsiveness of the factor proportions to the factor price changes.

4.7 Empirical Results of the Functions Estimated

4.7.1 For the four sub-groups in the industry, the Cobb-Douglas production function and the C.E.S. function were fitted. The Cobb-Douglas function was fitted with two independent variables labour and total productive capital, and value added as dependent variable. It was also fitted using three independent variables viz. fixed capital, working capital and labour. All the values are expressed in real terms.

4.7.2 Fertilisers and Pesticides

In the case of the fertiliser and pesticides group of industry, the Cobb-Douglas two variable model did not yield significant results. None of the coefficients of K and L are statistically significant even at 10% probability level of the two tailed test. t value of β (productive capital) = 1.5884 $<$ 2.365 $t_{7,\ 5\%}$ and 1.895$_{t7,\ 10\%}$.

t value of (labour) = 1.4274 also less than 1.895. The value of $\bar{R}^2$ is however sufficiently high (.7853). This situation may be due to the presence of high multi-collinearity between the variables capital and labour. Simple correlation between capital and labour is .847. On the other hand, for the same industry group taking a three variable Cobb-Douglas model where productive capital is split into fixed capital and working capital we find the coefficient of fixed capital to be statistically significant.

$t_{fixed\ capital}$ 2.4363 $>$ $t_{6,\ 10\%}$ = 1.943. The value of $\bar{R}^2$ is also higher than that of the previous function (.8324).

Thus it seems that the production function taking fixed and variable capital separately is a better fit than the two variable model, the explanatory power of $\bar{R}^2$ being higher. However, in this function also the coefficient of labour appears insignificant t = 0.1118 ($t_{6,\ 5\%}$ = 2.447 and $t_{6,\ 10\%}$ = 1.943). This is probably indicative of the highly capital-intensive nature of the industry or the heavy dose of fixed capital compared to labour.

4.7.3 Basic Industrial Chemicals (Heavy Organic and Inorganic)

For basic industrial chemicals in the two variable Cobb-Douglas model the productive capital coefficient does not appear significant (t = 1.0432 $<$ $t_{9,\ 5\%}$ = 2.262). In the three variable model, however, the fixed capital coefficient appears significant (t = 1.9557 $>$ $t_{8,\ 10\%}$ = 1.860). In the two variable as well as the three variable model the labour coefficient appears significant. (Two variable t_{labour} = 5.2852 $>$ $t_{9,\ 1\%}$ = 3.250; three variable t_{labour} = 2.3031 $>$ $t_{8,\ 10\%}$ = 1.860). The value of $\bar{R}^2$ is very high in the two variable model (.903521). In the three variable model also it is .794673.

4.7.4 Drugs and Pharmaceuticals

In the case of drugs and pharmaceuticals, none of the coefficients of productive capital, fixed and working capital or labour appears significant in the three variable model. (Two variable model $t_{productive\ capital} = 1.9313$; $t_{labour} = 2.2539$; $t_{2,\ 5\%} = 4.303$. Three variable model $t_{fixed\ capital} = 0.0444$; $t_{labour} = 1.2232$). $\bar{R}^2$ is very high in the three variable model (0.964052) which may again indicate high multicollinearity. Correlation between capital and labour here is 0.894.

4.7.5 Miscellaneous Chemicals

This group consists of all those chemical products which have less than three units producing them. In the case of this sub-group neither coefficients of productive capital nor labour appear to be significant ($t_{productive\ capital} = 1.0735$; $t_{labour} = 0.0804$; $t_{7,\ 5\%} = 2.365$). In the three variable model the fixed capital coefficient appears significant ($t = 3.7613$; $t_{7,\ 5\%} = 2.365$). The value of $\bar{R}^2$ is also high for the two variable model and the three variable model. (.948962; .794673). The fact that only the fixed capital coefficient appeared to be significant is again indicative of the highly capital-intensive nature of the industry.

4.7.6 In general for all subgroups of the industry marginal product of labour is higher than the wage rate vide Table 4.1(b). This might as postulated earlier, be the effect of the high amounts of capital invested in the industry. Capital productivity however is uniformly lower than r leaving much room for improvement.

4.7.7 In general the Cobb-Douglas model has not proved very satisfactory except in the case of fertilisers and pesticides and miscellaneous chemicals. Taking into consideration the limitations of the Cobb-Douglas model, the C. E. S.

function has also been fitted for the different sub-industry groups.

4.8 Estimate of the C.E.S. Function

4.8.1 The C.E.S. function provides a better estimate for the data. In the case of fertilisers and pesticides the time variable is significant at 5 per cent level. ($t = 2.3760 > t_{7,\ 5\%} = 2.365$) $R^2 = .839822$. Only the scale parameter does not appear significant $t = 0.8954 < t_{7,\ 5\%} = 2.365$). Therefore, the value of $\gamma = 1.7184$ may be the result of changes in the time pattern. The value of elasticity of substitution $\sigma = .55$. For a highly capital-intensive industry like fertilisers and pesticides this is nothing strange since the technological coefficients are more or less fixed and arbitrary capital labour substitution is impossible.

4.8.2 Basic Industrial Chemicals

Here the time trend coefficient is not significant ($t = 1.5414 < t_{9,\ 5\%} = 2.306$). But efficiency parameter r is significant ($t = 2.4598 > t_{9,\ 5\%} = 2.306$). Elasticity of substitution again is equal to 0.55 only which again limits the possibilities of capital labour substitution.

4.8.3 Drugs and Pharmaceuticals

In drugs and pharmaceuticals alone we find neither the coefficient of time nor the efficiency parameter significant $t = 0.2922 < t_{3,\ 5\%} = 4.303$, $t_r = 0.1641 < 4.303$). R^2 is only .0577995; $\sigma = 0.56$.

4.8.4 Miscellaneous Chemicals

In this group of chemicals the coefficient of the time trend and efficiency parameter are significant ($t = 2.7669 > t_{7,\ 5\%} = 2.365$, $t_r = 3.1813 > t_{7,5\%}\ 2.365$), σ appears to be the highest here ($\sigma = 0.82$). But even here σ is less than one which shows that as a general rule capital - labour substitution is not feasible in the case of the different sub-industry groups in the chemical industry. To ease the unemployment problem in the State directly and to increase productivity, the industry cannot do much directly. The only other possibility that seems open to it is to make the maximum use of the linkage effects which the industry can generate and provide more employment opportunities by setting up subsidiary industries. Productivity can be improved by better utilisation of capital and labour and by tightening controls.

Table 4.1 (a)

Estimates of the Parameters of Cobb-Douglas Production Function (Two Variable Model)

Industry	Constant	β_1	β_2	$\beta_1 + \beta_2$	R^2
Fertilisers & Pesticides	-1.44	0.5069* (1.5884)	0.5810* (1.4274)	1.09	.79
Basic Industrial Chemicals (Heavy organic & Inorganic)	-0.2297	0.2153* (1.0432)	0.8473 (5.2852)	1.06	.90
Drugs & Pharmaceuticals	13.4241	-2.1648* (1.9313)	1.7406* (2.2539)	-1.4242	.625
Miscellaneous Chemical Products	2.5772	0.6677* (1.0735)	0.4823* (0.0814)	1.15	1.2418

Note:

Figures in brackets represent the t values.

*Denotes statistical insignificance.

Table 4.1 (b)

Marginal Product of Labour, Wage Rate, Marginal Product of Capital & Rate of Return on Capital

Industry	MP_L	W	MPc	r
1. Fertilisers & Pesticides	4.06	3.35	.095	.11
2. Basic Industrial Chemicals	6.70	4.12	.08	.21
3. Drugs & Pharmaceuticals	6.49	1.42	.05	.597
4. Miscellaneous Chemicals	3.31	1.87	.44	1.01

Table 4.2

Estimates of the Parameters of the Cobb Douglas Function (Three Variable Model)

Industry	Constant	β_1	β_2	β_3	$\beta_1+\beta_2+\beta_3$	$\bar{R}^2$
Fertilisers & Chemicals	-1.7323* (0.8932)	.7412 (2.4363)	.2530* (1.7361)	.0544* (0.1118)	1.14	.832
Basic Industrial Chemicals	0.1083* (0.0502)	0.3398* (1.9557)	0.0126* (0.0257)	0.6468 (2.3051)	.99	.795
Drugs & Pharmaceuticals	-1.2739* (0.5048)	0.0548* (0.0444)	0.4016* (0.7594)	0.8247* (1.2232)	1.2811	.964
Miscellaneous Chemicals	0.3140 (0.3145)	1.0329 (3.7613)	-0.2054* (.7490)	0.2799* (.8447)	1.0	.949

Note:

(Figures in paranthesis indicate t values)

*Signifies statistical insignificance.

Table 4.3

Estimates of the Parameters of the C.E.S. Production Function

Industry	Constant γ	Coefficient of time trend θ^t	σ	$\bar{R}^2$
1. Fertilisers & Pesticides	1.7184* (0.8954)	0.2786 (2.3760)	0.55 (3.8735)	.8398
2. Basic Industrial Chemicals	3.1078 (2.4598)	0.2917* (1.5414)	0.55 (4.3679)	.819
3. Drugs & Pharmaceuticals	1.6921* (0.1641)	- 0.3780* (0.2922)	0.56* (0.5043)	0.057
4. Miscellaneous Chemicals	6.2716 (3.1813)	0.4705 (2.7669)	0.82* (1.2683)	.5735

Note:

Figures in paranthesis represent t values.

*Denotes statistical insignificance.

CHAPTER - V

TECHNOLOGICAL RELATIONS AND INPUT-OUTPUT ANALYSIS OF THE UNITS STUDIED

5.1.0 Technological relations through inter-industry linkages cannot obviously be thought of as the only factor determining the industrial location. However, they may be one such factor in addition to the natural resource endowments, final demand patterns, transport technologies etc.* The effect of inter-industry transactions on industrial location may operate directly through transport costs or indirectly in the sense that a scarce primary factor important for the set of inter-related industries is more relatively available in a particular region. So also the process of industrialisation may create factors suitable for the further development of a set of inter-related industries operating through agglomeration economies specific to a particular set of industries.

5.1.1 "The chemical industry is its own most important supplier and its own most important customer".[1] This is

* For details see Webber, A., Theory of the Location of Industries, University of Chicago Press, New York, 1929.

[1] UNIDO, Monograph on Industrial Development: Industrialisation of Developing Countries - The Chemical Industry, Vienna, 1969, p.13.

because the industry is characterised by processing chains that involve many intermediate steps in the transformation of chemicals. The input coefficients show the proportion in which various industrial sectors including the chemical sector itself and other economic sectors provide the goods and services consumed by the enterprises that make up the chemical sector. The output coefficients show the proportion in which these enterprises sell their products to various sectors and also to final consumers or the export market. The most important inputs will be the raw materials and intermediate chemical products. In general, inter-industry linkages increase with the level of industrialisation. In the initial stages of industrial development the industrial sector tends to consist of a collection of fairly isolated projects between which there are only weak linkages. It is only at the later stages of industrialisation that a web of complex industrial relationships links up the scattered projects.

5.1.2 The demand for chemical products is not closely tied to the development of a few selected industries, but rather depend on the development of the economy as a whole. The chemical industry sells to a large number of other industries producing final products, intermediate goods and capital equipment in addition to its sales to the Government or final consumers.

5.1.3 Sales to final consumers would generally include drugs and pharmaceuticals, cosmetics and soaps, household chemicals and photographic materials. Only one step removed from the final consumers, there are a number of industries which supply goods for final consumption with an indication of the chemical products sold to them. They include:

(i)	Processed foods	: Acids, cleaning fluids, preservatives, disinfectants.
(ii)	Textiles	: Alkalies, detergents, dyes, bleaches, resins, and adhesives for sizing synthetic fabrics.
(iii)	Leather	: Tanning agents, dyes, bleaches, printing and publishing inks.

5.1.4 Other industrial goods less closely identified with consumer goods are also supplied with an extremely wide variety of chemical products, some of which are as follows:

(i)	Agriculture	: Fertilisers, agricultural control chemicals (Pesticides), Chemicals for animal husbandry, feed additives, veterinary drugs, disinfectants.
(ii)	Pulp and Paper	: Chemicals for pulp making, bleaches and adhesives.
(iii)	Glass and Ceramics	: Soda ash and additives.

(iv)	Lumber and wood products	:	Wood preservatives, resins and adhesives, paints and varnishes, bleaches, stains.
(v)	Metallurgy	:	Pickling acid for steel, sodium hydroxide, aluminium flotation, chemicals, bleaching agents, additives.
(vi)	Petroleum Refining	:	Sulphuric acid, alkalies, solvents.

Sales to industries manufacturing capital goods and consumer durables include:

(i)	Construction	:	Roofing materials, paints and varnishes, adhesives, plastic components, explosives.
(ii)	Electrical Machinery	:	Plastics for insulating wires and cables, insulating bases and shapes.
(iii)	Transport equipment	:	Components for batteries, plastics for seals and paints and varnishes.
(iv)	Household appliances and furniture	:	Plastic components, enamel.

5.1.5 In short the demand for chemical products is widely diffused throughout the economy. The inter-industry demand as distinct from the sale of end-products generally represents between 1/2 to 2/3 of the total demand. So also inter-industry sales are less sharply concentrated in the case of the chemical industry than for most other manufacturing and extractive industries.

5.1.6 Demand for an individual chemical product is based on many different end-uses. Growth in product demand, therefore, depends on a balanced growth in the economy as a whole, rather than on the expansion of one or two particular industrial sectors.

5.1.7 One consequence of this widespread distribution of chemical demand is that planners have only a limited scope to create a market by simultaneously expanding one or two key industries. The only significant concentrated linkage of the chemical industry is to the agricultural sector particularly at the early stages of development, when other inter-industry linkages are not highly developed in most countries.

5.2 Input-output Analysis - Definition and Scope

5.2.1 "An input-output table shows the flow of goods and services from each branch of the economy to different branches of the economy over a specified period of time, usually a year".[2] For producing the output of any sector in the economy different types of raw material inputs and capital equipment

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2 Saluja, M.R., Input-Output Tables for India, Wiley Eastern Limited, Delhi, 1980, p.29.

alongwith labour are required. The output produced may be used both for intermediate and final use. The part of the total gross output used as input for further production of goods and services may be termed as intermediate use. The remainder of the gross output is used directly by the final users. The output produced by each branch is distributed to the other branches that use them as input in the production process and to final consumers. A systematic description of this interdependence among different branches in the economy is provided by the input-output table.

5.2.2 The economy is divided into a number of homogeneous sectors, each of which is represented by a row and a column in the table. The row corresponding to the sector in the table gives the use pattern of the total supply of the sector, while the column gives the details of the inputs absorbed by the sector. The entry into the cell of the i^{th} row and the j^{th} column is the quantity of output of sector i consumed as input by sector j and is denoted as x_{ij}. The output of sector j is denoted as x_j.

5.2.3 The input-output model provides a link between the final demands and the output levels of different sectors. It is a theoretical scheme, a set of linear equations in which the levels of production of different sectors are unknown and can be estimated on the basis of the information contained in the input-output table, provided the final demand of the different sectors is exogenously determined.

5.2.4 The basic input-output model was based on certain basic assumptions:

(i) Each sector produces a single homogenous output with a single input structure and there is no substitution between the outputs of different sectors.

(ii) There is fixed proportion of the Leontief type of the production function. In other words, the quantity of each input used by any sector is a constant proportion only of the level of output of that sector, i.e. the amount of each kind of input utilised by a sector varies in direct proportion to its output.

(iii) The Hawkins Simon viability condition must be satisfied. This ensures that the level of gross output in each sector is adequate to meet the intermediate and final demands for that sector in a closed economy. Alternatively, the output x_i should not be less than the direct and indirect requirements of the output of this sector for producing x_i.

5.3 <u>Formal Structure of the Input-output Model</u>

5.3.1 For an economy consisting of n sectors, the total distribution of the physical output of each sector can be described by n balance equations

$$X_i = \sum_j X_{ij} + F_i \qquad i = 1, 2 \ldots\ldots n$$

X_{ij} is the total intermediate demand for the output of sector i. F_i is the sum of output consumed by all the components of the final demand for sector 'i's output. This means that the output of any sector is equal to the total of the output consumed by different sectors and the different components of final demand. Hence we write

$$X_{ij} = a_{ij} \; x_j$$

where a_{ij} is the requirement of the output of sector i used as input for a unit level production of sector j. a_{ij}s are, therefore, the structural or technical coefficients. These balance equations can be written as

$$X_i = \sum_j a_{ij} \, x_j + F_i$$

$$\text{or} \quad (1 - A) \; X = F$$

where A (n, n) is the input-output coefficient matrix, X is the vector of outputs and F is the vector comprising of total final demand. The matrix A is obtained by dividing each column of the flow matrix by the output of the purchasing sector. The column of coefficients of any sector gives the input structure of the sector. Given the coefficient matrix A and the final demand levels it is possible to solve the equation (1 - A) X = F and the level of gross output of the various sectors can be estimated.

5.3.2 The input coefficients a_{ij} gives the direct input requirement of the i^{th} sector for the production of one unit of the j^{th} sector's output. However, it does not indicate the indirect or second or higher round effects of producing one unit of the j^{th} sector. Through the input-output system the direct as well as indirect requirements of producing an additional unit of any sector can be estimated.

On solving the equation $(1 - A)\ X = F$

We get $X = (1 - A)^{-1}F = RF$

where $r = [r_{ij}]$

5.3.3 The R matrix is known as the Leontief inverse or the matrix multiplier. Each coefficient r_{ij} represents the amount of output of sector i required directly and indirectly for one unit of final demand for sector j. It is this matrix which shows the full impact of the demand for the output of each sector on all other sectors. Once the output level X_i are estimated, the total demand for different kinds of primary inputs can be worked out by multiplying the sectorwise output levels with the corresponding primary input coefficients. The effect of the final demand requirements on primary inputs can also be estimated by multiplying the primary input rows with $(1 - A)^{-1}$.

5.4 The Input-output Table in Value Terms

5.4.1 The input-output system was basically formulated on the assumption that inputs are dependent on the level of corresponding output in physical terms only and the input coefficients per unit of gross output are invariant with respect to changes in the prices of inputs or outputs. However, in actual practice most of the tables are prepared in money values. If the coefficients are in physical terms it is not possible to add up the different inputs going into the sector because the inputs may be measured in different units. The sum total of inputs used by any sector is also important in the computation of value added by that sector. The changes in coefficients overtime will consist of the possible changes in physical inputs and the changes in relative prices. To remove the effect of price changes a series of tables can be made at constant prices, which, by itself, is a stupendous task. Hence a table can be prepared in value terms alongwith the material balances for important commodities.

The coefficient expressed in value terms can be written as

$$\overline{a_{ij}} = X_{ij} \; P_i / X_j \; P_j$$

$$a_{ij} = a_{ij} \; P_i / P_j$$

where P_i and P_j are the prices of the i^{th} and j^{th} sector respectively.

$\overline{a_{ij}}$ is the value of the i^{th} sector's output used as input for producing one unit of output in value terms of the j^{th} sector. The total inputs absorbed by any sector will be equal to the output of that sector. Since each column of the matrix gives the distribution of the total cost of the sector it is called the cost structure of the sector.

The equations for the columns can be written as

$$X_j = \sum_{i=1}^{n} \overline{a_{ij}} \quad X'_j + V_j$$

$$\text{where } X'_j = X_j P_j \qquad j = 1 \ldots \ldots n;$$

V_j is the value added by the j^{th} sector. The corresponding row equation will be

$$X'_i = \sum_{j=1}^{n} \overline{aij} \quad X'_j + F_i'$$

F_i is the final demand of the output of i^{th} sector in value terms $i = 1, 2, \ldots \ldots \ldots n.$

5.4.2 <u>Concepts and Definitions Used</u>

5.4.2.1 The type of prices used to obtain input-output tables in value terms are of two types - producer's prices and purchaser's prices. Producer's prices are those which are received by the producers, ex-factory price in the case of factories while purchaser's prices are those that are paid by the purchasers. The difference between the two sets of prices consists of trade and transport margins and net indirect taxes. The purchaser's prices of a commodity may be different for different kinds of consumers. The part of the output used for intermediate consumption may be purchased at wholesale prices, while the output used for private consumption may be purchased at retail prices. Transport margins depend on the distance and mode of transport between the place of manufacture and the place from where the demand occurs. Also the indirect tax rate may be different for different buyers as for personal consumption and governmental consumption.

5.4.2.2 Producer's prices are generally favoured over purchaser's prices, since under the former the value of output corresponds more closely to physical output than under the latter. Also there is uniformity of valuation for different buyers.

5.4.2.3 Moreover under the purchaser's price system the total value of output of a sector includes the distributive costs in each delivery of output. The total output value will change with the geographical and sectoral distribution of demand, even though there is no change in the output. Hence the coefficients are not likely to be stable. On the other hand, under the producer's price system the marketing costs vary with the input structure and not with the output structure. This is likely to be more stable than the other system.

5.5 Applications of Input-Output Techniques

5.5.1 The input-output table is mainly an accounting statement of the transactions between the sectors in the economy under study for a given time period. Hence it contains a great deal of information about the economy under review. The tendency has been for the analyst to concentrate on the analytical aspects of the input-output table. Apart from this the transactions table can contribute substantially to an understanding of the nature of the regional economy. Comparative studies of transaction tables can provide a valuable basis for studies of regional economic development. The structural comparisons can serve as a guide in determining whether the different regions are following the same growth path or not.

5.5.2 The sector-wise comparison of the structure of different economies is best done by comparing the individual coefficients of the A matrix and the coefficients of the matrix $(1 - A)^{-1}$. Given the equation $X = (1-A)^{-1}F$, it is possible to project or to estimate future levels of final demand Y for each sector and to calculate the levels of output X from each sector required to achieve the targeted goals. Some crude comparisons can also be made with the help of sector-wise backward and forward linkages. For a sector the proportion of the cost of inputs to the total value of output gives the backward linkage, while the proportion of the intermediate demand to the total output gives the forward linkage coefficient. Mathematically

$$U_j = \sum_i x_{ij}/x_j$$

$$W_j = \sum_i x_{ji}/x_j$$

where U_j and W_j are the backward and forward linkages respectively.

5.5.3 Chenery and Watanabe have compared the structures of Japan, Norway, Italy and the United States by comparing the sector-wise backward and forward linkages for these states.[3] They have attempted a triangularisation of the matrix such that all the entries on one side of the diagonal of the matrix are zero. This will bring to light the interdependence between the different sectors of the economy. However, such a triangularisation is difficult to achieve in actual practice. Manne and Rudra have developed a block

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3 Chenery, H.B. & Watanabe, T., "International Comparison of the Structure of Production", Econometrica, Vol.26, 1958.

angular input structure for the Indian economy for the year 1960-61.[4] With the proper arrangement of the sectors the structure can be divided into a number of independent blocks such that the entries outside the block are zeroes as far as the sectors corresponding to the block are concerned. They have also mentioned that such a similar structure holds for the U.S. economy. This structure, e.g. can estimate the effect of shortfall of major raw materials in the block on different related structures. It also helps in the detailed analysis of individual sectors. A partial analysis of an industrial complex can be made using this method.

5.5.4 Use in Impact Analysis The analytical properties of the input-output tables led to their wide use for impact studies and as tools of national and economic planning. It is possible to measure the result in terms of output, income and employment of any change in the local economy due to an impacting agent -- say the impact of fiscal decisions on the output levels of various sectors. It can also be used to find out the effect of changes in price levels on input costs.

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4 Op. cit., Manne, A.S. and Rudra, A., Sankya, Series B, June, 1965.

5.5.5 Market and Structural Analysis The input-output table provides a substantial amount of information relating to the market of various sectors. Schaffer has postulated the use of the transactions table as a market information system.[5] Parker has postulated that it is possible to determine the extent to which the final demand sales by each sector are responsible directly or indirectly for absorbing the output of all sectors individually.[6] It is also possible to determine the extent to which imports contribute to the satisfaction of local final demand. In particular the import content can be an important factor in determining industrial location. It is also possible to calculate the extent to which the local economy contributes in terms of value added to each category of final demand.

5.5.6 Economic Intelligence The term economic intelligence applied by Schaffer refers to the ability of the authorities to examine strategic questions relating to regional economic development by a detailed study of the nature of regional industries. By the use of self-sufficiency analysis it is possible to identify the apparent "missing links" or bottlenecks in an economy and thus facilitate strategic planning.[7]

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[5] Schaffer, W.A. (ed.), "On the Use of Input-Output models for Regional Planning", Studies in Applied Regional Science, Martinus Nijhoff, Leiden, 1976.

[6] Parker, M.L., "Inter-industry Study of Western Australian Economy", Agricultural Economics Research Report No.6, University of Western Australia Press, 1967.

[7] Op. cit., Schaffer, p.80.

5.5.7 Inter-industry Linkage Effects Due to the interlinkages that exist between the producing sectors of the economy, the expansion of any industry leads to a series of effects. Depending upon the linkages, different industries have varied inducements in the economy.

The inducements can be measured by impact multipliers[8] or by measuring the linkage indices as suggested by Rasmussen.[9] The multiplier analysis emphasises only backward linkages. Moreover, sometimes the high multiplier values may be misleading.[10] If one estimates the direct and indirect income/employment multipliers per unit of final demand by using a static input-output model one finds that the sectors that have the highest backward linkages give the highest value of multipliers. The conclusion would emerge that these and only these sectors be given top priority for future expansion. This, in turn, would lead to the perpetuation of the existing structure.

5.6 Rasmussen Method of Estimating Linkages

5.6.1 According to the Rasmussen method of estimating linkage indices both backward and forward linkages are

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8 Bhalla, G.S., "Sectoral Income Multipliers in the Punjab and India", Anvesak, Vol.1, 1971, pp.210-229.

9 Rasmussen, P.N., Studies in the Intersectoral Relations, N. Holland Publishing Co., Amsterdam, 1953.

10 Kashyap, S.P., Regional Input-output Models - A Case Study of Gujarat, Ph.D. Dissertation, Gujarat University, 1977 (Mimeo).

estimated by using the Leontief inverse. The backward and forward linkages are given as:

$$U_j = 1/m \; Z_j / \frac{1}{m^2} \sum_{j=1}^{m} Z_j$$

and

$$U_i = 1/m \; Z_i / \frac{1}{m^2} \sum_{i=1}^{m} Z_i$$

where m = number of industries

$Z_j = \sum_{i=1}^{m} z_{ij}$ given $Z = (I-A)^{-1}$ z_{ij}, a typical element, shows direct and indirect output of industry i required to meet unit requirement of final demand of industry j. Thus Z_j the column total of the Leontief inverse indicates output requirements from the system of industries to cope with a unit increase in the final demand requirements of industry j.

Z_i = the row total of the Leontief inverse and indicates the output to be supplied by industry i to cope with a unit increase in the final demand for the product of each industry. Hence it follows that

$$\sum_{j=1}^{m} Z_j = \sum_{i=1}^{m} Z_i = \sum_{i=1}^{m} \sum_{j=1}^{m} Z_j$$

5.6.2 The two values U_j and U_i have great significance according to Rasmussen. "U_j greater than unity means that industry number j draws heavily on the system of industries and vice versa in the case of $U_j < 1$. Hence this index U_j has been called as the index of the power of dispersion of the industry concerned. This index describes the relative extent to which an increase in the final demand for the product of industry No.j is dispersed throughout the system of industries. . . . . The index impresses the extent of expansion caused in the system of industries in general by an expansion in industry No.j".[11]

5.6.3 Similarly it follows that $U_i > 1$ means that industry No.i generally will have to increase its output more than other industries for given increase in demand and vice versa for $U_i < 1$. Thus index U_i (i = 1, 2, ...m) may be termed as an index of sensitivity of dispersion for the industry concerned. It expresses the extent to which the system of industries draws upon industry No.i or, in other words, the extent to which industry No.i is affected by an expansion in the system of industries.[12]

5.6.4 As Rasmussen says, the high linkages, unless accompanied by an even spread in the system of industries, can lead to lopsided development. Hence these two

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11 Op. cit., Rasmussen, pp.134-135.

12 Ibid.

measures are supplemented by a standard deviation coefficient V_j and V_i for each of the linkage indices.

$$V_j = \sqrt{\frac{1}{m-1} \sum_{i=1}^{m} \left\{ Z_{ij} - \frac{1}{m} \sum_{i=1}^{m} Z_{ij} \right\}^2} \Big/ \frac{1}{m} \sum_{i=1}^{m} Z_{ij}$$

$$V_i = \sqrt{\frac{1}{m-1} \sum_{j=1}^{m} \left\{ Z_{ij} - \frac{1}{m} \sum_{j=1}^{m} Z_{ij} \right\}^2} \Big/ \frac{1}{m} \sum_{j=1}^{m} Z_{ij}$$

V_j is interpreted as the index showing the extent to which industry j draws evenly on the system of industries and V_i as an index showing the extent to which the system of industries draws evenly from industry i. Thus the smaller these indices, the more evenly distributed would be the spread-effects of backward and forward linkages respectively. Hence, other things remaining the same, the regional planners would have preference for industries with more unit linkage indices U_i and U_j and relatively low standard deviations.

5.7 <u>Limitations of Input-output Analysis</u>

5.7.1 A static input-output table describes the inter-sectoral relationships within the framwwork of general equilibrium. By assuming fixity of technical coefficients it imparts some sort of sanctity to the existing structure. Using the static input-output model, the sectors that have the highest backward linkages give the highest value of the multipliers. Under the circumstances it is only natural that these sectors be given top priority for future expansion. This will inevitably lead to a perpetuation of the existing structure. In any attempt to change the existing structure the priorities will have to be reallocated.

5.7.2 Another important limitation of the static input-output model is that it is unable to satisfactorily incorporate technical change into the model. Technical change in itself has a dual character. It primarily leads to a change in the technical coefficients; secondly, relative input and output prices undergo a change. Under the static input-output system technical coefficients are assumed to be fixed and prices are treated as given. Based on an ex post accounting system, it fails to incorporate the process of technical change.

5.7.3 With all its limitations, the input-output table is an integral and important part of the statistical framework of national accounting. The output-output table has played and will play a very important role in the improvement of statistical data, because it clearly shows "those statistical shortcomings which should be eliminated first".[13]

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[13] United Nations, "Input-Output Tables and Analysis", Studies in Methods, United Nations Series F No.14.1, 1973, p.1.

Its importance in regional planning cannot also be underestimated. The schematic and piecemeal nature of planning at the State and regional level have been well established. The specific "schemes", around which the State plans are built, have been detailed.[14] Case studies of regional plans have shown how schematic allocation in State plans have bypassed regional priorities.[15] The difficulties arising out of a dual system of inter-state allocation of resources by the Finance Commission and the Planning Commission cannot be ignored. Hence, "the piecemeal nature of regional planning in India and the discussion of criteria for federal transfers is inevitable unless the structure of regional economies and interregional flows is examined systematically".[16]

5.8 Results of the Analysis Conducted Among The Chemical UNITS

5.8.1 Methodology

5.8.1.1 A partial input-output table has been formulated for nine important chemical units in the State in order to analyse the input-output flow between these units. The

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14 Agarwal, P.P., The System of Grants-in-Aid in India, Asia Publishing House, Bombay, 1959.

15 Alag, Y.K., "Formulation of a State Plan: Rajasthan - A Case Study", Economic and Political Weekly, July 7, 1962, pp.1051-1055 and "Formulation of Plans at the State Level in India", Seminar on Union State Relations in India", Indian Institute of Advanced Study, Simla, 1969.

16 Ibid.

other chemical industries in the State have been treated together as a single unit since individually their contribution was not substantial enough. The flow of commodities to units outside the State are treated as exports to outside the system and the flow of inputs from outside the State are treated as imports. So in effect this system of 10 units is treated as a closed system for the purpose of analysis. The table has been prepared in terms of money values since it was not possible to add up the different inputs going into the sector physically the inputs being measured in different units. The money value of inputs have been expressed in producer's prices so that there would be uniformity of valuation for different buyers.

5.8.2 <u>Analysis of Backward and Forward Linkages</u>

5.8.2.1 Initially the backward and forward linkages were calculated as the proportion of the cost of inputs to the total value of output and the proportion of intermediate demand to total output. The coefficients U_j and W_j give the backward and forward linkage respectively where

$$U_j = \sum_i x_{ij}/X_j \quad \text{and}$$

$$W_j = \sum_i x_{ji}/X_j$$

Examining the results of this analysis vide Table 5.1, unit No.1 is seen to exhibit the highest forward linkage. The output of this unit as also its by-products are being utilised by many of the other units. In fact the availability of raw material from this unit has been a primary incentive for many of the units to locate their factories in the nearby areas. Unit No.7 and also No.4 showed prospects of forward linkages. The fact that unit No.2 shows the weakest forward linkage does not detract from its prospects. This unit produces fertilisers and hence the majority of its products goes outside this system into the agricultural sector.

5.8.2.2 As regards the backward linkages given in terms of U_j unit number nine has the highest backward linkage. In fact the very installation of this unit in the state was induced by the availability of raw materials in this area. Unit number three and one also exhibit backward linkages in that they depend to a great extent on the nearby units for their raw material supply. Unit number two again has poor backward linkages because the main raw materials for it, naphtha and rock phosphate have to be imported from outside the system. Similarly the other units also which have poor backward linkages have to import very costly raw materials.

5.8.3 Rasmussen's Linkage Indices

5.8.3.1 Rasmussen's formula has been used to compute the linkage indices. According to interpretation of the linkage coefficients, $U_i > 1$ means that industry No.j will have to increase its output more than other industries for given increase in demand. Examining the linkage indices computed using the Leontief inverse of input coefficients vide Table 5.3 unit one has $U_i > 1$. Unit ten also has $U_i > 1$ which means that these units are also supplying an important share of their output to the system. Units one, two, four and six will generally be affected by an expansion in the system of units.

5.8.3.2 On the other hand $U_j > 1$ means that industry No.j draws heavily on the system of industries. Units 1, 5, 6, 7 and 9 have U_j greater than unity. This index which is known as the power of dispersion for the industry concerned implies the extent of expansion caused in the system of industries in general by an expansion in industry j. An interesting finding was that unit 9 comes second in rank with respect to U_j but ranks the lowest in the case of U_i. Using the raw materials of the other units in the system in particular and of the economy of the State in general, it is not feeding any of its output back into the system. Rather it exports the bulk of its product to the parent company.

5.8.3.3 Examining the standard deviation coefficients V_i and V_j also unit 1 has the lowest V_i followed by unit 9. V_j is lowest for unit 10 followed by unit 1. In general U_i and U_j greater that unity and low V_i and V_j are commended by planners. In such a situation unit 1 would stand higher than the other units with U_i = 1.231; V_i = 2.007; U_j = 1.128 and V_j = 1.725.

5.8.3.4 As evident from the linkage coefficients the forward linkages are very poorly developed except in the case of one or two units. Even the coefficients of the backward linkages provide much scope for improvement. The low linkages are basically indicative of the underdeveloped nature of the economy. As development proceeds the availability of materials and infra structure will provide an impetus to the establishment of new units. This will inevitably lead to higher linkages both backward and forward.

5.8.4 Prospects for a Petrochemical Complex

5.8.4.1 The recent schemes proposed for the petrochemical industry in the State can accelerate the tempo of industrial dynamism and generate higher linkages as between the different units and between the different sectors. The installation of the fluid catalytic cracker unit at Cochin Refineries, the Phenol Plant of Hindustan Organic Chemicals, The Carbon

Black Unit of Carbon and Chemicals Ltd. and the Caprolactum Plant of the Fertilisers and Chemicals Travancore Ltd. offer immense potentialities for development. The fluid catalytic cracker unit offers tremendous potential for a variety of petrochemical intermediates and end products from the products of the refinery. With a naphtha feedstock of 300 thousand tonnes the products envisaged are.

			(Thousand tonnes)
1.	Benzene	-	155.14
2.	Gas	-	38.56
3.	L.P.G.	-	11.82
4.	Naphtha	-	93.89
5.	Gasolene	-	0.65

The investment for the naphtha cracker and down-stream plants will be around Rs.300 crores with a foreign exchange content of Rs.75 crores.

The phenol acetone plant of the Hindustan Organic Chemicals would be the first real petrochemical industrial unit to come up in the State. By the end of 1985, 40,000 TPA of phenol and 24,000 TPA of acetone would become available.

The 50,000 TPA caprolactam plant of F.A.C.T. scheduled for production by the latter half of 1987 will open up another range of products which could be planned based on inputs available in the State.

Figure-5.1 ~~following figure~~ illustrates the flow of product and primary intermediates from Cochin Refineries Ltd. to Hindustan Organic Chemicals Ltd. and the Caprolactam Plant of F.A.C.T. Ltd.

5.8.4.2 <u>Major Petrochemical Inputs from Cochin Refineries</u>

1. <u>Cracked gases</u> Propylene is recovered by Hindustan Organic Chemicals from the cracked gas from the Refinery. The gas after recovery is sent back. This gas containing about 70,000 TPA of C_4 hydrocarbons is a good source for a variety of chemical intermediates such as Isobutylene, MTBE (methyl tertiary butylether) and TBA (tertiary butyl alcohol).

2. <u>Naphtha</u> The Refinery is expected to have a huge surplus of naphtha after setting up the F.C.C. Unit. Even after the maximum possible recovery of benzene there will be over 600,000 TPA of naphtha available for potential end-uses such as conversion to ammonia or for feeding a cracker. Naphtha cracker yields olefins which are the basic building blocks for petro-chemicals.

3. Benzene The recovery scheme will yield 87,000 TPA benzene which will meet the needs of HOC and FACT. There is potential to increase benzene yield up to 156,000 TPA which open up further avenues.

5.8.4.3 H.O.C's end-products - phenol and acetone can be the starting materials for a range of petrochemicals such as resins, moulding powders, pharmaceuticals, dye intermediates, plasticisers, solvents, insecticides and protective coatings. Caprolactum is used in nylon textile fibre, tyre cord, carpet yarn, belting, fishing nets, industrial yarn, chips etc. open up scope for a variety of finished products in the consumer market. Thus there is a tremendous potential for a wide range of petrochemicals from the products available from Cochin Refineries Ltd., H.O.C. and F.A.C.T. Cochin Refineries' products are the basic petrochemical building blocks whereas H.O.C. and F.A.C.T. will produce processed intermediates ready for conversion into consumer end-products. A planned scheme of tapping and harnessing the potential would result in a surge in the industrial scene not only in Kerala but in all the southern States.

5.8.4.4 Figure 5.2 gives a flow chart of the principal petrochemical raw materials, intermediates and end-products. The prospects and possibilities open before the State with these primary intermediates and end-products are many and varied. The development of downstream industries are to be planned and work on them has to be started immediately if full advantages are to be taken from the time of availability of supplies of feedstocks. The intermediates produced in the large units can be advantageously processed in small scale industries and hence a number of small scale industries is bound to come up. This will not only generate surpluses within the State but also provide employment to a large number of people in rural and urban areas. A rough computation on the direct and indirect employment potential of the suggested petro-chemical complex would indicate a figures of 10 to 12 lakhs. Apart from mitigating unemployment in the State, the petrochemical industry will throw up challenging opportunities to enterprising technicians to venture into the field of petrochemicals.

5.8.4.5 Despite the immense potentialities offered by this new industry it is bound to come up with several problems. Considering the large amounts of capital involved proper market surveys have to be undertaken, feasibility studies have to be made, availability of capital and technical know-how has to be considered before any fresh programme is launched. Otherwise the future of the new units will appear to be rather bleak.

Table - 5.1

Backward and Forward Linkages for the Ten Units using the proportion of inputs to total output and the proportion of intermediate demand to total output

Units	Forward Linkage $(W_j = \sum_i x_{ji}/X_j)$		Backward Linkage $(U_j = \sum_i X_{ij}/X_j)$	
1.	0.842	(1)	0.329	(4)
2.	0.015	(10)	0.171	(9)
3.	0.034	(8)	0.285	(7)
4.	0.291	(4)	0.153	(10)
5.	0.028	(9)	0.325	(5)
6.	0.103	(6)	0.290	(6)
7.	0.519	(3)	0.304	(3)
8.	0.057	(7)	0.208	(8)
9.	0.167	(5)	0.414	(1)
10.	0.78	(2)	0.341	(2)

Note: Figures in brackets indicate ranks.

Table - 5.2

Leontief Inverse Matrix of Input Coefficients $(1-A)^{-1}$

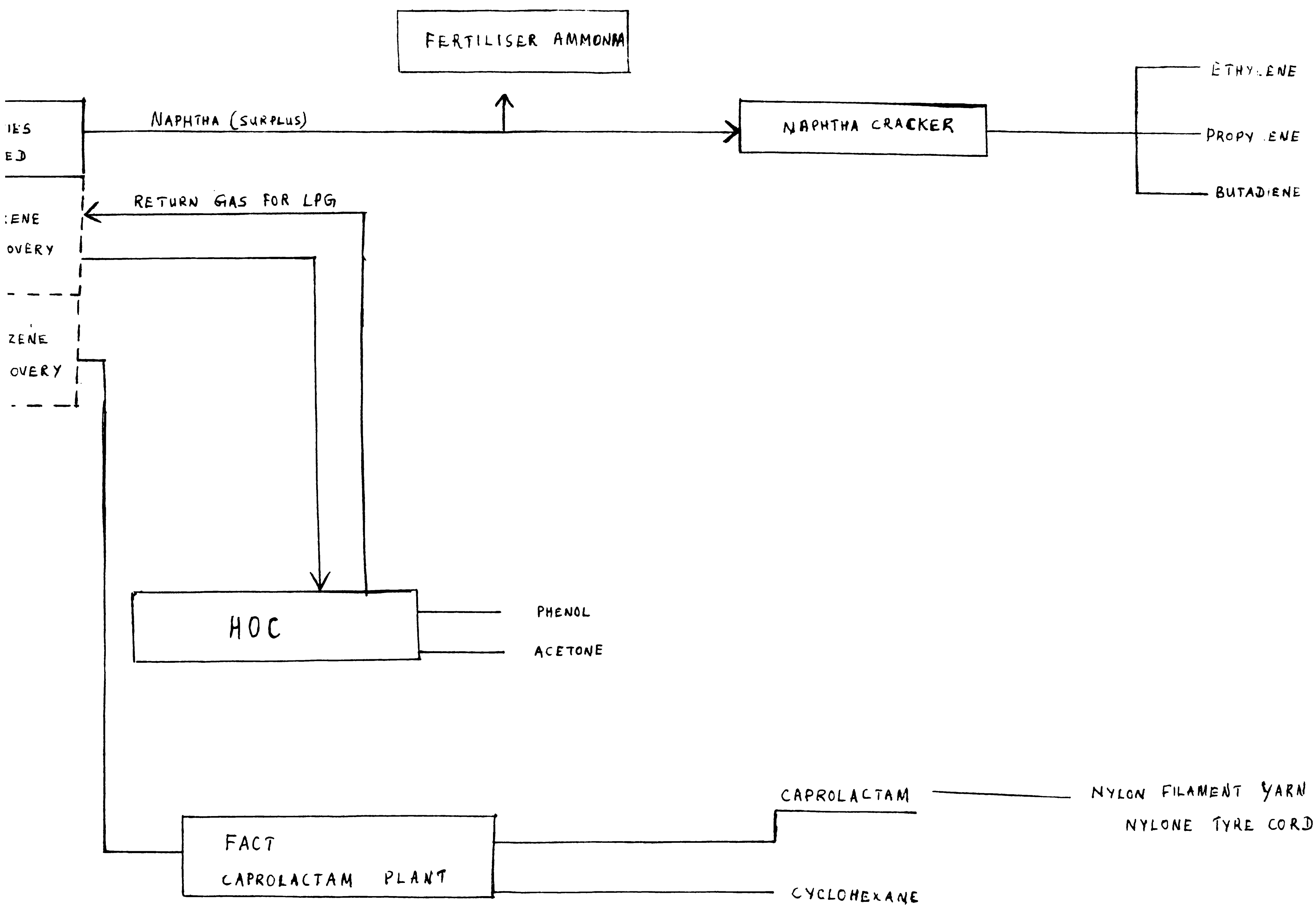
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.	1.02275	0.04262	0.15447	0.03019	0.04331	0.08968	0.1597	0.01723	0.12952	0.06297
2.	0.0698	1.00486	0.09608	0.00286	0.06365	0.00726	0.07575	0.00243	0.01249	0.01083
3.	0.00285	0.00145	1.00068	0.00039	0.00080	0.00068	0.00056	0.00052	0.00011	0.00264
4.	0.05617	0.01316	0.01398	1.01206	0.02244	0.06488	0.01316	0.01695	0.02977	0.08366
5.	0.00278	0.00045	0.00059	0.00039	1.00074	0.00067	0.00048	0.00052	0.00105	0.00265
6.	0.02299	0.00429	0.00475	0.01581	0.00539	1.00562	0.06555	0.01771	0.00952	0.01876
7.	0.00575	0.00286	0.0022	0.00256	0.00513	0.00389	1.04403	0.00383	0.00354	0.01987
8.	0.0549	0.00279	0.0021	0.00244	0.00588	0.00371	0.00122	1.00365	0.00594	0.01855
9.	0.0011	0.00055	0.00042	0.00049	0.00098	0.00074	0.00024	0.00073	1.00119	0.00379
10.	0.3658	0.18193	0.14015	0.1625	0.32585	0.24751	0.08116	0.244	0.39568	1.26332

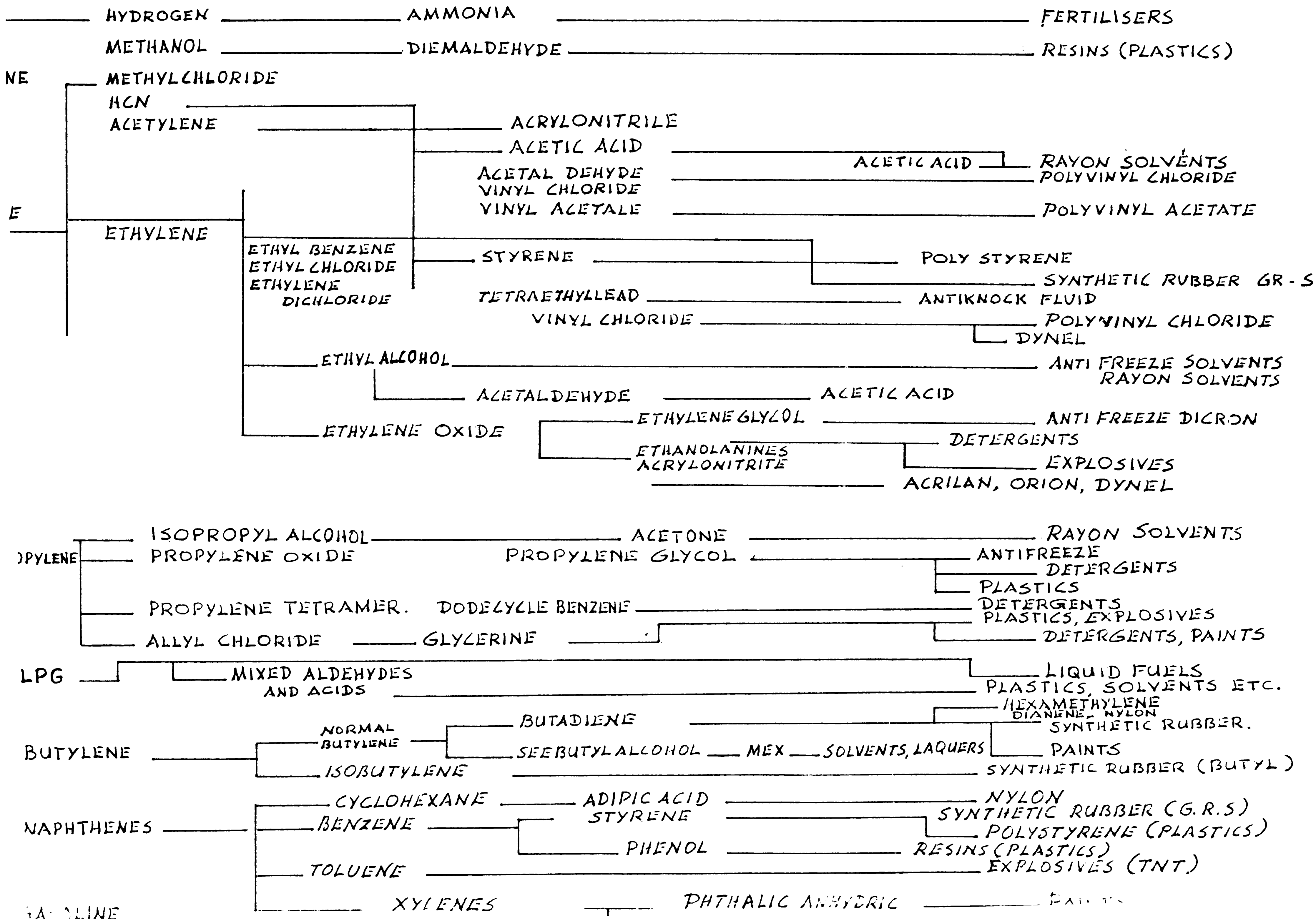
Table - 5.3

Linkage Analysis of the Ten Chemical Units using the Leontief Inverse Matrix

No. of Units	U_i	V_i	U_j	V_j
1	1.231 (2)	2.007 (1)	1.128 (1)	1.725 (2)
2	0.9459 (3)	2.501 (8)	0.882 (9)	2.287 (3)
3	0.7105 (8)	2.176 (4)	0.994 (7)	3.128 (8)
4	0.9318 (4)	2.573 (9)	0.864 (10)	2.338 (4)
5	0.7098 (9.5)	2.142 (3)	1.036 (4)	3.129 (9)
6	0.8222 (5)	2.197 (5)	1.001 (6)	2.672 (5)
7	0.7688 (7)	2.223 (6)	1.013 (5)	3.003 (7)
8	0.7737 (6)	2.305 (7)	0.919 (8)	2.855 (6)
9	0.7098 (9.5)	2.083 (2)	1.117 (2)	3.131 (10)
10	2.3953 (1)	2.640 (10)	1.045 (3)	0.996 (1)

... AND FINISHED GOODS BETWEEN COCHIN REFINERIES, FACT and HOC




HYDROGEN
AMMONIA
FERTILISERS
METHANOL
DIEMALDEHYDE
RESINS (PLASTICS)
NE
METHYLCHLORIDE
HCN
ACETYLENE
ACRYLONITRILE
ACETIC ACID
ACETIC ACID
RAYON SOLVENTS
ACETAL DEHYDE
VINYL CHLORIDE
POLYVINYL CHLORIDE
VINYL ACETALE
POLYVINYL ACETATE
E
ETHYLENE
ETHYL BENZENE
ETHYL CHLORIDE
ETHYLENE DICHLORIDE
STYRENE
POLY STYRENE
SYNTHETIC RUBBER GR-S
TETRAETHYLLEAD
ANTIKNOCK FLUID
VINYL CHLORIDE
POLYVINYL CHLORIDE
DYNEL
ETHYL ALCOHOL
ANTI FREEZE SOLVENTS
RAYON SOLVENTS
ACETALDEHYDE
ACETIC ACID
ETHYLENE OXIDE
ETHYLENE GLYCOL
ANTI FREEZE DICRON
ETHANOLANINES
ACRYLONITRITE
DETERGENTS
EXPLOSIVES
ACRILAN, ORION, DYNEL
OPYLENE
ISOPROPYL ALCOHOL
ACETONE
RAYON SOLVENTS
PROPYLENE OXIDE
PROPYLENE GLYCOL
ANTIFREEZE
DETERGENTS
PLASTICS
PROPYLENE TETRAMER.
DODECYCLE BENZENE
DETERGENTS
PLASTICS, EXPLOSIVES
ALLYL CHLORIDE
GLYCERINE
DETERGENTS, PAINTS
LPG
MIXED ALDEHYDES AND ACIDS
LIQUID FUELS
PLASTICS, SOLVENTS ETC.
BUTYLENE
NORMAL BUTYLENE
BUTADIENE
HEXAMETHYLENE DIANENE, NYLON
SYNTHETIC RUBBER.
SEEBUTYL ALCOHOL
MEX
SOLVENTS, LAQUERS
PAINTS
ISOBUTYLENE
SYNTHETIC RUBBER (BUTYL)
NAPHTHENES
CYCLOHEXANE
ADIPIC ACID
NYLON
BENZENE
STYRENE
SYNTHETIC RUBBER (G.R.S)
POLYSTYRENE (PLASTICS)
PHENOL
RESINS (PLASTICS)
TOLUENE
EXPLOSIVES (TNT)
XYLENES
PHTHALIC

C H A P T E R - VI

GENERAL AND FUNCTIONAL PROBLEMS OF THE ENTERPRISES

Part - I

6.0 The functioning of an industrial enterprise is confronted with a number of problems. These problems can be broadly classified as (i) general and (ii) functional. The general problems include:

(1) Location and size of the firm
(2) Choice of technology
(3) Delays in Government approvals
(4) Problem of pollution

Of these the first three mainly arise during the project planning and implementation stage. At this stage a number of crucial decisions have to be taken, on which will depend the viability and efficiency of the enterprise. Nevertheless, it happens that these decisions are more often political rather than based on sound business or economic principles.

The functional problems arise in the course of the day-to-day functioning of the firm. Increasing cost of production over sales, and the reasons thereof such as high cost of raw materials, labour, power and fuel, excess consumption of materials and power, problems of inventory control and capacity utilisation, improper planning and diversification are all significant functional problems which come under the purview of this study.

6.1 Location of the enterprise

6.1.1 In considering the location of a plant a balance should be struck between immediate as well as long-term benefits. Availability of raw materials, utilities, pure water, labour and proximity of markets should inevitably form the major determinants of the location of sites. At the same time due consideration should also be given to the development of backward areas. The importance of adequate and low cost electric power for the chemical industry cannot also be over-emphasised. This would lead to an inevitable saving in capital investment and operational costs. Transportation is also of utmost importance both for providing raw materials and for distributing end-products. Generally chemical industrial units are located near related industries and, in some cases, near consuming centres in order to form a balanced and efficient complex as regards both raw material supplies and market distribution. However, in the establishment of large-scale chemical companies many a time such decisions are made by the political machinery and may not be to the best advantage. Regarding size of the enterprise, chemical companies generally require huge investments as they are invariably large in size.

6.2 Choice of Technology

6.2.1 Regarding the choice of technology and the problem of employment, there is a severe controversy raging especially in a labour-abundant capital-scarce developing economy like India. On the one hand it is argued that in continuous process industries there are net social cost benefits in large-scale capital-intensive techniques of production even in labour-abundant economies with limited capacities in the capital goods sector. On the other hand, technologists conscious of the compulsions of mass poverty and unemployment argue that in many branches of production there are large possibilities for generating new technology such that it matches better with the factor endowments of such economies. Reddy of the Indian Institute of Science has postulated a ten point desiderata as a guide to technical choices appropriate to our conditions. He put up a strong case for small-scale rather than large-scale technologies, intensive in the use of local materials and traditional skills, energy saving rather than energy using which promote urban rural relationship which is mutually reinforcing rather than sub-ordinating and exploitative.[1]

6.2.2 However a clear preference for capital-intensive labour augmenting techniques seem to have been an outstanding feature of technical change in India. Capital intensity as

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[1] See Reddy, A.K.N., op. cit., May, 1973.

measured by the capital labour ratio at constant prices increased by nearly 150 per cent between 1947 and 1962. Over the same period the productivity of labour (output-labour ratio at constant prices) increased by 140 per cent whereas efficiency in capital use (output-capital ratio) declined by nearly 50 per cent.[2] Such a situation becomes all the more important in the highly capital-intensive chemical industries in the country, i.e. rising capital intensity, rising labour productivity and declining efficiency in the use of capital goods.

6.2.3 In the fifties it was generally argued that factor endowments or relative prices were not really relevant to the question of technical choice. The entrepreneurs in the developing countries believed the available techniques to be quite rigid in their required factor proportions.[3]

6.2.4 Later on ideas changed, and a general concensus was arrived that a whole range of technical alternatives are available not only in the discrete processing industries, but also in the continuous processing industries.[4]

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[2] Mundle Sudipto, op. cit., pp.3-4.

[3] Ibid., p.12.

[4] See (1) Morawetz, D., op. cit., 1974.
(2) Ranis, G., "Industrial Technology, Choice and Employment - a Review of Developing Country Evidence", Interciencia, Vol.12, No.1, 1977.

6.2.5 Though it has been put forward that while less capital-intensive techniques may be technically feasible they are not economically viable at the going relative prices. Mrs. Robinson has postulated that there may be capital augmenting technical change, which is definitely superior. Such a technology may entail a rise in the output-capital ratio associated with a rise in the output-labour ratio. This is borne out by the evidence of the cotton textile industry in Japan in the 1880s when the capital-labour ratio was almost halved. However, at this time the output capital ratio registered a sharp increase and the output-labour ratio also showed some increase.[5] This was again evidenced in the Japanese automobile industry in the 1950s where capital-augmenting technical progress was associated with quality improvements and near constancy or occasional increase in labour productivity.[6]

6.2.6 Apart from this there is the general situation of capital-augmenting technical change where the output-capital ratio and the labour-capital ratio rise overtime, but the output-labour ratio declines. This occurs especially when the sacrifice of labour productivity is more than compensated

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[5] Ranis and Saxon House, op. cit., 1978.

[6] Odaka, K., op. cit., 1978. (The place of Medium and small-scale Firms in the Development of the Automobile Industry: A study of the Japanese Experience in Ohkawa, K. & Havami, Y. (ed.) Paper & Proceedings of the Conference on Japan's Historical Development Experience & contemporary Developing countries: Issues for comparative Analysis, International Development Centre of Japan, Tokyo, 1978 (mimeo).

profitwise by the gains from a more efficient deployment of capital.

6.2.7 In a recent paper Ishikawa[7] has shown that labour productivity and capital intensity are positively associated in Japan as well as in developing economies like India, Pakistan, and Philippines. He estimated a regression of labour productivity (measured by the value of output per unit of labour) on capital intensity (measured by the value of capital stock per unit of labour). He came to the conclusion that for any given level of capital intensity, the productivity of labour is much higher in Japan than in the developing economies like India. Moreover, the productivity differences seem to be much reduced at lower levels of capital intensity.

6.2.8 Under such a situation the importance of economies of scale in the capital-intensive chemical industry cannot be overemphasised. The markets in the developing economies are too small to support an optimum-sized plant. Hence the choice would be for the newly-developing countries to start in such a way as to be in tune with its factor endowments and relative prices, but plan in a big way such that a whole industrial complex strategy can be evolved as development proceeds.

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7 Ishikawa, S., "Appropriate Technology: Some Aspects of Japanese Experience" in A. Robinson (ed.) Appropriate Technologies for Third World Countries, International Economic Association Tehran Conference Proceedings, Macmillan, London, 1979.

6.2.9 In short, the direction of technological change in any system is not some macro level choice of technique, but an aggregation of hundreds and thousands of micro level choices in individual enterprises. Such decisions are mainly profit-guided responses to the particular opportunities facing each enterprise. These opportunities consist of the firm's access to technology, finance and foreign markets, position in the domestic product market, managerial capacities etc. Such micro level decisions add up to the macro level in the form of a relation between the direction of technical change and the size of industries.

6.3.0 Delays in Government Approvals

6.3.1 It is a self-evident fact from the experience of thirty years of planned development that nothing gets done quickly and efficiently in the country without passing through a whole host of regulations and approvals. Much time is wasted while the Governmental authority appraises and approves a project and grants a license. As a consequence, valuable capital, foreign exchange, manpower and machinery are inevitably wasted. Right from the time of project planning and inception till output is forthcoming and sales launched, the enterprise will have to pass through the intricate web of rules and regulations which will invariably dampen the initiative and enthusiasm of the entrepreneurs.

6.4.0 <u>The Problem of Pollution</u>

6.4.1 Environmental pollution has become a major problem in industrially developed countries. Pollution has inevitably evolved as a natural by-product of industrialisation. As J.R. Griffin puts it "Man in his efforts to kill a bug has slain fish, birds and animals, tainted his food and also disrupted or destroyed the ecology of vast areas. And the question becomes now whether he has become so successful that at last he is poisoning himself".[8] President Nixon has remarked that, "we can no longer consider air and water common property free to be abused by any one without regard to the consequences. Instead we should now begin to treat them as scarce resources which are no more free to contaminate than we are free to throw garbage into our neighbour's yard. . . . . The price tag on pollution control is high. Through our past years of carelessness we increased a debt to nature and now that debt is being called. . . . . We have been much tolerant of our surroundings and too willing to leave it to others to clean up our environments".[9]

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8 Griffin, J.R., "Environmental Pollution", <u>Chicago Sunday Times</u>, 25th May, 1969.

9 Nixon Richard, "The beginning of a new décade", Q.F.Mazumdar, A.H., "Environmental Pollution", <u>Chemical Industry News</u>, Vol.XV, No.12, April 1971, p.613.

6.4.2 The American ecologist Barry Commoner has remarked that the new technological man carries Iodine 131 in his thyroid, streatwin 90 in his bones, D.D.T. in his bone marrow, and asbestos in his lungs. The effects of pollution are visible in the notorious petrochemical smog of Los Angeles, the murkey haze over Mexico city, the choking carbon monoxide smoke of automobiles in New York, Tokyo etc., and also the acid rains over Norway and Sweden.[10] This is apart from the water pollution scenario of the big lakes and rivers in U.S.A., Sweden, U.S.S.R. and the muddy waters of the Thames. The Rhine alone is estimated to carry annually 95 tonnes of mercury, 600 tonnes of lead, and 2,000 tonnes of arsenic in its waters. With the increase in crude oil and petroleum traffic in super tankers, over 10 million tonnes of oil alone go into the sea water. These alarming statistics lead us to wonder how we manag to survive in the face of such overwhelming obstacles.

6.4.3 A team of M.I.T. Scientists in their provocative study, "The limits to growth"[11] have provided detailed estimates and future trends in pollution index caused by the exponential growth of carbon dioxide, thermal release, nuclear release,

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10 Trivedi, D.M., "Pollution Index For Growth Strategy", Chemical Industry News, Vol.XXII, No.6, Oct. 1977, p.395.

11 Ibid.

impact on fish-catch from the lakes, rivers and ocean beds, oxygen depletion in sea water, increase in mercury, lead and D.D.T. in human systems etc. According to them if the exponential trend in economic growth were to continue at the present rate, then the very survival of mankind will be in jeopardy within another 100 to 150 years due to the exhaustion of non-renewable resources and pollution saturation of the natural eco-system.

6.4.4 Any programme of industrialisation is liable to bring in its wake environmental problems if the effluent disposal problems are not properly attended to. This does not, however, mean that there has to be a fundamental conflict between growth and development. The ultimate purpose of both environmental and development policies is thus the enhancement of the quality of life beginning with the satisfaction of the basic human needs. In development planning environmental considerations have a central role to play. Environmental problems are created often by unforeseen and unplanned activities that contribute to environmental degradation alongwith material development. Hence the development process must be so designed and managed that environmental problems are kept to a minimum. Man is both the creature and moulder of his environment which gives him physical sustenance and affords him the opportunity for intellectual, moral, social and spiritual growth. In the long and tenuous evolution of the human race on this planet, a stage has been reached when through the rapid acceleration of science and technology man has acquired the power to transform his environment in countless ways and on an unprecedented scale. Both aspects of man's environment, the natural and the man-made are essential to his well-being and to the enjoyment of basic human rights - even the right to life itself. Hence planning for development involves environmental management. Environmental management involves the process of allocating natural and man-made resources so as to make the optimum use of the environment in satisfying basic human needs. Development properly defined is much more than a process of stimulating economic growth fuelled by the endless consumption of resources. It should also seek to conserve, replenish or improve both natural resources and human potentialities. Otherwise it is bound to be self-defeating because it will eventually devour its own life substance.

6.4.3 Kinds of Pollution

6.4.3.1 Environmental pollution can be broadly divided into three - air, water and soil pollution. Though civilian factors are also responsible for air pollution such as the increase in motor traffic and smoke from the chimneys, it is the chemical industry which has been branded as the major source of pollutant. Emissions from these industries are said to cause all three types of pollution -- air, water and soil. The incidence of air pollution is responsible for lowering visibility, sky darkening, soiling of surfaces, corrosion of structures and equipments, irritation to the eyes, nose and throat, and damage to life.

6.4.6 Sources of Pollution

6.4.6.1 (4) Air Pollution Air pollution is caused by a wide spectrum of factors ranging from dust, oxides of sulphur, ammonia, fluorides, chlorine, benzene etc. Dust eminating from the pneumatic phosphate rock handling unit is also an important source of air pollution. Rock dust pollution varies with the source of supply of rock and the fineness of rock. The greater the fineness of the rock, the greater will be the pollution due to rock dust powder. Jordan rock is considered to be much finer than Moroccan rock. Dust from ammonium sulphate and ammonium phosphate is also found to cause pollution. Sulphur dioxide and SO_3 also constitute another source of pollution. Hydrofluoric acid, chlorine, hydrogen chloride and benzene also pollute the atmosphere.

6.4.6.2 Water Pollution With an increasingly sophisticated industrial set-up, water pollution by industrial effluents has assumed alarming proportions in the last twenty years.

India's worst industrial water pollutants are pulp and paper mills, straw-board industries, distilleries, sugar industries, tanneries, nitrogenous fertiliser plants, petroleum industries, viscose rayon industries, steel plants, coal works, coke ovens, dyestuff industries, textile mills and chemical industries. The problem of water pollution is exaggerated by the fact that most of the water courses, in which these industries discharge their effluents, have seasonal flows and for eight to nine dry months of the year the dilution factor is nil.

6.4.6.3 Sources of Water Pollution A variety of water pollutants are discharged from the chemical industries as waste materials. Fertiliser factories produce large quantities of wastes ranging from two to three mgd for average-sized factories in India. The wastes contain a variety of substances such as:

(i) Carbon slurry (where partial oxidation method is used in the gasification).

(ii) Scrubber wastes such as (a) monoethanolamine (MEA), (b) Arsenic (As_2O_3), (c) Potassium carbonate (K_2Co_3) (d) Caustic soda (NaOH)

(iii) Ammonia-bearing wastes from the ammonia synthesis unit.

(iv) Urea and ammonia bearing wastes from the manufacture of ammonium sulphate.

(v) Ammonium sulphate wastes from the manufacture of ammonium sulphate.

(vi) Phosphates and fluoride containing wastes from the phosphoric acid plant.

(vii) Ammonium phosphate and ammonia from the ammonium phosphate plant.

(viii) Acidic spillages from the sulphuric acid plant.

(ix) Acid from regeneration of cation exchange units.

(x) Cooling waters.

(xi) Domestic sewage.

6.4.6.4 Soil Pollution The chemical industry discharges many solid wastes which, if indiscriminately dumped, can cause soil pollution. Calcium carbonate sludge obtained from the manufacture of ammonium sulphate by the double decomposition method is an important source of soil pollution. In the manufacture of urea, naphtha is converted to produce carbon dioxide and hydrogen. In the partial oxidation process carbon is discarded after scrubbing the gases. Indiscriminate discharge of carbon can create soil pollution. In urea production arsenic is used in scrubbing liquors. Weak wastes containing arsenic are further diluted and treated with the remaining wastes. However, strong wastes and sludges bearing arsenic have to be disposed of in land or barged to the sea. Careless disposal of these and other oil-bearing wastes can lead to heavy soil pollution.

6.4.7 Effects of Pollution

6.4.7.1 The effects of the most common pollutants in the chemical industry can be summarised as follows:

Pollutant	Typical sources	Effects
1. Ammonia	Fertiliser Industry	Violent respiratory reflexes, high concentration produces chemical burns on wet skin.
2. Carbon Monoxide	Burning of organic chemicals, flue gases	Carbon monoxide combines with haemoglobin of the blood and leads to blood poisoning.
3. Chlorine	Inorganic chemical Industries	Attacks the entire respiratory tract as well as the mucuous membrane of the eyes. Severe exposure can lead to death. Liquid chlorine causes burns.
4. Hydrogen Fluoride	Processing of phosphatic rock for fertilisers, fluorine-based chemical industry	Strong irritant and corrosive action on all body tissues, diseases of the bone, inhalation may lead to death, destruction of crops.
5. Hydrogen sulphide	Chemical industries using sulphur compounds, decomposition of organic materials	Irritating to the eyes and respiratory tract. High concentration may lead to death.
6. Mercury	Caustic soda cell operations, chlorine manufacture	Continued exposure results in blue line on gums, while absorption results in high blood pressure.
7. Nitrogen oxides	By-product of the fertiliser industry	Nitrogen dioxide NO_2 and nitric acid N_0 are toxicants. High concentration may lead to death.

Pollutant	Typical sources	Effects
8. Sulphur dioxide	From acid plants and sulphur roasters, sulphur producing oil or coal when burned in air	High concentration leads to respiratory paralysis leading to death, corrosive to equipments, destruction of plants.

6.4.3.2 The effects of the major pollutants are rather over-whelming. A great social and moral responsibility is thrust upon the industrial units to keep the level of pollutants at a minimum and to do the maximum possible to control the detrimental effects of pollution. This will impose a further financial burden on the enterprises, but when we consider the social cost of unleashing the pollutants into the midst of the innocent masses, this cost has to be borne with equianimity.

6.5 Functional Problems

6.5.1 As mentioned earlier functional problems include those mainly connected to the production process. High cost of production above selling price, lowering profitability, high cost of materials, power and fuel, underutilisation of capacity and such other problems are ever-increasing in the industrial units.

6.5.2 High Cost of Production

6.5.2.1 Cost of production has been showing an increasing trend. Except in monopoly concerns, they are generally found to be higher than the sales value of products. One main reason for this is the increase in the cost of raw materials, power and fuel and wages paid to employees. All these elements of cost need to be analysed to find the reasons for the high cost of production.

6.5.2.2 <u>Raw Material Costs</u> Raw materials form an important element in the cost structure of chemical industries. Not only do they form an important element of cost, the additional burden is that many of them have to be imported. This entails additional costs and depletion of our valuable foreign exchange reserves. Apart from this there is also the problem of sporadic supply. Since supply is uneven and cannot be pre-determined, huge quantities are invariably stored up as inventories.

6.5.2.3 <u>Efficiency of Raw Material Consumption</u> There has been a continually increasing trend in the quantity of raw materials consumed. Alongwith this there also appears to be a reduction in the efficiency of raw materials usage as estimated by the ratio of the cost of raw material to the total cost. An increase in this ratio inevitably shows a decline in the efficiency of raw material usage.

6.5.2.4 <u>Standards of Raw Material Consumption</u> All the products manufactured have specifications regarding the quantum of raw material to be consumed. However, these standards are rarely adhered to. The attainable ratios of consumption of raw materials as fixed by the management are generally higher than the designed ratios. In many cases the actual ratios even exceeded the attainable ratios especially in the case of public sector chemical companies. This is a further blackmark on the efficiency of the enterprises.

6.5.2.5 Inventory Control

6.5.2.5.1 Inventory control is an important element of efficient management of material usage of the enterprises. Firms are expected to have an "optimum or desired" stock in relation to a given output which they try to achieve. Metzler[12] has given a well-known explanation of the fluctuations in inventories based on the stock-flow analysis or the acceleration principle. Whether firms do seek to maintain an optimum relation between stock and output has been hotly debated by economists.[13]

6.5.2.5.2 The primary purpose of inventory accumulation appears to be to secure the advantage of minimum costs associated with bulk procurement of raw materials. These

12 Metzler Lloyd, "The Nature and Stability of Inventory Cycles", Review of Economics and Statistics, Vol.23, No.3, August 1941, p.113.

13 Abramovitz, M., op. cit., p.317.

economies arise due to decreasing unit cost of procurement with the lot size. There are also bound to be discounts and concessions permitted for bulk buying. However, on the other side of the picture problems are likely to arise due to the spoilage, obsolescence, interest payments, cost of storage etc. The economies of large-scale purchases may be offset by the excessive cost of maintenance. It is a balancing of these opposite forces that reveals the optimum level of inventory in relation to output.

6.5.2.5.3 Inventories are also held to even out the fluctuations in the rate of production to synchronise with concomitant sales. The lead time between production and off-take would result in the accumulation of inventories. Uncertainties in the raw material market and in the demand for final output also contribute to the holding of inventories. In the case of chemical industries particularly, when the raw materials have to be imported the uncertainties of foreign trade inevitably lead to an accumulation of inventories.

6.5.2.5.4 Even though the immediate aim of decisions affecting stock is not that of maintaining stock at any given time in a certain desirable relation to sales, as a general proposition we can assume that, "firms endeavour to establish and maintain such a relation although this relation may be disturbed by short run factors like price expectations and long run factors associated with technical change.[14]

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[14] Modigliani, op. cit., p.503.

6.5.2.5.5 It has been postulated that firms generally attempt a partial adjustment of the discrepancy between desired stocks and the existing inventory levels. Under such circumstances instantaneous adjustment of stocks to output may appear to be more realistic.[15] Even in an attempt at partial adjustment there are many economic and physical factors involved which provide the motivation for such an adjustment.[16]

6.5.2.5.6 Among the economic factors are included the time lags involved in replenishment or depletion of stocks, adjustment of storage capacity when an expansion is required and the time involved in the realignment of the heterogeneous composition of stocks. Higher costs that may have to be paid for speedy delivery may also contribute to partial adjustment. Market conditions may also advise a partial adjustment. "Full adjustment may not be attempted as manufacturers may not be sure as to how permanent the anticipated sales would be".[17]

6.5.2.5.7 The short run factors that influence the normal inventory output relationship are interest rate, price

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15 Goodwin Richard, in Murty & Sastry, op. cit., p.3.

16 Lovell Michael (i) "Manufacturers, Inventories, Sales Expectation and the Acceleration Principle", Vol.29, No.3, NBER, 1961, pp.293-314., (ii) "Determinants of Inventory Investment", Models of Income Determination, Studies in Income and Wealth, Vol.28, NBER, 1964, pp.177-224.

17 Eisner Robert & Strotz Robert, op. cit., pp.159-233.

anticipations, utilisation of productive capacity and availability of raw materials. Interest rate is said to exert a negative influence on inventory levels. Higher the cost of borrowing funds to finance inventories, lower will be the level of inventories. Anticipated changes in the price of raw materials can also change the level of inventories. When a price increase is expected the producer is likely to purchase the material immediately rather than wait for it till later. Nevertheless, it must be conceded that manufacturers do not purchase the raw materials earlier with a speculative motive of selling it at a higher price later. Their strategy is that of cost minimisation of future output.[18] As regards the stock of finished materials, manufacturers do not speculate but leave it to the traders whose specialised activity it is.[19]

6.5.2.5.8 Supply conditions can also influence the level of inventories. When supply conditions are easier with stable prices and shorter lead time, inventories in relation to a given level of output are likely to go down. The utilisation of productive capacity also has a definite impact on inventory output relationship.[20] Increased production in

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18 Abramovitz, op. cit., p.305.

19 Ibid., p.124.

20 Abramovitz, op. cit., p.310; Modigliani, op. cit., p.504. Zarnovitz Victor, "Unfilled Orders, Price Changes and Business Fluctuations", Occasional Papers, 84, NBER, New York, 1964.

relation to a given productive capacity may draw down the existing level of inventory of raw materials. If the increased capacity utilisation is expected, the manufacturer can increase the desired stock of raw materials in relation to current output. An increased demand for the product can lead to an instantaneous depletion in the stock of finished goods. The finished goods inventories in relation to output will increase if capacity utilisation changes at a faster rate than that required to replenish the depleted stock. The increase in utilisation implies an increase in output which comes out after a time lag. This necessarily implies also increased goods in process in relation to current output. Hence any change in productive capacity or in the rate of utilisation can lead to a change in the stock of raw materials, finished goods and goods in process.

6.5.2.5.9 "The long run factors that have relevance on inventory output relation may be broadly grouped as those relating to changes in production technology, communications, business institutions and practices and the composition of output".[21] Technological improvement in transport and

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21 Murty Krishna, K. and Sastry, D.U., Inventories in Indian Manufacturing, Academic Books Ltd., Bombay, 1970, p.7.

communication may lead to a reduction in the inventory output ratio overtime as such improvements would imply shorter time lags between orders and inventories.[22] Any change in production technology ushering in greater mechanisation will inevitably enhance the size of the establishment and the speed of operations. Increased mechanisation leading to higher speed of operations will necessarily require only a lower stock of raw materials and finished goods. "Greater mechanisation would, by reducing the period of production, decrease goods in process stocks with respect to the flow of output".[23] This lowering of the level of inventories will not be the unconditional result of mechanisation. Its effectiveness is subject to the existence of certain vital preconditions in the organisational and environmental set-up. "The economies in inventories associated with greater mechanisation may be realised subject to efficient internal organisation, efficient transport and distribution system, changes in the organisational structure of the industry like mergers both vertical and horizontal may contribute to a reduction in inventories in relation to output".[24]

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22 Kuznets Simon, Capital in the American Economy - Its formation and Financing, NBER, New York, 1961, p.163.

23 Boon, G.K., op. cit., p.31.

24 Darling Paul, "Inventory Fluctuations and Economic Instability", Inventory Fluctuations and Economic Stabilisation Part III, Materials prepared for the Joint Committee of the 87th Congress of the U.S., Washington, 1961, p.36.

6.5.2.5.10 Changes in the composition of output can also change the level of inventory requirements. An increased share of durables can increase inventory requirements as this involves larger stock of goods in process. If there is a change away from goods made to stock to goods made to order this may lower the stock of finished goods.

6.5.2.5.11 In the case of large-scale manufacturing a lowering of the capital-output ratio at the later stages of manufacturing may make for lower inventory levels. "Economy in the use of capital in the later stages may make for declining inventory-output ratios due to the indivisibilities of large-scale operations; although their impact may not apply with equal force on inventories as they should in the case of fixed capital".[25]

6.5.2.5.12 The size of production establishments can also influence the inventory levels. A larger establishment implies lower inventory holdings. Larger firms have greater accessibility to markets by their sheer size and hence require to hold only a lower level of inventories. On the other hand they may also have greater accessibility to capital markets and may resort to speculative holding of stocks.

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[25] Kuznets Simon, Introduction to Creamer Daniel et. al., Capital in Manufacturing and Mining - Its Formation and Financing, NBER, 1960, p.41.

But this is only a special case and not the general rule of the system.

6.5.2.5.13 Raw material inventories may be influenced by the character of raw materials and their sources of supply. In the case of raw materials coming from the agricultural sector, they will be influenced by the farm production cycles. In the case of raw materials imported directly by the manufacturers the adjustment of raw material stock to output may take time and hence larger stocks will have to be maintained. Government import restrictions and customs clearance etc., can also account for the tardy adjustment of the raw material stocks.

In the case of finished goods inventory, if the industry makes goods to order, finished goods inventory output ratio will be less than those in the goods made to stock.

6.5.2.6 <u>Inventory Accumulation in the Indian Context</u> Excessive inventory accumulation affects the cost of production as well as the profitability of the enterprises. This is especially true in the case of public sector enterprises. "Despite a perceptible increase in capacity utilisation, the rate of return on capital employed in public undertakings was merely 5.2 per cent in 1973-74".[26] "Another disturbing

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26 Singh, D., in <u>Organisation and Management of Public Enterprises, Vol.I,</u> (ed.) Gupta, K.R., Allied Publishers & Distributors, New Delhi, 1978, p.107.

factor in the Indian economy is that about 90 per cent of the working capital of most of our industries is locked up in inventories as against 30 per cent in industrially advanced countries".[27] The adoption of material management techniques, resulted in a reduction in material cost from 62 to 58 per cent in Japan. U.S.A. also achieved the distinction of reducing inventory investment by 20 - 30 per cent through the introduction of better inventory investment techniques. The reduction of store items by 16 - 70 per cent on an average of 40 per cent by some of the leading firms resulted in an average cost reduction of 80 per cent. Hence the cost of production in industries in general and the chemical industries in particular can be greatly minimised through an effective reduction in the level of inventories.

6.5.2.7 Factors Responsible for Increasing Inventory Investment

6.5.2.7.1 Different reasons have been attributed to the heavy increase in inventory investment. Inadequate material and inventory management amounting to heavy accumulation of slow moving/non-moving surplus stock coupled with unassigned

27 Rao, P.S., "Inventory Control in an Inflationary Economy", Lok Udyog, Vol.VIII, No.4, July, 1974, p.16.

responsibilities have been mentioned as one of the primary causes of increased inventory accumulation.[28] Delays in the disposal of surplus/unserviceable/obsolete stock, defective allocation of inventories amounting to excessive weightage to stores and spares, ill-equipped purchase organisation, procedures leading to longer lead time and excessive purchase at the close of the financial year, are also responsible factors.[29] Defective purchases and absence of proper purchase manuals are also factors which cannot be overlooked.

6.5.2.7.2 The failure of the stores department to maintain proper store accounts as to the stock of a particular item available, the average monthly requirements of the item etc., have also resulted in excessive inventory accumulation. Projections of future requirements are very often the result of guess work and a scientific approach is never taken. The value of outstanding discrepant items of storage and excesses have not been worked out. Purchases of stores and spares are not linked with total payments during the respective years. Non-maintenance of proper store accounts is a regular feature of many public sector enterprises.

28/ Government of India, Report of the Comptroller and Auditor General (Commercial), Part 7, 1970, p.73.

29/ Government of India, Committee on Public Undertakings - Fifth Lokasabha, Fortieth Report, 1972-73, p.31.

6.5.2.7.3 Moreover, in many industries there is a high percentage of orders for small items most of which are purchased on an emergency basis. Such unplanned purchases inevitably lead to excessive inventory accumulation. Besides this, "many public sector enterprises have not made any attempt to make a detailed analysis of inventories on the basis of their consumption and importance. In consequence there could not be any proper control on inventories".[30]

6.5.3 <u>Labour</u>

Labour forms the second important element of the cost structure. Chemical industries being capital-intensive, the percentage share of labour in the cost structure may not be very high. Yet the efficiency of labour usage, increasing trend in remuneration, overtime payments, increase in idle time and increasing number of mandays lost are all causes for concern.

6.5.3.1 <u>Increasing trend in remuneration</u> With the increase in the cost of living index, and increased bargaining power of the trade unions, labour inevitably gets an increase in the level of wages unconditional of the fact whether there is an increase in productivity or not. There has been a general

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30 Rao, S.R.K., "Inventory Investment in Public Sector Enterprises in India", Nigam, R.K. (ed.), <u>Management of Public Sector in India</u>, Vora & Co., Bombay, 1971, p.186.

increase in the amount of wages paid to the workers. At the same time this does not preclude an increase in the efficiency of labour usage. Efficiency of labour usage as evidenced by a decline in the ratio of labour remuneration to total cost is not generally seen.

6.5.3.2 Overtime Payments The increasing trend in overtime payments has become a salient feature of almost every manufacturing concern especially in the public sector. Overtime payments are generally made to give an increased impetus to productivity, but this has now become a loophole which the employees utilise to supplement their regular income. Overtime allowances are generally claimed by mutual adjustments or by purposefully delaying the job.

6.5.4 Power and Fuel

6.5.4.1 Power and fuel are the third vital element in the analysis of the functional problems of the chemical industries. They form a sizeable portion of the cost structure of chemical industries. In fact the easy availability of power appears to be one important reason for the establishment of chemical industry in the particular locality. Kerala until now had claimed to be extremely lucky in that respect, insofar as it had a satisfactory quantity of hydroelectric supply sources. However, in the present context the non-availability of this factor gives reasons for concern. It is no longer an abundant factor and the power shortage owing to lack of adequate rainfall has caused substantial losses to the different productive enterprises. Power-cuts and the severity of the salt water problem owing to severe drought has resulted in heavy losses for many of the chemical companies. In Ernakulam district alone which, is noted for its concentration of chemical industries, losses have amounted to Rs.10 crores in the year 1983. The major fertiliser plant - F.A.C.T - sustained a production loss of Rs.10 lakh per day. The undue concentration of salt in the water used has led to the stoppage of work in Cominco Binani Zinc Ltd. The salt content in the water used had risen upto 550ppm. Unless this falls to at least 150 - 200 ppm., the company will not be able to proceed with its work.

6.5.4.2 The stoppage of production in F.A.C.T. and Cominco Binani Zinc Ltd. has inevitably affected production in the two neighbouring factories producing formic acid viz. Kerala Acids and Chemicals Ltd. and Periyar Chemicals Ltd. Both these factories obtain carbon monoxide from F.A.C.T. and Sulphuric acid from Cominco Binani Zinc Ltd. Since these two materials were no longer forthcoming, the two companies had no alternative other than to stop production. Kerala Acids and Chemicals Ltd. tried to put off declaring a lay-off and thereby had to face a daily production loss of Rs.90,000. The company has yet to find the finance to meet the interest payments amounting to about Rs.3 lakhs on the Rs.24 lakh loan taken from the bank. Periyar Chemicals Ltd., in its turn, is facing a daily loss of at least Rs.75,000. The losses due to power-cut are severe. The 40 per cent power-cut has resulted in a drastic cut in the output of many chemical enterprises. In Travancore Titanium Products Ltd. the daily production of 30 - 35 tonnes had to be brought down to about 17 tonnes. This resulted in a loss of about Rs.3 lakhs per day. In Travancore Electro Chemical Industries Ltd. production levels have fallen from 100 - 120 tonnes per day to 50 - 60 tonnes per day resulting in a loss of about Rs.2 lakhs per day. Judging from the present experience there is little likelihood that the situation will improve. On the contrary it is only likely to deteriorate.

6.5.4.3 Increasing Trend in Power and Fuel Consumption

The rate of power and fuel consumption has continued to increase in many enterprises over the years. This increase, however, is not commensurate with the increase in output. Hence a decline in the efficiency of power usage is also noted. Standards of power consumption are established for every sector, but they are very rarely adhered to and whereever reports are available there appears to be an excess of consumption over the standards specified.

6.5.5 Financing Charges

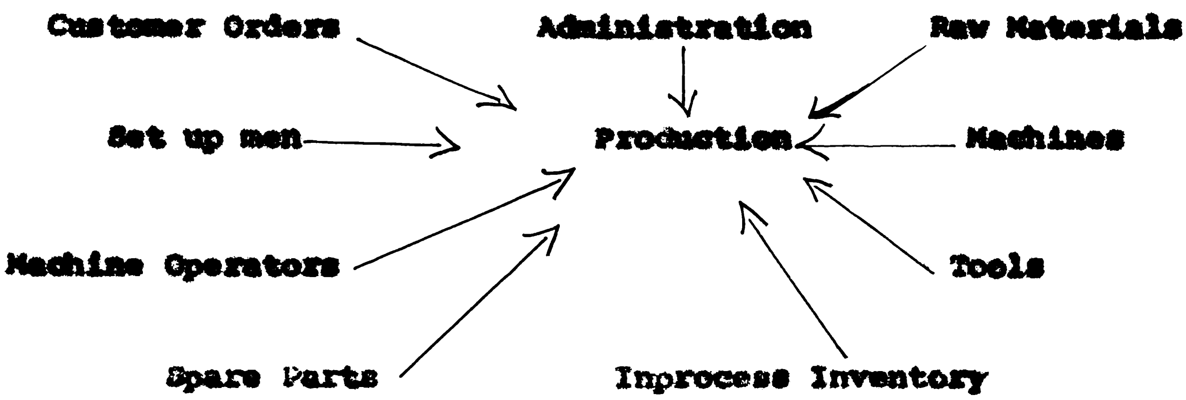
6.5.5.1 Financing charges are also found to exhibit an increasing trend thereby contributing their share to cost escalation. In the structure of finance of a commercial enterprise, internal finances such as depreciation, allowances, general reserve and various provisions, loans and cash credits command greater importance than equity capital. When the investors look for security of funds rather than return on capital, when marketing efforts require giving out long term loans to purchasing concerns, it may be profitable to take long term loans rather than to raise equity capital especially in a tight money market. However, when the volume of debts go beyond certain limits, interest charges tend to become so large that they ultimately become even larger than the principal. With huge amounts of capital outlays involved and with the gestation period of the profits being very high, financing charges can become a millstone round the entrepreneur's neck.

6.5.6 Depreciation

6.5.6.1 Depreciation is another element in the cost structure which has shown an increasing trend over the years. It has today become almost a variable expense on account of additional machinery purchased for expansion and replacement. Also in some companies the old age of plant and machinery which have more than outrun their life span makes for high depreciation charges. Replacement of old machinery and additions required for simultaneous expansion programmes have increased the depreciation expenses.

6.5.7 Capacity Utilisation

6.5.7.1 "Production can be considered as the joint resultant of many forces which facilitates production such as set-up men, machines, tools, customer orders, in process inventory, spare parts, raw materials and machine operator".[31] This can be illustrated as per the following figure:



In such a complex production process, the production can be held in waiting by anyone of the above factors.

31 Solomon Morris, J., Better Plant Utilisation in India, A Blue Print for Action, Asia Publishing House, Calcutta, 1963, p.13.

Such waiting erodes the capability of the system and inevitably leads to underutilisation of capacity. The efficient working of an enterprise depends upon the maximum possible utilisation of capacity.

6.5.7.2 Definitions of capacity have been as many and as varied as there are relevant studies on the subject. 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 processes and conditions".[32] Maximum capacity as defined by micro level studies computes total capacity on the basis of "total amount of productive time available per year on per capita equipment".[33] Bergstorm feels that capacities must be defined with reference to product lines and technical characteristics as well as inter-relationships among different groups.[34] He, therefore, estimates maximum capacity of a manufacturing facility using linear programming techniques.

6.5.7.3 At the establishment level, capacity may be defined either in terms of physical production functions or

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32 Budin Morris & Paul Samuel, "The Utilisation of Indian Industrial Capacity - 1949-59", <u>Indian Economic Journal</u> Vol.IX, No.1, July 1961, p. 20.

33 Solomon, M.J., <u>op. cit.</u>, p.15.

34 Bergstrom, G.L.D.R., <u>Resource Utilisation in Indian Manufacturing: A Mathematical Analysis</u>, Progressive Corporation Pvt. Ltd., Bombay, 1973, pp.7-11.

cost functions. In the latter case, output at the minimum of the long run average cost curve is sometimes used to define capacity.[35] This definition looks for the output rate towards which each firm is headed in its long range expansion plans; that output rate at which, given factor process, technology and a perfectly competitive situation, a profit-maximising entrepreneur would not be induced to expand or contract his scale of operations. However, this concept can no longer be accepted in an environment in which competition is imperfect and technology and input supply parameters are changing. Any minimum average capacity concept would be inappropriate under such conditions. De Leeuw has suggested another measure of capacity viz. that output at which short run marginal cost has reached a value, say 25 per cent above minimum short run average cost.[36] Such an estimate would be closer to an engineering estimate of the sustainable physical capabilities of plant and equipment, provided no material or labour shortages were encountered at outputs lower than the engineering rating and the equipment was in proper condition.

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35 Klein, L.R., "Some Theoretical Issues in the Measurement of Capacity", Econometrica, April 28, 1960, pp.272-286.

36 de Leeuw, F., "The Concept of Capacity", Proceedings of the Business and Economics Statistics Section, American Statistical Association, 1961, pp.320-323.

6.5.7.4 When the productive sector has a multiproduct mix a complete measure of capacity will run in terms of a production possibility surface in the multidimensional space of outputs. The capacity levels for the various output-mixes could be defined as the set of points on the various possible product-mix rays (one point per ray).

6.5.7.5 Phillips has specified two types of utilisation rates with the following requirements. "If output were defined in terms of the product mix existing at the time of the survey, two measures of excess capacity are possible. One is the difference between the actual output rate of the mix and the capacity output rate of the same mix. The other is the difference between the capital stock being utilised for the actual output and the total capital stock. When the structural factors are significant, the latter would yield a larger estimate of excess capacity than would the former".[37]

6.5.7.6 <u>Importance of the rate of capacity utilisation</u>

6.5.7.6.1 Underutilisation of capacity has been one of the important factors affecting the efficiency of a productive enterprise. "Accelerated industrial growth depends partly on the sustained increase in capacity and partly on the

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[37] Phillips, A., "Appraisal of Measures of Capacity", *American Economic Review*, Paper & Proceedings, 153, May 1963, pp.275-293.

optimum use of machinery, equipments, labour and materials. In recent times industrial growth has suffered due to the difficulties of maximising production against capacities installed and increasing capacity commensurate with demand".[38]

6.5.7.6.2 Studies made by the United States Agency for International Development and N.C.A.E.R. emphasise the view that net output in large scale enterprises in the industry could be increased substantially. The U.S.A.I.D study points out that "the net output of large scale enterprises could be increased with the already installed capacity by about 15 per cent in the case of chemical industries if an additional shift was introduced in their operation and the necessary import of raw materials (described as maintenance imports) provided for".[39] The N.C.A.E.R. estimate shows that "for the period 1961-64 the increase in net output that could be realised under what was described as desirable working conditions was over 50 per cent in the chemical industries. The shortage of foreign exchange for the import of components, raw materials and spare parts is undoubtedly the most important single factor limiting output in the industries studied. With greater availability of imported supplies, production can be raised almost immediately in at least the

38 Background paper on Maximising of Capacity Utilisation and Productivity, F.I.C.C.I., 1978, p.1.

39 Raj, K.N., op. cit., p.3.

same proportion".[40] The demand for final products in the present day is, however, substantially less than full capacity output in the technical sense. In such a situation it would be demand and not capacity that would set the limit to output if an adequate supply of components and raw materials are available.

6.5.7.7 Underutilisation of Capacity in Chemicals and Chemical Products

6.5.7.7.1 With a contribution of over 9 per cent to the net value added, the chemical industry occupies an important position in the manufacturing sector of the economy. The N.C.A.E.R in its study on underutilisation of capacity has prepared an index of the percentage of capacity utilisation in the chemical industry in India. On the basis of shifts actually worked (vide Table 6.1(a)), underutilisation which was very high during the I Plan period has been showing a tendency to decline. However, this does not mean that we can take a complacent view since there is much room for improvement especially in the case of agricultural chemicals (see Table 6.1(b).

6.5.7.7.2 In the case of nitrogenous fertilisers there was an annual capacity growth of 11.1 per cent, while capacity

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40 Ibid.

utilisation worked out to an average of 58 per cent. In P_2O_5 the rate of growth in capacity over 1974-78 is 12.5 per cent and the rate of capacity utilisation 56.6 per cent (vide Table 6.2).

6.5.7.7.3 It is self-evident that over the course of years the fertiliser industry has had a rather low rate of capacity utilisation. While capacity creation in N and P_2O_5 ranged between 11 and 12 per cent respectively over the past decade, capacity utilisation fluctuated between 56.2 and 54.3 per cent in 1974 to 71 per cent and 61 per cent in 1976 and 58 and 56.6 per cent in 1978. The inevitable consequence of this state of affairs is that there has been a sharp increase in the quantity of imports. While imports amounted to only 481,000 tonnes in 1971-72 it increased to 12,33,000 tonnes in 1978-79, even though domestic production had simultaneously increased from 94,900 tonnes to 21,200,000 tonnes. Even though the industry had a total installed capacity of 4.34 million tonnes consisting of 3.3 million tonnes of N and 1 million tonnes of P_2O_5, output of N was less than 2 million tonnes and that of P_2O_5 less than 7 lakh tonnes as per the Economic Survey of 1979-80. Even though output has increased, imports have increased at a faster rate because of the rapidly-increasing demand at home. In the case of N, production has increased from 949 thousand tonnes in 1971-72 to 2,200 thousand tonnes in 1978-79. At the same time imports have more than trebled from 481 thousand tonnes in 1971-72 to 1,283 thousand tonnes in 1978-79 (vide Table 6.3).

6.5.7.8 <u>Reasons for the Underutilisation of Capacity</u>

6.5.7.8.1 Many reasons - external and internal - have been postulated for the underutilisation of capacity. Some of these may be external in the sense that they may be causing underutilisation due to the particular socio-political environment in which the industry is situated. Other reasons may be internal in that they may be due to technological limitation, management problems etc. According to the Economic Survey 1979-80, "several factors are responsible for this poor performance but the most important is the unsatisfactory performance of the infrastructure. There was an acute shortage of power and severe powercuts in many parts of the country. Shortage of essential inputs led to an actual decline in production in a number of key industries and depressed performance over a wide range of industries. Hence industrial production rate was again negative (i.e. -1% compared to a 7.6% increase in 1978-79)".[41]

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[41] Government of India, <u>Economic Survey 1979-80</u>, p.12.

6.5.7.8.2 According to Samuel Paul, all the factors that can explain underutilisation of capacity in an industry can be divided into three groups:

(a) Industry characteristics

(i) Market structure
(ii) Pressure demand
(iii) Size of the firm

(b) Policy Influences

(i) Import substitution
(ii) Effective rate of protection
(iii) Raw material allocation

(c) Outliers

(i) Major additions to capacity in the preceding year
(ii) Strikes
(iii) Power shortage
(iv) Transport bottlenecks.[42]

6.5.7.8.4 In general the main factors affecting capacity utilisation can be grouped into:

(i) Raw material shortage

(ii) Transport bottlenecks

(iii) Technical factors

(a) Power shortages
(b) Old age of plants and interdependence
(c) Underutilisation of by-products
(d) Plant technology limitations
(e) Improper planning and diversification
(f) Poor labour relations and manpower planning.

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42 Samuel Paul, op. cit., pp.2025-2032.

6.5.7.8.5 Raw Material Shortage Among the reasons for underutilisation of capacity, raw material shortage occupies a prominent position. About 60 per cent of the idle capacity is attributed to this factor. Production is held up when raw materials are not regularly available and the nation's resources remain unutilised and underutilised. The shortage is experienced both with regard to imported and indigenous raw materials such as rock phosphate, sulphur, potash rock and naphtha. We depend heavily on imports for the supply of major raw materials. The Arab Oil crisis has given an impetus to other resource-producing countries also to form international commodity cartels in sulphur rock phosphate, bauxite etc. As a result, raw material price has jumped sky-high and availability is also not steady.

6.5.7.8.6 Transport bottlenecks Transport bottlenecks produce another serious problem in the way of efficient capacity utilisation. Location of industries are very often decided on political considerations rather than on scientific lines e.g. the Kerala State Drugs and Pharmaceuticals located near Alleppey would seem to be an ideally-situated one being on the National Highway. But it has no quick access to railway or air traffic. This is a unit which requires the best and quickest modes of transport. Moreover, the water in this area is salty and pure water is an important requirement where the manufacture of drugs is concerned. Any expansion programme will magnify these problems several-fold.

6.5.7.8.7 Technical factors

(a) Power shortage: Power shortage is a very serious drawback that almost every industry faces. Almost 10 percentage of the idle capacity has been attributed to power shortage. By the turn of the decade, this percentage is likely to shoot up. As things stand Kerala State which was once abundantly rich in its power resources has turned out to be a poor one and started begging power from neighbouring states. If this state of affairs persists and the monsoons continue to fail the necessary impetus for many new industries in the form of adequate power will no longer exist. This will inevitably affect Kerala's development programmes. Rapid expansion of capacity without proper planning and the switch-over to more sophisticated equipment in the thermal sector has also produced a number of problems. New plants are taking a longer time to stabilise. Due to erratic supply of power many plants have to be constantly shut down. After each shut-down it takes a long time for the plant to resume normal operations. This entails a complete disruption of the production programme which means additional losses for the unit.

The power sector has received due importance in all the planning schemes and there has been no dearth of investment in this sector. An average of at least 10 - 15 per cent of the Plan outlay has gone to the power sector over the past two and a half decades. However, capacity utilisation in the power sector has averaged only 44.5 per cent over a decade. Unless this state of affairs improve, it will prove to be a serious impediment to the enhancement of capacity utilisation in the chemical industry which is heavily dependent on power.

(b) Old age of Plants and Interdependence

Due to many financial and technical constraints expansion and renovation schemes are not forthcoming and many plants which had been set up thirty to thirty five years back still continue to run. For example in the oldest fertiliser factory in the State, many plants, which had been set up at its time of inception in 1948, still continue to run though they have far outlived their utility. The interdependence of as many as twenty plants of different vintages with varying capacities and different process routes all of which have to operate simultaneously to avoid constraints of raw material supply and their efficient working is the biggest problem.

(c) Underutilisation of by-products

Better utilisation of by-products would be of great help in reducing the cost of production. In many cases the by-products are just thrown down the drain and in fact additional expenditure has to be increased to dispose of the unutilised by-products. In fact subsidiary industries which effectively utilise the by-products could be established.

(d) Plant Technology Limitations

Plant technology problems have been in evidence at every stage of expansion. Due to our limited technological development we have to depend on foreign collaborators for the installation and running of new plants. These plants may not be suited to our local environment and serious design defects are often evidenced. Debottlenecking the plant will have to be undertaken at different stages which means an enhancement of the cost of capitalisation. With better internal technical services this problem can be solved to some extent.

(e) Improper Planning and Diversification

In many industries diversification and expansion have taken place without proper planning or demand surveys. Expansion of projects have been worked out in anticipation of the starting of new industries and the expansions connected with it. And it so happens in our country that the works do not proceed according to schedule and the new project inevitably gets delayed. All the planned programmes of the basic industry connected with the new project are inevitably dislocated and there is heavy underutilisation of capacity and undue financial losses. A little more careful planning and judicious decision-making might be more advisable.

(f) <u>Labour Relations and Manpower Planning</u>

Under the present social and political set-up it is becoming increasingly difficult to maintain work standards or introduce a system of rewards and punishments. It is the politicians who lead the unions and it is they who play the dominant role in making work rules. Any attempt at punishment are thwarted by the labour unions. The incentive schemes, as they appear now, have become a part of fixed costs to be awarded whether or not the worker has contributed towards increased productivity. Lethargy, waste of work time, opposition to control from above, are all the bane of any industrial concern. All this has directly or indirectly undermined the level of capacity utilisation of any industrial unit.

6.6.0 To conclude, the industrial units have to face a wide spectrum of general and functional problems during the course of their operation. The intensity of these problems, the way how they face them and their line of management are dealt with respect to the units studied in the next chapter.

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Table - 6.1(a)

Industry-wise Annual Percentage Underutilisation of Industrial Capacity

Chemical & Chemical products	No.of shift	No.of shifts	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
1. Sulphuric Acid	330	3	20.0	32.8	28.2	22.0	22.0	23.8	25.0	32.8	30.8	32.8
2. Caustic Soda	330	3	22.6	30.1	6.2	13.2	30.5	22.8	5.5	0.4	15.9	2.0
3. Soda Ash	330	3	14.3	6.5	15.0	19.6	15.6	34.1	19.5	16.1	2.3	5.1
4. Chlorine Liquid	330	3	42.5	28.7	25.0	36.2	23.6	7.3	1.7	23.0	14	12.5
5. Bleaching powder	330	3	67.4	68.0	63.3	55.3	64.5	71.5	69.8	58.4	43.5	39
6. Bichromates	330	3	45.5	50.7	44.6	49.6	36.6	26.6	24.5	1.3	16.6	5.9
7. Superphosphate	330	3	58.9	69.5	48.9	46.3	25	7.5	12.2	29.8	22.7	16.8
8. Ammonium sulphate	330	3	7.5	17.5	12.0	11.1	12.6	16.0	16.7	21	10.2	18.9
9. Hydrochloric Acid	300	1	57.1	41.0	33.0	36.5	39	33	18.5	17.5	0.2	11.5
10. Nitric Acid	300	1	70.6	67.8	63.3	58.0	53.7	35.1	55.8	45.8	63	18.6
11. Phosphoric Acid	300	1	85.0	69.9	82.8	60.0	40.0	25.7	30	60.7	70	28.3
12. Ammonium Chloride	300	1	-	-	-	25.3	38	73.0	59.7	65.5	55	63.1
13. Urea (N)	300	1	-	-	-	-	-	-	38.4	23.0	20.9	20.3
14. Ammonium phosphate (N)	300	1	-	-	-	-	-	-	-	27.2	20.1	29.5
15. Ammonium phosphate (P_2O_5)	300	1	-	-	-	-	-	-	-	70.4	74.3	48.2

Table - 6.1(b)

Capacity and Production in Certain Selected Industries

Industry	Unit	1980-81			1981-82			1982-83 (Anticipated)			1983-84 (Targets)		
		Capacity	Production	% of utilisation	Capacity	Production	% of utilisation	Capacity	Production	% of utilisation	Capacity	Production	% of utilisation
Basic Chemicals													
1. Caustic Soda	'000 tonnes	779	575	73.81	778.3	614	78.92	817.2	600	73.42	969	710	73.27
2. Soda Ash	"	633	563	88.94	680	632	92.94	746	600	80.43	761	630	82.79
3. Industrial Oxygen	MCM	124	95.1	76.69	135	115	85.19	150	115	76.67	165	125	75.76
Agricultural Chemicals													
1. Nitrogenous Fertilisers	'000 tonnes	4575	2164	47.30	4719	3144	66.62	5144	3420	66.49	5295	3802	71.80
2. Phosphatic Fertilisers	"	1282	842	65.68	1418	949	66.92	1418	976	68.83	1493	1150	77.03
3. B.H.C.	"	37.9	28.8	75.99	41.9	28.4	67.78	41.9	35	83.53	41.9	40	95.46
4. D.D.T	"	4.1	4.0	97.56	4.1	3.2	78.04	9.1	5.0	54.95	9.1	8.0	87.91
5. Other pesticides	"	27.5	9.3	33.94	27.5	14.4	52.36	31.7	16.4	51.74	31.7	21	66.25
6. Malathion	"	5.3	1.3	24.53	6.3	3.0	47.62	12.8	5.6	43.75	12.8	8	62.5
Petroleum Products	Million tonnes	35.85	24.12	67.28	135	115	85.19	150	115	76.67	165	125	75.75

Source: The Economic Times Statistical Survey of the Indian Economy 1984 (ed.) Hannan Ezekiel, Vikas Publishing House, New Delhi, 1984, pp.1975-76.

Table - 6.2

Trends in Capacity Utilisation in N and P_2O_5 Fertilisers for the Years 1974-78.

(in '000 tonnes)

Year	Capacity		Production		Percentage of capacity utilisation	
	N	P_2O_5	N	P_2O_5	N	P_2O_5
1974	1980	560	1112	304	56.2	54.3
1975	2458	685	1432	401	58.3	58.5
1976	2508	708	1780	432	71.0	61.0
1977	2929	829	1824	480	62.3	57.9
1978	3312	1082	1920	612	58.0	56.6

Source: Capacity Utilisation in Indian Industry, Mahanti, P.C., Commerce Pamphlet 151.

Table - 6.3

Production and Imports of N, P_2O_5 and K_2O Fertilisers

FOR THE Years 1971-72 to 1978-79

Year	N Production	N Imports	P_2O_5 Production	P_2O_5 Imports	K_2O Production	K_2O Imports
1971-72	949 (13.9)	481 (0.8)	290 (27.2)	248	-	269 (124.21)
1972-73	1054 (11.1)	665 (38.3)	330 (13.8)	204	-	326 (21.2)
1973-74	1050 (-0.4)	659 (-0.9)	325 (-1.5)	213	-	369 (13.2)
1974-75	1186 (13.0)	884 (34.1)	331 (1.8)	286	-	438 (18 .7)
1975-76	1508 (272)	996 (12-7)	320 (-3.3)	361	-	278 (-36.5)
1976-77	1909 (26.7)	751 (-24.6)	478 (49.4)	23	-	278
1977-78	2037 (6.7)	758 (0.91	670 (40.2)	164	-	599 (115.5)
1978-79	2200 (8.0)	1233 (62.7)	760 (13.4)	244		617 (-13.7)

Figures in brackets indicate rate of growth over previous year's level.

Source: Fertiliser Association of India, Fertiliser Statistics, 1978-79.

CHAPTER - VII

GENERAL AND FUNCTIONAL PROBLEMS OF THE ENTERPRISES

PART-II

7.0 In the light of the general and functional problems discussed in Chapter-VI, a survey was conducted in 14 major chemical units to ascertain the gravity of the problem with reference to each of the 14 units. Of the fourteen units, two have gone into production only recently. So a detailed discussion on them was not possible. Again, another company could not provide independent accounts as its accounts were clubbed with the other units of the parent company. Hence for this company, important variables such as sales, profitability and cost elements could not be studied in isolation.

A company has to face a variety of problems in areas such as availability of men, money and materials. An attempt has been made here to analyse the major problems which confront the chemical industrial units. The units whi have been surveyed had requested to conceal their identity and hence the names of these companies have not been exposed. They have been numerically ordered as Company I to XIV. Of these companies I to VII belong to the Public Sector, while Companies VIII to XIV belong to the private sector. An analysis of the production and cost elements is made to get the correct picture of the various problems encountered by the enterprises in their day-to-day functioning. The major production cost elements analysed here relate to cost of raw material, labour, power and their increasing trend in usage, efficiency of usage, depreciation and financing charges. The problem of capacity utilisation has also been studied because it has been seen that many of the public sector chemical companies are working much below their capacity levels. Pollution is another problem which acquires great significance as chemical industry is a major source of pollution of land, air and water.

7.1 <u>Company-I</u>

7.1.1 This company was one of the earliest chemical companies established in the State. Set up in the year 1944, it went into commercial production in the year 1947. It has the distinction of being the first large-scale manufacturer of nitrogenous fertilisers in India. It started with a capacity of 50,000 tonnes of ammonium sulphate to be manufactured from ammonia, based on gas generated out of junglewood and gypsum mined from Tiruchi. Hence even the process of production was of a unique nature so far as the industry was concerned. Soon after a super phosphate plant was started. Programmes of diversification and expansion were introduced subsequently and the unit came to manufacture a large variety of chemical fertilisers. Ammonium phosphate in two grades, ammonium sulphate, ammonium chloride, superphosphate, sulphuric acid, cryolite, urea, N P K etc., were the main products of the unit. Tables 7.1(a) and 7.1(b) show the annual installed capacity nutrient-wise and product-wise from the time of incorporation till 1-4-1980. From these tables it is evident that over the span of nearly three decades the company has come to manufacture a large variety of products. During this period it should have marked itself as a viable one, fulfilling economic and social objectives.

7.1.2 A study of the sales and total cost of the unit over the course of years shows that although the sales value of products has increased, the cost of production has also been increasing more than proportionately. The sales value of products increased substantially from Rs.2,605.803 lakhs in 1970-71 to Rs.8,333.158 lakhs in 1978-79. The loss for this period ranged from Rs.189.39 lakhs in 1970-71 to the all time high of Rs.1,396.12 lakhs in 1976-77. There appears to have been a turn for the better at the beginning of this decade in 1979-80 when the company appears to have made a profit of Rs.64.91 lakhs as per the balance sheet accounts (vide Table 7.2). But even here when we consider the amount disbursed as subsidies (Rs.4,311.08 lakhs in 1979-80 when the total sales was Rs.8,735.431 lakhs) it is self-evident that there was not any phenomenal reduction in the cost of production.

7.1.3 In order to identify the reasons for the increase in the cost of production which was responsible for increased losses, the important cost elements have been dissected into raw materials, labour, power and fuel, depreciation and financing charges. An attempt has also been made to probe into the reasons behind the increase in the cost of these elements. These cost elements have all shown a persistently increasing trend over the years.

7.1.4 Raw Material Costs

7.1.4.1 This forms an important element of the cost structure of chemical industries. Not only do the raw materials form a large percentage of total cost, the additional burden is that many of them such as naphtha, rock phosphate, crude oil etc., have to be imported. This often makes supply sporadic entailing additional costs. This necessitates storage of large quantities of raw materials as inventories. This increases raw material costs.

7.1.4.2 Raw Material Consumption

7.1.4.2.1 Apart from a continually increasing trend in raw materials, the efficiency of raw material usage has declined. This efficiency of usage has been estimated by finding the ratio of the factor to total cost. An increase in this ratio shows a decline in the efficiency of usage. The ratio of the cost of raw material consumed to total cost has increased steadily from 48 per cent in 1975-76 to 77 per cent in 1979-80 (vide Table 7.3). The absolute cost of raw materials has nearly doubled from Rs.3,503.06 lakhs in 1976 to Rs.6,987.3 lakhs in 1979-80 (vide Table 7.4).

7.1.4.3 Standards of Raw Material Consumption

7.1.4.3.1 Standards of raw material consumption have been duly fixed by the ISI. These are further revised by the management as designed and attainable ratios. In many cases the actual ratios are above the designed and attainable ratios (vide Table 7.5(a) and (b). The value of excess consumption of raw materials increased from Rs.30 lakhs in 1970-71 to Rs.85 lakhs in 1973-74.[1]

1 Sixty-seventh Report of the Committee on Public Undertakings 1974-75, V Lok Sabha, p.17.

7.1.4.3.2 The reasons for excess consumption have been stated by the management as follows:

(a) Naphtha The naphtha-ammonia ratios are not satisfactory since the plants are frequently shut down due to power interruptions. After each shutdown it takes about 8 - 10 hours for the oil gasification plant and 36 - 118 hours for the composite ammonia plant to come back on line. Another reason for the excess consumption is due to the venting of the gas as the load on the oil gasification plant cannot be reduced beyond 50 per cent even when the ammonia-consuming plants are shutdown.

(b) Sulphur Excess consumption of sulphur was mainly because of the poor performance of the 160 TPD. chemi-beu plant due to design deficiency. The two Monsanto Acid plants which had already outlived their useful lives were also responsible for the excess consumption of sulphur.

(c) Rock Phosphate and Sulphuric Acid Excess consumption of rock phosphate and sulphuric acid was due to the poor performance of the phosphoric acid, slurry filters and pumps.

(d) Ammonia Excess consumption of ammonia was due to the low production level in the end plant.

7.1.4.3.3 Besides the excess consumption of raw materials there had been losses due to the wastage of hydrogen and ammonia. In the case of hydrogen the percentage of wastage over production increased from 10 per cent in 1970-71 to 14.5 per cent in 1973-74. The corresponding losses increased from Rs.18 lakhs in 1970-71 to Rs.30 lakhs in 1973-74. In the case of ammonia the percentage of wastage increased from 1.5 per cent in 1970-71 to 2.6 per cent in 1972-73 and decreased to 2 per cent in 1973-74. The corresponding losses in value terms, however, increased from Rs.4.82 lakhs in 1970-71 to Rs.9.98 lakhs in 1972-73 and Rs.10 lakhs in 1973-74 (vide Table 7.6). The percentage of waste of ammonia has come down because of the installation of recording instruments and the control over consumption of ammonia.

7.1.4.3.4 <u>Loss of Steam:</u> During the year 1969-70 out of the total quantity of 324,000 tonnes of steam produced only 217,000 tonnes were accounted for. Even allowing for a 10 per cent wastage in production 23 per cent of the total production valued at Rs.12 lakhs was not accounted for. This was stated to be due to lack of instrumentation in some of the plants.

7.1.4.4 <u>Inventory Control</u>

7.1.4.4.1 Efficient inventory control can go a long way in increasing the efficiency of material usage. However, in actual practice very few companies undertake scientific management of inventory control. There is an inevitable overstocking of materials, stores and spares and finished goods with the result that the working capital is blocked up.

7.1.4.4.2 In company X, the inventory of stores has shown a decrease from Rs.15.29 crores at the end of 1970-71 to Rs.8.85 crores on March 31st 1974. The value of spares included in the inventory, however, showed an increase from Rs.108 lakhs representing 42.8 months consumption to Rs.185 lakhs representing 71 months' consumption. The value of stores and spares further increased to Rs.15.28 crores in 1978-79 and Rs.24.88 crores in 1979-80.

7.1.4.4.3 With regard to the raw materials like sulphur and rock phosphate there was a shortage of the stock valued at Rs.113.53 lakhs during 1969-70 and 1970-71 out of which Rs.46 lakhs were written off.[2] The stock of raw materials has increased nearly four times from Rs.208.16 lakhs in 1977-78 to Rs.856.89 lakhs in 1979-80.

7.1.4.4.4 A special audit covering a period from April 1st 1967 to March 31st 1972 brought to light a number of deficiencies in the stores procedures. The major among them are listed below:

2 *Ibid.*, p.20.

(i) No weighment of raw materials carried by boats to the factory was done and the quantity indicated in the bill of lading was shown as fully received. Payments to suppliers were made on the basis of the weights indicated in the bill of lading.

(ii) Material report receipts of sulphur and rock phosphate were issued only after considerable delay.

(iii) Entries to store ledgers have not been made in chronological order.

(iv) Theoretical consumption ratios were adopted from time to time to cover handling and other losses. They were not charged in the accounts.

(v) Rock phosphate was reported to have been washed downstream due to the collapse of the retaining wall. No steps were taken to ascertain the quantity.

(vi) Survey of sulphur was also defective. Sulphur and rock phosphate were kept in open heaps and gypsum was dumped in various parts of the township.

(vii) Discrepancies were noted between survey figures and book balances. It was reported that the survey figures were made to agree with the book figures.

(viii) As against the shortage of Rs.1.38 crores both in regard to rock phosphate and sulphur during the period 1967-68 and 1971-72 the value of stores written off in the accounts for 1969-70 to 1971-72 was Rs.1.11 crores only, although the entire quantity of shortage had been written off.

(ix) The quantities charged to accounts as consumed are higher than those calculated on the basis of reasonable consumption ratios of sulphur and rock phosphate. There was a loss of Rs.43.25 lakhs in sulphur and Rs.37.83 lakhs in rock phosphate.

(x) There was no effective system of internal check on raw materials and efficiencies in their usage and on finished products.

(xi) There was no proper system of assessing the raw material requirements and for planning purchases which resulted in excessive stocks.

(xii) With regard to stores and tools in plants, for none of the items maximum limits were fixed, store ledgers were in arrears, bin cards for about 6,000 spares and stores were continued to be maintained though the stores were not physically available.

(xiii) Inspite of a system of perpetual stock verification only a small number of total items was covered every year. The value of shortages in 1972-73 was of the order of Rs.10.89 lakhs and excess Rs.2.23 lakhs.

(xiv) Non-moving stores which constituted 28 per cent of the total value of stores accounted for more than Rs.118 lakhs as on 31-3-1972. No procedure was adopted to review the store items from time to time.

(xv) No reconciliation of bincard balances with ledger balances was done.

(xvi) Accounts of tools and plants were not properly maintained.

(xvii) Physical verification reports were not pursued centrally.

In short inventory management in the unit leaves much to be desired.

7.1.5 Efficiency of Labour Usage

7.1.5.1 The remuneration paid to employees has steadily increased from Rs.694.75 lakhs in 1974-75 to Rs.1,014 lakhs in 1979-80. The ratio of remuneration to total cost also increased from 9.6 per cent to 11.2 per cent signifying a decline in efficiency (vide Table 7.3).

7.1.5.2 Overtime Payments

7.1.5.2.1 While the basic idea behind overtime payments was to increase productivity per worker, it has today to come to be established as a supplementary allowance. Overtime payments in this unit was found to be very high. In the Udyogamandal Division it increased from Rs.33.66 lakhs in 1975-76 to Rs.57.44 lakhs in 1979-80. In percentage terms this showed an increase from 13.44 per cent to 22.98 per cent of the total wage bill. In certain departments it has spiralled to as much as 72 per cent in certain months. Cochin Division has also shown an increase in overtime allowances paid. It went up from Rs.8.33 lakhs in 1975-76 to Rs.27.55 lakhs in 1979-80 — an increase from 12.35 per cent to 21.35 per cent (vide Table 7.7). The additional expenditure due to the surplus staff was of the order of Rs.72 lakhs. The surplus in certain departments like marine, transport, garage, security etc. cannot be utilised for production or maintenance departments where the incidence of overtime is high. Suitable productivity norms should be fixed, so that expenses on overtime are obviated.

7.1.6 Power and Fuel Power and fuel consumption has also increased. Annual loss on account of power failure was estimated to be to the extent of Rs.150 lakhs in 1973-74.

7.1.7 Financing Charges The ratio of financing charges to total cost increased from 6 per cent in 1975-76 to 9.54 per cent in 1979-80. The interest cost figures nearly doubled from Rs.443.95 lakhs in 1975-76 to Rs.850.47 lakhs in 1979-80 (vide Table 7.4).

7.1.8 Depreciation

7.1.8.1 Due to the old age of plants and machinery which have more than outrun their life span, depreciation figures are very high. Replacement of old machinery and the additions required for the expansion programmes have increased the depreciation expenditure from Rs.742.55 lakhs in 1975-76 to Rs.1,049.61 lakhs in 1979-80 (vide Table 7.4).

7.1.9 Underutilisation of Capacity

7.1.9.1 Production and capacity utilisation of nutrients for the last five years shows that in the case of 'N' capacity utilisation varied between 61 and 68 per cent and for P_2O_5 it varied between 58 per cent and 76 per cent (vide Table 7.8).

7.1.9.2 The main problems encountered in raising production and capacity utilisation are:-

1. Frequent power failure
2. Old age of equipment

3. Interdependence of plants
4. Non-availability of spare parts
5. Raw material shortage for ammonium chloride
6. Inadequate quantity of sulphuric acid

7.1.9.3 The low capacity utilisation in the Udyogamandal plant has been mainly due to the large number of multistream plants, power interruptions and consequent changes, lack of spare equipments and built-in capacity, undue interdependence of plants and lack of intermediaries mainly sulphuric acid, insufficient refrigeration capacity etc.

7.1.9.4 In the Cochin Division Phase I plants capacity utilisation was low due to serious design defects in the waste heat recovery section of the ammonia plant. After the implementation of the plant operating improvement programme, plant load could be increased to 85 per cent on a sustained basis. However, further increase in load could not be achieved due to the shortage of high pressure stream. Shortage of raw materials restricts the capacity utilisation in the urea plant. In the Phase II plants capacity utilisation was restricted due to various operating problems and the congested lay out of the plant. M/s. Asian Development Services had to be entrusted with debottlenecking the plant. All this meant that the actual cost of capitalisation went far beyond the estimated figure. With better internal technical services and prior planning, many problems could have been avoided and capacity utilisation enhanced.

7.1.10 The Problem of Pollution

7.1.10.1 Atmospheric pollution from the various plants of the company and the raw material handling sections are a constant hazard to men and materials. The main air pollutants of the Udyogamandal plants are dust, H_2S, HCl, SO_2, SO_3, HF, Benzene and Chlorine. The dust mostly emanates from the pneumatic rock phosphate handling unit. The greater the fineness of the rock, the greater will be the pollution due to rock powder dust while handling it for stacking, transferring, melting etc. In addition, rock dust from ammonium sulphate and ammonium phosphate sections is also found to settle on the heavy electrical equipment. Sulphur dioxide and traces of SO_3 sent out from the stacks of sulphuric acid plants constitute another source of pollution. Hydrofluoric acid (HF) emanating from the superphosphate and phosphoric acid plants forms yet another source of atmospheric pollution.

7.1.10.2 The main sources of water pollution are free ammonia, dissolved phosphates, fluorides and suspended solids in the effluents.

7.1.10.3 Pollution Control Measures

7.1.10.3.1 A Rs.200 lakh-project is being implemented with a recurring expenditure of Rs.130 lakhs to control water pollution in the Udyogamandal unit. The unit has made arrangements for drains containing free ammonia to be segregated and arrangements have been made to use them in the sulphate and So_2 recovery plant. Dissolved phosphates and fluorides are removed as insoluble calcium fluoride and phosphates. For this treatment plants and a clarifloculator for settling the sludge have already been completed.

7.1.10.3.2 Suspended solids and chalk of gypsum are treated and carried to an intermediate storage shed through conveyor belts from where they are dumped to low-lying areas.

7.1.10.3.3 Carbon impurities from the O.G plant have been separated from the effluent by treating with naphtha. It is mixed with furnace oil and is pumped to the boiler plant to be used as fuel. The naphtha is distilled, cooled and reused.

7.1.10.3.4 Air Pollution Control The construction of a Rs.244 lakh-project of D.C.D.A has been envisaged. A sulphuric acid plant was also installed earlier, so as to increase acid production and also to reduce So_2 emission to the air.

Mist eliminators have been installed to remove acid mist escaping to the atmosphere. All grinding mills have been attached with automatic bag filters and cyclonic water scrubbers.

7.1.10.3.5 The National Environmental Engineering Research Institute (NEERI) envisages schemes costing Rs.6 crores and a recurring cost of Rs.328 lakhs per annum with a view to reduce the hazards of pollution in Cochin Division from ammonia, chromium, arsenic and oil. Ammonia strippers have been installed to remove the ammonia from the effluents coming from the Phase I plant. When the NPK facilities are operated to the full extent nearly 1,800 tonnes of gypsum will be produced as by-product. It has been envisaged to set up a 450 TPD ammonium sulphate plant with an outlay of Rs.13 crores which can effectively utilise the by-product gypsum. The by-product of this new plant - calcium carbonate - can get a ready market from the cement plants. The company itself is evaluating the viability of a cement sulphuric acid plant to utilise the by-product.

7.1.10.3.6 Despite such measures by the company, the threat of pollution is ever-strong. The carbon recovery plant installed to separate the carbon from the oil gasification plant has not been functioning. Of the two sulphur dioxide plants, one could not function systematically due to the old age of the plant. Hence the quantum of sulphur dioxide emissions has been very high. The poisonous gases from the ammonium phosphate, super phosphate and phosphoric acid plants is a threat to all forms of life - plant and animal. The dust emissions from the ammonium sulphate plant and rock phosphate grinding mill is also another source of pollution. Gypsum from the phosphoric acid plant, calcium carbonate from the ammonium sulphate and carbon particles from the oil gasification plant are all causes for air and water pollution in and around the area. The carbon recovery plant worked for only a month since its installation. It was once again worked when the Tilak Committee visited the factory to study the prospects for the caprolactum plant. Not only was the sulphur recovery plant not working, but the concrete stack 400 feet high was rendered useless due to the breaking of the refractory bricks. There can be leakage of the gas, if the stack breaks down at any time. The effluent mixed with carbon, phospharic acid and gypsum has been responsible for the destruction of cultivation around the industrial belt.

7.1.11 Selling Prices lower than Cost of Production

7.1.11.1 Upto 1977 fertiliser prices were administered by the Government and sales realisation was less than the cost of production. Around 1977 the Government set up a Fertiliser Industry Coordination Committee. A scheme of retention prices applicable to each fertiliser manufactured was brought into effect from 1-11-1977 for nitrogenous fertilisers and from 1-2-1979 for phosphatic fertilisers. The retention price scheme was broad-based and fixed retention prices to provide a 12 per cent return on investments. This improved product profitability to a certain extent (vide Table 7.9). The table shows selling price and cost of production in respect of the major products for the years 1974-75 to 1979-80. The total sales realisation inclusive of subsidy, however, has been persistently less than the cost of sales with respect to all the major products. The main reason for this is inevitably the escalating cost of production over the course of years. The old age of plant and equipment and problems of technology in the new plants have also caused underutilisation of capacity. Table 7.10 shows the budgeted and actual production for the years 1971-72 to 1979-80, and the cumulative losses upto the period. There has been perpetual losses over the years except for the year 1979-80 when the company appeared to have earned a profit of Rs.65 lakhs. The cumulative losses upto the period amounted to Rs.5,538 lakhs which came upto nearly half of the paid-up capital, viz. Rs.12,321 lakhs. Though the company managed to obtain a profit of Rs.160 lakhs for another year 1980-81, it sustained a heavy loss of Rs.1,099 lakhs in 1981-82 and Rs.7.2 lakhs in 1982-83. The only ray of hope for this company is the proposed caprolactum plant. It is hoped that this plant will help it to tide over its difficulties. Without enlightened management and strict financial controls the future of this major chemical plant appears to be rather bleak.

7.2 Company-II

7.2.0 This company was incorporated in the year 1951 with the main object of undertaking the manufacture and sale of caustic soda, other allied chemicals and by-products. Started originally in the private sector the company was taken over by the State Government in August 1960. Like Company-I, this company also was a pioneer in its field in Kerala.

7.2.1 The caustic soda plant was installed in December 1953 and commercial production started in 1954. Today the company is engaged in the manufacture of caustic soda, sodium hydrosulphite, sodium sulphide and chlorine. The main product of the company is caustic soda. Caustic soda is a basic alkali used in the manufacture of articles of daily use like soap, paper and textiles. The company initially started commercial production with an installed capacity of 20 tonnes of caustic soda per day. With the completion of the IV Stage expansion this has increased to 180 tonnes per day. Chlorine is a by-product in the manufacture of caustic soda. A part of the chlorine so produced is burnt with hydrogen to produce hydrochloric acid and the other part is liquified for sale as liquid chlorine. Chlorine is used for the purification of water, bleaching and as a base for insecticides, plastics and organic chemicals.

7.2.1.1 Sodium hydrosulphite is produced by the reaction of zinc dust with liquid sulphur dioxide and the conversion of zinc hydrosulphite so formed into sodium hydrosulphite by double decomposition with caustic soda solution. The chemical finds application in the textile industry, particularly when using vat stuffs for lightening or levelling out dyeings, stripping dyed shades, pre-reducing vat dyestuffs in textile printing and also in the sugar industry as a strong reducing and bleaching agent.

7.2.1.2 Sodium sulphide is another product of the company. The sodium amalgam produced by electrolysis of sodium chloride brine is heated with polysulphide solution when the sodium from the amalgam is converted into sodium sulphide. Sodium sulphide finds application in tanning operations, textile dyeing and printing photography and other industries.

7.2.1.3 The cost of production for the different items has been increasing steadily. It increased from Rs.567.70 lakhs in 1975-76 to Rs.906.94 lakhs in 1976-77, while the sales increased from Rs.412.17 lakhs to only Rs.600.68 lakhs during the same period. Losses more than doubled from Rs.150.53 lakhs to Rs.306.26 lakhs (vide Table 7.11). At the turn of the decade there appears to be a slight change for the better when the sales value increased from Rs.674.24 lakhs to Rs.932.10 lakhs. The probable reason for this increase was the increased selling price of caustic soda. In the case of caustic soda lye it increased from Rs.1,635/M.T. in 1977-78 to Rs.2,622/M.T. in 1979-80. For solids the increase was from Rs.1,646/M.T. to Rs.3,167 and for flakes from Rs.1,893 to Rs.3,287 for the same period. In the case of sodium hydrosulphite it increased from Rs.16,810 to Rs.18,793 and for sodium sulphide from Rs.3,655 to Rs.4,395 (vide Table 7.12). Though the cost of production has also increased the quantum of losses has come down significantly.

7.2.2 Raw Material Consumption

7.2.2.1 The value of raw material consumed increased from Rs.152.29 lakhs in 1975-76 to Rs.211.04 lakhs in 1979-80 (vide Table 7.13). The relevant point here is not the increase in absolute values, but how efficiently they are utilised. An enquiry into the standard norms of raw material consumption and the actual quantities utilised shows that there are wide variations between the two. Consequently the extra expenditure incurred due to excess consumption was considerably large. The value of excess consumption of common salt for the production of one tonne of caustic soda for the years 1971-72, 1972-73 and 1973-74 were Rs.18.63, Rs.16.27 and Rs.17.49 respectively. For the production of one tonne of hydrosulphite the excess value of zinc dust was Rs.136.08 and Rs.99.63 for 1971-72 and 1972-73, that of sulphur dioxide was Rs.76.22 and Rs.43.26 for the same years and menthol Rs.107.20, Rs.194.43 and Rs.177.5 for 1971-72, 1972-73 and 1973-74 (vide Table 7.14(a)). The extra expenditure due to excess consumption during the years 1971-72, 1972-73 and 1973-74 amounted to Rs.8.70 lakhs, Rs.6.76 lakhs and Rs.6.08 lakhs respectively.[3] In 1973-74 the excess consumption compared to norms in respect of common salt and menthol was 8 per cent and 76 per cent respectively. During the years 1977-78, 1978-79 and 1979-80 the value of excess consumption over norms fixed by the company seems to be coming down (vide Table 7.14 (b)). This is mainly because the norms fixed by the company are inevitably higher than the guaranteed norms. The company's norms in respect of common salt are 2 and 1.9 tonnes per tonne of caustic soda produced for the old and new plant respectively, whereas the guaranteed norms are 1.5551 and 1.524 tonnes. The company claims that this is done,

[3] Government of Kerala, Report of the Comptroller and Auditor General of India 1973-74 (Commercial), p.37.

so as to cover the handling and storage loss and the impurities of the salt produced. The value of excess consumption of common salt for this period was Rs.6.46 lakhs, Rs.3.00 lakhs and Rs.4.27 lakhs. For sulphur dioxide it was Rs.1.76 lakhs in 1977-78 and Rs.0.31 lakhs in 1979-80. In the case of sulphur dioxide also it decreased to Rs.0.61 lakhs, Rs.0.21 lakhs and Rs.0.58 lakhs.[4]

7.2.2.2 Excess Consumption of Mercury Mercury is used in the unit as a cathode for electrolysis in the production of caustic soda. An assessment of the physical balance of mercury in the plant was conducted only once at the end of 1979-80. The figures for the consumption of mercury since inception upto 1980 appeared to be far in excess of the guaranteed norms and even the norms fixed by the company. The cost of excess consumption of mercury on the basis of guaranteed norms amounted to Rs.244.622lakhs and to Rs.131 lakhs on the basis of norms fixed by the company. Another interesting point is that while the excess consumption in the old plant occurred during a period of 26 years (January 1954 to March 1980) the excess consumption in the new plant occurred within a period of five years.

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[4] Cost Audit Reports of the Company 1979-80.

7.2.2.3 Inventory Control An analysis of the level of inventories held shows that the levels held are far in excess of the generally acceptable norms. The stock of raw materials held at the end of 1973-74 represented 4.8 months' consumption as compared to 5.2 months' and 3 months' consumption in 1972-73 and 1971-72 respectively. The stock of common salt alone worked out to 4.3 months', 6 months' and 3.6 months' consumption as against 3 months' stock required according to the company's estimate. The closing stock of spares and stores, which formed the bulk of inventory, equalled about 26 months' consumption in 1973-74 as compared to 40 months' consumption in 1972-73 and 38 months' in 1971-72.[$] The closing stock of graphite, mercury and general stores held on 31-3-1979 amounted to Rs.37.00 lakhs, Rs.6.81 lakhs and Rs.125.68 lakhs, respectively. This is very high compared to the consumption of the same items for 1977-78 as Rs.19.47 lakhs, Rs.5.77 lakhs and Rs.50.02 lakhs respectively. In 1979-80 also the picture was not much better. The value of closing stock of graphite, mercury and general stores on 31-3-1980 was Rs.51.08 lakhs, Rs.7.99 lakhs and Rs.164.23 lakhs, whereas the annual consumption was only Rs.26.76 lakhs,

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$ Report of the Comptroller and Auditor General (Commercial), 1973-74, p.39.

Rs.7.44 lakhs and Rs.88.68 lakhs. The stock levels of these three items amounted to 23, 13 and 22 months' consumption respectively.[6] If this state of affairs continues, the inventory levels will prove to be a heavy burden on the company's financial position whose debt burden is already a heavy millstone round the neck.

7.2.3 Labour Cost

7.2.3.1 The amount disbursed as salaries and wages increased from Rs.103.87 lakhs in 1973-74 to Rs.162.45 lakhs in 1979-80 (vide Table 7.15). This includes the wages paid to workers in the sodium sulphide and sodium hydrosulphite plants. These two plants were working only at intervals, but the workers engaged for these plants were deployed throughout the year resulting in payment of idle wages.

7.2.3.2 Overtime Allowances Overtime allowances paid in the company during the years 1971-72, 1972-73 and 1973-74 for the factory staff amounted to Rs.6.35 lakhs, Rs.7.20 lakhs and Rs.9.18 lakhs respectively. In percentage terms this works out to 18.86, 22.91 and 22.92 per cent respectively of the total salaries and wages. In the case of administrative

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6 Cost Audit Reports of the Company for the years 1977-78, 1978-79 and 1979-80 (unpublished).

staff also overtime allowances for the same period were a sizeable percentage namely 14.01, 18.57 and 20.35 per cent of their salaries, the corresponding amounts being Rs.1.36 lakhs, Rs.1.46 lakhs and Rs.2.32 lakhs (vide Table 7.16).

7.2.4 Power and Fuel

7.2.4.1 An increasing trend in power and fuel consumption has been in evidence. The cost of power and fuel has increased from Rs.41.38 lakhs in 1972-73 to Rs.124.16 lakhs in 1977-78 and Rs.122.05 lakhs in 1979-80 (vide Table 7.17).

7.2.4.2 Not only is there an increasing trend in power and fuel consumption, the standards are also very rarely maintained. The extra expenditure on excess consumption of power worked out to Rs.0.96 lakhs in 1971-72, Rs.6.84 lakhs in 1972-73 and Rs.6.40 lakhs in 1973-74.[7] This is because the actual consumption has exceeded the standards by as much as 801 and 891 kw per tonne of caustic soda produced for the years 1973-74 and 1972-73.

Excess Consumption of Power

	1971-72	1972-73	1973-74
	(kwh per tonne of caustic soda produced)		
Power required as per norm.	3,855	3,855	3,855
Power consumed	3,970	4,674	4,656
Excess consumption of power	115	819	801

[7] Report of the Comptroller & Auditor General 1973-74, op.cit., p.38.

The value of excess consumption of power in the years 1977-78, 1978-79 and 1979-80 was Rs.3.94 lakhs, Rs.3.31 lakhs and Rs.3.66 lakhs respectively.[8]

7.2.4.3 There has also been an abnormal wastage of furnace oil. Actual consumption of furnace oil is nearly three and a half times that of the standard. Loss on this account alone is of the order of Rs.14 lakhs.[9] In conditions of uncertain availability and the ever-increasing prices of petroleum products, it is absolutely necessary that such losses be avoided.

<u>Furnace Oil Consumption for 1979-80</u>

(Quantity in KL)

	Standard	Actual	Wastage Quantity	Wastage %
1. Caustic soda fusion	1,073	1,126	53	
2. Broiler brine treating and fusion	160	554	394	
3. Other products	286	990	704	
Total (2+3)	446	1544	1098	246%

[8] Report of Comptroller & Auditor General 1979-80, *op. cit.*, p.84.

[9] Cost Audit Report of the Company 1979-80 (unpublished).

7.2.5 Financing Charges

7.2.5.1 This has been another heavy burden on the company. The amount of financing charges increased from Rs.20.17 lakhs in 1974-75 to Rs.172.03 lakhs in 1979-80. The ratio of financing charges to total cost increased from 4 per cent in 1973-74 to 18 per cent in 1979-80. For the loans acquired from the I.D.B.I., I.F.C.I., L.I.C., S.B.T., I.O.B. and K.S.I.D.C. the company has accumulated interest upto Rs.482.26 lakhs from 1975-76 to 1979-80 for a total principal of Rs.408.25 lakhs. It appears in this case to be a pure question of interest eating away the principal.

7.2.6 Depreciation

7.2.6.1 Depreciation has also shown an increasing trend. The amount of depreciation which was only Rs.63.93 lakhs in 1972-73 increased to Rs.151.39 lakhs in 1977-78. However, it showed a slight decline in the next two years, viz. to Rs.147.51 lakhs in 1978-79 and Rs.141.99 lakhs in 1979-80 (vide Table 7.17).

7.2.7 Underutilisation of Capacity

7.2.7.1 Capacity utilisation has never reached the desirable levels. The percentage of production to installed capacity was 46.2 per cent for caustic soda gross and 31.28 per cent for caustic soda solids/flakes in 1977-78. In 1976-77 the corresponding figures were 49.48 per cent and 27.89 per cent and in 1975-76 it was 48.79 per cent and 14.47 per cent ...

respectively. The production of sodium hydrosulphite and sodium sulphide during the three years upto 1979-80 varied from 5.2 per cent to 16.8 per cent, and 16.3 per cent to 27.3 per cent of the installed capacity (vide Table 7.18). The reason put forward for this situation by the Management was that "the demand for sodium hydrosulphite was very poor in the face of severe competition as other manufacturers were following cheaper methods of manufacture, while the company was following the costlier method, namely, the zinc processing".[10] This is no excuse for the low production itself, as actual production was as low as one-third of the budgeted quantity for the years 1977-78 to 1979-80 in succession. In the case of sodium sulphide also the management attributed "the shortfall in production to lack of demand caused by the introduction of cheaper sodium sulphide in the market and poor performance of the plant".[11] No effective programme for achieving greater utilisation of plant capacity was evolved.

7.2.7.2 Low Utilisation of By-product Chlorine Utilisation of by-product chlorine in the year 1975-76 was only 77.4 per cent and in 1976-77 it was only 58 per cent. In the following

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10 Report of the Comptroller & Auditor General 1979-80, op. ci p.75.

11 Ibid., p.76.

years it again varied from 66.2 per cent in 1977-78 to 61.3 per cent in 1979-80.

Year	Production	Utilisation for: Hcl Acid & Hcl gas	Liquid Chlorine (Tonnes)	Total	% of utilisation to products
1977-78	24,747	10,710	5,281	15,991	66.2
1978-79	23,657	10,257	6,008	16,265	68.9
1979-80	27,824	10,713	6,336	17,049	61.3

Source: Report of Comptroller & Auditor General 1979-80, op. cit., p.74.

7.2.7.2.1 The chlorine gas which could not be utilised had to be rendered harmless by treating with burnt lime. Expenditure of Rs.20.76 lakhs, Rs.14.40 lakhs and Rs.17.60 lakhs totalling to Rs.52.76 lakhs had to be incurred during the three year period 1977-78 to 1979-80. This amount could have been profitably employed, if better utilisation of by-product was effected.

7.2.8 Pollution

7.2.8.1 The chlorine pipes have become badly rusted and there are frequent leakages of chlorine. The water treatment plant in the company does not function properly. Hence very often caustic soda and bleach liquor flow directly into the rivers. There has not been any arrangement to absorb the chlorine coming out of the plant. The pipeline carrying chlorine from the company to the other units nearby are subjected to increased pressure with the result that chlorine leakages occur. Instances of chlorine cylinders breaking have also occurred. All these have caused widespread scare among the people living in the neighbourhood. Moreover mercury is also absorbed in the atmosphere in gaseous form with the result that bronchial asthma and allergic conditions are very high among the residents of this area.

7.2.9 Summing up

7.2.9.1 The company incurred very heavy losses of Rs.287.65 lakhs and Rs.157.33 lakhs in 1977-78 and 1978-79 respectively. Against a paid-up capital of Rs.634.75 lakhs the accumulated loss upto 1979-80 amounted to Rs.786.24 lakhs which makes it 125.9 per cent of the paid-up capital.

7.2.9.2 The production of caustic soda, sodium hydrosulphite and sodium sulphide was much below capacity. Capacity utilisation for caustic soda varied from 38.8 per cent to 42.6 per cent and 49.1 per cent to 60.7 per cent for old and new plants respectively. For sodium hydro-sulphite it varied from 5.2 per cent to 11.8 per cent and 16.3 per cent to 27.3 per cent for old and new plants. In fact the hydrosulphite plant was stopped since 1982 due to lack of demand. Unless capacity utilisation improves, the very justification for the very existence of the company can be questioned. The percentage of chlorine utilisation was also much lower than the anticipated amount.

7.2.9.3 The physical verification of stock items revealed a shortage of Rs.14.47 lakhs which could not be accounted for.

7.2.9.4 Raw material consumption and power and fuel usage exceeded the guaranteed norms and even those fixed by the company. Large sums had to be incurred on account of excess consumption.

7.2.9.5 Diversification and expansion programmes have been undertaken without proper planning or market surveys. In 1972-73 it was decided to double the capacity of the caustic soda plant by 100 TPD. This was done in anticipation of the proposed demand from the Vellore Newsprint factory. This factory which was expected to be commissioned long ago has not yet started commercial production. This resulted in heavy losses for the company as increased offtake by other major customers did not come upto expectations due to heavy recession in the consuming industries.

7.2.9.6 A severe tightening of management controls and a strict monitoring of the different processes of production together with proper planning are absolutely necessary for keeping the company in the industrial map of this region.

7.3 Company-III

7.3.1 This company was established in December 1946 for the manufacture of titanium dioxide utilising ilmenite extracted from the beach sands of Chavara. It went into commercial production in September 1951. The company produces titanium dioxide by the sulphate process with ilmenite and sulphur as the raw materials. Sulphur is imported. The company installed in 1967 a pilot plant costing Rs.1.91 lakhs for the production of 500gms. of titanium tetrachloride per day. In 1968 the chlorination process to produce titanium tetrachloride was tried using titanium dioxide as raw material. However, due to the highly corrosive nature of chlorine and titanium tetrachloride the plant could not run continuously and was shut down for maintenance and modifications. Another pilot plant for the manufacture of 100kgs. of butyl titanate per day and a third pilot plant for the production of 2 to 3 tonnes of potassium titanate per month were installed in 1973 at a cost of Rs.2.50 lakhs and

Rs.0.02 lakhs respectively. The company initiated in March 1973 a scheme for the manufacture of synthetic rutile also from ilmenite utilising the dilute sulphuric acid. With the completion in December 1973 of the expansion scheme designed to increase the production of anatase/rutile titanium dioxide, the installed capacity of the titanium dioxide plant was increased from 6,500 tonnes to 24,500 tonnes per annum. Being a monopoly concern this unit did not face the problem of losses except for certain years. The company fixed the sales price of its products with reference to the cost of the imported materials. However, even here the cost elements have shown an increasing trend.

7.3.2 Raw Material Consumption

7.3.2.1 The value of raw materials consumed increased from Rs.129.58 lakhs in 1974-75 to Rs.494.97 lakhs in 1980. The ratio of raw material consumed to total cost increased from 15 per cent in 1974-75 to 35 per cent in 1977-78 (vide Table 7.20). This would mean a decline in the efficiency of raw material usage. The increase in the value of raw material consumed is not merely because the prices of raw materials have increased, but also because the standards of raw material consumption are rarely adhered to.

7.3.2.2 Standards of Raw Material Consumption

7.3.2.2.1 The quantity of raw material consumed has been in excess of the norms fixed with the result that undue expenses had to be incurred on this front (vide Table 7.21). The value of excess consumption of these raw materials during 1971-72 amounted to Rs.1.30 lakhs and Rs.2.32 lakhs respectively. In 1973-74 it was Rs.4.21 lakhs. The management attempted to justify this position, "it was difficult to fix reliable usage ratios for various raw materials due to the variations in the quality of the basic raw material ilmenite and also difficulties in obtaining auxiliary raw materials of uniform standards".[12] By 1976-77, the value of raw materials consumed in excess of the existing norms was Rs.112.56 lakhs.[13]

7.3.2.2.2 Consumption has exceeded standards of raw materials for every item. In some cases as in sodium sulphide, the percentage of excess consumption over standard has been as high as 120.41 per cent and 146.94 per cent in 1976-77 and 1977-78. The excuse given by the government was that the use ratios of raw materials in the new plant which was

12 Report of the Comptroller & Auditor General 1973-74, p.21.

13 Report of the Comptroller & Auditor General 1977-78, p.84.

designed and fabricated from indigenous sources were slightly higher than the norms applicable to the old plant and efforts were made to lower the use ratios. But this was no legitimate excuse for such tremendous difference. Unless a real attempt is made to control the excess consumption of raw materials it will have serious repercussions on the cost factor.

7.3.2.2.3 In the sulphuric acid plant also the quantity of sulphur consumed in the manufacture of sulphuric acid was found to be far in excess of the standard fixed at 337Kg. of sulphur per tonne of acid produced. In the year 1975-76 the cost of excess consumption was Rs.4.28 lakhs, which increased to Rs.7.16 lakhs in 1976-77.[14]

Year	Excess consumption in tonnes	Percentage of excess consumption over standard	Cost of excess consumption (Rs. lakhs)
1975	478	5.95	4.28
1976	825	5.93	6.52
1977	1,802	6.62	7.16

According to the management the standard rate of consumption could be achieved only under ideal conditions. This could not be achieved due to the following reasons: gas leak,

14 *Ibid.*, p.88.

contamination of sulphur, ageing of catalyst, frequent shutdown of the plant due to power failure etc. The management revised the use ratio of sulphur and fixed it at 375Kg. per tonne of acid produced (98% purity).

7.3.2.3 Inventory Position

The inventory position with regard to raw materials and stores and spares appear to be increasing over the years. In the case of raw materials it increased from Rs.11.76 lakhs in 1971-72 to Rs.20.58 lakhs in 1973-74, while the actual consumption of raw materials ranged from Rs.55.85 lakhs to Rs.57.34 lakhs during the same period. The inventory of stores and spares was as high as Rs.47.05 lakhs in 1971-72 and Rs.63.72 lakhs in 1973, while consumption was only Rs.18.49 lakhs and Rs.16.46 lakhs (vide Table 7.22).

7.3.3 Labour Cost

7.3.3.1 Wages, salaries and allowances have, as in the case of other units, shown an increasing trend. It increased from Rs.61 lakhs in 1971 to Rs.86.15 lakhs in 1973. This further increased to Rs.246.78 lakhs in 1980.

7.3.3.2 Overtime Allowance The company had to incur substantial amounts as overtime allowances. In the case of the factory workers it amounted to Rs.4.40 lakhs in 1970-71, Rs.5.59 lakhs in 1971-72 and Rs.7.88 lakhs in 1972-73. This works out to 18.3 per cent, 18.4 per cent and 21.8 per cent of the total wages for 1971-72, 1972-73 and 1973-74 respectively. In the case of administrative staff it was Rs.0.95 lakhs, Rs.1.34 lakhs and Rs.1.58 lakhs for the same time period. In percentage terms this comes to 6.3, 7.4 and 7.5 per cent respectively (vide Table 7.23). The increase towards labour and supervision charges comes to 66.1 per cent.[15]

7.3.3.3 In the year 1976 the government introduced a scheme for the payment of incentive bonus to workers with 900 tonnes as the minimum monthly production to be achieved. This was done with the view to step up production of the unit. The then plant capacity was 2,041 tonnes per month. The minimum production fixed for the payment of bonus represented 44.1 per cent of the capacity which in itself was very low. Yet there was hardly any improvement in production. The monthly production was less than the minimum of 900 tonnes. The increase in production during 1977 over that in 1976 was less than two per cent. Capacity utilisation still remained very low and static around 40 per cent during 1976 and 1977. But the attraction of the bonus scheme could arouse the workers from their lethargic state.

15 Report of Comptroller & Auditor General 1973-74, p.25.

7.3.4 Power and Fuel

7.3.4.1 Power and fuel consumption which was Rs.75.42 lakhs in 1974 came upto Rs.198.89 lakhs in 1980.

7.3.5 Financing Charges

7.3.5.1 Financing charges remained more or less steady at Rs.38.92 lakhs in 1974-75 and Rs.35.17 lakhs in 1979. It increased to Rs.45.37 lakhs in 1980. As a percentage of total cost it varied between 8 per cent in 1974 and 3 per cent in 1980.

7.3.6 Capacity Utilisation

7.3.6.1 The installed capacity of the old titanium dioxide plant in operation from September 1963 is 18 tonnes of titanium dioxide per day or 6,500 tonnes per year. With the completion in December 1973 of the expansion scheme which was designed to increase the production of anatase/rutile titanium dioxide so as to meet internal demand and enter foreign markets, the installed capacity of the plant was increased from 6,500 tonnes to 24,500 tonnes per annum. Capacity utilisation, however, has been low ranging between 34.2 per cent in 1979-80 and 44.6 per cent in 1980-81 (vide Table 7.24).

7.3.6.2 The reasons stated by the management for the shortfall in production during 1971-72 were, "unavoidable dislocations necessitated by expansion projects particularly at the closing stages, maintenance needs of the old plant due for modernisation after completion of the new plant and local disturbances causing interruption of normal work".[16] During the year 1974-75 also production fell far below capacity. This was attributed by the government to: "(i) initial troubles in the new plant, (ii) deliberate curtailment of production during the last quarter of 1974 in the wake of an unprecedented slump in the domestic and export markets, and (iii) suspension/curtailment of production during 1975 to avoid accumulation of stock and to save an investment on raw materials".[17]

7.3.6.3 Production targets as seen from Table 7.24 were fixed at a level lower than installed capacity. This was due to the budgeting of production on the basis of estimated sales. The shortfall in production during 1976 was ascribed to (i) the failure of the ilmenite grinding mills, (ii) water scarcity experienced and difficulties at the initial stages of the commissioning of the equipment of the

16 Report of the Comptroller & Auditor General 1973-74, Op. Cit., p.12.

17 Report of the Comptroller & Auditor General 1977-78, Op. Cit., p.83.

wet treatment section and (iii) changes introduced in the specification and process control in the production of rutile grade titanium dioxide from time to time. It may be stated here that the company has not yet been able to achieve the required quality in the production of rutile grade titanium dioxide due to technical problems. More than five years have passed since the technical problems arose but the Management has neither identified the reasons for the poor quality of the company's product nor taken remedial steps.

7.3.6.4 <u>Production of rutile grade titanium dioxide</u> As part of the expansion scheme, the company commissioned in December 1973 an additional plant costing Rs.80 lakhs. The installed capacity of the composite plant (old and new) is 15,480 tonnes. Production fell far short of installed capacity, the percentage of capacity utilisation ranging from 2.43 per cent in 1975 to 5.73 per cent in 1977.

Year	Installed capacity of plant	Actual production	Percentage of plant utilisation to installed capacity
1975	15,480	377	2.43
1976	15,480	1,233	7.96
1977	15,480	887	5.73

<u>Source</u>: Government of Kerala, Report of the Comptroller & Auditor General of India (Commercial) 1977-78, p.86.

7.3.6.5 While the plant capacity remained unutilised to the extent of 92 to 98 per cent, the Government of India had to import 16,792 tonnes of rutile grade titanium dioxide at a cost of Rs.1,458.68 lakhs between 1974-75 and 1977-78 to meet the internal demand.[18] Production had to be tailored to demand as the consumers were reluctant to buy rutile grade titanium dioxide due to its inferior colour vis-a-vis the imported variety.

7.3.6.6 <u>Sulphuric acid plant</u> Sulphuric acid is one of the main raw materials consumed in the production of titanium dioxide. The company had three plants with an installed capacity of 400 tonnes per day (2 old plants with a capacity of 50 tonnes each per day in operation from September 1963 and a third plant with a capacity of 300 tonnes per day commissioned in April 1974). According to the management the attainable capacity of the three plants for 270 stream days was 108,000 tonnes per annum. As against this the acid produced in 1975, 1976 and 1977 was 23,849 tonnes, 41,307 tonnes and 44,944 tonnes respectively. On account of the frequent breakdowns the company could not produce enough acid for its requirements and this necessitated purchase of

18 Report of the Comptroller & Auditor General 1977-78, Op. Cit., p.86.

1,437 tonnes at a cost of Rs.5.61 lakhs during 1977. Before stabilisation of production in the new plant the management decided to dispose of the two old acid plants. Accordingly one of them was sold in January 1979 for Rs.2.58 lakhs.

7.3.7 Pollution

7.3.7.1 The company has estimated the extent of effluents to be 100 metricubid per tonne of titanium dioxide. A rough composition of this would be around 3 per cent of free dilute sulphuric acid and 3 per cent of iron sulphite. This effluent disposal is effected through a straight discharging to tidal waters through constructed channels. The extent of pollution is being felt in an area 200 metres off shore and 200 metres to either side on the discharge point of the beach beyond which there appears to be no acidity. Public opinion has recently risen vigorously against the company and its half-hearted attempts at pollution control. The indiscriminate discharge of effluents is claimed to have detrimental effects on the life of human and aequatic beings. The major air pollutant - sulphur dioxide from the sulphuric acid plant is also a serious threat. Conversion of the existing plant to the D.C.D.A system is expected to reduce sulphur dioxide emissions substantially. To counteract particulate matter emissions electro-static precipitators and back filter systems have been installed at an estimated cost of Rs.2 crores. Sulphuric acid recovery is also being tried with West German advice.

7.3.8 Summing up

7.3.8.1 Capacity utilisation levels are very unsatisfactory. An expansion programme was undertaken and completed by the company in December 1973 to increase the production of titanium dioxide from 6,500 tonnes to 24,500 tonnes per annum. This was undertaken to meet the national demand in full and to enter foreign markets. The utilisation of installed capacity, however, has not exceeded 45 per cent in any of the following years. The company also was not able to achieve the required quality and colour in the manufacture of rutile grade titanium dioxide. Hence the demand for this has not been forthcoming in the market. Rutile grade titanium dioxide would have fetched a higher margin of profit.

7.3.8.2 In view of the company's inability to increase its capacity utilisation the Government of India had to import 16.792 tonnes of rutile grade titanium dioxide at a cost of Rs.1,458.68 lakhs during the four year period 1974-75 through 1977-78 to meet the internal demand in the country. An attempt by the company to increase the capacity utilisation by providing incentive bonus to workers was also a failure.

7.3.8.3 One main reason for the increasing cost of the products manufactured is that the standards of raw material consumption are rarely adhered to. Consumption of raw materials has been largely in excess of the standard, costing Rs.112.56 lakhs during 1976 and 1977. No step has yet been taken to lower the use ratios of the raw materials in the new plants. The performance of the sulphuric acid plant was also far from satisfactory. This necessitated the purchase of acid from external sources at an additional cost of Rs.0.75 lakhs over the cost of production of acid in its own plants. The consumption of sulphur to produce sulphuric acid was also far in excess of the standard consumption ratios.

7.3.8.4 Unless capacity utilisation improves and the company is able to maintain the standards for the quality of goods produced, the productivity and future prospects of the company would appear to be rather bleak.

7.4 Company-IV

7.4.1 This unit was incorporated on 1st November 1963. The company took over in February 1964 four government departmental concerns. The major products of the company are soaps, shark liver oil products and glycerine. Production of soaps has generally been much less than the budgeted levels (vide Table 7.25). Owing to the fact that production could never reach the budgeted levels, the percentage of capacity utilisation was also never appreciable (vide Table 7.26). The only exception was in the case of soap production in the year 1974-75 when it reached a record level of 104 per cent. The installed capacity of soaps was increased from 4,300 tonnes in 1974-75 to 7,000 tonnes in 1978-79. This was again increased to 9,000 tonnes in 1979-80. Although actual production increased from 413 tonnes in 1972-73 to 6,079 tonnes in 1979-80, other than the year 1974-75 the capacity utilisation figures varied between 47 per cent and 68 per cent. In the case of shark liver oil production the highest level of capacity utilisation achieved was 26 per cent in 1972-73. This was the maximum ever reached till 1979-80. In 1977-78 it dipped as low as 16 per cent. The glycerine plant with an installed capacity of 2.60 tonnes achieved only 18 per cent of the capacity utilisation in 1977-78 and 22 per cent in 1979-80. Vanaspathi and refined oil were not produced till the end of 1979-80. It is only recently that attempts are being made to resume the production of Vanaspathi and refined oil.

7.4.2 <u>Unprecedented rise in cost of production</u>

7.4.2.1 The total cost of production has increased out of proportion to the quantity of output produced or sold. While the capacity utilisation has never reached anywhere near appreciable levels, the costs have been increasing several fold. Within a period of four years from 1971-72 to 1974-75 total costs doubled from Rs.38.90 lakhs to Rs.91.91 lakhs. In 1975-76 costs decreased to Rs.59.51 lakhs. This was primarily due to a fall in the cost of raw materials from Rs.45.51 lakhs to Rs.14.57 lakhs. From 1976-77 costs have been increasing steadily to Rs.299.57 lakhs in 1978-79 and Rs.511.54 lakhs in 1979-80. This has shown a continuous history of losses (vide Table 7.27). Owing to the persistently increasing trend in total costs, the accumulated losses reached upto Rs.63 lakhs in 1972-73 as against an equity capital of Rs.53 lakhs. Though losses were incurred in later years it was at a diminishing rate reaching Rs.16 lakhs in 1977-78. According to the management, diversification of production and better managerial control helped to make a nominal profit of Rs.11.82 lakhs in 1979-80.

7.4.2.2 <u>Raw Material Consumption</u> Raw material forms a major element in the cost structure. It ranged from 34 per cent in 1972-73 to 65 per cent in 1979-80. Since it constitutes more than half of the total cost, abnormal increase in raw material costs is bound to have its effect on total costs (vide Table 7.28).

7.4.2.3 Labour Labour costs increased steadily and went up by nearly four times from Rs.12.71 lakhs in 1971-72 to Rs.44.84 lakhs in 1979-80. It was only in 1975-76 that a declining trend in labour cost was noticed. This was partly due to the fact that part of the labour was diverted to expansion activities. The increase in labour cost was due to periodical wage agreements. But it is interesting to note that the ratio of labour to total cost has shown a declining trend from 21 per cent in 1975-76 to 9 per cent in 1979-80. This raises some hope of increasing efficiency.

7.4.2.4 Financing charges Financing charges also showed an increase from Rs.1.99 lakhs in 1971-72 to Rs.21.41 lakhs in 1979-80. This increase in financing charges inevitably proved to be a burden on the company's resources.

7.4.2.5 Depreciation Owing to the increased cost of production the company attempted to keep its overhead expenses low by providing an insignificant depreciation on fixed assets. In 1976-77 the depreciation provided was only a little more than 1/2 per cent and the cost of fixed assets were over Rs.100 lakhs. This inevitably meant that losses made by the company were actually much more than those shown in the accounts.

7.4.2.6 Power and Fuel The cost of power and fuel has also shown a steadily increasing trend.

7.4.3 In short unless the management succeeds in chalking out definite plans of action to reduce the cost of production of the products this company has no future. As the first step raw material consumption and power and fuel usage should be cut down to standard levels.

7.5 Company-V

7.5.1 This company was incorporated in December 1971 with the objective of supplying standard drugs in adequate quantities to the Government hospitals. The main object of the company was the manufacturing and undertaking trading of drugs, pharmaceuticals, radio pharmaceuticals, nutriments, cosmetics, hospital equipment etc. The company commenced partial production of drugs in September 1974. The entire project work was completed at the end of March 1979 at a total cost of Rs.94.11 lakhs as against the original estimate of Rs.30 lakhs. The sales value of products increased from Rs.67.83 lakhs in 1974-75 to Rs.310.61 lakhs in 1979-80. Total costs for these years have also increased substantially (vide Table 7.29). The company charges a pre-tax profit of 2.5 per cent on its sales and moreover the price fixation policy as accepted by the Kerala Government and the Kerala Health Services Department account for its profit despite the high costs it has been incurring.

7.5.2 Increasing trend in Raw Material consumption

7.5.2.1 Raw materials form the most important item of consumption. Raw material consumption increased from Rs.48.70 lakhs in 1974-75 to Rs.131.46 lakhs in 1978-79 (vide Table 7.30). The ratio of raw material consumed to total cost however showed a decline from 66 per cent to 42 per cent. This was mainly due to the increase in other charges viz. labour, financing charges, depreciation etc.

7.5.2.2 The raw materials required for the production of pharmaceutical products were purchased from the canalising agencies and also from the open market. Some of the basic drugs, imported and indigenous which constitute the raw materials for drug formulations are distributed by the Government of India through the I.D.P.L. and S.C.P.C. under a direct allotment scheme. However, the company did not have an industrial licence for all items of manufacture. Hence it would not import directly or obtain allocation of the canalised items of raw materials required for production. These, therefore, had to be obtained from the open market at higher rates resulting in higher costs of production. In fact the company incurred an extra expenditure of Rs.13.60 lakhs on the purchase of drugs during 1978-79 and 1979-80. This also included an amount of Rs.1.12 lakhs representing the extra cost of 1,140kgs. of chloramphenicol which was alloted by the S.C.P.C in 1978-79 but was not lifted by the company.

7.5.2.3 Inventory Control The inventory of raw materials and packing materials increased from Rs.40.75 lakhs in 1977-78 to Rs.71.19 lakhs in 1978-79. This was reduced to Rs.53.60 lakhs in 1979-80. This constituted around 33.5 per cent, 49.77 per cent and 31 per cent of the consumption of raw materials and packing materials. The year-end inventories of raw materials and packing materials constituted 4.02, 5.97 and 3.71 months' requirements. The inventory of stores and spares was valued at Rs.2.72 lakhs, Rs.3.45 lakhs and Rs.3.38 lakhs respectively for the three year period under review. The consumption of stores, spares and lubricants, however, was only Rs.2.66 lakhs, Rs.3.63 lakhs and Rs.4.38 lakhs. Hence these inventories constituted 12.28, 11.39 and 9.10 months' requirements which appeared to be very high (vide Table 7.31).

7.5.2.4. Defective Products Retained in Stock

7.5.2.4.1 A large number of items which became unfit for use were retained in stock. The largest item was ferrous sulphate tablets amounting to 15.50 lakhs and costing Rs.0.13

lakhs. 5.40 lakhs of paracetamol tablets costing Rs.0.20 lakhs were also stocked. Another item was piperazine phosphate tablets amounting to 3.90 lakhs costing Rs.0.09 lakhs.

Tablet	Number (in lakhs)	Amount (Rs. in lakhs)
1. Ferrous sulphate (from November 1976 to July 1980)	15.50	0.13
2. Piperazine phosphate (from April 1975 to July 1980)	3.90	0.09
3. Paracetamol (from August 1978 to July 1980)	5.40	0.20
		0.42

These products had to be written off as attempts to recover the same by reprocess methods were not successful. The management could not provide any explanation as to why these tablets were kept in stock for so long.

7.5.2.4.2 Apart from the tablets, 1,750 out of 5,500 bottles of Dextran injections produced in 1978-79 remained in the Parenteral Department and could not be sold due to the presence of particulate matter in the injections.

7.5.2.5 Excess Consumption of Glass Containers

7.5.2.5.1 This company was the only pharmaceutical company using USP Type I & II narrow-mouthed bottles. A review of the consumption of different types of glass containers revealed that the actual consumption far exceeded the standards fixed by the company. Such excess consumption for the three years upto 1979-80 was of the value of Rs.6.54 lakhs. This was also in excess of the norms adopted for price fixation under the Drugs (Price Control) Order 1970, and ranged between 18.4 and 102.0 per cent in 1977-78, 1.6 and 31 per cent in 1978-79 and 3.0 and 15.9 per cent in 1979-80.[19]

7.5.2.5.2 The consumption of triple aluminium seals used as packing materials for sealing 540 ml. bottles in the Parenteral Department also revealed that the excess consumption of seals over and above the permissible limit of 6 per cent varied from 10.2 to 33.8 per cent. The loss on excess consumption over the norm for the three years upto 1979-80 amounted to Rs.0.77 lakhs.[20]

7.5.3 Labour Cost

7.5.3.1 Labour charges increased from Rs.3.89 lakhs in 1974-75 to Rs.34.30 lakhs in 1978-79. The ratio of labour to total cost remained more or less the same between 15 per cent and 11 per cent. The heavy increase in labour charges is partly due to the large increase in overtime wages.

19 Report of the Comptroller & Auditor General (Commercial) 1979-80, op. cit., p.141.

20 Ibid., p.142.

7.5.3.2 Overtime Wages

The overtime wages paid to workers in the production and maintenance departments of the company during the three years 1977-78 to 1979-80 was Rs.1.22 lakhs, Rs.3.61 lakhs and Rs.4.38 lakhs respectively. This worked out to 15.4 per cent, 37.4 per cent and 41.1 per cent of the salaries paid in the corresponding years.[21] Even with the payment of such huge amounts as overtime wages there was no substantial improvement in the production levels and capacity utilisation fell much below target. The workload and staff strength has not been fixed in all the departments.

According to the management the primary reason for the payment of overtime wages was the inflexible attitude of labour. When there was no production in one section due to the non-availability of raw material or any such reason, the workmen there were not willing to take up work in another section. To-date the company had no work norms and the workmen had developed over a period of several years an attitude of setting up their own work norms. These norms were far below the average work to be performed and hence total production requirements could not be completed in the normal

21 Report of the Comptroller & Auditor General (Commercial) 1979-80, op. cit., p.137.

shift. The only solution, then, would be to pay substantial overtime to get the work done in time. Unless the work norms are fixed and implemented at the earliest date this state of affairs is likely to continue which will inevitably affect the efficiency of labour usage.

7.5.4 Financing Charges Financing charges also went up from Rs.3.04 lakhs in 1974-75 to Rs.19.73 lakhs in 1978-79, an increase of nearly six times within a period of five years. The ratio of financing charges to total cost increased from 4 per cent in 1974-75 to 8 per cent in 1976-77 and thereafter declined to 7 per cent and 6 per cent in 1977-78 and 1978-79 respectively.

7.5.5 Depreciation Depreciation charges have increased from Rs.3.04 lakhs in 1974-75 to Rs.36.51 lakhs in 1980-81. As a ratio to total cost it fluctuated from 6 per cent in 1974-75 to 3 per cent in 1975-76 and 1976-77 and then increasing to 8 per cent in 1978-79.

7.5.6 Locational Costs The very location of the unit has resulted in additional costs. It is located in such a place where pure water is not available and being a drug manufacturing unit pure water is an absolute necessity. Secondly, although it is located on the national highway it has no direct access to railway or airway traffic. In such a vital industry, it is absolutely necessary that the raw materials and finished products reach their destination as quickly as possible. Hence additional costs have to be incurred due to such locational factors.

7.5.7 Capacity Utilisation

7.5.7.1 The installed capacity for various items far exceeded the licenced capacity.

(Quantity in lakhs)

Items of Manufacture		Licensed capacity	Installed capacity
Tablets (numbers)	-	630	2,514
Capsules (")	-	110	149
Liquids (litres)	-	0.7	2.25
Parenteral (numbers)	-	5	79.50
Granules (kilograms)	-	-	0.20

Source: Report of the Comptroller & Auditor General 1979-80, op. cit., p.129.

7.5.7.2 The industrial licence for substantial increase in capacities was turned down by the Government of India on the ground that the company did not fulfil the ratio parameters prescribed in the drug policy of the Government of India. In the absence of an industrial licence covering all items of manufacture, the company could not engage in direct import and allocation of canalised items of raw materials required for production. Hence these had to be purchased from the open market at higher rates.

7.5.7.3 There had been considerable shortfall in respect of tablets, capsules, liquids and parenterals in all the years with reference to the achievable capacity. Though production was budgeted below the installed capacity (except in tablet and parenteral bottles), the actual production (except in tablet section during 1978-79 and 1979-80 and granules during 1979-80) was still lower than the budgeted target. (vide Table 7.32). The management declared that since almost 95 per cent of the company's production was oriented to supplies to the State Government, the utilisation of capacity depended on orders received from the State Government and the availability of raw materials canalised by the Government of India. This is no legitimate excuse for the low level of capacity utilisation, sometimes even as low as 21.3 per cent as in the case of granules in 1979-80.

7.5.7.4 Unless stringent measures are taken to improve capacity utilisation, to reduce the level of inventories and to improve the efficiency of labour usage, the company will not be able to stand on its own without the support of the Government.

7.6 Company-VI

7.6.1 This company was incorporated in March 1954 with the object of starting indigenous production of insecticides. It has two factories, one at Delhi and the other at Alwaye. The factory at Alwaye, which is relevant to our study, was started with an installed capacity of 1,344 tonnes per annum of D.D.T. It was commissioned in July 1958. The main products of the company are:

1. Technical D.D.T.
2. Hildit 50 WDP (50% Form D.D.T)
3. Technical B.H.C.
4. Hilbech 50 WDP (50% Form B.H.C.)
5. Endosulfan 35% E.C (Hildon 35 EC)

The by-products are hydrochloric acid and spent sulphuric acid.

The net licensed capacity and net installed capacity of the different products are given below:

Item		Net licensed capacity		Net installed capacity
Technical D.D.T	-	1,320	tonnes/year	1,344
Hildit WDP	-	2,640	"	2,680
Technical B.H.C.	-	3,000	"	3,000
Technical B.H.C. Hilbech W.D.P.				
Technical Endosulfan	-	1,600	"	1,600

7.6.2 Due to the heavy demand for insecticides, the sales value of production has been continually higher than the cost of production (vide Table 7.33). The figures shown are for the Alwaye unit alone and hence the profit figures shown relate to that unit alone. Even though the cost of production has remained below the sales value of products, there has been a considerable increase in the cost of raw materials, labour, power and fuel etc.

7.6.3 <u>Raw Material Consumption</u>

7.6.3.1 Raw material consumption increased from Rs.56.56 lakhs in 1971-72 to Rs.237.90 lakhs in 1979-80. Raw materials form the major share of the cost of production i.e. nearly half of the total cost. The ratio of raw materials consumed to total cost varied from 51 per cent in 1971-72 to 59 per cent in 1979-80. It had increased to as much as 83 per cent in 1978-79 (vide Table 7.34). Since raw materials constitute the bulk in cost any increase in the cost of raw materials will doubtless push up total costs.

7.6.3.2 <u>Inventories</u> The level of inventories of materials, stores and fuels showed an increase from Rs.14.75 lakhs in 1971-72 to Rs.64.2 lakhs in 1978-79. In 1979-80 it showed an abnormal increase to Rs.264.05 lakhs, an increase of nearly 18 times. In the case of semi-finished goods the increase was from Rs.1.86 lakhs in 1971-72 to Rs.15.3 lakhs in 1979-80, an increase of eight times and that for products and by-products from Rs.9.54 lakhs to Rs.46.40 lakhs - an increase of four times (vide Table 7.35). The total value of production for these years increased from Rs.154.31 lakhs to Rs.655.86 lakhs i.e. an increase of only 3.25 times. Like other public sector concerns, here also the levels of inventory are bound to be high. Raw materials accounted for 7 months' requirements in 1976-77. For the year 1978-79 the inventory of spares was equivalent to 7 months' production, whereas for stores other than spares and insurance items it was equivalent to 14 months' and 43 months' respectively. In 1979-80 spares accounted for 11 months' requirements and stores other than spares 17 months' and insurance items as high as 36 months' requirement. Such high inventory levels will inevitably block up working capital and also push up the cost of production. The justification put forth by the Management for such high inventory levels are the high cost of raw materials and the difficulty of obtaining adequate quantity of raw materials in time.

7.6.4 <u>Labour Costs</u>

7.6.4.1 The total amount disbursed as salaries increased from Rs.28.02 lakhs in 1971-72 to Rs.82.46 lakhs in 1979-80. The ratio of labour to total cost has more or less remained steady fluctuating between 0.25 in 1971-72 to 0.31 in 1973-74 and 0.27 in 1978-79, but falling to 0.21 in 1979-80.

7.6.4.2 Nevertheless, there has been an increase in the level of absenteeism. The percentage of man-shifts lost to man-shifts worked increased from 17.49 per cent in 1975-76 to 20.3 per cent in 1979-80.

	1975	1976	1977	1978	1979	1980
Number of man-shifts lost -	18191	18 040	20321	22055	25027	27002
Number of man-shifts worked -	103954	101793	99406	114155	117020	133037
Percentage of man-shifts lost to man-shifts worked -	17.49	17.72	20.44	19.32	21.39	20.30

7.6.4.3 The percentage of overtime to salaries and wages also showed a slight increase from 8.76 per cent in 1977-78 to 9.77 in 1978-79 and 9.42 in 1979-80.

7.6.5 <u>Power and Fuel</u> The cost of power and fuel increased from Rs.8.21 lakhs in 1971-72 to Rs.29.21 lakhs in 1979-80. The ratio of the cost of fuel to total cost remained more or less steady at 7 per cent except in the year 1974-75 when it was 3 per cent. In 1978-79 it increased to 10 per cent.

7.6.6 Depreciation The value of depreciation increased from Rs.11.66 lakhs in 1971-72 to Rs.17.19 lakhs in 1979-80. The ratio of depreciation to total cost varied at 10 per cent in 1971-72 to 4 per cent in 1979-80.

7.6.7 Financing Charges The problem of financing charges is not dealt with in this analysis, since the financial accounts of the company are clubbed together for all the units.

7.6.8 Capacity Utilisation Capacity utilisation has been more or less satisfactory in Technical D.D.T., where production has exceeded capacity in certain years. In the case of formulated D.D.T. it came down to 58 per cent in 1976-77 and 56.77 per cent in 1977-78. In the case of B.H.C. Technical also it was 56.03 per cent in 1972-73 and 56.4 per cent in 1974-75 and 58.4 per cent in 1975-76. However, it increased to 89.8 per cent in 1976-77 and 85 per cent in 1979-80 (vide Table 7.36).

7.6.9 Pollution Like the other chemical units in the area this unit also poses a severe threat to environmental cleanliness. Thionyl chloride is one of the main raw materials imported from West Germany for use in the endosulfan plant. While unloading the shipment of thionyl chloride the barrels burst and caused untold misery. This chemical contains sulphur dioxide and hydrochloric acid and is available in liquid form. When in direct contact with the atmosphere it absorbs vapour and gasifies. This gas if breathed in leads to suffocation. Thionyl chloride is stored alongwith other strong chemicals like technical endosulfan. Alongwith these chemicals, the tins and bags of cement are also stored in the warehouses. The first thionyl chloride barrel burst in June 1980 and the gas spread throughout the godown. Due to its action, other barrels also burst and lakhs of rupee worth of items were destroyed. This gas came out of the store walls of the godown and the asbestos roof was fast disintegrating. In and around the unit the atmosphere is so polluted, that the people in the area are prone to illnesses like breathlessness, bronchial asthma etc. This situation is aggravated by the fact that almost in the same locality Rare Earths Ltd. disposes of lead sulphide in concrete boxes. Lead sulphide is an effluent arising out of the production of thorium. Experts are of the opinion that lead sulphide and elements of radioactive thorium and uranium can have long drawnout effects. The radio activity of these elements can even pollute the underground springs for a radius of 25 kms. The elements which are buried underground can maintain their radio activity for a period of more than thirty years. It is doubtful whether the concrete boxes can withstand the alkaline and radio active properties of the materials buried underground.

7.6.10 Summing Up In the Alwaye unit of the company sales value of products has been continually higher than cost of production. However, analysing the cost elements we find that the ratio of raw material cost to total cost could be brought down. The efficiency of material usage could be improved by controlling the inventory levels especially that of stores and spares. The efficiency of labour could also be stepped up by lowering the level of absenteeism and the percentage of overtime wages. Stricter controls on material and labour levels can raise the company to better heights.

7.7 Company-VII

7.7.1 This company went on stream in September 1966 with an authorised capital of Rs.15 crores. It was set up with an installed capacity to refine 50,000 barrels of crude oil per day or 2.5 million tonnes per year. The capacity of the unit was further expanded to 66,000 barrels of crude oil per day or 3.3 million tonnes per year. The company made a profit of Rs.110 lakhs during the first year of its working. Being a monopoly concern in such a strategic sector it continued to make profits. It made a profit of Rs.574.07 lakhs in 1978-79 which rose to Rs.668.60 lakhs in 1979-80 as per the book records. However, examining the cost factors we find that costs have also been increasing very fast (vide

Table 7.37). This accelerated rate of increase was caused mainly due to the heavy increase in the cost of raw materials. Cost of raw materials consumed have increased from Rs.12,055.03 lakhs in 1974-75 to Rs.38,473.24 lakhs in 1980-81. Looking at the cost structure we find that raw materials constitute a high percentage of total costs. In fact it contributes to about 90 - 99 per cent to the total cost during 1974-75 through 1980-81. The increase in the cost of raw materials is inevitably the result of the heavy increase in the price of crude oil in the world market. Hence we find that other elements in the cost analysis of the cost structure are not very relevant in the case of this unit. Wages have also increased from Rs.77.19 lakhs to Rs.107.41 lakhs during the same period under review. Power and fuel consumption has increased from Rs.30.84 lakhs to Rs.59.14 lakhs, but interest charges has come down from Rs.124.85 lakhs to Rs.65.74 lakhs and depreciation has remained steady at Rs.201 lakhs (vide Table 7.38).

7.7.2 <u>Capacity Utilisation</u> Capacity utilisation in respect of petroleum products has been more or less satisfactory with 68.4 per cent in 1973-74 and 82.76 per cent in 1979-80 (vide Table 7.39). Perhaps it is the only unit whose daily production is outrunning the designed capacity. Even though the design capacity was only 66,000 barrels per day, it has been successfully running at 70,000 barrels per day on a continuous basis.

7.7.3 The new expansion programme of the unit to set up a fluid catalytic cracking unit at an investment of Rs.39 crores is bound to yield a number of petroleum products and aromatic feedstocks like benzene, toluene, xylene and naphtha. A number of petrochemical projects can be started to make use of these products.

7.8 Company-VIII

7.8.1 This company, located in the Cochin-Alwaye Industrial belt, was the first to produce formic acid in the State. It was set up under the parent company M/s. Aspinwall & Company Limited and started commercial production in October 1971. The main products are formic acid and sodium sulphate. The reaction of caustic soda and carbon monoxide under pressure produces sodium formate which, on further reaction with sulphuric acid, produces formic acid and sodium sulphate.

7.8.2 Import Substitution and Exchange Saving

Till 1970-71 all the requirements of formic acid were met through imports. Huge amounts had to be allocated for this. The setting up of this unit involved a considerable saving in foreign exchange resources (vide Table 7.40).

In the year 1963-64 formic acid of the value of Rs.8.35 lakhs was imported. This amount nearly tripled by 1968-69 to Rs.23.60 lakhs. In 1970-71 the value of imports was Rs.16.12 lakhs.

7.8.3 Sales and Cost of Production

The sales value of products increased from Rs.74.55 lakhs in 1974-75 to Rs.188.70 lakhs in 1979-80. There was also a simultaneous increase in the cost of productioh, the main reason being the heavy increase in the cost of raw materials (vide Table 7.41).

7.8.4 Raw Material Consumption

7.8.4.1 This unit is in a very advantageous position so far as availability of raw materials is concerned. It uses the stack gases from Company-I and caustic soda from Company-II and sulphuric acid from Company-X and Company-II. The stack gas from Company-II is obtained as a waste product after the wasting of hydrogen for ammonia synthesis with liquid nitrogen. The reagent gas so produced contains carbon dioxide,methane and hydrogen and is used for the first time as a producer gas.

7.8.4.2 There has been a continually-increasing trend in raw material consumption which increased from Rs.17.88 lakhs in 1973-74 to Rs.51.47 lakhs in 1979-80. The ratio of raw material consumption, however, has been showing a slightly decreasing trend from 34.00 per cent in 1973-74 to 31 per cent in 1978-79 and 28 per cent in 1979-80 (vide Table 7.42). This is probably the result of skilful control, operational adjustments and manipulations which have made maximum utilisation of the gas possible.

7.8.4.3 Regarding the standards of the raw material consumption, though attempts are made to adhere to the standards as far as possible, deviations are noticed (vide Table 7.43).

7.8.5 Wages and Salaries Wages and salaries have increased from Rs.5.02 lakhs in 1973-74 to Rs.19.61 lakhs in 1979-80. The ratio of wages and salaries has increased from 9 per cent in 1973-74 to 15 per cent in 1977-78, after which there was a fall to 14 per cent and 11 per cent in the next two years. The percentage of absenteeism to total number of days worked showed an increase from 4.08 per cent in 1977-78 to 7.1 per cent in 1979-80.

7.8.6 Power and Fuel Consumption This item also registered an increase from Rs.1.93 lakhs to Rs.6.34 lakhs during the years 1973-74 to 1979-80. The ratio did not change much.

7.8.7 Interest Charges Interest charges also registered an increase from Rs.3.30 lakhs in 1973-74 to Rs.7.20 lakhs in

1979-80. The ratio of interest charges to total cost actually showed a decline from 6 per cent to 4 per cent for the same years.

7.8.4 <u>Depreciation Charges</u> Depreciation charges did not show much variation either in their absolute amounts or percentage to total cost.

7.8.10 <u>Capacity Utilisation</u> Capacity utilisation has been more or less satisfactory attaining a high level of 79.47 per cent in 1977-78 for formic acid and 82.8 per cent for sodium sulphate. In the year 1975-76 it was only 44.27 per cent and 44.00 per cent respectively. This was attributed to the lack of availability of the raw materials. In the year 1979-80 also there was a fall in the capacity utilisation due to the non-availability of the raw materials from the neighbouring units (vide Table 7.44).

7.8.11 <u>Future Prospects</u>

7.8.11.1 The unit has great prospects, since its products are greatly in demand by the rubber-processing industry. Around 45 per cent of the product is absorbed locally itself and the rest goes outside Kerala mainly to the pharmaceutical industry.

7.8.11.2 The industry is facing a very critical situation in the present context. Imports are still being continued.

The cost of production of the local product is around Rs.14,500 per tonne, whereas the value of the imported product comes upto only Rs.12,000 per tonne. Formic acid is produced abroad as a by-product of petro chemicals and hence price is not a big factor. We are still following the conventional method and hence the large variation in the cost of production. Thus it is self-evident that we cannot sustain without some form of protection.

7.8.11 Pollution The poisonous and inflammable nature of carbon monoxide has made it necessary to install special fire and health requirements from the early stage itself. The high humidity conditions prevalent in Kerala necessitated special arrangements for the mechanical conveyance and charging of the highly hygroscopic sodium formate. The effluent treatment programmes in the unit are more or less satisfactory.

7.9 Company-IX

7.9.1 This company set up in Kottayam district, manufactures calcium carbide and acetylene black. It started commercial production in 1974 with an installed capacity of 25,000 M.T. of calcium carbide. Though the company had to face problems in the initial stages of operation, it has shown an increasing trend in sales and production. At the turn of the decade it witnessed a tremendous increase in production levels leading to a record level of capacity utilisation. Even though the cost of production has also increased alongwith the increase in sales it has been able to keep the cost of production below the sales. Net profits by 1979-80 increased to Rs.118.54 lakhs (vide Table 7.45).

7.9.2 Raw Material Consumption

7.9.2.1 The main raw materials are lime shell and carbon. Lime shell is locally available from the Vembanad lake. Carbon is obtained in the form of coal -- wood charcoal. The availability of lime shell and power was the major reason behind the installation of the factory in this locality. With the non-availability of wood charcoal from the locality most of it has to be obtained from Maharashtra.

7.9.2.2 Raw material consumption has increased from Rs.35.20 lakhs in 1973-74 to Rs.313.46 lakhs in 1979-80. The ratio of raw materials consumed to total cost has increased from 24 per cent to 27 per cent (vide Table 7.46).

7.9.2.3 The inventory levels for lime shell are for only about 15 days' production since there are regular incomings. For charcoal it comes to 2 months' and for steel sheets for drums around 7-8 months', since 75 per cent of the requirement is met through imports.

7.9.3 Wages and Salaries Wages and salaries have also increased from Rs.23.99 lakhs in 1973-74 to Rs.90.81 lakhs in 1979-80. As a percentage of the total cost it varied from 16 per cent in 1973-74 to 17 per cent in 1979-80. Overtime allowances come upto 15-20 per cent of the total wages and salaries. Absenteeism has been estimated around 30 per cent and the number of man-days lost around 18 per cent.

7.9.4 Power and Fuel Power constitutes a major item of the cost structure. It increased from Rs.13.94 lakhs in 1973-74 to Rs.195.23 lakhs in 1979-80. As a proportion of costs it has increased from 9 per cent in 1973-74 to 23 per cent in 1978-79, but fell to 17 per cent in 1979-80.

7.9.5 Interest Though interest charges have also increased from Rs.10.18 lakhs in 1973-74 to Rs.66.35 lakhs in 1979-80 they form only an insignificant part of the total costs.

7.9.6 Depreciation Depreciation charges have also increased from Rs.8.34 lakhs to Rs.37.29 lakhs, but the ratio has remained more or less steady at 3 per cent.

7.9.7 Capacity Utilisation Capacity utilisation has been more or less satisfactory after the initial years. While it was 60.91 per cent in 1973-74 it increased to 89.48 per cent in 1974-75, but fell to 52.97 per cent in the next year.

It soon recovered and by 1979-80 it reached the all-time high level of 103.16 per cent (vide Table 7.47).

7.9.8 Pollution Like other chemical industries, this unit also discharges its effluents into the nearby areas. The carbon gas in the atmosphere pollutes the whole atmosphere in and around the area.

7.9.9 Prospects

7.9.9.1 At the way in which the company is picking up, it is bound to expand and diversify in the future and increase its profit levels. But it remains significant that while it makes use of the State's resources, very little of the returns are ploughed back into the economy.

7.10 Company-X

7.10.1 This company was registered in the year 1962. Set up on the banks of the Periyar river in the Cochin-Alwaye Industrial belt it produces zinc, sulphuric acid and cadmium. Like the majority of chemical units in the private sector in the State, this unit is also having sales higher than the cost of production consistently except in the years 1975-76 (vide Table 7.48).

7.10.2 Raw Materials Raw material consumption increased from Rs.479.66 lakhs in 1973-74 to Rs.1,154.18 lakhs in 1976-77. In the next two years there was a decline to Rs.685.22 lakhs in 1977-78 and Rs.419.64 in 1978-79. The ratio of raw material consumption to total cost also increased from 57 per cent in 1973-74 to 67 per cent in 1976-77, but fell to 50 per cent and 44 per cent in the next two years (vide Table 7.49).

7.10.3 Wages and Salaries Wages and salaries increased from Rs.46.44 lakhs in 1973-74 to Rs.78.59 lakhs in 1975-76 and to Rs.81.67 lakhs in 1976-77. This later declined to Rs.76.30 lakhs and Rs.67 lakhs in the next two years. The ratio of wages and salaries to total cost first declined from 6 per cent to 4 per cent, but in the year 1978-79 increased to 7 per cent.

7.10.4 Power and Fuel Power and fuel consumption has shown a steadily increasing trend from Rs.60.13 lakhs in 1973-74 to Rs.129.67 lakhs in 1978-79. In terms of the ratio to total cost also it has shown an increase from 7 per cent to 14 per cent.

7.10.5 Interest and Depreciation Interest charges have actually fallen from Rs.57.75 lakhs in 1973-74 to Rs.1.70 lakhs in 1978-79, and hence ratios are not much relevant.

Depreciation charges have also declined, and are not much relevant.

7.10.6 Capacity Utilisation Capacity utilisation for all products - zinc, sulphuric acid and cadmium showed an increase during the period 1973-74 to 1976-77. However, there was a general decline in the year 1977-78 (vide Table 7.50). Production of sulphuric acid and cadmium could be stepped up. The production of sulphuric acid, when increased, could benefit the neighbouring companies-IX and XI which are utilising it.

7.10.7 Pollution Zinc wastes and Pb. are discharged into the Eloor branch of the Periyar increasing the water pollution in that area.

7.11 Company-XI

7.11.1 Company-XI was also set up in the Edayar region in the year 1968. The main products are catalysts used in fertilisers, petrochemicals etc. The sales value of products has increased from Rs.235.87 lakhs in 1976 to Rs.443.08 lakhs in 1980. Total cost has also increased from Rs.248.57 lakhs in 1976 to Rs.409.7 lakhs in 1980. In spite of the increase in the cost of production it has been below the sales, except for the year 1976 (vide Table 7.51).

7.11.2 Raw Material Consumption Raw materials form the most important element of cost. It increased from Rs.138.81 lakhs in 1976 to Rs.204.52 lakhs in 1980. The percentage of raw material consumption, which was 55 per cent in 1976 declined to 50 per cent in 1980 (vide Table 7.52). As regards the composition of raw materials consumed we find a significant change. In 1976 the value of the imported raw materials was only Rs.17.10 lakhs (12 per cent), while that of the indigenous raw materials was Rs.121.71 lakhs (88 per cent). In the year 1980 the corresponding figures are Rs.156.60 lakhs (91 per cent) and Rs.16.32 lakhs (9 per cent). It is all the more important that most of the raw materials imported are from the parent company abroad. While part of the product is being exported, it does not in any way compensate for the outflow of the foreign exchange.

7.11.3 Wages and Salaries Wages and salaries also recorded an increase from Rs.28.98 lakhs in 1976 to Rs.62.44 lakhs in 1981. The ratio of wages to total cost increased from 12 per cent to 15 per cent during the same period. Labour problems in the unit with outside casual workers and contract workers has been affecting the level of production and capacity utilisation considerably.

7.11.4 Power and Fuel Though power and fuel costs have incresed from Rs.22.7 lakhs in 1976 to Rs.41.44 lakhs it has not affected the cost ratio, which remained more or less steady at 8 per cent.

7.11.5 Interest and Depreciation Interest and depreciation charges have also been seen to increase, but they are not very significant in the cost structure.

7.11.6 Capacity Utilisation Capacity utilisation has been very low over the period under review. It was only 38.45 per cent in 1976 which increased to 44.18 per cent in 1978 (vide Table 7.53). However, there was a decline in the next years until it reached a low level of 33.02 per cent in 1981. The main reasons for such a low level of capacity utilisation was the lack of orders for the naphtha reforming catalysts and ammonia synthesis catalysts. Imports for such items were being freely permitted. Against a 300 tonne/year licensed capacity for steam reforming units, sales came upto only 18.5 tonnes. Labour problems at the unit also contributed to low capacity utilisation. The shutdown of the C12 system and extended period on account of labour problems also accounted for the low capacity utilisation.

7.11.7 Pollution Problem Effluents equivalent to 2,800 cu. cms. per day are being discharged into the Eloor branch of the Periyar river. The main effluents are Ph. hexavalent chromium.

7.12 Company-XII

7.12.1 The company has units at Kalamassery, Kundara, Mettur and Tuticorin. The Kalamassery unit produces copper sulphate, copper oxychloride and formulations such as fytolan, perecloud etc. Since the accounts for all units are clubbed together, it was not possible to estimate and analyse the cost elements for the Kalamassery unit in isolation. The importance of the installation of the unit in this locality lies in the fact that it obtains two important raw materials from Company-II and Company-X viz. caustic soda lye and hydrochloric acid from Company-II and sulphuric acid from Company-X.

7.12.2 Raw Material Consumption Raw material consumption has increased from Rs.264.93 lakhs in 1975-76 to Rs.422.38 lakhs in 1979-80. During the same period sales has increased from Rs.534.95 lakhs to Rs.882.21 lakhs (vide Table 7.54).

7.12.3 Capacity Utilisation Capacity utilisation has been more or less satisfactory. For copper sulphate it increased from 79.56 per cent in 1975-76 to 99.53 per cent in 1979-80 (vide Table 7.55). In the case of copper oxychloride also it increased from 37.92 per cent to 81.08 per cent during the same period. In the case of sodium aluminate there was a rapid increase from 54.90 per cent to 130.66 per cent. Chlorate of potash varied its capacity utilisation from

102.28 per cent to 96.88 per cent. In sodium aluminate and sulphate of alumina capacity utilisation could be improved.

7.13 Company-XXII

7.13.1 With a capital investment of Rs.320 lakhs, this unit has a licensed capacity to manufacture 2,210 tonnes of Ossein and 4,250 tonnes of di calcium phosphate annually. The installed capacities for these products are 2,760 tonnes and 5,310 tonnes respectively. In the initial year of production itself it was able to produce 2,256 tonnes of Ossein (81.74% of the installed capacity) and 4,172 tonnes of di calcium phosphate (78.57%). Both these products are mainly exported to Japan. Prospects for developing new chemical-based industries in the locality utilising these products would be worth looking into. Today none of the output is being used in the State. Raw material in the form of crushed bones for the manufacture of Ossein are easily available in India. It also obtains the required quantity of hydrochloric acid from Company-II and furnace oil from Company-VII. Another important requirement is fresh water, which is also available in plenty in the locality. Raw materials form the main cost element, 68.5 per cent of the total cost. Power and fuel constitutes 6.9 per cent and wages and salaries 4.5 per cent.[22]

[22] Annual Report of the Company 1979-80, p.12.

7.14 Company-XIV

7.14.1 This unit has just started production with an authorised capital of 227.8 lakhs. It has an installed capacity to produce 1,200 tonnes of formic acid per year. Since the demand for formic acid is very high and not commensurate with the supply position, it can find a ready market for its products. The free import of formic acid into the country however poses a severe threat to this unit also since the price of imported formic acid is lower than the price of the local product. So unless some form of protection is granted, it will be difficult for the unit to survive its initial problems.

7.14.2 Nearness to raw materials and nearness to the market are points in favour of the unit. The unit requires caustic soda flakes, soda lye, co gas, and sulphuric acid, which it can obtain from Company-II, I and X respectively.

7.14.3 Since formic acid is mainly used in rubber coagulation, it can find a ready market in the rubber industry. Pollution problem is also not expected except for some floor sweepings, which may contain some chemicals.

7.15 General Findings

7.15.1 An overview of a number of large and medium scale chemical units in Kerala has brought to light a number of interesting findings. The major large scale units in the public sector are all facing the problem of heavy losses except those which enjoy a monopoly. Even these units are encountering a fast increasing trend in their cost elements. Inefficient management of the critical cost elements such as raw materials and power have inevitably resulted in low production and underutilisation of capacity. With heavy increases in cost, standards of material consumption are very rarely adhered to. Inventory levels are very high in almost all the public sector units. Overtime payments are found to be very high in many of the units. Interest charges are also so high in some units, that accumulated interest has become more than the principal. In short some of these units have been experiencing such heavy losses that their accumulated losses over a period have been more than the unit's paid-up capital.

7.15.2 On the contrary, in the case of the private sector units many of them have started making profits not long after they went into commercial production. Even though they may experience some of the general problems, efficient management and better control have obtained for them better production levels and capacity utilisation. But the problem lies in the fact that while these units are making good use of the raw materials available in the State and its workers, very little of the products are used within the State, nor will the profits be ploughed back into the economy. The goods are mainly sold in other States or exported to parent companies as in the case of Company-XIII. So, in effect, the economy is threatened by the ineffectiveness of the public sector units and the exploitation by the private units. A reorganisation of the public sector units, with stricter control and monitoring of utilisation of factors, will increase the efficacy of these units. A number of new units which can make effective use of the products of the existing units can be started in the joint or private sector, thereby generating an entire series of linkages which are inevitably high in the chemical industry.

Table - 7.1(a)

Annual Installed Capacity of the Unit Nutrientwise

(In tonnes based on 330 days)

Nutrient	As at the beginning	As at the end of 1st Stage expansion 1959-60	II Stage 1962	III Stage 1966	IV Stage 1973	1-4-1980
N	1,100	21,300	28,300	70,000	231,500	266,536
P_2O_5	7,000	13,600	13,600	34,300	44,200	151,360

Source: Handbook of F.A.C.T 1979-80 (unpublished), p.7.

Table - 7.1(b)

Annual Installed Capacity Product-wise of Company I

(In tonnes based on 330 days)

Sl. No.	Products	As at the beginning	As at the end of I Stage expansion	As at the end of II Stage expansion	As at the end of III Stage	As at the end of IV Stage	As on 1-4-1980
1.	Ammonia	13,200	26,400	39,600	77,550	315,150	310,200
2.	Ammonium Sulphate	44,000	66,000	99,000	198,000	198,000	198,000
3.	Ammonium Phosphate 16:20	-	33,000	33,000	132,000	132,000	99,000
4.	Ammonium Phosphate 20:20	-	-	-	-	48,500	49,500
5.	Super Phosphate	44,000	44,000	44,000	49,500	49,500	49,500
6.	Sulphuric Acid	22,400	44,800	100,000	246,180	246,180	576,180
7.	Phosphoric Acid	-	-	8,250	41,250	41,250	143,800
8.	Ammonium Chloride	8,000	8,000	8,000	24,750	24,750	24,750
9.	Sulphur Dioxide	-	-	3,300	8,250	8,250	8,250
10.	Oleum	3,300	3,300	3,300	6,600	6,600	6,600
11.	Urea	-	-	-	-	330,000	330,000
12.	NPK Fertilisers (Various Grades)	-	-	-	-	-	485,000

Source: Ibid p.8.

Table - 7.2

Sales, Cost of Production and Profit/Loss for Company I for the years 1970-80

(Rs. in lakhs)

Year	Sales	Cost of Production	Profit/Loss
1970-71	26,05.803	2795,183	- 189,38
1971-72	3170,121	4092,531	- 382.41
1972-73	3422.96	3655.42	- 232,46
1973-74	2320.68	3117.307	- 796.63
1974-75	2929.511	3234,391	- 305,88
1975-76	5783.673	7068.103	-1284.43
1976-77	6704.69	8100.81	-1396.12
1977-78	6633.72	7519.57	- 885.85
1978-79	8333.158	9387.338	- 554.18
1979-80	8735.431	8670.521	+ 64.91

Source: Annual Reports of the Company 1970-1980.

Table - 7.3

Cost Ratios for Company-I for the Years 1975-76 to 1979-80

Year	Raw Material / Total cost	Labour / Total Cost	Financing charges / Total Cost	Depreciation / Total Cost
1975-76	3503.06 / 7232.85 = 0.48	694.75 / 7232.85 = 0.096	443.95 / 7232.85 = .08	742.55 / 7232.85 = .102
1976-77	4048.98 / 7617.52 = 0.53	663.024 / 7617.52 = 0.090	572.66 / 7617.52 = .08	719.8 / 7617.52 = 0.09
1977-78	3900.31 / 7565.25 = 0.52	886.25 / 7565.25 = 0.117	518.04 / 7565.25 = .08	679.77 / 7565.25 = 0.08
1978-79	4520.59 / 8442.20 = 0.54	938.71 / 8442.20 = 0.111	580.98 / 8442.20 = 0.07	708 / 8442.20 = 0.08
1979-80	6987.3 / 9071.68 = 0.77	1014.65 / 9071.68 = 0.112	850.47 / 9071.68 = 0.09	1049.61 / 9071.68 = 0.12

Source: Annual Reports of the Company for the years 1975-76 to 1979-80.

Table - 7.4

Increasing Trend in Consumption for Company-I

(Rs. in lakhs)

Year	Raw Material consumed	Labour	Finan-cing charges	Depre-ciation
1975-76	3,503.06	694.75	443.95	742.55
1976-77	4,048.98	663.024	572.66	719.18
1977-78	3,900.31	886.25	518.04	679.77
1978-79	4,520.59	938.71	580.98	708
1979-80	6987.3	1,014.05	850.47	1,049.61

Source: Ibid.

Table - 7.5(a)

Designed, Attainable and Actual Ratios of Raw Materials for Company-I, Udyogamandal Division During 1970-71 to 1973-74

Product	Raw Material	Designed Ratio	Attainable Ratio	Actual Ratio 1970-71	1971-72	1972-73	1973-74
1. Hydrogen	Naphtha	0.382	0.395	0.420	0.394	0.398	0.398
2. Ammonia	Hydrogen	2.138	2.200	2.280	2.288	2.260	2.230
3. Ammonium sulphate a) Direct Neutralisation	Ammonia	0.275	0.280	0.296	0.293	0.298	0.296
	Sulphuric Acid	0.765	0.750	0.733	0.778	0.781	0.788
b) Gypsum Process	Ammonia	0.275	0.300	0.338	0.360	0.366	0.363
4. Ammonium Phosphate 16:20	Ammonia	0.201	0.215	0.221	0.222	0.231	0.225
	Sulphuric Acid	0.420	0.420	0.435	0.429	0.427	0.428
5. Ammonium Phosphate 20:20	Ammonia	..	0.300	0.349	-	0.289	0.297
	Sulphuric Acid	..	0.420	0.454	-	0.447	0.436
6. Ammonium Chloride	Ammonia	0.344	0.350	0.407	0.361	0.350	0.350
	HCL	0.676	0.700	0.703	0.701	0.781	0.720
7. Sulphuric Acid	Sulphur	0.344	0.350	0.350	0.355	0.356	0.368
8. Sulphur dioxide	Sulphate	0.510	0.510	0.514	0.515	0.515	0.515
9. Phosphoric Acid	Sulphuric Acid	0.372	0.370	0.389	0.379	0.380	0.380
10. Super Phosphate	Sulphuric Acid	0.372	0.372	0.389	0.379	0.380	0.380
	Rock phosphate	0.595	0.600	0.612	0.600	0.600	0.600

Source: Sixty seventh Report of the Committee on Public Undertakings, V Lok Sabha, 1974-75.

Table - 7.5(b)

Design Budgeted and Actual Ratios for Cochin Division Phase I & II of Company-I for the Years 1975-76 to 1979-80

Product	Raw material	Designed Ratios	Budgeted Ratios	Actual Ratios 1975-76	1976-77	1977-78	1978-79	1979-80
Phase-I								
1. Ammonia (O.G)	Naphtha	0.850	0.935	1.008	1.0012	0.9798	0.9689	1.056
Ammonia (composite)	"	0.812	0.935	0.920	1.0380	0.9463	0.962	0.912
Ammonia (overall)	"	-	0.935	0.9637	1.0132	0.9017	0.9662	0.993
2. Sulphuric Acid	Sulphur	0.344	0.360	0.3663	0.3688	0.3483	0.3497	0.368
3. Sulphur dioxide	"	0.514	0.530	0.515	0.515	0.515	0.515	0.515
4. Oleum	"	0.374	0.440	0.374	0.374	0.374	0.374	0.374
5. Superphosphate	Rock	0.595	0.600	0.598	0.595	0.596	0.598	0.599
6. Phosphoric Acid	"	3.200	3.500	3.8603	3.724	3.422	3.588	3.540
7. Ammonium	HCL Gas	0.728	0.728	0.733	0.724	0.722	0.704	0.70
Phase-II								
1. Ammonia	Naphtha	0.866	1.1	1.158	1.211	1.09	-	1.09
2. Sulphuric Acid	Sulphur	0.3336	0.345	-	-	0.359	-	0.36
3. P_2O_5	Rock	3.08	3.4	-	-	3.263	-	3.45

Source: Information furnished by the Committee to the Expert Committee on Public Undertakings (unpublished).

Table - 7.6

Production, Consumption, Wastage and Loss of Hydrogen and Ammonia for the Years 1970-71 to 1973-74

Year	Item	Production	Consumption	Wastage	% of 5 to 3	Factory Cost (Rs. lakhs)	Loss (Rs. lakhs)
1	2	3	4	5	6	7	8
1970-71	Hydrogen	128343 MM^3	115475 MM^3	12871 MM^3	10	141.03	18.15
1971-72		114227 "	100903 "	13324 "	11.7	186.45	24.84
1972-73		97764 "	85393 "	12371 "	12.6	194.05	24.01
1973-74		100178 "	85590 "	14588 "	14.5	208.99	30.49
1970-71	Ammonia	50323 T	49545 T	778	1.55	581.23	4.82
1971-72		60841 "	59633 "	1208	1.99	698.75	8.44
1972-73		48479 "	47200 "	1279	2.64	780.00	9.98
1973-74		61114 "	59892 "	1222	2.00	832.42	10.17

Source: Sixty seventy Report of the Public Undertakings Committee, 1974-75.

Table - 7.7

Extent of Overtime Paid in the two Divisions in Company-I for the Years 1975-76 to 1979-80

(Rs. in lakhs)

	1975-76		1976-77		1977-78		1978-79		1979-80	
	O.T.	% of O.T	O.T.	% of O.T.	O.T.	% of O.T.	O.T.	% of O.T.	O.T.	% of O.T.
Udyogamandal Division	33.66	13.44	26.25	12.63	37.65	12.24	48.16	19.54	57.44	22.98
Cochin Division	8.33	12.35	9.78	10.35	16.36	16.67	26.22	22.93	27.55	21.35

Source: Report submitted to the Committee on Public Undertakings, 1981 (unpublished).

Table - 7.8

Production and Capacity Utilisation of Nutrients for Company-I for the years 1975-76 to 1979-80

Nutrients	Installed capacity	1975-76		1976-77		1977-78		1978-79		1979-80	
		Production	C.U. %	Production	C.U. %	Production	C.U. %	Production	C.U. %	Production	C.U. %
N	74,176	45261	61	45289	61	49611	67	50593	68	51007	61
P_2O_5	37,620	21072	58	23333	62	27071	72	27793	74	28449	76

Source: Report submitted to the Committee on Public Undertakings, 1981 (unpublished).

Table - 7.9

Selling Prices, Total Cost of Major Products for Company-X for the Years 1974-75 to 1979-80

(Rs./Tonne)

Product	Year	Total cost	Selling Price (average realisation)	Subsidy Coverage	Total sales realisation	Net Loss (3-6)
1	2	3	4	5	6	7
1. Ammonium Sulphate	1974-75	1,179	896	-	896	283
	1975-76	1,255	920	-	920	335
	1976-77	1,292	919	-	919	373
	1977-78	1,166	920	93	1,013	153
	1978-79	1,187	915	228	1,143	44
	1979-80	1,321	885	216	1,101	220
2. Factom-phos 20:20	1976-77	2,296	1,977	250	2,227	69
3. Super phosphate	1975-76	1,059	925	52	977	82
	1978-79	747	459	200	659	88
	1979-80	932	526	200	726	206
4. Ammonium Chloride (Sold as fertiliser)	1975-76	1,271	1,215	-	1,215	56
	1976-77	1,655	1,223	-	1,223	452
	1977-78	1,549	1,471	-	1,471	78
5. Urea	1975-76	2,438	1,872	-	1,872	476
	1976-77	2,359	1,731	-	1,731	628
	1977-78	2,127	1,604	133	1,737	390
	1978-79	2,094	1,538	438	1,976	118
6. N.P.K. 28:28	1977-78	2,800	2,336	350	2,686	114
	1978-79	2,961	2,331	393	2,724	237
	1979-80	3,544	2,199	1,293	3,492	52

1	2	3	4	5	6	7
7. N.P.K. 18:46	1977-78	2,842	2,196	575	2,771	71
	1978-79	3,858	2,207	575	2,782	676
	1979-80	4,264	2,200	1,676	3,876	388
8. N.P.K. 17:17:17	1977-78	2,378	1,805	213	2,018	360
	1978-79	2,523	1,768	473	2,240	283
	1979-80	No production.				

Source: Handbook on F.A.C.T., 1979-80 (unpublished).

Table - 7.10

Budgeted and Actual Production, Value Added, Profit/Loss Before Tax and Cumulative Loss at the end of the year

(Rs. in lakhs)

Year	Production		Value added		Profit & Loss before tax		Cumulative Loss at the end of the year
	Budget	Actual	Budget	Actual	Budget	Actual	
1971-72	4042	35 21	980	954	-200	-382	-748
1972-73	2413	2482	927	779	-246	-232	-980
1973-74	3858	3270	1319	1424	- 78	-197	-1177
1974-75	6342	7116	2790	2540	-398	-306	-1483
1975-76	9616	7945	2451	1961	-1083	-1284	-2767
1976-77	6981	7281	2267	1992	-1211	-1386	-4163
1977-78	9372	7191	2318	2089	-1617	- 886	-5049
1978-79	12013	8448	3641	3487	- 871	- 554	5603
1979-80	13206	14057	4157	5872	-1454	+ 65	-5538

Source: Handbook on F.A.C.T., 1979-80 (unpublished).

Table - 7.11

Sales, Cost of Production and Profit/Loss for the Company-II for the Years 1975-76 to 1979-80

(Rs. in lakhs)

Year	Sales	Cost of production	Profit (+)/ Loss (-)
1975-76	417.17	567.70	-150.53
1976-77	600.68	906.94	-306.26
1977-78	585.00	872.65	-287.65
1978-79	674.24	831.57	-157.33
1979-80	932.10	944.10	- 12.02

Source: Annual Reports of the Company 1975-76 to 1979-80.

Table - 7.12

Average Selling Price/M.T. and Cost of Production for Different Products for Company-II for the years 1977-78 to 1979-80

(Rs./M.T.)

Year	Caustic Soda Lye		Caustic Soda solid		Caustic Soda flakes		Sodium Hydro sulphite		Sodium Sulphide	
	Average selling price	Cost of production	Average selling price	Cost of production	Average selling price	Cost of production	Average selling price	Cost of production	Average selling price	Cost of production
1977-78	1635	2251	1646	3022	1893	2942	16810	30678	3655	6194
1978-79	1959	2366	2007	3233	2277	3107	16805	19896	4018	6931
1979-80	2622	2443	3167	3250	3257	3174	18793	35640	4395	11447

Source: Cost Audit Reports of the Company (unpublished) 1977-78 - 1979-80.

Table - 7.13

Cost Ratios for Company-II

Year	Raw Material / Total cost	Labour / Total cost	Depreciation / Total Cost	Financing charges / Total Cost	Power & Fuel / Total Cost
1973-74	$\frac{172.49}{463.78}$ = 0.37	$\frac{103.87}{463.78}$ = 0.22	$\frac{65.71}{463.78}$ = 0.14	$\frac{18.42}{463.78}$ = 0.04	$\frac{47.14}{463.78}$ = .10
1974-75	$\frac{169.77}{488.78}$ = 0.34	$\frac{115.86}{488.78}$ = 0.24	$\frac{65.99}{488.78}$ = 0.14	$\frac{20.17}{488.78}$ = 0.04	$\frac{50.95}{488.78}$ = 0.10
1975-76	$\frac{152.29}{567.70}$ = 0.27	$\frac{118.63}{567.70}$ = 0.21	$\frac{127.53}{567.70}$ = 0.22	$\frac{60.15}{567.70}$ = 0.114	$\frac{64.06}{567.70}$ = 0.11
1976-77	$\frac{183.55}{906.94}$ = 0.20	$\frac{128.48}{906.94}$ = 0.14	$\frac{197.21}{906.94}$ = 0.22	$\frac{150.51}{906.94}$ = 0.166	$\frac{99.65}{906.94}$ = 0.11
1977-78	$\frac{150.10}{872.65}$ = 0.17	$\frac{151.38}{872.65}$ = 0.17	$\frac{151.39}{872.65}$ = 0.17	$\frac{158.53}{872.65}$ = 0.18	$\frac{124.19}{872.65}$ = 0.14
1978-79	$\frac{170.90}{831.51}$ = 0.21	$\frac{152.30}{831.51}$ = 0.18	$\frac{147.51}{831.51}$ = 0.18	$\frac{160.89}{831.51}$ = 0.18	$\frac{80.34}{831.51}$ = 0.10
1979-80	$\frac{211.04}{944.12}$ = 0.22	$\frac{162.45}{944.12}$ = 0.17	$\frac{141.99}{944.12}$ = 0.15	$\frac{172.03}{944.12}$ = 0.18	$\frac{122.05}{944.12}$ = 0.13

Table - 7.14(a)

Norms Fixed by the Company, Actual Consumption/Tonne and the Value of Excess Consumption of Principal Raw Materials for Company-II for the Years 1971-72 to 1973-74

Raw Materials	Standards as per norms fixed	Consumption of Raw materials (actuals)			Excess consumption			Value of Excess consumption/tonne		
		1971-72	72-73	73-74	1971-72	72-73	73-74	1971-72	72-73	73-74
A: For the production of one tonne of caustic soda										
1. Common salt (tonne)	1.900	2.090	2.060	2.055	0.190	0.160	0.155	18.63	16.27	17.49
B: For the production of one tonne of sodium hydro sulphate										
2. Zinc dust (kg.)	510	536	525	500	26	15	-	136.08	99.63	-
3. Sulphur dioxide (kg.)	910	985	952	905	75	45	-	76.22	43.26	-
4. Methanol (kg)	98.4	159	192	173	60.6	95.6	74.6	107.79	194.43	117.55

SOURCE: Report of the Comptroller and Auditor General (Commercial) 1973-74 p.937

...tity and Value of Materials for Co.II for the years 1977-'78 to 1979-'80

...uantity Reqd. as per Norms					Actual Consumption			Excess Consumption			Value of Excess Consumption (Rupees in Lakhs)		
-78	[illegible]	78-79	79-80		77-78	78-79	79-80	77-78	78-79	79-80	77-78	78-79	79-80
N.P.	O.P.	N.P.	O.P.	N.P.									
30791	20496	31607	21954	38048	58195	53741	68442	4954	1638	2440	6.46	3.00	4.27
125.42		179.52		96.10	135.45	168.80	98.00	10.03		1.90	1.76	-	0.31
220.72		320.32		100.1	244.905	327.7	115.00	24.285	7.380	14.9	0.61	0.21	0.98

Cost Audit Reports of the Company (unpublished) 1979-'80.

Table 7.15

Increasing trend in Remuneration For Company II for the years 1975-76 to 1979-80

(Rs. in lakhs)

Year	Wages/salaries
1975 - 76	118.63
76 - 77	128.48
77 - 78	151.38
78 - 79	152.30
79 - 80	162.45

Source: Annual Reports of the Company for the years 1975-'80.

Table No.7.16

Overtime allowances paid to the staff as a percentage of the total wage bill during the three years ending 1973-74 for Company II

(Rs. in lakhs)

	1971-72		1972-73		1973-74	
	Factory staff	Admn. staff	Factory staff	Admn. staff	Factory staff	Admn. staff
Salaries & wages	33.66	9.71	31.43	8.83	41.18	11.41
Overtime Allowance	6.35	1.36	7.20	1.64	9.18	2.32
Percentage of overtime Allowance to total salaries	18.86	14.01	22.91	18.57	22.29	20.35

Source: Report of the Comptroller & Auditor General (Commercial), 1973-74.

Table - 7.11

Increasing Trend in Power and Fuel Consumption Financing Charges and Depreciation for Company-II for the Year 1972-73 to 1979-80

(Rs. in lakhs)

Year	Power & Fuel	Financing Charges	Depreciation
1972-73	41.38	--	69.93
1973-74	47.14	18.42	65.71
1974-75	50.95	20.17	65.99
1975-76	64.06	68.15	127.53
1976-77	94.65	150.51	197.23
1977-78	124.16	158.53	151.39
1978-79	80.34	168.89	147.51
1979-80	122.05	172.03	141.99

Source: Annual Reports of the Company 1972-73 to 1979-80.

Table— 7.18

Installed capacity, Production and Percentage of production to capacity for Company II for the years 1975-76 to 1979-80

(in M.T)

Year	Caustic Soda				Sodium Hydrosulphite				Sodium sulphide			
	Installed capacity	Budgeted production	Actual Production	% Capacity utilisation	Installed capacity	Budgeted production	Actual production	% Capacity utilisation	Installed capacity	Budgeted production	Actual production	% capacity utilisation
1975-76	39050	25726	21468	55	-	-	-	-	1917	980	695	36.3
1976-77	59400	37067	29394	49.4	-	-	-	-	2100	1499	911	43.4
1977-78	59400	41620	27440	46.2	2100	1020	242	11.5	2100	1775	573	27.3
1978-79	59400	41200	26883	45.3	2100	900	352	16.8	2100	1200	456	21.7
1979-80	59400	41200	31002	52.2	2100	360	110	5.2	2100	600	342	16.3

Source: Annual Reports of the Company 1975-76 to 1979-80.

Table - 7.19

Sales, Cost of Production & Profit/Loss for Company-III

(Rs. in lakhs)

Year	Sales	Total cost of production	Profit(+)/Loss(-)
1974	547.64	576.05	-28.41
1975	598.16	845.16	-247.0
1976	951.17	932.30	18.87
1977	972.09	926.90	45.19
1978	983.34	910.52	72.82
1979	871.56	925.4	-53.84
1980	1,287.14	1,388.19	-101.05

Source: Annual Reports of the Company 1974-1980.

Table - 7.20

Cost Ratios for Company - III

Year	Raw Material / Total Cost	Labour / Total Cost	Power & Fuel / Total Cost	Financing Charges / Total Cost	Depreciation / Total Cost
1974	$\frac{160.26}{576.05} = 0.28$	$\frac{81.71}{576.05} = 0.14$	$\frac{75.42}{576.05} = .13$	$\frac{46.82}{576.05} = .08$	$\frac{128.36}{576.05} = .22$
1975	$\frac{129.58}{845.16} = 0.15$	$\frac{109.26}{845.16} = 0.13$	$\frac{85.45}{845.16} = .10$	$\frac{38.92}{845.16} = .04$	$\frac{145.13}{845.16} = .17$
1976	$\frac{219.42}{932.30} = 0.23$	$\frac{129.31}{932.30} = 0.14$	$\frac{147.46}{932.30} = .16$	$\frac{40.44}{932.30} = .04$	$\frac{138.21}{932.30} = .15$
1977	$\frac{235.38}{926.90} = 0.25$	$\frac{158.70}{926.90} = 0.17$	$\frac{182.72}{926.90} = .19$	$\frac{36.31}{926.90} = .04$	$\frac{106.62}{926.90} = .12$
1978	$\frac{266.65}{910.52} = 0.39$	$\frac{162.55}{910.52} = 0.18$	$\frac{169.39}{910.52} = .19$	$\frac{35.26}{910.52} = .04$	$\frac{89.35}{910.52} = .09$
1979	$\frac{277.96}{925.4} = 0.30$	$\frac{196.58}{925.4} = 0.21$	$\frac{159.99}{925.4} = .17$	$\frac{35.16}{925.4} = .037$	$\frac{71.89}{925.4} = .07$
1980	$\frac{494.97}{1388.19} = 0.36$	$\frac{246.78}{1388.19} = 0.17$	$\frac{198.89}{1388.19} = .14$	$\frac{45.37}{1388.19} = .03$	$\frac{75.28}{1388.19} = .05$

Table - 7.22

Inventory Distribution in Company-III for the Period 1971-72 to 1973-74

(Rs. in lakhs)

Item	1971-72	1972-73	1973-74
1. Raw Materials	11.76	11.21	20.58
2. Stores and Spares	47.05	48.83	63.72
3. Loose Tools	0.11	0.12	0.09
4. Goods in Process	8.12	3.44	9.14
5. Finished Goods	0.71	0.54	0.57
Total	67.75	64.14	94.10
1. Consumption of raw materials	55.85	55.52	57.34
2. Consumption of stores and spares	18.49	17.00	16.46
3. Year end inventories of raw materials as number of months requirements for production, repair and maintenance.	3.00	3.00	4.00

Source: Report of the Comptroller & Auditor General 1973-74, p.20.

Table - 7.23

Remuneration to Employees, Overtime Paid and Percentage of Overtime to Wages in Company-III for the Years 1971-1973

(Rs. in lakhs)

	1971	1972	1973
Workmen:			
Wages ..	24.09	30.42	36.08
Overtime allowance ..	4.40	5.59	7.88
% of overtime allowance to wages. ..	18.30	18.90	21.8
Staff:			
Pay & Allowance ..	14.99	18.01	21.04
Overtime allowance..	0.95	1.34	1.58
% of overtime to wages ..	6.33	7.44	7.51

Source: Report of Comptroller & Auditor General 1973-74, p.24.

Table - 7.24

Installed Capacity, Targeted Production for Company-III Actual Production and Percentage of Plant Utilisation to Installed Capacity

Year	Installed capacity	Targeted production	Actual production	Percentage of Actual to Targeted Production	Percentage of plant utilisation to installed capacity
1971	6,500	6,000	5,456	90.93	83.94
1972	6,500	6,000	5,886	98.10	90.55
1973	6,500	6,000	4,369	72.82	67.22
1974	24,500	-	7,611	-	-
1975	24,500	-	5,377	-	-
1976	24,500	12,000	9,717	81.0	40.0
1977	24,500	18,000	9,888	55.0	40.0
1978	24,500	-	9,916	55.0	40.47
1979	24,500	-	8,381	46.0	34.2
1980	24,500	-	10,939	60.77	44.6

Source: Annual Reports of the Company 1970-71 - 1979-80.

Table - 7.25

Budgeted and Actual Production of Soaps in Company-IV

Year	Toilet		Laundries		Carbolic		Sudopes		S.L.D.	
	Budgeted	Actual	Budgetted	Actual	Budgetted	Actual	Budgetted	Actual	Budgeted	Actual
1974 - 75	-	227.2	-	120.2	-	265.5	-	125.1	-	62
1975 - 76	625	22.9	630	108.9	995	279.3	157	94.0	110	53
1976 - 77	1100	81.9	750	301.9	2250	1635.0	157	99.0	100	57
1977 - 78	202.50	81.96	543.5	291.0	3375	2127.0	102	65.9	63	47

Source: Annual Reports of the Company for the years 1974-75 to 1977-78.

Table No. 7.26

Capacity Utilisation in Company IV during the years 1972-73 to 1979-80

Year	Soaps			Shark Oil Products			Glycerine		
	Instal-led capa-city	Actual produc-tion	% utili-sation	Instal-led capa-city	Actual produc-tion	% utili-sation	Instal-led capa-city	Actual produc-tion	% utili-sation
1972 - 73	700	413	59	300	78	26	260	-	-
1973 - 74	700	377	54	300	62	21	260	-	-
1974 - 75	700	729	104	300	62	21	260	-	-
1975 - 76	4300	505	12	300	53	18	260	-	-
1976 - 77	4300	2029	47	300	51	19	260	-	-
1977 - 78	7000	2566	37	300	47	16	260	47	18
1978 - 79	7000	4347	62	300	58	19	260	70	27
1979 - 80	9000	6079	68	300	63	21	260	57	20

Source : Annual Reports of the Company for the years 1972-73 to 1979-80

Table No.7.27

Sales, Cost of Production, Profit /Loss for Company IV for the years 1971-72 to 1979-80

(Rs. in lakhs)

Year	Sales	Cost of Production	(+) Profit/ (-) Loss
1971 - 72	26.27	38.90	- 12.63
1972 - 73	31.52	45.97	- 14.45
1973 - 74	39.84	49.91	- 10.07
1974 - 75	81.18	91.91	- 10.73
1975 - 76	57.53	59.71	- 2.18
1976 - 77	137.78	143.62	- 5.84
1977 - 78	165.60	176.60	- 11.00
1978 - 79	268.82	299.57	- 30.75
1979 - 80	523.36	511.54	+ 11.82

Source : Opcit , Annual Reports of the Company for the years 1971 - 72 to 1979 - 80.

Table - 7.28

Cost Ratios for Company-IV

(Rs. in lakhs)

Year	Raw Material consumption / Total Cost	Labour / Total Cost	Financing Charges / Total Cost	Depreciation / Total Cost
1971-72	17.13 / 38.90 = .44	12.71 / 38.90 = .33	1.99 / 38.90 = .05	-
1972-73	15.69 / 45.97 = .34	14.40 / 45.97 = .31	2.31 / 45.97 = .05	-
1973-74	20.65 / 49.91 = .41	16.72 / 49.91 = .34	0.61 / 49.91 = .01	-
1974-75	45.51 / 91.91 = .50	19.91 / 91.91 = .22	2.59 / 91.91 = .02	0.75 / 91.91 = .008
1975-76	14.57 / 59.71 = .24	12.54 / 59.71 = .21	2.84 / 59.71 = .04	0.69 / 59.71 = .01
1976-77	73.62 / 143.62 = .51	26.02 / 143.62 = .18	6.23 / 143.62 = .04	0.62 / 143.62 = .004
1977-78	94.93 / 176.60 = .54	29.17 / 176.60 = .17	13.48 / 176.60 = .07	0.65 / 176.60 = .004
1978-79	186.83 / 299.57 = .62	36.02 / 299.57 = .12	16.41 / 299.57 = .05	—
1979-80	333.01 / 511.54 = .65	44.84 / 511.54 = .09	21.41 / 511.54 = .04	—

Table - 7.39

Sales, Cost of Production and Profit/
Loss for Company - V

Year		Sales	Total cost of production	Profit/ Loss
1974-75	-	67.83	74.34	- 6.51
1975-76	-	154.50	158.67	- 4.17
1976-77	-	177.62	187.14	- 9.52
1977-78	-	170-01	313.36	-143.35
1978-79	-	273.62	310.30	- 39.68
1979-80	-	310.61	305.21	+ 5.40

Table - 7.30

Cost Ratios for Company-V

Year	$\frac{\text{Raw Material}}{\text{Total cost}}$	$\frac{\text{Labour}}{\text{Total Cost}}$	$\frac{\text{Power \& Fuel}}{\text{Total Cost}}$	$\frac{\text{Financing charges}}{\text{Total Cost}}$	$\frac{\text{Depreciation}}{\text{Total Cost}}$
1974-75	$\frac{48.70}{74.34}$ = .66	$\frac{3.84}{74.34}$ = .05	$\frac{0.54}{74.34}$ = .0073	$\frac{3.04}{74.34}$ = .04	$\frac{4.32}{74.34}$ = 0.06
1975-76	$\frac{92.85}{158.67}$ = .59	$\frac{14.38}{158.67}$ = .10	$\frac{2.45}{158.67}$ = .02	$\frac{10.96}{158.67}$ = .07	$\frac{4.73}{158.67}$ = 0.03
1976-77	$\frac{100.46}{187.14}$ = .54	$\frac{21.12}{187.14}$ = .11	$\frac{2.45}{187.14}$ = .01	$\frac{14.66}{187.14}$ = .08	$\frac{4.92}{187.14}$ = 0.03
1977-78	$\frac{110.63}{313.36}$ = .35	$\frac{30.76}{313.36}$ = .10	$\frac{2.75}{313.36}$ = .0088	$\frac{20.37}{313.36}$ = .07	$\frac{5.19}{313.36}$ = 0.02
1978-79	$\frac{131.46}{310.30}$ = .42	$\frac{34.30}{310.30}$ = .10	-	$\frac{19.73}{310.30}$ = .06	$\frac{25.23}{310.30}$ = 0.08

Table 7.31

Distribution of inventories

during the three years period upto 1979--80

(Rs. in lakhs)

Item		1977-78	1978-79	1979-80
I i)	Raw Materials and packing materials	40.75	71.19	53.66
ii)	Stores and spares	2.72	3.45	3.38
iii)	Construction Materials	0.21	0.08	0.24
iv)	Stationery	0.68	0.53	0.47
v)	Goods in process	2.38	0.48	0.95
vi)	Finished goods	19.52	19.25	14.00
	Total	66.26	94.98	72.70
II i)	Consumption of raw materials and packing materials	121.50	143.03	173.21
ii)	Consumption of stores and spares and lubricants	2.66	3.63	4.38
III A)	Year end inventories in terms of months requirement			
	(i) Raw materials and packing materials	4.02	5.97	3.71
	(ii) Stores and Spares	12.25	11.39	9.10
B)	Year end inventories of finished goods in terms of months production	1.45	0.85	0.55

Source: Opcit Report of the comptroller and Auditor General (Commercial) 1979-80 p.140

Table - 7.32

Installed capacity, Budgeted Production, Actual Production for three years upto March, 1980.

Category of Drugs	Year	Installed capacity (on single shift basis for 300 days) (in lakhs)	No. of shifts operated	Achievable capacity based on number of shifts operated	Budgeted Production (in lakhs)	Actual Production	% of actual production to budgeted production	% of actual production to achievable capacity
Tablets (Numbers)	1977-78	2514.00	512	4290.56	2065.00	1650.52	79.9	38.5
	1978-79	2514.00	592	4960.96	2319.00	2483.34	107.1	50.1
	1979-80	2514.00	586	4910.68	3095.00	3074.21	99.3	62.6
Capsules (Numbers)	1977-78	149.00	333	165.39	80.00	63.03	78.8	38.1
	1978-79	149.00	380	188.73	106.61	85.39	80.1	45.2
	1979-80	149.00	321	159.43	110.76	77.83	70.3	48.8
Liquids (litres)	1977-78	2.25	274	2.06	1.42	0.79	55.6	38.3
	1978-79	2.25	264	1.98	1.05	1.02	97.1	51.5
	1979-80	2.25	222	1.67	2.02	0.73	36.1	43.7
Parenteral								
a) Bottles (numbers)	1977-78	4.50	310	4.65	4.75	2.13	44.8	45.8
	1978-79	4.50	228	3.42	4.49	3.54	78.8	103.5
	1979-80	4.50	247	3.71	6.08	5.66	93.1	152.6
b) Vials (numbers)	1977-78	15.00	310	15.50	11.30	4.68	41.4	30.2
	1978-79	15.00	228	11.40	9.70	5.55	57.2	48.7
	1979-80	15.00	247	12.35	7.62	4.04	53.0	32.7
c) Ampoules	1977-78	60.00	310	62.00	31.88	14.94	46.9	24.9
	1978-79	60.00	228	45.60	26.10	15.99	61.3	35.1
	1979-80	60.00	247	49.40	29.74	27.45	92.3	58.6
Granules	1977-78	20000	..	20000	10000	12643	126.4	63.2
	1978-79	20000	..	20000	2300	4700	204.3	23.5
	1979-80	20000	..	20000	4511	4257	94.4	21.3

Source: Report of the Comptroller and Auditor General, 1979-80. p.130

Table - 7.33

Sales, Value of Production, Cost of Production and Profits for Company-VI

(Rs. in lakhs)

Year	Sales Value of Production	Cost of Production	Profit
1971-72	154.31	111.65	42.66
1972-73	179.43	114.41	65.02
1973-74	443.15	147.97	295.18
1974-75	359.03	219.43	139.6
1975-76	545.37	258.78	286.59
1976-77	528.18	257.07	271.11
1977-78	407.76	255.53	152.23
1978-79	473.15	266.40	206.75
1979-80	655.87	402.43	253.44

Source: Annual Reports of the Company for the years 1971-72 to 1979-80.

Table - 7.34

Cost Ratios for Company-VI

Year	Raw Material / Total cost	Labour / Total cost	Power & Fuel / Total cost	Depreciation / Total cost
1971-72	$\frac{56.56}{111.64}$ = .51	$\frac{28.02}{111.64}$ = 0.25	$\frac{8.21}{111.64}$ = 0.07	$\frac{11.66}{111.64}$ = 0.10
1972-73	$\frac{51.71}{114.41}$ = .45	$\frac{31.87}{114.41}$ = 0.27	$\frac{8.09}{114.41}$ = 0.07	$\frac{12.22}{114.41}$ = 0.11
1973-74	$\frac{73.66}{147.97}$ = .49	$\frac{46.53}{147.97}$ = 0.31	$\frac{5.79}{147.97}$ = 0.03	$\frac{12.63}{147.97}$ = 0.08
1974-75	$\frac{131.82}{219.43}$ = .60	$\frac{57.86}{219.43}$ = 0.24	$\frac{16.02}{219.43}$ = 0.07	$\frac{12.15}{219.43}$ = 0.05
1975-76	$\frac{149.10}{258.78}$ = .57	$\frac{59.42}{258.78}$ = 0.23	$\frac{19.72}{258.78}$ = 0.07	$\frac{14.59}{258.78}$ = 0.06
1976-77	$\frac{150.91}{257.07}$ = .58	$\frac{54.51}{257.07}$ = 0.21	$\frac{19.80}{257.07}$ = 0.07	$\frac{16.42}{257.07}$ = 0.06
1977-78	$\frac{135.86}{255.53}$ = .53	$\frac{67.35}{255.53}$ = 0.22	$\frac{19.41}{255.53}$ = 0.07	$\frac{18.15}{255.53}$ = 0.07
1978-79	$\frac{169.48}{266.40}$ = .63	$\frac{72.47}{266.40}$ = 0.27	$\frac{22.60}{266.40}$ = 0.10	$\frac{19.75}{266.40}$ = 0.05
1979-80	$\frac{237.91}{402.43}$ = .59	$\frac{82.46}{402.43}$ = 0.21	$\frac{29.22}{402.43}$ = 0.07	$\frac{17.19}{402.43}$ = 0.04

Table - 7.35

Inventory Analysis for Company-VI

(Rs. in lakhs)

Year	Materials, Stores and Fuels	Semi finished Goods	Products and By-Products
1971-72	14.75	1.86	9.54
1972-73	36.87	2.4	18.99
1973-74	43.9	3.65	27.01
1974-75	58.1	4.8	28.24
1975-76	79.3	7.8	28.26
1976-77	75.33	8.98	30.9
1977-78	68.8	6.4	35.05
1978-79	64.2	6.6	35.6
1979-80	264.05	15.3	46.40

Source: Annual Report for the years 1971-72 to 1979-80.

Table - 7.37

Sales, Total Cost and Profit/Loss for Company-VII

(Rs. in lakhs)

Year	Sales	Cost	Profit(+)/ Loss (-)
1974	12,361.57	13,283.86	-922.29
1975	19,047.59	18,749.7	+297.89
1976	21,273.31	20,863.66	+409.65
1977	27,094.71	26,563.23	+531.48
1978	14,976.83	14,846.18	+130.65
1979	25,446.49	24,990.95	+455.54
1980	38,546.68	38,945.06	-398.38

Source: Annual Report of the Company 1974-80.

Table - 7.38

Raw Materials, Wages, Power, Interest and Depreciation for

Company - VII

(Rs. in lakhs)

Year	Raw Materials	Wages & Salaries	Power & Fuel	Interest	Depreciation
1973-74	12,055.03	77.19	30.84	124.85	201.20
1974-75	17,191.53	86.72	27.68	507.83	192.48
1975-76	20,246.76	82.67	30.73	181.12	194.88
1976-77	26,055.90	95.73	50.27	42.43	196.38
1977-78	14,563.44	61.23	29.52	15.91	115.82
1978-79	24,508.10	100.90	57.53	25.27	201.14
1979-80	38,473.24	107.41	59.14	65.74	201.74

Table - 7.39

Installed Capacity, Production and Percentage of Capacity Utilisation for Company - VII

Year	Installed capacity	Production	Percentage of Capacity Utilisation
1973-74	3,300,000	2,256,552	68.4
1974-75	3,300,000	2,330,942	70.6
1975-76	3,300,000	2,193,558	66.5
1976-77	3,300,000	2,693,720	81.6
1977-78	3,300,000	1,610,509	48.8
1978-79	3,300,000	2,730,895	82.75
1979-80	3,300,000	2,731,075	82.76

Table - 7.40

Imports of Formic Acid into India

Year	Quantity (in kg.)	Value (in Rs.)
1963-64	558,624	8,35,216
1964-65	431,654	5,68,602
1965-66	618,690	8,79,766
1966-67	256,556	5,53,006
1967-68	548,565	13,63,972
1968-69	1,082,351	23,60,268
1969-70	771,505	16,45,320
1970-71	664,825	16,12,011

Source: News & Notes: Chemical Industry News, Vol.XVI, No.9, January, 1972.

Table - 7.41

Sales, Cost of Production for Company-VIII

(Rs. in lakhs)

Year	Sales	Cost of Production	Profit (+)/ Loss(-)
1973-74	74.55	51.4	+23.15
1974-75	96.59	64.76	+31.83
1975-76	112.13	72.3	+39.4
1976-77	83.18	105.85	-22.67
1977-78	111.07	124.51	-13.44
1978-79	169.26	136.08	+33.08
1979-80	188.70	176.45	+12.25

Source: Annual Reports of the Company for the years 1973-74 to 1979-80.

Table - 7.42

Cost Ratios for Company-VIII for the years 1973-74 to 1979-80

Year	Raw Material / Total cost	Wages & Salaries / Total Cost	Power & Fuel / Total Cost	Interest / Total cost	Depreciation / Total cost
1973-74	$\frac{17.88}{51.4}$ = .34	$\frac{5.02}{51.4}$ = .09	$\frac{1.93}{51.4}$ = .03	$\frac{3.30}{51.4}$ = .06	$\frac{6.76}{51.4}$ = .13
1974-75	$\frac{22.59}{64.76}$ = .34	$\frac{7.88}{64.76}$ = .12	$\frac{2.47}{64.76}$ = .03	$\frac{3.34}{64.76}$ = .05	$\frac{16.92}{64.76}$ = .26
1975-76	$\frac{22.22}{72.8}$ = .30	$\frac{10.15}{72.3}$ = .14	$\frac{2.72}{72.3}$ = .03	$\frac{3.65}{72.3}$ = .05	$\frac{7.23}{72.3}$ = .10
1976-77	$\frac{35.32}{105.85}$ = .33	$\frac{14.52}{105.85}$ = .13	$\frac{5.60}{105.85}$ = .05	$\frac{4.22}{105.85}$ = .03	$\frac{13.21}{105.85}$ = .12
1977-78	$\frac{41.17}{124.51}$ = .32	$\frac{19.53}{124.51}$ = .15	$\frac{6.02}{124.51}$ = .04	$\frac{7.71}{124.51}$ = .06	$\frac{13.16}{124.51}$ = .11
1978-79	$\frac{41.77}{136.08}$ = .31	$\frac{19.99}{136.08}$ = .14	$\frac{6.82}{136.08}$ = .05	$\frac{6.38}{136.08}$ = .05	$\frac{8.46}{136.08}$ = .06
1979-80	$\frac{51.47}{176.45}$ = .28	$\frac{19.61}{176.45}$ = .11	$\frac{6.34}{176.45}$ = .04	$\frac{7.20}{176.45}$ = .04	$\frac{8.14}{176.45}$ = .05

Table - 7.43

Ratios of Raw Material Usage for Company-VIII

Year	Sodium Formate		Sulphuric Acid	
	Standard	Actual	Standard	Actual
1975-76	1.5001	1.5560	1.2248	1.2210
1976-77	1.5001	1.6448	1.2248	1.2694
1977-78	1.5001	1.6661	1.228	1.2749
1978-79	1.5001	1.7094	1.2238	1.2589
1979-80	1.500	1.7329	1.2238	1.3046

Table - 7.44

Installed Capacity, Production and Percentage of Utilisation for Company-VIII

(M.T.)

Year	Formic Acid			Sodium Sulphate		
	Installed capacity	Production	Percentage Utilisation	Installed capacity	Production	Percentage of utilisation
1973-74	990	670.0	67.68	1518	1115	73.46
1974-75	990	678.0	68.48	1518	1053	69.37
1975-76	1500	664.0	44.27	2250	990	44.00
1976-77	1500	1045.0	69.67	2250	1610	71.56
1977-78	1500	1192.0	29.47	2250	1863	82.80
1978-79	1500	1098.14	73.21	2250	1737.41	77.22
1979-80	1500	876.28	58.42	2250	1411.10	62.72

Table - 7.45

Sales and Cost of Production for Company-IX

(Rs. in lakhs)

Year	Sales	Total Cost	Profit(+)/ Loss (-)
1973	188.75	170.98	17.77
1974	319.50	260.08	59.42
1975	308.80	330.28	- 21.48
1976	448.96	507.60	-58.64
1977	634.74	597.97	36.77
1978	561.61	503.53	58.08
1979-80 (18 months)	1225.03	1139.92	85.11

Table - 7.46

Cost Ratios for Company-IX

Year	Raw Material / Total Cost		Wages & Salaries / Total Cost		Power & Fuel / Total Cost		Interest / Total Cost		Depreciation / Total Cost	
1973	$\frac{35.20}{170.98}$ =	.24	$\frac{23.99}{170.98}$ =	.16	$\frac{13.94}{170.98}$ =	.09	$\frac{10.18}{170.98}$ =	.06	$\frac{8.34}{170.98}$ =	.05
1974	$\frac{72.76}{260.08}$ =	.23	$\frac{29.09}{260.08}$ =	.09	$\frac{20.87}{260.08}$ =	.06	$\frac{12.76}{260.08}$ =	.04	$\frac{8.40}{280.08}$ =	.02
1975	$\frac{82.86}{330.28}$ =	.26	$\frac{33.83}{330.28}$ =	.10	$\frac{45.72}{330.28}$ =	.14	$\frac{20.52}{330.28}$ =	.06	$\frac{13.87}{330.28}$ =	.04
1976	$\frac{104.51}{507.60}$ =	.24	$\frac{38.09}{507.60}$ =	.08	$\frac{84.09}{507.60}$ =	.19	$\frac{30.54}{507.60}$ =	.07	$\frac{15.14}{507.60}$ =	.03
1977	$\frac{102.89}{597.97}$ =	.22	$\frac{39.59}{597.97}$ =	.10	$\frac{99.24}{597.97}$ =	.21	$\frac{27.33}{597.97}$ =	.03	$\frac{16.04}{597.97}$ =	.03
1978	$\frac{101.13}{503.53}$ =	.20	$\frac{41.24}{503.53}$ =	.08	$\frac{118.43}{503.53}$ =	.23	$\frac{42.12}{503.53}$ =	.08	$\frac{19.49}{503.53}$ =	.03
1979-80	$\frac{313.46}{1139.92}$ =	.27	$\frac{90.81}{1139.92}$ =	.07	$\frac{195.23}{1139.92}$ =	.17	$\frac{66.35}{1139.92}$ =	.05	$\frac{37.29}{1139.92}$ =	.03

Table - 7.47

Production and Capacity Utilisation for Company-IX

Year	Installed capacity	Production of calcium carbide	Percentage of capacity utilisation
1973	15,000	9,137	60.91
1974	15,000	13,422	89.48
1975	25,000	13,243	52.97
1976	25,000	18,206	72 82
1977	25,000	18,761	75.04
1978	25,000	17,372	69.48
1979-80	30,000	30,949	103.16

Table - 7.48

Sales and Cost for Company-X

(Rs. in lakhs)

Year	Sales	Total Cost	Profit(+)/ Loss (-)
1973-74	921.70	840.23	81.47
1974-75	1,921.72	1,686.97	234.75
1975-76	1,480.47	1,710.32	(-)229.85
1976-77	1,921.34	1,360.23	561.11
1977-78	1,257.81	943.34	314.47
1978-79	1,455.94	1,357.95	97.99
1979-80	1,255.93	1,222.32	33.61

Table - 7.49

Cost Ratios for Company-X

Year	Raw Materials / Total cost	Labour / Total cost	Power & Fuel / Total cost	Interest / Total cost	Depreciation / Total cost
1973-74	$\frac{479.6}{840.23}$ = .57	$\frac{46.44}{840.23}$ = .06	$\frac{60.13}{840.23}$ 1= .07	$\frac{57.75}{840.23}$ = .06	$\frac{33.86}{840.23}$ = .04
1974-75	$\frac{967.24}{1686.97}$ = .57	$\frac{78.59}{1686.97}$ = .04	$\frac{138.50}{1686.97}$ = .08	$\frac{32.48}{1686.97}$ = .01	$\frac{212.99}{1686.97}$ = .13
1975-76	$\frac{1154.18}{1710.32}$ = .67	$\frac{81.67}{1710.32}$ = .04	$\frac{122.65}{1710.32}$ = .07	$\frac{14.32}{1710.32}$ = .008	$\frac{21.67}{1710.32}$ = .01
1976-77	$\frac{685.22}{1360.23}$ = .50	$\frac{76.30}{1360.23}$ = .05	$\frac{124.24}{1360.23}$ = .09	$\frac{6.75}{1360.23}$ = .005	$\frac{22.06}{1360.23}$ = .01
1977-78	$\frac{419.64}{943.34}$ = .44	$\frac{67.00}{943.34}$ = .07	$\frac{129.67}{943.34}$ = .14	$\frac{1.70}{943.34}$ = .002	$\frac{27.33}{943.34}$ = .02

Table - 7.50

Installed Capacity, Production and Percentage of Capacity Utilisation for Company-X

Year	Zinc (M.T.)			Sulphuric Acid (M.T)			Cadmium (kg.)		
	Installed capacity	Production	% capacity utilisation	Installed capacity	Production	% capacity utilisation	Installed capacity	Production	% capacity utilisation
1973-74	17,000	10,183	59.90	36,000	16,094	44.71	36,000	12,824	35.63
1974-75	17,000	11,137	66.57	36,000	19,074	52.98	36,000	17,227	47.85
1975-76	17,000	11,799	69.41	36,000	19,846	55.13	36,000	17,781	49.39
1976-77	17,000	12,501	73.54	36,000	21,362	59.34	36,000	19,259	53.50
1977-78	17,000	9,627	56.63	36,000	17,125	47.57	36,000	11,614	32.20

Table - 7.51

Sales and Total Cost for Company-XI for the years 1975-76 to 1979-80

(Rs. in lakhs)

Year	Sales	Total cost	Profit (+)/ Loss (-)
1975-76	235.87	248.57	-12.7
1976-77	300.12	270.17	+29.95
1977-78	339.64	321.18	+18.46
1978-79	385.55	369.0	+16.55
1979-80	443.08	409.7	+33.38

Table - 7.52

Cost Ratios for Company-XI

Year	$\frac{\text{Raw Material}}{\text{Total cost}}$	$\frac{\text{Labour}}{\text{Total cost}}$	$\frac{\text{Power \& Fuel}}{\text{Total cost}}$	$\frac{\text{Interest}}{\text{Total cost}}$	$\frac{\text{Depreciation}}{\text{Total cost}}$
1975-76	$\frac{138.81}{268.57}$ = .55	$\frac{28.98}{268.57}$ = .117	$\frac{22.7}{268.57}$ = .09	$\frac{7.98}{268.57}$ = .03	$\frac{8.92}{268.57}$ = 0.03
1976-77	$\frac{134.54}{270.17}$ = .50	$\frac{31.43}{270.17}$ = .116	$\frac{28.03}{270.17}$ = .10	$\frac{6.77}{270.17}$ = .02	$\frac{8.98}{270.17}$ = 0.03
1977-78	$\frac{143.75}{321.18}$ = .48	$\frac{37.75}{321.18}$ = .118	$\frac{27.24}{321.18}$ = .08	$\frac{3.20}{321.18}$ = .01	$\frac{10.11}{321.18}$ = 0.03
1978-79	$\frac{172.92}{369}$ = .47	$\frac{48.51}{369}$ = .13	$\frac{28.80}{369}$ = .08	$\frac{6.73}{369}$ = .01	$\frac{14.61}{369}$ = 0.04
1979-80	$\frac{204.52}{409.7}$ = .50	$\frac{65.21}{409.7}$ = .15	$\frac{32.22}{409.7}$ = .08	$\frac{16.73}{409.7}$ = .04	$\frac{13.75}{409.7}$ = 0.03

Table - 7.53

Installed Capacity, Production and Percentage of Capacity Utilisation for Company - XI

(Quantity in M.T)

Year	Installed capacity	Production	Percentage of capacity utilisation
1975-76	2,450.00	942.020	38.45
1976-77	2,450.00	928.885	37.91
1977-78	2,450.00	1,082.485	44.18
1978-79	2,468.00	1,052.646	42.65
1979-80	2,468.00	923.202	37.40
1980-81	2,468.00	814.898	33.02

Table - 7.54

Sales and Raw Material Consumption for Company-XII for the Years 1975-76 to 1979-80

(Rs. in lakhs)

Year	Sales	Raw Material consumption
1975-76	534.95	264.93
1976-77	542.09	285.76
1977-78	668.59	313.03
1978-79	796.67	388.95
1979-80	882.21	422.38

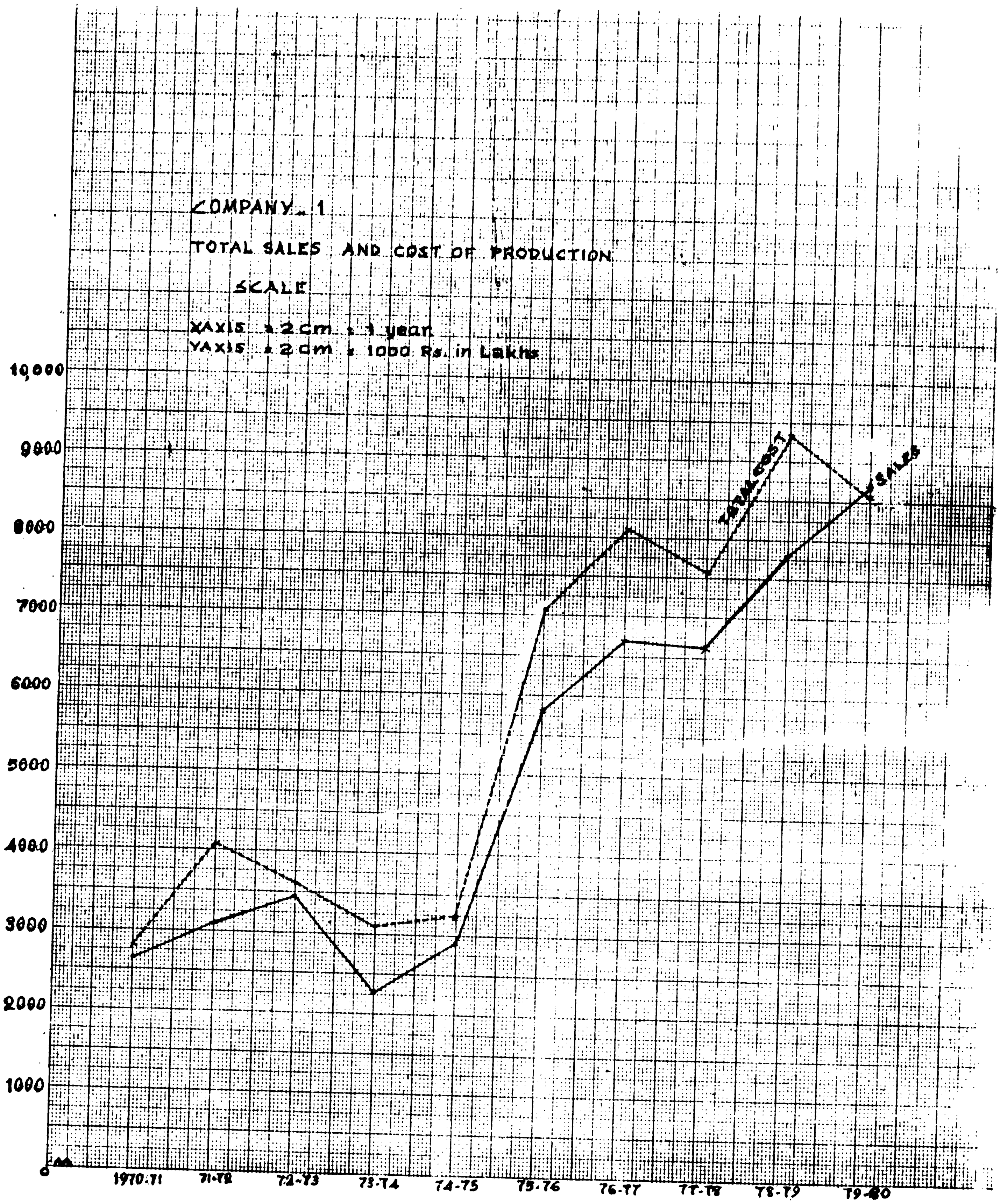
Source: Annual Reports of the Company for the years 1975-76 to 1979-80.

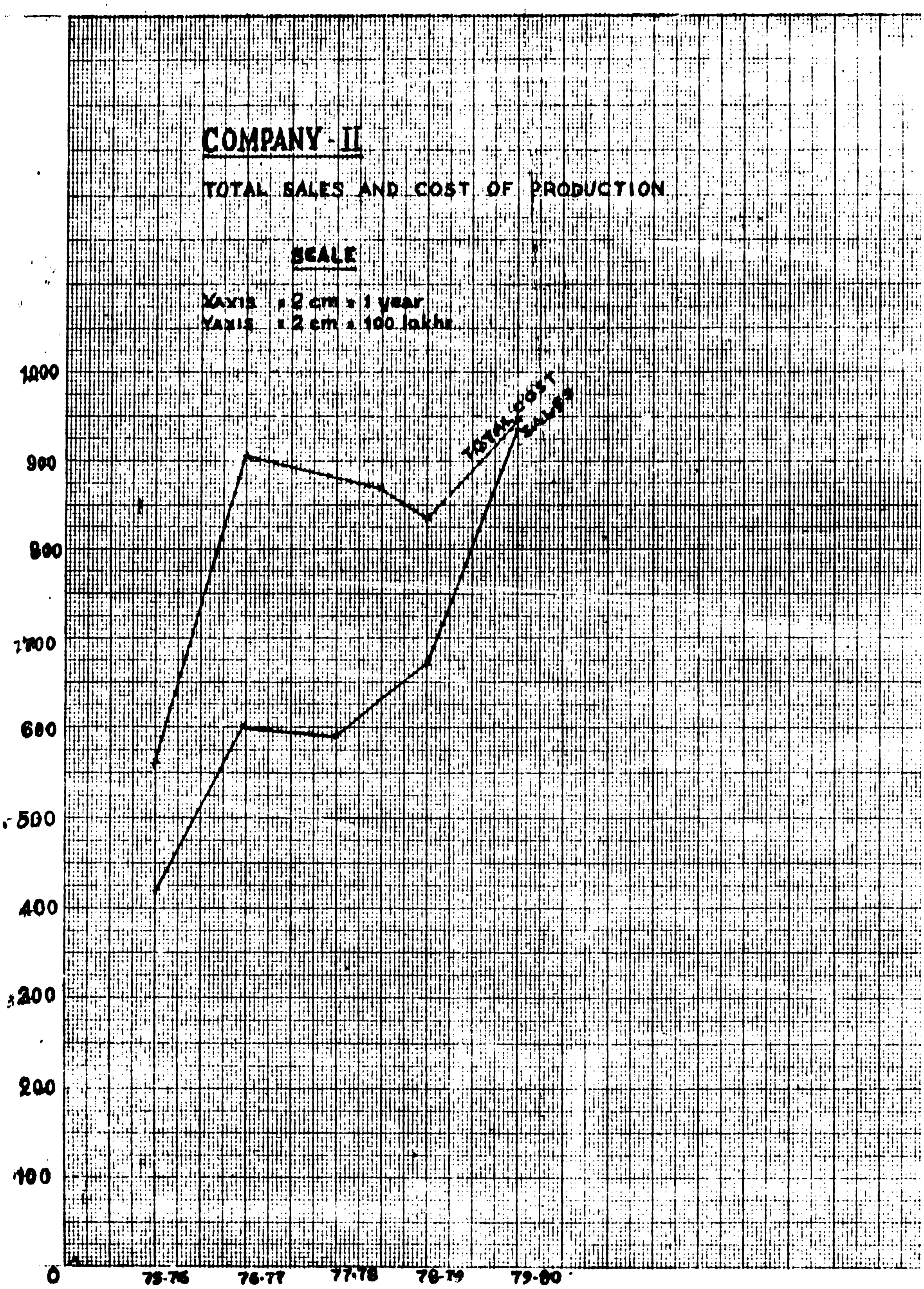
Table - 7.55

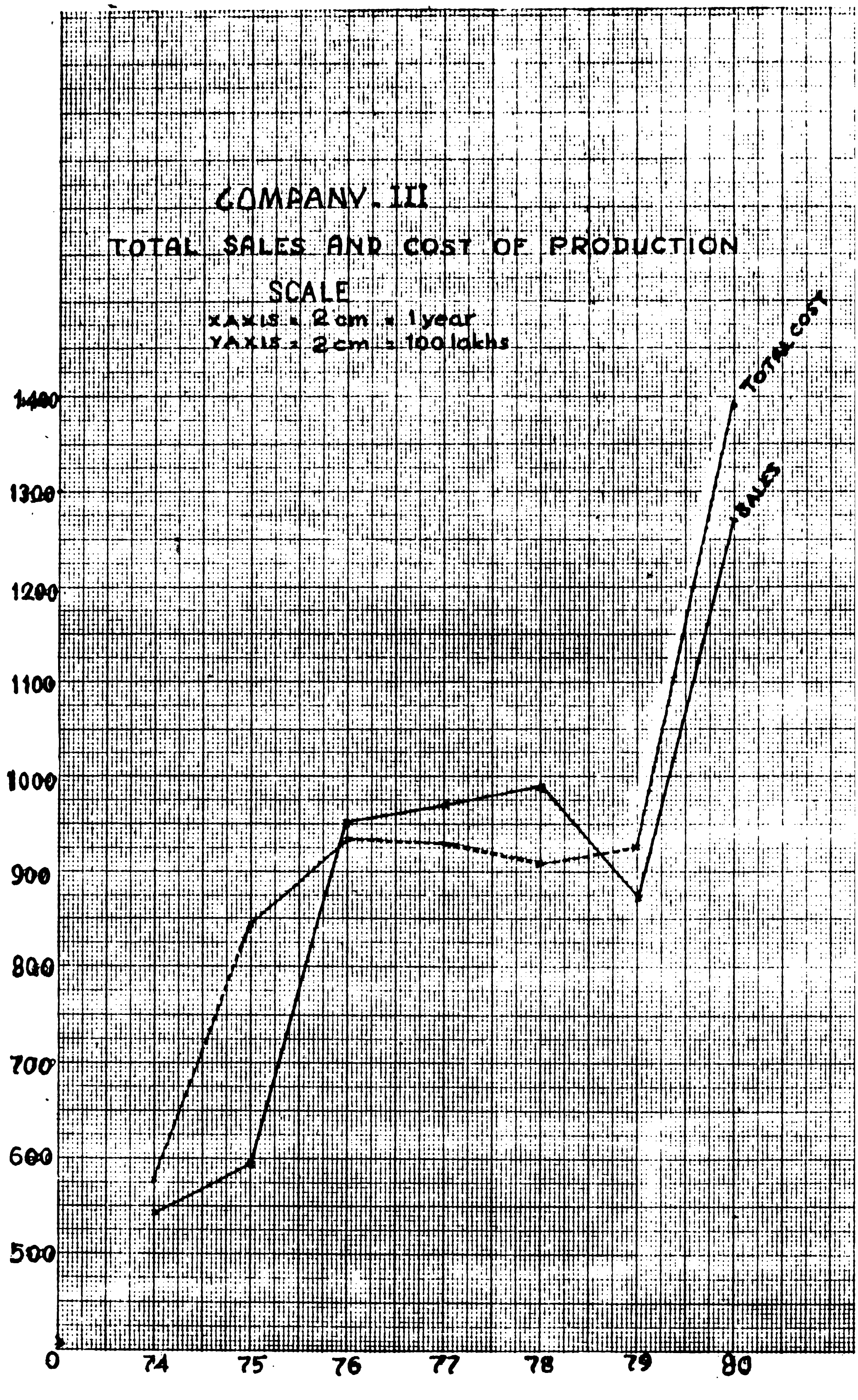
Percentage of Capacity Utilisation for Different Products for Company-XII

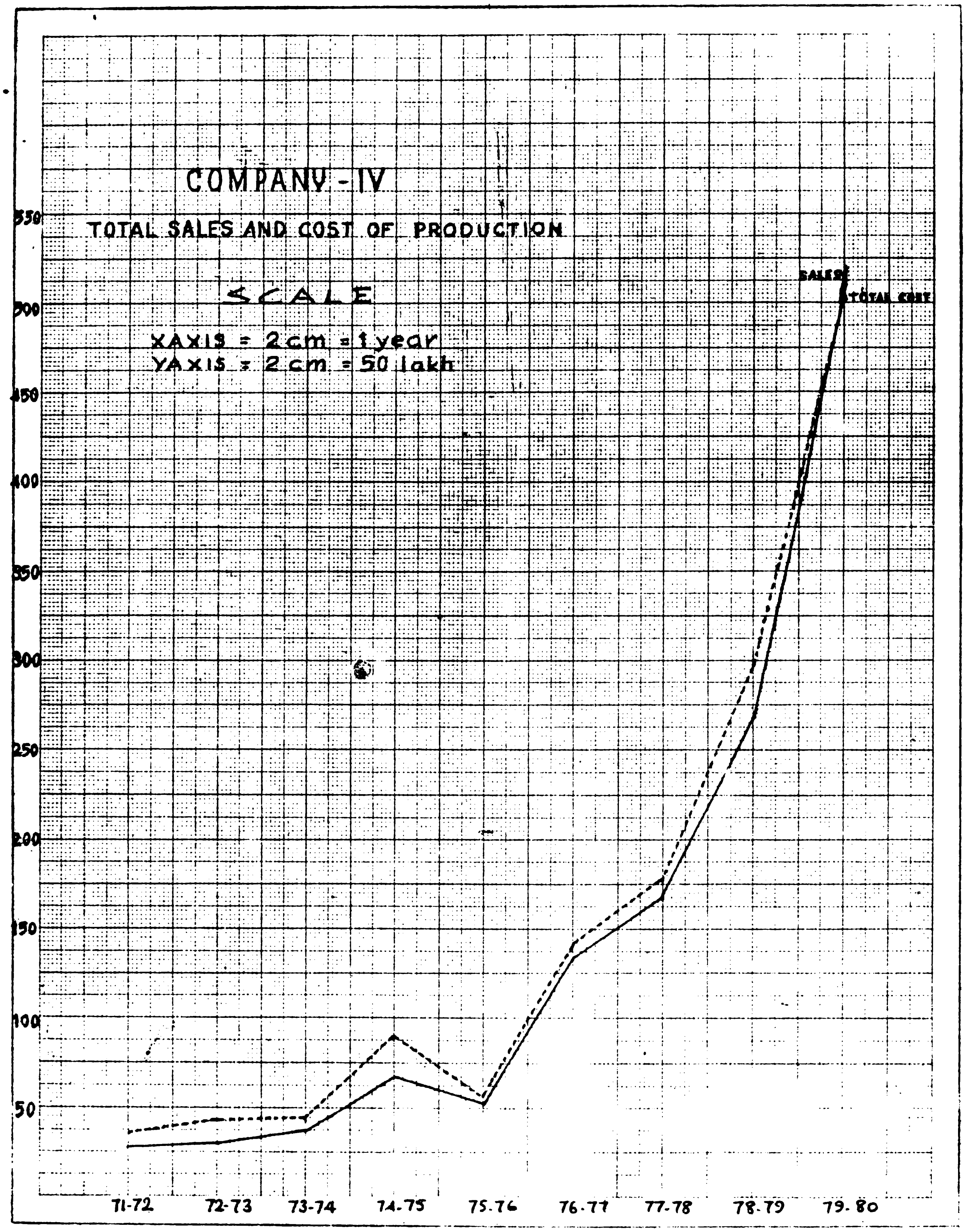
Product	1975-76	1976-77	1977-78	1978-79	1979-80
1. Copper Sulphate	79.56	78.23	75.4	97.3	99.53
2. Copper Oxychloride Technical	37.92	47.05	82.33	97	81.08
3. Copper oxychloride 50% W.D.P.	37.92	70.83	140.62	156	113.33
4. Copper Oxychloride dusts	4.79	8.33	13.33	37.92	50.20
5. Oil Misable C.oc paste	47.33	46	70	81.33	66
6. Sodium Aluminate	54.90	59.50	37.45	55	39.83
7. Sulphate of Alumina Iron free	94	61	48.5	42.83	30.38
8. Sulphate of Alumina Ferric	82.55	78.88	26.54	50.15	71.45
9. Chlorate of Potash	102.28	95.28	64.6	87.87	96.88
10. Sodium chlorate	-	10.37	76.6	52.95	66.83

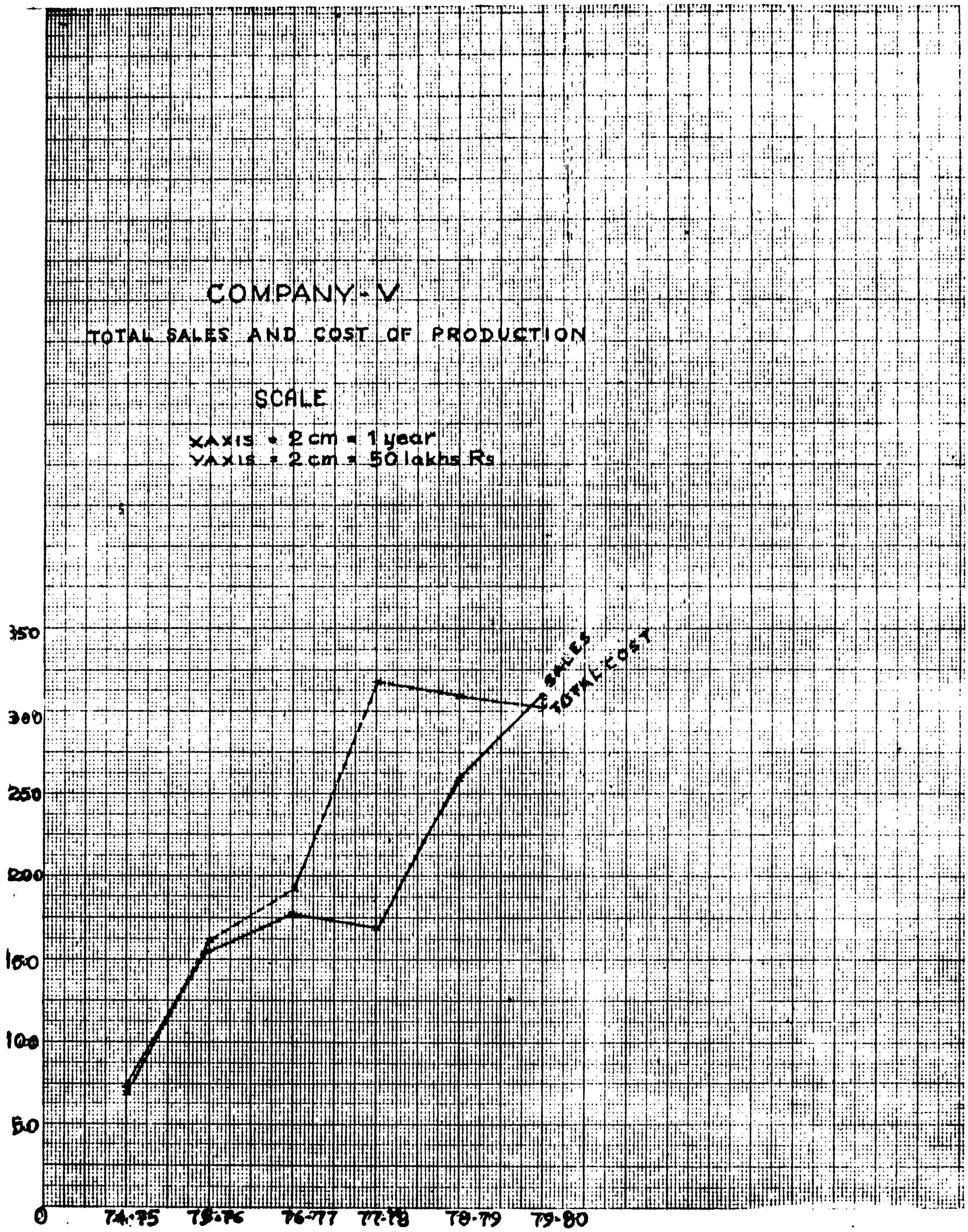
Source: Annual Reports of the Company 1975-76 - 1979-80.

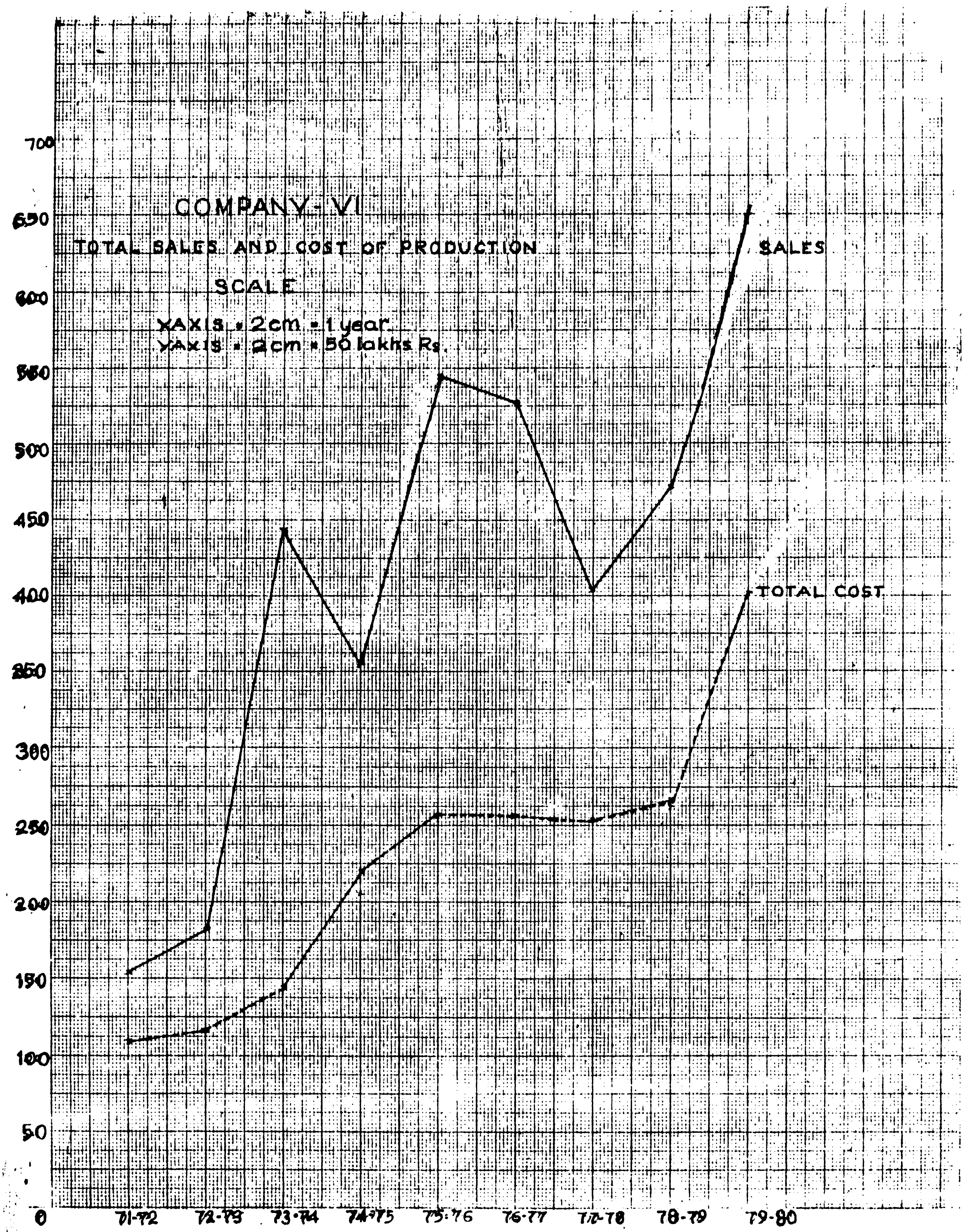

COMPANY - 1
TOTAL SALES AND COST OF PRODUCTION
SCALE
X AXIS = 2 cm = 1 year
Y AXIS = 2 cm = 1000 Rs. in Lakhs
10,000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1970-71
71-72
72-73
73-74
74-75
75-76
76-77
77-78
78-79
79-80
TOTAL COST
SALES


COMPANY - II
TOTAL SALES AND COST OF PRODUCTION
SCALE
X axis : 2 cm = 1 year
Y axis : 2 cm = 100 lakhs
TOTAL COST
SALES
1000
900
800
700
600
500
400
300
200
100
0
75-76
76-77
77-78
78-79
79-80

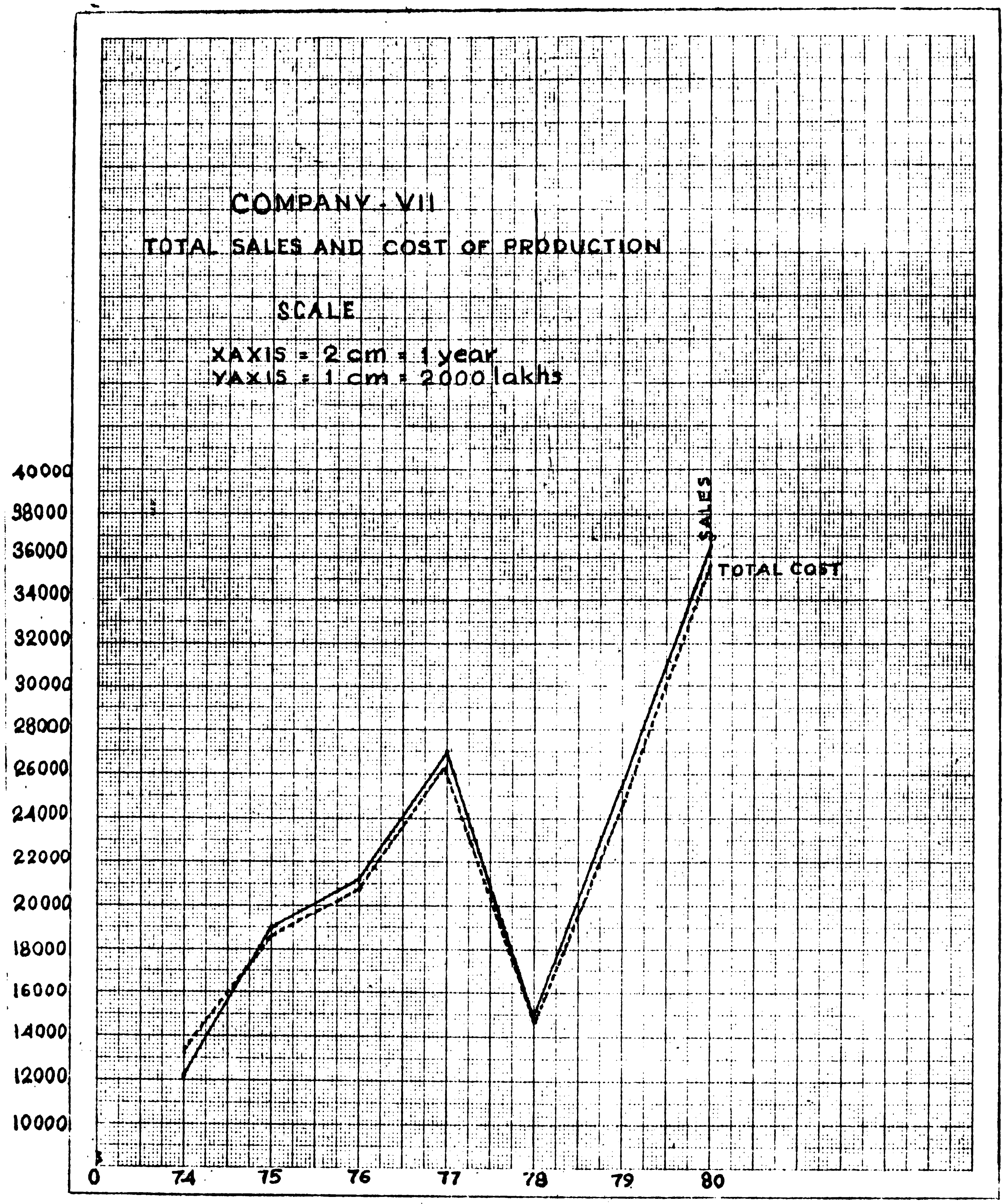

COMPANY. III
TOTAL SALES AND COST OF PRODUCTION
SCALE
X AXIS = 2 cm = 1 year
Y AXIS = 2 cm = 100 lakhs
TOTAL COST
SALES
1400
1300
1200
1100
1000
900
800
700
600
500
0
74
75
76
77
78
79
80


COMPANY - IV
TOTAL SALES AND COST OF PRODUCTION
SCALE
XAXIS = 2cm = 1 year
YAXIS = 2 cm = 50 lakh
SALES
TOTAL COST
50
100
150
200
250
300
350
400
450
500
550
71-72
72-73
73-74
74-75
75-76
76-77
77-78
78-79
79-80

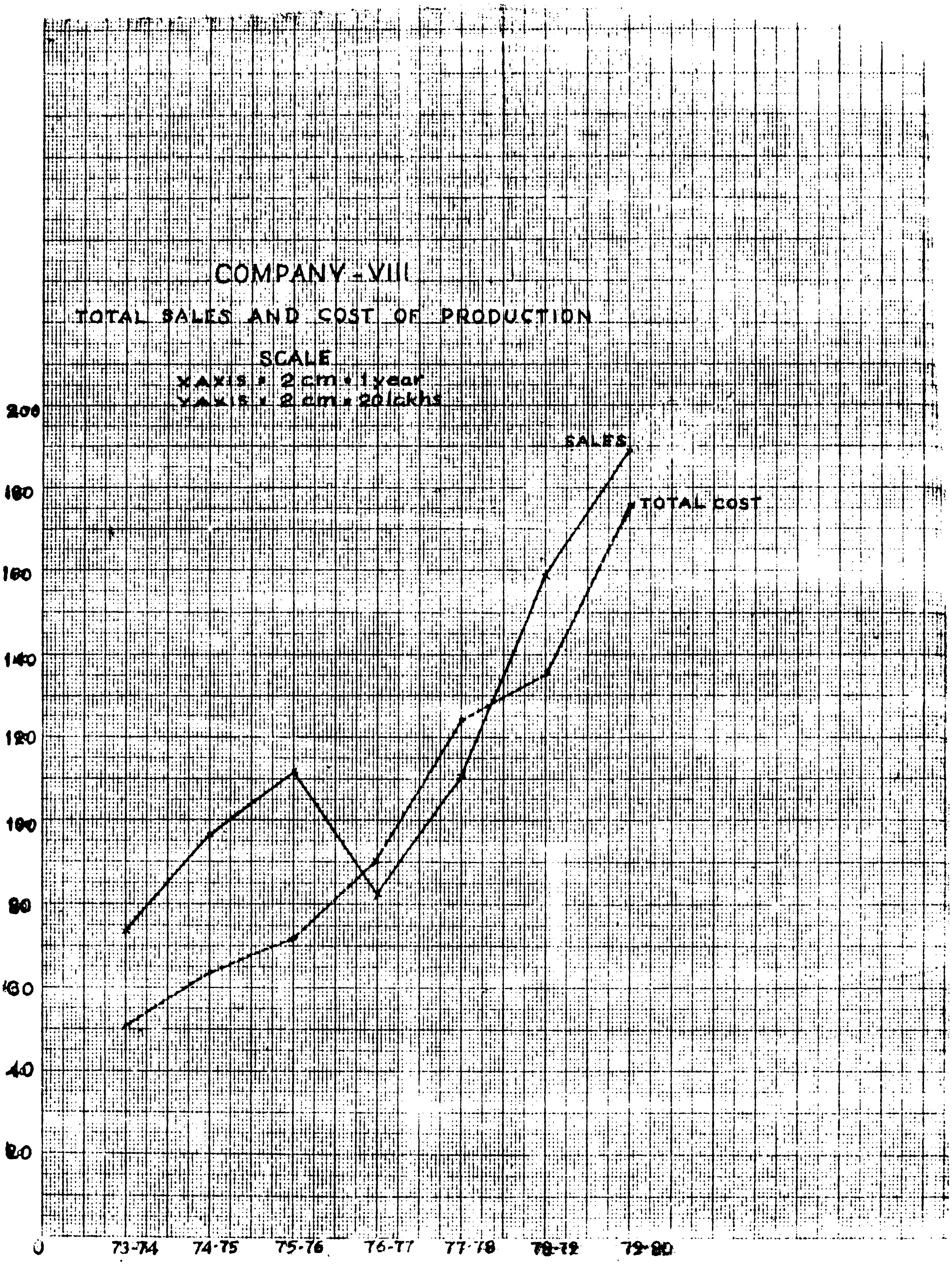

COMPANY - V
TOTAL SALES AND COST OF PRODUCTION
SCALE
X AXIS = 2 cm = 1 year
Y AXIS = 2 cm = 50 lakhs Rs
SALES
TOTAL COST
350
300
250
200
150
100
50
0
74-75
75-76
76-77
77-78
78-79
79-80



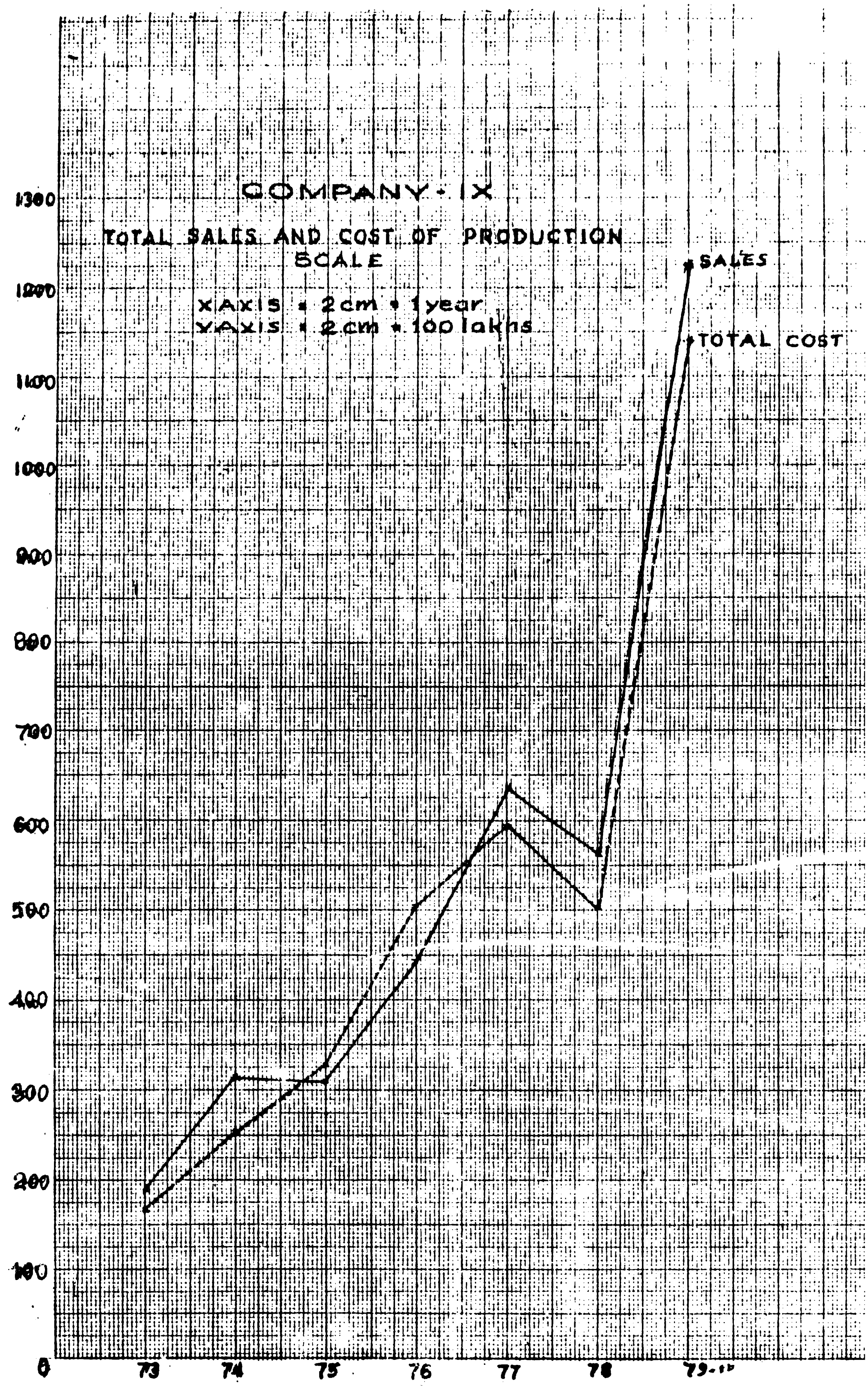
COMPANY-VI
TOTAL SALES AND COST OF PRODUCTION
SCALE
X AXIS = 2cm = 1 year
Y AXIS = 2cm = 50 lakhs Rs.
SALES
TOTAL COST
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
71-72
72-73
73-74
74-75
75-76
76-77
77-78
78-79
79-80

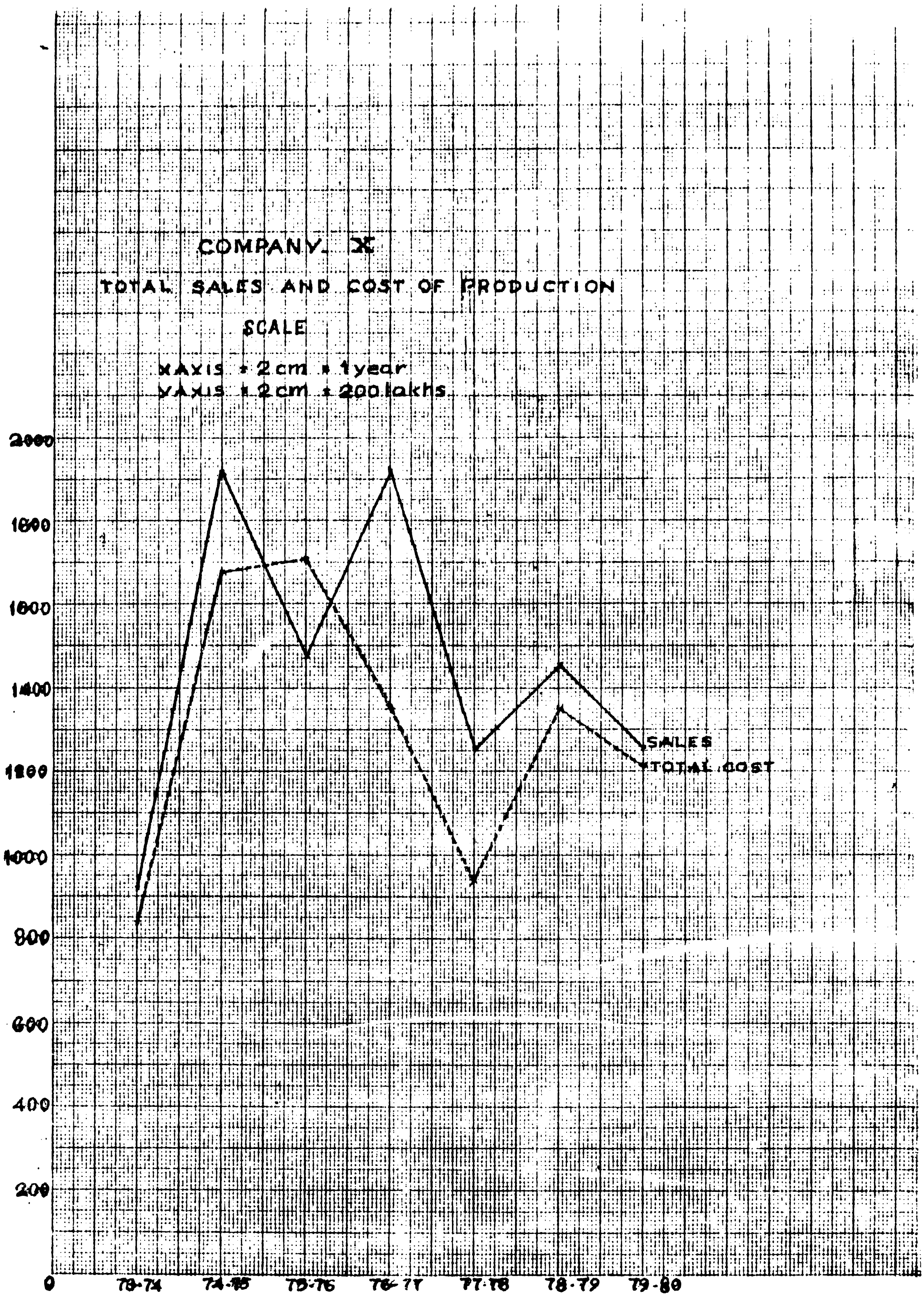


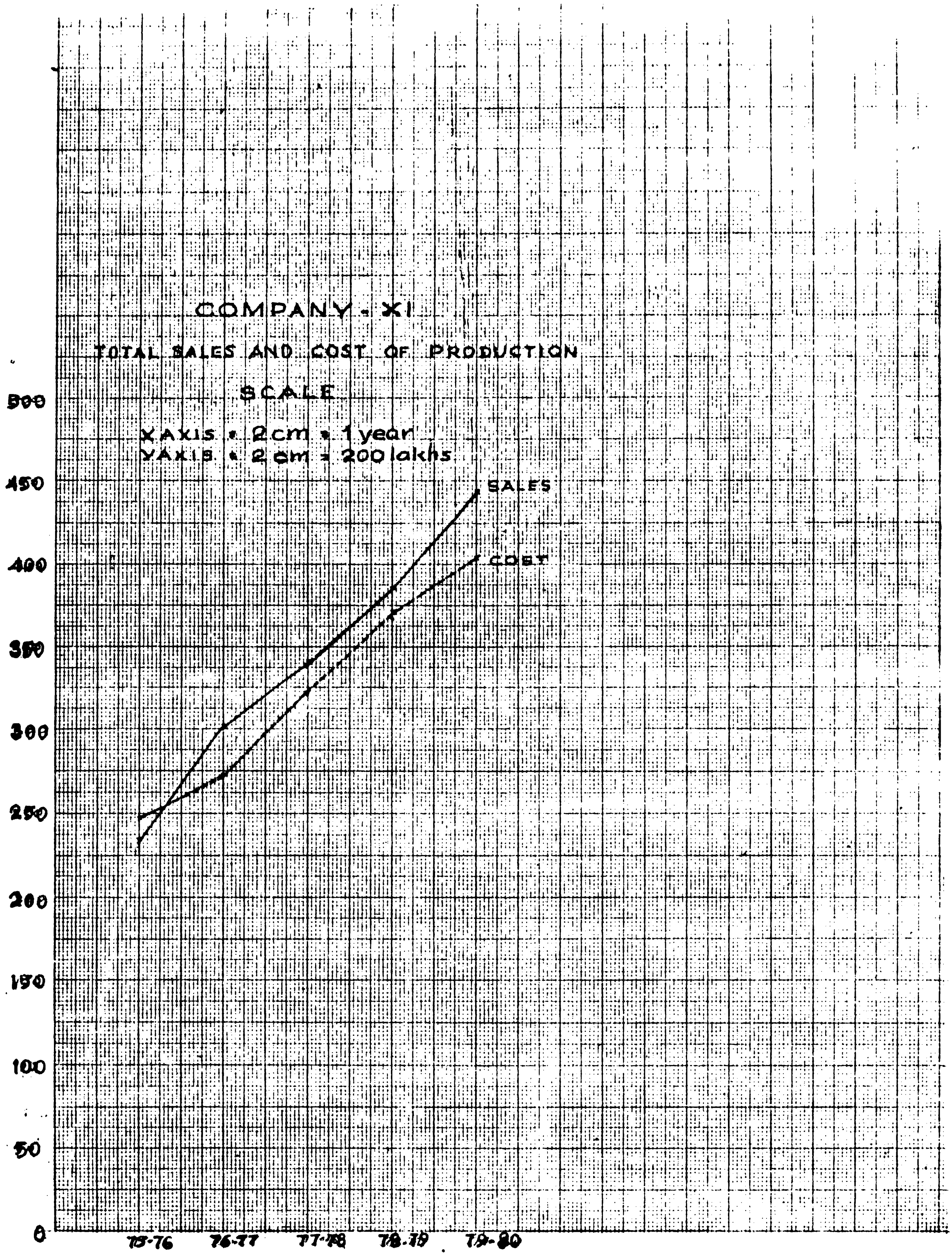
COMPANY - VII
TOTAL SALES AND COST OF PRODUCTION
SCALE
XAXIS = 2 cm = 1 year
YAXIS = 1 cm = 2000 lakhs
SALES
TOTAL COST
40000
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
0
74
75
76
77
78
79
80



COMPANY - VIII
TOTAL SALES AND COST OF PRODUCTION
SCALE
X AXIS : 2 cm = 1 year
Y AXIS : 2 cm = 20 lakhs
SALES
TOTAL COST
200
180
160
140
120
100
80
60
40
20
0
73-74
74-75
75-76
76-77
77-78
78-79
79-80


COMPANY - IX
TOTAL SALES AND COST OF PRODUCTION
SCALE
X AXIS = 2cm = 1 year
Y AXIS = 2cm = 100 lakhs
SALES
TOTAL COST
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
73
74
75
76
77
78
79-80


COMPANY X
TOTAL SALES AND COST OF PRODUCTION
SCALE
X AXIS = 2 cm = 1 year
Y AXIS = 2 cm = 200 lakhs
2000
1800
1600
1400
1200
1000
800
600
400
200
0
73-74
74-75
75-76
76-77
77-78
78-79
79-80
SALES
TOTAL COST



COMPANY - XI
TOTAL SALES AND COST OF PRODUCTION
SCALE
X AXIS = 2 cm = 1 year
Y AXIS = 2 cm = 200 lakhs
SALES
COST
500
450
400
350
300
250
200
150
100
50
0
75-76
76-77
77-78
78-79
79-80

CHAPTER - VIII

CONCLUSIONS AND RECOMMENDATIONS

The study leads to the following conclusions:

8.1 General Conclusions

8.1.1 Labour productivity and capital intensity have shown increases in the different sub-groups of the chemical industry. Capital intensity has been seen to increase much more than labour productivity.

8.1.2 Large increases in capital intensity has not resulted in any substantial increase in capital productivity. In fact, in the case of fertilisers and pesticides and miscellaneous group of chemicals capital productivity showed a decline.

8.1.3 As regards the correspondence between labour productivity and wage rate, labour productivity is generally seen to be higher than the wage rate in the chemical industry. This is probably the result of the highly capital-intensive nature of the industry.

8.1.4 Even though wage rates are lower than the labour productivity ratios, they are higher than the wage rates for all manufacturing industries.

8.1.5 From the production function estimates fixed capital appears significant in almost all the sub-groups. Labour co-efficient does not appear to be significant except in the case of basic organic and inorganic chemicals.

8.1.6 For all the sub-groups elasticity of substitution is less than one, which goes to show that capital-labour substitution is generally not feasible in the chemical industry. This is a very big handicap for a labour-abundant economy like Kerala.

8.1.7 The chemical industry, in general, is considered to be its own most important customer. It is therefore characterised by very high input-output linkages. These linkages are yet to be developed, so far as the chemical industry in Kerala is concerned. At present the forward linkages are in a very underdeveloped state and there is much room for improvement of the backward linkages also. Many of the units have very good prospects for expansion and diversification. Many new projects could be started making use of the products/by-products of the existing units. This could help in utilising the linkage effects more effectively.

8.1.8 As regards the working of the individual units the study has brought to light several interesting conclusions. The conclusion regarding public and private sector units are dealt with separately. However, problems such as high cost of materials, sporadic availability of materials and such other problems are common to both types of enterprises. Pollution is another threat posed by these units in common. Though many of the units advance claims regarding anti-pollution measures these have not yet proved to be very effective. The hazards of pollution from the chemical units is seen to increase especially in those areas where there is a concentration of chemical units.

8.2 <u>Conclusions Pertaining to the Units in the Public Sector</u>

8.2.1 With regard to the public sector chemical companies there has been a persistent trend of accumulating losses, with the exception of those which enjoy a monopoly.

8.2.2 Cost escalation of inputs is a very serious problem.

8.2.3 The efficiency of input usage in many cases appears to be going down.

8.2.4 Material standards of consumption are rarely adhered to.

8.2.5 Lack of controls like inventory control, production planning and control have resulted in heavy losses for many of the enterprises.

8.2.6 Overtime payments are found to be very high in most of the public sector chemical units. Labour efficiency, however, does not come up to the desirable levels.

8.2.7 Heavy costs incurred on power and fuel, interest payments and depreciation charges have inflated costs.

8.2.8 Capacity utilisation also has not reached satisfactory levels.

8.3 Conclusions pertaining to the Units in the Private Sector

8.3.1 Even though the private units also face the problem of cost escalation, they have managed to obtain a persistent trend of profits. In fact, in the case of Company-IX profit has reached record levels, which goes to show that a profit-yielding unit is not an unrealisable dream.

8.3.2 Stricter controls have achieved higher levels of capacity utilisation for the private units except for one or two of them.

8.4 Recommendations

8.4.0 To enable the chemical industry to establish itself on a stronger footing in Kerala the following recommendations are made:

8.4.1 A massive effort should be made to increase labour and capital productivity. A more efficient utilisation of resources, better management and planning of production can help to increase productivity.

8.4.2 Linkages between the chemical units can be strengthened. New enterprises which utilise the products and by-products of the existing ones or which provide materials for the existing ones can be set up within reach. The new enterprises can well make use of the country's rich mineral wealth.

8.4.3 The individual units which are working at a loss should be made more efficient. Strict controls should be exercised as far as material and labour usages are concerned.

8.4.4 Overtime payments should be kept to a minimum and should be made only in absolutely unavoidable situations.

8.4.5 Power and fuel consumption should adhere to the standards as far as possible. Wastage should be reduced to the minimum.

8.4.6 Financing charges, depreciation etc. should be properly controlled.

8.4.7 Capacity utilisation should be stepped up to increase productivity.

8.4.8 Pollution control measures should be strengthened to reduce health hazards.

8.4.9 Expansion and diversification schemes should be undertaken only after careful planning.

8.4.10 Political interference in the working of the enterprises should be discouraged.

8.4.11 The schemes for setting up new enterprises and the spill-over schemes of the existing enterprises should be such that they are beneficial to the economy at large.

8.4.12 While exploiting the State's resources the profits should also be ploughed back for the development of the State economy.

8.5 <u>Recommended Plan of Action for the Individual Units</u>

8.5.1 <u>Company - I</u>

1. The company should try to reduce its cost of production. Material cost can be reduced by adhering to the standards

of material consumption, reducing inventories as far as possible and streamlining the supply of materials and production.

2. Sales promotional activities can be stepped up to compete with the other products in the market.

3. Labour usage efficiency can also be improved. Overtime payments can be kept to a minimum.

4. Power and fuel consumption can also be toned up.

5. Interest payments should be brought to a minimum.

6. Capacity utilisation should increase to at least 75 per cent to 80 per cent.

7. Pollution should be controlled to ensure the safety of men and animals.

8. The worn-out plants should be scrapped and modern technological know-how should be incorporated.

8.5.2 Company - II

1. Stringent measures to control the spiralling cost of production should be undertaken.

2. Material utilisation should conform to standards.

3. Inventory controls should be tightened.

4. Overtime allowances should be brought down to a minimum.

5. Wastage of power and fuel should be reduced.

6. Capacity utilisation for the various products should be stepped up.

7. Utilisation of by-product can be enhanced.

8. Diversification and expansion programmes should be undertaken only after proper planning.

8.5.3 Company - III

1. Measures should be taken to increase production and capacity utilisation.

2. Standards of material consumption should be adhered to.

3. Overtime payments should be controlled.

4. Pollution control should be made more effective.

8.5.4 Company - IV

1. Costs of production should be reduced by controlling material and labour costs.

2. Consumption of power and fuel should be reduced.

3. The quality of the products should be improved to compete with the other established products in the market.

8.5.5 Company - V

1. Since raw materials form the most important item of consumption, cost of this element should be controlled.

2. Quality control measures should be enforced in order to reduce the quantity of defective items. This will bring down the high inventory levels which includes defective items.

3. Excess consumption of materials should be brought down.

4. Overtime payments should be brought down.

5. A water purification plant should be installed to tide over the problem of pure water.

6. The quality of the products should be improved.

8.5.6 Company - VI

1. Raw material costs should be controlled. Inventory levels which are as high as 36 months' requirement in the case of certain items can be brought down to 4-5 months' requirement.

2. Absenteeism should be strictly dealt with.

3. Overtime payments should be strictly monitored.

4. Pollution control measures should be given top priority.

8.5.7 Company - VII

1. The fluid catalytic cracking unit should be commissioned as early as possible.

2. Schemes for new petro-chemical projects utilising the products/by-products of the company should be given due consideration.

8.5.8 Company - VIII

1. Raw material standards should be maintained.

2. Labour efficiency should be stepped up.

3. Absenteeism should be reduced.

4. Production should be stepped up to meet the increased demand.

5. Effluent treatment should be given proper attention.

8.5.9 Company - IX

1. Raw material costs should be reduced. Attempts should be made to obtain the raw material, viz. wood charcoal locally or find an alternative material.

2. Overtime payments should be brought down.

3. Absenteeism should be reduced.

4. Power and fuel consumption should be controlled.

5. The huge profits earned by the company should at least be partly used for the development and growth of the industry.

8.5.10 Company - X

1. Increased power and fuel consumption should be broguht down.

2. Capacity utilisation, especially for sulphuric acid, can be stepped up.

3. Pollution of water with zinc wastes should be minimised.

8.5.11 Company - XI

1. Import of raw material should be reduced.

2. Labour problems especially conflicts with casual and contract labourers should be resolved.

3. Capacity utilisation should be stepped up.

8.5.12 Company - XII

1. Capacity utilisation can be improved in the case of sodium aluminate and sulphate of alumina.

2. Increased raw material consumption should be controlled.

8.5.13 Company - XIII

The prospects for utilising the product of the unit within the State to start new chemical-based units should be given due consideration.

8.5.14 Company - XIV

1. Production should be stepped up to meet the increased demand for formic acid.

2. Efficiency of material and labour usage should be maintained.

3. Pollution control measures should be stringently observed.

4. Costs of production should be kept to a minimum to compete with the cost of the imported product.

8.6 To conclude, a humble attempt has been made to trace the growth, prospects and problems of the chemical industry in the State. Being a relatively new industry it has immense scope for many more works which can be taken up in future. Intersectoral flows to the other sectors of the State economy and the transfers thereof can form an important part of future studies. Prospects for the development of new petrochemical units, project evaluation studies of the chemical units and studies relating to investment criteria are other fields which can be taken up for further research.

APPENDIX - I

Existing Large and Medium Scale Chemical and Allied Units in Kerala

Trivandrum District			**Products**
1.	Travancore Titanium Products	-	Titanium dioxide Sulphuric acid
2.	Trivandrum Rubber Works	-	Bicycle Tyres, tubes and rims, tread rubber cycles.
3.	Hindustan Latex Ltd.	-	Rubber contraceptives
4.	T.K. Chemicals Ltd.	-	Manganous sulphate electrolytic manganese dioxide
Quilon District			
5.	Punalur Paper Mills Ltd.	-	Printing and writing paper, kraft paper
6.	Lakshmi Starch Factory	-	Tapioca starch, glucose
Alleppey District			
7.	The Travancore Sugars and Chemicals Ltd.	-	Sugar, spirit potable liquor
8.	McDowell and Company Ltd.	-	Alcoholic liquors
9.	Mannam Sugar Mills	-	Sugar
10.	Excel Glasses Ltd.	-	Glass bottles
11.	Kerala State Drugs and Pharmaceuticals Ltd.	-	Pharmaceutical formulations

Kottayam District

12.	Travancore Electro Chemical Industries Ltd.	- Calcium carbide
13.	Ruby Rubber Works	- Cycle Tyres
14.	The Travancore Cements Ltd.	- White cement

Idukki District

Nil

Ernakulam District

15.	Fertilisers and Chemicals Travancore Ltd.	
	(a) Udyogamandal Division	- Ammonium sulphate Ammonium phosphate Super phosphate Ammonium chloride Cryolite
	(b) Cochin Division	- Urea, NPK complex, fertilisers of various grades
16.	Hindustan Insecticides Ltd., Udyogamandal	- D.D.T., B.H.C.
17.	Cochin Refineries Ltd.	- Motor spirit, kerosene, diesel oil, furnace oil, asphalt etc.
18.	Cominco Binani Zinc Ltd.	- Zinc, sulphuric acid, cadmium
19.	Periyar Chemicals Ltd.	- Formic acid, sodium sulphate
20.	Kerala Rubbers & Reclaims Ltd.	- Reclaimed Rubber
21.	Southern Gas Ltd.	- Oxygen, dissolved acetylene

22.	Travancore Cochin Chemicals Ltd.	-	Caustic soda, sodium hydrosulphite, sulphur dioxide
23.	Bombay Oil Industries Ltd.	-	Pepper Oleoresin
24.	Premier Tyres Ltd.	-	Automobile Tyres and Tubes
25.	Tata Oil Mills Co. Ltd.	-	Soaps, hair oils, glycerin
26.	Travancore Chemical and Manufacturing Co. Ltd.	-	Copper sulphate, potassium chlorate, sodium silicate
27.	United Catalysts India Ltd.	-	Catalytic chemicals
28.	Travancore Rayons Ltd.	-	Rayon, cellophane paper
29.	West Coast Industrial Gases	-	Oxygen, acetylene
30.	Travancore Ogale Glass Manufacturing Co.	-	Glass bottles
31.	Carbon & Chemicals India Ltd.	-	Sodium silicate, carbon black

<u>Trichur District</u>

32.	Apollo Tyres Ltd.	-	Automobile Tyres and Tubes
33.	Tapioca Products (P) Ltd.	-	Starch, Glucose
34.	Kerala Chemicals & Proteins Ltd.	-	Ossein, di-calcium phosphate

<u>Palghat District</u>

35.	Premier Breweries Ltd.	-	Beer
36.	Chittoor Sugar Mills Ltd.	-	Sugar, rectified spirit, confectionery
37.	Rallis India Ltd.	-	Pesticides, Fungicides

Kozhikode District

38.	Kerala Soaps & Oils Ltd.	-	Soaps, vanaspathi etc.
39.	The Gwalior Rayon Silk Manufacturing Co. Ltd.	-	Wood pulp, staple, fibre
40.	Tata Oil Mills Ltd.	-	Soap

Cannanore District

41.	Western India Plywoods	-	Resins, plywood etc.

Malappuram District

Nil

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APPENDIX - II

Task Force on Large & Medium Scale Industries Spill Over Schemes of Existing Units

Name of Unit	Proposal: Line of production/annual capacity	Cost of scheme	Power requirement	Employment No.
1	2	3	4	5
I. GENERAL SECTOR				
1. F.A.C.T	(a) Existing Programme:- Manufacture of Synthetic Cryolite: 10 tonnes/ day	254	746 KW	57
2. Hindustan Insecticides	Diversification:- (i) Endosulphan 35 EC formulation: 2105 t.	733.4	1500KW	141
	(ii) Endosulphan (tech):1600t	134.2		
3. Hindustan Paper Corpn.	Newsprint:80000 t.	13000	25MW	1491
4. Cochin Refineries Ltd.	Secondary Processing: Petroleum products: 3.5 lakh tonnes of Bombay High Crude	3300	10 lakh units	1500
II STATE SECTOR				
A. Fully owned/ majority shares				
1. Travancore Titanium Products	Diversification: i) Sulphuric acid:72600t. ii) Titanium Tetrachloride:2000t.	1400/ 2400		200
2. Travancore-Cochin Chemicals Ltd.	a) Existing Scheme: i) Sulphur dioxide:4500t. ii) Mercury elimination from HCL:30000t.	258	-	-
	b) Thionyl chloride:900t.	50	-	-
3. Kerala Soaps & Oils Limited	Diversification & Expansion a) Glycerine recovery: 262t.	40	1.5-2 lakh KWH	-
	b) Toilet Soap Cap. (exp) 4300t. to 9000t.	96.4	-	-

1		2	3	4	5
4.	Trivandrum Rubber Works Limited	a) Existing:- i) Journal Lubricators: 2.5lakh Nos.	16.2	-	22
		ii) Modernisation&replacement of machines	106.7	-	--
		b) Future Scheme: Diversification: From rubber lubrication: 2.5 lakh Nos.	16.2	-	22
5.	Kerala State Detergents & Chemicals Limited	NEW SCHEME (Kuttippuram) Synthetic detergents: 10,000t.	302	500KVA	--
B.	JOINT SECTOR				
6.	Carbon & Chemicals India Limited.	NEW SCHEME Carbon black 13700t.	900	-	200
7.	Formalin Products Limited	Formaldehyde 7500 tpa	90	210 KW	80
8.	Kerala Chemicals & Proteins Ltd.	Ossein: 2210 tpa Dicalcium Phosphate 4250 tpa	320	--	90
9.	Kerala Chemicals & Chlorate Ltd.	Potassium chlorate 1000 tpa	82	7500 KVA	89
10.	Premier Morarji Chemicals Co. Ltd.	Ferric Alum 16500 tpa	70	-	97
III	PRIVATE SECTOR				
1.	Travancore Electro Chemical Industries Limited	Diversification: Acetylene black: 1000t.	75	10000KVA	29
2.	West Coast Industrial Gases Limited	Dissolved Acetylene Plant 0.2 million m^3	40	0.22 lakh	24

APPENDIX - III

New Project Proposals

Project	Capacity in tonnes/year	Approximate project cost (Rs. lakhs)	Power requirement in kilowalts.	Employment potential
1	2	3	4	5
JOINT SECTOR				
(PRIORITY-I)				
1. Dyes	90	2.50	150	116
2. Polyol & Polysulphide	Polyol:1000 Polysulphide:5	120.00	100	80
3. Carbide chemicals	Dicyandioimide 1000	180.00	80	45
4. Nylon filament yarn	2100	1600.00	5000	350
5. Conveyor belt	6000	2300.00	2400	600
6. Surgical rubber goods	—	60.00	50	30
7. Butenediol	1000	350.00	500	150
8. Vinyl acetate monomer	2000	300.00	400	80
(PRIORITY-II)				
9. Phyto chemicals	12	100.00	50	80
10. Activated carbon	1000	350.00	250	100
(PRIORITY-III)				
11. Sodium tripoly phosphate	10000	400.00	450	150

1	2	3	4	5
PRIVATE SECTOR				
(PRIORITY I)				
12. Mini paper plant	300	80.00	100	80
13. Pentaerythritol	600	200.00	150	70
14. Resins and paints from cashewnut shell liquid	500	40.00	100	50
15. Fatty alcohol	3000	150.00	150	100
16. Cast phenolics	500	30.00	100	20
17. Polypropylene corrugated sheets	900	100.00	100	50
18. Epoxy resins & paints	Resins: 500 Paints: 100	60.00	70	50
(PRIORITY II)				
19. Pesticides	Diuron: 600	300.00	100	120
20. Hydrogen cyanide	1000	200.00	500	100
21. Phosgene and derivatives	Phosgene:1000 Methyl Di isocynate: 1000 Dimethyl urea: 500	500.00	500	200
22. Polyvinyl acetate	1000	70.00	100	40
23. Plastic containers plant	—	50.00	50	15
24. PVC leather cloth	1000	80.00	200	25
(PRIORITY III)				
25. Synthetic resins	Alkyd resins Polyester resins 1000	40.00	200	35
26. Oleoresins & spice oils	30	40.00	50	50
27. Sodium carboxymethyl cellulose	1200	60.00	150	50
CENTRAL SECTOR (PRIORITY I)				
28. Caprolactum	50000	18100.00	5000	600

1		2	3	4	5
29.	Phenol	6000	600.00	350	250
30.	Polypropylene	20000	2500.00	550	350
31.	Dimthyl terephythalate/ Terephthalic acid	30000	800.00	530	250
32.	Ammonium sulphate from by-product gypsum	135000	1323.00	2500	500
PRIORITY II)					
33.	Styrene/Polystyrene	20000	2000.00	560	200
34.	Maleic anhydride	6000	200.00	850	120
35.	Chemical intermediates	1500	1000.00	1000	500
	T O T A L		34365.50	23390	5606

APPENDIX-4

METHODOLOGY EMPLOYED TO FIT THE CES PRODUCTION FUNCTION

Given the C.E.S. Function

$$Q = \gamma e^{\theta t} [(1-\delta) K^{-\rho} + \delta L^{-\rho}]^{-1/\rho}$$

Assuming cost minimisation, then

$$\frac{w}{r} = \frac{\delta}{1-\delta} \left(\frac{K}{L} \right)^{(1+\rho)}$$

Hence, $\log w/r = \log \left(\frac{\delta}{1+\delta}\right) + (1+\rho) \log (K/L)$

Using the form $Y = \alpha + \beta X$

where $Y = \log w/r$; $X = \log K/L$

$\alpha = \log \left(\frac{\delta}{1+\delta}\right)$; $\beta = (1+\rho)$

Solve for δ from $\alpha = \log \frac{\delta}{1+\delta}$ & ρ from $\beta = 1+\rho$

Estimate $F = [(1-\hat{\delta}) K^{-\hat{\rho}} + \delta L^{-\hat{\rho}}]^{-1/\hat{\rho}}$

Estimate $Q = \gamma e^{\theta t} \hat{F}$

as $\log Q = \log \gamma + \theta t + \log \hat{F}$

$y = a + \theta t + \log \hat{F}$

Estimate $y = \lambda + \theta t$, where $\lambda = a+b$

$\lambda = \log \gamma + \log F$

Source: Woodfield A: Estimates of Hicks Neutral Technical Progress, Returns to scale and the elasticity of substitution in New Zealand Manufacturing 1926-68, New Zealand Economic Papers 16 pp. 673-692 as quoted in Wynn R.F and Holden K. An Introduction to Applied Econometric Analysis, MacMillan Press Ltd. London 1974 pp. 54-56.

A N N E X U R E

S C H E D U L E

Identification Particulars and Classificatory Characteristics

1. Name of Factory :
2. Category of Industry :
3. Year of Establishment :
4. Year of Initial Production :
5. Type of ownership and organisation:
6. Employment :

Table - I

	1970	'71	'72	'73	'74	'75	'76	1977	1978	1979	1980
1. Gross Value of Plant & Machinery.											
2. Fixed Capital -											
3. Working Capital -											
4. All Invested Capital -											
5. All workers (No.) -											
6. Manhours worked -											
7. All employees (No.) -											
8. Wages to workers (Rs.) -											
9. Total Emoluments -											
10. Fuel consumed (Rs.) -											
11. Materials consumed -											
12. Total Input (Rs.) -											
13. Products (Rs.) -											
14. Net value of finished products-											
15. Total output (Rs.) -											
16. Depreciation (Rs.) -											
17. Value Added (Rs.) -											

T a b l e - II

Installed capacity of Production

Sl. No.	Product	1970			1971			1972			1973			1974			1975			1976			1977			1978			1979			1980		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3

Note: Column No.1 Installed capacity
" 2 Production
" 3 % capacity utilisation.

T a b l e - III

Inventory of Working Capital (1970 - 1980)

Sl. No.	Item	1970		1971		1972		1973		1974		1975		1976		1977		1978		1979		1980	
		O/B	C/B	O/B	C/B	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1.	Materials, stores and spares																						
2.	Semifinished goods including goods in process.																						
3.	Products and by-products.																						
4.	Sub-total (1+2+3) (Physical Working Capital.																						
5.	Cash in hand & at bank.																						
6.	Amounts Receivable.																						
7.	Amounts payable.																						
8.	Net balance (6-7)																						
9.	Total (4+5+8)																						

Column No.1 Opening Balance.
" 2 Closing Balance.

Table - XV

Outstanding Loans at the end of the Accounting Year

Sl. No.	Source		Amount										
			1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1.	I.F.C.	-											
2.	Industrial Development Bank	-											
3.	Industrial Credit and Investment Bank	-											
4.	State Bank and its subsidiaries	-											
5.	N.I.D.C.	-											
6.	S.F.C.	-											
7.	State Government	-											
8.	Co-operative Banks	-											
9.	Other Banks	-											
10.	Others	-											
11.	Loans through Head Office	-											
12.	Total												

Table - V

Details of Working

(Number)

Sl. No.	Item	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1.	Number of working days											
	Manufacturing	-										
2.	Repair & Maintenance	-										
3.	Total (1 + 2)	-										
4.	Total No. of shifts	-										
5.	Shifts/day (No.)	-										
6.	Length of shift (hr.)	-										
7.	Total No. of mandays worked.	-										
8.	No. of man days lost	-										

T a b l e - VI

Average Employment and Emoluments During the years 1970 - 1980.

So.	Item	1970			1971			1972			1973			1974			1975			1976			1977			1978			1979			1980		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1.	Workers Employed Directly.																																	
2.	Workers Employed through contractors.																																	
3.	Total (1+2)																																	
4.	Supervisory & Managerial Staff.																																	
5.	Other Employees.																																	
6.	Head Office Staff allocable to the factory.																																	
7.	Total (3-6)																																	
8.	Employers contribution to PF, pension, gratuity etc.																																	
9.	Total 7+8																																	

Column No.1 Mandays worked (2) Average No. of working days; (3) Salaries, wages, bonus etc.

Table - VII

Fuel and Lubricants Consumed

Sl. No.	Item	1970			1971			1972			1973			1974			1975			1976			1977			1978			1979			1980		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1.	Coal -																																	
2.	Coke -																																	
3.	Coal Gas -																																	
4.	Natural Gas -																																	
5.	Firewood -																																	
6.	Charcoal -																																	
7.	Motor spirit -																																	
8.	Naphtha -																																	
9.	High speed Diesel Oil -																																	
10.	Light Dieseloil -																																	
11.	Furnace oil -																																	
12.	Kerosene oil -																																	
13.	Liquified petroleum -																																	
14.	Other fuel oils -																																	
15.	Lubricating oils-																																	
16.	Electricity -																																	
17.	Water -																																	
18.	Others -																																	
19.	Total -																																	

Columns (1) Unit; (2) Quantity; (3) Value.

T a b l e - VIII

Materials Consumed for Repair and Maintenance, Work done by other Concerns and Purchase Value of Goods Sold in the same condition as purchased (1970 - 1980)

	Year & Amount										
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Materials consumed for Repair & Maintenance.											
1.											
2.											
3.											
4.											
5.											
6. Sub-total (1-5)											
7. Repairs & maintenance done by others to factory's fixed assets.											
8. Total (6+7)											

T a b l e - XX

Expenses not Included in Tables 6 - 8

Sl. No.	Item	Year & Amount 1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1.	Inward Transport Charges											
2.	Purchase Agency Service											
3.	Taxes & Duties on Purchase											
4.	Insurance											
5.	Postal Services other than Telephone											
6.	Telephone Charges											
7.	Legal Charges											
8.	Insurance											
9.	Head Office Expenses allocable to factory											
10.	$Subtotal_1$ (1-9)											
11.	Audit Fee, Account & Bank Charges											
12.	Local Rates & Factory Licence											
13.	Other Services											
14.	$Subtotal_2$ (11-14)											
15.	Managing Agents Remuneration & Office											
16.	Director's Fee											
17.	Interest Paid											
18.	Total											

Table - X

Materials Consumed

Sl. No.	Name	Unit	1970		1971		1972		1973		1974		1975		1976		1977		1978		1979		1980	
			Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V
1.																								
2.																								
3.																								
4.																								
5.																								
6.																								
7.																								
8.																								
9.																								
10.																								
11.	Others																							
12.	Sub-total (1-11)																							
13.	Chemicals & Auxiliary Materials																							
14.	Others if any																							
15.	Sub-total (13-14)																							
16.	Packing Materials																							
17.	Others																							
18.	Sub-total (16+17)																							
19.	Consumable Stores																							
20.	Total (12+15+18+19)																							

Q = Quantity V = Value

T a b l e - XI

Products and By Products Manufactured

Sl. No.	Item	Unit	Year 1970		1971		1972		1973		1974		1975		1976		1977		1978		1979		1980	
			Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V
1.																								
2.																								
3.																								
4.																								
5.																								
6.																								
7.																								
8.																								
9.																								
10.																								
11.	Others																							
12.	Total																							

Q = Quantity
V = Value

Table - XII

Details of Inputs Consumed and Output Sold During the Year 1979-'80

Sl. No.	Input	Source from which obtained	Quan-tity	Value	Sl. No.	Output Sold	Unit to which sold	Quan-tity	Value
1.					1.				
2.					2.				
3.					3.				
4.					4.				
5.					5.				
6.					6.				
7.					7.				
8.					8.				
9.					9.				
10.	Others				10.	Others			
11.	Inputs (from outside the systems)				11.	Exports (Outside the system)			
12.	Total				12.	Total			

Table - XIII

Output Other than those Reported in Table-XI

Sl. No.	Item	Year & Amount in Rs. 1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1.	Electricity Produced and Sold											
2.	Work done for other Concerns											
3.	Repair & Maintenance											
4.	Others											
5.	Sub-total(1-4)											
6.	Value of Semifinished goods at the end of the accounting year											
7.	At the beginning of the Accounting year											
8.	Net balance (6-7)											
9.	Sales Value of Goods sold in the same conditions as purchased											
10.	Total 5+8+9											

T a b l e - XIV

Wages Paid and Overtime Allowances

Year	Wages and Salaries	Overtime Paid	Percentage of Overtime to Wages & Salaries
1970			
1971			
1972			
1973			
1974			
1975			
1976			
1977			
1978			
1979			
1980			

Table - XV

Standards of Material Consumption

Sl. No.	Raw Material	1970		1971		1972		1973		1974		1975		1976		1977		1978		1979		1980	
		AS	ARA	AS	ARA	AS	ARA	AS	ARA	AS	ARA	AS	ARA	AS	ARA	AS	ARA	AS	ARA	AS	ARA	AS	ARA

AS = Attainable Standard

ARA = Actual Ratio Attained

Table - XVI

Effluents Discharged, Quantity and Value

Sl. No.	Name of Effluent	Quantity Discharged	Effect on Plant, Animal & Aquatic Life	Measures taken to reduce pollution problems
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

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